

Supporting Research and Development (R&D) for Realization of Post-2015 Development Agenda in Nigeria

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Abstract: Since independence, October 1, 1960, Nigeria has adopted several development programmes (home-designed and international), such as green revolution (GR), operation feed the nation (OFN), structural adjustment programme (SAP), national poverty eradication programme (NAPEP), millennium development goals (MDGs), to develop its economy. But the expected results have not been achieved because currently, by international grouping, Nigeria is among countries with low human development index (HDI). Presently, Nigeria has adopted the Post-2015 Global Development Agenda, with a broad objective of “eradicating poverty and transforming economies through sustainable development”. Nigeria seeks to deliver the agenda, possibly, before 2030. One of the key elements for realization of the Agenda is “increased funding for research and development (R&D). However, R&D, has been an integral part of technological capability development policy in Nigeria since 1970s, “when government started to promote scientific and technological activities in Nigeria in order to make Nigeria technologically strong”. However, the expected results have not been achieved because, currently, Nigeria is characterized by a very low level of technological development. Investigations show that the country’s approach to technological capability development lack the necessary ingredient - functional research and development. Changes are needed in the country’s technological capability development programmes. This paper suggests that research and development (R&D) needs to be well funded, and the number of researchers and technicians in R&D be increased to enhance the chance of realizing the post-2015 development agenda.

Keywords: Research and development, Technology, development agenda

JEL CLASSIFICATION NUMBERS: O, O3, O33.

INTRODUCTION

The role of research and development (R&D) in economic development and social progress of nations, especially the more - developed ones, is vital and unrivalled. Research and development (R&D), simply, is scientific investigation into existing knowledge and ways of doing things in a society with a view to improving the existing quality of human life [1]. Development of national science, technology, R&D, and innovation capacities has been proven to be an important prerequisite for the social and economic transformation that enable sustainable economic growth, human development and poverty alleviation [2]

The Post-2015 Global Development Agenda seeks to “eradicate poverty and transform economies”. In its framework for achieving this, the Development Agenda acknowledges, *inter alia*, increased capacity in innovation, invention, and R&D as the key to producing higher quality and greater range of products [2]. In acknowledgement of the vital role of R&D and technological progress in the development of a nation, the Assembly of Heads of State and Government of the

African Union(AU), at the 22nd Ordinary Session held on January 31, 2014, adopted the Common African Position (CAP) on the Post-2015 Development Agenda, and grouped Africa’s development priorities into six pillars with “innovation, technology and R&D” as the number two priority pillar, after “structural economic transformation and inclusive growth”. Other priority pillars are: People-oriented development, Environmental sustainability, natural resource management, disaster and risk management, Peace and security, and Finance and partnership.

Nigeria, in its engagement in the Global Development Agenda, seeks to deliver the targets and goals of the agenda through the key elements of the six pillars and enablers of the CAP on the Agenda. One of such key elements is “increased funding for research and development ((R&D)” [3]. However, it is pertinent to note that R&D has been an integral part of technology development policies in Nigeria since 1970s, when government started to promote scientific and technological activities and sought to expose Nigerians to advanced technology[4]. The crucial need

for innovation, technology transfer and R&D in Nigeria's development agenda led to the establishment of the Nigerian Ministry of Science and Technology in 1977 with the mission "to chart the course of scientific and technological development of the country". Major activities of the ministry include: (i) Planning and guiding science and technology, research and development (R&D), (ii) monitoring progress in R&D among the industrial and educational communities, (iii) ensuring that public R&D efforts align with the overall development plans of the nation, (iv) linking researchers with entrepreneurs for commercialization of R&D. More so, each state in the country has Ministry of Science and Technology whose aims and activities are derived from the Federal's. However, the expected results have not yet been achieved, for Nigeria today is characterized by very low technological capability [5,6]. The state and level of technological capability development, specifically R&D, in Nigeria poses a great challenge to early delivery of the Post-2015 Development Agenda in Nigeria. The paper, therefore, seeks to examine the basic policy issues involved in dealing with the problem of technological development in Nigeria so as to draw attention of policy makers to the need to support and sustain R&D as a prime mover for early delivery of the Post-2015 Development Agenda.

CONCEPTUAL AND THEORETICAL OVERVIEW

Meaning, Components and Types of Technology

Technology: what is it?

