Afr. J. Lib. Arch. & Inf. Sc. Vol. 27, No. 2 (October 2017) 97-115

Open Access Publishing in Africa: Advancing Research Outputs to Global Visibility

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Abstract

The purpose of the study was to examine the status of Africa in the open access environment as well as the challenges of providing global visibility to African research outputs. A descriptive bibliometric approach was adopted for the study. Data was extracted from two world repository directories (Registry of Open Access Repositories - ROAR and Directory of Open Access Repositories - DOAR) and Directory of Open Access Journals – DOAJ to determine the presence of Africa and size of repositories and records found in the directories. Findings reveal that only 20 African countries have presence in ROAR and DOAJ, but 22 countries have presence in DOAR. South Africa has more repositories in ROAR and DOAR while Egypt has over 70% of African contributions to DOAJ. The subject coverage of the repositories indicates that there are more publications in the sciences than there are in the social sciences and humanities; the preferred languages of publication in the directories are English, German and French. Though there is slow adoption of publishing in open access journals in Africa, there has been an increase in the number of open access journal articles from 2,019 in 2005 to 24,997 in 2014. The paper calls on African governments, researchers and librarians to deploy sustainable mechanisms to increase global visibility of African research findings using open access platforms.

Keywords: Open Access, Institutional Repository, Scholarly Communication, Research Productivity, Research Visibility, Africa

Introduction

The adoption of open access scholarly communication in Africa has been an issue of great concern among scholars within and outside Africa (Bowdoin, 2011; Ezema, 2011; Chalabi and Dahmane, 2012; Ezema, 2013; Nwagwu, 2013; Fox and Hanlon, 2015). These scholars are concerned with the provision of a sustainable ICT infrastructure, capacity building and political will among African governments for the adoption of open access in Africa. The increasing interest in open access scholarly communication is because of the great opportunities which open access initiatives provide for wider dissemination of research findings, particularly among the developing countries. Open access movement evolved in response to paucity of research materials created by journal publishers who through business models for scholarly journals continuously increase the cost of journal subscription all over the world, as subscription fees overwhelm library budgets (Mann, von Walter, Hess and Wigand, 2009). In relation to this, Lewis (2012) and Akpokodje (2014) posit that open access emerged as alternative to high cost of journal subscription among libraries. It is a platform that offers scientists greater opportunities for wider dissemination of research findings without article-processing charges (Van Noorden, 2013). The open access movement evolved with the development of the World Wide Web in the 1990s, as researchers found a new platform for research dissemination on the Internet.

With this new information environment (that is, the WWW), interest in open access publishing tremendously increased, leading to the meeting of the Open Society Institute in 2001. The outcome of this meeting was the Budapest Open Access Initiative (see http://www.budapestopenaccessinitiative.org/

read) which provided different open access models, namely the gold route which relies on the traditional journal publication system, but shifts the financial burden to the authors or the research funders and the green route model which relies on authors archiving their publications in repositories in the form of pre-print or post-print (Sanchez-Tarrago and Fernandez-Molina, 2009; Peekkhaus and Proferes, 2015). The Budapest Open Access Initiative (BOAI) has been described as the "first internationally focused formal statement to articulate a comment to open access" (Peekkhaus and Proferes, 2015). Paragraph three of the BOAI clearly defines the concept of open access as provided by the initiative:

> By "open access" to this literature, we mean its free availability on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. The only constraint on reproduction and distribution, and the only role for copyright in this domain, should be to give authors control over the integrity of their work and the right to be properly acknowledged and cited.

Other open access movements or initiatives followed shortly after the Budapest Initiative, and these include Bethesda Statement on Open Access (2003) which focuses on access to biomedical research and the Berlin Declaration on Open Access (2003) which was adopted for science and humanities research. All these are aimed at advocating for the provision of free access to scientific information to assist researchers and libraries globally and more particularly in developing countries (Peekkhaus and Proferes, 2015; Fox and Hanlon, 2015). This development is a reflection of earlier scholarly communication pattern before the debut of the journal. Nwagwu and Onyancha (2015) recently submitted that early scientific communication was even more open than is being canvassed now through OA initiative, and therefore predicted the death of the journal as a channel for communication of research reports.

Since the advent of open access movement, African scholars and institutions have been struggling to key into this initiative for global dissemination of their research reports using the platform. Self-archiving offers researchers opportunity of depositing their research reports (in the form of preprints or post prints) in open repositories (Onyancha, 2011); while open access journals publish research reports, which are freely made available to scholars without any access barriers. The last two decades have witnessed an increase in publication of open access journals funded through article-processing charges (APC) from authors (Fox and Hanlon, 2015) or through funding from agencies and organisations such as universities. The Directory of Open Access Journals (DOAJ) (see https://doaj.org/) was launched in 2002 during the First Nordic Conference on Scholarly Communication (Stenson, 2011). Since then, DOAJ hosts a number of open access journals from many countries all over the world under the Creative Commons Attribution license (https://creativecommons.org/licenses/by/2.0/) which permits sharing (copy and redistribute the material in any medium or format) and adapting (remix, transform, and build upon the material) for any purpose, even commercially.

The benefits of this new publication platform have been reported in a number of published works. While Hitch (2005) and Ezema and Ugwu (2013) demonstrate that open access (OA) publishing increases citation impact; Garner, Horwood and Sullivan (2001) have noted that OA ensures speedy dissemination of research findings to a wider audience and ensures adequate archiving of scientific data. Similarly, Correia and Teixeira (2005) remark that open access drives creation of institutional repositories that are now current indicators of universities' quality, prestige and global visibility. But even with these benefits, there has been reported a slow response in the adoption of institutional repositories in Africa (Kakai, 2009; Adewumi and Ikhu-Omoregbe, 2010; Ezema, 2011; Zaid and Okiki, 2015) when compared with other regions such as Europe and America. While Ezema (2011) canvassed for creation of awareness among libraries and researchers, Zaid and Okiki believe that building collaboration among libraries would improve the situation.

Though low research productivity has been reported in Africa (Ezema, 2010; Gailard, 2010; Nwagwu, 2013), the greatest challenges that African researchers face include poor visibility and dissemination of their research reports (Ezema, 2013). A large proportion of local content materials often regarded as grey literature such as theses and dissertations, conference/seminar papers, inaugural lectures, and others, are poorly distributed for international visibility and thus present Africa as bereft of research production (Chisenga, 2006; Ezema, 2013). Consequently, Africa is often regarded as only consumer of scientific research productivity, leading to low ranking of African universities as revealed in *The Times Higher Education's* (2015) World University Rankings 2014-2015, powered by Thomson Reuters. It appears that the low visibility and the ranking of African universities are linked with inability to adopt open access publication.

