Comparing Research outputs of Nigeria Federal Universities Based on the Scopus Database

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ABSTRACT

Research outputs are among the key indices in the world ranking of universities. The focus of Nigerian universities, is teaching and research. This paper compares research outputs of Nigerian Federal Universities (NFU's) based on their publication records in the Scopus database. It was found that University of Ibadan (UI) has the highest total number of research outputs more than other NFU's. Bayero University Kano has the highest percentage of papers with international research collaborations than other NFU's although there is a general growth pattern in publications in all of the universities selected for the study. Researchers in NFU's can use these findings in creating collaborative efforts amongst each other. The National Universities Commission (NUC) can also use these findings as the basis in developing and implementing a framework that can significantly increase the visibility of research outputs from NFU's in the Scopus database and hence pave the way for the NFU's to be listed in the Quacquarelli Symonds (QS) World Universities Rankings.

CCS Concepts

• **General and reference** →**Document types** →**Surveys and overviews**

Keywords

Research outputs; Patent; Scopus; QS World Universities Ranking; International collaborations

1. INTRODUCTION

Some of the best known university rankings are: The Academic Ranking of World Universities; the Quacquarelli Symonds (QS) Ranking; the Times Higher Education World Universities Ranking; the SCImago Institution Ranking; the Leiden World Ranking; the Performance Ranking of Scientific Papers for world universities; the ranking of the Web of World universities [1] and the Web of Universities of the Cybermetrics Ranking [20] [26]. However, the Times Higher Education Ranking is the only private independent ranking [1].

The ranking of universities has recently gained interest as a result of the need to acquire tools which can be used for management,

policy making, grant allocation, quality assurance, quality assessment, quality improvement, benchmarking and sustainability among other factors [9][27]. For example, in Nigeria, the National Universities Commission (NUC) presidential special scholarship scheme for innovation and development adopted the QS World Universities ranking to select universities for first class honors degree scholars, for their postgraduate programs [16]. The QS World Universities Rankings of 2013/2014 indicated that no Nigerian university (NU) is listed among the ranked universities [24].

Research is one of the key indices in the ranking of universities and NU is focused on teaching and research. In this paper, our focus is on research because it constitutes one of the major criteria for ranking of universities [18]. Research has proven to be the source of important breakthroughs regarding our knowledge of the world and the evaluation of scientific research is considered to be of great importance. One of the main factors in the assessment of research performance is its international influence which represents a measurable aspect of scientific quality [12].

The various works such as that of [17] [19] [23] have compared research outputs of NU, however all of them were using questionnaires as tools for their analysis. The main issue with questionnaire analysis is that the accuracy of the responses cannot be verified as database with such publications are not available to the researchers. Others such as [6] [13] have analyzed research outputs of NU based on some specific Nigerian journals and African Journals respectively. The issue with using only these two journals is that the scope is narrow as international collaborations and patents were not investigated in their studies. Objective and accurate research outputs, including citations, number of authors, journals, countries, etc. are typically provided by databases [17] which are arguably the most reliable sources of data for bibliometric studies [10]. Clearly, there is the need for a verifiable and accurate comparison of NU research outputs in terms of citations, h-index, research outputs, number of authors and publication records in journals, international collaborations as well as patent.

As such in this paper, we compare the research outputs of Nigeria Federal Universities (NFU's) based on the Scopus database. Scopus is a product of Elsevier and is the world's largest abstract and citation database comprising of peer-reviewed research literature. The Scopus database contains more than 18,000 titles of international journals from over 5,000 international publishers. The objectives of the study are fourfold:(1) to identify the number of research outputs published by each of the NFU's selected for the study; (2) to compare the productivity of the NFU's; (3) to determine the extent of international research collaborations of the NFU's; (4) to identify the most prolific authors in the NFU's. This analysis will create collaborative efforts between scholars in the Nigerian Universities, may guide the NUC to adapt their

publication policy with a view to significantly increasing the visibility of NU's research outputs in the Scopus database, and can be used to encourage international collaboration in NFU's.

The paper is organized as follows: section 2 present some related works, section 3 presents a detailed description of the research methodology including the selection criteria of the universities under study. Section 4 discusses the results of the study and makes some concluding remarks and further research is discussed in section 5.

