

Science Research and Publication in Africa: The Nigeria Perspective

Oyeboade Adebayo

National Horticultural Research Institute, P.M.B 5432, Idi Ishin, Ibadan, Nigeria

Corresponding author: akinboade2005@yahoo.com

ABSTRACT

Africa is a continent of huge ethnic and cultural diversity. This often led to political instability, poverty and disease prevalence. Science and technology is crucial to the continent's economic prosperity, food security, disease control and environmental sustainability. The wise use of this tool and its visible output in terms of scientific collaboration and publication is still lacking in Nigeria. In this opinion paper I wish to highlight factors affecting the development of science research and publication in Nigeria vis a vis the continent and global picture. This information could further sharpen the focus of policy makers to evolve strategies to access faster the gains and developmental impact of science and technology research on the country's economy.

Keywords: Collaboration, publication, science research

SCIENCE RESEARCH AND PUBLICATION IN AFRICA

Africa is a continent of huge ethnic and cultural diversity. This often led to political instability, poverty, corruption, disease prevalence. Food production to alleviate poverty in particular has been a major challenge, and per-capita production has even declined in some countries, leading to grave problems (Janick *et al.* 2008).

Science and technology are critical not only to the continent's economic prosperity but to such matters as food security, disease control, access to clean water, and environmental sustainability (UNESCO 2007). One can therefore conclude that science research occupies a strategic position as an indispensable tool for the advancement of human society, permeating all aspects of human endeavour, and accounting largely for the acceleration in progress. The wise use of this tool seems to be the reason why countries in the developed world are able to achieve national economic development. China is fast advancing in this area and their emphasis on science and engineering (S&E) research is a major factor attributed to their emerging economy. The resultant effect is clearly evident in the output of publications in S&E credited to China. Between 1999 and 2009, the total world S&E article output in the SCI/SSCI database grew at an average annual rate of 2.6% (NSB 2012). Leading this growth was China at 16.8% per year, which propelled it from ninth largest S&E article producer in 1999 to second largest in 2009 behind the United States. The United States accounted for 26% of the world's total S&E articles in 2009, while China comes second producing 9% of the world total (NSB 2012).

The question then is Africa rightly positioned to achieve such growth in science and technology? The continent is no doubt blessed with abundant natural resources, human and infrastructural capacity to use the veritable tool of research in science. It is home to a rich history of higher education and knowledge creation. The University of Al-Karaouine, at Fez in Morocco, was founded in CE 859 and is identified by many as the oldest degree-awarding institution in the world (Adams *et al.* 2010). Today, the Association of African Universities lists 225 member institutions in 44 countries. How is the continent fairing in terms of output in

science research? Adams *et al.* (2010) reporting on Africa's output of publications indexed on Thomson Reuters *Web of Science*SM databases between 1999 and 2008, showed that the northern region of the continent had the highest number of papers with more than 10,500 in 2008 while the south and central regions had more than 10,000 and 7,100 papers respectively. This suggests an uneven distribution of research and innovative capacity at both country and regional levels. They reported further that a breakdown of these figures revealed that African science as a whole is dominated by three nations: Egypt in the north, Nigeria in the centre, and South Africa in the south. In the 10 years between 1999 and 2008, for example, Egypt produced nearly 30,000 papers. In west-central Africa, Nigeria's total for the same period was over 10,000, South Africa's dominance, as might be expected, is even more pronounced: nearly 47,000 papers (Adams *et al.* 2010). South Africa even improved its international ranking by two positions during 2000–2010 and was ranked 33rd in the world by 2010 (Pouris 2012). The across-the-board increases in the number of publications were attributed to the New Funding Framework (NFF) for higher education institutions introduced by the government during the early 2000s affecting all scientific disciplines. Collaboration and co-authorship was another factor identified to boost the level of publication output in South Africa. Jacobs (2008), analysing research output in terms of publication from five research universities of South Africa over a 9-year period between 1995 and 2003 showed that South African authors collaborated more frequently with international authors (73.99%) than with national authors (26.01%). This definitely must have improved research output significantly in terms of both quality and quantity. There is a need for other nations in the continent to follow after such good government initiatives, which must have opened the research system up for international collaboration.

