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Mapping of Agriculture Research Output in Sri Lanka: A Scientometric Analysis

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Abstract **- The study examines Sri Lanka's performance based on its publication output in Agriculture during 1989–2015, based on several parameters, including the year wise growth, national publication output and impact in terms of average citations per paper, international collaboration output and share and contribution of major collaborative partners, contribution, impact of select top 15 Sri Lanka institutions and select top 15 most productive authors, patterns of communication in national and international journals. The study uses 27 years (1989–2015) publications data in dental sciences of India and other countries drawn from Web of Science international multidisciplinary bibliographical database.**
Keywords: **Agriculture, Research Output, Sri Lanka, Scientometric Analysis**

I. INTRODUCTION

In recent years, the Scientometric techniques have become very popular. The literature on Scientometrics has been growing over the past two decades. It reveals that it is measurement of the pattern of all forms of written communication and their authors. Scientometric analysis has been increasingly used to calculate the research performance of the scientists and the growth of the various disciplines of science.(Ranganathan, Balasubramani, Science & Nadu, 2014) The major focus of the study is to apply the Scientometric analysis with a view of analyze the mapping of research output on Agriculture. This study has resulted in a special attention on the performance of research output in Agriculture(Balasubramani, 2011). It aims to examine the emergence of research areas, research groups and countries with a view to map the cognitive or intellectual structure of research(Bala & Gupta, 2008). Further, this study spells out the relationship between authors, institutions, journals and articles and other means of assisting the peer review procedure(Raja & Balasubramani, 2011). The study attempts to evaluate the performance of Agriculture Research output in terms of content and coverage, growth rates and areas of research concentration in Agriculture Research, research performance of various institutions, author productivity. This type of analysis reflects a wider notion of the present study(Bala & Gupta, 2008).

II. METHODOLOGY

This study is based on the Sri Lanka publication data in the field of Agriculture retrieved from the Web of Science Citation database for 27 years (1989-2015). A citations window has been used for counting the citations received and to access the impact of Sri Lanka research output, leading Sri Lanka institutions and authors.

Citations derived from the database have been used to evaluate the research performance of top productive Sri Lanka Universities and prolific authors. H-Index is a more rational method suggested by J.E. Hirsch(Hirsch, 2005), to measure the scientific productivity and citation impact of an individual author or institution compared to simpler measures such as total number of citations or total number of publications.[10] It is based on the highest number of papers included that have had at least the same number of citations e.g. a scholar having h-index means has published h number of papers each of which has been cited by others at least h times.

III. OBJECTIVES OF THE STUDY

The researcher has framed the following objectives for the purpose of present research.

1. To identify the pattern of distribution of Agriculture research output in India.
2. To examine the effectiveness of various sources of research publications in Agriculture research.
3. To identify the authorship pattern of Agriculture research output in India.
4. To prepare a ranking list of core journals.

IV. RESULTS AND DISCUSSION

Table I indicates that the year wise research output from 1999 to 2013. It is evident that a significant growth in terms of publications is registered from the year 1989. Totally 735 scholarly paper published with in Sri Lanka level twenty seven years. Highest percentage of papers was published in the year 2007, 2008 and 2014 respectively. The years 2007, 2010, and 2008 were having 671,547, and 424 citations for the publications respectively.

A less number of global citations are available for the year 2015 and 2014 with 4 and 40 global citations respectively. It's also interesting to note that less number of publications in the year 1989 have got more citations. More number of publications produced in the year 2008, 2007 and 2014.

TABLE I GROWTH OF PUBLICATION

S. No.	Publication Year	Recs	TLCS	TGCS
1	1989	11	1	41
2	1990	17	7	124
3	1991	9	7	62
4	1992	16	6	177
5	1993	20	5	129
6	1994	18	5	79
7	1995	22	6	116
8	1996	16	5	121
9	1997	15	11	192
10	1998	24	15	150
11	1999	21	17	246
12	2000	28	19	496
13	2001	27	21	290
14	2002	16	3	224
15	2003	50	34	660
16	2004	29	25	414
17	2005	38	12	436
18	2006	29	10	484
19	2007	49	15	671
20	2008	40	13	424
21	2009	31	10	358
22	2010	39	20	547
23	2011	34	12	166
24	2012	35	4	82
25	2013	35	6	107
26	2014	41	3	40
27	2015	25	1	4
	Total	735	293	6480

Table II indicates ranking of authors by number of publications. Sangakkara UR published highest number of articles for the study period with 38 records; next author De Costa WAJM published next highest number of articles for the study period with 26 records. It also shows that author Bastiaanssen WGM has got highest 490 global citations against 14 publications, followed by the author Qadir M with 350 global citations against 20 publications and third one is with more citations by Seneviratne G having 259 global citations for 19 publications. There are only one author having more than 400 global citations and five authors having more than 200 global citations.