2. LITERATURE REVIEW

There are bibliometrics studies in the literature regarding research outputs in NU's. For example, Nwagwu [13] studied the research outputs of biomedical scholars in Nigeria based on publications in Nigerian journals indexed in Medline. The study covered research published between 1967 and 2002 and found that the productivity coefficient of first authors was higher than the productivity of any other authors.

Similarly, [17] conducted a study on the research outputs of some selected NU's located in three geopolitical zones of Nigeria namely; South South (SS), South East (SE) and South West (SW). Data regarding the scholar's publications in science and engineering faculties in both indexed and non-indexed journals were elicited through questionnaires and the period covered was from 1997 to 2006. Results showed that the scholars published more in local journals than in international journals. Further analysis of the results revealed that no significant differences existed in the research outputs of the scholars in local publications; however a significant difference existed in their international publications [19].

Popoola [23] investigated the impact of information sources and services on the research outputs of social scientists in 13 first and second generation universities in Nigeria. The data for the study were collected through questionnaires and analyzed. It was established that the use of information sources and services had an effect on the research outputs of social scientists, with on average two outputs produced each year.

Also [6] compared research outputs in Nigeria's tertiary institutions by extracting data from 7 journals selected from the African Journals online database, for a period from 1999 to 2005. It was found that polytechnics in Nigeria have very low research outputs, although African Journals online is of course limited only to journals from Africa.

Furthermore, [19] analyzed the research outputs of 13 Federal Universities in Southern Nigeria. The data was collected through administering of questionnaires. Their results showed that there is no significant difference in the mean research output of academics in the universities of southern Nigeria. However there is statistical difference in the mean research output between the universities when local journal publications were considered. Their results also showed that the University of Benin had the highest mean publication output in local journals while University of Agriculture, Abeokuta had the highest in international journals.

Oliver and Miriam [29] also investigate the research output of about 1,800 business economists working at Austrian, German and Swiss universities. The research rankings of the university departments were analyzed to determine each department's research performance. Their results showed that individual research productivity and consequently departmental research productivity is affected by institutional and personal characteristics.

Research outputs in the context of NU's based on the Scopus database are scarce in the literature. In fact, it can be seen that none of the cited studies have investigated the pattern of research outputs of Universities in Nigeria based on the Scopus database.

3. METHODOLOGY

The NUC indicated that there are 40 federal universities in Nigeria [16]. The oldest University is the University of Ibadan (UI) as shown in Table 1. A complete list and details of the universities can be found through the NUC official website (http://www.nuc.edu.ng/). Nigeria is divided into 6 geopolitical zones: North Central (NC), North East (NE), North West (NW), SS, SE and SW. Each of these zones has 6 states, except the SE which has 5. The NFU's are spread across these 6 zones.

Data was collected from publication records (journals, conference proceedings and book chapters) as well as patents for each of the federal universities from the Scopus database and was analyzed using Scopus Analyzer. The Times Higher Education World Universities Ranking also used research publications in the Scopus database for ranking the research outputs of universities [1].The Scopus database provides researchers a fast, simple, and virtually complete resource to support the research needs of the scientific, technical, medical, social science, and art and humanities disciplines [28]. The year span for this research was limited to year 1990-2014, for fairness of comparison, since the universities were not established in the same year, as discussed in the study [11] on Korean Universities. For the purpose of selection, publications of each of the NFU's were collected since inception of the universities. In each of the zones, the 2 universities with the highest number of research outputs were selected for study (see Table 1) to have a reflection of the Universities in Nigeria. Numbers of publications were used as the criteria for the selection because the focus of this research is the research outputs of the NFU's, a major indicator of research reputation of a university [6].

