RESEARCH PRODUCTIVITY AND COLLABORATION PATTERN OF BANARAS HINDU UNIVERSITY (2001-2020): A SCIENTOMETRIC ANALYSIS

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ABSTRACT

This study evaluates and analyse the two-decade research publication journey of Banaras Hindu University (BHU) from 2001 to 2020. The study performed based on the data collected from Scopus database with the affiliation of BHU and the analysis was performed using various scientometric indicators such as growth of publications, citation analysis, and the author collaborations etc. Various modules available with MS excel used to render the data and provide graphical and visual representations. The study found a total of 22,126 publications on different formats. The analysis indicates that there is a consistent growth in the production of research publications throughout the years. However, the emergences of publications varied from 368 in the year of 2001 to 1849 in the year of 2020. It is also observed from the study that BHU is having a major collaboration with other countries such as USA, Germany and China and also established local collaboration with institutions like Bhabha Atomic Research Centre (BARC), University of Delhi (DU) and All Indian Institute of Medical Sciences (AIIMS), New Delhi etc. This study presents how the research output of BHU has flourished in last two decades and can be major source of reference for the similar studies as well as other decision-making processes.

Keywords: Bibliometrics, Scientometrics, Research Analysis, Research Productivity, Publication Productivity, Publication Output, Annual Growth Rate, Collaboration, Relative Specialization Index, h-index, SCImago, Banaras Hindu University, India.

1. Introduction

As one of the largest and quality systems of its kind in the world, the higher education system in India has grown in a remarkable way during the few decades. India hold Central and State universities including state private universities, institutes of national importance and institutions of deemed to be universities at the higher education sector with a good number of students enrolment ratio. There are more than thousand Universities and more than 42000 Colleges in India. Technical education is treated as a separate sector in Indian higher education system. There are around 100 centrally funded technical institutions.

There are more than forty Central Universities in India. Banaras Hindu University popularly known among the academicians as BHU established by the great Indian education reformer Pandit Madan Mohan Malviya in 1916. The university is located in the famous and holy city of Varanasi in the state of Uttar Pradesh in India. It is one of the largest residential Universities in Asia with over 30,000 students from 48 countries.

This is the only University in the World where course ranging from nursery and primary school up to Doctoral/ Post -doctoral degrees are taught. There are 2 campuses, 6 institutions, 16 faculties, 140 departments, 4 advanced centres and 4 interdisciplinary schools. According to SCImago Institutions Rankings released in the year 2021, BHU hold an overall rank of 710 worldwide. The ranking system follows three methodologies such as research rank, innovation rank and societal rank in which BHU received 396th, 486th and 231st rank respectively. Ministry of Education ranks the higher education system across India based on the NIRF (National Institutional Ranking Framework based on some essential parameters such as "Teaching, Learning & Resources (TLR)", "Research and Professional Practice (RP)", "Graduation Outcomes (GO)", "Outreach and Inclusivity (OI)", "Peer Perception" in which BHU stood in 3rd position among all universities and 10th position on overall ranking. BHU has recently been declared as Institution of Eminence (IoE), a recognition scheme for higher education institutes in India, set by the University Grants Commission granting more autonomy and facilitating a better collaboration opportunity with global universities. There are good number of publications appeared in different publications with the affiliation of BHU.

The term 'Scientometric' was coined by V. Nalimov and Mulchenko in 1969. According to them Scientometric as,"the quantitative method which deal with the analysis of science viewed as an information process". Scientometrics is comparing the output as well as the impact of science at national and international levels and is identified as the science about science. Scientometry apply the quantitative methods to study of all aspects of history of science and technology and deals with the analysis, evaluation and graphic and visual representations of them. It can also be act as a tool for policy making by measuring and analysing the discipline. There are different scientometric tools used by different researchers such as citation mapping, bibliographic coupling, co-authorship networking, collaboration patterns, visualization, co-word mapping etc., to qualitatively and quantitatively analyse the publication impact. This particular study utilizes quantitative analysis to describe patterns of research productivity of BHU for the last two decades.

2. Review of Literature

In this study, researchers collected and screened the literature related to the research on scientometric analysis of publications of BHU and similar institutions. It is found from literature search that few studies at different periods have been conducted by different authors to measure the research productivity of BHU.

