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Scholarly Research Trend of Banaras Hindu University During 2004-2013: A Scientometric Study Based on Indian Citation Index

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ABSTRACT

Indian Citation Index (ICI) is a fully web-based abstract and citation database covering R&D literature across all disciplines published in journals/serials or in other documents emanating from India. The current study seeks to describe and analyse scholarly research publications of Banaras Hindu University, Varanasi, India. In this regard 1041 articles were collected from ICI for the period of 2004-2013. The study attempts to measure year-wise distribution of publication output, co-authorship index, collaborative co-efficient collaborating universities/institutes/colleges, states and countries. The result indicates that research productivity of Banaras Hindu University is increasing at the average rate of 104.1 publications per years, most of the researches are contributed by joint authors, 404 (39 %) articles published in SCIE indexed journals and 637 (61 %) articles published in non SCIE-indexed journals

Keywords: Scientometric, co-authorship index, collaborative-coefficient, scholarly productivity, prolific author

1. INTRODUCTION

Higher education system of India is the world's third largest in terms of students, next to China and the United States, offering facility of education and training in almost all aspects of human creativity and intellectual endeavour. Higher education in India has witnessed an impressive growth over the years. The number of higher educational institutions (HEIs) has increased from about 30 universities and 695 colleges in 1950-51 to about 700 universities (as of 2012-13) and 35,000 colleges (as of 2011-12) as per UGC report 2013. It is seen that research is the primary and important function of any higher education system. In any higher educational institutions (HEIs) every faculty member is viewed as scientists and he is always encouraged to build a research team consisting of junior and senior students. In any educational institutions tacit knowledge is present in individual faculty, researchers, administrators and decision-makers which is shared to the community in the form of published sources such as books, journals, course materials, curriculum and research reports, etc. Knowledge-rich organisations generate value from their intellectual and knowledge-based assets.

1.1 About the University

Banaras Hindu University is established by Pandit Madan Mohan Malviya in the year 1916 in Varanasi in the state of Uttar Pradesh, India. It is one of the best and largest universities in Asia having over 20,000 students. The main campus spreads over 1,300 acres was built on land donated by the Kashi Naresh. The another Rajiv Gandhi South Campus spreads over 2,700 acres hosts the Krishi Vigyan Kendra (Agriculture Science Centre) and is located in Barkachha in Mirzapur district. The university comprises 3 institutes, 14 faculties 140 departments, 4 inter disciplinary centres a constituent college for women and 3 constituent schools, spanning a vast range of subjects pertaining to all branches of humanities, social science, technology, medicine science, fine arts and performing arts. It has 6 centres of advanced studies, 10 departments under special assistance programme and a large number of specialised research centres. Four degree colleges of the city are affiliated to the University.

2. LITERATURE REVIEW

Sevukan,[1] *et al.,* analysed 349 bibliographic records of plant sciences contributed by faculties in central universities of India. Data were retrieved from ISI Science Citation Index Expanded (SCIE) for a period of ten years from 1997-2006. They found that research output of BHU faculties was on the top followed by JNU, AMU and PU. BHU contributed 47.40 % of PaI that was first place that showed its share in the literature contributed by its faculty. Collaboration has been shown by the fact that 30.41 %, 29.86 %, and 21.37 % of articles written by two, three and four authors respectively.

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Then again Sevukan & Sharma[2], examined the biotechnology contribution of the selected central university of India from 1997-2006. The data used for the study were retrieved from two database sources, namely, PubMed, NCBI (National Centre for Biotechnology Information); and ISI Web of Science database—Science Citation Index Expanded (SCIE). They found the growth of literature in biotechnology has steadily increased from 15 articles in 1997 to 43 articles in 2006. The BHU was leading from the front with 42.55 % contribution and there was a trend towards collaborative research with two-authored papers being maximum followed by three-authored papers. Kumbar[3] analysed 1518 research papers indexed in SCOPUS, published by the University of Mysore staff during 1996-2006. It were founded that average citations per paper have risen from 1.53 in 1996 to 2.62 in 2003. The international collaborative research activity in the university was confined to select few subjects, such as physics 38.4 %, biochemistry 35.6 %, and chemistry 28 %. In the another bibliometric assessment Ahila & Nagarajan[4], analysed a total of 22,065 research articles published in Web of Science and found that only 1.41 % articles were contributed by Indian authors and ranking 11th among 15 countries in which highest USA contributed 41.58% followed by England 10.37 %, Germany 8.21 %, France 6.24 % Japan 5.02 % and Canada 3.97 %. In collaborative research it has been found that 90 to 95 % of the research outputs were collaborative in nature. Shariatmadari & Mahdi[5] explored the existing barriers to research productivity based on faculty members perspectives of Islamic Azad University. Baskaran[6] analysed the author productivity, discipline-wise and institution-wise collaboration and ranking of authors in research contribution of Alagappa University during 1999-2011.