Technology, according to Cardoso (1980) is a way of doing things in a given society to better the lots of the people of the society [7]. It is the knowledge, skill and dexterity needed to design, create and/or implement a production process [8]. Technology can be seen as a set of techniques and skills needed for carrying out activities [9,10]. Succinctly, technology can be conceived as practical arts and science embedded in the manner in which things are done in a given society for the betterment of that society.

There are two perspectives of technology: the broad and the narrow perspectives. The broad perspective involves the cultural traditions developed in a given human society for the purpose of meeting the needs of that society [9]. In this perspective, we talk of Italian technology, French technology, Japanese technology, American technology, Nigerian technology, Zimbabwean technology, etc. Narrowly, technology is defined as the "know-how", that is, information, skills, procedures needed for doing particular things in a society [9]. In this case, we talk of hot (hard) drink production technology, *amala* production technology, canoe production technology, palm wine production technology, mat production technology, etc.

Components of Technology

There are two components in the technology of any activity. These are:

- a. the process technology, that is, knowledge of the input combinations, and the processing procedures necessary for completing an activity; and
- b. the design and fabricating technology, that is, knowledge of how to design and fabricate the necessary machines and tools, and to install and operate the productive system.

For any society or country to develop and advance technologically, the two components of technology are necessary; however, such a society or country has to:

- a. discover relevant knowledge through conscious and/or unconscious efforts, (that is, by research and development, R&D, and/or chance event) and invent the necessary equipment and machines.
- b. learn from countries that have already possessed the relevant knowledge (that is, by transfer of technology); and
- c. combine the former and the later, (that is, combine i and ii) [9].

Given the above conditions, technological progress is likely to occur, and this will increase the volumes and qualities of goods and services produced in a given society.

Types of Technology

There are two broad types of technology namely, endogenous technology and exogenous technology. Endogenous technology involves the internally (or locally) generated ways of learning, practising and expressing traditional initiatives in activities (usually referred to as indigenous technology), while exogenous technology refers to imported (or foreign) inputs in the traditional ways of doing things in a society (usually referred to as transferred technology) [11]. Being indigenous implies belonging to a particular place rather than coming from somewhere else. In this light, the term 'indigenous' is used to describe or qualify a thing that originates or occurs naturally in a society, country or region [12]. For instance, the arts of writing known as hieroglyphics and cuneiform were indigenous to Egypt and Babylon, respectively.

Indigenous technology may be simply referred to as the material expression of a people's life, values and attitudes. Indigenous technology, therefore, encompasses a society's ways of applying scientific knowledge to specific practical uses for overall benefit of the society [13]. In the same vein, indigenous technology is described as the application of total

knowledge and skills available to any human society, based on available local resources, for industry, arts and science [12]. This paper, *ipso facto*, views Indigenous technology as the application of the knowledge of arts and science by a society to its ways of doing things for the immediate and future welfare of its people. On this note, progress in research and development (R&D) in a given society is the bedrock of development in such a society [14, 15]

Research and Development (R&D) Model

The research and development (R & D) model is expressed as

$$\frac{\dot{A}}{A} = \lambda + \alpha_N \left(\frac{\dot{N}}{N}\right) \dots \quad (1)$$

Where α_N is the research share of

output, $\frac{\dot{A}}{A}$ is the residual part of output after the

professional share and $\left(\frac{\dot{N}}{N}\right)$ is the growth of net

knowledge, adjusted for the obsolescence of prior research [16]. Based on the growth of N in (1), implied by assumptions about life and depreciation of research investment, equation (1) is often replaced by:

$$\frac{\dot{A}}{A} = \lambda + r\left(\frac{I}{O}\right) \dots \quad (2)$$

Where I is net investment in knowledge (\dot{N}), O is output and r the return to knowledge. Equation (1), however, assumes knowledge to grow only through greater expenditures. This sounds restrictive with regards the possibilities of progress. Nevertheless, the general progress of knowledge is likely to improve the effectiveness of vintages of research; similarly the cumulative nature of learning, which builds on prior work, makes subsequent research more effective.

