SCIENTOMETRIC MAPPING OF VETERINARY RESEARCH AT SOKOINE UNIVERSITY OF AGRICULTURE, TANZANIA

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Abstract

A scientometric analysis was conducted to examine the research productivity of veterinary scientists at the Sokoine University of Agriculture from 1984 to 2015. Data on publications, citations and related metrics for 97 scientists were retrieved using the Publish or Perish software. A total of 2,392 publications were recorded for all veterinary scientists, giving an average of 74.75 publications per year. The whole study period recorded the mean RGR and Dt of 2.10 and 0.36 respectively. The rate of growth of publications increased while the corresponding doubling time deceased. A great majority (2304; 96.3%) of the publications were multiple-authored with over one third (891; 37.2%) of these being jointly contributed by six or more authors. The degree of collaboration among scientists was 0.96. The maximum number of citations received in a single publication was 530. The top 25 ranked veterinary researchers showed considerable variation in various metrics. Veterinary scholars at SUA published their research findings in 241 different journals during the period between 1984 and 2015.

Keywords: scientometrics, veterinary science, research productivity, Tanzania

INTRODUCTION

Veterinary research plays an important role in understanding animal health, diseases, production and behaviour. The research helps to protect both animal and human health by ensuring food security and safety, preventing and controlling emerging infectious zoonoses, protecting environments and ecosystems, contributing to bioterrorism and agroterrorism preparedness, advancing treatments and controls for non-zoonotic diseases (Pappaioanou 2004). Furthermore, veterinary research also leads to the production of biologicals such as vaccines and drugs for animal and human health, designing of technologies for animals, identification of infectious agents, surveillance for emerging and re-emerging pathogens and diseases as well as development of comparative medicine

where animal models inform advances in human medicine. Veterinary scholars also conduct research to meet promotion and tenure demands of their institutions as well as contributing to the body of literature and knowledge.

Evaluation on research productivity and impact of researchers is often conducted to understand the growth and development of research and to know research efforts of institutions and career progression of individual scientists. In universities and research institutes, evaluations on research productivity support decisions such as recruitment, promotion, rewards, workload and resource allocations. Traditionally, the number of publications produced in a given period of time has been used as a research productivity indicator. According to Bureau (1988), a written work is the most important visible proof of research productivity. On the other hand, the impact of those publications is often measured by how many times they are cited. Nevertheless, a use of indicators such as the Hirsch's h-index and its variants that combine different aspects of research output is increasingly being recommended (Costas and Bordons 2007).

The Hirsch's h-index combines the effects of quantity (number of publications) and quality (number of citations) and it is defined as the maximum number of papers h by a scientist where each paper has received h or more citations (Hirsch 2005). Egghe (2006) introduced g-index that gives more weight to highly cited publications. Sidiropoulos et al. (2007) developed Hc-index in order to add an age-related weight to each cited article by giving less weight to older articles. Furthermore, since the number of citations a publication receives can be influenced by the number of authors, the HI-norm index offers a better approximation of the author's impact (Braun, Glänzel, and Schubert 2006). In general, the h-index and its variants favor those authors who produce a series of influential papers (Kelly & Jennions 2006).

Scientometrics is quantitative method used in the analysis of science techniques and it is an important tool in evaluating research productivity of individuals (Nalimov and Mulchenko 1969). Advances in information technologies have led to creation of large databases from which publication and citation data are retrieved. The Publish or Perish (PoP) software, released in 2006, uses Google Scholar to retrieve the number of publications and sources which cite them. PoP also produces descriptive statistics of individual authors including the total number of publications, citations, number of citations per year, total citations per paper, total citations per author, and total papers per author. It also calculates several indices including the h-index, g-index, Hc-index and HI-norm index (AW Harzing 2008). Comparative studies indicate that PoP retrieves more publications and citations through Google scholar compared to others such as Web of Science and Scopus (Saad 2006; Bar-Ilan 2008).

