



Science and Technology Policy for Nigeria's Development Planning

Sunday Idowu Oladeji¹ and Abiodun Adewale Adegboye^{1*}

¹*Department of Economics, Obafemi Awolowo University, Ile-Ife, Nigeria.*

Authors' contributions

This work was carried out in collaboration between both authors. Author SIO generated the idea and drafted the first version of the paper. Author AAA revised the paper, modified the presentation and finetuned the idea to meet the purpose of the write-up. Both authors read and approved the final manuscript.

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ABSTRACT

Science & Technology (S&T) is recognised in intellectual discourse and public policymaking as strategic for development in contemporary times. The study assesses development planning experience in Nigeria and attempts to make a case for the integration of Science, Technology and Innovation (STI) policy within the overall framework of national development planning. Content analyses of the development plan documents were made alongside exposition on theoretical perspectives on S&T for growth and development. The framework leads to some implications for Nigeria's development plan. A survey of the theoretical perspectives on the interrelations between STI and national development is also undertaken. As Science & Technology planning is grossly lacking in Nigeria's development planning, the paper prescribes principles for effective interfacing of STI policy with national development plans. It draws attention to the essence of regular exchange of information between the sectors of Nigeria's economy and the Ministry of Science & Technology and the National Planning Commission, both at construction and implementation of plans. Development planning in Nigeria will serve the better if it is comprehensive and detailed to include S&T policy and programme. The regimes of ad-hoc/disintegrated sectoral reforms must no longer be allowed to rob the economy of desired growth and development.

*Corresponding author: E-mail: aadegboye@oauife.edu.ng;

While the planning of STI activities is of critical importance, the paper seems the first to call attention to the significance of integrating STI with the overall framework of national planning in Nigeria.

Keywords: National development; Nigeria; science; technology; innovation; planning.

1. INTRODUCTION

There is no gainsaying the fact that development at whatever level is a desideratum; a fundamental aspiration of all economic agents - individuals, corporation and nations. In a general sense, development represents a progression from a particular state to a more desirable and satisfying state. Nonetheless, it is never a spontaneous process but required to be propelled and fostered in a concerted manner through requisite resources, organisation and enabling environment, as well as policies and programme of actions. The importance of Science, Technology and Innovation (STI) as a veritable means of initiating, stimulating and sustaining the development process cannot be overemphasised.

The interrelations between science, technology and national development bring to the fore the issue of appropriate methodology of Science and Technology Policy Instruments (STPI) Project of the International Development Research Centre (IDRC), Canada. The first is related to the problem of integrating technology considerations into development planning. The second concern has to do with the planning of S&T activities on their own [1]. Apparently, the two concerns call for attention and as argued by Araoz [1], it is needful to interface development planning and S&T planning. However, given the orientation of this paper, the focus is on the former concern, namely the introduction of technology considerations into national development planning. It is therefore the aim of this study to call attention to the significance of interfacing STI planning with national development strategies in Nigeria. In this regard, this paper surveys the theoretical perspectives on the interrelations between STI and national development; examines the interfacing of STI planning with the national development plan in Nigeria and prescribes a framework and principles for effective interfacing.

2. CONCEPTUAL ISSUES

The two critical concepts that define the scope of this paper are Science, Technology & Innovation

(STI) and National Development. Apparently, there are some problems of definition as there is little or no agreement about the precise meaning and usage of these terms. Hence, the definitions in the current study are rather consensual and not absolute ones; nevertheless they would be true by virtue of the authority of common acceptance.

2.1 Science, Technology and Innovation (STI)

The acronym STI is here used to capture the intertwined terms: Science, Technology and Innovation. According to Green and Morphet [2], science is a branch of knowledge seeking to explain objects or experience through systematic study. A dictionary definition refers to science "as a system for organizing the knowledge about a particular subject, especially one concerned with aspects of human behaviour or society" [3]. The object of study in science could include technique, namely the process by which all activities are carried out. Such science of technique is what is generally referred to as technology - a systematic knowledge of technique. In a more comprehensive manner, the technology of a particular process or industry has been defined as the "assemblage of all the craft, empirical and rational knowledge by which the techniques of that process or industry are understood and operated" [2].