Balasubramani and Parameswaran (2014) used scientometric methods for analysing the research productivity of BHU using Web of Science as a data collection tool during a specific year range of 2000-2011 and found that the institute of technology leads in publication productivity with 21.3% articles. Singh (2015) conducted a scientometric analysis of research competitiveness of BHU by retrieving 13,977 publications from Web of Science database during 1990-2014 and the study justified with its findings that most of the publications have multiple author's collaboration and some publications have co-authored by international researchers. Gautam and Mishra (2015) analysed the scholarly research trend of BHU based on Indian Citation Index during 2004-2013 and opined that research productivity of BHU is increasing at the average rate of 104.1 per year. Dwivedi (2017) conducted a three-dimensional

bibliometric analysis on the publications of BHU by retrieving 16,556 records from Web of Science, Science Citation index during 1989 to 2016. The study found that the value of collaborative coefficient (CC) stood above 0.5 in every year and it is increasing consistently. Another study was conducted by Lal and Singh (2015) on research trends in the field of Geology in BHU with the support of data collected from the database hold by Sayaji Rao Gaekwad Central Library of BHU. The authors found that most of the documents are published in "Petrology" discipline. Researchers found that no studies were performed on the research publications of BHU accounting two decades using Scopus database recently which makes the uniqueness of this particular study.

The study conducted by Sheri net. al. (2021) on research productivity of Indian Institute of Science (IISc), Bangalore during 2000-2019 using the Web of Science retrieved a total publications of 29,580 and found that the year 2019 witnessed the highest number of publications with 2200 documents and the author with name Kumar found to be the most productive author during this period of study with 736 papers. Pradhan et. al. (2020) examined a scientometric assessment of the research output of Sambalpur University from 1990-2019 as reflected in Scopus database. During this period total of 1527 publications were appeared and found that annual growth rate of the publications is varying from -43.48 to +140. Mahala and Singh (2020) conducted a scientometric analysis on research publication of Indian Universities (2015-2019) by retrieving 26,173 documents from the Science Citation Index of Web of science database and is in the opinion that the most of prolific authors are from the medical and physics fields of science.

Mokhtari et. al. (2019) in their study visualized the scientific publication of Universities of Hamadan University of Medical sciences during 1992-2018 with the support of data retrieved from Scopus database and retrieved 3753 documents and found that the highest rate of collaboration in national level was with Tehran University of Medical Sciences. Internationally, HUMS's researchers had the highest collaboration with the authors from the United States, the United Kingdom and Switzerland, respectively. Klochkov (2019), analysed the publication activity of Indian University Researchers. Csomos (2016) conducted a spatial scientometric analysis on the publications output of cities worldwide (1986 – 2015) by Scopus database and found that the most productive discipline in greater number of cities in world is Medicine and the most collaborators in terms of cities are United State with 73.5% of all cities. Bid (2016) evaluated a scientometric analysis of research output of IIT, Kharagpur during the 2000-2015 appeared in Scopus database and identified that IIT, Kharagpur has contributed 18,927 papers with 187322 citations with a top priority in the subject of engineering. Sangam and Bagalkoti (2015) performed a scientometric study for rankings of Indian universities using Scopus database during 2001-2010 and selected top 50 universities to measure the research productivity of faculties in terms of publication counts and citation counts. Another study performed by Jeyasekar et. al. (2014) to measure the research output of global forensic science using Scopus database from 1975 to 2011. The total numbers of publications were found 13,626 documents and the most contributing country is being noted as USA with 30%.

Majhi and Maharana (2012), examined in their scientometric study on research productivity of Physical Sciences in Sambalpur University and assessed that the

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research output of Sambalpur University in Physical science subject, published 417 documents during (1971-2010), the data reflected from Scopus database. Lee (2003) conducted a scientometric analysis on research performance of Institute of Molecular and Cell Biology, Singapore and found that 95.6% of total publication was published in ISI journals. The articles received an average of 25-35 citations per articles, and the percentage of uncited articles are 11.6%.

3. Objectives of the Study

The main objective of this study is evaluate the research output of BHU during a selected period of time from 2001 to 2020 based on the data retrieved using Scopus database. The specific objectives of the study are as follows:

a) To examine the year wise growth of research publication of BHU.

b) To estimate the Annual Growth Rate (AGR), Average Annual Growth Rate (AGR) and Relative Specialization Index (RSI) of publications.

c) To find out the impact of research productivity in terms of Cited rate and citation average.

d) To assess the distribution of citations and identify the highly cited papers among them.

e) To identify the national and international institution wise and country wise research collaboration.

