Africa's Contribution to the Global Open Access Literature

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Abstract

This study was conducted to determine the contribution of Africa to the global open access literature. Data were extracted from the Directory of Open Access Repository (OpenDOAR). The findings indicate that only 22 (40.74%) African countries contributed 155 OA repositories in the OpenDOAR. Most of these repositories were from South Africa (33; 21.29%), Kenya (28; 18.06%) and Nigeria (21; 13.55%). Africa contributed 1,024,851 documents in the OpenDOAR, with Egypt and South Africa contributing nearly two thirds (634,025; 61.2%) of these documents. Despite its large size, the African continent had only 4.52% of the OA repositories and 0.14% of documents in the OpenDOAR. The average number of documents per repository in Africa was only 6,611.94 as compared to other continents such as Australasia (752,094.80 documents), Europe (342,896.64 documents) and North America (201,997.12 documents). The top 25 OA repositories in Africa contributed 820,574 documents, which is over 80% of the total African contribution to the OpenDOAR. Most OA repositories in Africa contained journal articles (74.84%) and they were multidisciplinary (61.73%). Overall, Africa's contribution to the global open access literature is still very low. Efforts should be strengthened to increase the level of research and publication productivity as well as increase the capacity of institutions to develop OA repositories.

Keywords: open access, repository, OpenDOAR, Africa

Introduction

Open Access (OA) is a mode of scholarly communication in which access to digital content is provided to users without price or copyright restrictions. The major purpose of OA mode is to increase the visibility, accessibility, retrievability and usability of scholarly publications through the Internet. There are two approaches to the open access mode namely the "Gold Road" and

"Green Road" to open access. In the "Gold Road" approach, publishers follow the traditional journal publication practices but an author or sponsor pays Article Processing Charges (APC) and then reading the article becomes free to anyone. The publishers get revenue from APC instead of charging subscription fees (Harnad et al., 2004; Harnad, 2005). One major example of open access journal initiatives is the Directory of Open Access Journals (DOAJ). In the "Green Road" approach, scholarly materials are made freely available on institutional repositories, subject repositories and personal/institutional websites. Often, authors are involved in "self-archiving" their own research outputs (Björk et al., 2014). Interestingly, there is now a "hybrid route" where "Gold Road" journals provide open access options to individual articles when APC is paid. The OA movement therefore supports authors, publishers and readers by leveraging the power of information and communication technologies (ICTs) to enhance scholarly communication.

Institutional and subject repositories are online systems developed by universities, research institutions, subject communities, government agencies or other groups to store, manage, disseminate and preserve various kinds of research output (Zuccala et al., 2008). Such scholarly output comprises journal articles, conference papers, theses, dissertations, books, datasets, learning objects, media files and other academic material, both published and unpublished. Hence, repositories create an important channel for realizing open access of academic resources (Bjork et al., 2010). They enhance access to research output, lessen the monopoly by journal publishers, and reduce the cost of journal subscriptions (Chan, 2004; Kennan and Wilson, 2006). Institutional repositories allow the accessibility of scholarly products to all users no matter whether they are inside or outside the institution. As a result, they improve the visibility and reputation of their parent institutions and increase the citation impact of publications (Gargouri et al., 2010). Institutional repositories have therefore become a necessary facility of any university and research institution.

Institutional repositories emerged since 2002 when the Massachusetts Institute of Technology and Cornell University in the USA as well as Southampton and Oxford University in the UK launched their repositories using DSpace and E-print software. In 2005, the Directory of Open

Access Repositories (OpenDOAR) was launched as a worldwide authoritative directory of academic open access repositories. By November 2015, OpenDOAR recorded 2,987 repositories with Africa possessing 132 (4.4%) repositories. South Africa had more repositories (31, 23.48%) followed by Kenya (21; 15.91%), Nigeria (15; 11.36%) and Algeria (12; 9.09%) (Ezema and Onyancha, 2016).

Open Access to knowledge movement has changed the traditional publishing system which existed for about 300 years (Roy, 2018). Literature on OA repositories is growing and focuses on various aspects including user attitudes and behaviors (Kim, 2010), citation advantage of OA (Swan, 2010; Wagner, 2010), different disciplinary positions (Xia, 2007), growth trends and key characteristics of repositories (Shearer, 2006; Tripathi and Jeevan, 2011; Nazim and Mukherjee, 2011; Nyambi and Maynard, 2012), subject-based repositories (Warr, 2003; Bhat, 2010), and costs of setting up and maintaining repositories (Houghton *et al*., 2009). Fox and Hanlon (2015) established a low visibility of African institutional repositories. Similarly, Ezema and Onyancha (2016) reported, among other things, that only 22 African countries had their presence in the OpenDOAR.

