

Scientometric Analysis of Astrophysics Research Output in India: A Study Based on H Index

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Abstract - This study analyzes the Astrophysics research output in India from the year 1989-2016. The data was downloaded from web of science database which was maintained by Thomson Reuters. The findings of the study revealed that The Tata Institute of Fundamental Research has contributed 2725 records in astrophysics research during the study period of 1989-2016. This institute's h index based local citation score is(LCS) 23 and h-index based on the local citation score excluding self- citations is (LCSX)15 and Global citation score (GCS) is 89.The time series analysis study shows the future trend of growth in astrophysics research output in India might take a decreasing trend during the years to come.

Keywords: Scientometrics, Astrophysics, Web of Science, Histcite H Index, Time Series Analysis

I. INTRODUCTION

Hirsch introduced the H index in the year 2005. It is a single number that assesses an individual's consistency of scientific performance and claimed to avoid the shortcomings pitfalls of JIF. The Hirsch definition for 'h index is as follows "A scientist has index 'h' is of his or her NP papers have atleast h citations each and the others (Np-h) have <h citations each". Here, h is the highest number of papers a scientist has published 60 papers, 40 of which have achieved 40 or more citations; his or her h-index is 40. Braun *et al.*, (1987) proposed an h-type index for journals. This index is equal to h if the journal has published h papers each of which has atleast h citations. According to these authors, this is an interesting supplement to the controversial use of JIF to rank journals because of the following two reasons:

1. It is insensitive to an accidental excess of un-cited papers and to one or several outstandingly highly cited papers.
2. It combines together the effects of 'quantity' (*i.e.* the number of publication) and quality (*i.e.* the citation rate in a rather specific balanced way that should reduce the apparent 'overlapping' of some of the review journals.

Gangan Prathap (2011) has extended a Hirsch-type index for institution. He recognizes two levels of h indice, h-1 and h-2 papers, each of which has at least h citations, and h2-h,

if the institution has h individuals, each having a index which is at least h.

Raja *et al.*, (2011) have examined plasmodium falciparum research publication output in India prévised from Histcite software and other tools. The findings give an idea about the increase of Indian literature in plasmodium falciparum deposition and create the quantitative assessment of the study in terms of year-wise research output, nature of collaboration, geographical distribution, the channel of communication used by the scientists and characteristics of highly productive institutions.

Mooghali *et al.*, (2011) exposed that out of 691 articles in the field of Scientometrics, a total number of 183 articles (26.48%) were written during 1980 to 2009 by the top ten authors. Some of these articles were produced in authors' collaboration and some of them were by single authors. Geographical analysis showed that the field had developed considerably in different regions of the world. Hungarian Academy of Science with 40 records (5.71%) was the large amount of dynamic institution in the field of Scientometrics.

RoulaInglesi-Lotz *et al.*, (2011) examined scientometrically the effect of the NRF on the output of the South African Social Science Researchers for the period 1981-2006. The number of research publication calculates their accomplishment. The study shows a positive impact of the NRF programme on the research output of Social Science researchers and the adaptation of the programme has significantly influenced in population of research articles by a healthy average of 24.5percent.

Miguel *et al.*, (2010) evaluated the impact of the socioeconomic crisis of 2001 in the scientific system in Argentina. The current study shows by means of a set of scientometric indicators that reflect economic effort, human resources devoted to research, publications, collaborative relations, and the international noticeable of scientific contributions.

II. OBJECTIVES OF THE STUDY

1. To calculate Top 20 Authors h-Index in astrophysics research output in India

2. To examine Top 20 Authors h-Index in astrophysics research output in India
3. To find out Top 20 Institutions h-Index in astrophysics research output in India
4. To apply Time series analysis of astrophysics research output in India

III. METHODOLOGY

The total number of astrophysics research literature output contributions over the research period, under individual year labels during the year 1989–2016 has used as the index of total astrophysics research output production. Now the Web of Science Database renamed as Clarivate Analytics. The required data was downloaded on 5th May 2017 (11.45 am) from the (Web of Science) database published by Thomson Reuters of USA. Totally 17046 records are downloaded and analyzed by using the Hist Cite software application.