Since the development of open access movement many studies have investigated the constraints to adoption of open access publishing in Africa. This study focuses on the status and adoption of open access movement in Africa using freely available global repositories such as open DOAR, DOAJ and ROAR to enhance wide dissemination of their local contents and global visibility of its research outputs. Specifically, the study intends to:

i. Determine the contributions of Africa in the world repository directories.

ii. Find out the types of contents in the African repositories.

iii. Identify the archiving software for the African repositories.

iv. Determine the subject coverage of open access publications in Africa.

v. Identify the most frequently used languages in open access publishing in Africa.

vi. Determine the trends in the growth of open access publishing in Africa.

Brief Literature Review

Open access movement provides researchers with opportunities of free availability of scientific information (Nwagwu, 2013), as it increasingly breaks down access barriers which for years have slowed down universal availability of scientific information. Since the launch of OA initiative over twenty years ago, the number of OA journals has been growing at the rate of 30% per annum (Laakso, Welling, Bukvova, Nyman, Bjork and Hedlund, 2011), and approximately half of the articles are published in journals with article-processing charges (Solomon and Bjork, 2012). Scholars have identified the challenges of OA publishing in Africa; some of which include funding shortages (McKay, 2011; Ezema, 2011), language barriers (Bowdoin, 2011; Chalabi and Dahmane 2012), inadequate ICT infrastructure, and highly skilled ICT experts (Ezema, 2011; McKay, 2011; Nwagwu, 2013). The technological challenges suggest low web usage and lack of access to the global scientific information on the web (Nwagwu and Ibitola, 2010), resulting in skewed distribution of knowledge in favour of the West. Other hindrances to open access publishing bother on institutional inertia because of doubt of its acceptability by some institutions for promotion, retention of tenure and access to research grants (Mann, von Walter, Hess and Wigand, 2009; Harley, Earl-Novell, Arter, Lawrence and King, 2007; Schonfeld and Housewright, 2010) and creation of awareness (Utulu and Bolarinwa, 2009; Swan and Brown, 2004). The study of Utulu and Bolarinwa (2009) reported increasing awareness of open access publications, but with low use as publication channel. While the study of Harley et al. (2007) raised the concern on the prestige of OA journals, Schonfeld and Housewright (2010) remark that researchers are more interested in publishing in journals which will not present any doubt when submitted for promotion.

However, a study by Bjork and Solomon (2012) observes that research grantors have started requesting for open access publishing from grantees. For instance, the National Institute of Health requires open access publishing for all its funded research to reduce the cost of subscription of health researchers (Roehr, 2004). Another study also found an increasing open access publishing from sponsored research (Bjork, Welling, Laakso, Majlender, Hedlund and Gounason, 2010). Another impediment to open access is the perceived poor editorial quality and peer review mechanism (Rowlands, Nicholas and Huntington, 2004; Nicholas and Rowlands, 2005). The belief of many is that OA publishing does not

pass through proper journal peer review processes; therefore, it is usually rejected when submitted for promotion or other research appraisal purposes. This perceived low ranking of open access journals is demonstrated in the study by McVeigh (2004) who reports that OA journals were heavily represented in low ranking journals found in Journal Citation Report of Thompson Reuters of 2003. However, this may not be unique to only OA journals because the skewed citations reports of Thompson Reuters have been reported in a number of literatures (Loonen, Hage and Kon, 2007; Moed, 2005; Meho 2007). A later study by Giglia (2010) using the Directory of Open Access Journals (DOAJ) found that of 355 science-based OA journals, only 38% are in Science Citation Index, while of 30 OA journals (54%) are in Social Science Citation Index – showing a little improvement in ranking from McVeigh's (2004) study.

Another major constraint of adoption of open access publishing is funding. The development of institutional repositories to drive open access archiving requires huge capital, which many universities may not afford without support from funding bodies such as government and other local and international organisations interested in funding research. Unfortunately, in Africa, governments pay lip services to research and scholarship. Nwagwu (2013) has alluded to this in the unarticulated OA policy by government agency such as the National Universities Commission which has the mandate to regulate all Nigerian universities. The same situation may likely repeat itself in other African countries. Another challenge is the reluctance of authors to send their papers to OA journals that levy article-processing charges (Eysenbach, 2006), as observation has shown that assessment charges are usually high.

Despite some of these constraints, studies have shown a growing interest in accessing OA research materials because of several perceived benefits such as visibility and increased availability of scholarly research outputs (Ezema, 2011; Bjork and Solomon, 2012), greater citations and impact influence (Eysenbach, 2006) and higher readership penetration (Davis, 2011). The study of Davis (2011), however, posits that the real beneficiaries of open access publishing are not necessarily the research community but the consumers of scientific information who rarely produce any research finding.

There have been attempts to provide evidence of Africa's contributions to open access scholarly communication in studies such as Fox and Hanlon (2015). Though the study found a low visibility of African institutional repositories, it provided statistical evidence of an increase in open access journals found in DOAJ, with Egypt leading other African countries. A study by Chimah, Ugwoke and Ogwo (2015), using Registry of Open Access Repository (ROAR), found that Nigeria has only nine repositories, representing only 0.23% of the world total. Apart from South Africa, the study failed to provide statistics on other African countries. Another study by Stenson (2011) found that 66% of the journals in DOAJ is published in Europe and North America, while only 2% is published in the whole of Africa, an increase from 1% in 2008. The study by Mann, von Walter, Hess and Wigand (2009) found that 90% of 481 respondents agree that open access publishing will guarantee free availability of research literature, but only 28% had published in open access platform. This implies a high level of access to OA publications, but reluctance in publishing using open access medium. A related study by Sanchez-Tarrago and Fernandez-Molina (2009) on open access publication in Cuban health research also found a low publication rate in open access journals, but revealed that 85% of the researchers agree to archive their publications in open access institutional repositories. This is related to the study by Frass, Cross and Gardner (2013) which reports that majority of the respondents agree to free availability of research literature, but only 40% of them choose to publish in OA journals, and 34% have really published using OA channels. Dalton (2011) also found that open access option has a relatively low consideration among researchers in the choice of publication channels. However, Xia (2010) reports an increasing awareness of OA publishing using a longitudinal study spanning four years. According to the study, the awareness has increased from 50% in mid 1990s to 85% by 2007.

Other studies have focused on citation penetration of open access journals. One of such studies is by Hajjem, Harnad and Gingras (2005) which found that open access articles have more citations consistently, than non OA articles; citation advantages vary from 36% to 172%. This is in line with an earlier study by Lawrence (2001) which

equally found that OA articles in computer science have more citations than non OA articles.

The relationship between open access publishing and global ranking has also been investigated by Onyancha (2015) using Research gate – a social media platform which allows researchers to self-archive their publications for global visibility and access. The study found a positive correlation between publications in open access outlet and ranking of universities. Similarly, Wren (2005) found a positive correlation of access of article from a non-journal website and the journal impact factor.