In Tanzania, studies on research productivity of individuals and institutions are scarce. The few available studies in the country have focused on the research productivity of forestry researchers (Sife et al. 2013), traditional medicine scholars (Lwoga and Sife 2013) and academic librarians (A. S. Sife and Lwoga 2014). There has not been any scientometric study focusing on research output of veterinary scientists in the country. Consequently, not much is known about research productivity of veterinary scholars at various levels in the country. The present study therefore analyzed the research productivity of veterinary scientists at Sokoine University of Agriculture (SUA) from

1984 to 2015. This 32-years period was chosen for the purpose of getting insights about developments in veterinary research since the establishment of SUA in 1984. The specific objectives of the study were to analyze the growth of veterinary literature; determine the collaboration patterns among veterinary scientists; establish citations trends; determine the productivity of individual scientists; and assess the journal preference.

AN OVERVIEW OF VETERINARY RESEARCH AT SUA

Veterinary research in Tanzania can be traced back to the start of veterinary education in East Africa at Makerere College in 1942. In 1972, this veterinary school shifted from Uganda to Kenya. In 1976, the Division of Veterinary Science was established under the Faculty of Agriculture and Forest of University of Dar es Salaam. After establishment of SUA in 1984, the Division of Veterinary Science was elevated to the Faculty of Veterinary Medicine. Currently, this Faculty offers two bachelor degrees (i.e. Bachelor of Veterinary Medicine and the Bachelor of Science in Biotechnology and Laboratory Science), numerous postgraduate degrees and diploma programs in animal health and laboratory technology. The Faculty undertakes a range of basic and applied research in the field of infectious and non-infectious diseases, livestock productivity, risk assessment, morphological studies, animal reproduction, toxicology, natural products and ecosystem health (SUA 2015). At present, SUA is the only university in the country with a high number of veterinary scientists and a dedicated faculty dealing with veterinary sciences.

METHODS

This scientometric analysis was conducted for two weeks between 17th and 30th August 2015. This short period was important because online publications and citations keep on accumulating rapidly. The names of all faculty members were obtained from their respective departments and efforts were made to get the names of those who worked with the Faculty for different periods between 1984 and 2015 but had left for various reasons. In total, 97 faculty members were identified for this study. Analysis of all 97 faculty members was conducted for the 32-years period by using the PoP software. This particular software was used because it retrieves data through Google Scholar which has broader coverage than other databases such as ISI and Scopus (Anne-wil Harzing 2013).

A search strategy was developed including all authors' names and their possible variants and each individual scholar was searched through PoP to determine their statistics. Search results were carefully refined to ensure that only works of intended persons were captured whereas duplicates and publications from homonym authors were removed. Unclear publications were re-searched via Google scholar to verify whether they were actually written by those particular authors. Scholarly publications considered in this study were journal articles, books, book chapters and conference papers. For each scholar, the retrieved metrics included the total number of authors for each publication, total publications, total citation counts, average citations per paper, average citations per year, h-index, g-index, Hc-index and the HI-norm. The present study utilized data that were publicly available online.

RESULTS AND DISCUSSION

Publications Productivity of Veterinary Scholars

A total of 2,392 publications were retrieved for all 97 veterinary scientists at SUA during the period between 1984 and 2015. This number is based on the "[1]total or normal counting method" whereby each author receives a full count for joint publications. Of the 2,392 publications, majority (2,171; 90.76%) were journal articles followed by articles in conference proceedings (207; 8.65%), book chapters (11; 0.46%) and books (3; 0.13%). The average number of publications per year was 74.75 with the years 1984 and 2014 having the lowest (12; 0.5%) and highest (182; 7.6%) number of publications respectively (Table 1). It should be noted however that these publication data were extracted in August 2015; hence the total productivity of 2015 might be incomplete.

The growth of publications was also analyzed on the basis of the Relative Growth Rate (RGR) which is the increase in the number of articles per unit of time using the formula $RGR = (\ln N_2 - \ln N_1) / (t_2 - t_1)$ where N2 and N1 are the cumulative number of publications in the years t_2 and t_1. The study findings in Table 1 and Fig. 1 indicate that RGR had been increasing from 0.54 (1985) to 2.99 (2011) with some fluctuations in the years in-between. Similarly, the mean RGR for the block periods of eight years increased from 1.07 (1984 – 1991) to 2.77 (2008 - 2015). The period of time required for publications to double is known as Doubling Time (Dt) and it is related to RGR in that if the number of articles double then the difference between the logarithms of numbers at the beginning and end of that period has a value of 693. Dt is calculated as Dt = 0.693/RGR (Mahapatra 1994). Dt showed a decreasing trend from 1.28 (1985) to 0.24 (2015) with some fluctuations in the years in-between. Likewise, the mean Dt for the block periods of eight years decreased from 0.58 (1984 – 1991) to 0.25 (2008 - 2015). The whole study period records the mean RGR and Dt of 2.10 and 0.36 respectively. The findings therefore indicate that the publications productivity of veterinary scholars at SUA had increased over the period of 32 years.

