

A BIBLIOMETRIC STUDY OF RESEARCH ON DAR ES SALAAM REGION: 1980 TO 2003

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Abstract

This bibliometric analysis examines research trends on Dar es Salaam region from 1980 to 2003. The study was carried out using CD-ISIS based Regional Bibliographic Database, hosted by the University of Dar es Salaam Library. The findings of the study show that: literature on Dar es Salaam is increasing exponentially; Medicine, Social Science and Humanities are the most productive disciplines; large proportion of research 1076 (62.8%) is unpublished; 58.8 % of authors are male, 32.19% are female; generally there is low level of authors' productivity and collaboration. New emerging research areas are: gender and women studies, electrical engineering, hydraulic engineering, mining engineering and geology. The study makes the following recommendations: researchers should be encouraged to publish their research findings in local and international journals; there is a need to mainstream gender in research in order to promote female researchers; research institutions should encourage multidisciplinary research and collaboration among researchers and more research need to be conducted on prevailing social problems in Dar es Salaam region.

Introduction

In Tanzania, the lack of national research policy, weak national support, inadequate human resources and poor funding limit effort to develop strong research base for national social and economic development in country (Luhanga et al, 2003; UDSM, Directorate of Planning and Development, 2004). However, Tanzania is one of the most intensively studied countries in Africa. Literature produced about Tanzania, either locally or outside the country, runs into thousands of references (Darch, 1985). Additionally, there has been a rapid growth of research and academic institutions in the country. Currently there are five public universities, five constituent colleges, fourteen private universities and six intermediate learning institutions. These developments are among indicators of increasing number of researchers and research outputs in the country.

Although there are a growing number of research and academic institutions in Tanzania, little is known about the characteristics and extent to which literature has been generated over the years. Academicians, students and other interested parties experience difficulties in identifying publications that exist (Nyika and Francis, 1999) and the nature of research that have been carried out. There is

a gap in understanding the extent, nature and trends of research conducted on Dar es Salaam in various scientific disciplines. This paper therefore, contributes to the generation of knowledge on the nature and characteristics of research produced in Dar es Salaam. Its main objective is to analyze trends in the production of knowledge on Dar es Salaam region. Specifically, it identifies institutions involved in research on Dar es Salaam region; examines the rate of production of literature and knowledge, research output, research gaps and emerging research areas on Dar es salaam region.

Literature Review

Bibliometrics as research area dates back to 1913, when Auerbach conducted a study on the hyperbolic relationship between the rank and the size of German cities, an idea which later on was used by Zipf to develop Zipf's Law of author's richness in vocabulary (Rousseau, 2002). The development of Information and Communication Technology (ICT), particularly the use of internet as a tool for storage, retrieval and dissemination of information, has brought tremendous changes in the field of bibliometrics. These include the emergence of new sub-fields such as Infometrics; Webmetric or Cybernetics, Scientometrics and Missiometrics.

Research performance for both individual researchers and institutions can be evaluated using two major methods. The first method is that of comparing research outputs with resources that have been invested in the process of production of research and measuring the impact of research produced in the real world, particularly betterment of people's welfare. Among the studies which have been conducted using this method include those of Ocholla (2000) and Afolabi (1997). Ocholla (2000) examines the overall research potential and capacity in the field of Library and Information Science in South Africa. The study analyzed gender, race and level of education of authors. It found that 82% of all research are master degree studies and that 58.7% of all masters and doctoral researchers are female. The study also revealed that 15.6% of all researchers were black. Afolabi (1997) examined the institutional research outputs of archive and records management theses in Nigerian universities. It was found that the University of Ibadan was the most productive.

