December 2018

Measuring Research Performance of Himachal Pradesh institutions: using citation analysis

Suresh K. Chauhan

Jaypee University of Information Technology, sureshbabal@yahoo.com

Measuring Research Performance of Himachal Pradesh institutions:
Using citation analysis

By Suresh K Chauhan
Jaypee University of Information Technology
Waknaghat, Solan, Himachal Pradesh (India)
sureshbabal@yahoo.com

ABSTRACT:
At higher education front, Himachal Pradesh has been focusing on delivering quality education and research. Currently, the state has over 25 prominent institutions which are dealing with higher education. In this study, an effort is being made to know the research output of the 10 prominent institutions of the state. The data for the period from 2001 to 2015 were extracted from the Scopus. The analysis for assessing the total number of publications, citations, cited rate, an average annual growth rate of publications was derived for an individual institute. The degree of author collaboration for each institute was also assessed. On basis of quantity (Publications) and quality (Citations received) of research output, a ranking of studied institutions was also derived. The first rank was accommodated by Institute of Himalayan Bioresource Technology India, Kangra and last rank attained by Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Solan.

Keywords: Research Output; Bibliometric Studies; Citation Analysis; Research Output of Himachal Pradesh.

1. INTRODUCTION:

Himachal Pradesh has been known as a hilly land of God, endowed with natural beauty. It is also known for the standard of education. As per Census of India, in 2001, Himachal Pradesh achieved 76.48% literacy rate which increased to 82.80% in 2011. As per Census of India 2011, among 35 states and union territories of India, Himachal Pradesh holds the 11th position with respect to its literacy rate. The government of Himachal Pradesh is not only focusing on school education but also encouraging the establishment of quality higher learning institutions. For the last few decades, Himachal Pradesh has emerged as a hub of higher education enveloping various universities, specialized institutions, and institutions of national importance. Currently, the higher education of Himachal Pradesh envelops over 23 universities, One Indian Institute of Technology, One National Institute of Technology and other specialized research institutions. All these institutions are expected to deliver a quality output with respect to students and research.

In this study, an effort is being made to analyse research output of ten prominent institutions of Himachal Pradesh which are dealing with quality higher education and research.

2. LITERATURE REVIEWED:

Although, across the world, various bibliometric studies have been conducted in the pursuit of evaluating or measuring research output of an institute, region, country or subject but limited studies explored the research output of Himachal Pradesh (India). Singh (2015) conducted a scientometric study of publications published by Central University of Himachal Pradesh during 2011-2014. He extracted the data from the Web of Science (WoS) index and found only 28

publications. The analysis revealed that about 92.86% of publications were produced in multiple authorship and from these, about 14.29% were internationally co-authored. Madaan (2015) analysed publications of Himachal Pradesh (India) by retrieving data from SCOPUS for the period of 1952 to January 2015. She discussed decade-wise growth of publications, most prolific authors and most preferred journals for publications. She found that among ten prolific authors, seven are from Himachal Pradesh University, Shimla. She further analyzed that authors affiliated to district Shimla have written the high number of publications because many prominent institutions are located in this district. The study reflected that production of pure and applied science publications prevailed more as compare to social sciences. Agriculture is the most promising subject area of research in the state. Ray, Shah and Nundy (2016) measured research output of 579 Indian medical institutions and hospitals, affiliated to MCI or NBE, published during 2005 to 2014. They used Scopus database of extracting required data. They found that about 57.3% of these medical institutions did not have a single publication, whereas 4.3% of the medical institutions published over 100 research papers during the period of study. These institutions contributed 40.3% to the total medical research output of the country. In Himachal Pradesh, the Indira Gandhi Medical College, Shimla found the top place by contributing about 743 publications during this period.

