Research Performance of the Physics Professors in the Sri Lankan Universities: A Scientometric Study

T. Pratheepan,
Uva Wellassa University of Sri Lanka,
Badulla, Sri Lanka.
Mobile+94 778436572,
e.mail: pratheepan12345@gmail.com

Abstract

The objective of this study is to provide an integrated scientometric profile of the scholarly productivity of professors working at the department of physics in the Sri Lankan universities. The analysis covered the entire professors of physics working in the university system as on August, 2015. Twenty-eight professors from seven universities of Sri Lanka were included. The scientometric database outputs of the number of publications (N_p), citations (N_c) and h-index were tabulated. Overall, mean h-index was 7 [95% confidence interval (CI),4.82 – 9.18]. For number of publication, the range was 2-135, mean was 32.86 (95% CI, 21-44.54). For citation, the range was 00 -1832, mean was 401.5 (95% CI, 182 – 620.64). In terms of collaboration profile, the professors show preference for "mega – authored" papers. There are 920 papers written by 28 professors. Of these 73.26% of papers are collaborated with three or more authors called "mega authored" papers. Only 8.01% of papers have been written by single authors. The values of Co-authorship Index (CAI) for mega – authored papers of professors (54%) are higher than the average level (CAI>100) of 28 professors.

Key words

Scientometrics, Citation analysis, h-index,

Electronic access

The journal is available at www.jalis.in

INTRODUCTION

In keeping with the requirements of globalization, meaningful steps are being contemplated to raise the standard of academics working in the Sri Lankan universities. To cope with the modern challenges an academician should be an outstanding researcher. So, it is the bounden duty of all universities of Sri Lanka to encourage potential researchers by evaluating their performance using recognized yardstick. Scientometrics become key drivers in evaluating research performance of scientists. It has recognized as a widely used method for the assessment of the scientific output of researchers. There is an increasing interest in the evaluation of researchers using some important parameters, particularly research output and citations received for their publications. It was observed that Scientometrics indicators have become an important tool to monitor the progress of research groups in recent decades (Fakhree, and Jouyban 2011). The analysis of publication output, citation impact and co-authorship has a long-standing tradition in the field of information science, and these three indicators have been employed in many disciplines to measure research success in terms of output. Academic fields differ in publication performances at many levels. In general, the Sri Lanka's physics research base is performing strongly. The contribution of research output of physicists towards the science and technological development of a country has progressed. Universities are the most predominant contributors in the R&D activity in Sri Lanka. Senaratne,(2015) noted that technology has become the prime mover of development, it needs to be emphasized that university academics must continue and enhance their cutting-edge research relating to high priority national concerns and issues. Rorstad and Aksnes (2015) found that professors are the most prolific personnel while people in lower academic positions tend to publish fewer publications. It is well accepted fact that there are large differences in the publication output between academics. Comparatively, small group of academics contributes to the majority of the publications in the academic institutions. According to Wickremasinghe (2008), measuring research output of the scientific community is important because it gives an insight to the research and development (R&D) of a particular country in a filed.

The present study focuses on the evaluation of the publication output of physics professors working

in the Sri Lankan universities as on Auguest,2015, through application of scientometric indicators and techniques. There are number of related studies have been made by Wickremasinghe (2008), Mehbuba and Rousseau (2010), Pratheepan (2011) Gupta (2012), Navaneethakrishnan (2014), Pratheepan &Weerasooriya (2015).

Despite the studies indicated above, no studies have systematically analyzed the publication output of research groups working in Sri Lanka except the study conducted by Pratheepan & Weerasooriya (2015). This study fills this gap and analyzing the citation impact, authorship and productivity of physics professors working in the Sri Lankan universities.

This paper is also trying to explore the answers for previous study conducted by Pratheepan and Weerasooriya (2015). There was a question in their study that is there any particular factors influencing in receiving citation/h-index for publications of professors? Two answer might be that professors where did their PhD. in terms of country and types of collaboration preferred by scientists.