Majhi & Maharana[7] assessed 417 papers published by the Physical Science researchers of Sambalpur University. They found that three-authored contributions ranked first forming 123 (29.42 %) and single-authored formed 7.65 % which was very low. Chemistry and physics are the two highly productive subjects contributing large quantity of publications than other subject areas in physical science disciplines of Sambalpur University. In another scientometric study, Gopikuttan & Aswathy[8] evaluated form-wise, year-wise, subject-wise classification of published papers; most productive authors and the most preferred journals, etc. of University of Kerala over a period of 13 years from 2000 to 2012. Balasubramani & Parameswaran[9] analysed the research productivity of Banaras Hindu University indexed in Web of Science. They analysed the year-wise productivity in which the highest number of research output 1052 (15.15 %) was produced in 2011 and the least research output was in 2002 with 306 (4.41 %). However, there was a gradual growth of publications during 2003-2011. In authorship pattern, they analysed that two-authored papers ranked first in order of sharing (24.24 %) of the total research output. The three authored papers follow second in the order taking (26.65 %) of the total research contributions, followed by four and five authored contributions sharing (17.21 %), (9.55 %) of the total scientific research output during the study period. *Current Science* is one of the most preferred journals of the authors of BHU. The Institute of Technology leads in publications productivity with 1482 (21.3 %) articles. The authors of BHU have collaborated with the foreign authors for their research work.

3. OBJECTIVES

The objectives of the study are to:

- Trace the growth of scholarly publications from BHU during 2004-2013
- Examine the authorship pattern and nature of collaborative research
- Gauge the volume of collaboration of BHU with national, international and institutional level
- Identify highly preferred journals in which authors prefer to publish their research articles
- Examine the subject distribution of the publications from BHU.

4. METHODOLOGY

The study aims to evaluate scholarly literature of Banaras Hindu University published in Indian journals. The study based on the data retrieved from *Indian Citation Index (ICI)* online database, that is developed by The Knowledge Foundation (a registered society) with the required support of M/s Diva Enterprises Pvt. Ltd. It is a fully web-based abstract and citation database covering R&D literatures across all disciplines published in journals/serials or in other documents emanating from India. Data was retrieved on 5 January 2015. The search term Banaras Hindu University (BHU) was used in the institution search for the time span of 2004-2013 in basic search option of ICI. Total 1110 articles were downloaded, from these records, 69 records were removed that were published as editorial, case study, report and proceeding papers. Thus, the total number of papers included in the analysis was 1041. All these 1041 papers were marked and sent to e-mail address containing author, title, address and time cited fields and then these were analysed with the help of Microsoft Excel.

4.1 Collaborative Coefficient (CC)

A single step to measure collaborative research and termed it as collaborative coefficient. This method

is based on fractional productivity defined by Price & Beaver[10]. It is given by following formula:

$$CC = 1 - \frac{\sum_{j=1}^{k} \left(\frac{1}{j}\right) f_j}{N}$$

According to Ajiferuke[11], CC tends to zero as single-authored papers dominate and to 1-1/j as j-authored papers dominate. This implies that higher the value of CC, higher the probability of multi or mega-authored papers.

where, *j* is the number of *j* authored research papers; *N* is total number of research papers published; and *k* is the greatest number of authors per paper.

4.2 Co-Authorship Index

To examine how the pattern of co-authorship Index (CAI) has changed during the study period, the following formula of co-authorship index suggested by Garg & Padhi[12] was used.

$CAI=\{(N_{ij}/N_{io})/(N_{oj}/N_{oo})\}x100$

N_{ij}: Number of papers having *j* authors for the year *i*;

N_{io}: Total output of year *i*;

N_{oj}: Number of papers having *j* authors for all years;

N_{oo}: Total number of papers for all authors and all years;

j = 1,2,3.....*n*

CAI= 100 implies that co -authorship in a particular year for a particular type of authorship corresponds to the world average, CAI>100 reflects higher than average co-authorship efforts and CAI<100 lower than average co-authorship. For calculating CAI the entire data was divided into four blocks as single authored, two authored, multi-authored and mega-authored publications.