4. Limitations of the study

Though the study focuses on the scientometric analysis of the publication spectrum of BHU, the present study limited the research output range from 2001 to 2020. The study solely depends on the data indexed in the Scopus database and other publications which are not covered by Scopus during this period are not considered under the scope of the analysis.

5. Methodology

The data source used for the present study is Scopus, a product of Elsevier and one of the leading indexing and citation databases known globally. Scopus widely covered the publication and indexes most of the prolific journals. Search was carried out using the term 'BHU' as keyword. The search string BHU (AF ID 60008721) limiting the publication year as 'PUBYEAR 2001 to PUBYEAR 2020'.

The SCImago Journal & Country Rank is a publicly available portal that includes the journals and country scientific indicators developed from the information contained in the Scopus database. It facilitates three types of searching process – (i) Country wise, (ii) Institution wise and (iii) Journal wise. Search was carried out by Country Rankings. Further selection was done based on the subject areas by limiting the time period too. Further the detailed analysis was performed to get the desired results using different scientometric formulae as follows.

5.1. Annual Growth Rate (AGR)

This metric is used to measure the growth of publications over a time period of five years. The "Annual Growth Rate" (AGR) is calculated using the formula as follows

$$AGR = \frac{(Current\ Period - Previous\ Period)}{(Previous\ Period)} * 100$$

5.2. Average Annual Growth Rate (AAGR)

This metric is used to calculate the Average value of Annual Growth Rate (AGR) of fourth Five years period.

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$$AAGR = \frac{\text{(AGR of Period 1) + (AGR of Period 2) + (AGR of Period 3) + (AGR of Period 4)}}{\text{(Number of Period 4)}}$$

5.3. Real Citation Average

This metric is used to assess the quality of research publication across different subject areas and years.

$$\text{Real Citation Average} = \frac{\text{(Total Citation of the year or Subject areas)}}{\text{(Number of Publications which have at least 1 citation)}}$$

5.4. Cited Rate

This metric is used to measure the percentage of publications that have been cited at least 1 time.

$$\text{Cited Rate} = \frac{\text{(Number of Publications which have at least 1 citation)}}{\text{(Total Publications which are published)}} * 100$$

5.5. Percentage of Publications not Cited (PNC)

This metric defines percentage of publication which are not cited during given period.

$$PNC = \frac{\text{(Total Publication - Publication having at least 1 citation)}}{\text{(Total Publication)}} * 100$$

5.6. Relative Specialization Index (RSI)

The RSI compares the shares of subject disciplines in University's total publication to share subject discipline in world's total publications. RSI is a relative indicator which is based on the Activity Index (AI).

$$AI = \frac{\text{(Total no. of Publications in given discipline and university)}}{\text{(Total Publications which are published in World in given subject)}}$$

Then we define RSI,

$$RSI = \frac{(AI - 1)}{(AI + 1)}$$

RSI takes it value in the range -1 to 1. If RSI value (RSI >0), a university has a higher-than-average activity in the world or (RSI <0) it means a lower-than-average activity.

6. Results and Discussion

The researchers found from the data that during the selected year from 2001 to 2020, BHU produced 22126 publications across all disciplines and are cited at 3,72,407 times. It is identified from the publications analysis that most of publications are published in English language (22,137) followed by Turkish (4), French (3), Portuguese (3), Russian (3), Spanish (3), German (2) etc. The researchers used various scientometric parameters to further analyse the publication output of the organization as follows:

6.1. Year-wise Publications

Figure 1depicts the year-wise growth of research publications of BHU over the selected periods. The highest number of publications was produced in the year 2020 with 1849 documents and the least number of publications appeared in the year 2002 with 362 documents. The value of h-index was high in the year 2009 with 76 counts followed by 74 in the year 2011 and shows the lowest h-index value of 23 in the year 2020.
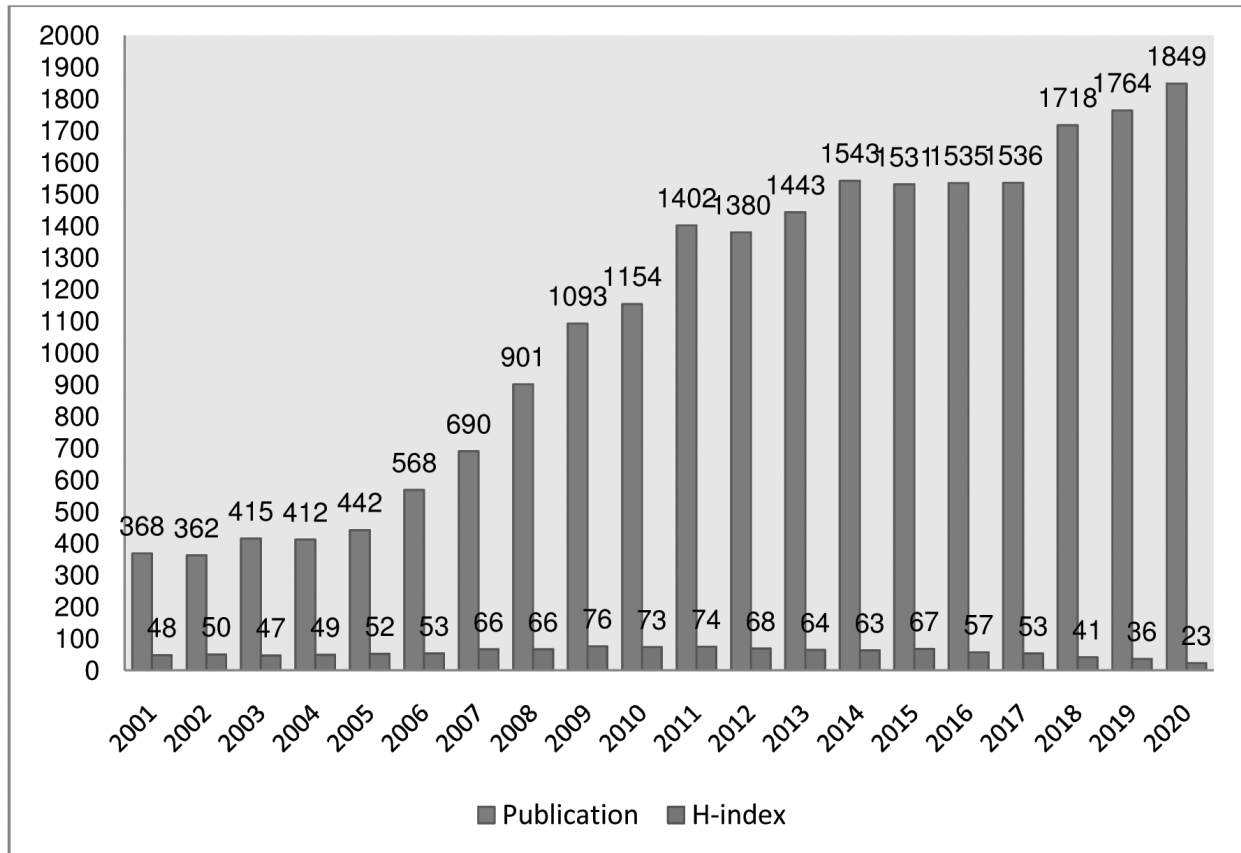
Fig.1. Year-wise Publication with H-index

6.2. Impact and Growth of Research Publications

Researchers evaluated the impact of research output of BHU in terms of the Real Citation Average, Cited Rate and the total publication having at least 1 citation and also the percentage of publication which are not cited. It is found from the analysis that a total number of 372,427 citations were received for 22,126 documents of BHU across all disciplines in past 20 years from 2001 to 2020. The cited rate varied from the maximum of 90.88% in the year 2002 to the minimum of 72.79% in the year 2020. The Real Citation Average also varies from maximum of 35.29% in the year 2005 to the minimum 13.84% in the year 2020. Over the period of 20 years from 2001 to 2020, 82.22% of papers had at least one citation and 17.78% papers did not receive any citations. Table 1 depicts the year-wise details of publications, its corresponding citations with total number of publications having at least 1 citation, Real Citation Average, Cited Rate and the percentage of publications which are never received any citations.