The present study analyzed the current state of OA repositories in order to describe their characteristics in terms of their number, number of documents, type of content, subjects, types of repositories and software used. The main objective was to determine the contribution of Africa to the global open access literature focusing on the OpenDOAR.

Methodology

The study adopted a bibliometric approach were by data were extracted from the Directory of Open Access Repository (OpenDOAR) (http://www.opendoar.org/) in September 2017. OpenDOAR is a global authoritative directory of academic open access repositories. OpenDOAR has been identified as a key resource for the Open Access community, the leader in repository directories and awarded the 2007 SPARC Europe Award for Outstanding Achievements in Scholarly Communications (OpenDOAR, 2017). OpenDOAR provides various repository statistics including quality-controlled list of repositories, number of documents, type

of content, subjects covered, types of repositories and software used. Extracted data were compiled and analyzed using MS Excel.

Results and Discussion

Africa's contribution to OpenDOAR

The study findings in Table 1 indicate that only 22 (40.74%) of the 54 African countries had OA repositories registered in the OpenDOAR. In total there were 155 OA repositories, giving an average of 7 repositories per each of the 22 countries and only 3 repositories per country in the whole continent. South Africa had the highest number (33; 21.29%) of repositories followed by Kenya (28; 18.06%) and Nigeria (21; 13.55%). Only six countries (South Africa, Kenya, Nigeria, Algeria, Tanzania and Zimbabwe) had 10 or more repositories. Surprisingly, the number of repositories in Africa increased from 132 in November 2015 (Ezema and Onyancha, 2016) to 155 in September 2017 but the number of African countries with repositories remained the same. In other words, the same 22 countries continued to establish new repositories. African countries had contributed 1,024,851 documents in the OpenDOAR, giving an average of about 6,612 documents per repository. Excitingly, despite having only five repositories, Egypt had contributed nearly one-third (334,005; 32%) of these documents followed by South Africa (300,020; 29.2%)

Table 1: Distribution of Open Access Repositories and their Contents by country

No	Country	No of OAR	Percent	No of documents	Percent
1	Egypt	5	3.23	334,005	32.0
2	South Africa	33	21.29	300,020	29.2
3	Kenya	28	18.06	138,575	13.5
4	Nigeria	21	13.55	66,468	6.4
5	Sudan	9	5.81	52,470	5.1
6	Algeria	13	8.39	46,021	4.4
7	Ghana	4	2.58	16,006	1.5
8	Tanzania	11	7.10	14,963	1.4

9	Ethiopia	2	1.29	14,333	1.3
10	Zimbabwe	10	6.45	12,022	1.1
11	Morocco	2	1.29	5,550	0.5
12	Rwanda	2	1.29	5,175	0.5
13	Zambia	1	0.65	4,607	0.44
14	Cape Verde	2	1.29	3,809	0.37
15	Mozambique	1	0.65	3,264	0.31
16	Uganda	2	1.29	2,353	0.22
17	Namibia	2	1.29	1,875	0.18
18	Botswana	2	1.29	1,176	0.11
19	Lesotho	1	0.65	1,000	0.09
20	Tunisia	1	0.65	724	0.07
21	Senegal	2	1.29	400	0.03
22	Cameroon	1	0.65	35	0.003
Average		**7.0**		6611.9	
Total		**155**	**100**	**1,024,851**	**100**