A few reports have also highlighted the status of research in Institutions of higher learning in Himachal Pradesh. Kumar et al. (2017) submitted a report on measuring the performance of Indian universities with respect to research output in science and technology to SERC, Department of Science & Technology, Government of India. The study was based on data retrieved from Scopus for the year 1998 to 2008. The Himachal Pradesh University found 48th position among 50 universities of India ranked on the basis of h-Index. In view of the maximum number of publications, among 20 North Zone universities, Himachal Pradesh University was ranked 12th in Physics, 17th in Chemistry, 7th in Mathematics, 20th in Biology, 20th in Energy, 11th in Chemical Engineering, 14th in Engineering and 8th in Material Science. The CSK Himachal Pradesh Krishi University was ranked 19th in universities of North Zone for publishing a maximum number of research publications in Agriculture. Gupta and Dhawan (2009) measured the Indian research output in the area of science and Technology for the period 1996 to 2006. The data for these 11 years were drawn from the Scopus database. Among all the states of India, Tamil Nadu attained the top position with respect to the share of productivity, whereas Himachal Pradesh found the last place under low productivity states in science and technology. The study also highlighted that all other states, except Himachal Pradesh, placed under the category of low productivity states were witnessed a slight increase of their share in India's total science and technology research output whereas Himachal Pradesh contributed 0.08% less than the previous years.

A few similar studies were also conducted to analyse the research output of other regions. Uddin and Singh (2014) conducted a scientometric study for measuring research output of South Asian countries. Their analysis was based on the data retrieved from Scopus for the period 1964 to 2013 covering 50 years. The data were furthered divided into five blocks of ten years each for deeper analysis. They found that India dominates by contributing about 90% of the total publications from this region. Countries like Bhutan and Maldives did not have any research paper during the first three decades of the study. They also tried to assess the impact of research publications. They stated that it is obvious that old publications have more citations than the new

because new publications get less time-span for being cited. Sachdeva, Sachdev and Sachdeva (2017) done a bibliometric analysis of publications published on Knowledge, Attitude and Practices (KAPs) by the Indian authors. They conducted the study on PubMed articles published during 2000 – 2014 in Indian Journal of Community Medicine (IJCM) and Indian Journal of Public Health (IJPH). Their study revealed that Karnataka has contributed 16.8% of the total research published on KAP, whereas a poor research contribution was reflected by the states like Chhattisgarh, Himachal Pradesh, Jammu and Kashmir, etc. Satpathy and Sa (2015) studied the research output of state universities of Odisha (India) on the basis of data retrieved from Scopus for the 2010-2014 period. They found Utkal University as a most productive university of the state and physics and astronomy subject area has the most number of publications. Further, they assessed that multi-authored publications were covering over 96% of the total publications.

Though some of the studies highlighted limitations of bibliometric indicators but it is the only technique available till now that helps in evaluating research output of any individual, institution, region, country or subject. Ioannidis, Boyack and Wouters (2016) focused on normalization or rescaling of citation for better analysis. They discussed that citations received by a paper may depend on various factors such as a subject area of the paper, the age, type of document and the coverage of the citation database. Hicks and Wouters (2015) commented that it is important to select relevant indicators while evaluating research performances. They stated that citations rates vary subject to subject as topmost journals of mathematics have an impact factor of about 3 whereas top journals of cell biology field have an impact factor of about 30. Similarly, a single publication of high citation can improve the ranking of any university, hence a process of normalization is required to use citation indicators. Lehmann, Jackson and Lautrup (2008) had believed in two aspects of qualitative observations one it is better to publish a large number of articles and, two, the high number of citations indicates visibility performance and quality of these articles. Keeping a note of above reviewed-literature, a careful analysis was made to highlight quantity and quality research output to know the strengths and weaknesses of studied institutions.

3. METHODOLOGY:

The 10 institutions which have been actively contributing or expected to contribute heavily in research output of Himachal Pradesh (India) were selected for the study. The data for each institute were obtained from Scopus which is known as one of the biggest indexing and citation databases of the world. The data were extracted from the Scopus by executing a query of the Institute's name under Affiliated ID (AF-ID) of an individual institute, one by one.