Another study by Adewumi and Ikhu-Omoregbe (2010) looked at the archiving software used in the management of institutional repositories in Africa and found that DSpace and EPrint are the most popular. It appears that many of the studies in open access initiatives in Africa focused mainly on challenges which impede the adoption of open access scholarly communication and software utilisation. The few studies that investigated current status of Africa such as Fox and Hanlon (2015) merely provided scanty information on the number of institutional repositories and OA journals without providing details. This informed the need for the present study.

Research Methods and Materials

The study adopted a descriptive informetric approach to determine the status of Africa in the open access initiative in terms of the number of repositories, number of open access journals, and number of records deposited in the repositories as well as published in OA journals. Data was extracted from repository directories (that is, the Registry of Open Access Repositories – ROAR, http://roar.eprints.org/ and Directory of Open Access Repository – DOAR, http://www.opendoar.org/) and Directory of Open Access Journals – DOAJ, ROAR and DOAR provide data on the number of registered repositories throughout the world. While the data in ROAR is limited to the number of repositories, software used for archiving, types of repositories and number of records, DOAR provides all the aforementioned types of data as well as an in-built mechanism for determining the repository statistics. Both directories can be searched by types of repository, geographical location of the repositories, types of archiving software, etc. As at November 9, 2015, DOAR had 2987 repositories. DOAJ provides data on open access journals from all over the world and has in-built mechanism to conduct search by journal, geographical region, article searches, among others. As at November 9, 2015 when data was extracted, the directory hosted 10,708 journals from 136 countries of the world.

Data was extracted into Microsoft Excel within four days (November 7 – 11, 2015) for computation. In both ROAR and DOAR, data for each country was extracted by typing the country name in the search field of the directory and through that process the number of repositories and records were generated. The same process was used to extract data from DOAJ. However, data concerning subject coverage, frequently used languages, and trends in the growth of open access journals were extracted by additional query of the database using the in-built mechanism for generating such information. All African countries with any open access presence from the three directories were included in the study. For the trends in open access growth, data was generated for ten years period (2005 – 2014) in line with the period open access awareness began in Africa as indicated by Ubogu (2006). Data was analysed using descriptive statistics of frequency and percentages and presented in tables and charts.

Results

The findings are presented and discussed in line with the objectives of the study, namely contribution of African countries to the world's repositories, content types of repositories in Africa, subject coverage of OA journals, language of publication in the repositories; and growth of OA publishing in Africa.

African Contributions to the World's Repository Directories

Table 1 reflects that Africa had 136 (3.4%) out of 4055 repositories in ROAR wherein South Africa ranks first with 47 (34.6%), followed by Kenya with 14 (10.3%), and Egypt and Nigeria with 11 (8.1%) repositories apiece. Only twenty African countries out of about 56 had any form of repository in ROAR.

A close observation shows that only five countries had up to 10 repositories while half of the contributors had less than three repositories each. The four top ranked countries (South Africa, Kenya, Egypt and Nigeria) contributed over 60% of the entire repositories from Africa. Egypt had the highest number of records in the directory, followed by South Africa. However, the numbers of records in the repositories of many of the countries are unknown, while others were partially provided. For instance, the number of records for Kenya with second highest number of repositories is unknown, while Nigeria with 11 repositories had information on only one of the repositories. The unavailable number of records in the repositories implies poor visibility of the universities in Africa despite the presence of repositories in their names, and this makes African region to trail behind other continents in global visibility of universities.

Table 2 shows the sub-regional distribution of the repositories, which indicates that Southern Africa, had the highest number of repositories with 45 (34.09%), followed by East Africa with 35 (26.52%) repositories, North Africa with 27 (20.45%), West Africa with 23 (17.42%), and Central Africa with only 2 (1.52%). However, North Africa had the highest number of records with 374,898 (46.97%), followed by Southern Africa with 235,321 (29.48%), and East Africa with 125,777 (15.76%). The contribution of Africa in the global distribution of repositories in DOAR is comparably low. The continent contributed only 132 (4%) of the global total of 2987, as can be seen in figure 1. Europe alone has nearly half (44%) of the global total.

Table 1: Distribution of African Repositories in Registry of Open Access Repositories (ROAR)

Rank	Countries	No of Repositories (N = 136)	%	No of Records	Remarks
1	South Africa	47	34.6	5763	Records for only 23 repositories
2	Kenya	14	10.3	NA	Unknown number of records
3	Egypt	11	8.1	7505	Records for only 3 repositories
4	Nigeria	11	8.1	98	Records for only 1 repository
5	Zimbabwe	9	6.6	502	Records for only 2 repositories
6	Algeria	7	5.1	NA	Unknown number of records
7	Tanzania	7	5.1	264	Records for only 2 repositories
8	Ghana	6	4.4	90	Records for only 1 repository
9	Sudan	5	3.7	NA	Unknown number of records
10	Morocco	3	2.2	NA	Unknown number of records
11	Lesotho	2	1.5	NA	Unknown number of records
12	Mozambique	2	1.5	256	For the 2 repositories
13	Namibia	2	1.5	241	Records for only 1 repository
14	Senegal	2	1.5	NA	Unknown number of records
15	Tunisia	2	1.5	NA	Unknown number of records
16	Uganda	2	1.5	171	Records for only 1 repository
17	Botswana	1	0.7	NA	Unknown number of records
18	Cameroun	1	0.7	26	Records for only 1 repository
19	Malawi	1	0.7	171	Records for only 1 repository
20	Rwanda	1	0.7	NA	Unknown number of records
	Total	**136**	**100**		
	World Total	**4,055**	**3.4**		

Table 2: Distribution of African Regions by Contribution to DOAR

African Region	No of Repositories N = 132	%	No of Records N = 798,158	%	Mean records/Rep.
Central Africa	2	1.52	69	0.009	34.5
East Africa	35	26.52	125.777	15.76	3593.6
North Africa	27	20.45	374,898	46.97	13885.1
Southern Africa	45	34.09	235,321	29.48	5229.4
West Africa	23	17.42	62,093	7.78	2699.7