SCIENCE RESEARCH AND OUTPUT IN NIGERIA

Nigeria possesses the largest number of universities in sub-Saharan Africa which produce most of the country's skilled professionals (Okebukola 2002; Ogbogu 2009). It is clear, however, that despite Nigeria's high volume output in terms

Table 1 Comparative analysis of Nigeria among the top 5 prolific Africa Nations in some disciplines.

| Field | Top five nations ranked by number of papers / percentage of papers | | | | |
|-----------------------------|--|-------------------------|---------------------|---------------------|---------------------|
| | 1 | 2 | 3 | 4 | 5 |
| Agricultural Sciences | Nigeria 952 / 0.95 | South Africa 692 / 0.69 | Egypt 461 / 0.46 | Kenya 380 / 0.38 | Tunisia 247 / 0.25 |
| Biology and Biochemistry | South Africa 1242 / 0.46 | Nigeria 1004 / 0.37 | Egypt 521 / 0.19 | Tunisia 505 / 0.19 | Morocco 200 / 0.07 |
| Clinical Medicine | South Africa 4183 / 0.41 | Egypt 2584 / 0.26 | Tunisia 1587 / 0.16 | Nigeria 1392 / 0.14 | Morocco 867 / 0.09 |
| Pharmacology and Toxicology | Egypt 600 / 0.66 | South Africa 375 / 0.41 | Nigeria 235 / 0.26 | Morocco 101 / 0.11 | Tunisia 90 / 0.10 |
| Plant and Animal Science | South Africa 4179 / 1.55 | Egypt 798 / 0.30 | Kenya 784 / 0.29 | Nigeria 602 / 0.22 | Tunisia 527 / 0.19 |
| Neuroscience and Behaviour | South Africa 310 / 0.21 | Egypt 75 / 0.05 | Tunisia 58 / 0.04 | Morocco 45 / 0.03 | Nigeria 37 / 0.03 |
| Environment and Ecology | South Africa 1707 / 1.29 | Kenya 420 / 0.32 | Egypt 367 / 0.28 | Nigeria 351 / 0.27 | Tanzania 206 / 0.16 |
| Psychiatry and Psychology | South Africa 667 / 0.56 | Nigeria 102 / 0.09 | Egypt 43 / 0.04 | Tanzania 179 / 0.09 | Kenya 30 / 0.03 |
| Social Sciences, General | South Africa 2107 / 1.06 | Nigeria 331 / 0.17 | Kenya 222 / 0.11 | Tanzania 179 / 0.09 | Ghana 140 / 0.07 |

Adapted from Adams *et al.* (2010); Web of ScienceSM

of human capacity, it is not returning as much productivity as would be expected given the size of its economy. The value of its resources is not yet being felt in its knowledge base in a major way because of policy instability. The Federal Government developed strong science-oriented strategies and policies like the National Economic Empowerment and Development Strategy (NEEDS) and New Agricultural Policy Thrust (NAP). NEEDS focuses particularly on reorienting values, reducing poverty, creating wealth and generating employments which are based on the notion that these goals can be achieved through creating an enabling environment for business to thrive, redirecting the government to providing basic services and empowering the people to take advantages of new livelihood the plan will stimulate (NEEDS 2004). However such strategies and policies should be translated into an implementable action plan, supported by legislative action and sustained with appropriate public expenditure.

Science in Nigeria has been the subject of a multitude of changes and this seems to be closely linked with its output. For instance, a major reorganization and expansion of the national agricultural research system took place when various research stations and departments were upgraded to research institutes with specific mandates for research on food and industrial crops, livestock, forestry, fisheries, extension, and processing and storage (IFPRI 2008). The National Agricultural Research Project was therefore launched in 1992 by the Federal Ministry of Agriculture and Natural Resources with the assistance of the World Bank (Shaib *et al.* 1997). This was a governmental effort to strengthen the agricultural research system. Through this project, the National Agricultural Research Strategy Plan, 1996–2010, was formulated. One of the objectives was to improve the output and cost-effectiveness of research through effective collaboration of the national agricultural research institutes (NARIs) with universities and the international agricultural research centres. The strength of this initiative seems to pay off in increased scientific publication in agricultural sciences. **Table 1** provides a closer look at Nigeria's output in comparison with other five most-prolific Africa nations in some main fields, according to the classification scheme employed for Thomas Reuters Essential Science Indicators. The analysis reflects papers indexed in the five-year window between 2004 and 2008, where Nigeria topped in terms of numbers and percentage of scientific publication in agricultural sciences. On the other hand, the table also shows the weakness of Nigeria in terms of output of publications in basic sciences and engineering. A bibliometrics study exploring the level of research output in science and engineering in terms of publication of journal articles between 1997–2006 involving 13 universities in the south of Nigeria showed 42.1% did not have any article in international journals (Okafor and Dike 2010). This may however be linked to scarce resources available for research in basic sciences and engineering.

