The research performance and citation impact of Tanzanian scholars: a scientometric study

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Abstract

Purpose: A scientometric analysis was conducted to map the research performance and citation impact of Tanzania scholars from 1991 to 2015. The study analyzed the growth of the Tanzanians' scholarly literature; ascertained the year-wise distribution of publications, subject-wise distribution of publications; determined the authorship pattern and degree of collaboration; and analyzed the citation impact. Scientometric analysis is a type of quantitative methods used in evaluating research productivity of individual scientists. Data for research productivity of all Tanzania scholars were obtained using the SCOPUS database. For the Tanzanians' scholars, a total of 12,379 articles were published from 34 academic and research institutions from 1991 to 2015. Most Tanzanians scholars had published journal articles (n= 10392, 83.9%), which was followed by review articles and conference papers. The top three universities with high cumulative number of publications were Muhimbili University of Health and Allied Sciences (MUHAS) (n=2009, 16.2 %), University of Dar es salaam (n=1880, 15.2%) and Sokoine University of Agriculture (n=1571, 12.7%). The three universities alternated the first three ranks over the period of 25 years. The top five subjects where Tanzanians scholars published were related to medicine (n=6868, 25.0%), agricultural and biological sciences (n=5260, 19.2 %), immunology and microbiology (n=2781, 10.1%), environmental sciences (n=2309, 8.4%), and biochemistry, genetics and molecular biology (n=1853, 6.8%). Forty two percent of all publications were co-authored with researchers from the United States of America and the United Kingdom each contributing almost equally. Kenya is the third collaborating country contributing to 870 publications (7.0%). The maximum number of citations received in a single publication was 1914. The study findings call for scholars to recognize the importance of publishing in visible journals in order to receive large citation counts. Institutions are urged to employ scientometrics in evaluating the research performance of their scholars since such techniques take into account a combination of several measures. These findings suggest that many factors should be considered in combination when evaluating researchers' productivity and impact**.** For Tanzania to achieve its sustainable goals it and progress from a low- to a middle-income country, it needs to involve its researchers, policy-makers and providers such as the health care providers to collaborate in efforts to bridge the gaps between research, policy and practice.

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Keywords: scientometrics; research productivity; research performance; research publications; citation impact; Tanzania.

1. Introduction

Science, technology and research are widely acknowledged as important components in achieving sustainable economic development goals (Confraria & Godinho 2015; Toivanen & Ponomariov 2011; Inglesi-Lotz & Pouris 2013; Guindon et al. 2010; Lavis et al. 2010). Parallel to this movement, the United Nations Sustainable Development Goals emphasized the critical role of improving science, technology and research cooperation as a specific goal, and as a means of implementing a number of thematic goals (United Nations 2015). Universities and research institutions play a key role in building a strong public sector of research and development of a country or region, and their capacity is critical for national system of innovation (Kotecha et al. 2011). However, there have been inadequate efforts to improve science, technology and research activities in Africa, despite the movement from agriculture-dominated economies to a research and knowledge-based future (Schemm 2013). To achieve the Vision 2025, Tanzania created in 1999 the Development Vision 2025 which aims at propelling Tanzania from a least developed country to a middle income country with a high level of human development and whose economy is diversified and semi-industrialized. The country need to embrace science and technology and innovation. This implies priority on science and technology and innovations to raise productivity in agriculture with priority to value addition by moving up the value chain in agriculture and promoting linkages with other sectors (The Citizen Magazine 2016; The United Republic of Tanzania 2010).

Scientometrics is used to analyze the research productivity and citation impact of researchers work in their discipline, institutions or region. It is important in informing policies and decisions regarding country or regional development trends. Most universities and research institutions in sub-Saharan Africa have a weak research infrastructure, capacity and funding which affects their contribution to the world's knowledge production and development through research activities (Abrahams et al. 2009; Pouris 2015; Toivanen & Ponomariov 2011; Kotecha et al. 2011). Lack of access to international and local research outputs, and poor visibility of Africa's research outputs contribute to low research productivity (Nature 2015; Abrahams et al. 2009). Most of the African scholars "publish in journals that are not counted by the Index" (Nature 2015:1). Africa faces many challenges of which investments in science, technology and research could assist to improve their economic base. Understanding the nature and dynamics of research performance of a specific country is important for building and integrating the national innovation system (Toivanen & Ponomariov 2011).

The African scientific outputs have been growing at a rapid rate than the world average, although the share of the Africa's scientific output at the global level has remained low (Godinho 2013; Confraria & Godinho 2015; Schemm 2013). For instance, Schemm (2013) reported that the share of Africa's research outputs to the world increased from 1.2% in 1996 to around 2.3% in 2012, although the contribution of Africa to the global research outputs and impact still remains small. According to Onyancha (2016), sub-Saharan Africa contributes a "mere 0.03% of the global research data as compared to an average of 1.4% of the world's research articles". Confraria and Godinho (2014) also reported that the Africa's research outputs have increased in recent years to a level above the world average, although the continent's productivity in relation to population is well below world average. The rapid developments of technology, open access movement and other initiatives such as research for

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life programmes have immensely contributed to the growth of African research outputs (Schemm 2013).

The level of collaborative research activities in Africa is substantially higher as compared to the rest of the world, although the intra-Africa collaboration is still low (Onyancha & Maluleka 2011; Nature 2015; Confraria & Godinho 2015). For instance, a recent Nature report revealed that "Africa led the world in collaborations in 2014 articles in the Index" (Nature 2015:1). About 70% of Africa's research output was generated through international collaborative research in the 2014 Nature Index (Nature 2015). Pouris and Ho (2014) also found that the internationally collaborative articles grew by 66 %—almost twice the growth of the single-country articles in Africa. However, scholars found that the research collaborations within African countries are still low, when compared with extra-Africa collaborations (Onyancha & Maluleka 2011; Nature 2015; Confraria & Godinho 2015). Further, the research collaboration of the top publishing African countries is dominated by a few external partners, mainly the US, UK and France (Confraria & Godinho 2014: 1260).

Evidence also shows that the research output in Tanzania is considerably less than other countries in the African region (Pouris 2010; Boshoff 2010; Abrahams et al. 2009; Confraria & Godinho 2015; Onyancha 2016; Godinho 2013). For instance, Abrahams, Burke, and Mouton (2009) found that Tanzania total publications according to Information Sciences Institute (ISI) were 4,815 out of the 95,711 papers in 14 countries in the Southern African Development Community (SADC) during the period of 1990 to 2007. In another study, Pouris (2010) reported that South Africa published almost 14 times more publications than the second country in the list-Tanzania, with a total of 4184 publications from 1994 to 2008. A recent study reported that Tanzania total publications were 2,354, which was twelve times more publications produced by South African scholars during the period 2007–2011 (Pouris & Ho 2014). Further, the African science is dominated by a few countries. For instance, South Africa accounted for 64% of the region's 2014 WFC, followed by Egypt, Kenya, Algeria and Tunisia (Nature 2015). Another research also reported almost similar findings that the leading countries in terms of research outputs were South Africa, Egypt, Tunisia and Nigeria (Confraria & Godinho 2015). It is therefore important to have a complete picture of research productivity of a certain region or country in order to determine gaps critical for socio-economic development.

