

Scientific and Technological Advancement of Silica Sand; A Strategy for National Development in Nigeria

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Abstract

This paper discusses the impact of scientific and technological transformation of silica sand in national development. Science is the study of knowledge that depends on seeing and testing facts while technology is the practical application of scientific knowledge. Technology refers to making, modifying, usage and knowledge of tools, machines, techniques, crafts and methods of organization in order to solve a problem, achieve a goal or perform a specific function. Thus, any application of science to accomplish a particular function is known as technology. Technological progress is viewed as a credible index for power and over all economic growth. Its great economic multiplier effect is shown to rest on its ability to inspire acquisition of knowledge, introduction of new ideas, skills, products and markets among others. Hence the central importance of technology in national development is discussed herewith. Evident is the fact that the global economic landscape is experiencing rapid changes and nation's power is tilting in favour of the countries with superior technological knowledge. The position of Nigeria in emerging science and technology is examined. The following research efforts of Nigerian scientists are recognized and recommendable: the hosting of the Synthetic Aperture Radar a space technological project, the development of drugs for the treatment and control of diseases and the breakthrough in biotechnology in biogas production and improved agricultural seedlings for better yields. The sources and potentials of Nigeria silica sand were reviewed. The fundamental problems attendant to technological development of the sand is highlighted particularly: high capital cost, high energy dependence, high quality material, lack of quality education and logistics impediments to commercialisation of R & D results. Funding for technological effort has been the sole responsibility of the government making it narrow and insufficient Practical suggestions on how best to counter poise these problems and some developmental strategies have been proposed. It is advocated that increased support for technological advancement of local materials: silica sand among others is indispensable for self- reliance, industrialization and economic development of Nigeria.

Keyword: Materials Scientific Technological Development Index

1.0 Introduction

Science is the study of knowledge that depends on seeing and testing facts where as technology is the practical application of scientific knowledge. Any application of science to achieve a particular function is known as technology. For example the way the television, motor vehicles and telephones work is known as technology. These are skills learnt and imbibed at the basic level of education. Hence, science and technological exploration should become part of our lives and culture. Scientific and technological development involves the creation, innovation

of a product, process or service and its diffusion through the society or industry. [2] It is a catalyst for economic growth, employment and social inclusions. The objective of this review is to highlight the need to harness and develop the huge deposits of silica sands in the country through scientific research and technology. This is rational because of its great potential to stimulate the economy through the ancillary and downstream industries.

2.0 SCIENCE AND TECHNOLOGY AS AN ECONOMIC TRIGGER

Science and technological progress is viewed as a credible index for economic growth of a nation, [3] because it is intrinsically linked to all sectors of the economy thus enhances economic development. It has the capacity to invigorate home grown technologies that could transform local materials and services into value added products for global consumption. Modern gadgets in all aspects of human endeavour are inventions of science and technology. Recent analysis has shown that the world's economic growth over the period of 1950 – date is indebted to inventions, innovations and gains arising from technological advancements. [3] Advances in Science and Technology can help diversify the economy by improving productivity in agriculture through the improvement of seedlings and storage facilities. Also the development of hybrid engines that harness solar power and batteries for powering engines is a good challenge to carbon emission emanating from the use of fossil fuels. The impact of technological advancement in ICT sector is strongly associated with economic growth: job creation, faster and better business practices that have brought the globe into a single room. In medicine and health care research has proven vital to the prevention, diagnosis and treatment of diseases. In educational sector, ICT has made learning easier. Massive Open Online Courses (MOOC) market place is available in some universities providing free, high quality and highly accessible online university level education to the masses. [3]

Therefore to aspire for economic emancipation, a nation would primarily have to bid for a self-reliant technological base which involves a systematic development of its resources “human and materials” to support the nation's products and services. A strong and stable nation is a nation with adequate technology to make its citizens comfortable and happy. To this end Nigeria is considered to be highly underdeveloped. It depends on other countries for the provision of basic necessities needed for human existence and comfort.

SCIENCE AND TECHNOLOGY AS AN INDEX OF POWER

All nations of the world have come to appreciate the fact that the Science and Technologically advanced nations influence both economic and military power to the disadvantage of others that are yet to be economically alert. History has shown that United States led the economy and might of the world in the 20th century because she lead the world in research innovation. [3] Hence science and technology is an INDEX OF NATIONAL POWER. Today, the global economic landscape is experiencing rapid changes and national power is tilting in favour of the most technologically advanced countries. The profile of scientific and technological innovations of various countries are illustrated by the global technological index

Global Technological Index

Science and technological advancement are measured according to three main matrices, research and development efforts, scientific and research talents and the level of innovations.