In Economics, a preoccupation with the usage of the word technology has always been about change - a derivative of the principle of "marginalism". Hence, of particular attention in the discipline are the terms technical change and technological change. Technical change describes a change in the technique chosen out of the possible spectrum of techniques. Given T as the boundary of technical efficiency or boundary production function, technical change takes place when a firm stops using technique D and chooses some other technique A, B or C because it is more efficient (see Fig. 1).

It also includes a movement along line T from lines A to C. In contrast, technological change refers to a change in the available set of

techniques that involve a shift of the bounding production function; a movement of the boundary from T to Z. Technological change implies a much more technically efficient and cost-minimising set of techniques. Change in technology results from a combination of research, invention, development and innovation. Research and invention 'create' knowledge while development and innovation are the activities which apply new knowledge to the production process.

The essence of S&T (invention and innovation inclusive) is knowledge and power of ideas. It is knowledge as embedded in human beings and combined with understanding. As argued by Farrell [3], the visible artefacts of technology (aircraft, computers, cars etc.) are actually the embodiment of technology; the result of the application of human knowledge to the physical materials of our world. Thus, the intrinsic value of technology is in knowledge, skills and capabilities of human resources.

2.2 Policy Aspect of Science, Technology and Innovation (STI)

Science, Technology and Innovation are all knowledge-related activities which overlap considerably and are thus inseparable. For this reason, no clear distinction may be drawn in policy-making between the areas covered by science policy and technology policy, especially on the basis of the type of knowledge targeted. Both are concerned with the generation of

scientific and technological knowledge. And so, within the framework of science and technology policy, both types of policy are usually developed simultaneously.

The foregoing notwithstanding, attempt at differentiating these policies in the literature has been quite revealing and instructive for policy-making. Vaitos [4], for instance, establishes a difference between the concepts of science and technology on the basis of criteria related both to the objectives and to the time frame and institutional standards. According to Vaitos, science policy is designed to encourage the acquisition of scientific and technological understanding, but not necessarily for immediate applications to economic and social goals. Its measures are oriented toward the scientific world, stimulating creativity and training; creating and fostering necessary infrastructure for scientific development. For this reason, science policy is usually linked with educational policy. Technology policy objectives, in contrast, are defined to "*stimulate the generation of the scientific and technological knowledge to be applied in the solution of well-defined problems in certain areas of production and in social welfare*". In other words, the objectives of technology policy are defined by the requirements of socio-economic development.

In science policymaking, where basic research is a preoccupation, the time perspective of necessity is of a longer time scale. This stems from the fact that scientific discoveries and principles take much time to establish as their

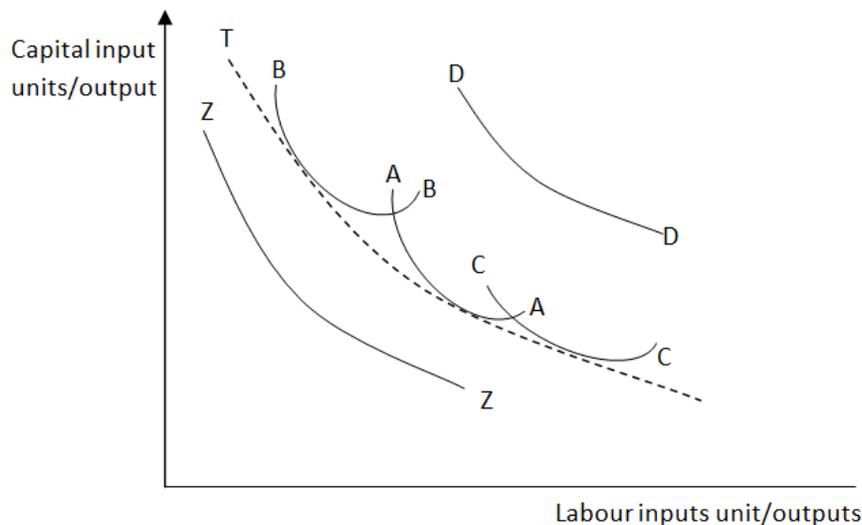


Fig. 1. Production functions for a set of techniques

Source: Authors' Construction

results need to be evaluated over a long period. At the policymaking level, science policy objectives are therefore less open to programming. Technology policy-making, on the other hand, always has objectives which may be only short-term. Under some circumstances, the objectives of technology policy are dependent on (or could take advantage) of advances in basic research into certain phenomena. Situation of this kind makes technology policy objectives programmable, deriving from the fact that these objectives are defined by the requirements of social and economic development.

