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Abstract

This article describes scientific journals indexed in the Web of Science from 2000 to 2015 featuring Mozambican authors or researchers. The study sample included 1,536 articles in which 896 Mozambican authors and their institutions were identified. Mozambican authors published primarily in subscription-based journals from the United States and the United Kingdom. A Google Scholar search for the same authors yielded 423 documents, including articles published in 72 journals in 14 countries. Mozambican research is often published in English with an international partner in Western countries.

Keywords: Mozambique, scientific publishing, Mozambican authors, scientific communication

Résumé

Cet article décrit des revues savantes indexées dans le Web of Science entre 2000 et 2015 qui incluent des auteurs ou chercheurs mozambicains. L'échantillon de cette étude comprend 1 536 articles dans lesquels on a identifié 896 auteurs mozambicains et leurs institutions. Les auteurs mozambicains ont principalement publié dans des revues par abonnement américaines et britanniques. Une recherche de ces mêmes auteurs avec Google Scholar a relevé 423 documents, y compris des articles publiés dans 72 revues de 14 pays. La recherche mozambicaine est souvent publiée en anglais en collaboration avec un partenaire d'un pays occidental.

Mots clés : Mozambique, édition savante, auteurs mozambicains, communication savante

Introduction

Information science is an interdisciplinary subject that deals with the selection, classification, analysis, storage, and dissemination of information that is used to generate knowledge (Araujo, 2014). Information science has been applied to scientific communi-

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ation with different objectives; however, all studies share the same purpose: to bring forward historical and conceptual developments in scientific research and to contribute to information policies and the dissemination of research (Jacobs, 2008).

Studying scientific production helps to measure scientific development and makes it possible to examine the behaviour and performance of researchers. Research publication is essential for the supply research cycle; by publishing scientific research, authors earn social recognition and contribute to knowledge sharing and dissemination (Ocholla, 2011). According to the African Observatory of Science, Technology and Innovation (2013), research activity in Africa needs more investment. Helder Gemo (2011) argues that government and research agencies should finance scientific research.

Mozambique is listed among the poorest countries in the world (Giovetti, 2019) and is ranked 124th in the world economy (World Bank, 2015). According to the Foundation for Community Development and the United Nations, “peripheral” countries such as Mozambique have the lowest socio-economic and human development indicators in the world. Such countries have low-income, low-qualified human capital with few technical skills and are scientifically and economically vulnerable (Fundação para o Desenvolvimento da Comunidade & Organização das Nações Unidas, 2013).

Mozambique’s economy is based on agricultural activity, which employs about 70 percent of the population (República de Moçambique, 2011). Currently, agriculture contributes 30 percent of Mozambique’s gross domestic product (GDP). Mining has experienced the highest growth of any sector in the country since 2005 and contributes approximately 33 percent of the GDP. The other 37 percent of the GDP is divided among tourism, fishing, and trade (Instituto Nacional de Estatística, 2016).

This study explores Mozambican scientific research production by identifying journal articles indexed on the Web of Science database from 2000 to 2015 that include at least one Mozambican author. It aims to identify Mozambican researchers and their affiliated institutions, describe the journals that publish them, and analyze access to the journals.

Scholarly communication

According to Anne Elizabeth Galvao Coutinho Correia (2012), knowledge generated through scientific research should be published in a journal that has an established reputation and proven track record for research dissemination, quality control, and relevance to the scientific community (Meadows, 1999). According to Rosângela Schwarz Rodrigues and Aline Borges Oliveira (2012), scientific journals are vital to the dissemination of scientific studies. Hebe Vessuri, Jean-Claude Guédon, and Ana Maria Cetto (2013) point out that publishing in a reputable journal increases “prestige, visibility, and authority” (p. 649). It is through journals that researchers report the results of their work and establish the importance of their discoveries and contributions.

Luis Fernando Sayão (2010) emphasizes that journals have historically been the primary vehicle of scientific communication. Scientific journal production has changed in recent years as a result of the emergence of the internet, the improvement of information and communication technologies, and the adoption of electronic formats. An analysis of the

scholarly communication of a designated country provides insight into its publications, identifies its active scientific communities, and calls attention to its researchers.