ear	No of publications	Cumulative publications	$\ln N_1$	$\ln N_2$	RGR	Mean RGR	Dt	Mean Dt
1984	12	12	-	2.48	-		-	
1985	17	29	2.83	3.37	0.54		1.28	
1986	26	55	3.26	4.01	0.75		0.92	
1987	16	71	2.77	4.26	1.49	1.07	0.47	0.58
1988	27	98	3.30	4.58	1.28		0.54	
1989	26	124	3.26	4.82	1.56		0.44	
1990	38	162	3.64	5.09	1.45		0.48	
1991	50	212	3.91	5.36	1.45		0.48	
1992	36	248	3.58	5.51	1.93	1.99	0.36	0.36

[1]There are three methods of counting the number of publications: (1) Total or normal counting method that involves assigning every author a weight for each of the publications. (2) Straight counting that involves assigning only the first author a weight for each of the publications. (3) Fractional counting that involves assigning every author a weight 1/n in an n-authored paper (Egghe, 1993; Lindsey, 1980).

1993	37	285	3.61	5.65	2.04		0.34	
1994	70	355	4.25	5.87	1.62		0.43	
1995	44	399	3.78	5.99	2.21		0.31	
1996	84	483	4.43	6.18	1.75		0.40	
1997	107	590	4.67	6.38	1.71		0.41	
1998	113	703	4.73	6.56	1.83		0.38	
1999	46	749	3.83	6.62	2.79		0.25	
2000	68	817	4.22	6.71	2.49		0.28	
2001	60	877	4.09	6.78	2.69		0.26	
2002	70	947	4.25	6.85	2.60		0.27	
2003	72	1019	4.28	6.93	2.65	2.59	0.26	0.27
2004	55	1074	4.01	6.98	2.97		0.23	
2005	95	1169	4.55	7.06	2.51		0.28	
2006	137	1306	4.92	7.17	2.25		0.31	
2007	109	1415	4.69	7.25	2.56		0.27	
2008	107	1522	4.67	7.33	2.66		0.26	
2009	123	1645	4.81	7.41	2.6		0.27	
2010	91	1736	4.51	7.46	2.95		0.23	
2011	92	1828	4.52	7.51	2.99	2.77	0.23	0.25
2012	107	1935	4.67	7.57	2.90		0.24	
2013	140	2075	4.94	7.64	2.70		0.26	
2014	182	2257	5.20	7.72	2.52		0.28	
2015	135	2392	4.91	7.78	2.87		0.24	
	2392				**2.10**		**0.36**	