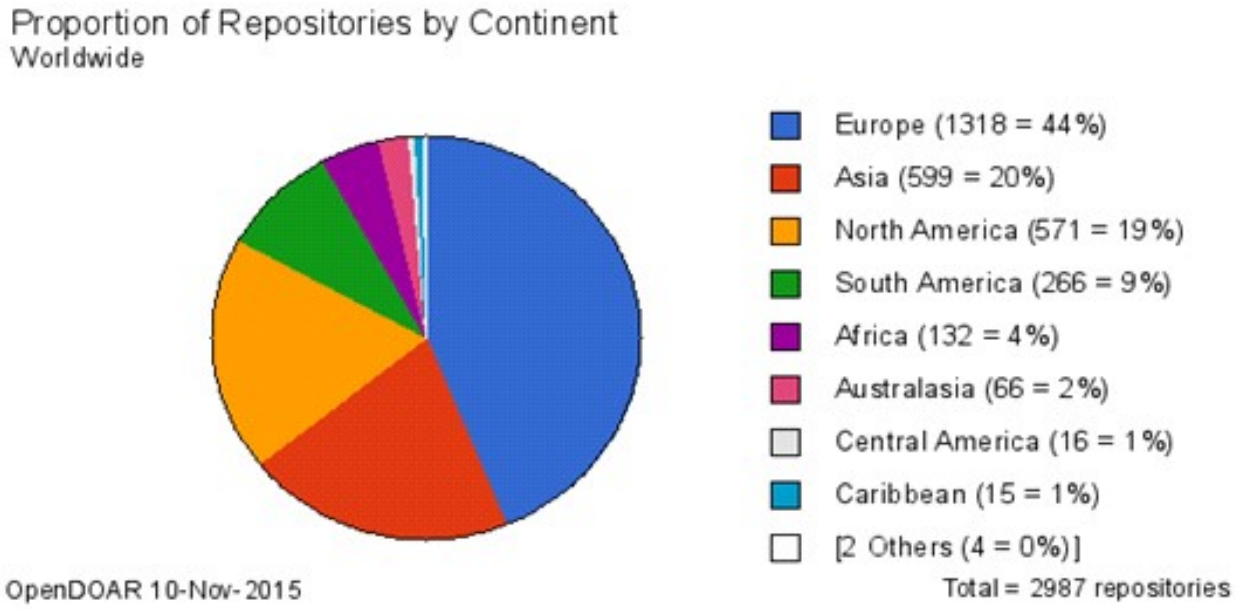

Figure 1: Global distribution of repositories in DOAR

Types of Contents in the Open Access Repositories

The leading types of contents found in the repositories of open DOAR were journal articles (73%), followed by theses and dissertations (71%), and conference and workshop papers (46%). It is clear from figure 2 that Africa had low production of datasets since it is the lowest type of content found in African repositories in DOAR with only 3(2%) repositories archiving datasets. In figure 3, we could see that African repositories were more of institutionally-based rather than discipline or government-based. A total of 120 (91%) of them were institutional repositories, while 8(6%) were discipline-based repositories (institutional repositories are usually established by universities, research institutes and other institutions of higher learning, while discipline-based repositories are often established by professional bodies); aggregating repositories were 2 (2%) and government repositories were 2 (2%) showing that African governments lack interest in open access initiatives.

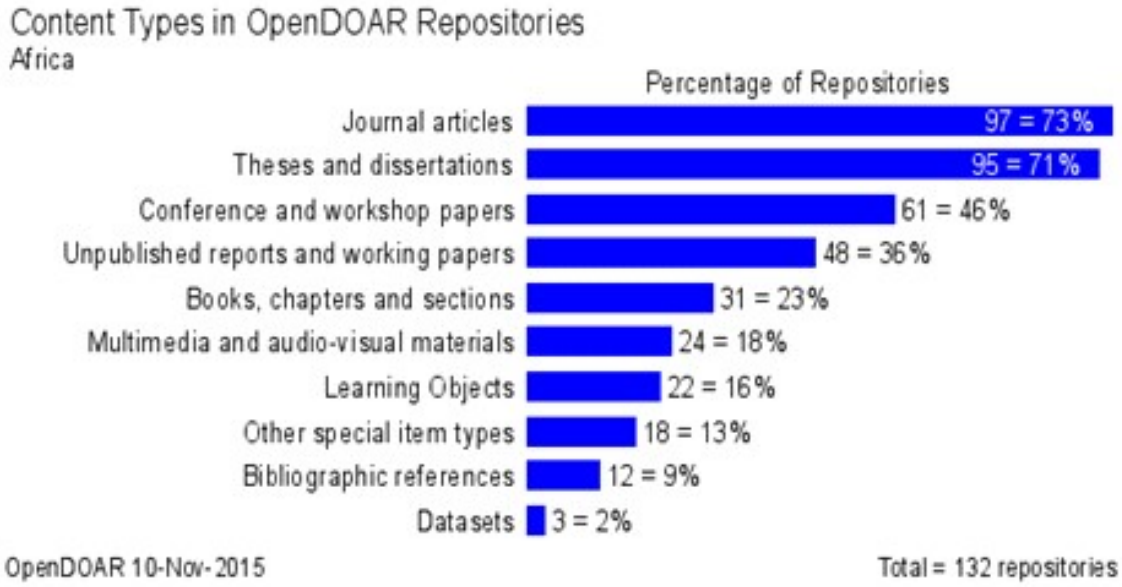

Figure 2: Types of Contents in African repositories

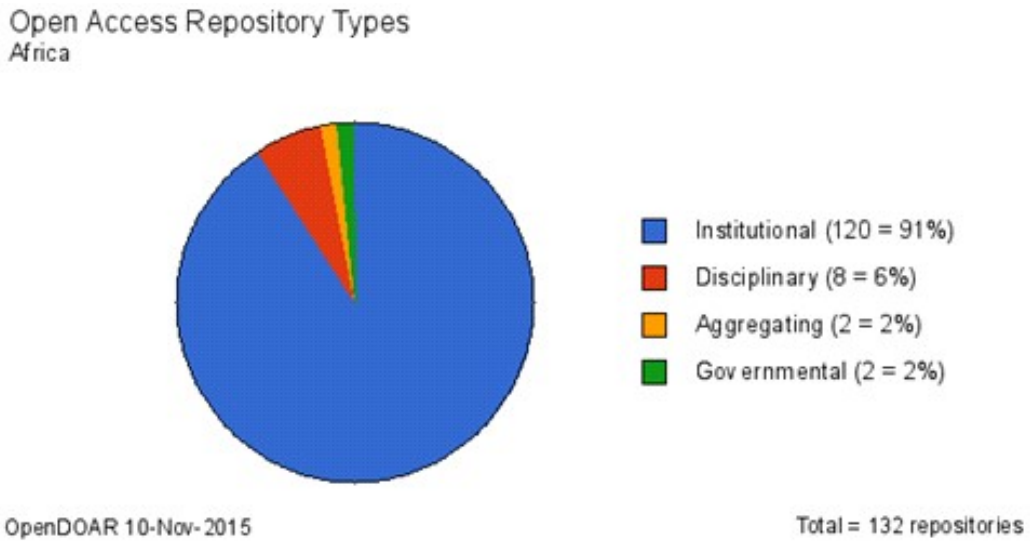

Figure 3: Types of African Repositories in DOAR

Software Used to Develop the Repositories in Africa

In the development of institutional repositories, there is often a choice between open source software, which is freely available online, and proprietary software, which is purchased from vendors. A total of 97 (73%) repositories adopted DSpace for archiving, making it the most dominant software used among African repositories found in DOAR. This was followed by EPrint with 12 (9%) while 4 (3%) archive their documents using Greenstone. Information on archiving software of 7 (5%) repositories was not known, while 2 (2%) of the repositories adopted ContentPro. Other archiving software used was Drupal and CONTENTdm. While there was no explanation on the archiving software for 6 (5%) other repositories, indications showed that DSpace was the most preferred repository software, probably because it is an open software (which is relatively cheap to install and maintain) with user-friendly features, as it had been noted by Adewumi and Ikhu-Omoregbe, (2010).