Using journal output as an assessment tool permits the analysis of the results presented by researchers and assesses their contribution to scientific knowledge.

Methodology

This study had two elements. First, data was collected from Web of Science; second, data was collected from the Google Scholar search engine. The study is exploratory and descriptive. It counts the number of publications, as indicated by Wildemuth (2009), and analyzes a combination of data sets that identify authors and verify their affiliated institutions.

The study covers a period of 15 years (from 2000 to 2015). This period was chosen because the Mozambican government invested increased funds and reformulated its policies in higher education, science, and technology in 2000. During this period, it also created a higher education ministry to co-ordinate higher education and scientific activities (Massarani & Lima, 2012).

Three criteria were used for including articles in this study: the inclusion of a Mozambican author, the involvement of an institution operating in Mozambique, and the presence of a published article about Mozambique. In the advanced search, the key word was set to “Mozambique” including “Mozambique” and “Moçambique” (Portuguese).

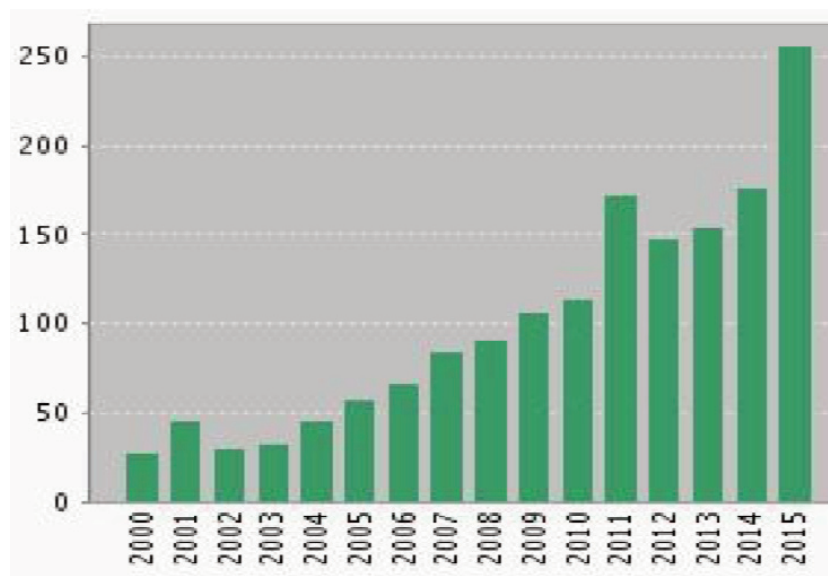
Findings and discussion

The Web of Science contained 1,536 unique valid records between 2000 and 2015 (see Figure 1).

Mozambican researchers and their institutions or affiliations

Within the 1,536 Web of Science indexed articles, there were 896 different Mozambican researchers affiliated with 121 institutions, 46 (38%) of which were foreign institutions operating in Mozambique. The 121 institutions were public and private institutions, owned in Mozambique and in foreign countries. Table 1 shows the number of researchers and the number of articles associated with each institution.

Figure 1: Distribution of published articles by year of publication
(y axis is the number of articles)



Note: Data collected by the authors (2016)

Table 1: Categories of institutions affiliated with Mozambican researchers

Categories of institutions affiliated with researchers	Number of researchers	%	Number of articles	%
Ministry of Health and related health institutions	286	31.91	553	36
Public educational institutions	273	30.46	461	30.01
National and international NGOs	153	17.07	209	13.60
Public and governmental institutions	113	12.61	185	12.04
Private institutions	51	5.69	88	5.72
United Nations institutions and co-operation agencies	20	2.23	40	2.60
Total	896	100	1,536	100

Source: Web of Science (2016)

Table 2 further details the seven Ministry of Health and health-related institutions responsible for the largest group of articles in Table 1, which accounts for 553 articles.