Institutional requirements also make the difference between science policy and technology policy making. Science policy-making makes demand on role fulfilment of relevant educational institutions, notably universities. The level and quality of university activity and that of scientific research centres are crucial success factors in the attainment of science-policy objectives. They affect the supply of engineers and qualified scientists that constitute the critical mass of experts for the generation of scientific knowledge. In the case of technology policy development, the knowledge is organized, promoted and financed for the explicit purpose of using it to serve specific social and economic needs. Concerning the development of technology policy objectives, the institutions are the departments and offices of sectoral planning of ministries designated to formulate sectoral policy, planning institutes or ministries, technological institutes, the ministries of technology and so on.

2.3 National Development

The term "development" means different things to different people at different times. It is such a multi-faceted concept that could refer to social and political development, as well as economic development. It is also possible to refer to such things as legal and administrative development, military development and technological development, just to mention a few. The totality of these and many others constitute the so-called general or national development.

More than any other aspects of development, economic development has received so much attention in planning and policymaking. Worthy of note is the fact that "*economic development since the mid-twentieth century has come to imply consciously sought and directed social change of a type and scope*" [5]. This has been, and remained the preoccupation and thinking in

Development Economics. Economic development is clearly only a subset of national development. Economic development focuses on materially oriented issues (output, employment, income and so on) whereas, development in its totality (national development) deals with changes in the human condition.

Over the last six decades, there has been search for the relevant critical variables that should reflect adequately the notion of economic development. Such attempts have come up with the following understanding: Growth as development; development as reduction in poverty, unemployment, inequality and dependency; development as provision of basic needs; development as human-development centered; and sustainable development.

It is clear from these alternative operational definitions that the modern concept of development is beyond economic growth; though critically necessary for economic development. Also, while economic development is not equivalent to total development, the strategic interrelationships among various facets of development should be acknowledged for there to be sustainable development. As a matter of fact, it is instructive to appreciate the fact that socio-cultural and political development, as well as technological development contribute to economic development and are in turn determined by it [6].

To give the paper the required focus, however, it is needful and would suffice to settle for some working definitions or core perspective that relates the concepts of science and technology policy to economic growth and economic development. Using the words of Kindleberger and Herrick [5], for our purpose, economic growth means more output while economic development implies both more output and changes in the technical and institutional arrangements by which it is produced and distributed. Thus, in what follows a review is made of theories of development that includes explicitly scientific and technological considerations, with a view to drawing requisite policy implications.

3. THEORETICAL PERSPECTIVES

3.1 The Earlier Schools of Development Theory

Ever since economic development became the subject of study and investigation in the 18th

century, economists have always emphasized the importance of the application of improved technology in the process of development. These earliest writings not only reduced the development issue to explaining economic growth, their contributions were largely uni-causal in which a factor of production was singled out in succession as the strategic factor in economic growth. The physiocrats stressed land as the chief source of wealth at the beginning of the 18th century while the classical economists focused on human labour as the major and strategic source of wealth. In the mid-19th century, it was fashionable to look upon material capital as the missing component of economic development. For instance, Karl Marx's writings underscored the output-creating aspect of capital, so also Keynes, which much later found expression in the Harrod-Domar growth model.