This study does not include the informal publications and others that are not covered by Google scholar. It should not be forgotten that the total output and citations/h-index counted in this study based on the Google Scholar has to be taken as a reliable estimate of output, rather than precise values.

OBJECTIVES

This study attempts to:

- assess the efficiency and effectiveness of professors working at the department of physics in the Sri Lankan universities using scientometric indicators.
- identify the collaboration profile of physics professors on the basis of Co-Authorship Index (CAI).
- explore the determinant of research output and impact in terms of country of PhD.
- investigate the influence of collaborative papers of professors working at the department of physics in the university system of Sri Lanka.
- identify the top 10 highly cited papers written by physics professors of Sri Lankan universities.

DATA & METHODOLOGY

This research involved collecting and analyzing publications, citations, h-indices and types of collaborations of professors working at the department of physics in the Sri Lankan universities. This covers a wide range of publications spanning 1980-2014. Sample of this study covers all professors (associate professors, professors and senior professors) of physics working at the Sri Lankan universities as on January 2015; university websites were individually accessed for listing of professors working in physics departments. If university websites were inaccurately reflected current active professors and their names, the data of this study, would be consequently inaccurate to a certain degree. In this connection, study only considers the universities that have physics professors. Twenty eight professors from seven universities of Sri Lanka {*University of Colombo (CBO), University of Kelaniya (KLN), Open University of Sri Lanka (OUSL), University of Peradeniya (PDN), University of Sri Jayewardenepura (SJP), University of Ruhuna (RUH), and University of Jaffna (UJA)*} were included for analysis.

The data for this study were collected from the Google Scholar using Publish or Perish open source software for each professor separately Harzing, (2007). Searching the names of the professors with single initial was a problem because of homonyms among names. To eliminate ambiguities, maximum initials for the name of professors as available in the official websites of the universities were used as guide. To complete the entire data collection process for a professor took about 10 minutes in most cases. However, authors of papers required a bit more time for professors with namesakes.

The publication output and impact of professors have been evaluated individually on the basis of the following indicators; 1.Number of papers (N_p) , 2.Number of citations (N_c) 3.Citation per paper N_{pp}), 4.h-index, 5.Co Authorship Index (CAI), 6.Publication Efficiency Index (PEI).

Further, a descriptive statistical analysis was performed to calculate the mean, median for the N_p, N_c and h-index of individual physics professors. A numeric ranking was performed of all included h-indices and with stratification by academic position (associate professors vs. professors vs. senior professors).

Table 1.Metrics profile & ranking of professors based on h-indices

Rank	Gender	Position	Professors	University	h-index	Articles	Citations	Cites_Paper
1	Male	Senior Professor	Premaratne,K	PDN	22	135	1832	13.57
2	Male	Senior Professor	Sonnadara,U	CBO	21	81	1791	22.11
3	Male	Professor	Perera,VPS	OUSL	19	93	1685	18.12
4	Male	Senior Professor	Siripala,WP	KLN	15	89	1063	11.94
5	Male	Professor	Kandasamy,K	UJA	14	48	510	10.63
6	Male	Professor	Ravirajan,P	UJA	10	25	1704	68.16
6	Male	Professor	Jayakody,JRP	KLN	10	21	444	21.14
7	Male	Senior Professor	Jayasuriya,KD	KLN	8	41	398	9.71
8	Male	Professor	Sumathipala,HH	KLN	7	13	101	7.7
8	Male	Professor	Wijesundera,RP	KLN	7	49	263	5.37
9	Male	Professor	Perera,PAA	KLN	6	21	163	7.76
9	Male	Professor	Hewageegana,Prabath	KLN	6	22	171	7.77
10	Male	Senior Professor	Tantrigoda,DA	SJP	5	32	59	1.84
10	Male	Senior Professor	Kumaravadivel,R	UJA	5	8	179	22.5
10	Male	Associate Professor	Daya,DDNB	CBO	5	13	157	12.08
10	Male	Professor	Jayanetti,JKDS	CBO	5	28	160	5.71
11	Male	Professor	Kalingamudali,SRD	KLN	4	28	29	1.04
11	Male	Professor	Fernando,GWAR	OUSL	4	54	92	1.7
11	Male	Senior Professor	Ariyaratne,TR	CBO	4	36	117	3.25
11	Male	Senior Professor	Kunaratnam,K	UJA	4	11	76	6.91
11	Male	Associate Professor	Punyasena,MA	KLN	4	10	84	8.4
12	Female	Associate Professor	Wijewardena,KAIL	CBO	3	25	18	0.72
13	Male	Professor	Jayaratne,Chandana	CBO	2	2	51	25.5
13	Male	Professor	Rajendra,JCN	OUSL	2	9	33	3.67
13	Female	Associate Professor	Abayaratne,Chula	SJP	2	7	22	3.14
14	Male	Senior Professor	Dharmaratne,WGD	RUH	1	2	25	12.1
14	Male	Professor	Yapa,KKAS	RUH	1	8	15	2.25
15	Male	Associate Professor	Rosa,SRD	CBO	0	9	0	0