Table 1. The profile of the selected universities each with a corresponding total number of research outputs since the inception of the university as retrieved from Scopus (May 2014)

University	Official Website	Established	Research outputs	Generation
UI	http://www.abu.edu.ng/	1948	14,197	First
OAU	http://www.oauife.edu.ng/	1962	6,673	First
ABU	http://www.abu.edu.ng/	1962	5,209	First
BUK	http://www.buk.edu.ng/	1975	773	Second
UNIMAID	http://www.unimaid.edu.ng/	1975	1,498	Second
ATBU	http://www.atbu.edu.ng/	1988	350	Third
UILORIN	http://www.unilorin.edu.ng/	1975	3025	Second
UJ	http://www.unijos.edu.ng/	1975	1,610	Second
UB	http://www.uniben.edu.ng/	1970	4,271	Second
UP	http://www.unip	1975	2,121	Second

	ort.edu.ng/			
UNN	http://www.unn.edu.ng/	1960	5,762	First
UNIZIK	http://www.unizik.edu.ng/	1992	1,110	Third

A total of 12 Universities were included in the study: the University of Maiduguri (UNIMAID) (Borno State); Abubakar Tafawa Balewa University (ATBU) (Bauchi State); Bayero University Kano (BUK) (Kano State); Ahmadu Bello University (ABU) (Kaduna State); the University of Jos (UJ) (Plateau State); the University of Ilorin (UNILORIN) (Kwara State); the University of Ibadan (UI) (Oyo State); Obafemi Awolowo University (OAU) (Osun State); the University of Port-Harcourt (UP) (Rivers State); the University of Benin (UB) (Edo State); the University of Nigeria Nsukka (UNN) (Enugu State); and Nnamdi Azikiwe University (UNIZIK) (Anambra State). The universities were classified into generations (Table 1) based on the classifications given by [14].

4. RESULTS AND DISCUSSIONS

The results of the analysis provided by the S*copus analyzer* are presented below and comprise the analysis of the NFU research outputs based on subject area, author index, international collaborations, patents, together with a comparison of research outputs of the UI and selected universities from Malaysia, Brazil, Indonesia, and South Africa.

Research productivity by university affiliation
Table 2 presents the total number of research outputs for each of the NFU's including the scholars involved in the research. The first column is the name of the university, the second column represent the period covered for the research outputs, the third column shows the number of research outputs within the latter and the fourth column presents the number of authors involved in producing the research outputs. The last column of Table 2 shows the ranking of each of the universities in terms of the number of research outputs published. The period of the publications are categorized into 4 subgroups in an interval of 5 years, similar to the work of Park [21], in order to investigate any changes in research output over time [12].

Table 2. Research productivity of the universities and authors involved during 1990–2014

University	Period covered	Research outputs	Authors involved	Rank
UNIMAID	1990-1994	149	155	
	1995-1999	180	157	
	2000-2004	179	156	
	2005-2009	395	150	
	2010-2014	532	158	
Total	1990-2014	1435	776	9th
ATBU	1990-1994	34	58	
	1995-1999	71	127	
	2000-2004	43	85	
	2005-2009	105	156	
	2010-2014	106	144	
Total	1990-2014	359	570	12th
BUK	1990-1994	41	41	
	1995-1999	32	54	
	2000-2004	36	73	
	2005-2009	159	158	
	2010-2014	361	158	
Total	1990-2014	629	484	11th
ABU	1990-1994	329	157	
	1995-1999	361	158	
	2000-2004	457	156	
	2005-2009	967	158	
	2010-2014	1474	160	
Total	1990-2014	3588	789	4th
UNILORIN	1990-1994	219	154	
	1995-1999	236	158	
	2000-2004	269	158	
	2005-2009	748	158	
	2010-2014	1211	159	
Total	1990-2014	2683	787	6th
UJ	1990-1994	219	155	
	1995-1999	177	155	
	2000-2004	193	154	
	2005-2009	408	150	
	2010-2014	458	150	
Total	1990-2014	1455	764	8th
UI	1990-1994	524	160	
	1995-1999	633	159	
	2000-2004	961	159	
	2005-2009	2458	160	
	2010-2014	3261	158	
Total	1990-2014	**7837**	**796**	1st
OAU	1990-1994	549	158	
	1995-1999	521	160	
	2000-2004	788	159	
	2005-2009	1699	159	
	2010-2014	1643	159	
Total	1990-2014	5200	795	2nd
UB	1990-1994	261	157	
	1995-1999	259	158	
	2000-2004	390	158	
	2005-2009	1163	158	
	2010-2014	1210	158	
Total	1990-2014	3283	789	5th
UP	1990-1994	173	157	