By the beginning of the 20th century the focus had shifted to organization and management. Schumpeter's writings and later that of Harbison brought to the limelight the issue of entrepreneurial organization as a critical factor in economic development. According to them, economic development would proceed in the underdeveloped countries much more rapidly if the supply of entrepreneurs, middle-level managers and "genuine decision makers" were much greater. Behind each of these factors of production identified in these writings was the issue of technical change, constituting the dynamic force for each of the factors in the growth process. For instance, Adam Smith while emphasizing the role of labour in economic growth actually identified technical change as the principal factor permitting the division of labour. This meant increasingly specialized tasks which culminated in increased productivity and consequently economic growth. Karl Marx in his own case undertook detailed and comprehensive research on the emergence of machine technology. He observed widespread substitution of mechanical energy for human energy in production and concluded that technical development constituted the material basis for enhanced productivity and the revolutionary changes in the social relations of production accompanying the rise of industrial capitalism. Other writers of the classical 19th century school also identified technical change as a major contributor to economic growth, though sometimes technical change and capital accumulation were regarded as virtually one and the same thing.

By the middle of 20th century the experience of the advanced countries, also shared by the underdeveloped countries, pointed in the direction of what then was referred to as the "residual" factors of economic growth. Usually, what was done was to identify the contribution of increased capital, increased and improved labour, and then assigns the "residual" increase of output to the contribution of some other factors. These were thought to be related directly or indirectly to better education. The writing of Denison [7] and Schultz [8] in this regard underscored the significance of education in advanced and underdeveloped countries, respectively. Apparently, writings of this kind shifted emphasis to education as the chief missing component of economic development in the underdeveloped countries. In furtherance of this emphasis, the underdevelopment theory associated with the Chicago School [9,10] lately traces the slow growth of developing nations to low human capital and knowledge. According to them, to propel these countries from a low-growth trajectory to a high-growth one, all that governments need to do is to invest in human capital.

The identification of education as a veritable factor of development invariably has brought into reckoning the issue of technology. A characteristic feature of technology is that it can only find expression in the form of the skills of human labour, in alterations in the form of the natural environments and machines and other man-made aids to production. Evidently these are products of education and knowledge applied to enhance human capability, improve man's environment and facilitate production, all with a view to stimulating the growth process.

3.2 The Newest Schools of Development Theory

The emerging growth theories of the late 20th century appear rather much more instructive on what should be the expected role of technology in the growth process. For the purpose of this presentation, the Solow Neoclassical Growth Model is being examined and compared with the Endogenous Growth Theory. The attempt in this presentation is not to undertake a review of theories, but to distil the relevant facts from the theories on the connection between technology and development.

The Solow neoclassical growth model is probably the best-known model of economic growth. The

model took its bearing from the Harrod-Domar formulation which emphasizes the role of investment and capital accumulation in the growth process. Solow expanded this formulation by adding labour and introduced technology to the growth equation. Instead of adopting the fixed-coefficient and constant returns to scale, Solow's model assumed diminishing returns to labour and capital separately and constant returns to both factors jointly. Technological progress became the residual factor explaining long-term growth. However, as for the level of technology, it was assumed to be exogenously determined. Hence, Solow's new classical model is sometimes described as an exogenous growth model.

An important postulate of the Solow's new classical model is that output growth is expected to result from one or more of the following factors: Increase in labour quantity and quality through population growth and education respectively; increase in capital through savings and investment; and improvement in technology. Given the exogeneity of technology, Solow is a strong advocate of economic liberalization such that inflow of foreign investment and the concomitant technology transfer help to facilitate technological progress. The conclusion is reached in the Solow's model that *technological progressiveness (new production techniques, processes and methods, and new products) plays a necessary role in offsetting diminishing returns to capital as the capital stock increases*¹. Also, for sustained economic growth, not only is capital widening required, but also deepening.

As the name suggests, the endogenous growth theory is all about looking inward for growth impetus - i.e. growth generated by factors within the production process. Such factors include economies of scale, increasing returns to scale, induced technological change as opposed to outside (exogenous) factor such as increase in population and use of imported technology. The endogenous growth theory was developed as a reaction to omission and limitations in the Solow's neo-classical growth model. The theory comes in all kinds of models all of which emphasise technical progress resulting from the rate of investment, the size of the capital stock, and the stock of human capital. They assume, among others: Increasing returns to scale in production, leading to imperfect competition; knowledge or technological advance is a non-

rival good. Hence, many individuals and firms have market power and earn profits from their discoveries; technological advances come from things people do - i.e. those technological advances are based on the creation of new ideas. On what people do, a number of ideas have been propounded to explain growth process, namely: Learning by doing in the Arrow model; Learning by watching in the King-Robson model; Learning by investment in the Romer model; and Spillover effects of increased knowledge in the Levhart-Sheshinski model. All of these direct attentions to the power of ideas from learning of all kinds, creating as it were technical spillover effects capable of bringing about sustained endogenous growth.