This brings me to the issue of funding of academic research in Nigeria. The federal government provides the bulk of funding for research in the country. However, there is a need for a closer look at the components of such spending and the agricultural sector is a good example. Between

2001 and 2005, the aggregate federal spending budget averaged 824 billion naira per year (approximately \$5.5 billion dollars at 150 naira to a dollar). Out of this amount, the agriculture sector budget constituted a very small share, averaging only 14.7 billion naira (\$98M) per year which is slightly less than 1.8% of the total budget (IFPRI 2008). It is interesting to note that greater percentage of the budget of the agricultural sector goes into input subsidies, particularly fertilizers and food grain reserves, while areas considered vital for promoting agricultural productivity are funded at very low levels, or not at all. These areas include basic and applied agricultural research, agricultural extension and capacity building, agricultural finance, irrigation development, and agribusiness development. Several reports globally have shown that when governments put emphasis on such areas, they achieve food security and economic growth (McCunn and Huffman 2000; Smith *et al.* 2007; Enright and Cao 2010). Furthermore, there seems to be a gap between the worlds of policy makers and researchers in Nigeria (Olemba 2002). Nwagwu and Iheanetu (2011), studying the use of scientific information by policy makers in science and technology, reported that the most inaccessible information sources were student theses and dissertations (40%) and reports from research institutes (37.1%). There is need for developing an innovation system ties between and among universities, research institutes, industries, and government which can be beneficial for all sides. These ties should include the flows of knowledge among these sectors, for which research article outputs and collaboratively produced articles will be proxy indicators. This ultimately will guide policy makers into apportioning sufficient funds to the right science sector. Be that as it may, there is a need for institutions involved with research in science to diversify from relying on a sole source of funds for research. There is a need to strengthen their ties with the industry so that they too can be sources of funds for science research. In the United States for instance, the industry's percentage of funding for academic research and development was 6% in 2009 (NSB 2012). The place of industries in science research in Nigeria is still lacking.

COLLABORATION

The global publication output since 1990 revealed a trend of rapid growth of articles with authors from the developing world that is the result of collaboration among researchers internationally (NSB 2012). By 2010, two thirds of all science and engineering articles were co-authored laying further credence to the fact that knowledge creation, transfer and sharing among institutions and across national boundaries. The National Science Board (2012), using special tabulations (2011) from Thomson Reuters, SCI and SSCI, reported that co-authored articles grew from 40% of the world's total science and engineering articles in 1988 to 67% in 2010. However, Nigeria seems to be nowhere in this global picture unlike developed countries like the USA and emerging ones like China who experienced an increase in co-authorship of articles in science and engineering. United States researchers co authored 43% of the total world's co authored S&E articles in 2010 while co-authored articles

Table 2 Top collaborating countries for six key African countries (percentages).

| Nigeria | Algeria | Tunisia | Egypt | Kenya | South Africa |
|---------------|---------------|---------------|--------------------|-------------------|-----------------|
| USA - 7.4 | USA - 2.6 | USA - 2.8 | USA - 9.6 | USA - 32.0 | USA - 15.1 |
| UK - 5.9 | UK - 2.3 | UK - 2.1 | UK - 4.0 | UK - 23.6 | UK - 11.7 |
| Germany - 2.9 | France - 42.0 | France - 32.6 | Saudi Arabia - 6.0 | Germany - 6.8 | Germany - 5.7 |
| Italy - 1.8 | Italy - 2.6 | Italy - 2.7 | Germany - 5.2 | Netherlands - 5.8 | Australia - 4.5 |
| China - 1.5 | Spain - 2.6 | Spain - 2.5 | Japan - 3.7 | Belgium - 4.8 | France - 3.9 |