CBO: University of Colombo, *KLN:* University of Kelaniya ,*OUSL* :Open University of Sri Lanka

PDN: University of Peradeniya, *SJP* :University of Sri Jayewardenepura,*RUH* :University of Ruhuna,*UJA* :University of Jaffna

RESULTS AND DISCUSSION

H-index based ranking & quantitative indicators

The scientometric indicators are the valid and useful tools in the assessment of research performance. Firstly, study focus on the counts of publications published by the 28 professors; citations, citation per paper received for their publications; and ranking of professors on the basis of h-index is given in the Table 1. The *h-index* is defined as follows: "A scientist has index *h* if h of his/her *Np* papers have at least h citations each, and the other *(Np – h)* papers have no more than h citations each" (Hirsch 2005). For example, the highest *h* among physics professors is 22. Thus, this professor has written 22 papers with ≥22 citations each. Of the 28 academics working in the physics department 18% were associate professors; 50% were full professors and 32% were senior professors. There were no

women academics in the categories of senior professor and professor. Only 02 were working as associate professors in the physics department of Sri Lankan universities.

According to ranking list, senior professor K.Premaratne associated with *University of Peradeniya* is ranked first among the professors of physics in the Sri Lankan universities on the basis of publications, citations and h-index followed by senior professor U.Sonnadara associated with University of Colombo, and professor VPS. Perera associated with Open University of Sri Lanka. According to citation per paper professor P.Ravirajan is found to be the predominant scientist among the physics professors with 68.16 citations per paper. He is associated with University of Jaffna. Among the professors only one professor had no citation. The h-index range was 0-22, Overall, mean h-index was 7 [95% confidence interval (CI),4.82 – 9.18]. For number of publication, the range was 2-135,

Table 2.Distribution of publication metrics by position

| Position	N	(%)	Mean	(95 % CI)	Median	(Range)
Associate Professor	5	(18)				
h-index			2.8	(1.29-4.31)	3	(0-5)
Npubs			12.8	(7.19-18.41)	10	(7-25)
N Cites			56.2	(5.51-106.89)	22	(0-157)
Professor	14	(50)				
h-index			6.9	(4.42-9.44)	6	(1-19)
Npubs			30.07	(17.96-42.18)	23.5	(2-93)
N Cites			387.21	(97.76-676.67)	161.5	(15-1,704)
Senior Professor	9	(32)				
h-index			9	(4.6-14.29)	5	(1-22)
Npubs			48.33	(20.89-75.77)	36	(2-135)
N Cites			615.55	(153.7 - 1077.41)	179	(25-1,832)

CI confidence interval.