The Lucas [10] model makes a distinction between the internal effects of human capital (increased productivity through training), and external effects, which spillover and increase the productivity of capital. He reaches the conclusion, based on his empirical evidence, that it is human capital (learning by doing or on-the-job training) rather than physical capital that has spillover effects that increase the level of technology. Romer's [9] model of endogenous technical change assumes a technological production function whose variables are as indicated in the following:

$$\Delta A = F(K_A, H_A, A)$$

where

- ΔA : The increasing technology
- K_A : The amount of capital invested in producing the new design
- H_A : The amount of human capital employed in research and development of the new design
- A : The existing technology of designs
- F : Production function of technology

Romer identifies a research sector specializing in the production of ideas and establishes on the basis of the model formation that ideas and technology are essential for the growth of an economy. To him, ideas are even more important than natural resources, citing Japan as a classical example; a country with few natural resources that used new western ideas and technology to achieve sustained growth.

3.3 Imperative of Government Intervention

In contemporary times, economic liberalization, laissez-faire and privatization hold much sway in development policy making. These days'

¹ <https://financial-dictionary.thefreedictionary.com/Solow+economic-growth+model>

problems of development are traced to the heavy hand of the state and corruption, inefficiency and lack of incentives in developing nations. In line with neoclassical thoughts and doctrine on development issues, there is so much expectation in free markets and laissez faire policy as the way out of the diverse development problems of these countries. To the proponents of this approach, market mechanism can be counted upon to guide resource allocation and stimulate economic development. The question still remains: to what extent can the third world countries rely on the market mechanism given the widespread imperfections in their markets? In the planning of science and technology for national development, what scope is there for the market mechanism? Or is there no rational basis for government intervention in the market for technology?

The neoclassical challenge to the extant development orthodoxy prior to 1980s is in three different forms: the free-market approach, the public-choice theory and the market-friendly approach. As far as the free-market approach is concerned, markets alone are efficient, competition is effective, even if not perfect and technology is freely available and nearly costless to obtain. Hence, any government intervention in the economy is distortionary and counterproductive to economic development. To the public-choice theorists, governments can do nothing right as the politicians, bureaucrats, citizens, and States act solely from a self – interested perspective. In other words, the various interest groups only operate in a manner inimical to the overall interest of the larger society. It therefore follows that minimal government is the best government, which makes the government's role in technology management superfluous. In contrast, the market-friendly approach recognises that there are many imperfections in the product and factor market in the developing countries. Hence governments do have a key role to play in facilitating the operations of the markets through market-friendly interventions. Such intervention includes: investing in physical and social infrastructure, health care facilities and educational institutions; and providing a suitable climate for private enterprises. This approach also recognises the prevalence of missing and incomplete information, externalities in skill creation, learning and economies of scale in production, which are largely true of technology market and thus constitute the bases for government intervention in the market.

Elsewhere, invoking the real initial conditions necessary for Pareto optimality (the platform on which market mechanism rests), the conclusion is reached that “the market system, by itself, does not provide much scope for S&T development in practice [6,11]. Oladeji argues further that the market for technology generation and trade is never perfect, and the imperfections are not of the type that can be corrected with the traditional self-correcting mechanisms. In the same vein, Britton and Gilmour [12] had earlier argued in the context of Canada that the market place has proved unable to promote technological development and to ensure its correspondence with social and economic objective.