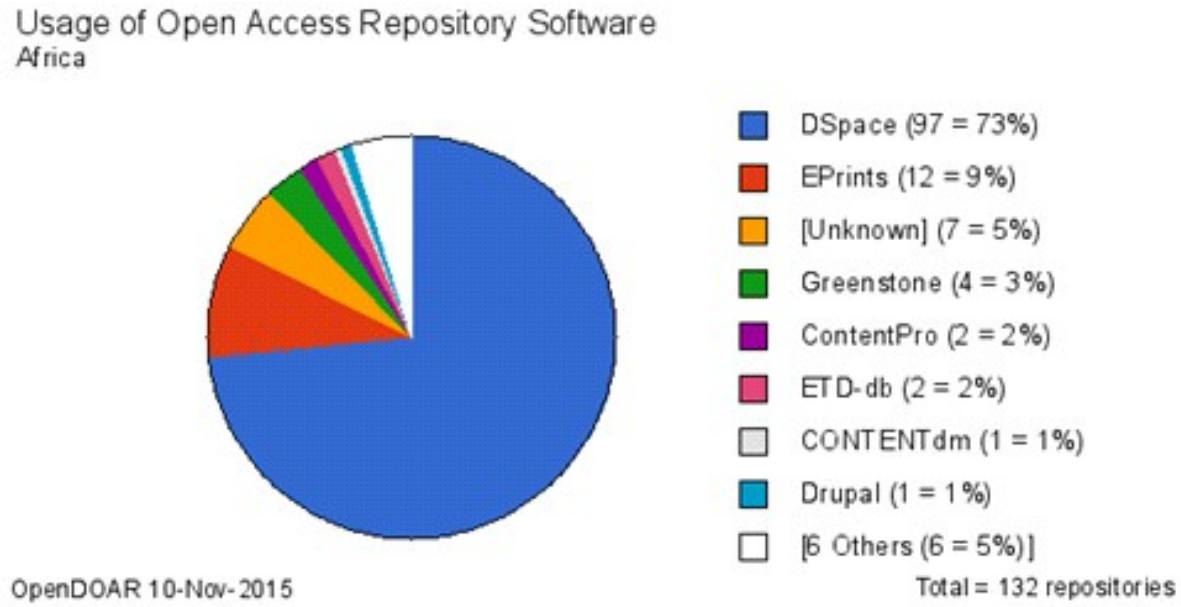

Figure 4: Repository Software in DOAR

African Contributions to Directory of Open Access Journals (DOAJ)

African contributions to Directory of Open Access Journals presented almost a similar picture in regard to the contents as in ROAR and DOAR; almost the same countries re-appear as shown in Table 3. Africa contributed 696 OA journals, accounting for a mere 6.5% of the 10,712 global journals contributions as reflected in DOAJ. Twenty African countries registered their presence in DOAJ with Egypt contributing 538 (77.3%) journals, followed by South Africa with 75 (10.78%) journals, and Nigeria with 36 (5.17%) journals. Morocco and Kenya contributed 9 (1.29%) and 7 (1.01%) respectively. In sub-regional distribution of African journals contribution, North Africa contributed 564 (81.03%), Southern Africa contributed 76 (10.92%) and West Africa contributed 37 (5.32%). East and Central Africa contributed 15 (2.16%) and 4 (0.57%) respectively. However, East Africa had higher mean articles per journal (416.8), followed by Southern Africa (329.6) and North Africa (201.6). Central Africa and West Africa had very low mean articles per journal with 93.3 and 20.9 respectively.

Table 3: Distribution of African Contribution to DOAJ

African Region	Countries	No of Journals N = 696	%	No of Articles N = 146,152	%	Mean Article/ Journal
Central Africa	Burundi	1	0.14	147	0.10	147
	Cameroon	1	0.14	108	0.07	108
	Congo DR	1	0.14	90	0.06	90
	Rwanda	1	0.14	28	0.02	28
	Total	**4**	**0.57**	**373**	**0.26**	**93.3**
East Africa	Kenya	7	1.01	1396	1.00	199.6
	Mauritius	2	0.28	2930	2.00	1465
	Tanzania	1	0.14	1318	0.90	1318
	Zambia	2	0.28	476	0.33	238
	Uganda	3	0.43	132	0.09	44
	Total	**15**	**2.16**	**6,252**	**4.30**	**416.8**
North Africa	Algeria	6	0.86	101	0.07	16.8
	Egypt	538	77.30	111067	75.99	206.4
	Ethiopia	5	0.72	906	0.62	181.2
	Libya	2	0.28	215	0.15	107.5
	Morocco	9	1.29	530	0.36	58.9
	Sudan	1	0.14	813	0.56	813
	Tunisia	3	0.43	71	0.05	23.7
	Total	**564**	**81.03**	**113,703**	**77.80**	**201.6**
Southern Africa	Madagascar	1	0.14	131	0.09	131
	South Africa	75	10.78	24,921	17.05	332.3
	Total	**76**	**10.92**	**25,052**	**17.14**	**329.6**
West Africa	Ghana	1	0.14	13	0.01	13
	Nigeria	36	5.17	759	0.52	21.1
	Total	**37**	**5.32**	**772**	**0.53**	**20.9**
	African Total	**696**	**100**	**146,152**	**100**	**210.0**
	World Total	**10,712**	**6.50**	**2,012,039**	**7.26**	**187.8**

Subject Coverage of Open Access Publications in Africa

A look at the subject coverage of the open access repositories found in DOAR revealed that majority of them (i.e. 88 or 66%) were multidisciplinary as indicated in Figure 5. Science-related fields had more coverage in the repositories than humanities and social science. The science fields covered were general science, which had 16 (12%) repositories; the agriculture, food and veterinary science group had 15 (11%); and ecology and environment which had 11 (8%). Apart from these, health and medicine had 15 (11%), technology had 12 (9%), while computer and information technology had 11 (8%) repositories. Social sciences received more coverage than humanities as evident in Figure 5. Business and economics had 17 (12%) repositories; law and politics; 16 (12%) repositories; general social sciences; had 14 (10%) repositories while education had 12 (9%) and library and information science 9 (6%) repositories. In the humanities, language and literature had the highest with 9 (6%), followed by history and archaeology with 7 (5%) repositories. It is important to note that some of these subject fields overlap, as a particular repository may cover two or more subject areas.