Going by Sveikauskas (1980), assume the research investment increases by g% annually, and that the quality of research investment improves at $\lambda\%$. The effective research investment vintage v, I(v), is

$$I(v) = I_0 e^{(g+\lambda)v}$$

With a depreciation rate, d, the surviving knowledge stock of vintage v, $S_v(t)$, is

$$S_v(t) = I(v)e^{-d(t-v)}$$

t is time, $t \geq v$

The stock of knowledge, S(t), is

$$S(t) = \int_{-\infty}^t I_0 e^{(g+\lambda)v} \cdot e^{-d(t-v)} dv$$

= $I_0 e^{(g+\lambda)t} / (g + \lambda + d)$ and the rate of change in

knowledge is

$$d \log S / dt = g + \lambda$$

In terms of equation (1), increases in knowledge occur because of g, the rate at which research investment increases, and also because of λ , the rate of knowledge quality improvement. The total impact of knowledge on productivity, therefore, is $A_N (N/N)$ or $\alpha_{NG} + \alpha_N \lambda$.

Evolution of Technology Policy in Nigeria

The evolution of technology policy in Nigeria is traced to the first National Development Plan, which covered the period, 1962-1968. The plan stated that:

The basic objective of planning in Nigeria is not to accelerate the rate of economic growth... it is to give her an increasing measure of control over her own destiny...Nigeria should be in a position to generate from a diversified economy, sufficient income and saving of its own to finance a steady rate of growth with no more dependence on external sources for capital and manpower than is usual to obtain through the natural incentives of international commerce [17].

In an attempt to give Nigeria an increasing measure of control over her destiny, some attempts to develop Nigeria’s technological adequacy were made with the establishment of the National Cereal Research Institute (NCRI) in 1968. This was prompted by the need for research in agriculture, but actual research was not promoted, hence local farmers were not affected by the effort. The second National Development Plan, 1970-1974, followed the first closely with the following principal objectives of establishing Nigeria as: (a) a united, strong and self-reliant nation, (b) a great dynamic economy, (c) a just and egalitarian society, (d) a land of bright and full opportunities for all citizens, and (d) a free and democratic society [18].

To actualize the above objectives, Nigeria Council of Science and Technology (NCST) was established in 1970, whose main function was “to coordinate research and development activities in the country”. However, NCST was not directed on how to pursue its function, so there was little or no sign of progress [9]. It was in the Third National Development Plan, 1975-80, that the government took the most significant step in the country’s search for technological development. Science and technology was for the first time incorporated into the development plan strategy. In this plan the Government showed a desire to use the activities of the foreign-owned enterprises in the country to speed up the process of technological development. Thus, in the plan, the government planned to adopt:

...a system which, while liberalizing the expatriate quota allocation system, will at the same time ensure that Nigerians are exposed to advanced technology and will be in the position to take over the operations within a reasonable time period [4].

In 1977, NCST was dissolved and replaced with the National Science and Technology Development Agency (NSTDA). Shortly, the government created a ministry for technology matters, the Ministry of Science and Technology (MST), NSTDA was then dissolved, and its functions transferred to the new ministry. The broad objective of MST was "to make Nigeria a technologically oriented country". To pursue this objective, the government mandated the Ministry of Science and Technology to:

- i. formulate and monitor a national policy on Science and Technology;

- ii. promote and administer technology transfer programmes;
- iii. promote and coordinate scientific and technological research and development (R&D) activities in some specific fields;
- iv. promote and coordinate scientific and technological innovation, development, adaptation and production; and
- v. establish relations with relevant international scientific and technological research bodies [9].

The Ministry of Science and Technology sought to develop modern technological adequacies in the country by employing the twin approach programme: local R & D efforts, and transfer of technology. As the necessary leap ahead, the MST created five professional departments and assigned each of them specific functions, as mirrored in Table 1.