[8] This is summed up as Global Technological Index. It is a broad assessment of the technology and innovative capabilities of the world leading nations that are charted in maps below. Figs 1 – 4 (The Atlantic Cities Webpage)

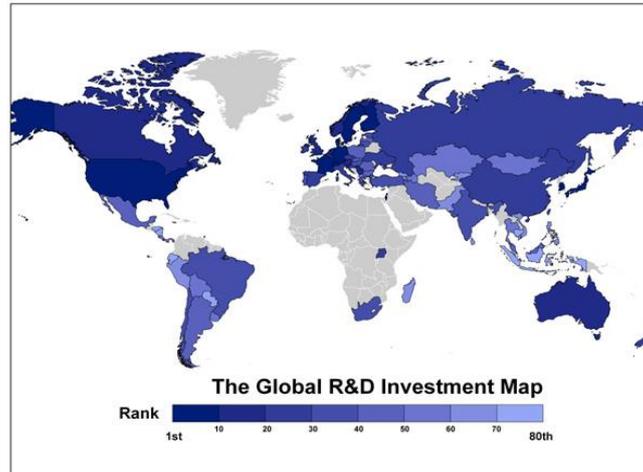


Fig 1. Global R & D Investment

The maps chart the percentages of economic output countries devote to R & D investments. In the above graph. Israel ranks first followed by Sweden, Finland, Japan and Switzerland. US ranked sixth while South Korea, Germany, Denmark and France rounded up the first 10. Nigeria with less than 2% of its annual budget investment on Scientific and technological development over the past decades has no place in the map. Further down the list, Russia, China, Brazil and India ranked 22nd, 26th, 31st and 38 respectively.

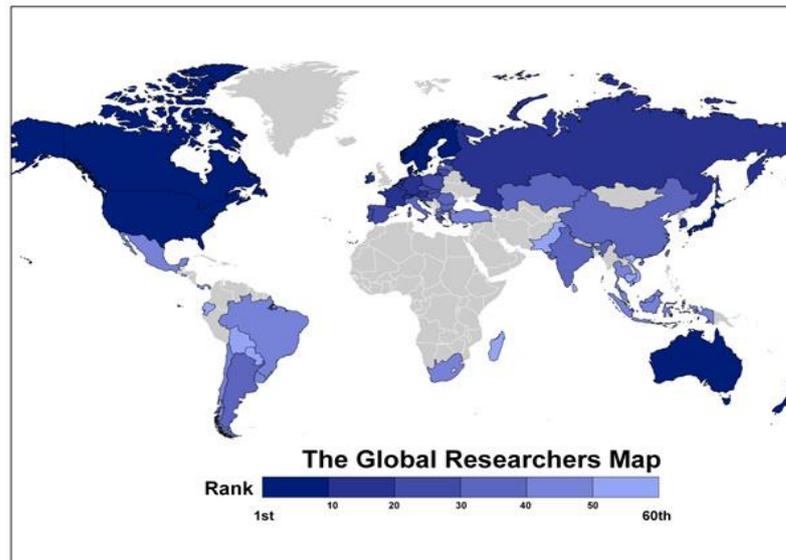


Fig. 2. The Global Researchers Map

The map charts scientific and engineering researchers per capita. Finland tops the list followed by Sweden, Japan, Singapore and Denmark. United States ranked 7th, Russia, India, China and Brazil took 12th, 36th, 39th and 43rd positions.

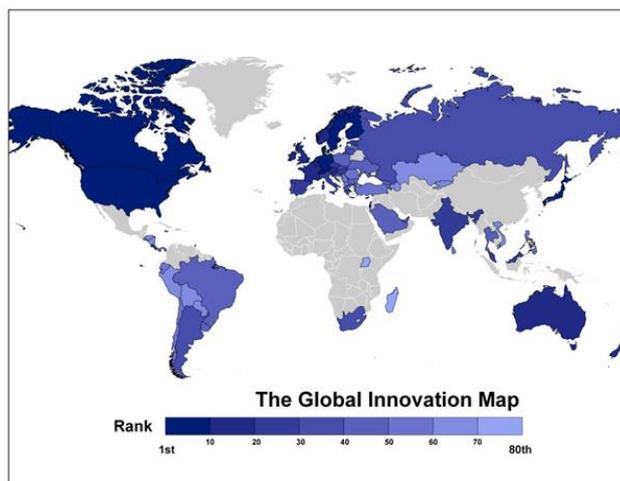


Fig 3. The Global Innovation Map

The map plots innovations measured as patents per capita. United States took the first place followed by Japan, Switzerland, Finland and Israel. India is 26th, Russia 34th and Brazil 41st.