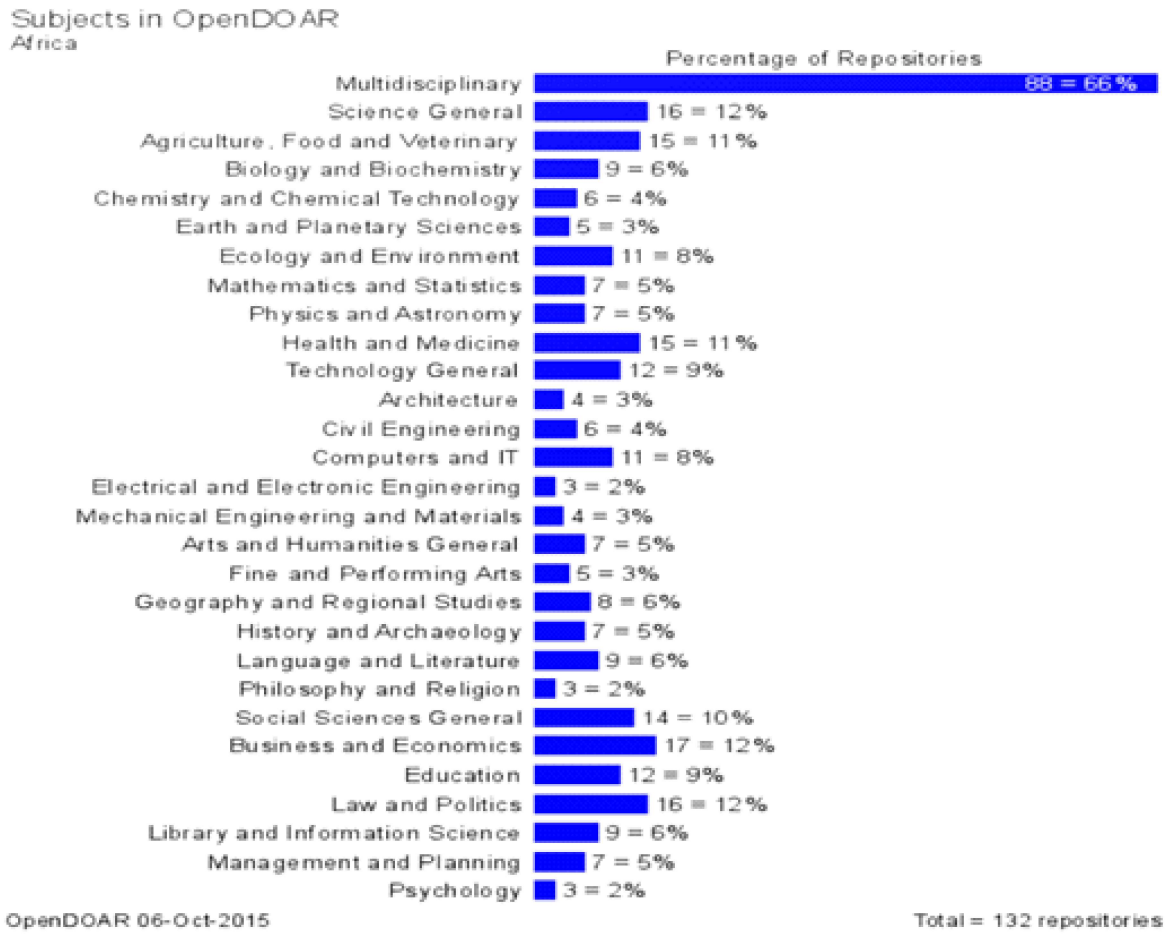

Figure 5: Subject Coverage of Open Access Publications in Africa

Most Frequently Used Language in Open Access Publishing in Africa

In scholarly communication, language of research publication is critical to international scientific publication. Olaoye (2009) has remarked that man's access to knowledge is facilitated through the use of languages. Thus, it is usually difficult for a researcher to comprehend research paper written in a strange language. Scientific publications in African languages are often considered as strange to the global scholarly community; and consequently, observations have shown that they are rarely indexed by major databases such as Thomson Reuters, Scopus, Medline and Google scholar. This reduces the visibility of research published in African languages.

In figure 6, English was the dominant language of the publications in the open access repositories found in DOAR with 122 (92%), followed by French with 20 (15%); Arabic 13 (9%); while Afrikaans had 5 (3%). Other languages used in publishing research reports in the repositories were Dutch with 3 (2%) and Portuguese 2 (1%). Apart from Afrikaans; other African languages represented in the repository were Sesotho, 2 (1%); Swahili 2 (1%) and Amharic 1 (0.7%). Generally, publications in African languages were few, with almost all the African languages coming from Eastern and Southern Africa. In DOAJ (see Table 4); English was also the dominant language with133;044 (89.9%) records, followed by German with 4890 (3.3%); French 2957 (2.0%) and Dutch 2110 (1.4%). The most frequently used African language is Afrikaans with 1338 (0.9%), followed by Isipedi with 1160 (0.8%) records; the two are South African languages.