It is pertinent to remark that the ideas of the endogenous growth theorists appear convincing on the imperative for strategic intervention of government towards building up the country's human capital and technological capability. The challenges of investing in human capability are inclusive of the power of ideas imparted in the process of human resource development. Most successful development strategies are based on using imported ideas with expediency and making concerted efforts at creating new ideas locally. When enough ideas are present, the economy begins to develop and produce its new products and services [13]. Market imperfections in a developing nation like Nigeria and experience elsewhere, notably the Asian Tigers have shown that the government (visible hand) holds the ace as far as human capital accumulation and technological development are concerned. Characteristically, they do generate economies of scale and spillovers not recognized by the neoclassical paradigm and which, therefore, question the relevance of market fundamentalism in matters of this nature.

As far as the Nigerian experience is concerned, the significance of government intervention in S&T management derives from the following: *"Increasing realisation of the role of S&T in national development; the avowed policy of self-reliance, with particular reference to local sourcing of industrial raw materials; ineffectiveness of internal technological capacity and, therefore, the reliance on technological imports; ineffective support for the development of S&T from the private sector; and the declared intention to create, increase and maintain an endogenous S&T base through research and development"* [6,11].

Thus, instead of abandoning the development of S&T activities to the market forces and

organisations in the private sector, concerted efforts are required by way of deliberate planning, functional budgeting; rational, consistent and coordinated public policy for S&T development.

4. PLANNING FOR S&T DEVELOPMENT IN NIGERIA

Science and Technology (S&T) have long been regarded as catalysts in national development. In one way or the other, they have provided necessary support for diverse sectors of the economy, provided the prime source of innovations and adaptation required for improving production methods and stimulating growth and development. However, the role attributed to S&T in the economic plans in Nigeria up to 1980 was largely implicit, devoid of concrete institutional infrastructure, policy making and distinctive planning for S&T development.

The institutionalisation of S&T development came by Act No 5 of 1977 with the setting up of the defunct National Science and Technology Development Agency (NSTDA). Following the creation of a separate Ministry of Science and Technology in October 1979, NSTDA became dissolved by the Science and Technology Act of 1980. The responsibilities of the Ministry of Science and Technology include:

- i. Formulation of national policy on science and technology;
- ii. Promotion of science and technology research;
- iii. Liaison with Universities and Federal Polytechnics; and
- iv. Promotion and administration of technology transfer programmes.

The existence of the Ministry of Science and Technology paved way for the introduction of S&T considerations into development planning in Nigeria. And so, in the Fourth National Development Plan 1981-85, S&T was accorded recognition for the first time as one of the economic sectors. The chapter on the S&T sector in the plan articulates, among others, policies and objectives and highlights the programmes and projects to be executed by the various agricultural, industrial and other research institutes over the plan period. The overall objective of the sector then was to pursue the policy of promoting the socio-economic development of the country by the application of science and technology. The overall purpose was to build a strong and self-reliant nation with

a dynamic and modern economy. The specific policies pursued during the Fourth Plan period were:

- i. Development of a comprehensive policy on science and technology;
- ii. Promotion of scientific and technological research;
- iii. Development of technical manpower;
- iv. Direction, co-ordination and supervision of science and technology research; and
- v. Dissemination and commercial exploitation of the results of scientific and technological research"

Apart from the foregoing, concerted efforts were to be made to have in place copious database for S&T required for socio-economic development of the nation; robust technological capability; human resource development for S&T; and opposite linkage between education and S&T on one hand, and S&T and the economy on the other. The second half of the 1980s, meant for the Fifth National Development Plan ran into severe problems of dismal resource profile occasioned by sharp decline in international oil price between 1976 and 1986. The usual traditional planning process was abandoned for the so-called market forces operated within the framework of the Structural Adjustment Programme (SAP). Several sectors of the economy became deregulated, notably agriculture, manufacturing, and external transactions. Nonetheless, SAP was not oblivious of the imperative of government intervention in the S&T sector. Through the instruction of the country's scientists, engineers and technologists, international cooperation and government support, the first National Science and Technology policy was produced in 1986. The National Science and Technology Fund was established in 1987 with a Board of Trustees constituted to administer it. Also in 1987, the Raw Materials Research and Development Council was set up and was charged with the responsibility of promoting the development and use of local raw materials- a cardinal objective of SAP policy.