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Table 1

Year-wise Impact of Research Output of BHU

Year	Publications	Citations	Total Publication with at least 1 citation	Real Citation Average	Cited Rate in %	% of Publication not Cited
2001	368	9731	331	29.40	89.95	10.05
2002	362	9962	329	30.28	90.88	09.12
2003	415	10264	361	28.43	86.99	13.01
2004	412	10273	369	27.84	89.56	10.44
2005	442	13974	396	35.29	89.59	10.41
2006	568	13623	499	27.30	87.85	12.15
2007	690	21826	623	35.03	90.29	09.71
2008	901	19805	809	24.48	89.79	10.21
2009	1093	25394	966	26.29	88.38	11.61
2010	1154	33127	1038	31.91	89.95	10.05
2011	1402	29307	1220	24.02	87.02	12.98
2012	1380	25964	1240	20.94	89.86	10.14
2013	1443	22479	1268	17.73	87.87	12.13
2014	1543	25039	1304	19.20	84.51	15.49
2015	1531	23657	1308	18.09	85.49	14.51
2016	1535	25689	1277	20.12	83.19	16.81
2017	1536	18395	1238	14.86	80.60	19.40
2018	1718	18532	1339	13.84	77.94	22.06
2019	1764	10856	1284	08.45	72.79	27.21
2020	1849	4530	994	04.56	53.76	44.24
Total	22106	372427	18193	16.85	82.30	17.70

6.3. Subject-wise Impact of Research Publications

Researchers made an attempt to assess the subject-wise impact of research output and found that the publication outputs of BHU have received significant number of citations on different subject areas. Among them top 10 disciplines were chosen for the analysis and are represented in table 2. It is identified from the analysis that the cited rate varies from a maximum of 93.37% in the subject area of 'Chemistry' followed by 89.12% in 'Materials Science' to the minimum of 78.56% in 'Medicine'. The highest citation average appeared in 'Environmental Science' with 24.13% citations per paper followed by Chemistry with 23.39% and lowest citation average is in 'Earth and Planetary Science' with 14.87% citations per paper. Percentage of non-cited papers varies from maximum of 22.44% in the subject areas of 'Medicine' followed by 20.91% in 'Agriculture and Biological Science' to the minimum of 06.63% in the field of 'Chemistry'.

Table 2

Impact of Subject-wise Publication of BHU

Subjects	Publi-cations	Citati-ons	Total Publication having at least 1 citation	Real Citation Average	Cited Rate in %	% of Publica-tion not Cited
Medicine	4240	77240	3331	23.19	78.56	22.44
Physics and Astronomy	4013	76958	3501	21.98	87.24	12.76
Biochemistry, Genetics and Molecular Biology	4006	72962	3486	20.93	87.02	12.98
Agricultural and Biological Sciences	3453	51555	2731	18.88	79.09	20.91
Chemistry	3440	75139	3212	23.39	93.37	06.63
Materials Science	3117	59315	2778	21.35	89.12	10.88
Engineering	2996	44888	2417	18.57	80.67	19.33
Environmental Science	1898	37930	1572	24.13	85.53	14.47
Pharmacology, Toxicology and Pharmaceutics	1716	32260	1424	22.65	82.98	17.02
Earth and Planetary Science	1312	16461	1107	14.87	84.38	15.62

## 6.4. Growth Rate of Research Publication

An assessment has performed for calculating the growth of publications, its annual growth rate and the aggregate AGR. Results (table 3) indicates, over a period of 20 years, BHU has recorded increase in research output ranging from the maximum 24.42% in 'Environmental Science' followed by 18.48% in 'Agricultural and Biological Science' to the minimum of 05.29% in 'Physics and Astronomy'. There are negative growths registered in 'Chemistry', 'Materials Science and Pharmacology', 'Toxicology and Pharmaceutics' during the time period 2016-2020. Figure 2 represents the maximum number of publications published in the subject area of 'Medicine' with 4240 documents followed by 'Physics and Astronomy' with 4013 documents. The minimum number of publications published in 'Earth and Plantory Science' was identified as 1332 documents.