Table 2: Ministry of Health and health-related institutions affiliated with Mozambican researchers

Ministry of Health and related institutions	Number of researchers	%	Number of articles	%
Ministry of Health	177	61.88	332	60.03
Center of Health Research of Manhiça	43	15.03	98	17.72
Central hospitals	29	10.13	47	8.49
National Institute of Health	23	8.04	42	7.59
Health provincial directorates	11	3.84	26	4.70
National Laboratory for Reference in Tuberculosis and Leprosis	2	0.69	5	0.90
Center for Environmental Hygiene and Medical Tests	1	0.34	3	0.54
Total	286	100	553	100

Source: Web of Science (2016)

Table 3 shows parallel data for the 10 educational institutions affiliated with Mozambican researchers. It identifies 273 researchers associated with 461 articles. Some are independent and others, such as the Biotechnology Center and the Ethnobotanical Research Center, are linked to public institutions, in this case Eduardo Mondlane University. Many of the articles come from faculties of medicine.

Table 3: Educational institutions affiliated with Mozambican researchers

Public educational institutions	Number of researchers	%	Number of articles	%
Eduardo Mondlane University	226	82.78	334	72.45
University Pedagógic	19	6.95	32	7.42
Lúrio University	8	2.93	29	6.29

Table 3 (continued)

Public educational institutions	Number of researchers	%	Number of articles	%
Higher Polytechnic Institute of Gaza (ISPG)	7	2.56	12	2.60
Biotechnology Center of UEM	4	1.46	12	2.60
Zambeze University	3	1.09	18	3.90
Ethnobotanical Development Research Center	2	0.73	8	1.73
Higher Institute of Health Sciences (ISCISA)	2	0.73	6	1.30
Natural History Museum	1	0.36	4	0.86
Josina Machel Secondary School, Vilankulo	1	0.36	6	1.30
Total	273	100	461	100

Source: Web of Science (2016)

Table 4 provides parallel detail for the 31 non-governmental organizations (NGOs) affiliated with Mozambican researchers, which are mostly humanitarian organizations dedicated to the prevention and treatment of health problems. The top seven organizations involve 86 researchers and 84 articles. The remaining 24 institutions account for 67 researchers and 125 articles.

Table 4: National and international NGOs affiliated with Mozambican researchers

National and international NGOs	Number of researchers	%	Number of articles	%
Friend Global Health	26	16.99	16	7.65
Doctors without Borders	20	13.07	25	11.96
Center for Disease Control and Prevention	11	7.18	9	4.30
SolidarMed	8	5.22	13	6.62
Clinton Health Access Initiative	7	4.57	9	4.30
Health Alliance International	7	4.57	6	2.87
International Center for AIDS Care and Treatment Programs	7	4.57	6	2.87
Other	67	43.8	125	59.8
Total	153	100	209	100

Source: Web of Science (2016)

Table 5 presents the output of government ministries identified in this study. This does not include the 177 researchers involved with 332 articles associated with the Ministry of Health, which are listed in Table 2.

Table 5: Governmental institutions affiliated with Mozambican researchers

Public and governmental institutions	Number of researchers	%	Number of articles	%
Institute of Agricultural Research of Mozambique	31	27.43	58	31.35

Table 5 (continued)

Public and governmental institutions	Number of researchers	%	Number of articles	%
Ministry of Agriculture	21	18.58	36	19.45
National Directorate of Geology	12	10.61	18	9.72
Institute of Fisheries Research	12	10.61	18	9.72
Water Supply Regulatory Council (CRA)	9	7.96	6	3.24
National Institute of Meteorology (INAM)	7	6.19	9	4.86
Ministry of Planning and Development	4	3.53	3	1.62
Other	17	5.46	37	20
Total	113	100	185	100

Source: Web of Science (2016)

Thirteen United Nations agencies and other nonprofit co-operative agencies focused on humanitarian aid and/or social causes are involved with 20 researchers who authored or co-authored 40 articles. This category includes the International Institute of Tropical Agriculture, the World Health Organization, and the World Food Program, which account for the highest number of researchers.

In general, study results show that health institutions have more researchers than other public institutions in the country. According to the Instituto Nacional de Estatística (2016), however, agriculture has more qualified professionals than any other area. There are 121 agricultural institutions operating in Mozambique; 60 are Mozambican and 61 are international organizations, co-operation agencies, and other agencies. The number of international organizations indicates the involvement of foreign communities in Mozambican research and the dependence of Mozambican research on international agendas.