Contribution of OA literature by different continents

The contribution of each continent to the global OA literature show that Europe had a lion share both in terms of number of repositories (1,548; 45.16%) and the number of documents (530,804,000; 72.85%) followed by North America which had 613 (17.88%) repositories and 123,824,232 (16.99%) documents. Despite its large size, the African continent ranked the fifth in terms of the number of repositories (155; 4.52%) and the sixth with respect to the number of documents (1,024,851; 0.14%) as a contributor to the OpenDOAR. North America had the highest average number of repositories per country (204.3 repositories) followed by Europe (39.7 repositories) and Australasia (35 repositories). With regard to the average number of documents per repository, Australasia ranked the first with 752,094.80 documents followed Europe (342,896.64 documents) and North America (201,997.12 documents). The average number of

documents per repository in Africa was only 6,611.94 (Table 2). This indicates that the vast majority of repositories in Africa are relatively small. This is a clear indication of the little scientific activities in African and its low contribution to the global research output (Ondari-Okemwa, 2007; Nwagwu and Ahmed, 2008; Pinfield *et al*., 2014). Nevertheless, available statistics indicate that during the past 10 years (i.e. 2008 – 2017), the number of OA repositories in Africa increased from 19 to 155 which is a growth of 715.79%. This is the highest growth rate worldwide because other continents such as South America, Asia and Europe had growth rates of 458.18%, 404.35%) and 158.43% respectively during the same period.

Table 2: Open Access Repositories by continent

No	**Continent**	**No of** OAR	**Average no of** OAR **per country**	**No of documents**	**Average no of documents per** OAR
1	Europe	1,548 (45.16)	39.7	530,804,000 (72.85)	342,896.64
2	North America	613 (17.88)	204.3	123,824,232 (16.99)	201,997.12
3	Australasia	70 (2.04)	35.0	52,646,636 (7.23)	752,094.80
4	Asia	696 (20.30)	21.8	14,907,374 (2.05)	21,418.64
5	South America	307 (8.96)	27.9	5,261,104 (0.72)	17,137.15
6	Africa	155 (4.52)	2.9	1,024,851 (0.14)	6,611.94
7	Caribbean	19 (0.55)	3.2	66,245 (0.01)	3,486.58
8	Central America	19 (0.55)	4.8	76,695 (0.01)	4,036.58
9	Unknown	1 (0.03)	-	16,439 (0.002)	16,439.00
Total		**3,431(100.00)**		**728,627,576 (100.00)**	

*****Numbers in brackets represent percent

Major repositories in Africa

The study findings show that the Digital Assets Repositories of Egypt was the largest OA repository in Africa with 301,647 documents which is nearly one-third (29.4%) of the total African contribution to the OpenDOAR. The University of Nairobi Digital Repositories ranked the second in this case with 82,341 (8%) documents and the Stellenbosch University Repository with 52,326 (5.1%) documents ranked the third. The top 25 OA repositories contributed 820,574 documents, which is 80.07% of the total African contribution to OpenDOAR. Of these top 25 OA repositories, 12 were from South Africa with 264,512 documents, which is more than quarter (25.8%) of the total Africa's contribution to OpenDOAR. The remaining 130 OA repositories in Africa contributed less than 20% of the total number of documents (Table 3). This again suggests that the majority of OA repositories in Africa still have very low number of documents. One reason is that most OA repositories in Africa are relatively new because available literature shows that there was only 13 repositories by the end of 2007 (Jain et al., 2009).

Table 3: Major repositories in Africa

No	Repository	Country	No of documents
1	Digital Assets Repository	Egypt	301,647
2	University of Nairobi Digital Repository	Kenya	82,341
3	Stellenbosch University SUNScholar Repository	South Africa	52,326
4	UPSpace at the University of Pretoria	South Africa	46,851
5	Rare Books and Special Collections Digital Library	Egypt	28,035
6	Open Resources	Nigeria	23,367
7	SEALS Digital commons	South Africa	23,277
8	KhartoumSpace	Sudan	22,613
9	University of Johannesburg Institutional Repository	South Africa	22,610
10	OpenUCT	South Africa	22,566

11	North-West University Institutional Repository	South Africa	22,303
12	Unisa Institutional Repository	South Africa	17,040
13	Dspace at SUST University	Sudan	15,867
14	Mahider	Kenya	15,263
15	Wits Institutional Repository on DSPACE	South Africa	14,985
16	Addis Ababa University Libraries Electronic Thesis and Dissertations Database	Ethiopia	14,357
17	Kenyatta University Institutional Repository	Kenya	13,565
18	ResearchSpace@UKZN	South Africa	13,074
19	Bibliothèque Virtuelle de l'université d'Alger	Algeria	12,513
20	SUNDigital Collections	South Africa	12,280
21	dspace@UABT	Algeria	9,087
22	University of Biskra repository	Algeria	8,958
23	University of Pretoria Electronic Theses and Dissertations	South Africa	8,774
24	ABU Zaria Research Publications	Nigeria	8,449
25	CSIR Research Space	South Africa	8,426
	Total		**820,574**