Table 1: Science and Technology Programme: Departments and Functions

Professional Department	Major Functions
Science and Technology Promotion	<ul style="list-style-type: none"> • Formulation of science and technology policies. • Promotion of science culture. • Promotion of indigenous scientific and technological activities. • Publication and dissemination of scientific and technological information.
Research and Development (R&D)	<ul style="list-style-type: none"> • Planning and guiding research and development (R&D). • * Monitoring progress in R&D among the industrial and educational communities, • Ensuring that public R&D efforts align with the overall development plans of the nation • * Linking researchers with entrepreneurs for commercialization of R&D.
Agricultural Sciences	<ul style="list-style-type: none"> • Formulation of agricultural research policies. • Identification of problems in agricultural science research and determining the resources solution. • Promotion of the development of special services in support of agricultural production. • Monitoring, evaluation and coordination of agricultural extension and training to develop intermediate level manpower for agriculture.
Industrial Technology	<ul style="list-style-type: none"> • Formulation of policies for industrial research. • Development of priorities in industrial research. • Promotion, monitoring, direction and coordination of activities of industry-based research institutes, including the National Office for Technology Acquisition and Promotion (NOTAP).
Medical and Pharmaceutical Sciences	<ul style="list-style-type: none"> • Formulation of policies for medical and pharmaceutical sciences research. • Promotion of medical and Pharmaceutical Science research in the public and private sectors. • Promotion of the development of traditional medicine, with a view to giving it a scientific basis. • Promotion of local drugs and their production. • Monitoring and evaluation of research in the medical and pharmaceutical sciences.
Energy and Natural Resources Research	<ul style="list-style-type: none"> • Formulation of policies for energy and natural sciences/resources research. • Promotion of research in all forms of energy and areas of natural sciences. • Coordination of research in energy and the natural sciences. • Supervision of research establishment in energy and natural sciences under the Ministry. • Promotion of the development of indigenous expertise in the application of new and renewable energy technologies.

Sources: [9, 19].

To quicken the pace of achieving the broad objective of MST, that is, making Nigeria “technologically oriented nation”, government established some research institutes such as the Federal Institute for Industrial Research (FIIR) – Oshodi; Projects Development Agency (PRODA) – Enugu; and Raw Materials Research Development Centre (RMRDC), with offices in almost all the states of the nation. Some Federal Universities of Technology were also established for collaborative researches with the research institutions.

In 1986, the Ministry of Science and Technology, through the Department of Science and Technology Promotion, published the National Policy on Science and Technology.

The specific objectives of the policy were to:

- i. increase public awareness of science and technology (S&T) and their crucial role in national development and well-being;
- ii. direct S&T efforts along identified national goals;
- iii. promote the translation of S & T results into actual goods and services;
- iv. create, increase, and maintain an endogenous S&T base through R&D;
- v. motivate creative output in S&T;
- vi. increase and strengthen the theoretical and practical scientific base in the society; and
- vii. increase and strengthen the technological base of the nation [20].

With the recognition of the place of R&D in a nation’s development by the Federal Government and from the mandate given the MST, and its take-off arrangements, it was believed that the country would soon breakthrough technologically. However, the objective of the country’s efforts at technology development, has not been achieved [9, 19, 21, 22] Even the achievements of the research institutions to date are only modest. Several factors have been identified to plague the Nigeria’s Science and Technology system. These include:

- i. *Poor Funding*: Funding for research and development (R&D) is grossly inadequate (see Table 2).
- ii. *Lack of Incentives and Poor Modalities*: The modalities for implementing science and technology activities are poorly formulated: not targeting a specified goal within a given time

frame. More so, no incentives are given for achievement and no sanctions are spelt out for failure.

- iii. *Poor Linkage*: The existing policies have not helped to strengthen the link between research and development and the production system. Our production system is largely foreign. There is little evidence to indicate that innovation and development of endogenous technology are taking place effectively.
- iv. *Poor Research Facilities*: Our research institutes such as the Federal Institute of Industrial Research (FIIR), Project Development Agency (PRODA), Raw Materials Research Development Centre (RMRDC), etc. are inadequately funded, and are lacking in special engineering workshops.
- v. *Poor Relations*: There are poor relations between the research institutes and the Universities of Technology in the country. There is also a great gap between universities and the society: research findings in the universities seldom reach indigenous technologists and the economy for consideration and adoption into their production processes [9, 19, 21, 22]

EFFECTIVENESS OF SCIENCE AND TECHNOLOGY PROGRAMMES IN NIGERIA: A CURSORY OVERVIEW

Effectiveness of science and technology programmes in Nigeria need be assessed so as to know the country’s relative position and strength in R&D and the level of preparedness Nigeria needs in her quest for early delivery of the post-2015 development agenda since “development of national science, technology, R&D, and innovation capacities has been proven to be an important prerequisite for the social and economic transformation that enable sustainable economic growth, human development and poverty alleviation” [2]. We will do this by adopting the five major indices of technological capability used by UNESCO INSTITUTE OF STATISTICS (UIS)[6 23]. The indicators are: (1) number of researchers (per million people) in R & D, (2) number of technicians (per million people) in R&D, (3) number of scientific and technical journal articles, (4) expenditure on R&D (percentage of GDP), and (5) value of high technology exports (expressed both in \$ million and percentage of manufactured exports). Table 2 contains information on the above major indicators for selected countries of the world including Nigeria.