Evidences from literature show that citation analysis is the most widely focused area of bibliometrics. Citation analysis is used in

identifying core journals in a collection and determining obsolescence of literature, access and use of information (Dulle et al 2003; Okiy, 2003; Gomez, 2002; Gooden, 2001; Aina and Mabawonku, 1996). Citation analysis is described as machinery behind journal "impact factors." In principle citation analysis assumes that influential scientists and important works are cited more often than others (Meho, 2007). Although citation analysis is described as the best method to judge the validity of a scientific claim, there are a number of weaknesses that critics of this technique identify. For example Meho (2007), pointed out a number of weaknesses of citation analysis such as the problem of "homographs", characterized by failure to separate citations to two unrelated scientists who happen to share the same last name and first initial, cronyism, whereby friends or colleagues reciprocally cite each other to mutually build their citation counts, self citations and ceremonial citations whereby an author cites an authority in the field without ever having consulted the relevant work itself; and negative citations pointing out incorrect results. Meho (2007), however, argues that proponents of citation analysis claim that these problems are relatively insignificant because most citations found in articles and books are useful. Citations, they claim, pay homage to pioneers, identify original publications; provide background readings and alert readers to forthcoming works.

Another area of interest in bibliometrics analysis is the characteristics of research and researchers. Variables used to determine the nature and characteristics of research and researchers include; forms of literature, gender of researchers, nature and extent of collaboration among researchers, level of education of researchers, language, age of literature and ethnic or racial composition of authors. Several studies have examined authorship patterns from gender perspective. Studies (Koehler et al, 2000; Atinmo and Fimba, 2002) found that there is a predominance of male over female authors. However, findings by Cronin, Martinson and Davenport (1997) found that women authors constitute 90% of all authors in women studies.

Collaboration among authors is defined in terms of co-authorship (Katz and Martin, 1997). The weakness of using co-authoring as a metric for collaboration among authors is that not all authors mentioned in a paper are responsible for the work. Sometimes collaboration is purely for social reasons such as friendship Katz and Martiin (1997). Studies (Fimba and Atinmo, 2002; Al-Ghamdi et al, 1998; Aina and Mabawonko, 1997) found that single authored papers dominate. Fimba and Atinmo (2002) noted that female authors are more likely to co-publish, both in mixed gender research

teams and in single gender research teams than their male counterparts. Attempts have been made to compare degree of collaboration and nature of discipline. Cronin, Martinson and Davenport (1997) associate degree of collaboration with the level of maturity of a field and researching on complex issues. Subramanyan (1993) cited by Harande (2001) argues that there is a more opportunity for researchers to collaborate in natural sciences than in social sciences or humanities.

Numerous studies have used bibliometric laws and theories to guide research and strengthen research findings, research methodologies and to test the validity of these laws. These studies include those of Mmahapatra (1985) who examined the validity of the theory of exponential growth of scientific literature on plant physiology in India. The study reveals that there has been an exponential growth of literature on plant physiology from 51 research entries in 1951 - 1955 to 2707 research entries in 1976 - 1980. Zenebe (1994) used Bradford and Lotka's laws to examine productivity patterns of authors and journals in literature on Ethiopian studies. The author found that Lotka's law fits the distribution pattern of authors' productivity. The study also found that Bradford's law is applicable to the distribution of journal articles within different journals in Ethiopian literature.

Rowlands (2005) used Lotka's law to examine the likelihood of authors to return to a particular publisher and revealed that authors' productivity distribution described in Lotka's law could also be used to determine authors' probability to return to a publisher. Newby et al (2003) cited by Rowlands (2005) used Lotka's law to examine the productivity of software developers in open software system. The author found that the law can be used to explain productivity among software developers. The most commonly used laws in bibliometric studies are Lotka's Law of Authorship productivity, which describes the productivity of an author based on number of articles published (Taher, 1997) and Zipf's Law which is used to measure author's richness in vocabulary and in the construction of a controlled vocabulary subject index, and Bradford's Law of Scattering or Distribution of articles in journals that is used for identifying core journals.