mean was 32.86 (95% CI, 21-44.54). For citation, the range was 00 -1832, mean was 401.5 (95% CI, 182 – 620.64). Table 2 lists the number of publication output, citations and h-index for each group. Senior professors had statistically higher mean h-index of 9 (95% CI, (4.6-14.29). H-index for associate professors was markedly lower than for professors (mean, 2.8 vs 6.9). There was a marked difference in distributions between associate professors and senior professors (mean,2.8 vs 9). In term of publications and citations, senior professors had greater number of publications and citations than other professors' category, differences were not statistically significant between professors and senior professors (mean, 30.7 vs 48.33 and 387.21 vs 615.55 respectively). There is a high degree of correlation between the three metrics. Principal component analysis of h-index, number of output and citations yielded a single a highly related domain.
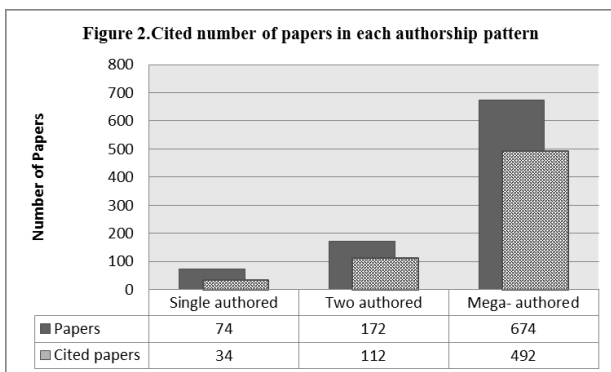
COLLABORATION PROFILE

The complex and interdisciplinary nature of science encourages scholars and scientists to cooperate with one another to gain more advantages through collaboration (Gazni and Didegah,2011). The present study aims to examine the association between the number of citations and the collaboration category involved in the publications of professors of physics working in the Sri Lankan universities. Different categories of collaboration considered in this study consist of three types such as no collaboration, collaboration between two authors and collaboration between three and more authors called mega collaboration. According to Wagner-Doebler (2001), at the beginning of the 20th century, co-authorships accounted for less than 10% of all publications, while at the end of the 20th century, this percentage had gone up to account for over 50% of all publications. Generally speaking, research collaboration enhances the quality of research, which leads papers with more authors to be cited more often (Katz and Martin 1997). It is characterized by the proportion of mega authored papers accelerating steadily. In this analysis Co – authorship Index was used to describe the co authorship characteristics of professors. Figure 1 shows the percentage of professors involved in each types of collaboration or co authorship pattern. Total research output of 28 professors is 920. Of these 73% of papers are written by 03 or more authors.

Figure 1.Preferred authorship categories of professors
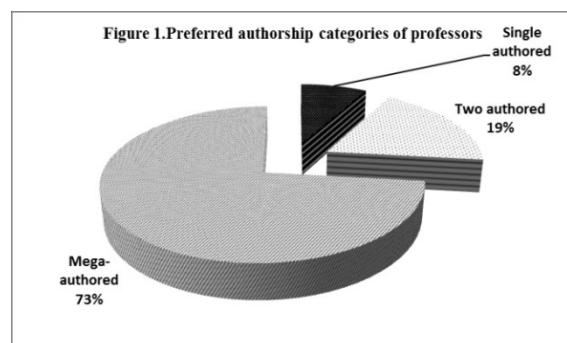
Only 8% of papers are written by single author. Overall, 92% of papers are collaborative papers. So, professors of physics are mainly focusing to publish their article in collaboration with other.

Figure 2.Cited number of papers in each authorship pattern

	Single authored	Two authored	Mega- authored
Papers	74	172	674
Cited papers	34	112	492

There was a question that is there any influence by collaboration for articles in receiving citation? Figure 2 has given answer for that question. 674 papers were mega authored. Of these, 73% of papers have been cited at least one time. Only 27% of papers have not been cited. There are 172 papers are written by two authors. Among them, 65% have been cited; while; only 45% were cited in the category of single authored papers. So, this might be an answer for the question that collaboration has been influencing in receiving citations.