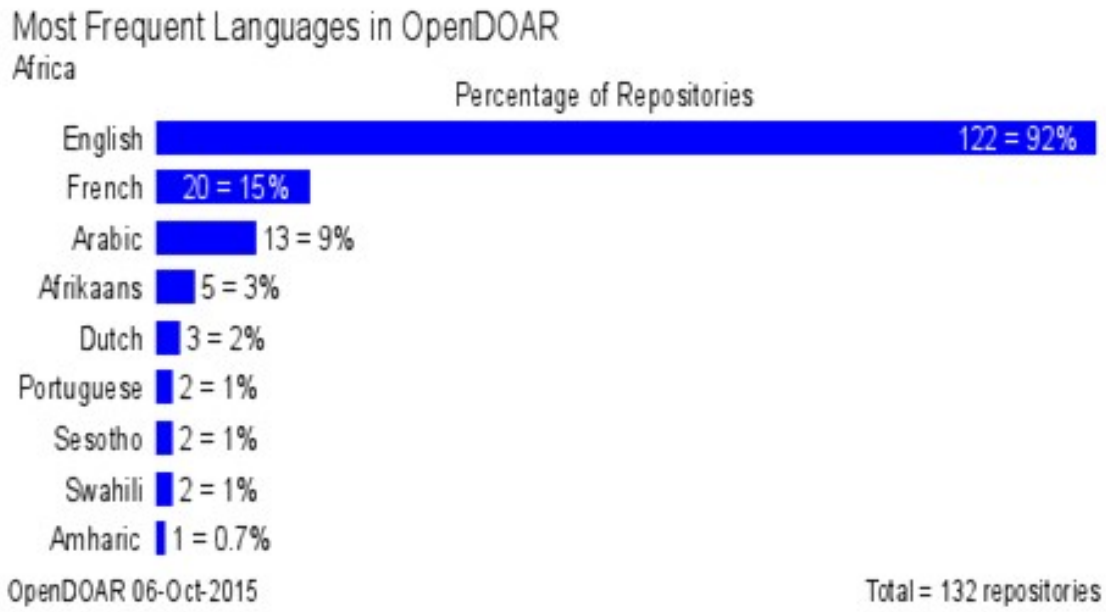

Figure 6: Frequently Used Language in Open Access Publishing

Table 4: Frequently used languages of publications in DOAJ

Language	Freq. (N = 148,039)	Percentage
English	133,044	89.9
German	4890	3.3
French	2,957	2.0
Dutch	2110	1.4
Afrikaans	1338	0.9
Isipedi	1160	0.8
Spanish	716	0.5
Arabic	654	0.4
Portuguese	301	0.2
Italian	164	0.1
Turkish	145	0.1
Russian	140	0.1
Japanese	134	0.1
Czech	134	0.1
Xhosa	121	0.1
Dutch Flemish	12	0.01
Romania	8	0.01
Chinese	7	0.01
Serbian	4	0.01
Total	**148,039**	**100**

Trends in Open Access Publishing in Africa

The trend of open access publications in Africa drawn from DOAJ is shown in Figure 7. The ten-year trend (2005 –2014) indicated a very low level of open access publishing in 2005 with 2,019 articles, which increased to 2,340 in 2006. By 2009, it had doubled to 4,881 publications; and by 2010, it rose to 7,261 publications. The number of open access publications in 2011 was 12,019 but jumped to 21,086 in 2012 (almost double within a year), and then began to grow slowly between 2012 and 2013, but rapidly increased to 24,997 publications in 2014.

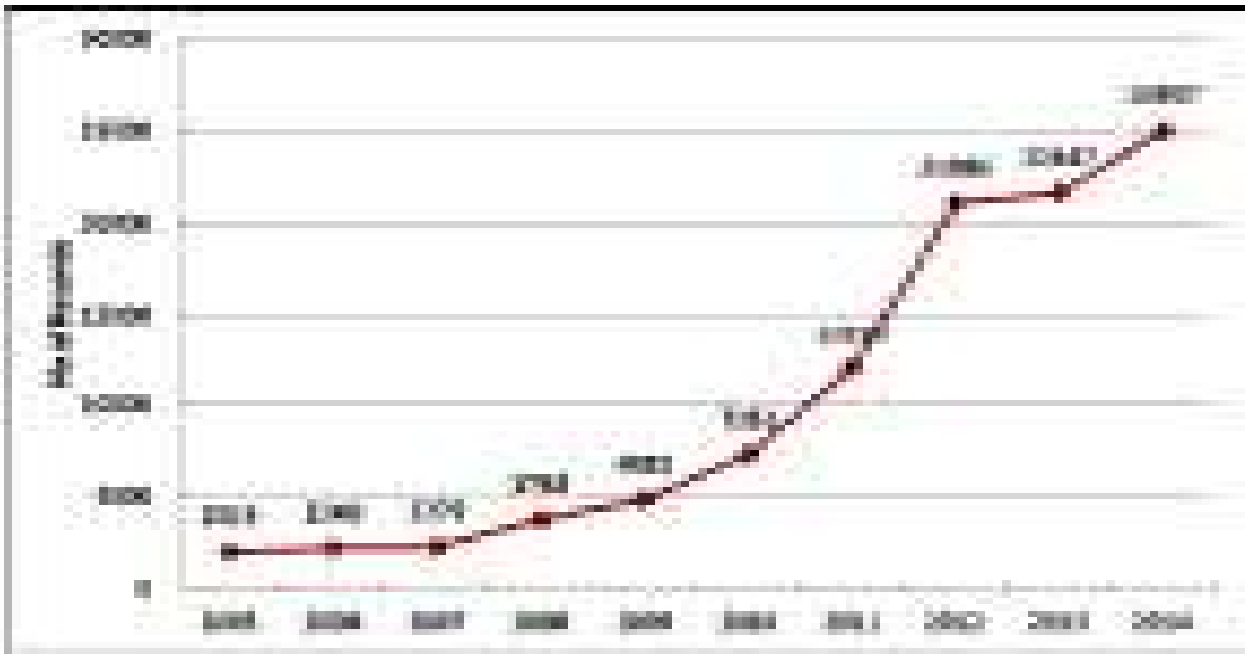

Figure 7: Ten-Year Trend of Growth of Open Access Publishing in Africa (2005 - 2014)

Discusion

The findings of the study present the realities of the involvement of African countries in open access publishing. Twenty-seven African countries did not have any presence in OA publishing, resulting in low contributions to the global open access publications. Though twenty African countries registered their presence in ROAR and DOAR, only 4 of them (South Africa, Egypt, Nigeria and Kenya) had substantial number of repositories and records. This is in line with the findings of Fox and Hanlon (2015) and Chimah, Ugwoke and Ogwo (2015) who also found a low visibility of African institutional repositories as South Africa and Egypt lead open access publishing in Africa. The absence of so many African countries in OA movement is surprising because the thinking was that OA is a good opportunity for developing countries to disseminate their research outputs to the global scholarly community. It appears that researchers in such countries are yet to accept open access publishing as a means of disseminating their research outputs which Dalton (2011) identified as one of the contraints of OA publishing. Another explanation could be that the people charged with the establishment of OA repositories have not done their work, resulting in researchers' lack of access to the facilities.

Although not surprising, considering the reported low research output in Africa (see Ezema, 2010; Gailard, 2010; Nwagwu, 2013), the contributions of Africa to OA movement are comparably low. The region had only 3.4% contributions to ROAR and 4% contribution to DOAR while Europe contributed 44% to DOAR. The concern here is that Africa is finding it difficult to bridge the visibility gap, even with the advantages of open access environment.

Other findings indicate that journal articles, theses and dissertations are the dominant contents of the repositories in Africa. This is expected because large proportion of reseach outputs all over the world are usually disseminated through the journals while postgraduate research is on the increase (Uborgu, 2006). Beside this, there is large archiving of theses and dissertations because they are part of the requirements of the students before they are awarded degrees at both undergraduate and post graduate levels. Since majority of the repositories are institution-based, the contents will be dominated by research emanating from the staff and the students of the institutions. Observations have shown that

institutions usually began by archiving theses, dissertations and staff publications which are often found in journals. More importantly, copyright infringement is usually considered when archiving materials in the repositories. Consequently, materials that permit self-archiving without copyright infringement such as theses, dissertations and open access journals were usually given more consideration than books which would require permision from the copyright owners. That probably explains the low number of repositories which archive books and book chapters.

Governments' lack of interest in education and research is demonstrated by the number of government repositories present in DOAR. This has been the major challenge in open access movement in Africa. The major funder of research all over the world is government; and without the required funding, universities and other research bodies will find it almost impossible to establish repositories of international standard. The government's role in funding of research has been highlighted by Nwagwu (2013) who also points out that some government agencies in charge of education and research lack the policy framework for open access movement in Africa.