Table 2: Major Indices of Technological Capability of Selected Countries, 2000 - 2012

Country	Researchers in R & D (per million people)	Technicians in R&D (per million people)		Scientific and Technical Journal Articles		Expenditure on R&D (% of GDP)		High Technology Exports		
								\$ million	% of manufactured Exports	
	2000 – 2004	2000-2004		2003		2000-2004		2005	2005	
Nigeria	n.a	n.a		384		n.a		8	2	
New Zealand	3,945	833		3,034		1.16		943	14	
Poland	1,581	282		6,770		0.58		2,688	4	
Hong Kong	1,564	222		n.a		0.50		94,808	34	
Belgium	3,065	1473		6,604		1.90		22,809	9	
	2004 – 2008	2004 – 2008		2007		2004 - 2008		2009	2009	
Nigeria	n.a	n.a		427		n.a		46	3	
New Zealand	4,365	894		3,173		1.21		504	10	
Poland	1,629	191		7,136		0.61		7,172	5	
Hong Kong	2,650	459		n.a		0.81		1,849	31	
Belgium	3,435	1,407		7071		1.92		29,6276	10	
United Kingdom	4,269	895		47,121		1.88		57,178	23	
Sweden	5,239	1,871		9,914		3.75		17,089	17	
Singapore	6,088	539		3,792		2.52		97,207	49	
	2010	2011	2010	2011	2010	2011	2010	2011	2012	2012
Nigeria	39	n.a.	n.a	n.a.	432	439	0.2	0.2	77	2
New Zealand			902	n.a.	n.a.	n.a.	n.a.	n/a	706	10
Poland	1689	1679	386	361	7,157	7,564	0.74	0.77	9600	7
Hong Kong	2925	n.a.	306	n.a.	n.a	n.a.	0.75	n. a.	841	16
Belgium	3502	3679	n.a.	n.a.	7,389	7,484	2.0	2.04	36594	11
United Kingdom	4134	4202	955	971	45,978	46,035	1.8	1.77	67787	22
Sweden	5256	5191	n.a.	1984	9419	9437	3.39	3.37	16,547	13
Singapore	6307	n.a.	461	n.a	47043	4,7106	2.09	n.a.	128,239	45

Sources: [5, 6, 24, 25]

n.a. – not available

NOTE: 1. Researchers in R&D are professionals engaged in conceiving of or creating new knowledge, products, processes, methods, and systems and in managing the projects concerned. **2. Technicians in R&D** are people whose main tasks require technical knowledge and experience in engineering, physical and life sciences and humanities. They engage in R&D by performing scientific and technical tasks involving the application of concepts and operational methods, normally under researcher supervision. **3. Scientific and technical journal articles** are published articles in physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences. **4. Expenditure for R&D** are current and capital expenditures on creative work undertaken to increase the stock of knowledge in the society, and the use of knowledge to devise new application. **5. High technology exports** are products with high R&D intensity, such as aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery [5].

From Table 2, in 2003, Nigeria got 384 scientific and technical journal articles, while New

Zealand, Poland and Belgium got 3,034; 6,770 and 6,604, respectively. In 2005, the value of high

technology exports by Nigeria was \$8 million, which was only 2 per cent of her total manufactured exports for the year. Poland, in the same year, exported high technology goods worth \$ 2,688 million while Hong Kong exported \$94,808 million worth of high technology goods, which accounted for 14 and 34 per cent of their respective total manufactured exports. In 2007, the number of scientific and technical journal articles by Nigeria was 427. Although this was an improvement relative to 382 in 2003, it was very insignificant when compared with 7,136 of Poland and 7,071 of Belgium. United Kingdom, in 2007, got 47,121 scientific and technical journal articles while Sweden got 9,914. In 2009, the value of high technology exports by Nigeria was \$ 46 million, which accounted for only 3 per cent of her total manufactured exports.