CO-AUTHORSHIP CHARACTERISTICS

Co-authorship Index (CAI) has been suggested by Garg & Padhi, (2001), and firstly elaborated by Schubert & Braun, (1986). It is obtained by calculating the proportion of single, two, and mega-authored papers of scientist. Co-authorship Index (CAI) can be expressed mathematically as follows:

$$CAI = \{(N_{ij}/N_{i0})/(N_{0j}/N_{00})\} \times 100$$

N_{0j} : number of publications co-authored by all authors from all universities during the period,

N_{00} : total publications published by all authors from all universities during the period.

j = 1, 2, and (>3).

CAI=100 indicates that the number of publications for a specific type authorship corresponds precisely to the average of all authors. CAI>100 reflects higher than the average, and CAI<100 indicates lower than the average.

Here, publications have been divided into three categories according to the number of authors, namely single authored papers, two authored papers, and mega-authored papers. Papers completed by three or more authors are called as mega authored papers. Table 3 indicates the profiles of CAI for the compared universities. As shown in Table 3, for three Universities (University of Sri Jayewardenepura, University of Ruhuna , and University of Jaffna) the value of CAI for the single authored papers are all above 100, higher than the average number of the seven universities. On the other hand, University of Colombo, University of Kelaniya, Open university of Sri Lanka and University of Peradeniya the value for CAI for the mega authored papers are all above 100, higher than the average number of the seven university professors. In other words, they are more likely to work in big groups. With regard to professors of Sri Jayewardenepura prefer "single authored papers" and "Two authored papers".

Table 3.Profile of CAI of universities

University	Co-Authorship Index (CAI)		
	Single authored	Two authored	Mega- authored
University of Colombo	83.31	90.99	104.13
University of Kelaniya	71.89	89.15	105.86
Open University of Sri Lanka	63.76	96.00	105.00
University of Peradeniya	55.26	95.09	106.17
University of Ruhuna	372.97	160.47	54.60
University of Sri Jayewardenepura	446.29	274.30	17.50
University of Jaffna	175.68	87.21	94.96

where:

N_{ij} : number of publications co-authored by j authors in the university during the period in a field.

N_{i0} : total research output of professor working in the university during the period.

TOP TEN HIGHLY CITED PAPERS

To get better understanding of how articles are cited, and in particularly the high impact articles. Table 4 shows the top ten highly cited articles

Table 4. Top ten highly cited articles by physics professors of the Sri Lankan universities

Rank	Article	C_N	Author (S)	Journal	IF
1	Hybrid Polymer/Zinc Oxide Photovoltaic Devices with Vertically Oriented ZnO Nanorods and an Amphiphilic Molecular Interface Layer	480	P Ravirajan et al.	*J. Phys. Chem. B*	3.3
2	The characterization of x-ray photocathodes in the 0.1–10-keV photon energy region	381	K. Premaratne et al.	*J. Appl. Phys.*	2.18
3	Proton and pion production relative to the reaction plane in Au + Au collisions at 11A GeV/c	344	U Sonnadara et al.	*Physical Review C*	3.73
4	A Cu2O/TiO2 heterojunction thin film cathode for photoelectrocatalysis	288	W.Siripala et al.	*Solar Energy Materials and Solar Cells*	5.33
5	Hybrid polymer–metal oxide thin films for photovoltaic applications	286	P Ravirajan et al.	*Journal of Materials Chemistry*	6.62
6	An efficient dye-sensitized photoelectrochemical solar cell made from oxides of tin and zinc	256	VPS.Perera et al.	*Chemical Communications*	6.83
7	Hybrid polymer/metal oxide solar cells based on ZnO columnar structures	239	P Ravirajan et al.	*Journal of Materials Chemistry*	6.62
8	A solid-state photovoltaic cell sensitized with a ruthenium bipyridyl complex	231	V.P.Susira Perera et al.	*Journal of Physics D: Applied Physics*	2.72
9	Observation of Anisotropic Event Shapes and Transverse Flow in Ultrarelativistic Au + Au Collisions	229	U Sonnadara et al.	*Physical Review Letters*	7.51
10	Factors limiting the efficiency of molecular photovoltaic devices	180	P Ravirajan et al.	*Physical Review B*	3.73