	1995-1999	148	153	
	2000-2004	191	155	
	2005-2009	533	158	
	2010-2014	777	159	
Total	1990-2014	1822	782	7th
UNN	1990-1994	476	154	
	1995-1999	466	159	
	2000-2004	489	155	
	2005-2009	1025	155	
	2010-2014	2030	157	
Total	1990-2014	4486	780	3rd
UNIZIK	1990-1994	32	51	
	1995-1999	120	156	
	2000-2004	151	148	
	2005-2009	256	144	
	2010-2014	597	155	
Total	1990-2014	1156	654	10th

Table 2 clearly shows that in all of the universities included in the study, the pattern of research outputs are changing over time. The number of research outputs is increasing in each of the universities as well as the number of authors involved in those output. The increasing number of publications as well as authors might be attributable to an increased awareness of the need to publish in reputable indexed journals. The university with the highest number of research outputs between 1990 and 2014 is the UI whereas ATBU has the lowest output. This is not surprising because ATBU is a third generation university and research outputs increases with the age of the university, as shown in Table 1. The top 4 universities with the highest number of research outputs are the first generation universities (see Tables 1 and 2). If the researchers in NFU's are motivated to publish research outputs in journals indexed in Scopus, probably the number of the research outputs in Scopus from NFU's can significantly increase over time. Even if not all the NFU's is motivated, the motivation can be pilot test with the first generation universities in view of the fact that they have the potentials to compete with other world class Universities if adequately motivated. It was found however that most scholars in Nigerian universities publish in non-indexed local journals [17]. This limits the visibility of the research outputs internationally and hence also its impact. Figure 1 below depicts the rankings of NFU's based on Table 2.
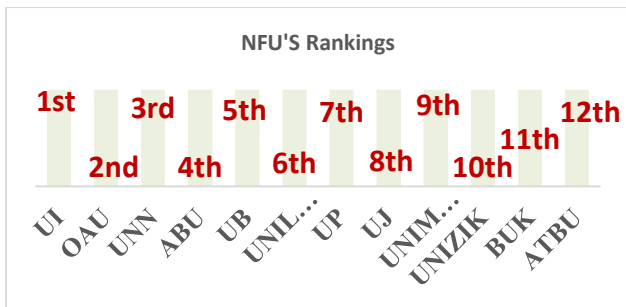

Figure 1: Ranking of NFU's

Table 3: The most prolific researchers in the 12 selected universities

Author ID	Author Name	University	Research outputs	Citations (h-index)
70062 41848	Mohammed, Idris	UNIMAID	47	274(4)
66034 34330	Aliyu, Usman O.	ATBU	30	144(6)
35569 54140	Habib, Abdulrazaq Garba	BUK	37	390(10)
70063 56993	Ameh E. A.	ABU	148	822(15)
70036 08012	Abdurrahman, Murtala B.	UNILORIN	76	278(1)
66026 79143	Agaba, Emmanuel I.	UJ	54	206(8)
70065 18286	**Ogunniyi, Adesola O.**	**UI**	151	2862(22)
70038 46322	Bassir, Olumbe	OAU	113	241(0)
70035 32113	Okieimen F. Ebhodaghe	UNIBEN	117	1101(18)
70039 98930	Orisakwe, O. E.	UP	122	700(12)
70048 48496	Akah, Peter Achunike	UNN	119	1216(15)
67016 61871	Esimone C. Okechukwu	UNIZIK	95	454(10)

In a similar manner to the work of Bar-Ilan [3], Table 3 shows the most productive scholars in each university in terms of their ID, name, institutional affiliation, and department, number of publications, citations, and *h-index*. The performance index of the researchers is based on the number of publications, citations, and *h-index* [15] [7].In each of the universities, the scholar with the highest number of publications based on the Scopus rankings was selected for inclusion. The scholar that has the highest number of research outputs, citations, and *h-index* is *Ogunniyi, Adesola O.*, who can probably therefore be considered as the most influential researcher in medicine in Nigeria. Bassir, Olumbe and Abdurrahman, Murtala B. have 0 and 1 *h-index* respectively, despite having high publications and citations. This is because Scopus considers only articles published after 1995 for computation of the *h-index* [28].