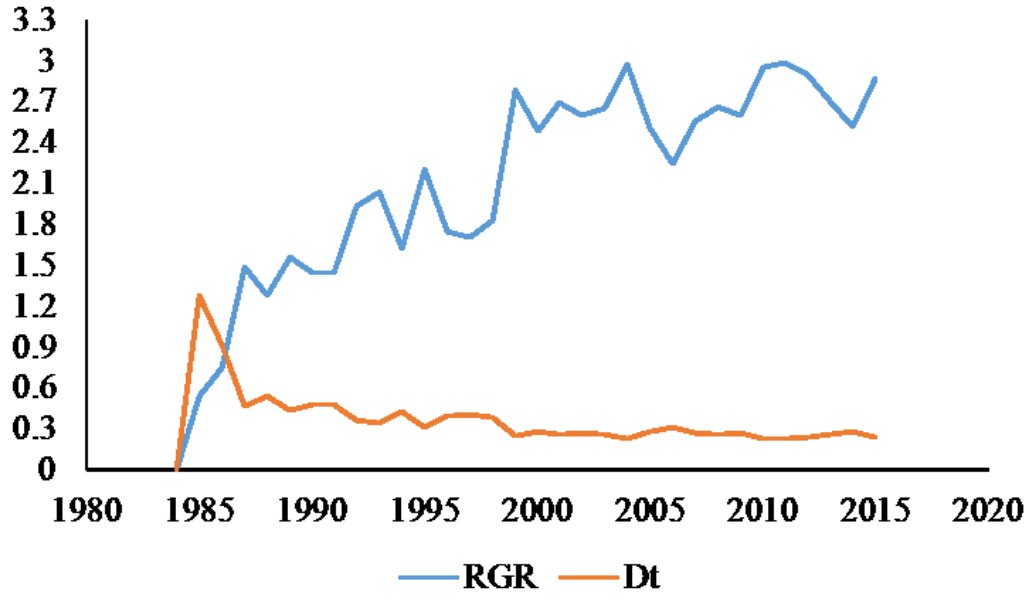

Figure 1: Growth Rate and Doubling Time

Collaboration Patterns among Veterinary Scholars

The study findings show a domination of multiple authorship (2304; 96.3%). Over one third (891; 37.2%) of the publications were jointly contributed by six or more authors whereas only 88 (3.7%) publications were single authored (Table 2). An article titled "Capacity building efforts and perceptions for wildlife surveillance to detect zoonotic pathogens: comparing stakeholder perspectives" published in 2014 in *BMC Public Health* has as many as 103 authors in the byline. The ratio of team work to that of sole work was 26:1 and the average degree of collaboration computed as the ratio of the total number of collaborative publications to the total number of publications (Subramanyan 1983) was 0.96. The lowest collaboration coefficient was 0.75 in the year 1987 and maximum was 1.0 in the years 1999, 2012 and 2013. All these point towards a very high level of collaboration in research. Arya (2012) has also reported a dominance of multi-authored papers (95.55%) with a high degree of collaboration in the field of veterinary medicine in India. Preference to high levels of teamwork can be attributed to the fact that veterinary research is increasingly interdisciplinary in nature and hence it calls for scientists to put in their diverse expertise collectively. Research teams could be in form of teacher-student collaboration, collaboration among colleagues, supervisor-assistant collaboration, researcher-consultant collaboration and collaboration among institutes (Subramanyan 1983).

Year	Number of publication by number of authors							Collaboration coefficient
	Single author	Two authors	Three authors	Four authors	Five authors	≥6 authors	Total	
1984	1	1	9	0	1	0	12	0.92
1985	1	5	7	3	0	1	17	0.94
1986	2	8	7	6	2	1	26	0.92
1987	4	3	3	6	0	0	16	0.75
1988	6	8	9	3	0	1	27	0.78
1989	5	6	8	6	0	1	26	0.81
1990	7	11	10	6	1	3	38	0.82
1991	4	26	11	4	3	2	50	0.92
1992	6	10	9	5	3	3	36	0.83
1993	6	5	14	7	2	3	37	0.84
1994	2	8	21	29	5	5	70	0.97
1995	2	12	3	13	8	6	44	0.95
1996	1	18	22	25	8	10	84	0.99
1997	5	9	21	37	13	22	107	0.95
1998	1	9	15	40	17	31	113	0.99
1999	0	1	6	15	4	20	46	1.00
2000	1	3	13	19	9	23	68	0.99
2001	2	1	7	9	15	26	60	0.97
2002	1	4	10	16	11	28	70	0.99
2003	3	2	7	14	6	40	72	0.96
2004	2	1	6	4	8	34	55	0.96
2005	1	0	8	10	16	60	95	0.99
2006	2	3	10	21	39	62	137	0.99

2007	2	4	6	11	24	62	109	0.98
2008	1	7	29	13	17	40	107	0.99
2009	6	5	23	30	12	47	123	0.95
2010	5	9	16	21	10	30	91	0.95
2011	4	8	11	15	15	39	92	0.96
2012	0	18	7	9	17	56	107	1.00
2013	0	6	19	27	24	64	140	1.00
2014	4	4	22	22	27	103	182	0.98
2015	1	4	13	10	39	68	135	0.99
Total	**88**	**219**	**382**	**456**	**356**	**891**	**2392**	**0.96**
Percent	**3.68**	**9.16**	**15.97**	**19.06**	**14.88**	**37.25**	**100**	