Table 3

Top 10 Subject-wise Publication with AAGR and AGR

Subject	Number of Publication				Total Publication	Annual Growth Rate (in%)			AAGR (2001-2020)
	2001-2005	2006-2010	2011-2015	2016-2020		2006-2010	2011-2015	2016-2020	
Medicine	412	1023	1309	1496	4240	29.66	05.59	02.50	12.58%
Physics and Astronomy	485	916	1290	1322	4013	17.77	08.17	00.50	05.29%
Biochemistry, Genetics and Molecular Biology	375	693	1398	1540	4006	16.96	20.35	02.03	13.11%
Agricultural and Biological Sciences	235	523	1190	1505	3453	24.51	25.51	05.41	18.48%
Chemistry	295	695	1300	1150	3440	27.12	17.41	-02.31	14.07%
Materials Science	344	661	1086	1026	3117	18.43	12.86	-01.10	10.06%
Engineering	282	605	952	1157	2996	22.91	11.47	04.31	12.90%
Environmental Science	98	305	534	961	1898	42.24	15.02	15.99	24.42%
Pharmacology, Toxicology and Pharmaceutics	161	372	603	580	1716	26.21	12.42	-00.76	12.62%
Earth and Plantory Science	111	253	331	617	1312	25.59	06.17	17.28	16.35%
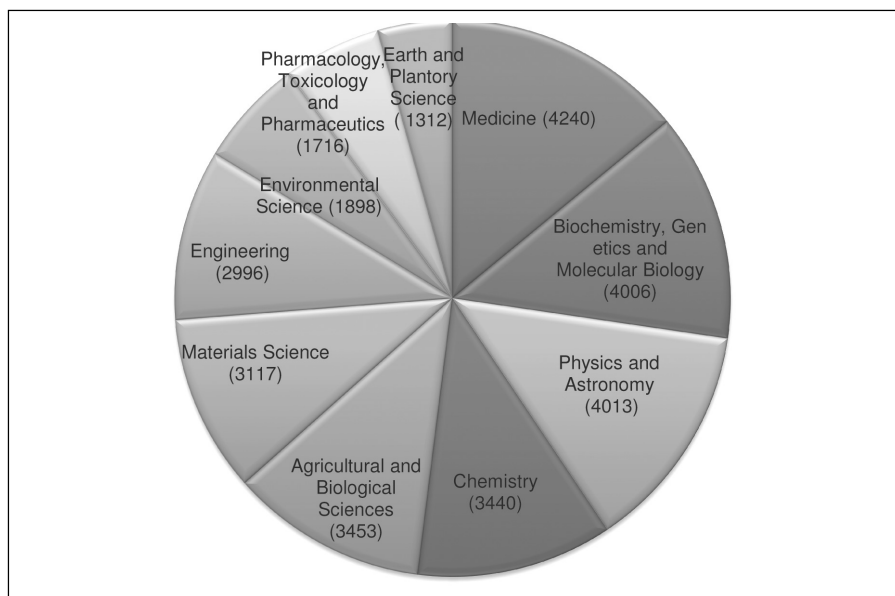
Fig. 2. Top 10 Subjects (BHU)

6.5. Comparing BHU's Publication with India and World

Subject wise contribution of BHU in comparison with the World's and India's total publications output has been carried out. Findings of the study (table 4) indicate that the Relative Specialization Index (RSI) of BHU varies from-00.9982 in the area of 'Pharmacology, Toxicology and Pharmaceutics' to -00.9994 (each) in the field of Medicine and Engineering. Table 4 provide a detailed account on RSI and the data collected for the publication output at different levels have taken based on the data provided in the SCImago Journal and Country Rankings portal.

Table 4

RSI of BHU Compared with World's and India's Publication Output

| Subjects	World	India	BHU	RSI
Medicine	16498101	437957	4240	-00.9994
Biochemistry, Genetics and Molecular Biology	6693609	214309	4006	-00.9988
Physics and Astronomy	7999875	289670	4013	-00.9990
Chemistry	5010548	251911	3440	-00.9986
Agricultural and Biological Sciences	4148932	154643	3453	-00.9984
Materials Science	6094785	266634	3117	-00.9990
Engineering	11271574	488967	2996	-00.9994
Environmental Science	3170622	129477	1898	-00.9988
Pharmacology, Toxicology and Pharmaceutics	1820086	145104	1716	-00.9982
Earth and Plantory Science	3078317	73337	1312	-00.9992

Source: SCImago Journal & Country Rankings; RSI - Relative Specialisation Index

6.6. Collaboration

6.6.1. Country wise Collaboration

Research productivity of BHU is further analysed to assess its collaboration with other countries. Country wise collaboration of BHU along with its h-index is represented in Figure 3 and only top 10 counties were taken into consideration. It is examined from the analysis that BHU has made the highest number of research collaboration with USA in-terms of its publication output and is indicated as 1436 documents which has contributed to reach the h-index as 120. It is followed by Germany with 697 documents (h-index 100) and the Brazil is indicated as last in the top 10 countries with 356 research publication at a rate of 94 for as its h-index.