Since, these selected institutions were established in different years, hence the study restricted to analyse research publications produced by these institutions from 2001 to 2015. For easy representation, wherever needed, the data for these 15 years were computed in three separate block periods covering 5 years in each block. The three institutions under the study were established after 2002, therefore, the analysis was made on an average basis wherever needed. The 10 Institutions, shown in Table 1, have been publishing quality publications and selected for study:

Table 1
Top 10 Institutes covered in the study

S. No.	Institute	Code	Location	Year of Establishment

1	Central Potato Research Institute India	CPRI	Shimla	1949
2	Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishwavidyalaya	CSKH	Kangra	1978
3	Central University of Himachal Pradesh	CUHP	Kangra	2009
4	Himachal Pradesh University	HPUS	Shimla	1970
5	Indira Gandhi Medical College	IGMC	Shimla	1966
6	Indian Institute of Technology Mandi	IITM	Mandi	2009
7	Institute of Himalayan Bioresource Technology India	IHBT	Kangra	1984
8	Jaypee University of Information Technology	JUIT	Solan	2002
9	National Institute of Technology Hamirpur	NITH	Hamirpur	1985
10	Dr. Yashwant Singh Parmar University of Horticulture and Forestry	YSPU	Solan	1985

The data downloaded in excel sheets and computed by using various bibliometrics and simple calculations to derive the required indicators.

4. DATA ANALYSIS:

The analysis of extracted data was made to highlight quantity and quality of research output of 10 institutions of Himachal Pradesh which are known for producing quality research output. The publications of each institute were extracted from Scopus citation database and analysed accordingly.

4.1 Publications and citations received:

Table 2 represents the total publications produced by institutions and citations received by these publications. The Central University of Himachal Pradesh (CSKH) had no publications during the first two blocks of the study, i.e. 2001-05 and 2006-10. The university was established in the year 2009 and publications started taking place after 2010. Similarly, there is no publication in the first block period (2001-05) by the Indian Institute of Technology, Mandi (IITM). The IITM was also established in 2009 and publications were made by the institute from 2010 onwards. The Jaypee University of Information Technology was established in the year 2002 and publications started taking place from 2004 onwards.

Table 2
Publications and citations received

Code	Publications in each block period			Citations in each block period		
	2001-05	2006-10	2011-15	2001-05	2006-10	2011-15
CPRI	79	145	231	749	920	1204
CSKH	162	144	263	1373	882	740
CUHP	-	-	70	-		219
HPUS	239	467	682	3837	6212	4483
IGMC	131	257	585	1636	1356	931
IITM	-	2	419	-	8	1858
IHBT	147	309	504	2963	8236	3356
JUIT	11	341	740	45	1930	2927
NITH	87	290	723	1051	4181	3487
YSPU	258	229	331	1035	947	558

The Table also reflects that in the first block period (2001-2005), Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni produced the most number of publications (258) followed by Himachal Pradesh University, Shimla (HPUS) with 239 publications. In the second block period, i.e. 2006-2010, HPUS published 467 publications followed by Jaypee University of Information Technology (JUIT) with 341 publications. The third block, covering a period from 2011 to 2015, Jaypee University attained the top position by publishing 740 publications, followed by National Institute of Technology Hamirpur (NITH) with 723 publications. The table also shows, number of citations attracted by publications against each block period.

4.2 Average Annual Growth of publications:

The progress of each institute with respect to publications produced was also determined in the form of Annual Growth Rate (GR). The growth rate (GR) was calculated on the basis of following formula.

$$Annual\ Growth\ Rate\ (GR) = (\frac{\Pr esent\ Publications}{Past\ Publications})^\wedge(\frac{1}{Number of Years}) - 1$$

Table 3 presents growth rate of each institute in different block periods as well as collectively for the whole period of the study, i.e. 2001-2015. The CPRI started well with the average growth rate of 21.98% in the first block period. The growth rate got slightly decreased in the second block period (2006-10) and which further gone to negative in the third block with -0.41%. An uneven growth rate was observed for CSKH, it achieved 0.58% growth rate during 2001-05, a negative growth rate, i.e. -7.03% was observed during 2006-10 that slightly improved to 3.47% during 2011-15 block period. Central University of Himachal Pradesh (CUHP) accumulated 33.03% of the growth after inception. The Himachal Pradesh University, Shimla started with a growth rate of 19.93% in 2001-05, 5.65% during 2006-10 and a negative growth rate of -8.47% was found for the period 2011-15. The Indira Gandhi Medical College (IGMC) achieved 20.11% growth rate in 2001-05, 11.10% in 2006-10 and 6.58% during 2011-15.