International collaborations

International research collaborations are measured based on international co-authorship [11]. International collaborations in research are essential for some types of research as they may be necessary for funding purposes and to increase research productivity [10]. Moreover, Amin and Mabe [2] have shown that international collaborative papers have more impact than papers authored by a single author. Therefore, it was necessary to analyze the international research collaborations between the NFU's and other universities outside Nigeria. As per Beaver [4], the collaborations were extracted from the Scopus categorization of international collaborating affiliations of institutions. Scopus is one

of the standard methods used in such an analysis of co-authorship [10]. Table 5 shows the total number of international collaborations and percentages (bold) computed using Equation (1) for each of the universities.

$$Pic = \frac{tic}{tp} x100 \qquad (1)$$

Where *Pic*, *tic*, and *tp* are the percentage of international collaborations, number of research outputs with international collaborations (see Table 5) and the total number of research outputs (1990–2014 refer to Table 2). The rank column in Table 5 indicates the ranking for each of the universities based on percentage of international collaborations. The highest rank is 1 and the lowest 12.

Table 4. Percentage of university international collaborations 1990–2014

University	International Collaborations	Rank
UNIMAID	233 (**16.23**)	4th
ATBU	112 (**31.20**)	2nd
UNILORIN	20 (**0.75**)	12th
UJ	276 (**19.00**)	3rd
UB	204 (**6.21**)	7th
UP	52 (**2.85**)	10th
ABU	251 (**7.00**)	6th
BUK	199 (**31.64**)	1st
UI	61 (**0.78**)	11th
OAU	198 (**3.81**)	9th
UNN	253 (**5.64**)	8th
UNIZIK	101 (**8.74**)	5th
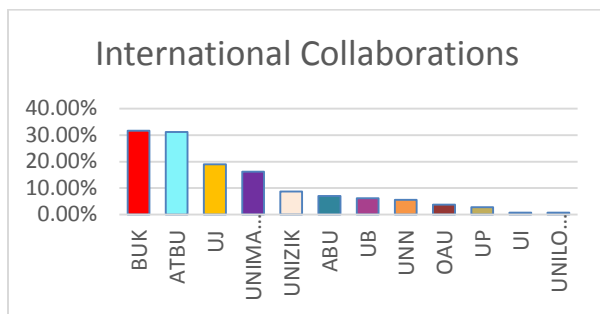
Figure 2: NFU's International Collaborations

Table 4 reveals that BUK and ATBU have the highest percentage of papers with international research collaborations, possibly a result of their own limited research resources, a practice similarly engage by Korean researchers (Kim, 1999). Another possible reason for the high percentage of international collaborations in BUK and ATBU is the increase in the number of scholars in these universities who have gone overseas for their postgraduate training. These universities (BUK and ATBU) might have possibly motivated their scholars to collaborate with researchers in foreign Universities. The first generations universities (see Table 1) have a very low proportion of international research collaborations compared to BUK and ATBU which are second and third

generation universities respectively. The universities with the lowest number of international collaborations are the UNILORIN and the UI as indicated in Table 4. The UI, despite having a very high number of research outputs compared to the other NFU's, still requires significant improvement in terms of international profile.

5. CONCLUSION

The paper compares the research outputs of the NFU's in order to allow policy makers to quickly identify areas of weakness. The research outputs of the NFU's were collected from the Scopus database and analyzed. The major findings are; The UI has the highest number of research outputs among the universities under study and was found to be leading in mathematics, computer science, medicine and the social sciences and BUK has the highest percentage of papers (31.64%) with international research collaborations.

Future work will include extension to other research subject areas. We also suggest future researchers to conduct a study on the comparison of first, second and third generation universities in Nigeria. To investigate the annual research and development budgets of the universities and to look in more detail at citations per staff, international faculty, ratio of international students and citation per faculty among other characteristics as derived from the Scopus database. We also suggest that future research compare the productivity of the private, state and federal Universities in Nigeria.

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