Citations Trends of Individual Publications

Highly cited publications were identified as those which have received at least 100 citations each and only 11 publications met this criterion. The maximum number of citations was 530 for the paper titled "A canine distemper virus epidemic in Serengeti lions (*Panthera leo*)" published in *Nature* in 1996. The newest article in this group was "Insulin resistance and cancer: the role of insulin and IGFs" published in *PLoS Endocrine-Related Cancer* in 2013 which had been cited 53 times (Table 5). These findings confirm the fact that citation counts depend on many factors including the accessibility of journals where articles are published, the age of the publication, the quality of the publication, the size of the scientific community, the number of authors and the topic which ones publishes (Bornmann and Daniel 2008).

Table 3: Highly cited journal articles

No	Title of article	Citations
1	Roelke-Parker *et. al.* (1996). A canine distemper virus epidemic in Serengeti lions (*Panthera leo*). *Nature*	530
2	Stenseth *et. al.* (2003). Mice, rats, and people: the bio-economics of agricultural rodent pests. *Frontiers in Ecology and the Environment*	144
3	Meerts *et. al*. (2006). Correlation between the presence of neutralizing antibodies against porcine circovirus 2 (PCV2) and protection against replication of the virus and development of PCV2-associated disease. *BMC Veterinary Research*	134
4	Chessa *et. al*. (2009). Revealing the history of sheep domestication using	130

	retrovirus integrations. *Science*	
5	Ahmed *et. al.* (2006). Multilocus sequence typing method for identification and genotypic classification of pathogenic Leptospira species." *Annals of clinical microbiology and antimicrobials*	125
6	Assey *et. al.* (1994). Oocyte morphology in dominant and subordinate follicles. *Molecular reproduction and development*	117
7	Greve *et. al. (1995).* The effects of exogenous gonadotropins on oocyte and embryo quality in cattle. *Theriogenology*	107
8	Lembo *et. al.* (2010). The feasibility of canine rabies elimination in Africa: dispelling doubts with data. *PLoS Negleccted Tropical Disieases*	107
9	Gwakisa *et. al.* (1994). Characterization of Zebu cattle breeds in Tanzania using random amplified polymorphic DNA markers. *Animal genetics*	102
10	Scott *et. al.* (1995). An epidemiological study of Cryptosporidium parvum in two herds of adult beef cattle. *Veterinary parasitology*	100
11	Malago *et. al.* (2002). The heat shock response and cytoprotection of the intestinal epithelium. *Cell stress & chaperones*	100

Productivity and Scholarly Impact of Individual Authors

The study findings in Table 4 indicate various productivity and impact measures of the top 25 ranked veterinary scholars at SUA. These top 25 ranked veterinary scholars together contributed nearly two thirds (1498; 62.6%) of all publications with an average of 57.6 publications per author. These findings support the Lotka's Law of scientific productivity which postulates that large proportions of authors tend to produce relatively few articles, with the bulk of production being made by a small number of individuals (Lotka 1926). These top 25 ranked veterinary researchers showed variation among productivity and impact measures since no single scholar maintained the same rank in all metrics. Hence, these findings support the argument that research performance is a

complex multifaceted endeavour that cannot be assessed using a single indicator (Smith & Katz 2000).

With respect to the number of publications, D.M. Kambarage was the most prolific author (120 publications) followed by R.R. Kazwala (111 publications) and E.D. Karimuribo (96 publications). When re-ranked based on citation counts, Kazwala ranked the first (2066 citations) followed by A.A. Kassuku (1279 citations) and Kambarage (1169 citations). In this case, some of the top scholars in terms of publications had fewer citations compared to some scholars with fewer publications. For example, B.M. Mutayoba with 59 publications moved up from tenth to the fourth place with 1041 citations. In terms of researchers' yearly impact, Kazwala ranked number one (82.64 cites per year) followed by G. Misinzo (51.93 cites per year) and Karimuribo (49.60 cites per year). Taking into account the number of cites given to each individual publication, L.D.B. Kinabo ranked the first followed by Kazwala and Mutayoba with 21.61, 18.95 and 17.35 cites per paper respectively.