C_N : Number of Citations,   IF : Impact Factor

among 920 articles. This table includes rank, title of the article, author(s), citation count, name of the source, impact factor of the journal. Top the list is the article "Hybrid Polymer/Zinc Oxide Photovoltaic Devices with Vertically Oriented ZnO Nanorods and an Amphiphilic Molecular Interface Layer" authored by P Ravirajan et al. who was associated with university of Jaffna; Article was published in J. Phys. Chem. B , has been cited 480 times; impact factor of the journal is 3.3. No article ranked in the list written by single author. It is a good indication to show the importance of collaboration in receiving citation. All these highly cited papers were collaborative papers. There are four article ranked in the list are written by P Ravirajan. Almost all articles were published in the high impact journals.

The determinants of research output in terms of country of PhD.

Table 5 shows that determinants of publication output of professors on the basis of country of PhD. The physics professors working in the Sri Lankan universities have been completed their PhD across the world. Here, countries divided in to four continents such as North America, Europe & UK, Australia and Asia. Sri Lanka has not been included in these categories. High percentage of professors did their PhD.in North American Universities; followed by Europe and Sri Lanka. Only three professors have been completed their PhD in Sri Lankan universities. 02 were in university of Colombo, one were in the University of Peradeniya. In order to evaluate the performance of professors in terms of country of PhD; there are 04 indicator were used.

Publication Efficiency Index (PEI) is one most important indicator. It indicates whether the impact of publications in a given field is commensurate with the publication efforts devoted to it. The value PEI>1 for a country indicates that the impact of publications exceeds the research efforts devoted to it for that particular country. and vice versa. Mathematically, it can be defined as follows:

$$PEI = \frac{TNCi/TNCt}{TNPi/TNPt}$$

where,

Table 5.The determinants of publication output in terms of country of PhD.

No	Country/continents	Professors	PEI	Mean N_P	Mean N_C	Mean h-index
1	Sri Lanka	3	1.34	39.6	647.6	10
2	North America	11	1.09	39.18	522.3	8
3	Europe & UK	10	0.92	25.3	285	5
4	Australia	2	0.51	33	208	5
5	Asia	2	0.46	25.5	144	4

Np : Number of Publications, Nc: Number of citation
PEI : Publication Efficiency Index

TNCi : total citations of the country i for a given field,

TNCt : total citations of all countries for a given field,

TNPi: total publications of the country i for a given field,

TNPt: total publications of all countries for a given field.

Table 5 presents the corresponding values of PEI on the compared 04 continents and a country. Table shows that the value of PEI for Europe, Australia and Asia are all less than 1. Analysis of PEI suggests that the impact of publications of professors in relation with those three countries are not commensurable to their research effort, On the contrary, in the case North America and Sri Lanka, the values of PEI are all greater than 1. It is worth to note that the values of PEI for Sri Lankan products are higher among the 05. That is, Sri Lanka has achieved most remarkable impact of publication when compared to research effort devoted amongst the professors as product of different countries.

CONCLUSION&RECOMMENDATION

There are several internationally renowned physics professors with an impressive research profile, i.e. H-Index ranging from 10 to 22. The study has identified them with great dedication and passionate commitment amid manifold constraints. Many of them have developed strategic academic partnerships with world class universities in many parts of the world, improving the global visibility of the Sri Lankan universities. In addition, there are promising post-docs with an impressive research profile of international stature. They need to be recognized and rewarded. Their creative energies and relentless passion for research could be harnessed through appropriate programmes to establish high profile research fora in order to enhance the research and intellectual atmosphere in Sri Lankan universities (Senaratne ,2015).