Table III includes the list of the top twenty joournals that published most of the articles contributed by the authors from Sri Lanka. The journals are arranged in decreasing order by the number of articles published. There are 145 journals contributed 735 and above articles during the study period with the total ranking of 42. The highly productive journals up to the 5 ranks are as follows

"AGRICULTURAL WATER MANAGEMENT ranked first in order published 63 articles.

1. "IRRIGATION AND DRAINAGE" ranked second in order published 37 (19.2%) articles.
2. "JOURNAL OF HORTICULTURAL SCIENCE & BIOTECHNOLOGY" ranked third in order published 22 articles.
3. "JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE" ranked fourth in order published 20 articles.
4. "EXPERIMENTAL AGRICULTURE" ranked fifth in order published 19 articles.

TABLE II TOP 20 MOST PRODUCTIVE AUTHORS

S. No.	Author	Recs	TLCS	TGCS
1	Sangakkara UR	38	18	182
2	De Costa WAJM	26	4	187
3	Qadir M	20	15	350
4	Seneviratne G	19	10	259
5	Stamp P	15	6	36
6	Bastiaanssen WGM	14	21	490
7	Ibrahim MNM	14	4	94
8	Molden D	13	17	273
9	Turral H	13	8	154
10	Ravindran V	12	11	202
11	Kulasooriya SA	11	4	58
12	Wijesundera RLC	11	8	111
13	Hussain I	10	2	144
14	Rodrigo VHL	10	17	89
15	Weerakoon WMW	9	7	143
16	Barker R	8	7	189
17	de Fraiture C	8	3	119
18	Jansz ER	8	5	77
19	Karube J	8	6	19
20	Leelamanie DAL	8	6	19

V. ZIPF's LAW OF WORD OCCURRENCE

This law states that, "in a long textual matter if words are arranged in their decreasing order of frequency, then the rank of any given word of the text will be inversely proportional to the frequency of occurrence of the world" i.e. ral/f {where V' is rank and '/' is frequency)

rf = c (where, c is constant)

Taking log on both the sides, Log (f) + log (r) = log c

Or

log (f) + log (r) = c {where, c is constant)

Only those words occupying frequency up to 8887 items are given in Table 24. On applying this law, it was found that log of frequency of occurrence of words when added to log of their rank; the results are almost same for each word. The log of frequency of three most potent words appeared in the titles "Sri Lanka", "Water" "Soil" is given below:

1. Word: Sri

Frequency: 144 Rank: 1 Log of frequency + log of rank Log 144 + log 1 = 2.15 + 0 = 2.15 word Thus, it is proved that Zipf's law is valid even today.

TABLE III TOP 20 MOST PRODUCTIVE JOURNALS WITH RESPECT TO THE NUMBER OF ARTICLES DEALING WITH AGRICULTURE, SOURCE: SCI (WOS) JOURNALS (145)

S. No.	Journal	Recs	TLCS	TGCS
1	Agricultural Water Management	63	58	1406
2	Irrigation and Drainage	37	5	278
3	Journal of Horticultural Science & Biotechnology	22	6	127
4	Journal of the Science of Food and Agriculture	20	10	190
5	Experimental Agriculture	19	10	64
6	Journal of Agronomy And Crop Science-Zeitschrift Fur Acker Und Pflanzenbau	17	4	36
7	Plant and Soil	17	10	166
8	Asian-Australasian Journal of Animal Sciences	16	8	44
9	Biology and Fertility of Soils	16	7	192
10	Communications in Soil Science and Plant Analysis	15	1	29
11	Field Crops Research	15	19	170
12	Journal of Agronomy and Crop Science	15	11	196
13	Paddy and Water Environment	15	11	115
14	Tropical Animal Health and Production	15	4	76
15	Agriculture Ecosystems & Environment	13	15	248
16	Agroforestry Systems	13	8	72
17	Crop Protection	11	6	94
18	Journal of Irrigation and Drainage Engineering-Asce	11	8	124
19	British Poultry Science	10	1	94
20	Fertilizer Research	10	0	57