When searching the literature on research productivity and impact in Tanzania, we found few African studies, which had included Tanzania in their analysis (Abrahams et al. 2009; Confraria & Godinho 2015; Pouris 2010; Pouris & Ho 2014; Onyancha 2016; Boshoff 2010). Other Tanzanian's studies either focused on the research productivity and impact of a specific institution or discipline, or profession (Lwoga & Sife 2013; Lwoga & Sife 2014; Sife & Bernard 2016; Sife et al. 2013; Sife et al. 2014). Although few studies analysis (Abrahams et al. 2009; Confraria & Godinho 2015; Pouris 2010; Pouris & Ho 2014; Onyancha 2016; Boshoff 2010) have investigated Tanzanians research productivity, there is still no comprehensive study that has been conducted to examine the patterns and impact of research performance among the Tanzanian scholars.

This study reports findings of a scientometric study of research productivity and impact in Tanzania scholars from 1991 to 2015. The broader aim of the paper is to provide empirical findings to inform multi-sectoral policies, programmes, capacity, and financing issues related to improving research performance across the country. The study seeks to answer the following research questions:

1. What is the growth of the Tanzanians' scholarly literature?

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2. What is the year-wise and subject-wise distribution of publications"
3. What is the authorship pattern among Tanzania scholars?
4. What is the pattern of collaboration in knowledge production in Tanzania?
5. What is the citation impact of Tanzania scholars?

The scientometric approach was conducted to assess the extent and impact of research performance among Tanzanian's scholars. Scientometrics is the "statistical analysis of research pattern" (Ramkumar 2016). Scientometric is important for measuring research productivity and quality, specializations, collaborative networks, patterns of scientific communications (Perron et al. 2016). It allows a wide range of metrics to be conducted, including comparisons of different disciplines, institutions, countries, changes over time etc. (Pouris 2012). Scientometric can inform decisions related to policy, resource apportionment, and understanding the socio-economic impact of research (Perron et al. 2016).

2. Methodology

Data was extracted from the SCOPUS (Elsevier 2016) database, because it indexes quality research outputs and it provides adequate coverage of African research (Fari & Ocholla 2016; Onyancha & Ocholla 2009). The list of the Tanzanian universities was acquired from the Tanzania Commission for Universities (TCU) website. The list of the research institutions was acquired from the Tanzania Commission for Science and Technology (COSTECH) website. The data was extracted and downloaded from SCOPUS by using institutional affiliation as the search term. The study created the search query with the specific names of the different search phrases (i.e. AFFIL (''name of the university'') AND (LIMIT-TO (AFFILCOUNTRY,''Tanzania''))). Thereafter, in order to identify a wide range of research institutions, we used truncated queries with terms that are broadly used to name research-based institutes in the country, such as science-, technology-, research, center, etc., (i.e. AFFIL(''sci* '') AND (LIMIT-TO(AFFILCOUNTRY,''Tanzania'')). Both specific and truncated queries were restricted to the year between 1991 and 2015 covering journals, book series, and conference proceedings, while excluding editorials, erratum, letters, and notes. Through descriptive bibliometrics or publication count, domestically and internationally co-authored papers were identified for co-authorship analysis.

From the list of aggregated authors and affiliations, we identified the authors' affiliations and countries from the fields of affiliation and corresponding address. Multinational collaboration was determined by author's affiliation was located outside Tanzania. The names of affiliations and countries that were not well formatted were reconstructed from the author's address. Besides, some institution such as the Muhimbili University of Health and Allied Sciences changed its names during the study period. Other institutions changed their several affiliates. We therefore manually reprocessed the author's affiliation to reflect the historical changes of names. The data cleaning and splitting of authors was aided by Python version 2.7 scripts (https://www.python.org/) which re-organized the data and stored it to a MySQL® version 5.5 (https://www.mysql.com/) database. The final data cleaning was finalized using Microsoft Excel® version 2010 (https://products.office.com/en-us/excel).

A total of 16,662 articles were identified when search term included was Tanzania. In order to confirm that these articles were published by the Tanzanian scholars, we added all the Tanzanian institutions found by the search term so that the researchers in the affiliations of authors, and excluded articles that were not published by authors in country, which had been

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accidentally included in the original set. A total of 12,379 articles published by Tanzanian scholars were finally analyzed.

3. Results

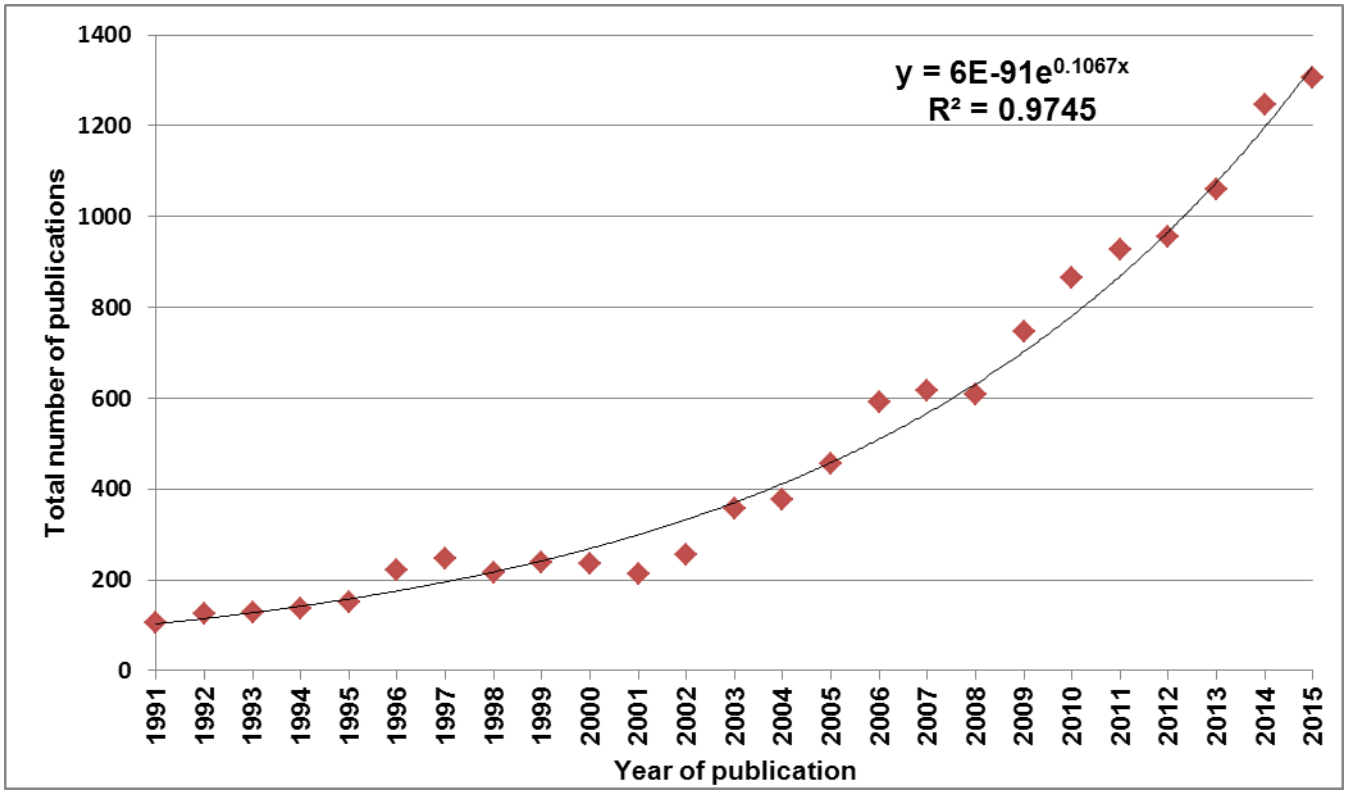

Figure1: Annual increase of research articles in Tanzania from 1991 to 2015. The articles increased exponentially to a total of 12,379, the highest number of publication (1307) was in 2015.