In the 21st century, universities, as providers of intellectual capital, crucibles of R&D, fountainheads of innovation and seedbed of new enterprises, have to play a crucial role in transforming Sri Lanka into a knowledge-based economy. As they account for around 60% of the R&D personnel in the country, it is of paramount importance that a conducive environment for research and innovation is created and sustained in the universities so that they could contribute effectively towards the above goal. In this connection, several factors including right institutional leadership and policies, increased funding for research, strengthening research capabilities and analytical facilities, introduction of research-friendly rules and regulations, and forging strategic partnership with industry and reputed foreign universities assume prime importance.

Results of such studies may be very useful in decision making in research administration and planning, in collection development and use in libraries. These results further enable policy makers in different organisations and funding agencies such as National Science Foundation, National Research Council etc. to evaluate their decisions on the awarding of grants to individuals and institutions.

References

Fakhree, M., & Jouyban, A. (2011) Scientometric analysis of the major Iranian medical universities. Scientometrics, 87 (1): 205-220.

Garg, K. C., Padhi, P. (2001), A study of collaboration in laser science and technology, Scientometrics, 50 (2) : 415–427.

Gazni,A., & Didegah, F.(2011). Investigating different types of research collaboration and citation impact: a case study of Harvard

University's publications. Scientometrics, 87:251–265.

Gupta,B.(2012) Sri Lanka S &T output during 2001- 2010: A scientometric assessment. Malaysian Journal of Library & Information Science, 17(3):49-65.

Harzing,A.W.(2007). Publish or Perish, available from hhttp://www.harzing.com/ pop.htm.

Hirsch, J.E. (2005) An index to quantify an individual's scientific research output. Proceedings of the National Academy of Science USA 102: 16569–16572

Katz, J. S., & Martin, B. R. (1997). What is research collaboration? Research Policy, 26(1) :1–18.

Mehbuba, D.,& Rousseau, R. (2010) Scientific research in the Indian subcontinent: selected trends and indicators 1973-2007 comparing Bangladesh, Pakistan and Sri Lanka with India, the local giant. Scientometrics, 84 (2): 403-420.

Navaneethakrishnan, S.,(2014), Authorship patterns and degree of collaboration of Sri Lankan scientific publications in Social sciences and Humanities – a picture from SCOPUS, Retrieved on December,2015 from http://digitalcommons.unl.edu/cgi/viewcontent.c gi?article=2966&context=libphilprac

Pratheepan, T. (2011) Research Productivity of Sri Lankan Universities during 1999-2010 based on the ISI Web of Science database: a Scientometric study. Proceeding of the University Librarians Association Sri Lanka: 288 – 295.

Pratheepan,T.,& W. A. Weerasooriya,W.A., (2015) The publication output and impact of various faculties in Sri Lankan universities: a Scientometrics assessment and policy implications. Journal of the University Librarians Association of Sri Lanka 19 (1): 54-70.

Ranjith Senaratne, R.,(2015) Creating vibrant research culture and rich intellectual ambience in SL universities, Retrieved on November,2015 from http://www.island.lk/index.php?page_cat=article -details&page=article- details&code_title=121146

Rørstad,K., & Aksnes,D.W.(2015) Publication rate expressed by age, gender and academicposition – A large-scale analysis of Norwegian academic staff. Journal of Informetrics, 9 : 317–333.

Schubert, A., Braun, T. (1986), Relative indicators and relational charts for comparative assessment of publication output and citation impact, Scientometrics, 9 : 281–291.

Wagner-Doebler, R. (2001). Continuity and discontinuity of collaboration behaviour since 1800 from a bibliometric point of view. Scientometrics, 52 :503–517.

Wickremasinghe,S.I., (2008).Evaluating research productivity: a case study of the rice scientists in India and Sri Lanka. Journal of the National Science Foundation of Sri Lanka,36(1):59-68.