Major Repositories in the World

The Europe PubMed Central, which holds 420,000,000 documents, was the largest OA repository in the world followed by the Papers Past repository of New Zealand with 50,474,317 documents and Wikimedia Commons of USA with 41,559,957 documents. The top global 25 OA repositories had 647,168,595 documents, which is equivalent to 80.82% of all documents in the OpenDOAR. Of these top 25 repositories, none was from Africa (Table 4) and the total contribution of Africa to OpenDOAR is even less than the 25th ranked OA repository in this case.

Table 4: Major Repositories in the World

No	Repository	Country	No of documents
1	Europe PubMed Central	United Kingdom	420,000,000
2	Papers Past	New Zealand	50,474,317
3	Wikimedia Commons	United States	41,559,957
4	DIALNET	Spain	41,169,467
5	Research Papers in Economics	United States	23,000,000
6	Internet Archive	United States	22,141,997
7	English Heritage ViewFinder	United Kingdom	8,000,000
8	Geograph British Isles	United Kingdom	5,511,031
9	PubMed Central	United States	4,500,000
10	Open Access Library (Repository)	China	4,229,739
11	University of Michigan Library Repository	United States	3,665,558
12	Gallica, Bibliotheque Numerique	France	3,036,568
13	Jable. Archivo de prensa de Canarias	Spain	2,576,594
14	Cross Collection Discovery	United States	2,000,000
15	PhilPapers	United Kingdom	1,774,419
16	LAReferencia - Red Federada de Repositorios…	Argentina	1,431,703
17	Utrecht University Repository	Netherlands	1,403,858
18	Getty Search Gateway	United States	1,376,411
19	ArtXiker - @HAL	France	1,361,180
20	Thèses en Ligne	France	1,361,180
21	Hyper Article en Ligne	France	1,360,747
22	Archaeology Data Service	United Kingdom	1,351,724
23	Social Science Research Network	United States	1,351,354
24	arXiv.org e-Print Archive	United States	1,303,435

25	Biblioteca Virtual de Prensa Histórica	Spain	1,227,356
	Total		**647,168,595**

Type of content stored in OA repositories

The findings in Table 5 show 12 different types of contents currently stored in OA repositories registered in the OpenDOAR. Majority of OA repositories in Africa (74.84%) and worldwide (71.26%) contain journal articles. This is expected because one of the key objectives for the development of OA repositories has been to archive and increase visibility of institution's research productivity of which journal articles are the major research output. Often, many journals permit authors to archive their pre-prints or post-prints in OA repositories. Other important contents archived in OA repositories include theses, conference papers and books. Surprisingly, very few (14; 9.03%) OA repositories in Africa had theses as compared to the worldwide number, which is 1935 (56.40%).

Table 5: Type of content archived in OA repositories

No	Content type	Worldwide		Africa	
		No of repositories	%	No of repositories	%
1	Journal articles	2445	71.26	116	74.84
2	Conference papers	1243	36.23	68	43.87
3	Unpublished documents	1209	35.24	54	34.84
4	Books	1321	38.50	41	26.45
5	Multimedia	773	22.53	29	18.71
6	Leaving Objects	533	15.53	28	18.06
7	Special	519	15.13	19	12.26
8	Theses	1935	56.40	14	9.03
9	References	545	15.88	13	8.39
10	Datasets	183	5.33	4	2.58
11	Patents	104	3.03	0	0.00
12	Software	52	1.52	0	0.00

Africa's contribution by subject

The findings show that multidisciplinary repositories represent 61.73% of the repositories worldwide and 68.39% of those in Africa. This is because the great majority of OA repositories registered in OpenDOAR are those of institutions (Table 6), and as pointed out earlier, the major purpose of establishing institutional repositories is to collect all research outputs of a particular institution. Similarly, Pinfield *et al.* (2014) reported that most repositories are multidisciplinary in coverage because they are institutionally focused. On the other hand, there are subject specific OA repositories of which, health and medicine led the list followed by business and economics and science general, both globally and in Africa.