TABLE IV WORD WISE DISTRIBUTION OF PUBLICATIONS

S. No.	Word	Recs	TLCS	Log F	Log R	Log c
1	Sri	144	1	2.158362	0	2.158362
2	Lanka	135	2	2.130334	0.30103	2.431364
3	Water	103	3	2.012837	0.477121	2.489958
4	Soil	69	4	1.838849	0.60206	2.440909
5	Irrigation	62	5	1.792392	0.69897	2.491362
6	Growth	60	6	1.778151	0.778151	2.556303
7	Rice	60	7	1.778151	0.845098	2.623249
8	Effect	55	8	1.740363	0.90309	2.643453
9	Yield	46	9	1.662758	0.954243	2.617
10	Effects	43	10	1.633468	1	2.633468
11	Nitrogen	42	11	1.623249	1.041393	2.664642
12	Different	40	12	1.60206	1.079181	2.681241
13	Productivity	35	13	1.544068	1.113943	2.658011
14	Use	34	14	1.531479	1.146128	2.677607
15	Coconut	31	15	1.491362	1.176091	2.667453
16	Performance	30	16	1.477121	1.20412	2.681241
17	System	30	17	1.477121	1.230449	2.70757
18	Tropical	30	18	1.477121	1.255273	2.732394
19	Soils	29	19	1.462398	1.278754	2.741152

The above table shows that Ranking of words according to Zip Law's Distribution. Among this the word can be found "*Sri Lanka"* with 279 records with first rank of the frequency. The next word follows as "Water" with 103.

TABLE V INSTITUTION WISE DISTRIBUTION OF PUBLICATION

S. No.	Institution	Recs	TLCS	TGCS
1	University of Peradeniya	237	62	1511
2	International Water Management Institute	150	92	2858
3	University of Ruhuna	52	12	198
5	Institute of Fundamental Studies	38	11	388
6	Coconut Research Institute	27	8	134
7	University of Colombo	22	9	114
8	Veterinary Research Institute	18	4	130
9	Rice Research & Development Institute	17	11	154
10	Rubber Research Institute of Sri Lanka	17	25	197
11	Uva Wellassa University	15	4	31
12	University Sri Jayewardenepura	12	4	81
13	Tea Research Institute Sri Lanka	11	1	29
14	Sabaragamuwa Univ Sri Lanka	7	0	9
15	University of Kelaniya	7	1	52

TABLE VI SRI LANKA COLLABORATION WITH OTHER COUNTRIES

S. No.	Country	Recs	TLCS	TGCS
1	UK	57	25	549
2	Australia	55	29	593
3	USA	48	21	636
4	Netherlands	42	20	565
5	Canada	39	14	304
6	Japan	39	9	315
8	India	29	11	393
9	Peoples R China	24	15	252
10	Switzerland	20	3	201
11	Pakistan	18	5	217
12	Syria	18	15	357
13	Belgium	13	4	211
14	Malaysia	12	7	134
15	Philippines	12	6	92
16	South Korea	12	2	27
17	Germany	10	3	82
18	South Africa	9	0	49
19	Sweden	9	1	35
20	Thailand	9	4	121

Table V provides publication productivity of top 14 institutions. This table indicates that Institution-wise research productivity University of Peradeniya has the highest number of research publications 237 with 62 local citation score and 1511 global citation score and International Water Management Institute has second highest number of research publications 738 with 92 local citation score 2858 global citation score and University of Ruhuna has third highest number of research publications with records 52.

The Extent of International collaboration as seen from co-authored is presented in Table VI. Sri Lanka has collaborated often with United Kingdom, Australia United States of America and Netherlands with 57,55, 48 and 42 papers. Other countries less than 40 research papers collaborated with Sri Lanka In the field of agriculture.

VI. FINDINGS AND CONCLUSION

The finding of growth of publication of Agriculture research output brings out the research paper published trend in increasing and decreasing trend. The overall study period the highest percentage publication published in 2007. The analysis of the growth of Agriculture literature at the Sri Lankan level reveals that the relative growth rates of Agriculture research output have shown a declined trend, contrastingly doubling the time for publications that have increased remarkably. The find output author contribution, Sangakkara UR has published the highest number of articles (38 articles) in the field of Agriculture in Scientometric with the first rank. And followed De Costa WAJM has published next highest (28 article) with second rank. The countries such as United Kingdom, Australia and USA, have considerably recognized the research articles of Sri Lankan researcher published the same in their journals.

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