No.	Author name	No. of publications	No. of citations	Cites/year	Cites/paper	H-index	G-index	HC-index	HI-norm	Average position
1	R.R. Kazwala	111 (2)	2066 (1)	82.64 (1)	18.95 (2)	29 (1)	43 (1)	20 (1)	12 (1)	1.25
2	A.A. Kassuku	95 (4)	1279 (2)	42.63 (5)	13.14 (7)	20 (3)	34 (2)	13 (2)	9 (2)	3.38
3	D.M. Kambarage	120 (1)	1169 (3)	44.96 (4)	9.58 (13)	19 (4)	30 (4)	12 (3)	9 (2)	4.25
4	B.M. Mutayoba	59 (10)	1041 (4)	38.56 (7)	17.35 (3)	17 (5)	31 (3)	12 (3)	8 (3)	4.75
5	M.M.A. Mtambo	70 (7)	1008 (5)	38.77 (6)	13.09 (8)	21 (2)	30 (4)	10 (5)	9 (2)	4.88
6	G. Misinzo	53 (13)	779 (7)	51.93 (2)	14.70 (6)	13 (9)	27 (5)	12 (3)	8 (3)	6.00
7	R.S. Machang'u	50 (14)	840 (6)	32.31 (10)	16.15 (4)	16 (6)	27 (5)	11 (4)	8 (3)	6.50
7	E.D. Karimuribo	96 (3)	744 (8)	49.60 (3)	7.75 (15)	15 (7)	21(8)	12 (3)	6 (5)	6.50
8	P.S. Gwakisa	71 (6)	740 (9)	32.17 (11)	10.14 (11)	15 (7)	25 (6)	10 (5)	7 (4)	7.38
9	L.J.M. Kusiluka	62 (9)	609 (12)	29.00 (13)	9.82 (12)	14 (8)	23 (7)	9 (6)	7 (4)	8.88
10	R.H. Mdegela	83 (5)	539 (13)	31.71 (12)	6.82 (17)	14 (8)	20 (9)	11 (4)	6 (5)	9.13
11	L.D.B. Kinabo	31 (25)	670 (10)	23.10 (16)	21.61 (1)	12 (10)	25 (6)	5 (9)	9 (2)	9.88
12	H.A. Ngowi	44 (15)	374 (15)	34.0 (9)	8.50 (14)	11 (11)	18 (11)	10 (5)	5 (6)	10.75
13	M.N. Mgasa	40 (17)	645 (11)	23.04 (17)	16.13 (5)	8 (13)	25 (6)	3 (11)	4 (7)	10.88
14	H.E. Nonga	54 (12)	349 (17)	34.90 (8)	6.46 (18)	12 (10)	16 (13)	11 (4)	5 (6)	11.00
15	A.P. Muhairwa	37 (20)	416 (14)	20.80 (18)	11.24 (9)	12 (9)	20 (10)	8 (7)	7 (4)	11.38
16	G.K. Mbassa	68 (8)	368 (16)	12.27 (22)	5.41 (20)	11 (11)	17 (12)	5 (9)	7 (4)	12.75
17	J.J. Malago	32 (24)	348 (18)	26.77 (14)	10.88 (10)	9 (12)	18 (11)	8 (7)	1 (10)	13.25
18	P.L.M. Msoffe	42 (16)	288 (19)	16.94 (19)	6.86 (16)	11 (11)	15 (14)	8 (7)	5 (6)	13.38
19	P.N. Wambura	55 (11)	230 (20)	25.56 (15)	4.18 (21)	8 (13)	11 (16)	9 (6)	5 (6)	13.50
20	L.S.B. Mellau	36 (21)	227 (21)	12.61 (21)	6.31(19)	8 (13)	13 (15)	6 (8)	4 (7)	15.63
21	C.J. Kasanga	44 (15)	131 (23)	14.56 (20)	2.86 (25)	7 (14)	9 (18)	8 (7)	3 (8)	16.25
22	A.E. Pereka	39 (18)	132 (22)	6.29 (24)	3.30 (24)	7 (14)	10 (17)	5 (9)	3 (8)	17.00
23	D.G. Mpanduji	33 (23)	119 (25)	6.61 (23)	3.61 (22)	7 (14)	10 (17)	4 (10)	3 (8)	17.75
24	J.A. Matovelo	38 (19)	128 (24)	4.13 (26)	3.37 (23)	5 (16)	9 (18)	2 (12)	3 (8)	18.25
25	E.C.J.H. Phiri	35 (22)	100 (26)	4.76 (25)	2.86 (26)	6 (15)	8 (19)	4 (10)	2 (9)	19.00