Table 3
Average Annual Growth Rate

Code	2001 – 2005	2006 – 2010	2011 – 2015
CPRI	21.98%	13.09%	-0.41%
CSKH	0.58%	-7.03%	3.47%
CUHP	-	-	33.03%
HPUS	19.93%	5.65%	-8.47%
IGMC	20.11%	11.10%	6.58%
IITM	-	200.00%	46.59%
IHBT	30.60%	6.65%	1.18%
JUIT	32.29%	28.62%	5.26%
NITH	108.07%	36.75%	2.84%
YSPU	23.91%	3.53%	7.84%
Total for all Institutions	22.15%	12.02%	4.21%

The Indian Institute of Technology, Mandi (IITM) observed highest annual growth rate of 200% and 46.59% for the block period of 2006-10 and 2011-15 respectively. The Institute of

Himalayan Bioresource Technology India (IHBT) also produced publications with the average growth rate of 30.60% in 2001-05, 6.65% in 2006-10 and 1.18% in third block period. The Jaypee University of Information Technology, the only private university included in the study, achieved 32.29% growth rate in 2001-05, 28.62% in 2006-10 and 5.26% during 2011-15. National Institute of Technology, Hamirpur (NITH) observed highest growth rate of 108.07% in the first block period (2001-05) among all other institutions. The growth rate of NITH computed to 36.75% in 2006-10 that decreased drastically to 2.84% during 2011-15. The Dr. Yashwant Singh Parmar University of Horticulture and Forestry (YSPU) achieved 23.91% growth rate in 2001-05, 3.53% in 2006-10 and 7.84% during 2011-15 in producing research publications.

The block period wise growth rate for all institutions was also computed collectively. It was found that these institutions produced research publications with the annual growth rate of 22.15% in 2001-05, 12.02% in 2006-10 and 4.21% during block period of 2011-15. This continuous decrease in the growth rate may not solely indicate that institutions have started diminishing interest in research activities. It sometimes also indicates the settled research output of the older institutions. Since some of the institutions may not go beyond a defined intake of students and, similarly, numbers of faculty members also remained proportionate to the number of students. Therefore, a constant rate of growth can be observed among older institutions whereas a good increase of growth rate can be found among newly established institutions. However, as presented in Figure 1, a cumulative growth rate of 15 years (2001 -2015) was also computed which could be used an indicator to know activeness of any institute with reference to research publications. The high growth rate of any institutions reflects the high interest in research activities.

Figure 1
Average Annual Growth Rate for the period from 2001-15
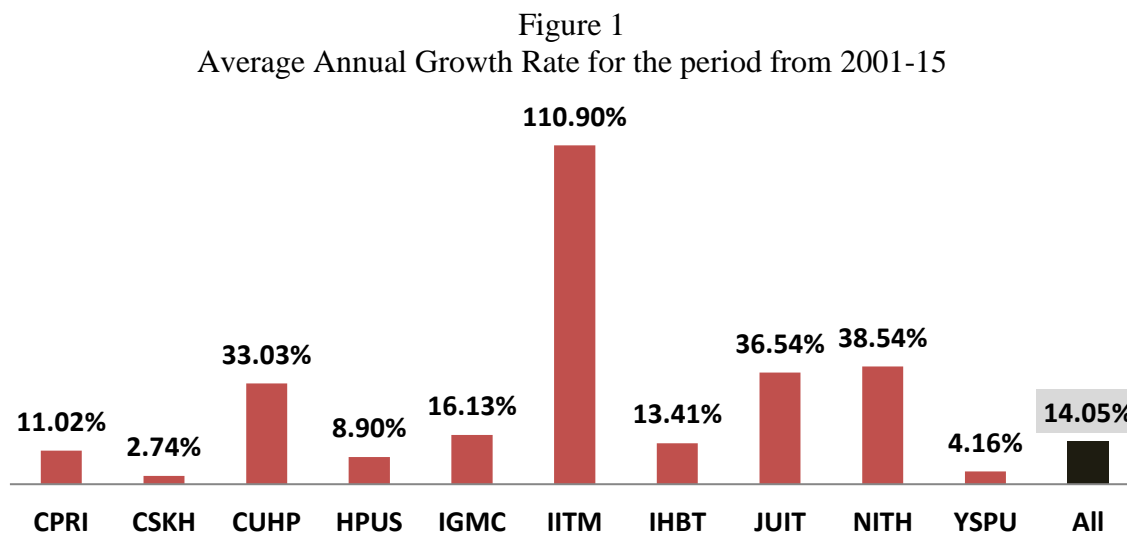
On basis of the average annual growth rate of the institutions, Indian Institute of Technology Mandi (IITM) stands far ahead than other institutions with the phenomenal growth rate of 110.90%. Although, the institute was established in 2009 but growth rate indicates that research activities of the institute are settling down with positive pace. Another technical institute, National Institute of Technology Hamirpur (NITH) also maintained its standard by capturing the second spot with 38.54% of average annual growth. The Jaypee University of Information Technology (JUIT) holds the third spot with 36.54% average annual growth rate in contributing