It has been argued that bibliometric is a neglected area in various curricula including the field of Library and information science (Womell, 2001). Despite its importance in books and serials acquisition, analysis of library use patterns and weeding of less used materials, in practice librarians seldom use bibliometric methods (Sternberg, 1995). There is also a low rate of research output in

bibliometrics (Ochalla, 2000; Rios, 1995). This has been associated with lack of formal training, particularly in higher learning institutions (Ochalla, 2000) and inaccessibility to complete, reliable, normalized, and indexed information (Rios, 1995).

In Africa, bibliometric research method has not been widely used. In Tanzania for example, few studies (Kiondo, 2003; Dulle et al., 2003; Manda, 2002; Eftemeijer and Semesi, 2001; Walsh and Swilla, 2000) have been done. However, these studies do not reflect the magnitude of research that has been conducted in the country. Also, they focus to specific subject areas, using published sources only although a large proportion of research in Africa is unpublished.

Research Methodology

A quantitative bibliometric research method was used in this study to quantify properties and behaviors of written human knowledge. The main source of data for this study was the computerized Regional Bibliographic Database of Dar es Salaam region compiled under the auspices of the local content development project of the University of Dar es Salaam Library. A purposive sampling method was used in selecting the units of analysis. A total of 1715 bibliographic records were selected in the database to form the sample. A comprehensive survey of various relevant sources of information was done for the purpose of collecting secondary data for the study. Data was collected for both published and unpublished sources of information in a variety of formats. Two classification scheme manuals namely Library of Congress and Dewey Decimal Classifications were used to identify the disciplines of the records in the Database. Statistical Package for Social Science (SPSS) and MS Excel were used in data analysis.

A pilot study was conducted prior to the main field work to test the reliability and validity of research instruments. The findings obtained from the data collected are presented using frequencies, charts, tables and descriptions.

Findings and Discussion

Research institutions

The findings of the study revealed that there are 22 local and international research institutions that are actively involved in research on Dar es Salaam region. (See table 1 for details). A total of 159 (9.3%) entries did not show institutional affiliation of authors.

**Table 1: Institutions involved in research on Dar es Salaam
N=1715)**

No.	Name of institution	Frequency	Percent	Ranking
1	University of Dar es Salaam	708	41.3	1
2	Muhimbili University Collage of Health Science	393	22.9	2
3	University Collage of Land and Architectural Studies	159	9.3	3
4	No institutions identified	159	9.3	3
5	Other International Institutions	67	3.9	4
6	Medical association of East Africa	51	3.0	5
7	College of business Education (CBE)	52	3.0	5
8	Social Warfare Training Institute DSM	20	1.2	6
9	REPOA	13	.8	7
10	Mzumbe University (Former IDM)	13	.8	7
11	Sokoine University of Agriculture (SUA)	12	.7	8
12	Tanzania Chemical Society	11	.6	9
13	United Nations Organizations	10	.6	9
14	Government ministries and agencies	8	.5	10
15	Social Warfare Training Institute of -DODOMA	7	.4	11
16	Centre for Energy	7	.4	11
17	Wild Conservation	5	.3	12
18	Institution of Engineers	4	.2	13
19	TAWLA	3	.2	13
20	ESRF	3	.2	13
21	TAMWA	4	.2	13
22	Friedrichbert-Dar es Salaam	2	.1	14
23	TIRDO	2	.1	14
24	National Institute of Transport	1	.05	15
25	East African Medical Research	1	.05	15

Source: Data extracted from regional bibliographies database, 2005

Results show that majority of entries 1295 (75.5%) on Dar es Salaam are produced by institutions of higher learning and 708, (41.3%) are from the University of Dar es Salaam, Muhimbili University College of Health Sciences with 393 (22.9%) entries and University College of Land and Architectural Studies with 193 (9.3%). These findings are similar to those by Pouris (2005) who found that higher education sector in South Africa accounts for more than 80% of South African visible research output.