There was a more than 12.5 fold increase in number if articles per year from 105 in the year 1991 to 1,327 articles in the year 2015, a 92% increase in publications.
Years after 2000 saw rapid growth in annual publication turnover for example the number of articles doubled in 4 years from 235 in 2000 to 456 publications in 2005.

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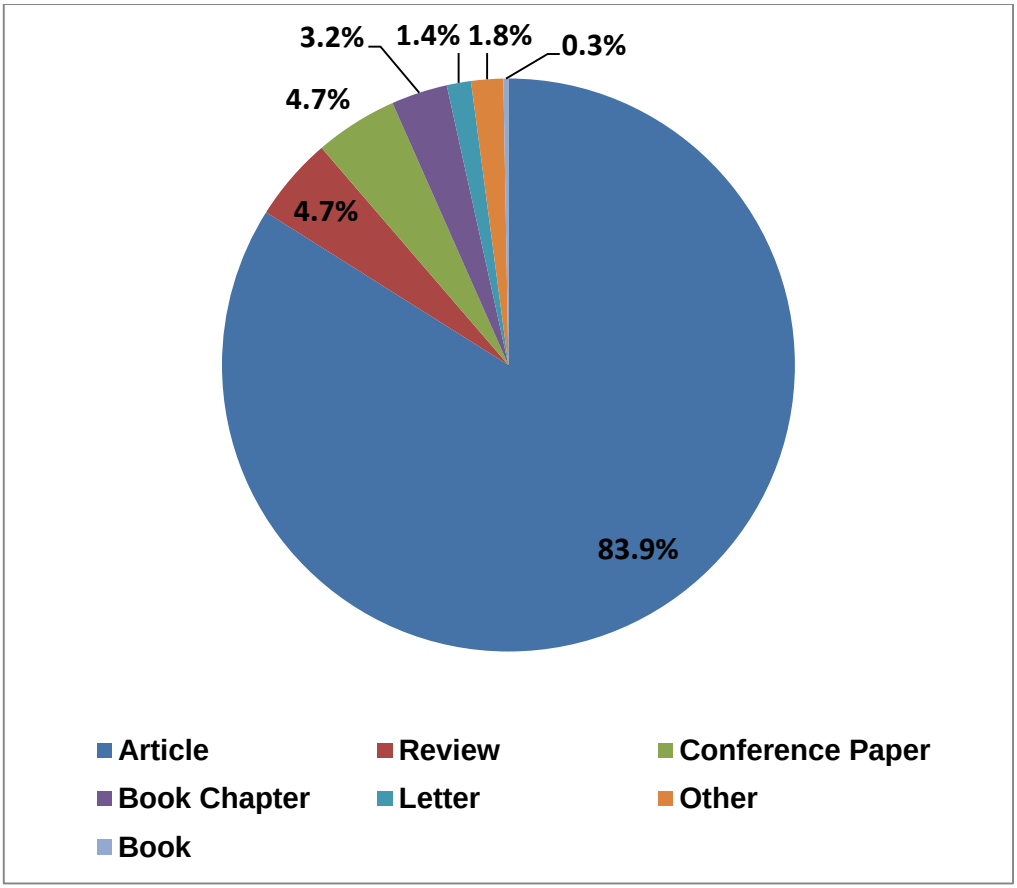

Figure 2: Article types published by Tanzanian Scholars

Eighty four percent of all publications were research articles, followed by reviews and conference presentation contributed 4.7% each, of all articles published between 1991 and 2015.

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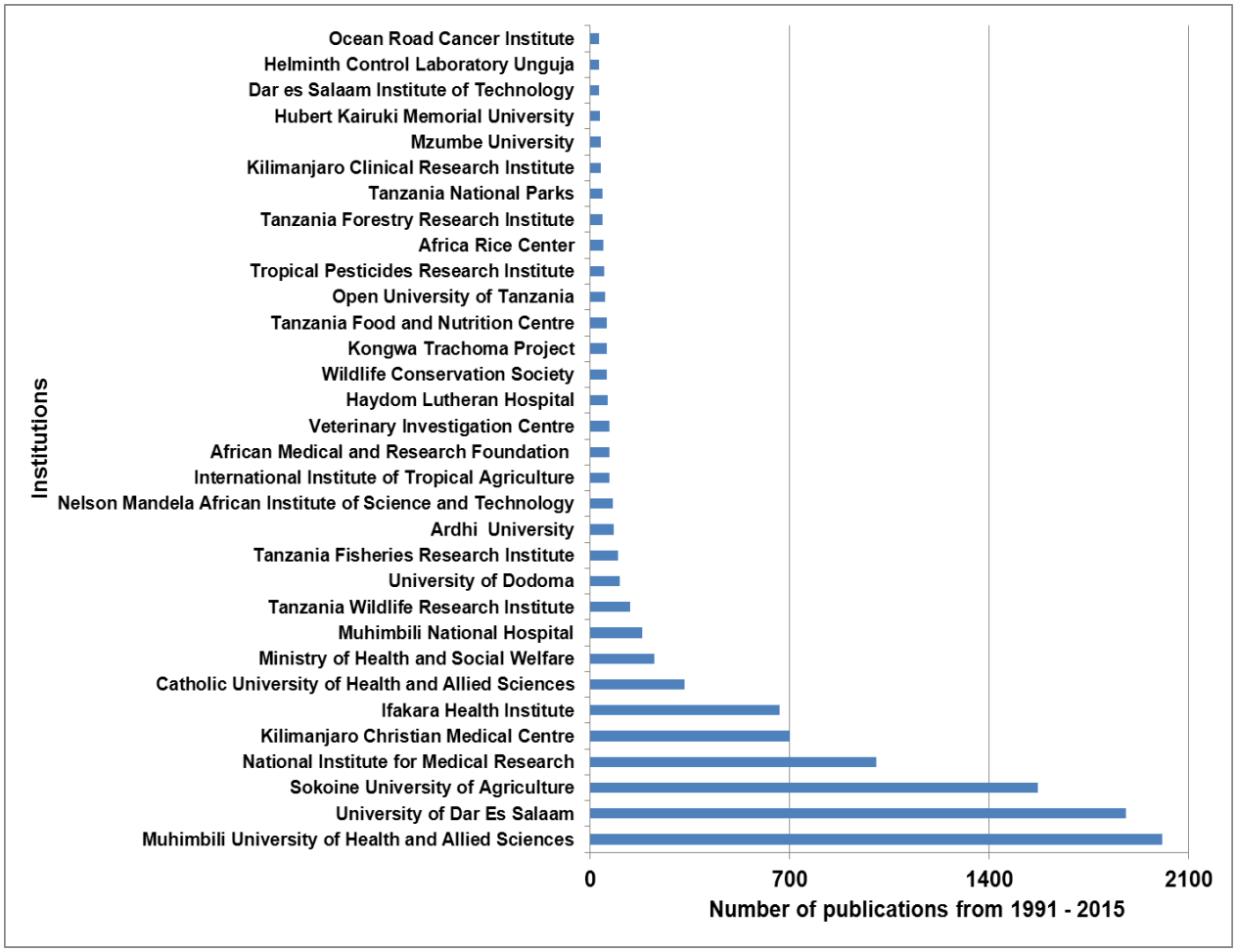

Figure 3: Overall Institution publication rank in the study period 1991-2015

The leading Institutions with cumulative total 500 or more articles during the 25 years were the Muhimbili University of Health and Allied Science (MUHAS) with 2009(16.2%) publications in the study period. This was followed by University of Dar es Salaam (UDSM) and Sokoine University of Agriculture (SUA) with 1880(15.2%) and 1571(12.7%), respectively. Next was National Institute for Medical Research (NIMR), Kilimanjaro Christian Medical Centre (KCMC) and Ifakara Health Institute (IHI). There is dominance of medical research literature among Tanzania researchers as most of these institutions conduct medical research with exception of UDSM and SUA. The first three overall ranking institutions when have alternated their rank positions over the years as depicted in Figure .