It is important to provide context by pointing out that Mozambique faces infrastructure challenges. In addition to poor internet connection, only 4.3 percent of the population has internet access. There is also a low level of research-supporting structures, such as libraries and laboratories (Smart & Murray, 2014). As Peter Johan Lor (2007) indicates, the lack of scientific and technology infrastructure in African countries is a barrier to scientific research.

In terms of scientific research, Mozambique is a peripheral country that needs more investment in resources to enhance its scientific production and communications research (Massarani & Lima, 2012).

Journals publishing Mozambican research

The 1,536 articles indexed in the Web of Science as having a Mozambican author or co-author were published in 677 journals, with an average of 2.3 items per journal. These journals are published in 37 countries from all continents and were grouped into 35 research areas using the Web of Science database. The U.S. and the U.K. led in the number of publications. The U.S. accounted for 634 articles and 236 journals, represent-

ing 41.21 percent and 34.86 percent of the total output, respectively. The U.K. accounted for 434 articles (32.03%) and 209 journals (30.87%). Journals in four other African countries published articles by Mozambican authors: South Africa published 70 articles in 24 journals, Nigeria published five articles in three journals, and Kenya and Egypt each published one article in one journal. These data confirm the findings of the African Observatory of Science, Technology and Innovation (2013), which show that the publishing activity in Africa is concentrated in a few countries. Also, the lack of publishing instruments in African countries leads to research publication in the developed countries of sponsors, researchers, and donor agencies. Of the 35 research areas identified, health stands out with 268 journals, 39.59 percent of the total number of journals retrieved, and 773 articles, 55.99 percent of all published articles. More than 71 percent of the 268 health-related journals are published in the U.S. and the U.K.

Agriculture has the next highest number of articles: 62 (9.16%). Mining studies and geology have three and eight articles, respectively. Agriculture and mining are essential to Mozambique's economy—they contribute substantially to the country's GDP (Instituto Nacional de Estatística, 2016)—and the dissemination of research may contribute to their growth. Mining has been vital to the country since 2005, however, according to this study, it is a research area with few publications. Heather Morrison (2009) points out that developing research activity can help build the economy of the country.

Table 6: Journals and articles by Mozambican researchers published in the Web of Science grouped by research area

#	Subject	Journals, number	Journals, percent	Published articles, number	Published articles, percent
1	Health	268	39.59	773	50.33
2	Agriculture	62	9.16	102	6.64
3	Biology	53	7.83	94	6.12
4	Ecology	50	7.39	72	4.69
5	Multidisciplinary	41	6.06	180	11.72
6	Engineering	22	3.25	30	1.95
7	Nutrition	21	3.10	37	2.41
8	Veterinary	21	3.10	43	2.80
9	Education	16	2.36	20	1.30
10	Economy	15	2.22	19	1.24
11	Aquaculture	14	2.07	36	2.34
12	Geography	13	1.92	18	1.17
13	Chemistry	12	1.77	18	1.17
14	Other	69	1.12	94	6.12
	Total	677	100	1,536	100

Source: Web of Science 2016

The most-used language to communicate Mozambican research is English, with 1,520 (98%) articles. Of the 677 journals that publish Mozambican research, 26 published six or more articles. *PLOS One* and the *Malaria Journal* have the most significant number of articles published by Mozambican researchers, with 103 and 60 items, respectively. Journals that publish health content account for 268 articles, or 39.59 percent.

Of the 37 countries identified, the U.S. leads in the publication of Mozambican research. Of the 562 subscription-based titles, the U.S. had 218 (38.79%), followed by the U.K. with 174 (30.96%) and the Netherlands with 70 (12.46%). Of the 115 open access journals, the U.K. had 35, followed by the U.S. with 18.

The 677 journals in 37 countries are published by 232 publishers. Elsevier publishes 20.24 percent, followed by Springer with 8.27 percent, Wiley Blackwell with 5.76 percent, and BioMed Central with 3.9 percent.