Singapore, United Kingdom and Sweden in 2009 exported high technology manufactured goods worth \$97,207 million (27 per cent of manufactured exports), \$57,178 million (23 per cent of manufactured exports), and \$ 17,089 million (17 per cent of manufactured exports), respectively. In 2010, there were 39 researchers per million people involved in R&D in Nigeria whereas between 2002 and 2004, there were 3,945 researchers in New Zealand who involved in R&D, while 3,065 involved in R&D in Belgium. In 2010, 5,256 researchers per million people involved in R&D in Sweden, while in Singapore 6307 researchers involved in R&D. Nigeria got 432 scientific and technical journal articles in 2010, and 439 in 2011, while Poland published 7,157 scientific and technical journal articles in 2010, and 7,564 in 2011. In 2010 and 2011, United Kingdom published 45,978 and 46,055 scientific and technical journal articles, respectively. Singapore published 47,043 scientific and technical journal articles in 2010 and 47,106 in 2011. Nigeria, in 2010 and 2011, consistently expended 0.2 per cent of her GDP on R&D whereas Belgium in 2010 and 2011 expended 2.0 and 2.04 per cent of her GDP on R&D. Sweden, in 2010 and 2011, expended more than 3.3 per cent of her GDP on R&D.

In 2012, Nigeria exported high technology manufactured goods worth \$77 million, which accounted for 2 per cent of total manufactured exports. This indicates that about 98% of Nigerian manufactured goods is devoid of the finesse associated with high technology which probably may account for the low patronage given to Nigerian manufactured goods by both indigenes and foreigners. Belgium and Singapore, in 2012, exported high technology manufactured goods worth \$36,595 million (11 per cent of manufactured exports) and \$128,239 million (45 per cent of total manufactured exports), respectively. Nigeria's expenditure on R&D was the least: 0.2 per

cent of her GDP in 2010 and 2011. With regard to investment (expenditure) on R&D. However, the salient point is that "gross domestic expenditure on R&D and percentage of GDP devoted to R&D activities are the most commonly used indicators to monitor the resources devoted R&D worldwide [23]. In this light, Nigeria has not given adequate attention to R&D: this then suggests the reason for its very low technological capability which has caused her enterprises to depend largely on external sources for technological inputs (capital goods and raw materials) in their production processes. A disaggregation of imports on the basis of the Standard International Trade Classification (SITC) would show that the value of imports has been increasing with the share of capital goods and raw materials being dominant. Table 3 presents the share of capital goods and raw materials in Nigeria's total imports between 1970 and 2010 [26, 27].

From Table 3, the value of total imports was N 756.4 million in 1970, with capital goods and raw materials taking N640.3 million (84.7 per cent) share. In 1980, capital goods and raw materials valued N7190.5 million (79.1 per cent) of total imports of N9095.6. By 1988, value of capital goods and raw materials imported by Nigeria rose to 86.4 per cent (that is, N18532.5 million of N 214445.7 total imports). For the years, 1990, 2000, and 2005, percentages of capital goods and raw materials were 83.1, 72.8, and 81.2, respectively. In 2010, capital goods and raw materials accounted for 82.1 per cent of Nigeria's total imports. On the whole, between 1970 and 2010, the percentage of capital goods and raw materials in total imports averaged 82, which indicated a very high dependence of Nigeria's economy on foreign sources for technological inputs. The implication of this is that local technological inputs accounted for about 18. per cent in Nigeria's industrial processes, indicating a very weak indigenous technological capacity (R&D). This development has been the bane of development agenda in Nigeria in the sense that many technologies sold to Nigeria in form of machinery and equipment are obsolete, and incongruous to the Nigerian economy, and this often times is deliberately done by the more developed countries to perpetuate Nigeria's underdevelopment status [9, 19, 29, 39].

In fact, past national development plans have been used in Nigeria to formalize too large an input of foreign technological system without evaluating their support requirements in terms of local (indigenous) science and technological capacity. This perhaps explains one of the major causes of the enormous quantity of discarded machinery in maintenance yards and the huge array of ineffectively/inefficiently operated

plants/equipment in various factories in Nigeria [31].

The advice, therefore, is that for guest of

mastery of modern technology, Nigeria should not expect any meaningful transfer of technology from the MDC_s [32].

Table 3: Nigeria's Imports, Value and Percentage Share of Capital Goods and Raw Materials in Imports by SITC (₦ million), 1970 – 2010.