IV. DATA ANALYSIS

H Index: The h index was suggested in 2005 by Jorge E. Hirsch, a physicist at University of California, San Diego (UCSD). The h-index is a factor determining both the quantity and the quality of a scientist's research output. The h-index can calculate without human intervention in Scopus and Web of Science or manually in other databases that give citation information (e.g., PsychINFO, SciFinder and Google Scholar). The index based on a list of publications ranked in descending array by the number of citations these publications received. The value of h is equal to the number of papers (N) in the list that have N or more citations.

A. Top 20 Authors H-Index in Astrophysics Research Output in India

TABLE I TOP 20 AUTHORS H-INDEX IN ASTROPHYSICS RESEARCH OUTPUT IN INDIA

S. No	Author	Records	H index Records	H index LCs	H index LCSx	H index GCS
1	Banerjee. S	1265	905	12	5	63
2	Kumar. A	971	490	11	5	53
3	Weber. M.	668	491	11	4	58
4	Hebbekar. T	636	636	11	4	59
5	Tully. C	632	632	11	4	58
6	Jain. S	629	330	11	3	49
7	Malik. S	581	397	11	3	50
8	Bhattacharya. S	571	371	9	3	49
9	Kim. H	562	413	11	4	57
10	Dominguez. A	532	532	11	3	55
11	Biasini. M	523	523	10	4	54
12	Chang YH	521	438	10	4	54
13	Zhang ZP	518	518	9	3	54
14	Reucroft. S	516	516	11	4	58
15	Filthaut. F	502	502	11	4	49
16	Finger. M	489	246	10	3	49
17	Aziz. T	487	487	10	4	56
18	Kaur. M	476	475	10	4	53
19	Choi. Y	472	470	9	3	58
20	Chen. A	469	469	9	3	51
	Total	12020	9841	208	74	1087

The Table I reveals that authors h index based citation scores. Here,

1. *h-index (LCS)* is the h-index based on the local citations in the collection. The author S. Banerjee has published 12 papers with 12 or more citations. Followed by the author A. Kumar has published 11 papers with 11 or more citations.
2. *h-index (LCSx)* is the h-index based on the local citations in the collection excluding self-citations. The

author S. Banerjee and A. Kumar has published only 5 papers with 5 or more external citations. The LCSx-based h-Index has great value.

3. *h-index (GCS)* is the h-index based on the global citation scores. The author S. Banerjee's global citation score is 63 followed by the Author Hebbekar. T global citation score is 59 and in next place Weber. M, Reucroft. S and Choi. Three authors are with GCS 58.

B. Top 20 Journals H Index in Astrophysics Research Output in India

TABLE II TOP 20 JOURNALS H- INDEX IN ASTROPHYSICS RESEARCH OUTPUT IN INDIA

S. No	Journal	Journal Code	Records	H index LCS	H index LCSx	H Index GCS
1	Physical Review D	PRD	3435	17	10	96
2	Physics Letters B	PLB	1992	18	11	89
3	Monthly Notices of The Royal Astronomical Society	MNRAS	1600	23	11	61
4	Astrophysics and Space Science	ASS	1531	15	13	33
5	Astrophysical Journal	AJ	1340	23	11	73
6	Astronomy & Astrophysics	AA	1170	21	12	70
7	Journal of Geophysical Research–Space Physics	JGRSP	453	11	7	33
8	Journal of Astrophysics & Astronomy	JAA	448	11	7	19
9	Classical & Quantum Gravity	CQG	431	16	10	49
10	Solar Physics	SP	423	14	8	34
11	Indian Journal of Radio & Space Physics	IJRSP	400	5	4	13
12	International Journal of Modern Physics D	IJPD	372	12	7	28
13	Advances in Space Research	ASR	342	7	5	17
14	General Relativity & Gravitation	GRG	316	13	11	27
15	Annales Geophysicae	AG	282	8	6	25
16	Journal of Cosmology & Astroparticle Physics	JCAP	213	0	0	21
17	Planetary & Space Science	PSS	175	8	4	20
18	Astrophysical Journal Letters	AJL	148	7	3	25
19	Astronomical Journal	AJ	137	8	4	25
20	New Astronomy	NA	128	9	2	16
	Total		15336	246	146	774