Mozambican research indexed on Google Scholar

Google Scholar presents an interesting complement to this data on Mozambican research and researchers. Of the 896 researchers indexed by the World of Science identified in the first phase of this research, 460 (51.34%) were found in Google Scholar. They encompassed 324 publications of various types and 108 theses, totalling 432 documents. Of these, 199 (46%) were articles published in journals not indexed on World of Science, followed by 108 theses (25%), 72 seminars (16%), 32 reports (7%), 17 books (3.9%), and four book chapters. If the 108 theses are added to the 324 publications of Google Scholar, they become 432 articles published in 19 countries. Table 7 depicts the distribution of 324 documents by country of publication, and Table 8 illustrates the distribution of these documents by area of study. Of the 108 theses, which were undertaken and approved in seven countries, 57 (53%) were completed in Brazil, 22 (20%) in Mozambique, 22 (20%) in Portugal, three in the U.S., and two in Italy. Sweden and the Netherlands each accounted for one thesis.

Table 7: Documents recovered from Google Scholar by country of publication

#	Location	Articles	Chapter of book	Book	Reports	Seminars	Total	%
1	Brazil	89	2	4	2	22	119	36.73
2	Mozambique	33		8	25	29	95	29.32
3	Portugal	13	2	2	3	13	33	10.19
4	U.K.	20		1			21	6.48
5	U.S.	20				2	22	6.79
6	South Africa	9		1	1	2	13	4.01
7	Germany	7					7	2.16
8	Spain	2				1	3	0.93
9	Sweden				1		1	0.31
10	Other	6		1		3	10	8.40
	Total	199	4	17	32	72	324	100

Source: Google Scholar (2016)

Table 8: Documents recovered from Google Scholar by subject of publication

#	Area of knowledge	Article	Chapter of book	Book	Report	Seminars	Total	(%)
1	Education	49	2	5	4	29	89	27.47
2	Health	51			2	1	54	16.67
3	Agriculture	17		4	11	9	41	12.65
4	Literature	16	1	4		5	26	8.02
5	Politics	7		2	2	5	16	4.94
6	Sociology	7			1	7	15	4.63
7	Economy	6			3	3	12	3.70
8	Cultural Studies	7		1	1	3	12	3.70
9	Environment Studies	11			1		12	3.70
10	Mining	1			3	2	6	1.85
11	Other	27	1	1	4	8	46	14.20
	Total	199	4	17	32	72	324	100

Source: Google Scholar (2016)

The Google Scholar data differentiates from World of Science data because Google Scholar includes a wider range of publications (beyond journal articles). Many Mozambican publications are not indexed in World of Science because they are written in Portuguese, the country's official language, not English.

Conclusion

The period of study covered 15 years from 2000 to 2015. During that time, there was no Mozambican journal engaged in publishing research in the country. However, personnel within 121 research institutions carried out research in the country. Thirty-eight percent of those institutions are foreign entities.

Mapping Mozambican authors and their institutions has helped to identify that the majority of researchers are from public health institutions and public learning institutions. In other words, scientific publishing in the country comes predominantly from researchers affiliated with public research institutions.

This research shows that there is interest in the publication of research in Mozambique. In the country, health organizations are most involved in publishing to international standards and using scholarly journals for scientific publication.

No Mozambican journals were identified in the Web of Science database during the research even though, according to the Instituto Nacional de Estatística (2016), nine Mozambican journals are sponsored by the major universities in the country that publish scientific research. There are also reader accessibility problems with journals publishing Mozambican research. Of the 677 journals publishing Mozambican research from 2000 to 2015, 83 percent are only accessible via subscription. Thus, the Mozambican scientific community has difficulty accessing its own publications, which

delays the research process and hinders further research. Programs should assist researchers from peripheral or developing nations to publish and access their own research.

Mozambican research is published abroad. As indicated by the findings, the U.S. and the U.K. have the most Mozambican publications, even more than Mozambique itself. Mozambican scientific publications mainly occur outside the country due to the absence of local journals and poor research publishing policies. Also, there is lack of indexing of Mozambican publications by international databases.

Mozambican research is sponsored by Mozambican governments, international organizations, national and international NGOs, international co-operations and agencies, and some United Nations organizations. In general, however, scientific research in Mozambique is published in overseas journals with international publishers that use subscription-based distribution. This creates access problems because of inadequate infrastructure in Mozambique.

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