Note: Numbers in parentheses is the scholars rank on that measure

Kazwala had the highest h-index of 29, meaning that his 29 publications had been cited 29 or more times each, and the rest of the publications had fewer than 29 citations. M.M.A. Mtambo ranked the second with the h-index of 21 followed by Kassuku with h-index of 20. When more weight is given to the authors' highly cited publications, Kazwala again ranked the first (g-index 43) followed Kassuku (g-index 34) and Mutayoba (g-index 31). When newly published works were given more weight, Kazwala once again topped the list (Hc-index 20) followed by Kassuku (Hc-index 13) whereas and the third place was shared by Kambarage, Mutayoba, Misinzo and Karimuribo each having Hc-index of 12. According to Harzing (2008), Hc-index for junior scholars is generally close to their regular h-index as most of their publications would be recent. With regard to the HI norm-index which evaluates the effects of co-authorship, Kazwala occupied the first position with HI-norm index of 12 followed by Kassuku, Kambarage, Mtambo and Kinabo with indices of 9 each. Three scholars - Mutayoba, Misinzo and R.S. Machang'u - tied up at the third position with indices of 8 each.

Overall, Kazwala ranked the first followed by Kassuku and Kambarage. It should be noted however that topping the list of researchers should not be considered that these scholars are always more prolific. Instead, these findings show how these scientists fared among others in the discipline in the period between 1984 and 2015. It should also be emphasized that ranking of researchers in this study was based on publications and citations that were available online covering the mentioned period. This means that some senior researchers could rank differently if their productivity and impacts were measured based on their career life and if offline publications and citations were retrieved.

Journal Preference

The distribution of articles in journals revealed that during the period between 1984 and 2015, veterinary scholars at SUA published their research findings in 241 different journals with 13 journals having at least 20 articles each. The Tanzania Veterinary Journal (TVJ) had 314 articles followed by the Tropical Animal Health and Production (123 articles) (Table 5). This is mainly because TVJ is the only journal that publishes veterinary sciences in the country and it is based at the faculty of Veterinary Medicine at SUA. Although the findings indicate that these scholars had been publishing their research findings in a wide range of international journals, it can also be said that there is scarcity of relevant journals in the country for these research to publish their articles. Only two Tanzanian journals (Tanzania Veterinary Journal and Tanzania Journal of Health Research) had 20 or more articles.

No	Journal	No of articles
1	Tanzania Veterinary Journal	314
2	Tropical Animal Health and Production	123
3	Livestock Research for Rural Development	58
4	Preventive Veterinary Medicine	53
5	Veterinary Pathology	47
6	Bulletin of Animal Health and Production	35
7	Journal of Veterinary Medicine Series A	30
8	Research Opinions in Animal and Veterinary Sciences	29

9	Onderstepoort Journal of Veterinary Research	28
10	Small Ruminant Research	28
11	Veterinary Record	23
12	Tanzania Journal of Health Research	22
13	Veterinary Research Communications	20
Total		**810**

CONCLUSION AND RECOMMENDATIONS

The study findings have shown an increase in publication productivity of veterinary scholars at SUA over the period of 32 years. There is domination of multiple authorship; suggesting a very high level of collaboration. Veterinary researchers have shown considerable variation in various metrics. Veterinary scholars at SUA published their research findings in 241 different journals. Majority of these were foreign journals with only two Tanzanian journals having a substantial number of articles. It is therefore recommended that several indicators should be considered in combination when evaluating research productivity of scholars. Relying on a single indicator such as number of publications is inadequate because each indicator might present some drawbacks. Researchers should publish their research articles in journals that are widely visible such as e-journals in order to increase their research impact. Since research in fields such as veterinary science has become increasingly collaborative, it is important for institutions to consider giving each author full credit when counting their publications. Furthermore, there is a need to establish more relevant journals in Tanzania for scientists to publish their findings. The limitation of this study is that it only focused on online publications.

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