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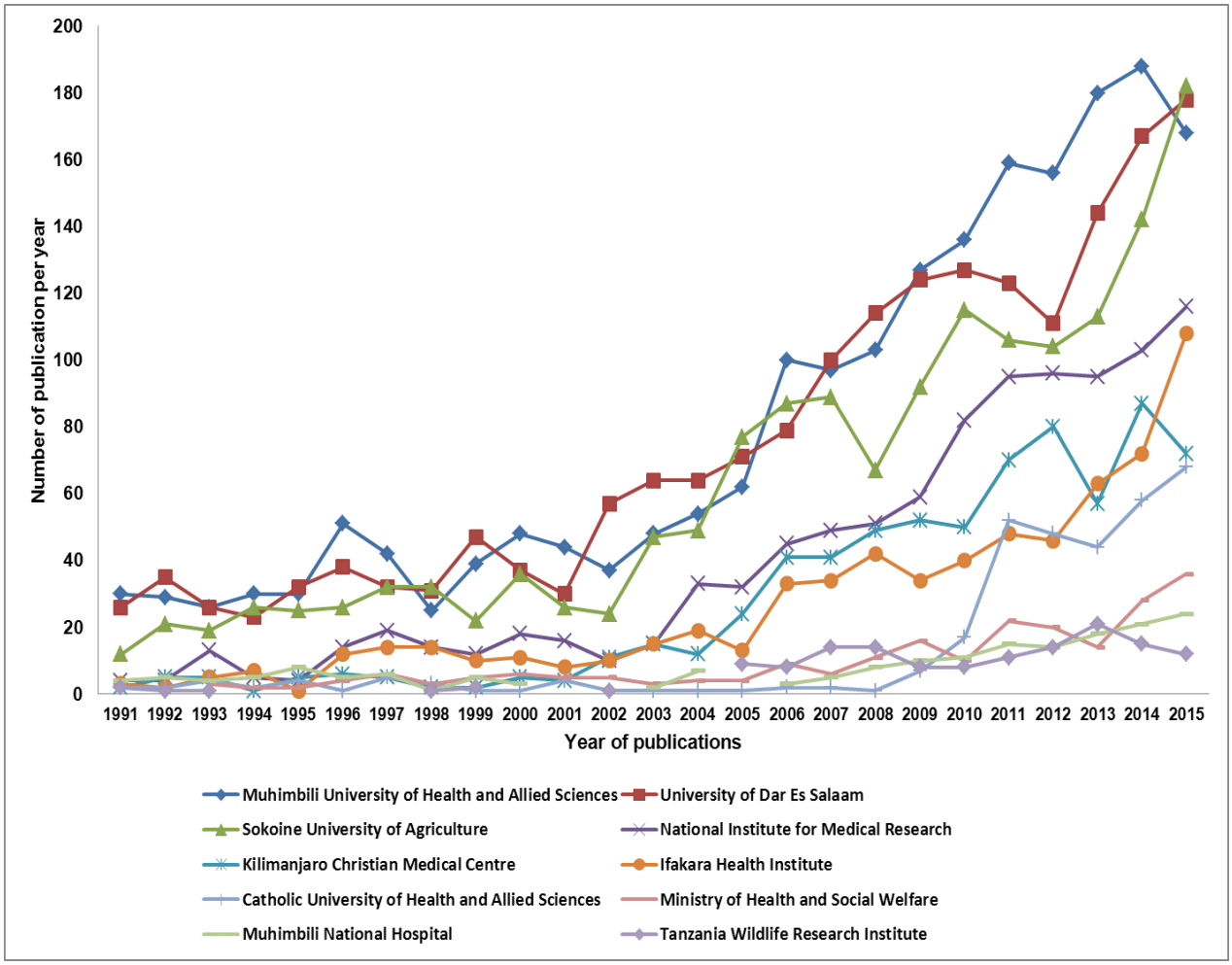

Figure 4: Annual progress of top 10 performing institutions in Tanzania

In 2015 SUA was leading with 183 articles compared to UDSM and MUHAS which produced 178 and 168 publications, respectively.

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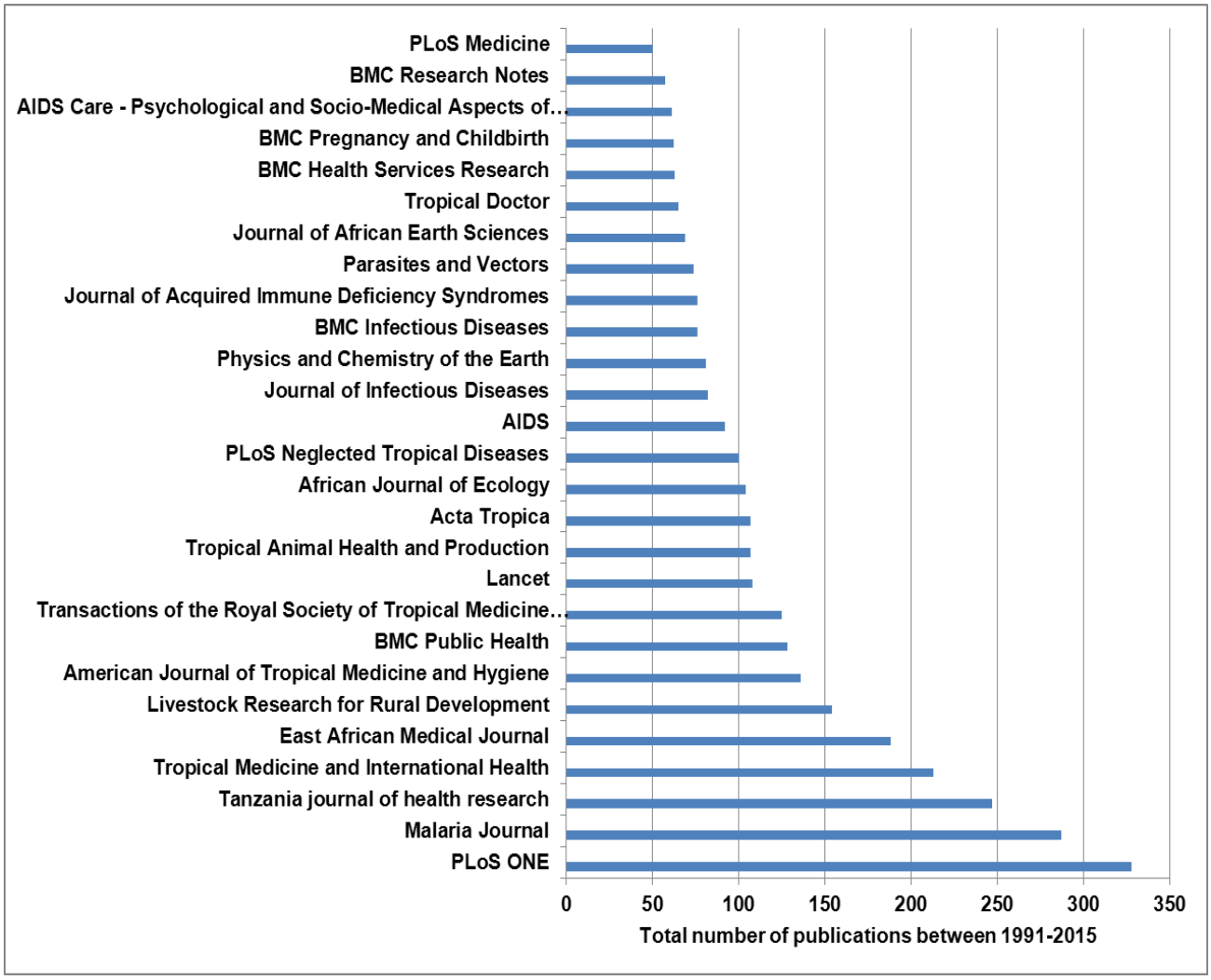