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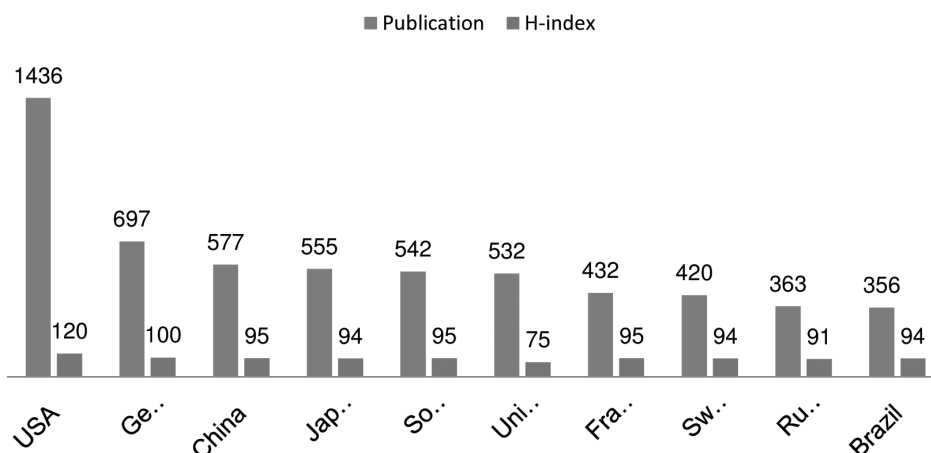
Fig. 3. Country-wise Collaboration

6.6.2. Institution wise Collaboration

Analysis on the institution wise research collaboration (table 5) indicates that BHU has made the highest number of collaborations in-terms of its research publication with 'University of Tokyo' followed by 'Lunds University','Columbia University' and 'Korea University' at the rate of 284, 277, 270 and 267 publications respectively. It is further analysed that 11.86% of the total publication have the collaboration with international institutions and the 10.72% of total publications have collaboration with national Institutions during the selected period of study. The highest h-index of international institution indicated as 88 with the 'Universidade de Sao Paulo, Brazil' and the highest h-index of national institution represented by BARC, Mumbai as 72.

Table 5

International and National Institute Collaboration with BHU

International Institutes	Country	Collabora-tive publications	H-index	National Institutes	Collabor-ative Publica-tions	H-index
University of Tokyo	Japan	284	87	BARC, Mumbai	353	72
Lunds University	Sweden	277	86	University of Delhi	328	38
Columbia University	USA	270	86	AIIMS, Delhi	299	44
Korea University	South Korea	267	86	University of Allahabad	277	41
Yonesei University	South Korea	257	81	CSIR, New Delhi	253	44
Kyoto University	Japan	256	86	University of Lucknow	184	26
Universidade de Sao Paulo	Brazil	255	88	ICAR, New Delhi	180	29
Iowa State University	USA	254	79	IIT, Roorkee	168	19
The University of Tennessee	Knoxville, USA	253	81	CDRI, Lucknow	167	33
The University of Mexico	Mexico	251	82	National Physical Laboratory, Delhi	163	34

6.7. Highly Cited Publications

It is observed that researchers of BHU published in a wide range of journals which are having high impact factors and the document with a title Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015 published in the journal 'The Lancet' with an IF of 6.392 received the highest number of citations as 3133. This is followed by another article published in the same journal with a title "Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015" got a citation of 2974.