research publications. The CUHP also achieved 33.03% growth rate followed by IGMC with 16.13%. The growth rate of CSKH (2.74%) and YSPU (4.16%) indicated that these universities need to put in some extra efforts to focus on producing quality research publications. The overall average growth rate of all institutions put together was computed to 14.05% for the period from 2001 to 2015.

4.3 Citations per publication, cited rate and Rank:

The quality of any publication, as of now, can only be determined through the citations it receives. Therefore, Average Citations per Publication (ACPP) and Cited Rate (CR), two important indicators of assessment, were clubbed together to rank these 10 institutions. As highlighted in Table 4, ACPP and CR were computed for the publications produced during 2001-15 by these institutions. In computing, the Total Publications were represented by TP and Total Citations by TC.

The Institute of Himalayan Bioresource Technology India, Kangra (IHBT) ranked first when assessed on the basis of ACPP and CR. All publications (960) of the institute were attracted 14555 citations with the rate of 15.16 citations per publication. It also achieved 87.92% cited rate that means, out of 100, nearly 88 publications of this institute attract one or more than one citations. It reflects the high quality of institute's publications. The second rank was attained by Himachal Pradesh University, Shimla. The university has produced the highest number of publications (1388) during the period 2001-15 and these publications attracted 14532 citations with the average citation rate of 10.47. The university also received 77.52% cited rate that again reflects a high standard of research in the university.

Table 4
Citations per publication, cited rate and Rank

Code	TP	TC	ACPP	CR in %	ACPP + CR (For ranking)	Rank
CPRI	455	2873	6.31	71.21	77.52	4
CSKH	569	2995	5.26	59.23	64.49	9
CUHP	70	219	3.13	68.57	71.70	5
HPUS	1388	14532	10.47	77.52	87.99	2
IGMC	973	3923	4.03	60.74	64.77	8
IITM	421	1866	4.43	62.71	67.14	7
IHBT	960	14555	15.16	87.92	103.08	1
JUIT	1092	4902	4.49	62.91	67.40	6
NITH	1100	8719	7.93	72.27	80.20	3
YSPU	818	2540	3.11	58.44	61.55	10

ACPP – Average Citations Per Publications (TC/TP)
CR – Cited Rate (percentage of articles having one or more number of citations)

National Institute of Technology, Hamirpur found the third place in the given ranking with 7.93 citations per publication and 72.27% cited rate. The CPRI holds the fourth position among 10 institutions assessed under the study. It got 6.31 citations per publication with 71.21% cited rate.

The Central University of Himachal Pradesh captured the fifth position on ranking table computed on basis of average citations per publications and cited rate. Although, the university is very young in age but shows sincerity while generating quality research output. It received 3.13 citations per publications with 68.57% cited rate. A marginal difference was notices among JUIT (Sixth Rank) and IITM (Seventh Rank) in points. Similarity, IGMC (Eighth Rank) and CSKH (Ninth Rank) also observed a slight difference in the computed points. The YSPU ranked at the last (Tenth Rank) that obtained 3.11 citations per publications along with 58.44% cited rate. The university had produced maximum numbers of publications in first block period (2001-05) but failed to retain the same pace in next both block periods.

4.4 Degree of collaboration:

Dr. K Subramanyam (1983) had given a mathematical formula to calculate the degree of authorship collaboration. According to him the degree of collaboration opted on a number of publications under single and multiple authorship patterns. He suggested the following formula:

$$\text{Degree of author collaboration (C)} = \frac{Nm}{Nm + Ns}$$

The degree of author collaboration represented by C, whereas Ns represents the number of publications under single authorship, and Nm signifies total number of publications produced in multi-authored pattern. On basis of this formula, the degree of author collaboration was computed for each institution as presented in Table 5 given below.