By the turn of 1980s, SAP was found to be an imperfect substitute for planning; economic liberalism and market forces notwithstanding. Consequently, government made a return to planning with the adoption of the First Three-Year National Rolling Plan in 1990. The First National Rolling Plan, 1990-92 actually set the tone for the series of rolling plans, which marked the decade of 1990s. Within this planning

framework, S&T sector was accorded explicit recognition, having a chapter of its own in the rolling plan document. The S&T sectoral planning in the rolling plan was prepared against the background of the following problems: ineffective support for the development of science and technology; problems of adoption of local research results; misconception of the roles of science and technology; and inadequate linkage between research and production.

Hence, toward ensuring S&T played a more positive role in the development of the various sectors of the economy, the First National Rolling Plan had the following as its policy objectives and strategies:

- i. Directing S&T efforts along identified goals or specific national objectives;
- ii. Promoting the translation of S&T results into actual goods and services; and
- iii. Creating, increasing and maintaining an endogenous S&T base through research and development."

The Raw Materials Research and Development Council was to play a pivotal role in the plan regarding the development of local raw materials, documenting and disseminating information on available raw materials. In addition, the council was to survey and evaluate indigenous and emerging technologies in the area of raw materials. In terms of programmes and projects, priority was on several aspects of agricultural research (crops, livestock, fisheries and forestry); industrial and technological research; as well as medical and chemical research.

With regard to the latest public policy thinking, reference should be made to Science, Technology and Innovation (STI) policy. The policy was reviewed in 1997 to have more emphasis on coordination and management of S&T system, sectoral developments, collaboration and funding. Further review was made on the policy document in 2003 with the aim of addressing the lapses and to have in place the institutional framework that would foster interaction among the various elements of the National System of Innovation (NSI). Nevertheless, the desired harmonization with other socio-economic policies was even lacking with the revised policy document. As it turned out, the 2003 'policy' constituted only a compendium of key sub-sectoral policies.

Beginning from 2005, a system-wide policy reform was undertaken under the Nigeria/UNESCO Science, Technology and Innovation (STI) reform initiative. The initiative adopted the National Innovation System (NIS) approach as a framework for STI system reform. It stressed the importance of economic development initiatives, institutional governance, research and development (R&D) agenda for the country, funding mechanisms, intellectual property (IP) and STI infrastructure development in a new policy design. The new STI policy draft was completed in September, 2011. Apart from the foregoing issues incorporated in the policy design, the packaging has been greatly influenced by the following aspirations and developments:

- (i) All-inclusive and participatory policy making approach to ensure collective ownership by all stakeholders.
- (ii) Emphasis on 'innovation' and renewed commitment R&D engagement to enhance new business development, employment generation and wealth creation;
- (iii) Intention to formulate and implement the Vision 20:2020 within the Economic Transformation Blueprint;
- (iv) The desire for a large, strong, diversified, sustainable and competitive economy that guarantees a high standard of living and quality of life; and
- (v) Promotion of the activities for STI communication and inculcation of STI culture in Nigerians."

The latest STI policy is perhaps the most comprehensive policy design and quite promising policy instrument for the Economic Transformation Agenda of the Federal Government of Nigeria. This is, however, subject to the appropriate instrumentality of planning, the platform for concretising the STI policy objectives and strategies. Needless to say, the policy should be faithfully implemented as an integral part of the Vision 20:2020 economic transformation blueprint.

5. INTERFACING STI POLICY WITH DEVELOPMENT PLAN

The effectiveness of the STI policy is better undertaken in the context of a National Development Plan. Apart from defining the socio-economic objectives and development strategies of the nation, the plan document makes explicit the STI policy environment. If the distinction

between science policy and technology policy is anything to go by, interfacing STI policy with development planning would make long-term/perspective planning an imperative, and in fact complemented with the medium-term planning. Scientific activities are less open to programming at the policy level while innovation is long term, a process that involves continuous search without endpoint. Technology policies as indicated earlier can be programmed because they are defined by economic and social requirements. Thus, the new STI policy should be interfaced with the methodology of rolling plan. It is a kind of planning approach that could make interface among the annual (short-term), medium term and perspective plan and thus STI policy effective.