Table 6

List of Top 10 Highly Cited Paper Published by BHU

Title of the research article	Source Title	IF of Source	Cited times
Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015	The Lancet 388 (10053), pp. 1545-1602	60.392	3133
Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015	The Lancet 388(10053), pp. 1459-1544	60.392	2974
Formation of dense partonic matter in relativistic nucleus-nucleus collisions at RHIC: Experimental evaluation by the PHENIX Collaboration	Nuclear Physics A 757 (1-2 SPEC. ISS.), 184-283 pp.	01.463	2351
Global, regional, and national incidence, prevalence, and years lived with disability for 354 Diseases and Injuries for 195 countries and territories, 1990-2017: A systematic analysis for the Global Burden of Disease Study 2017	The Lancet 392(10159), pp. 1789-1858	60.392	2249
Emergence of a new antibiotic resistance mechanism in India, Pakistan, and the UK: A molecular, biological, and epidemiological study	The Lancet Infectious Diseases 10(9), pp. 597-602	24.446	2018
Atomic layers of hybridized boron nitride and graphene domains	Nature Materials 9(5), pp. 430-435	38.663	1593
Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980–2017: a systematic analysis for the Global Burden of Disease Study 2017	The Lancet 392(10159), pp. 1736-1788	60.392	1581
Drug resistance in leishmaniasis	Clinical Microbiology Reviews 19(1), pp. 111-126	17.406	1178
Characterization of enhanced antibacterial effects of novel silver nanoparticles	Nanotechnology 18(22),225103	03.551	1073
Visceral leishmaniasis: What are the needs for diagnosis, treatment and control?	Nature Reviews Microbiology 5(11), pp. 873-882	34.209	1058

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7. Findings

The main aim of this study is to investigate the publication output of BHU for the last two decades as reflected in the Scopus database. From the analysis it is found that there is an increasing trend of contributing research output with collaborations at national and international levels. Following are the major findings of the present study.

a) It is found from the analysis that research productivity of BHU is consistent in the last two decades and the year 2020 witnessed the highest number of publications with a total of 1849 documents and the least number of publications appeared in the year 2002 with 362 documents.

b) It is observed from the analysis that a total number of 372,427 citations were received for 22,126 documents of BHU across all disciplines during the selected period from 2001 to 2020. The cited rate varied from the maximum of 90.88% (2002) to the minimum of 72.79% (2020) and the real citation average ranged from maximum of 35.29% (2005) to the minimum 13.84% (2020) and shown that 82.22% papers had atleast one citation.

c) It is identified from the study that the highest percentage of citation average appeared in the discipline of 'Environmental Science' (24.13% citations per paper) and lowest in 'Earth and Planetary Science' (14.87%). Further, percentage of non-cited papers varies from maximum of 22.44% (Medicine) and the minimum of 06.63% (Chemistry)

d) Over a period of 20 years, the University has registered increase in research output ranging from the maximum 24.42% in Environmental Science followed by 18.48% in Agricultural and Biological Science to the minimum of 05.29% in Physics and Astronomy.

e) It is found from the analysis that a maximum number of publications published in the subject area of 'Medicine' with 4240 documents and the minimum number of publications appeared under the subject area of 'Earth and planetary Science' with a record of 1332 documents during the selected period of study.

f) It is identified from the analysis that the RSI of BHU varies from-00.9982 to -00.9994 in the discipline of 'Pharmacology, Toxicology and Pharmaceutics' and 'Medicine and Engineering' respectively.

g) Findings of the study indicate that BHU has made its research collaboration with many countries and found that USA, Germany and China are the top 3 countries respectively in which the maximum number of publications were produced. At the institutional level, the highest number of collaborations was made with the University of Tokyo with 284 publications.

h) It is found that 11.86% of the total publications of BHU have the collaboration with international institutions and 10.72% of total publications have collaboration with national institutions during the selected period of study. The highest h-index of international institution indicated as 88 with 'Universidade de Sao Paulo, Brazil' and the highest h-index of national institution represented by BARC, Mumbai as 72.

i) Study identified that an article published in the journal ' *The Lancet*' having an impact factor of 60.392 with

a title "Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015 has received that highest number of citations during the selected period of study with a count of 3133.

8. Conclusion

The present study made an attempt to trace out the publication output of BHU from 2001 to 2020 as reflected in the Scopus database and to assess its growth, nature of collaboration and the research impact in terms of various scientometric parameters. Researchers have observed a consistent growth of research output throughout the selected period of study and over the past 20 years, there has been a remarkable increase in the research output of BHU. The analysis was undertaken to gain a better and comprehensive understanding of the recent research publications of BHU. Most of publications published in journals (20,067) forms followed by book (922), conference proceeding (857), book series (280) and so on. Further major portion of the publications during this period belongs to the subject area of medicine. BHU had a better collaboration with foreign countries and the publications appeared in different national and international journals of high reputation and impact factors. This study provides an indication of current publication patterns and its citation analysis of BHU and helps the researchers and faculties to analyse the publication trends in their respective areas.

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