5. ANALYSIS AND INTERPRETATIONS

5.1 Form-wise Distribution of Publications

Figure 1 shows literature from BHU has been contributed as many as 1041 items during 2004-2013 in different Indian journals. It could be noted that out of 1041 research output, 88.09 % of scientific publications of BHU are research article which forms the majority of the contributions and followed by short communication 65 (6.24 %), review article 46 (4.42 %), and less than 1 % are research note, opinion papers, and special articles.[14]

5.2 Year-wise Distribution of Publications

Figure 1 presents that 1041 publications were included in ICI database during 2004 to 2013 from BHU. The year in which more than 100 papers were published are last four years 2013 (133), 2012 (119), 2011 (146), and 2010 (125). The less productive years with less than 100 papers were in 2009, 2007, 2006, 2005, and 2004. It also seen that 82 papers published in the year 2004 from BHU, which increased gradually. In the early stage the quantity of scientific publications from Banaras Hindu university were less but increased gradually even though there are ups and drop downs in a few years and 2011 is the year which possess more number of articles.

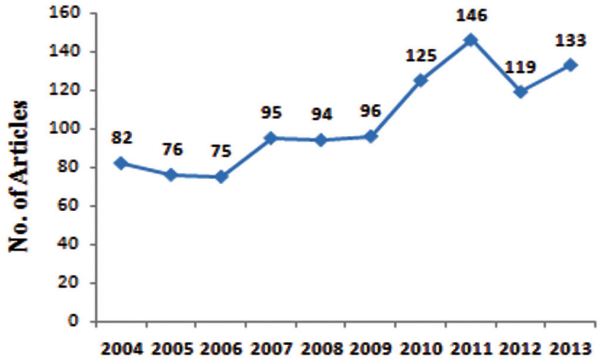

Figure 1. Year-wise publications.

5.3 Year-wise Co-authorship Index and Collaborative Coefficient

Table 1 describe that out of 1041 publications, 163 (15.66 %) were contributed by single- authored, 364 (34.96 %) by two-authored, 384 (36.89 %) by multi-authored and 130 (12.49 %) by mega-authored. The authorship pattern clearly shows that 71 % literatures were contributed by multi and two-authored. Table 1 represents year wise CAI and CC of the publications of BHU by single, two, multi and mega-authored papers. The average value of CC is 0.52. Table 1 indicates that in 2004, 2009, 2010, 2011 and 2013, value of CC was more than average (0.52). This implies that during these years, higher values of CAI are either for multi or mega-authored papers. Table 1 shows that in 2013, 2004, 2010, 2009, and 2011 had highest values of CAI for multi and mega-authored papers as during these period scholars have paid more attention on collaborative research. The value for mega-authored papers is higher in 2013, for multi-authored papers it is higher in 2004. Year 2005-2008 have low values of CC and higher values of CAI for single author and year 2005-2009 have higher values of CAI for two-authored papers, this indicates that during 2005-2008 less attention had been paid on multi and mega-authored researches.

5.4 Prolific Authors

Table 2 presents that A.K. Singh, Department of Physics and Arvind Singh Department of Botany are the most productive author with total 18 contributions followed by S.B. Agrawal, Department of Botany 14

Table 1. Authorship pattern

Year	Single-author (CAI)	Two-author (CAI)	Multi-author* (CAI)	Mega-author** (CAI)	Total	Collaborative coefficient (CC)
2004	7 (54)	26 (91)	44 (145)	5 (49)	82	0.56
2005	13 (109)	33 (124)	23 (82)	7 (74)	76	0.49
2006	15 (128)	32 (122)	23 (83)	5 (53)	75	0.47
2007	19 (128)	40 (120)	31 (88)	5 (42)	95	0.47
2008	20 (136)	37 (113)	23 (66)	14 (119)	94	0.48
2009	12 (80)	40 (119)	35 (99)	9 (75)	96	0.53
2010	14 (71)	46 (105)	51 (111)	14 (90)	125	0.54
2011	22 (96)	47 (92)	61 (113)	16 (88)	146	0.53
2012	24 (129)	34 *(82)*	40 (91)	21 (141)	119	0.51
2013	17 (82)	29 (62)	53 (108)	34 (205)	133	0.58
Total	**163**	**364**	**384**	**130**	**1041**	**0.52**

*Multi-authored (papers with 3 & 4 authors), **mega-authored (papers with >4 authors)

papers, Rajesh K Srivastava, Department of Geology 13 papers. Out of the 10 most productive authors, 5 authors are from the Botany Department having 64 contributions. This indicates that the Department of Botany has a strong research base.