The most popular archiving software used in African repositories is DSpace used by over seventy percent of the repositories. Though EPrint and Greestone are equally used, they are not as popular as DSpace, which recorded encouraging presence in DOAJ, even though the major contributors remain South Africa, Egypt, Nigeria and Kenya. The dominance of South Africa and Egypt in open access movement in Africa is demonstrated by their size of journal contributions and articles in DOAJ in relation to other countries. This dominance has been reported in an earlier literature. A common characteristic of the archiving software used by African repositories is that they are all open source software. This is in line with the finding of Adewumi and Ikhu-Omoregbe (2010) in their study of features, architecture, and design of African institutional repositories and Onyancha (2011) in his study of self-archiving by LIS schools in South Africa. The choice of open software is probably because of the cost effectiveness and user-friendliness of the software.

While the presence of African countries in ROAR and DOAR remains almost the same, findings show that some countries such as Mauritius, the Democratic Republic of the Congo, Libya and Madagascar, did not feature among the countries that are visible in two repositories such as Fox and Hanlon (2015). An interesting thing about the finding is the increasing growth of open access journals in Africa. From two percent as reported by Stenson (2011), it has moved to 6.5% to 2015 as seen in Table 3. This growth rate is likely to be linked with increasing campaigns for open access publishing as documented in earlier studies (see Utulu and Bolarinwa, 2009; Swan and Brown, 2004; Mann, von Walter, Hess and Wigand, 2009).

The most preferred language of publication for both the repositories and the directory of open access journals is English. This is expected, considering the position of English language in the global communication and the colonial background of many of the countries publishing in open access environment. French and German languages equally had sizeable shares in the language of publications in Africa open access movement, and this also relates with the colonial experience of African countries which adopt the languages of their former colonies as their official languages. It is however a source of worry that African indigenous languages were rarely used in research publications apart from Afrikaans and Isipedi, both from South Africa. Unfortunately, a large proportion of publications in African languages may not have global visibility since papers indexed in major databases are skewed in favour of English and other major languages of the world.

The findings show an increasing growth of open access publication in Africa even with the constraints reported in extant literature (see McKay, 2011; Ezema, 2011; Bowdoin, 2011; Chalabi and Dahmane 2012; Nwagwu, 2013). It is interesting to see that within ten years, open access publishing in Africa has grown from 2,019 articles in 2005 to 24, 997 articles in 2014. This is likely to be connected with the increasing awareness in open access publishing as reported by Xia (2010) and more acceptances given to it by granting agencies, as documented in earlier research by Bjork, Welling, Laakso, Majlender, Hedlund and Gounason, (2010). If this growth rate is sustained in DOAJ and more institutions join in archiving their research reports in open repositories, Africa may be on the way to enhance the visibility of their research reports.

Conclusion and Recommendations

Although findings of this study reveal an increasing growth of open access publishing in Africa, it is obvious that there is still a lot to do considering the huge opportunities OA presents to developing countries to aggregate their research reports for global visibility. The major challenge of Africa is beyond research productivity; it is more of creating international visibility for African research. With about 56 independent countries and several universities and research centres, Africa has huge research potentials. Nigeria alone has 141 universities (National Universities Commission, 2015), and other African countries have relatively large number of universities. Regretably, only twenty African countries have open access presence.

About the fate of the other countries in relation to open access publication, could it be that such countries lack awareness about OA movement? or they are yet to graple with the ICT infrastructure which drive OA publishing. Evidently, the twenty countries with open access presence are yet to explore their full potentials in OA publishing. For instance, a country such as Nigeria with the huge number of universities had less than twenty repositories and only 36 open access journals in DOAJ. Should the 141 universities establish a repository each, Nigeria would boast of over a hundred repositories with large number of records. This is likely to be the same situation in other countries, particularly countries with few number of repositories.

African governments, researchers, libraries and librarians should strategise on enduring framework to exploit the opportunities offered by OA movement to its full potential. As it has been noted in a number of published works (e.g. Ezema, 2011; McKay, 2011), funding is very critical to the adoption of OA publishing, particularly as it relates to establishing institutional repositories. African governments need to address this. Open access initiative is expected to be a priority of various African governments in terms of building ICT infrastructure which will drive the movement. The poor ICT infrastructure in many African countries have been highlighted as key impediment of OA publishing by McKay (2011) and Nwagwu (2013), and a recent study (Fox and Halon, 2015) reports no sign of improvement. African Union should put a sustainable ICT development plan through its agency the New Partnership for Africa's Development (NEPAD). In addition to this, African governments need to key into international best practices in development of government repositories for open government data. This is a social responsibility that will guarantee adequate citizen involvement in democratic governance.

University regulatory bodies in all African countries have important roles to play to ensure that African universities key into the OA initiatives through critical policy framework for OA publishing to enhance increased visibility of African research findings. Nwagwu (2013) had earlier remarked that some of these regulatory bodies provide little or no OA policy framework to support OA movement in the universities. Such policies, apart from providing OA guidelines, should make OA presence as part of the criteria for accreditation of programmes in the universities.

Open access publishing is critical to the survival of African researchers. Apart from providing universal access to the global research literature, it ensures the democratisation of research publishing. Therefore, African researchers should see OA publishing as a unique opportunity to improve on their global visibility through self-archiving of their publications in repositories and publication of their research in open access journals. Extant literature has demonstrated that open access publishing ensures greater access to research publications which promote citations and research impact of authors, institutions and journals (see Lawrence, 2001; Hajjem, Harnad and Gingras, 2005; Xia, 2010). Another interesting development is the acceptance of open access publishing by granting bodies and institutions as reported by Bjork and Solomon (2012), thus removing some factors which discourage open access publishing.

The position of African libraries and librarians is another source of concern in open access environment in the region. From the findings, there is concern about the policy thrust of African libraries in the development of institutional repositories. Ezema (2013) identified relevant local content materials which need to be digitised for the development of open access repositories. However, from the findings of the present study, it is obvious that very few

academic libraries in Africa have begun such digitisation projects. Though funding and technological support have been major constraints for the development of institutional repositories, African university libraries need to seek funding opportunities from their parent institutions, and also explore opportunities from private organisations within and outside Africa. Various national library associations and the International Federation of Library Associations (IFLA) –Africa section, need to develop an OA framework for African libraries.

OA movement is one change agent that cannot be wished away because the main philosophy behind it is to ensure free availability of research literature to the international scholarly community. Fortunately, it affords good opportunities for developing countries that lack access to research literature due to subscription barriers. Open access has come not only to mitigate these developmental challenges but also to localise and globalise scientific information for democratisation of scholarship globally. Africa cannot afford to miss this opportunity.

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