Figure 5: Journal sources for Tanzanian Scholars top 27 journals 50 publications or more

The leading journals are in the field of medical sciences

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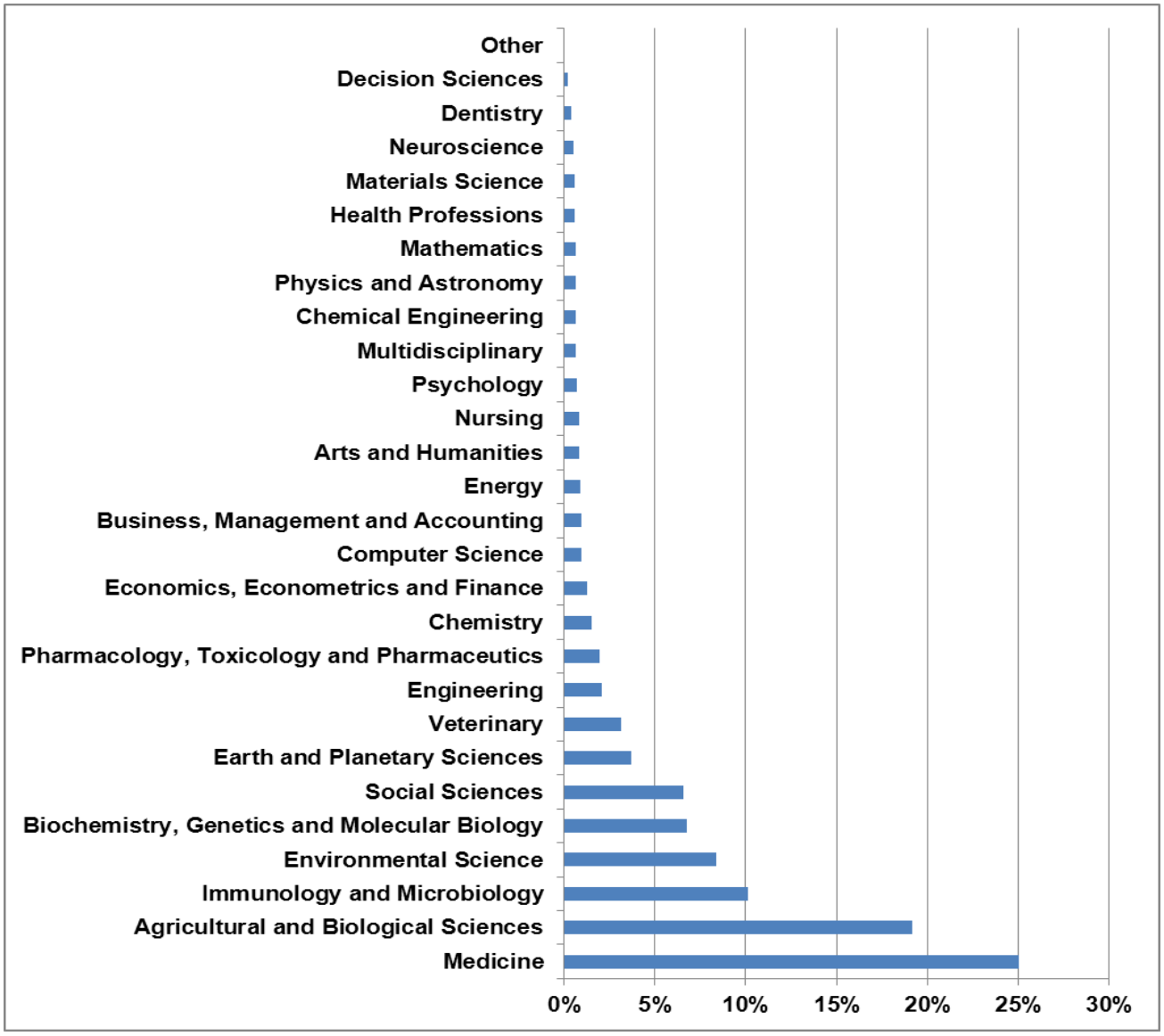

Figure 6: Subject classifications

The medicine subject category contributed 25% of publications followed by agricultural and biological sciences 19% and Immunology and Microbiology 10%. Pharmacology, toxicology and pharmaceutics contributed the least at only 2% of all articles published in the years 1991 to 2015.

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Table 1: Journal ranking with respect to total citations, total number of publications and average citation per publication

SNO	Journal	Total citations	Citations rank	Total publications	Publications rank	Average Citation	Average citation rank
1.	Lancet	10354	1	108	10	95.87	12
2.	Malaria Journal	6013	2	287	2	20.95	248
3.	New England Journal of Medicine	5506	3	26	66	211.77	3
4.	Tropical Medicine and International Health	4885	4	213	4	22.93	219
5.	PLoS ONE	3942	5	328	1	12.02	452
6.	American Journal of Tropical Medicine and Hygiene	3924	6	136	7	28.85	145
7.	AIDS	3668	7	92	15	39.87	76
8	Nature	3600	8	21	78	171.43	4
9	Transactions of the Royal Society of Tropical Medicine and Hygiene	3431	9	125	9	27.45	162
10	Journal of Infectious Diseases	2713	10	82	16	33.09	110
11	Science	2662	11	25	71	106.48	9
12	East African Medical Journal	1521	20	188	5	8.09	629
13	BMC Public Health	1414	24	128	8	11.05	491
14	Nature Genetics	835	40	3	692	278.33	2
15	Tanzania journal of health research	474	61	247	3	1.92	1101
16	Livestock Research for Rural	437	66	154	6	2.84	992

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	Development						
17	Nature Medicine	332	83	1	2176	332.00	1
18	Journal of Experimental Medicine	285	99	2	1086	142.50	5
19	Journal of Personality and Social Psychology	280	102	2	916	140.00	6
20	Journal of Cross-Cultural Psychology	267	108	2	968	133.50	7
22	Nature Reviews Microbiology	127	211	1	2174	127.00	8
23	Metallurgical and Materials Transactions A: Physical Metallurgy and Materials Science	105	255	1	2222	105.00	10

The Lancet journal is leading with total of 10,354 (5.5%) citations followed by Malaria journal and New England Journal of Medicine with 3.2% and 2.9%, respectively of all citations. The journals show variation in ranking based on number of articles, citation, and average number of citations per publication in that journal.

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Table 2 : Highly cited articles. Six papers each with more than 500 citations had a total of 5285 (2.8%) citation out of 186,777 citations from all Tanzanian publications in the study period. Includes first author and first Tanzanian author in the list, the institution of the Tanzanian author is indicated.