5.5 Subject-wise Distribution of Papers

To observe the research trends in terms of research output the whole publications were divided into broad disciplines of interest. Figure 2 reveals that Biological Science has more number of articles, i.e., 223 (21 %) and possesses the first position, while Earth & Geological Science owns the second position with 105 (10 %) articles. The subject Chemistry, Agriculture, General Science & Technology has 102 (10 %), 100 (10 %), and 96 (9 %). Botany has 68 (7 %) which is subject which has least number of contributions.

Table 2. Prolific authors (Top 10)

S. No.	Name of author	Department	Papers
1.	A.K. Singh	Physics	18
2.	Arvind Singh	Botany	18
3.	S.B. Agrawal	Botany	14
4.	Rajesh K Srivastava	Geology	13
5.	J.S. Singh	Botany	12
6.	O.N. Srivastava	Physics	10
7.	R.S. Upadhyaya	Botany	10
8.	Lallan Mishra	Chemistry	10
9.	Madhulika Agrawal	Botany	10
10.	K.P. Joy	Zoology	10

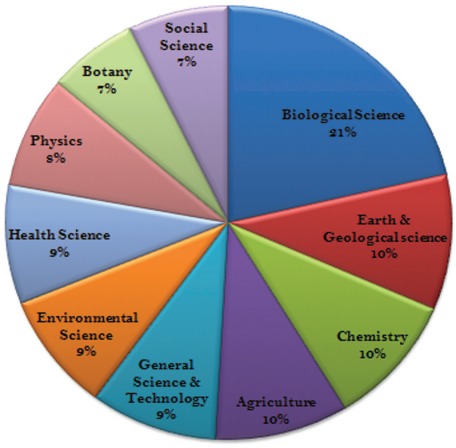

Figure 2. Subject distribution of the publications.

5.6 Collaboration with other Institutes Universities and Colleges

The scientists of BHU often collaborate with other institutions' faculties on research projects of mutual interest. Such collaboration may be spurred by informal contacts or prior acquaintance of the scientists. Table 3 represents that total 250 institutions have been collaborated in which 67% collaborated with Academic institutions, 28 % with research institutes/centers and 5 % with scientific agencies. At the global level 52 International institutions have collaborated with BHU.

5.7 Distribution of Collaborative Papers with Other Countries

Table 4 presents that 60(5.76%) of 1041 publications have been collaborated with 18 different countries of world in which highest 10 (0.96%) papers collaborated with USA in affiliation of 9 academic institutes followed by 6 (0.57 %) papers with Japan and UK, 5 (0.48 %) papers with Nepal, 4 (0.38 %) papers with Germany, 3 (0.29 %) papers with South Korea & Taiwan, 2 papers with China, Iran and Switzerland, and 16 (1.63 %) papers collaborated with other 8 countries.

5.8 Distribution of Collaborative Papers with Other States

Table 5 presents that 357(34 %) of 1041 publications have been collaborated with 28 different

Table 3. Collaboration with national and international institutions

Type of institution	Local	Domestic	Intern-ational	Total
Academic institution	60	135	39	234 (67 %)
Research institute/centre	9	78	12	99 (28 %)
Scientific agency	2	14	1	17 (5 %)
Total	**71**	**227**	**52**	**350 (100 %)**

Note: In local institutions all institutes of UP have been counted except all institutes of BHU main campus and affiliated colleges of BHU.