The Table II depicts that the Physical Review D journal’s h-index based local citation score is 17 and h- index based on the local citation score excluding self- citations is 10 and Global citation score is 96. Similarly, the second journal Physics Letters B journal’s h index based local citation score is 18 and h-index based on the local citation score

excluding self-citations is 11 and Global citation score is 89. The Monthly Notices of the Royal Astronomical Society’s h index based local citation score is 23 and h-index based on the local citation score excluding self-citations is 11 and Global citation score is 61.

C. Top 20 Institutions H Index in Astrophysics Research Output in India

TABLE III TOP 20 INSTITUTIONS H- INDEX IN ASTROPHYSICS RESEARCH OUTPUT IN INDIA

S. No	Institutions	Institutions Code	Records	H index LCS	H index LCSx	H Index GCS
1	Tata Institute Fundamental Research	TIFR	2725	23	15	89
2	Indian Institute Astrophysics	IIA	1527	16	9	55
3	Institute High Energy Physics	IHEP	1059	12	5	76
4	CALTECH	CT	1024	14	8	87
5	Physics Research Lab	PRL	1003	13	6	44
6	Institute Nuzl.FisNucl.	INFN	996	14	7	81
7	Princeton University	PU	984	12	5	76
8	Panjab University	PBU	928	13	5	72
9	Institute for Theoretical & Experimental Physics	ITEP	909	12	5	69
10	MIT	MIT	859	12	5	73

11	University Delhi	UD	837	12	6	58
12	Indian Institute Technology	IIT	836	15	9	51
13	Saha Institute of Nuclear Physics	SINP	765	11	7	60
14	University of Michigan	UM	764	12	5	68
15	University of California Riverside	UCR	728	11	5	62
16	Korea University	KU	720	11	3	65
17	University Claude Bernard Lyon 1	UL1	707	12	4	63
18	Northeastern University	NU	701	11	4	61
19	Raman Research Institute	RRI	693	15	8	53
20	University of Maryland	UML	689	12	5	67
	Total		19454	263	126	1330

The Table III shows that Tata Institute of Fundamental Research has contributed 2725 records in astrophysics research during the study period of 1989-2016. This institute's h index based local citation score is(LCS) 23 and h-index based on the local citation score excluding self-citations is (LCSX)15 and Global citation score (GCS) is 89. Followed by the Indian Institute of Astrophysics has published 1527 records in astrophysics. The institute's h index based local citation score is (LCS) 16 and h-index based on the local citation score excluding self- citations (LCSX) is 9 and Global citation score (GCS) is 55 and Institute High Energy Physics has published 1059 records and the institute's h index based local citation score is (LCS) 12 and h-index based on the local citation score excluding self- citations (LCSX) is 5 and Global Citation score (GCS) is 76.