Sno	Publication	Number of citations	Tanzania Institution
1	Haynes A.B., Kibatala P.L., et al., (2009). A surgical safety checklist to reduce morbidity and mortality in a global population. **New England Journal of Medicine.**	1914	St Francis Designated District Hospital
2	Grosskurth H., Mwijarubi E., et al., (1995). Impact of improved treatment of sexually transmitted diseases on HIV infection in rural Tanzania: randomised controlled trial. **The Lancet.**	1061	African Medical and Research Foundation (AMREF)
3	Sankaran M., Banyikwa F., et al., (2005). Determinants of woody cover in African savannas. Nature	649	University of Dar Es Salaam
4	Tishkoff S.A., Lema G., et al., (2007). Convergent adaptation of human lactase persistence in Africa and Europe. **Nature Genetics.**	592	Muhimbili University of Health and Allied Sciences
5	Tishkoff S.A., Lema G., et al., (2009). The genetic structure and history of Africans and African Americans. **Science.**	562	Muhimbili University of Health and Allied Sciences
6	Olldashi F., Nungu K. et al., (2010). Effects of tranexamic acid on death, vascular occlusive events, and blood transfusion in trauma patients with significant haemorrhage (CRASH-2): A randomised, placebo-controlled trial. **The Lancet**.	507	Muhimbili Orthopaedic Institute

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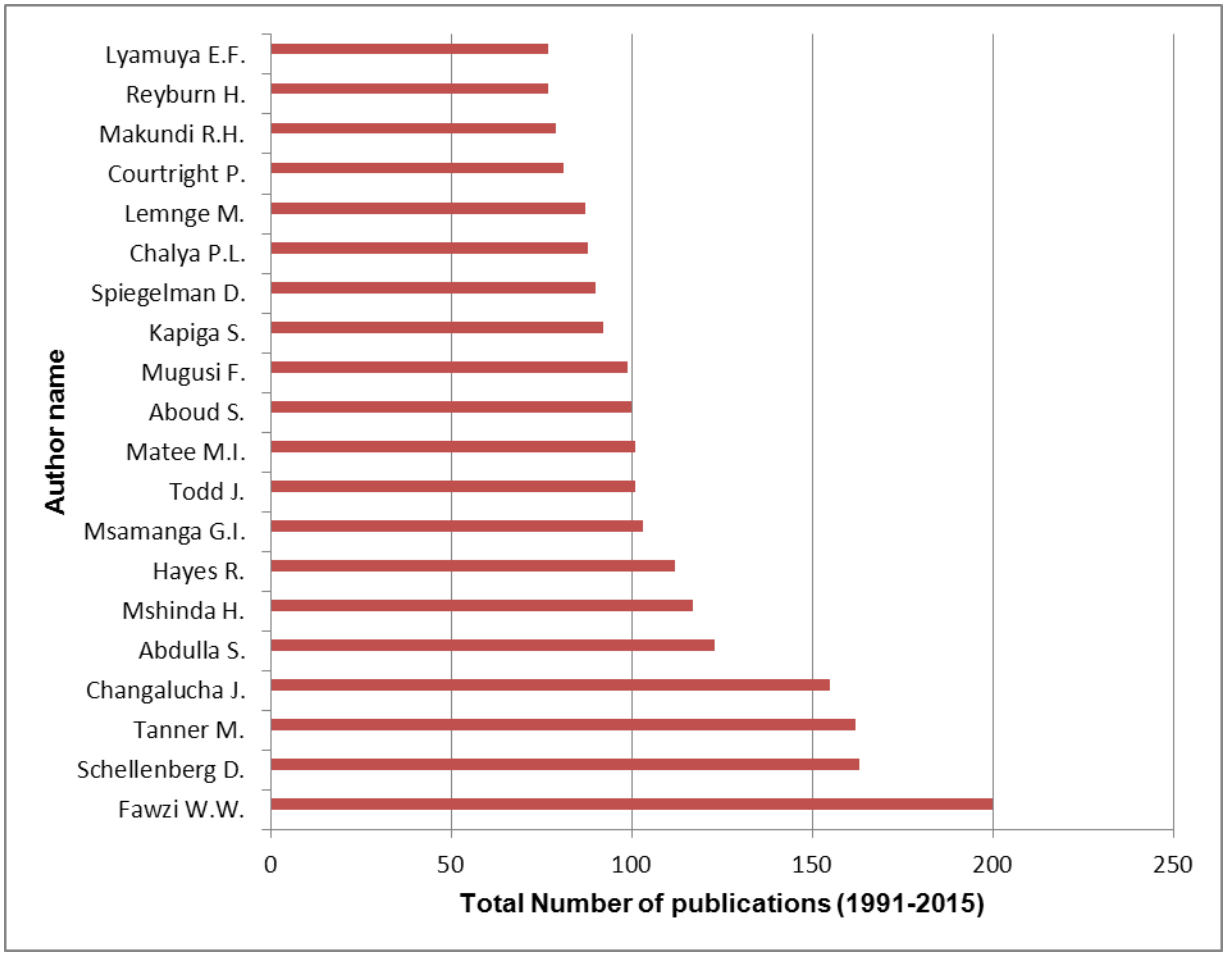

Figure 7: Top 20 most prolific authors in Tanzania

Top 20 prolific authors in Tanzania published 2207 (17.8%) of all publications and included many from the field of health sciences.

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Table 3: Top collaborating countries in published literature during 1991 to 2015

Sno	Country	Number of articles	% of all articles	Sno	Country	Number of articles	% of all articles
1	United States	2673	21.6%	17	Italy	294	2.4%
2	United Kingdom	2496	20.2%	18	Nigeria	236	1.9%
3	Kenya	870	7.0%	19	Ghana	219	1.8%
4	The Netherlands	752	6.1%	20	Zambia	211	1.7%
5	Switzerland	741	6.0%	21	Spain	205	1.7%
6	South Africa	724	5.8%	22	India	200	1.6%
7	Sweden	715	5.8%	23	Malawi	193	1.6%
8	Germany	661	5.3%	24	Ethiopia	182	1.5%
9	Denmark	627	5.1%	25	Zimbabwe	169	1.4%
10	Norway	576	4.7%	26	Austria	155	1.3%
11	Uganda	559	4.5%	27	Thailand	144	1.2%
12	Belgium	472	3.8%	28	China	139	1.1%
13	Canada	364	2.9%	29	Finland	134	1.1%
14	Japan	326	2.6%	30	Mozambique	130	1.1%
15	Australia	314	2.5%	31	Brazil	127	1.0%
16	France	305	2.5%	32	South Korea	125	1.0%

There was a high level of collaboration with 9075 (73%) publications co-authored with international scholars. The top collaboration countries were the United States and the United Kingdom contributing 21.6% and 20.2% of all collaborations with Tanzania. The top African collaborator is the East African Neighbor Kenya which ranked 3rd contributing 7% of collaborations with Tanzania.