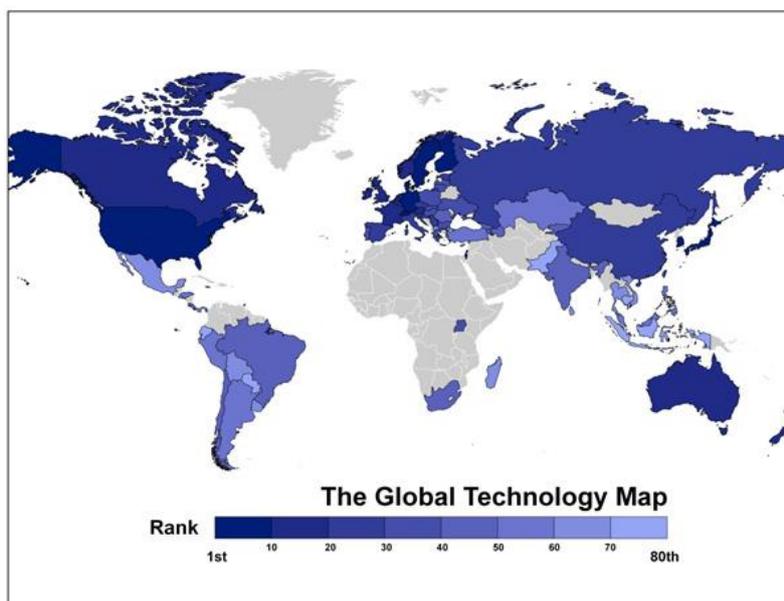


Fig 4. The Global Technology Map

The global technology map is a combination of the three measures summed up as the global technology index. It is a broad assessment of the technical and innovative capabilities of the

world's leading nations. Finland takes the 1st spot followed by Japan. United States took 3rd position while Israel came 4th on the line.

3.0 POSITION OF NIGERIA IN EMERGING SCIENCE AND TECHNOLOGY

In a nutshell, Nigeria and the African nations at large are yet to make impact on the global scene in respect to science and technological progress. However, Nigerian Scientists have taken some positive steps such as: sending satellites into the orbit. Nigeria is quoted to be developing the next level of space technology called Synthetic Aperture Radar, which shall be used to capture the country's weather condition [4] It could be used also on land and the maritime boundaries to expose sea robbery, bunkering and other security challenges. Nigerian scientists have made remarkable breakthrough in biotechnology. Genetically modified seeds have been used to improve yields, fight pest and drought thereby entrenching our food security. Nigerian scientists have also produced drugs for treatment of anemia and sickle cell. With the abundant silica deposits in the country, Nigerian scientist are working hard on a silicon value project as a raw material input for the energy research. There is no doubt that Nigerians are making some progress in science and technology but the performance is below expectation in relation to abundant human and material resources available in the country.

Records have shown that South Africa produced over 86,000 scientific papers publications which is 63% of the total research output of African countries surveyed between 1990 to 2015. [7] Egypt produced nearly 60000, which is about 27% of the output. Nigeria produced 27,743 papers about 6% of the total output about half of Egypt's output. It is very worrying that the productivity of Nigerians scientific research is the second lowest of the 19 African countries. Similarly, South African secured more than 1000 patents in 2015 alone according to the data obtained from the World Intellectual Property Organisation (WIPO) where as Nigeria secured 18 patents in the last 8 years. Egypt and Kenyan got 604 and 49 patents respectively over the same period. [7]

LOCAL MATERIALS AS ECONOMIC TRIGGER

The great importance of local materials in the national economy is not restricted to its immediate or direct application that is the major economic activity. Added to this, large scale economic and industrial activities associated with the raw materials usage are the ancillary downstream industries: processing industries, as well as extensive services such as transportation and supplies which are given a big boost. These do not include continuing research into the further development, utilisation and adaptation of the raw materials resources and technology.

Rich mineral resources, abundant energy supply and arable agricultural terrain are the vital requirements for modern technological development of a nation.

POTENTIALS OF NIGERIAN SILICA SAND AS AN ECONOMIC TRIGGER

Silica sand is the term given to quartz that has been broken down into tiny granules. It consists of mainly silicon dioxide SiO_2 . Other components may include aluminium, feldspar and iron bearing minerals. Sands with particularly high silica content that is used for purposes other than construction is known as silica sand or industrial sand. Statistical evidence has shown that Nigeria is endowed with abundant silica sand deposits [5]. Table 1 shows silica sand deposits

in Nigeria that can be used in the production of various goods and services in their primary and processed forms, as essential input raw material for a host of other industrial activities or works. Many allied industries that will receive stimulus from utilizing silica sands are shown in the table 2.