Adapted from Adams *et al.* (2010); Web of ScienceSM Analysis: Wolfram Mathematica® 7

from China rose 5% in 1999 to 13% in 2010 (NSB 2012). Within this global picture, the place of Nigeria is not found with less than 1% of the world co authored articles in S&E (NSB 2012). Looking at the web of science analysis of Africa top collaborating nations reported by Adams *et al.* (2010), all the nations collaborated with the USA and the UK with varied levels of collaboration (**Table 2**). Previous research revealed that language and cultural relations are determinants of such research collaboration (Chuang *et al.* 2011). Thus, possible reasons that African researchers are more likely to collaborate with European or American researchers may be due to the availability of research funding and the past colonial history of their country. It is possible that the source of funding may also affect the choice of collaboration partnership (Chuang *et al.* 2011)

Table 2 also reveals Nigeria's global reach and collaboration with China. Chinese researchers co-authored 1.5% of the country's total research publications in international journals between 2004 and 2008 up from 0.3% in 2000 (Nordling 2011). This may not be unconnected with new initiatives between China and African nations. In November 2009, the Chinese government launched a plan to boost African science - The Forum on China-Africa Cooperation (FOCAC), involving 49 African countries. The plan include funding of 100 joint demonstration projects on scientific and technological research and to host 100 African postdoctoral fellows and 5,500 African scholarship students in China, all by 2012 (Nordling 2011). The positive trend in Nigeria-China collaboration may serve as a key doorway into the West African and into Anglophone African research base for some of the most exciting research now appearing in Asia and Latin America. The Ministry of Agriculture in Nigeria for instance is involved in collaborative capacity building of scientists with Brazil to tap into the emerging Brazilian research base. Nigeria still needs to expand its academic networking infrastructure in capability and coverage.

Aside from the factors discussed above that are closely linked with the output of science research in terms of quality and quantity of published articles in Africa and Nigeria in particular, one must mention that it is not always easy for scholars in developing countries to get articles published in foreign journals because many of their papers address local issues and problems, which are not likely to interest overseas audiences. This accounts partly for the high rejection rate of manuscripts sent abroad for publication. That draws our attention really to the need for strengthening the regional publication system. The African Journals Online (AJOL) is a good initiative in this regard and Nigerians seems to be dominating the system. Chiemeke *et al.* (2009) investigated the research outputs of Nigerian tertiary institutions using nine journals randomly selected from AJOL. They found that the research papers from Nigeria in the journals accounted for 39.1% of the total number of publications in the journals during 1999-2005. The limitation of the study was that it did not focus on any specific subject area.

OTHER ISSUES

Ethics

Scientists live in a culture of "publish or perish". This is because the quality and quantity of research publications are used as benchmarks to monitor the performance of re-

searchers globally. The indicators in Nigeria are pertinent to the policies of the government parastatals like the Ministries of Education, Agriculture, Science and Technology, which distributes funds for research at institutions of research and higher education by measuring the volume of research outputs. They are also linked with promotions of research scientists in these organisations. In this scenario, scientists in their desperation engage in ethical breaches such as data fabrication and falsification, plagiarism, and redundant and duplicate publication occur (Benos *et al.* 2005).

In Nigeria, research institutions are solely responsible for the conduct of their researchers and ensure research integrity. This differs greatly from the United States, where issues of scientific misconduct received government attention since 1985, leading to a legislation named Code of Federal Regulations (CFR) (Benos *et al.* 2005). This undefined legislative regulation at the Federal level may be responsible for the high level of ethical breaches linked with Nigerian scientists. However, most Institutions involved with academic research have policy guidelines on issues of scientific misconduct.

Authorship

There is a whole diversity of aspects related to type of authorship, order of listing of authors and evaluation points assigned to such scientists in Nigeria. Generally, sole authorship is discouraged to prevent ethical misconducts among academia except perhaps in cases of reviews. Promotions and Appointments Committees weigh co-authored articles based on the perceived effort they infer from the authorship order. Generally, the assigned points reduce as the order of the author increases.

Guest, gift and ghost authorship as defined by Flanagin *et al.* (1998) are all inconsistent with the definition of authorship in Nigeria and they are unacceptable and a violation of the policy on authorship for most academic institutions (UI 2011). For most academic Institutions, there are in built rules frowning at employing the services of English language assistant and consequently qualifying such as a co-author. However some Universities or Research Institutes have the Publication units with English specialists who edit publications or manuscripts going out for publications. Efforts of such editors are usually acknowledged.