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Authorship patterns chart:

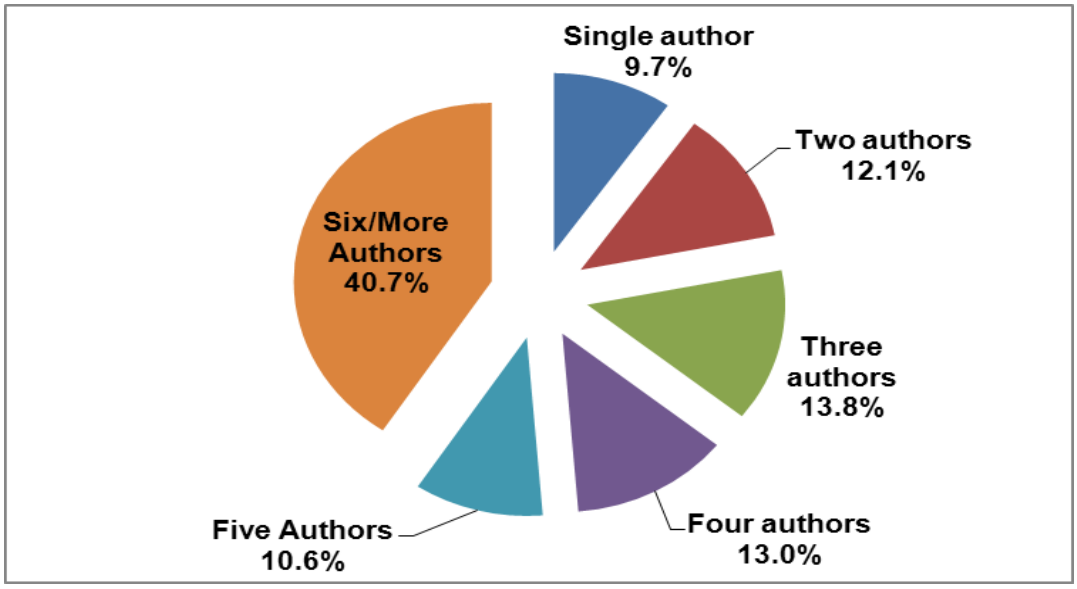

Figure 1 : Authorship patterns of Tanzania scholars between the years 1991 to 2015. Ninety percent of articles were multi-authored papers of these 49% by six or more authors.

4. Discussion

The use of Scientometrics can be helpful for countries to make informed political decisions with regards to achieving sustainable development goals. This is due to the fact that, the scientific research and scientific publication are requirements for the creation of the necessary long-term potential for sustainable economic development (Confraria & Godinho 2015).

4.1 Growth

Our study reveals an exponential growth of articles spanning over 25 years; between the year 1991 and 2015. The propensity to publish in the Tanzania has risen particularly fast since 2004-2008, suggesting that a possible take-off of Tanzania science similar to trend observed sub-Saharan Africa (Confraria & Godinho 2015; Breugelmans et al. 2015; Pouris & Ho 2014). This period was also marked by establishment of new private and public universities in Tanzania. Increase in number of publications from 2004 also observed by others in Africa [1] and may be due to presence of collaborations some of which marked by the presence of medical and Tropical research centers focusing in in poverty diseases priority in East Africa (Breugelmans et al. 2015). Notable apparent productivity of African science, as measured by publications to gross domestic product, has risen in recent years to a level above the world average, however, it is argued that looking at the equivalent ratio after it has been normalized by population, there is still a huge gap to overcome (Confraria & Godinho 2015). One needs to analyze the growth rate with respect to the country population and the number of researchers in a given institution.

4.2 Subject's category

The research on medical sciences appears to be leading in Tanzania. Medicine was the top subject, followed by Agriculture and Biological Sciences and immunology and Microbiology. This is in concordance other studies show that Africa's research outputs are highly represented in the fields of health sciences which is similar to the coverage of world's publications (Confraria & Godinho 2015; Abrahams et al. 2009). The high contribution of research publications in health-related sciences, such as medicine and immunology and microbiology, may stem from research work on tropical diseases and specific health problems, as well as from

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the location of international medical research centers in Africa. and the visible presence of international cooperation between Tanzanian researchers and those overseas (Confraria & Godinho 2015; Gondwe 2010). Accordingly, a number of health institutions including Medical universities and medical research institutions appear to rank high in the list of contributors of science in Tanzania, in our analysis. The prosperity of health related research may also be due to increase of funding in these areas by organizations such as SIDA, The European & Developing Countries Clinical Trials Partnership (EDCTP), Wellcome-Trust, National Institute for Health among others (Breugelmans et al. 2015). The ranking of Agricultural Sciences seems reasonable, given the needs of the Tanzania to depend on Agriculture the trend and the significance applies to African countries (Confraria & Godinho 2015; Abrahams et al. 2009). Therefore, scientific specialization, in Tanzania is not quite different from the overall Africa's specialization in areas of medical research and Agriculture. However, compared to the world patterns, Agricultural Sciences are relatively more important in Africa (Godinho 2013).

4.3 Authorship

Authorship pattern in Tanzania is dominated by multi-authors in 90.3% of the publications indicating a high degree of collaboration among Tanzanian scholars. Furthermore, collaboration between Tanzania and international researchers is quite high at 73%. In other studies, it was noted that collaborative patterns among African scholars are substantially higher than in the rest of the world (Pouris & Ho 2014). Tanzania Scientists that collaborate with peers in Europe and US are likely to receive more scholarly impact as reflected in their citation impact (Confraria & Godinho 2015; Breugelmans et al. 2015). Papers that had more citation impact were mostly those that were coauthored in collaboration with international researchers.

4.4 Institutional ranking

The most prolific institution in the 25 years period covered by the analysis is Muhimbili University of Health and Allied Sciences (MUHAS) who produced a volume of 2009 (16.2%) of all publications. The top 3 institutions alternatively exchanged first to third rank. In 2015 the leading institution was SUA followed by UDSM and MUHAS. This results coincide with web ranking of Tanzania University in 2016 (Anon 2016).

4.5 Prolific authors

The top 20 scholars comprise mostly researchers in the field of health. The list includes both Tanzanian native scholars and foreign scholars working in Tanzania.

4.6 High impact journals and article

Top ranking journals with regard to citations were the high impact journals such as Lancet and New England journal of medicine. Malaria journal, an open access journal ranked second in both number of articles and citations rank. Medical researchers in this area should consider the journal to boost their impact and visibility. One local journal the Tanzanian Journal of Health research ranked third in number of articles however the journal ranked poorly in average number of citations with each article receiving less than 2 citations. This implies that Tanzania authors need to publish in journals that are widely visible (e-journals & open access journals) and that Tanzania need to establish local online journals and improve visibility to boost the number of citations.

4.7 Implication for practice and policy

For Tanzania to achieve its sustainable goals it and progress from a low- to a middle-income country, it needs to involve its researchers, policy-makers and providers such as the health care

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providers to collaborate in efforts to bridge the gaps between research, policy and practice. However, the government needs to adopt a model to fund Tanzania research institutions and increase budget support for research to more than the current 1%.

4.8 Study limitations

We used Elsevier's Scopus (Elsevier 2016) database to analyze research impact of Tanzanian scholars over other online databases alternatives such Thomson's Reuters Web of Science (WOS) database. Scopus covers about 20000 journals compared to 13000 by WOS (Mongeon & Paul-Hus 2016). Moreover, the database is updated on daily basis rather than weekly. This gives opportunity to get more dependable amount of publications. WOS data has limitation with English-language journals is very comprehensive, one limitation of the Web of Science is that coverage of non-English-language journals is less extensive, although this has recently increased with the inclusion of French and Portuguese journals in particular. Scopus reported a higher citation rate for health relevant articles compared with the Web of Science possibly due to the fact that Scopus abstracts more from biomedical journals WOS. Thus implies that this kind results need to be interpreted with caution when another compared with data from other databases. However, when pharmacy and pharmacology journal research was analyzed from both Scopus and WOS there the two databases differed in the number of articles within a tolerable margin of deviation for most journals (Gorraiz & Schloegl 2008).

Another potential limitation of our analysis is the method used to assign papers to organization. Authors often report their affiliations in different ways for different publications, so we used an algorithm to unify these affiliations, but some authors who published in foreign countries may have been discounted in the analysis. Moreover, scientists from foreign countries working in Tanzania were also counted as Tanzanian scholars.