Technology is an all-pervading phenomenon which concerns everybody in the society because it is basically the interaction of science and society [14]. The import of this is to emphasise the essence of interfacing STI policy with economy-wide planning. The new STI policy appears to have sufficient grasp of this fact. The policy document opines thus;

“To effectively foster a seamless engagement of STI with the desired transformation, the policy has recognized also the weakness of the nation’s system of innovation and thus set out to strengthen structures for the coordination, promotion and management of interactions within the system. This is to reduce and eventually eliminate the current high level of “stand alone research efforts scattered all over the country and forge synergies among system components that will identify common problems and resources for research, the research agenda to national priorities...[15]”.

Towards having a robust framework for interfacing, STI policy should be guided by the following recommendations:

- i. STI should be integrated with development policy objectives and strategies in the medium-term and perspective plans;
- ii. The development of STI should be adapted to the country’s long –term objectives;
- iii. Endogenous STI development should be made to benefit from external S&T knowledge or imported ideas;

- iv. Promotion of a joint effort by government, scientific, and educational institutions and the productive system, especially in the areas of funding and R&D development; and
- v. The STI system should have close links with the educational system and the economy.

It is increasingly being acknowledged that every development planning effort has implication for technical input. There is therefore the need to incorporate the analysis and translation of economic development into specific technology needs. This calls for the exchange of information between the Ministry of Science and Technology and the National Planning Commission, not only at the plan construction stage but also at the phase of implementation. The interaction is expected to be initiated by feeding information about the National Development Plan into the Ministry of Science and Technology, which in turn reviews the information, generates its own information and feeds it back to the National Planning Commission [16]. This exchange of information between the two institutions can be repeated to perfect a feasible and implementable plan.

The process of exchange of information could also be extended to the sectors of the economy; especially the strategic ones: agriculture, manufacturing, transportation, energy, iron and steel, mining, etc. In this regard, all sectoral planners are to be versed in the goals of the National Development Plan and be able to exchange information with the overall coordinating body (i.e. the National Planning Commission and Ministry of Science and Technology), with a view to establishing their technological constraints, technological options and sources.

If the proposition that science and technology is not socially neutral is anything to go by, planning STI cannot be meaningfully handled just by scientists and technologists. In reality S&T is part and parcel of the economy, cultural and even political life of a nation. Hence, all available wise men from different walks of life, including wise politicians and learned men should participate in STI policy making. It is therefore heart warming to acknowledge that Nigeria’s latest STI policy is a product of participatory policy formulation; involving consultative meetings with various stakeholders and professionals with diverse background.

6. CONCLUSION

Development is never a spontaneous process; it is brought about by deployment of material and human resources; implementation of requisite policies and programme of actions. In intellectual and public policy discourse, STI has come to be recognized as a veritable tool of development, especially in contemporary times. More than other theories, the endogenous growth models emphasise the strategic importance of STI in development and at the same time call attention to the imperative of government intervention in STI management.

Although S&T have long been recognized as catalysts in national development, it was not until the creation of a separate Ministry of Science and Technology in 1979 that the public-policy making on S&T was made explicit. Since then the S&T policy has become part and parcel of planning effort in Nigeria. As a distinctive policy of its own, the National Science and Technology Policy came into existence in 1986, and was reviewed several times in 1997, 2003 and 2005. The latest attempt is the Science, Technology & Innovation Policy which was completed in September 2011. The new STI Policy has been designed to provide a platform for integrated engagement of science, technology and innovation with Nigeria's Economic Transformation Agenda. The crucial challenges in this regard are to enforce effective interface with the overall development planning of the nation.

In the light of the foregoing, this paper makes a strong case for the adoption of rolling plans, implemented within the framework of a perspective plan in order to make room for proper interfacing. Attention has also been drawn to the essence of information exchange between the sectors of the economy and the coordinating bodies like the Ministry of Science and Technology and the National Planning Commission. The two coordinating bodies themselves should also exchange collated information on regular basis, both at the plan construction and implementation stages.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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