Year	Imports	Capital Goods and Raw Materials*	Percentage of Capital Goods and Raw Materials in Imports**
1970	756.4	640.3	84.7
1972	990.1	844.7	85.3
1974	1,737.3	1,440.2	82.9
1976	5,148.5	4,347.2	84.3
1978	8,211.7	6,703.3	81.6
1980	9,095.6	7,190.5	79.1
1982	10,770.5	8,580.8	79.7
1984	7,178.3	5,247.0	73.1
1986	5,983.0	4,806.3	80.3
1988	21,445.7	18,532.5	86.4
1990	45,717.9	37,977.5	83.1
1992	145,911.4	104,829.8	71.8
1994	162,788.8	139,021.6	85.4
1996	562,626.6	439,973.2	78.2
1998	837,418.7	670,345.1	80.0
2000	962,970.2	700,745.5	72.8
2001	1,240,241.3	891,613.9	71.9
2002	1,249,381.0	993,757.4	80.0
2003	1,507,422.8	1,222,343.5	81.1
2004	1,638,353.7	1,329,444.8	81.1
2005	2,496,423.7	2,026,846.4	81.2
2006	3,108,519.3	2,527,226.4	81.3
2007	3,911,952.6	3180417.67	81.3
2008	5,189,802.6	4,307,536.6	83.0
2009	5,102,534.4	4,174,334.1	82.0
2010	8,005,374.7	6,574,594.5	82.1
Average			82.0

Note: *Capital goods and raw materials comprise: manufactured goods, machinery and transport equipment, miscellaneous manufactured goods and chemicals

**Computed by the Author from the Table

Sources: [26, 27, 28]

THE NEED TO SUPPORT RESEARCH AND DEVELOPMENT (R&D) IN NIGERIA

The Post-2015 Global Development agenda has twelve (12) ambitious goals, which constitute a framework for the development activities of the nations of the world. The goals are: 1) End poverty, 2) Empower girls and women and achieve gender equality, 3) Provide quality education and lifelong learning, 4) Ensure healthy lives, 5) Ensure food security and good nutrition, 6) Achieve universal access to water and sanitation, 7) Secure sustainable energy, 8) Create jobs, sustainable livelihood and equitable growth, 9) Manage natural resource assets sustainably, 10) Ensure good governance and effective institutions, 11) Ensure stable and peaceful societies, and 12) create a global

enabling environment and catalyze long term finance. All the goals have specific targets to be delivered by 2030. Efforts needed to achieve these goals in each country depend on the country's level of technological adequacy, which is generally accepted to come from two sources: the internal and external sources.

Internal Source

Technological capability is developed internally through research and development (R&D), that is, investigation into existing knowledge, skills and ways things are done in a given society with a view to improving the existing standard of living and quality of life. The more a country pays attention to R&D, the more progress it makes technologically, and this

defines the level of its socio-economic progress usually measured in human development index (HDI). For instance, between 2002 and 2010, Norway involved 5,503.7 researchers per million people in R&D and expended 1.8 per cent of her GDP on R&D. Norway's socio-economic status in 2010 was ranked the best in the world, thus, it emerged the first in a pool of countries with very high human development, with a value (HDI) of 0.955 in 2010, and maintained the position in 2011 and 2012 [6]. Within the same period, Australia engaged 4258.5 researchers per million people in R&D and allocated 2.3 per cent of her GDP to it. This gave its development efforts the necessary leap, which placed her second in global human development ranking, with a value (HDI) of 0.938 between 2010 and 2012. Even the United States of America and Japan, whose technological prowess is acknowledged worldwide do not relent efforts at supporting R&D. Between 2002 and 2010 United States involved 4,673.2 researchers per million people in R&D while Japan engaged 5,189.3. United States expended 2.8 per cent of her GDP on R&D while Japan expended 3.4 per cent within the period. These conscious efforts towards R&D continues to contribute significantly to the development of the economies of both countries, thus, United State was ranked 3rd while Japan was ranked 10th, with values of 0.937 and 0.912, respectively, in a pool of countries with very high human development. Nigeria, within the same period, 2002 – 2010, involved 38.6 researchers per million people in R&D, and expended 0.2 per cent of her GDP on R&D. This 'business-as-usual' behavior by Nigeria towards R&D deprived the Nigerian economy the necessary tonic and foundation a potential virile economy would need. Consequently, Nigeria was ranked 154, with a value of 0.471, among countries with low human development between 2010 and 2012 [6].