D. Time Series Analysis of Astrophysics Research Output in India

$$Y = a + b x$$

$$A = \frac{\sum y}{N}$$

$$A = \frac{17046}{28}$$

$$A = 608.79$$

$$B = \frac{\sum XY}{\sum X^2}$$

$$B = \frac{106208}{7308}$$

$$B = 14.53$$

Estimated Literature in 2020 is when

$$X = 2020 - 2002.5$$

$$X = 17.5$$

$$Y = 608.79 + 14.53 \times 17.5$$

$$Y = 608.79 + 254.28$$

$$Y = 863.07$$

$$Y = 863$$

Estimated Literature in 2025 is when

$$X = 2025 - 2002.5$$

$$X = 22.5$$

$$Y = 608.79 + 14.53 \times 22.5$$

$$Y = 608.79 + 326.93$$

$$Y = 935.72$$

$$Y = 936$$

TABLE IV TIME SERIES ANALYSIS OF ASTROPHYSICS RESEARCH OUTPUT IN INDIA

S. No.	Year	Y	X	X ²	XY
1	1989	358	-27	729	-9666
2	1990	416	-25	625	-10400
3	1991	420	-23	529	-9660
4	1992	389	-21	441	-8169
5	1993	434	-19	361	-8246
6	1994	403	-17	289	-6851
7	1995	341	-15	225	-5115
8	1996	370	-13	169	-4810
9	1997	437	-11	121	-4807
10	1998	417	-9	81	-3753
11	1999	412	-7	49	-2884
12	2000	447	-5	25	-2235
13	2001	499	-3	9	-1497
14	2002	498	-1	1	-498
15	2003	460	+1	1	+460
16	2004	468	+3	9	+1404
17	2005	493	+5	25	+2465
18	2006	622	+7	49	+4354
19	2007	617	+9	81	+5553
20	2008	697	+11	121	+7667
21	2009	731	+13	169	+9503
22	2010	753	+15	225	+11295
23	2011	893	+17	289	+15181
24	2012	986	+19	361	+18734
25	2013	1019	+21	441	+21399
26	2014	1112	+23	529	+25576
27	2015	1175	+25	625	+29375
28	2016	1179	+27	729	+31833
	Total	17046	0	7308	106208

On the application of the formula of Time Series Analysis for the prediction of literature output by the astrophysics

research output in India for the years 2020, 2025 has found that the future trend of growth in astrophysics research output in India might take a decreasing trend during the years to come. The inference is that there is a fluctuating growth level in astrophysics research output in India.

V. CONCLUSION

The study reveals that, the author S. Banerjee has published 12 papers with 12 or more local citations. The author S. Banerjee and A. Kumar has published only 5 papers with 5 or more external citations. The LCSx-based h-Index has great value. The author S. Banerjee's global citation score is 63 followed by the Author Hebbekar. T global citation score is 59 and in next place Weber. M, Reucroft. S and Choi. Three authors are with GCS 58. The Physical Review D journal's h-index based local citation score is 17 and h-index based on the local citation score excluding self-citations is 10 and Global citation score is 96. The Tata Institute of Fundamental Research has contributed 2725 records in astrophysics research during the study period of 1989-2016. This institute's h index based local citation score is (LCS) 23 and h-index based on the local citation score excluding self-citations is (LCSX) 15 and Global citation score (GCS) is 89. The time series analysis study

shows the future trend of growth in astrophysics research output in India might take a decreasing trend during the years to come.

REFERENCES

- [1] Braun, T., Bujdoso, E., & Schubert, A. (1987). A literature of analytical chemistry: A Scientometric evaluation, *CRC Press, Inc, Boca Raton, Florida*.
- [2] Gangan Prathap. (2011). A Thermodynamic explanation for the Glanzel-mode for the h-index. *Journal of American Society Information Science*, 62(5), 992-994.
- [3] Raja, S. & Balasubramani. R., (2011). Plasmodium falciparum research publication in India: A scientometric analysis. *European Journal of Scientific Research*, 56(3), 294-300.
- [4] Mooghali. A., Alijani, R., Karami, N., & Khasseh, A. A. (2012), Scientometric analysis of the scientometric literature, *International Journal of Information Science and Management (IJISM)*, 9(1), 19-31.
- [5] Roula Inglesi-Lotz & Anastassios Pouris. (2011). Scientometric impact assessment of a research policy instrument: the case of rating researchers on scientific outputs in South Africa. *Scientometrics*, 88, 747-760.
- [6] Miguel, S., Moya-Anegón, F. & Herrero-Solana, V. (2010). The impact of the socio-economic crisis of 2001 on the scientific system of Argentina from the scientometric perspective, *Scientometrics*, 85(2), 495-507.
- [7] Retrieved from Web of Science (www.webofscience.com) database on 5th May 2017 (11.45am).