REFERENCES

- Adams J, King C, Hook D (2010) Global Research Report Africa. Evidence, Thomson Reuters Business, UK. 12 pp. Available online: <http://www.researchanalytics.thomsonreuters.com/m/pdfs/globalresearchreport-africa.pdf>
- Benos DJ, Fabres J, Farmer J, Gutierrez JP, Hennessy K, Kosek D, Lee JH, Olteanu D, Russell T, Shaikh F, Wang K (2005) Ethics and scientific publication. *Advances in Physiology Education* 29, 59-74
- Chiemeke S, Chuang OB, Longe FA, Shaib IO (2009) Research outputs from Nigerian tertiary institutions: An empirical appraisal. *Library Philosophy and Practice*. Available online: <http://libr.unl.edu/LPP/chiemeke-longe-longeshaib.htm>.
- Chuang KY, Chuang YC, Ho M, Ho YS (2011) Bibliometric analysis of public health research in Africa: The overall trend and regional comparisons. *South African Journal of Science* 107 (5/6), Art. #309, 6 pp
- Enright NJ, Cao KF (2010) Plant ecology in China. *Plant Ecology* 209, 181-187
- Flanagin A, Carey LA, Fontanarosa PB, Phillips ST, Pace BP, Lundberg GD, Rennie D (1998) Prevalence of articles with honorary authors and ghost authors in peer-reviewed medical journals. *Journal of the American Medical Association*

- Association 280, 222-224
- International Food Policy Research Institute (IFPRI)** (2008) Agricultural public spending in Nigeria. IFPRI Discussion Paper 00789. 120 pp. Available online: <http://www.ifpri.org/sites/default/files/publications/ifpridp00789.pdf>
- Jacobs D** (2008) An informetric analysis of publication and research collaboration patterns in natural and applied sciences in South Africa. *South African Journal of Library and Information Science* 74 (1), 41-48
- Janick J, Altieri MA, Colwell RN** (2008) Agriculture, in AccessScience, McGraw-Hill Co. Available online: <http://www.accessscience.com.elibrary.calgarypubliclibrary.com>
- McCunn A, Huffman WE** (2000) Convergence in US productivity growth for Agriculture: Implications of interstate research spill over for funding agricultural research. *American Journal of Agricultural Economics* 82, 370-388
- National Science Board, NSB** (2012) *Science and Engineering Indicators 2012*. National Science Foundation, Arlington, VA. Available online: <http://nsf.gov/statistics/seind12/pdf>
- National Economic Empowerment Developmental Strategies, NEEDS** (2004) Available online: [http://siteresources.worldbank.org/INTPRS1/Resources/Nigeria_PRSP\(Dec2005\).pdf](http://siteresources.worldbank.org/INTPRS1/Resources/Nigeria_PRSP(Dec2005).pdf)
- Nordling L** (2011) China is pumping money into African science: But what do both sides stand to gain and lose? *Nature* 474, 560-563
- Nwagwu WE, Iheanetu O** (2011) Use of scientific information sources by policy makers in the science and technology sector of Nigeria. *African Journal of Library, Archives and Information Science* 21 (1), 59-71
- Ogbogu CO** (2009) An analysis of female research productivity in Nigerian universities. *Journal of Higher Education Policy and Management* 31 (1), 17-22
- Okafor VN, Dike VW** (2010) Research output of academics in the science and engineering faculties of federal universities in southern Nigeria. *African Journal of Library, Archives and Information Science* 20 (1), 41-51
- Okebukola P** (2002) The state of university education in Nigeria. Abuja, Nigeria: National Universities Commission
- Olembo N** (2002) Science and Technology and Africa's Global Inclusion. Available online: <http://www.Atpsnet.Org/Content/Files/Documents/Norah%2002lemb.Pdf>
- Pouris A** (2012) Science in South Africa: The dawn of a renaissance? *South African Journal of Science* 108 (7/8), Art. #1018, 6 pp
- Smith L, Fowler M, Mugerwa F, Ogeda M** (2007) Uganda: Agriculture Sector Public Expenditure Review – Phases 1 and 2. Oxford Policy Management
- Thomson Reuters, SCI and SSCI** (2011) Available online: http://thomsonreuters.com/products_services/science/
- UNESCO** (2007) Science in Africa. Available online: <http://www.unesco.org/science>
- University of Ibadan, Ibadan, Nigeria (UI)** (2011) Policy on authorship of scholarly publications. Available online: www.ui.edu.ng/content/university-ibadan-ibadan-nigeria