External source

Countries can also develop and beef up their technological capabilities through technology transfer. Four major channels through which technology can be transferred are:

- a. **Transfer of Knowledge:** This takes place when knowledge and ideas about current technologies are spread through research journals, books, and other research materials.
- b. **Commercial Channels:** These channels carry technology transferred commercially on bilateral basis from private firms, mostly transnational corporations (TNCs) to state – owned enterprises, and branches of TNCs operating in countries with low technological capability (LDCs). This occurs in the following ways:
 - i. Turnkey projects;
 - ii. Specialized services such as financial, managerial, engineering, construction, etc.;
 - iii. "project packed" sales of technology which may include raw material, machinery, equipment, spare parts, brand names, trademarks, joint ventures, wholly owned subsidiary, etc.;
 - iv. "processed packed" sales of technology which include complete production processes of planning along with market survey, product mix, drafts, design, technical specification, know-how, commissioning, supervision, and services of experts for training local personnel;
 - v. "technological package" or "simple direct" sales of technology which include embodied or outright sales of machinery and equipment or consulting services (disembodied) like managerial marketing including access to foreign markets and other expertise; and
 - vi. "unpackaged" sales of technology or direct investment in form of machinery, equipment, raw materials, processed products, training, licensing, management or supervision.

C Government channel: Technology is transferred through this channel in form of technical assistance, which is not related to the direct promotion of commercial goals. This takes place through educational and training facilities to students and personnel of the LDCS in institutions in industrial countries.

d International Organizations: Technology is transferred to LDCs by international organization under the aegis of the United Nations (UN), the European Community (EU), etc. through seminars, short- term courses, assistance in research, aids, etc.

The two sources of technology, R&D and technology transfer, are no substitutes: they are complementary with R&D serving as the foundation.

SUMMARY, POLICY RECOMMENDATIONS AND CONCLUSION SUMMARY

The achievement of the Post-2015 Global Development Agenda is largely predicated on functional R&D and "global partnership", which promote dissemination of knowledge, ideas and technology (technology transfer). However, in technology development, the two components namely, R&D and technology transfer are involved. Nonetheless, R&D usually serves as the foundation. The present state and level of technological capability in Nigeria calls for the need to support R&D to enable Nigeria to lay the needed solid foundation so as to be able to absorb knowledge, ideas and technology from the rest of the world, so as to consolidate its technological capability for achieving the goals of the

development agenda. “What matters in technology transfer is not just having technology, but understanding how to use it well and locally” [6]. This suggests that technology transferred from one country to another, through any channel, will be assimilated into the economy of the recipient country and become useful if and only if the recipient country has developed its technological capability (through R&D) to a level that can absorb the new knowledge, ideas and technology.

POLICY RECOMMENDATIONS

From the background of the foregoing theoretical elucidations, for Nigeria to stand a chance of realizing the Post-2015 Development Agenda, the following policy options are offered:

- i. The existing research centres should be well equipped and funded. Information network among research centres should be improved. Research findings by research centres should be published bi-yearly or yearly for public consumption.. The mandate to publish can be given to National Office for Technology Acquisition and Promotion (NOTAP).
- ii. Government, through the various research centres and institutions, should recruit more researchers and technicians of diverse areas of specialty in research and development (R&D). This will broaden the scope of research and strengthen the quantity of findings.
- iii. Researchers and technicians in research and development (R&D) should be called yearly to meet and discuss their R&D findings. This will challenge them to strive to consolidate their skills, it will bring about singleness of purpose and synergy.
- iv. Government should sponsor researchers and technicians in R&D for international conferences and exhibitions. This will to sharpen their minds and give them necessary challenges to improve.
- v. Scientific and technical journal articles should be recognized by institutions of affiliation and published in the national tabloids for a wider consumption. Authors of such articles should be encouraged. This can be done through an award of honor both by the institution of affiliation and the government.
- vi. Researchers and technicians in R&D should be given opportunities to experiment and unify their skills by involving them in the design and execution of projects. This will cause them to discover their strengths and weaknesses and to strive for improvement.
- vii. Yearly exhibitions by technical colleges should be encouraged. Students with skill-laden projects should be encouraged by the

government to develop such projects beyond the levels at exhibitions.

CONCLUSION

The paper attempted to highlight the importance of R&D in economic development and social progress of nations, *ipso facto*, the need to support R&D in Nigeria. It reveals that Nigeria’s expenditure on R&D has been grossly insufficient, and the number of researchers and technicians in R&D also inadequate. Consequently, R&D in the country is still in embryo. The paper, therefore, submits that for Nigeria to trek towards realizing the post-2015 development agenda, R&D must be given the needed attention and supports, for without which realization of the development agenda will be just another ‘business as usual’.

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