Table1: Silica Sand Deposits in Nigeria

S/N	STATE	LOCATIONS
1	Abia	Ukwa, Aba, Isiala Ngwa
2	Akwa Ibom	Ikwo, Ukem. Ibeno, etc
3	Bayelsa	Sagbama, Ijaw, Yenagoa
4	Benue	Buruku, Gboko, Guma, Kastina Ala
5	Bornu	Dikwa, Gwoza, Jere, Mongunu, etc
6	Cross River	Ikom, Mfamosing, Okorotong,
7	Delta	Ugheli, Aniocha, Burutu, Ethiope
8	Enugu	Enugu, Ekulu, Igbo Eze, Udi
9	Gombe	Yamaltu – Deba, Dukku
10	Imo	Ihiagwa, Obinze, Isu, Njeba
11	Jigawa	Kangama, Kasaure
12	Kaduna	Kaduna
13	Kano	Dambatt, Makoda
14	Kastina	Zango
15	Lagos	Apapa, Badagry, Epe, Lagos Island, Lekki
16	Nasarawa	Lafia, Doma, Nasarawa
17	Niger	Gbako, Gurara, Mokwa, Bida
18	Ogun	Ogun waterside, Obafemi –Owodo
19	Ondo	Igbokada, Akata, Agbala, Ilaje
20	Rivers	Etche, Obio, Okirika, Oyigbo
21	Sokoto	Sabo, Birini Wamako
22	Taraba	Jalingo, Bali, Takum
23	Yobe	Ngeji, Fika, Damaturu, Nguru, Tarmuwa
24	Zamfara	Jamuri, Gumi,

Source : RMRDC Technical Publications 020

Table 2: Industrial Application of Silica Sand

Industrial Applications
Production of Glass
Foundry Sands
Ceramics
Sand Blasting
Abrasives
Building Products

Fillers and Extenders
Production of Silicon
Silicon Derivatives
Pigments
Hydraulic Fracturing and Propping in the oil Industries
Silica products in the Electronic Industries:
Fibre optic Industries
Fused Silica
Silicone Products
Water Filtration

4.0 THE SILICA SAND SITUATION IN NIGERIA TODAY

The initial industrial uses of silica sand were related to metallurgical and glass making activities in 3000-5000 years BC. Since then the endowment of silica to industrial development has persisted. Currently, among other uses of silica is the contribution to information technology revolution being used in the plastics of computer mouse and providing raw materials for silicon chips. Silica sand is used as a component of solar panels. The Nigerian silica industry is a shadow of a similar industry in any of the developed countries. Silica sand in Nigeria is used mainly for glass, ceramic and foundry works. The range of myriad of downstream and ancillary industries processing the silica sand into high – cost products yielding high revenue is non-existing in Nigeria. Thus silica industries if assisted with ancillary industries will act as catalysts to the national economy, enhancing productivity and boosting employment. However, the problems attendant on the development of the silica industries are basic. These are essential inputs to a viable research and technological base such as

- Lack of - Quality education and technological culture,
- Good infrastructure with cheap and uninterrupted power supply
- Adequate funding by government and related bodies
- Commercialization of R & D results
- End users that should make serious demands from the environment

A minimum of half of the above points listed must be entirely indigenous for a meaningful technological growth in the silica industry.

FUTURE DEVELOPMENT STRATEGY

The challenge now is on how to move forward. It is advised that the government should establish strong and meritable silica sand research institute with qualified and competent manpower to train scholars on developing strong research and development culture. Infrastructure: water supply, electricity, telecommunication, roads and sanitation should be provided for to facilitate research work. Financing this research institute should be the responsibilities of the government and private organisations. This is rational as the government would benefit from improving the lives of the people while the private organisations could make money off these improvements. Trusts on the part of local scientists to be transparent and totally open in the release of their research findings to the public should be assured and secured while the interest of the scientist on his research findings being appropriated to another person guaranteed.

Emphasis and encouragement of demand driven Research and Development programs is important. This will introduce the triple helix model innovation where the government agencies, industrialists and academicians interact, exercising their responsibilities and capabilities to resolve a technological problem. Also necessary is the need to stimulate investors' interest in commercialization of R & D results and strengthening the public private partnership (PPP) in the nations program.

5.0 CONCLUSION

The global technological index of various countries was x-rayed and the position of Nigeria in emerging technologies evaluated. The potentials of Silica sand, an industrial raw material was reviewed as its occurrence spans through out the country. The fundamental problems attendant on utilization of silica sand to maximum capacity were examined and measured to counter poise these problems enumerated. It is therefore, recommended that these measures be adopted to add value to the silica sand for maximum utility.

Similarly, it is my suggestion that the adoption and implementation of these measures in other research and developmental programs in the country will go a long way in making the country self reliant through the scientific and technological progression of the application of local materials.

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