Table 6: Contribution by subject

No	Subject	Worldwide		Africa	
		No. of repositories	%	No. of repositories	%
1	Multidisciplinary	2118	61.73	106	68.39
2	Health & Medicine	328	9.56	18	11.61
3	Business & economics	256	7.46	18	11.61
4	Science General	241	7.02	17	10.97
5	Law & Politics	228	6.65	17	10.97
6	Agriculture, Food & Veterinary	151	4.40	16	10.32
7	Social science General	197	5.74	16	10.32
8	Technology General	240	7.00	14	9.03
9	Education	95	2.77	13	8.39
10	Ecology and environment	154	4.49	12	7.74
11	Computer & IT	172	5.01	12	7.74
12	Arts & Humanities General	171	4.98	10	6.45
13	Library & information Science	126	3.67	10	6.45
14	Biology and biochemistry	157	4.58	9	5.81
15	Language & Literature	149	4.34	9	5.81
16	History & Archaeology	248	7.23	8	5.16
17	Math & Statistics	124	3.61	7	4.52
18	Physics & Astronomy	107	3.12	7	4.52
19	Geography & Regional Studies	186	5.42	7	4.52
20	Management & Planning	103	3.00	7	4.52
21	Chemistry & Chemical Technology	101	2.94	6	3.87

22	Earth & Planetary sciences	90	2.62	6	3.87
23	Civil Engineering	45	1.31	6	3.87
24	Fine and Performing Arts	104	3.03	5	3.23
25	Architecture	62	1.81	4	2.58
26	Mechanical Eng. & material	69	2.01	4	2.58
27	Philosophy & Religion	131	3.82	4	2.58
28	Electrical & Electrical engineering	54	1.57	3	1.94
29	Psychology	77	2.24	3	1.94

Africa's contribution by repository type

The findings show that the great majority (92.26%) of Africa's repositories are those of institutions. Similarly, 85.84% of the OA repositories worldwide are institutional. Very few repositories are disciplinary, aggregating or governmental (Table 7). As pointed out earlier, most OA repositories are those of institutions for the purpose of collecting all research outputs of a particular institution.

Table 7: Contribution by repository type

No	Repository type	Worldwide		Africa	
		No of repositories	%	No of repositories	%
1	Institutional	2945	85.84	143	92.26
2	Disciplinary	305	8.89	8	5.16
3	Aggregating	106	3.09	2	1.29
4	Governmental	84	2.45	2	1.29

Software used for OA repositories

In Africa, DSpace was the most (76.13%) popular software used in the development of OA repositories followed at a distant by E-Print (8.39%). Worldwide, DSpace was used in 44.43% of

OA repositories followed by E-print (13.67%). There were more than 15 types of software used for development of OA repositories in Africa and globally there were more than 25 types of software. Previous studies (Wani and Rah, 2009; Shukla, 2016; Abrizah et al., 2017) have also reported DSpace as the most widely used software followed by Eprints. According to Pyrounakis and Nikolaidou (2009), the preference of DSpace over other open source software is because it has sufficient workflow management support and offers by default communities such as university departments and wide range of collections.

Table 8: Software used for repositories in Africa

No	Software	No of repositories	Percent
1	Dspace	118	76.13
2	E-Prints	13	8.39
3	Greenstone	4	2.58
4	ETD-db	2	1.29
5	VITAL	2	1.29
6	Invenio	1	0.65
7	Open Repository	1	0.65
8	PHP MySQL	1	0.65
9	SciELO	1	0.65
10	self-build CMS	1	0.65
12	WordPress	1	0.65
13	ContentPro	1	0.65
14	CONTENTdm	1	0.65
15	Drupal	1	0.65
16	Unknown	7	4.52
Total		**155**	**100.00**

Conclusion

Despite the fact that OA repositories are increasing in Africa, the overall Africa's contribution to the global open access literature is still very low. Africa is lagging behind in almost all aspects of OA repositories. Since OA repositories archive both peer reviewed and those which do not undergo peer review (e.g. theses, dissertations, conference articles), it was expected that Africa's contribution to scholarly would increase significantly particularly in the OA access channels. These findings suggest that more work is still required to sensitize and build capacity of African academic institutions to leverage the power of open access movement and that of ICT in order to increase visibility of their research output. These findings also signify the low level of scientific activities and scholarly publishing in Africa. Deliberate and concerted efforts should be invested to increase the level of research and publication productivity in Africa.

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