Table 4. International collaboration

S. No.	Country	Papers (% of 1041)
1.	USA	10 (0.96 %)
2.	Japan	6 (0.57 %)
3.	UK	6 (0.57 %)
4.	Nepal	5 (0.48 %)
5.	Germany	4 (0.38 %)
6.	South Korea	3 (0.29 %)
7.	Taiwan	3 (0.29 %)
8.	China	2 (0.19 %)
9.	Iran	2 (0.19 %)
10.	Switzerland	2 (0.19 %)
	Other (8)	17 (1.63 %)
	Total	**60 (5.76 %)**

states of India including 2 Union Territory (Andaman and Nicobar Islands and Chandigarh) in which 55 (5.3 %) collaborated with Delhi in affiliation of 32 institutes followed by Maharastra 33 (3.1 %) in affiliation of 20 institutes, Andhra Pradesh 30(2.9%) in affiliation of 19 institutes, M.P. 26 (2.5 %) in affiliation of 15 institutes, Uttarakhand 21(2 %) in affiliation of 13 institutes, Rajasthan & J&K 19(1.8 %), Haryana 14(1.3 %) collaborated, West Bengal & Gujarat 13(1.2 %) collaborated and 18 other states 114 (11 %) collaborated in affiliation with 74 institutions. Table 7 indicates that highest 13 academic institutions of M.P. have been collaborated, 18 research institutes/centers of Delhi have been collaborated and 5 scientific agencies of Delhi have been collaborated.

5.9 Collaborative Institute/University and Colleges

Table 6 shows top 10 collaborative institutes, in which highest numbers of papers have been collaborated with IARI 17 (1.63 %) followed by JNKV and UPC 11 (1.05 %), then NIT Srinagar, University of Lucknow 9 (0.86 %), University of Delhi (UD) and Indian Institute of Vegetable Research (IIVR) 8 (0.76%), Botanical Survey of India (BSI) 7 (0.67 %), and CSAUAT & IIT Roorkee 6 (0.58 %). As Table 8 indicates that highest 17 papers have been collaborated with IARI followed by JNKV & UPC to achieve the common goal of producing new scientific knowledge.

5.10 Distributions of SCIE indexed and non SCIE indexed journals and papers

Table 7 indicates that total 1041 publications have been published in 259 different India journals in which 54 journals are indexed in Science Citation Index Expanded (SCIE). It shows that 39 % papers have been published in 59 SCIE-indexed journal whereas 61 % literatures published in 205 journals that are not indexed in SCIE.

Table 8 represents that there is only one journal that have more than two impact factor and only 0.10% of total publications have been published

Table 5. Top 10 collaborative states of India

S. No.	States	Academic institutions	Research institutes/ centers	Scientific agencies	Total institutions	Papers (% of 1041)
1.	Delhi	9	18	5	32	55 (5.3 %)
2.	Maharastra	9	9	2	20	33 (3.1 %)
3.	Andhra Pradesh	10	8	1	19	30 (2.9 %)
4.	M.P.	13	1	1	15	26 (2.5 %)
5.	Uttarakhand	9	4	#	13	21 (2 %)
6.	Rajasthan	9	2	#	11	19 (1.8 %)
7.	Jammu & Kashmir	7	1	#	8	19 (1.8 %)
8.	Haryana	9	3	#	12	14 (1.3 %)
9.	West Bengal	8	3	#	11	13 (1.2 %)
10.	Gujarat	8	3	1	12	13 (1.2 %)
	18 Other	44	26	4	74	114 (11 %)
	Total	**135**	**78**	**14**	**227**	**357 (34 %)**

Table 6. Top 10 collaborative institute/university and colleges

S. No.	Institute/university/colleges	Papers	% of 1041
1.	Indian Agricultural Research Institute (IARI)	17	1.63 %
2.	Jawaharlal Nehru Krishi Vishwavidyalaya (JNKV)	11	1.05 %
3.	Udai Pratap College (UPC)	11	1.05 %
4.	National Institute of Technology Srinagar	9	0.86 %
5.	University of Lucknow (UL)	9	0.86 %
6.	University of Delhi	8	0.76 %
7.	Indian Institute of Vegetable Research (IIVR)	8	0.76 %
8.	Botanical Survey of India (BSI)	7	0.67 %
9.	Chandra Shekhar Azad University of Agriculture and Technology (CSAUAT)	6	0.58 %
10.	IIT Roorkee	6	0.58 %

Table 7. Journals indexed/ not indexed in SCIE

	No. of journals	No. of papers
Journals indexed in SCIE	54	404 (39 %)
Journals not indexed in SCIE	205	637 (61 %)
Total	**259**	**1041 (100 %)**

in this journal. There are only seven journals that have more than one impact factor and only 2.69% of total publications have been published in these seven journals and remaining 251 journals have less than one impact factor.