There are a number of factors that are associated with high research productivity in higher learning institutions. These include the fact that research is among the core mission of higher learning institutions, ranking of institutions and promotion of academic staff. Other factors are availability of research funding in higher learning institutions, availability of publication outlets and increasing enrolment of students in higher learning institutions.

Rate of growth of literature on Dar es Salaam

The study found that research output on Dar es Salaam is growing exponentially. This growth is probably explained by the increasing number of research institutions, funding agencies and researchers.

The findings show that social science and humanities have contributed 50.67% of all research output (see table 2). Medicine is the second most productive discipline with 34.16%. Technology and engineering contributed 9.56%, Science 5.01% and Agriculture 0.6%. Possible explanation for the high rate of research output in social sciences and humanity is the fact that this discipline is varied in terms of number of subjects, hence large number of researchers and research output. This was also observed by Price (1958) who noted that the amount of published research in any field is directly proportional to the number of researchers engaged in research. High level of research productivity in medicine is associated with high rate of authorship productivity, availability of many publications outlets such as scholarly journals, scientific conferences and professional associations, including The Medical Association of Tanzania, The Association of Surgeons, The National Institute of Medical Research, The Pediatrics Association and The Dar es Salaam Medical Student Association.

Table 2: Growth of literature in major disciplines

S/No.	Discipline	Frequency	Percent	Ranking
1	Social Science and Humanities	869	50.67	1
2	Medicine	586	34.16	2
3	Engineering and Technology	164	9.56	3
4	Science	86	5.01	4
5	Agriculture	11	0.6	5

Source: Data extracted from the Regional Bibliographies Database, 2005

Forms of literature

The study found that masters and doctoral theses and dissertations are the dominant forms of literature produced on Dar es Salaam, accounting for 29%. Other forms include: postgraduate diploma and undergraduate research papers which accounted for 27.8%, journal articles 22.9%, workshop and conference proceedings 8.9%, research reports 6% (see details on table 3). 62.8% of research on Dar es Salaam is unpublished. These findings correspond with the findings by Kiondo (2002); who analyzed trend of production of knowledge on the non profit sector in Tanzania and revealed that most of research in the non profit sector is unpublished. This trend is mainly associated with the limited number of local publication outlets and difficulties researchers face in publishing in international or local journals. Table 3 below shows frequency and percentage distribution of different forms of literature.

Table 3: Forms of literature (N=1715)

S/No	Form of Literature	Frequency	Percent	Ranking
1	Masters and Doctoral thesis /dissertations	497	29.0	1
2	Undergraduate and Postgraduate Diploma research papers	476	27.8	2
3	Conference papers	152	8.9	4
4	Books and book chapters	37	2.2	6
5	Technical Reports	28	1.6	8
6	Monographs	29	1.7	7
7	Journal articles	393	22.9	3
8	Research reports	103	6.0	5

Source: Data extracted from regional bibliographies database, 2005

Sex of authors

With the exclusion of corporate authors and authors whose sex were not identified a total of 1756 authors were identified from the database. Findings revealed that male dominate research on Dar es Salaam and 64.6 percent of all research has been conducted by men. This probably is more of a reflection of the dominance of the educational system in Tanzania by men in terms of numbers. The findings of this study correspond with those of Atinmo and Fimba, 2002 and Koehler et al, 2000 who found that research is a male dominated activity. Table 4 below presents distribution of sex of authors.

Table 4: Sex pattern of authors (N=1756)

S/No	Gender	Frequency	Percent	Ranking
1	Male	1135	64.6	1
2	Female	621	35.4	2

Source: Data extracted from the Regional Bibliographies Database, 2005

Authorship collaboration

In this study collaboration was strictly defined to mean co-authorship. To eliminate bias in the analysis of authorship collaboration, undergraduate research reports, theses and dissertations were left out because in most cases these are single authored by policy in Tanzania. A total of 742 articles were used in the analysis of authorship collaboration. The findings revealed a low degree of collaboration among researchers. Medicine is the only discipline with high rate of collaboration, where out of 742 documents, Medicine accounted for 254 researches, of which 215 items (84.6%) were co-authored. This pattern could be associated with the fact that medicine is interdisciplinary in nature, hence encourage teamwork research. Other factors include: availability of many peer-reviewed journals, academic and professional associations and conferences. Science is the second most collaborative discipline with 42.5% of co-authored research. Over 70% of research in Engineering and Technology, Social Science and Humanities and Agriculture is single authored.