Table 5
Degree of collaboration

Code	$Nm + Ns$	Ns	Nm	C
CPRI	455	27	428	94.07%
CSKH	569	28	541	95.08%
CUHP	70	10	60	85.71%
HPUS	1388	44	1344	96.83%
IGMC	973	95	878	90.24%
IITM	421	36	385	91.45%
IHBT	960	32	928	96.67%
JUIT	1092	62	1030	94.32%
NITH	1100	51	1049	95.36%
YSPU	1918	37	781	95.48%
Overall for 2001 - 2015	7846	422	7424	94.62%

The data reflects that majority of institutions under the study have achieved 90% and a higher degree of collaboration. The Central University of Himachal Pradesh (CUHP) is the only institute that achieved 85.71%, a low degree of author collaboration. It could also be stated that the university is in the initial stage of establishment and has published only 70 publications. The degree of collaboration, in the university, would expect to increase in every passing year.

5. CONCLUSION:

The study analysed research output with respect to publications of prominent institutions of Himachal Pradesh. The institutions like Institute of Himalayan Bioresource Technology India,

Kangra and Himachal Pradesh University, Shimla are extremely focused on producing quality research output. The recently established institutions such as the Central University of Himachal Pradesh, Dharmasala and Indian Institute of Technology, Mandi have shown intent to deliver quality research output. The Jaypee University of Information Technology, Solan has also shown promises and sincerity in producing quality research. Whereas, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Solan needs to embark upon producing research publications which were slackened in the last decade. However, the institutions of the state have shown endurance to be the front runners in producing quality research and new universities need to do sincere efforts to match them.

REFERENCES:

1. Singh, V.K. (2015) Mapping research output of the Central University of Himachal Pradesh. Indian Journal of Scientific Research, 11(2) : 25-28.

2. Madaan, D. (2015) Himachal Pradesh: Research Oriented State as Visualized in SCOPUS. In 10th International CALIBER, 12-14 March 2015, Shimla, India, edited by Arora, Jagdish et al., 2015, pp. 118-127.

3. Ray, S., Shah, I., & Nundy, S. (2016). The research output from Indian medical institutions between 2005 and 2014. Current Medicine Research and Practice, 6(2), 49-58.

4. Kumar, N., Kshitij, A., Garg, K C., & Tyagi., N. (2011) Measures of Performance of Universities in India: An Analysis of the Publication Output in Science and Technology (Study period 1998-2008). Report available at http://www.nistads.res.in/images/projectreports/MeasureofPerformanceofUniversitiesinIndia.pdf

5. Gupta, B. M. & Dhawan, S.M. (2009) Status of India in science and technology as reflected in its publication output in the Scopus international database, 1996–2006. Scientometrics, 80(2): 473-490.

6. Uddin, A. & Singh, V.K. (2014) Measuring research output and collaboration in South Asian countries. Current Science, 107(1): 31-38.

7. Sachdeva, S., Sachdev, T. R., & Sachdeva, R. (2017) Bibliometric Evaluation of Published Indian Research on 'Knowledge, Attitude, and Practices'. Indian Journal of Health Sciences and Biomedical Research, 10: 208-15.

8. Satpathy, S.K. and Sa, M.K. (2015) Research output of state government universities of Odisha: a bibliometric study. Library Philosophy and Practice (e-Journal). 1309.

9. Ioannidis, J.P.A., Boyack, K. & Wouters, P.F. (2016) Citation metrics: a primer on how (not) to normalize. PLOS Biology. 14(9). e1002542. doi:10.1371/journal.pbio.1002542.

10. Hicks, B. & Wouters, P. (2015) The Leiden manifesto for research metrics: use the ten principles in guide research evaluation. Nature, 520: 429-31.

11. Lehmann, S., Jackson, A., & Lautrup, B. (2008) A quantitative analysis of indicators of scientific performance. Scientometrics, 76(2): 369-390.

12. Subramanyam, K. (1983) Bibliometric studies of research collaboration: a review. Journal of Information Science, 1983, 6(1): 33-38.