Table 9 includes the list of the top 10 periodicals that have published most of the articles contributed by the authors from BHU. The periodicals are arranged in decreasing order by the number of papers published. Table 9 represents that *Current Science* was one of the most preferred journal followed by *Journal of Geological Society of India, Indian Journal of Physics, Pramana Journal of Physics, Indian Journal of Chemistry–Section A: Inorganic, Bioinorganic, Physical, Theoretical & Analytical, Indian Journal of Chemistry Section B–Organic Including Medicinal, Journal of Environmental Biology, Indian Journal of Landscape Systems and Ecological Studies, Psychological Studies* and *Plant Archives.*

5.11 Citation Distribution of Papers

Table 10 presents that 74.45 % papers are never cited and remaining 8 (0.77 %) papers were cited more than ten times, 1 (0.10 %) paper cited

Table 8. Top 10 Impact factor journals

S. No.	Journal	IF (2013)	Papers (%)
1.	*Journal of Food Science and Technology*	2.024	1 (0.10 %)
2.	*Journal of Biosciences*	1.939	12 (1.15 %)
3.	*Indian Journal of Medical Research*	1.661	3 (0.29 %)
4.	*Journal of Plant biology*	1.284	1 (0.10 %)
5.	*Journal of Chemical Science*	1.224	2 (0.19 %)
6.	*Indian Journal of Biochemistry and Biophysics*	1.077	3 (0.29 %)
7.	*Bulletin of the Astronomical Society of India*	1.066	2 (0.19 %)
8.	*Journal of Genetics*	1.013	5 (0.48 %)
9.	*Journal of Postgraduate Medicine*	0.972	2 (0.19 %)
10.	*Journal of Cancer Research and Therapeutics*	0.949	1 (0.10 %)

Table 9. Prolific journal (Top 10)

S. No.	Journal	No. of articles
1.	*Current science*	57
2.	*Journal of Geological Society of India*	51
3.	*Indian Journal of Physics*	26
4.	*Pramana Journal of Physics*	22
5.	*Indian Journal of Chemistry - Section a: Inorganic, Bioinorganic, Physical, Theoretical & Analytical*	21
6.	*Indian Journal of Chemistry Section B–Organic Including Medicinal*	19
7.	*Journal of Environmental Biology*	19
8	*Indian Journal of Landscape Systems and Ecological Studies*	19
9.	*Psychological Studies*	18
10.	*Plant Archives*	16

10 times, 2 (0.19 %) papers cited 9 and 7 times, 3 (0.29 %) papers cited 8 times, 4 (0.38 %) papers cited 6 times, 7 (0.67 %) papers cited 5 times,12 (1.15 %) papers cited 4 times, 28 (2.68 %) papers cited 3 times,65 (6.24 %) papers cited 2 times,134 (12.87 %) papers cited 1 times. Table 12 reveals that papers with more number of citations are decreasing and papers with least number of citations are increasing.

6. FINDINGS AND CONCLUSIONS

The present study attempted to analyse the scholarly research trends of Banaras Hindu University on the basis of the journals indexed in

Table 10. Citation of the papers

No. of times cited	No. of papers cited	% of 1041
0	775	74.45 %
1	134	12.87 %
2	65	6.24 %
3	28	2.68 %
4	12	1.15 %
5	7	0.67 %
6	4	0.38 %
7	2	0.19 %
8	3	0.29 %
9	2	0.19 %
10	1	0.10 %
10+	8	0.77 %
Total	**1041**	**100 %**

ICI. The actual scholarly productivity of Banaras Hindu University must be very high than we able to measure because numbers of authors from BHU also contributed their scholarly publications in various peer-reviewed, refereed journals which is not yet indexed in ICI. The results of the study indicate that the university has indeed progressed in terms of quantity of scholarly literatures. The present study suggests that research productivity of Banaras Hindu University is increasing at the average rate of 104.1 publications per years. The trend of co-authored pattern is dominating over the single authored paper. University has collaboration with 18 countries and 28 Indian states.. Delhi, Maharastra and Andhra Pradesh are the top three collaborative states. Biological Science, Earth and Geological Science, and Chemistry are the most dominating areas of research. *Current Science, Indian Journal of Physics* and *Journal of Geological Society of India* are the top three journals preferred by scientists of BHU.

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