Table 5: Trends in authorship collaboration (N=742).

Discipline	Science		Technology and Engineering		Medicine		Agriculture		Social Science and Humanities	
	Frequency and %		Frequency and %		Frequency and %		Frequency and %		Frequency and %	
Single	42	57.5%	72	83.7%	39	15.4%	9	81.8%	289	93.8%
Double	17	23.3%	9	10.5%	84	33.0%	0	0%	15	4.9%
Multiple	14	19.2%	5	5.8%	131	51.6%	2	18.2%	4	1.3%

Source: Data extracted from regional bibliographies database, 2005

Authorship productivity

The study revealed that there are generally a small number of prolific researchers. Only 42 prolific researchers were identified and 69.0% of these are from medicine. Other disciplines have demonstrated low rate of authorship productivity. Table 5 above presents data on degree of authorship collaboration across disciplines.

Less productive research areas and emerging research areas on Dar es Salaam

Two approaches were used to identify less productive subjects. The first approach was analyzing the current socio-economic problems in Dar es Salaam and examine the extent to which those problems have been addressed by researchers. This approach shows that research activities should be directed at social and economic problems emanating from HIV/AIDS, street children, public transport problems, poverty, water supply and sanitation and power and energy supply.

The second approach was that of relying on the rate of production of literature in different subjects as shown in the database. Different subjects were identified to have made little contribution to the generation of knowledge on Dar es Salaam. These subjects are: chemistry, astronomy, mathematics, physics and geology, electrical

engineering, mining engineering, chemical engineering, manufacturing and handcraft. Others include; dermatology, pathology, horticulture and gardening, aquaculture, animal culture, history, psychology, archeology. Statistics, performing arts, Journalism and Mass communication

Analysis of trends on production of knowledge on Dar es Salaam, show that the subjects of gender and women studies, electrical engineering, hydraulic engineering, mining engineering and geology have attracted a number of researchers in recent years. These subjects have provided new areas for researchers to explore different social, scientific and technical research problems.

Conclusions and recommendations

Conclusions

Based on the research findings, the following conclusions are made. Research on Dar es Salaam is growing exponentially where the growth of the research is explained by increased number of research institutions, funding agencies and researchers. Bulk of research conducted on Dar es Salaam is unpublished because of the lack of enough publication outlets and a lack of motivation among researchers to publish their research findings. Collaborative research is a key ingredient to both research productivity and research quality. Research collaboration is a result of multiple factors such as availability of publication outlets, nature of discipline under inquiry and institutional research policy. Lack of enough publication outlets and research policy that encourage interdisciplinary research has contributed to the limited collaboration among researchers.

Recommendations

Based on the findings and conclusions from this study, the following recommendations are made:

- Publish a comprehensive and up-to-dated bibliographic database of research on Dar es salaam make researchers keep abreast of what has been researched
- Increase the visibility of research findings on Dar es salaam by encouraging researchers to publish their research findings in local and international journals and in this long run this might improve the quality of research.
- Increase the number of women academicians in the higher learning and research institutions.

- Increase research funding for multidisciplinary research so as to encourage collaboration among researchers. This will increase the quality of research outputs and ensure that even junior researchers get opportunity to share experiences with senior researchers.
- Increase funding for research on current social problems in Dar es Salaam such as poverty, HIV/AIDS, street children, public transportation, urban planning, prostitutions, robbery, water supply and sanitations, energy and power supply.

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