5. Conclusion

The citation impact of research publications from Tanzania increased exponentially from 1991 to 2015; collaborative research had a higher impact and was more highly cited than non-collaborative research. We expect the observed trends to continue as suggested by the number of recent, high impact relevant papers that has been published in this period. In the future, scientometric study should be conducted to benchmarks Tanzania with neighboring African countries to compare their profiles with respect to achieving common developmental goals. Collaboration with external partners and publishing boost scholars' impact. However, Tanzania needs to increase collaboration with other African countries on common issues related to economic growth and sustainable development.

References

Abrahams, L., Burke, M. & Mouton, J., (2009) 'Research productivity-visibility-accessibility and scholarly communication in southern African universities.' *The African Journal of Information and Communication*, (10) pp.20–36.

Anon, (2016) *Ranking web of Universitities United Republic of Tanzania.* http://www.webometrics.info/en/africa/tanzania, united republic of [accessed November 3, 2016].

Boshoff, N.,(2010) ' South–South research collaboration of countries in the Southern AfricanDevelopment Community (SADC)' *Scientometrics*, 84(2) pp.481–503.

Breugelmans, J.G. et al., (2015) 'Bibliometric Assessment of European and Sub-Saharan African Research Output on Poverty-Related and Neglected Infectious Diseases from 2003 to 2011' D. J. Diemert, ed. *PLOS Neglected Tropical Diseases*, 9 (8) p.e0003997.

Confraria, H. & Godinho, M.M., (2015) 'The impact of African science: a bibliometric

analysis'. *Scientometrics*, 102(2) pp.1241–1268.
Elsevier,(2016) *Scopus. The largest database of peer-reviewed literature.* https://www.elsevier.com/solutions/scopus [accessed November 15, 2016].
Fari, S. & Ocholla, D. (2016) ' Nature, patterns and trends of research collaboration among academics in Nigeria and South Africa.' *Mousaion*, 34(1) pp.1–22.
Godinho, M.M. (2013) 'Science and Technology in Africa: A Bibliometric and Patent Analyis'
Gondwe, M., (2010) 'Global research report on Africa.' *Malawi medical journal : the journal of Medical Association of Malawi*, 22(2) p.59.
Gorraiz, J. & Schloegl, C.(2008) 'A bibliometric analysis of pharmacology and pharmacy journals: Scopus versus Web of Science.' *Journal of Information Science*, 34(5), pp.715–725.
Guindon, G.E. et al.(2010) 'Bridging the gaps between research, policy and practice in low- and middle-income countries: a survey of health care providers.' *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne*, 182 (9), pp.E362–72.
Inglesi-Lotz, R. & Pouris, A. (2013) 'The influence of scientific research output of academics on economic growth in South Africa: An autoregressive distributed lag (ARDL) application.' *Scientometrics*, 95(1) pp.129–139.
Kotecha, P., Walwyn, D. & Pinto, C.(2011) *Deepening Research Capacity and Collaboration across Universities* In *: SADC: A Southern African Universities Regional Research and Development Fund*, http://www.sarua.org/files/publications/RDFund/SARU_RD%20Fund_May%202011%20Ver%201.pdf [accessed 15 May 2017]
Lavis, J.N. et al.(2010) Bridging the gaps between research, policy and practice in low- and middle-income countries: a survey of researchers. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne*, 182(9), pp.E350–61.
Lwoga, E. & Sife, A.(2014) 'Research productivity and Web Visibility of Dental Faculty in Tanzania: A scientometric analysis.' In : *2nd MUHAS Scientific Conference 14th -15th May 2014*. Dar es Salaam, Tanzania.
Lwoga, E.T. & Sife, A.S.(2013) 'Mapping the Research Productivity and Scholarly Impact of the Traditional Medicine Scholars in Tanzania : A Scientometric Analysis.' *International Journal of Digital Library Services*, 3(3) pp.38–52.
Mongeon, P. & Paul-Hus, A.(2016) 'The journal coverage of Web of Science and Scopus: a comparative analysis.' *Scientometrics*, 106(1) pp.213–228.
Nature,(2015) '.*Nature*' 522(7556), pp.S28–S29.
Onyancha, O.B.92016) 'Open Research Data in Sub-Saharan Africa: A Bibliometric Study Using the Data Citation Index.' *Publishing Research Quarterly*, 32 (3) pp.227–246.
Onyancha, O.B. & Maluleka, J.R.(2011) 'Knowledge production through collaborative research in sub-Saharan Africa: How much do countries contribute to each other's knowledge output and citation impact? ' *Scientometrics*, 87(2) pp.315–336.
Onyancha, O.B. & Ocholla, D.N.(2009) 'Assessing researchers' performance in developing countries: Is google scholar an alternative?' *Mousaion*, 27(1) pp.43–64.
Perron, B.E. et al.(2016) ' Laying the Foundations for Scientometric Research: A Data Science Approach.' *Research on Social Work Practice*, (October).
Pouris, A.(2010) A scientometric assessment of the Southern Africa Development Community: science in the tip of Africa. *Scientometrics*, 85(1) pp.145–154.
Pouris, A.,(2015) 'An assessment of South Africa's research journals: Impact factors, Eigenfactors and structure of editorial boards.' *South African Journal of Science*, 111 (3-4) pp.1–8.
Pouris, A.(2012) 'Scientometric research in South Africa and successful policy instruments.' *Scientometrics*, 91(2) pp.317–325.
Pouris, A. & Ho, Y.-S.(2014) 'Research emphasis and collaboration in Africa.' *Scientometrics*,

ISSN 2223-7062 Proceedings and Report of the 9th UbuntuNet Alliance Annual Conference, 2016 pp 109-128

98(3) pp.2169–2184.
Ramkumar, S., (2016) 'Collaboration trend in Speech , Language and Hearing Sciences : A Scientometric Study Based on Select Journals.' *International Journal of Education & Multidisciplinary Studies*, 03(03) pp.530 - 537
Schemm, Y., (2013). 'Africa doubles research output over past decade, moves towards a knowledge-based economy.' *Research Trends*, (35), pp.11–12.
Sife, A. et al., (2014).' Publication productivity and scholarly impact of academic librarians in Tanzania.' *New Library World*, 115(11/12), pp.527–541.
Sife, A. & Bernard, R.B; (2016) 'Scientometric Portrait of Prof. Rudovick R. Kazwala: A Public Health Veterinarian.. *International Journal of Library and Information Studies*, 6(1) pp.63 – 76.
Sife, A.S. A. et al., (2013) 'Research productivity and scholarly impact of forestry researchers at Sokoine University of Agriculture: A bibliometric Analysis.' *Journal of Continuing Education and Extension (JCEE)*, 4(2) pp.261–278.
The Citizen Magazine, (2016)Industrial policy execution Tanzania's big challenge. http://mobile.thecitizen.co.tz/news/Industrial-policy-execution-TZ-s-big-challenge/2304482-3188448-format-xhtml-12cb5m7z/index.html [Accessed November 15, 2016].
The United Republic of Tanzania(2010) The National Research and Development Policy http://drp.muhas.ac.tz/Documents/Research_Information/The National Researc h and Development Policy.pdf.[accesssed 15 May 2017]
Toivanen, H. & Ponomariov, B.(2011) 'African regional innovation systems: Bibliometric analysis of research collaboration patterns 2005-2009.' *Scientometrics*, 88(2) pp.471–493.
United Nations (2015) Sustainable development goals.

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