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A Scientometric Profile of Sant Gadge Baba Amravati University, Amravati During 1996-2017

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ABSTRACT

The study presents the scientometric profile of Sant Gadge Baba Amravati University (SGBAU), Amravati during 1996-2017. The required research output for the study has been pulled out from SCOPUS database on the basis of affiliation based search. The complete research output is 1130 with 10.65 per cent average citations per paper. 83.98 per cent papers were published during the year 2007 to 2017 which is highly productive block compared to 16.02 per cent research output during 1996 to 2006. The highest H-index (17) was found in the year 2009. 20.08 per cent documents were produced though international collaboration. SGBAU, Amravati has the largest collaboration with Brazil (69) and United States (21). Authorship pattern predicts collaborative trend. Maximum 370 papers were written by two author, however research papers produced with three author have got the maximum 4444 citations for their 315 paper. Collaborative authorship pattern has received maximum citations (89.17 %). Average degree of collaboration is 0.96 while the average modified collaborative coefficient is 0.6289. 839 Journal and 174 Conference papers are the most popular source types preferred by the faculty of SGBAU for research expression. Mahendra Rai (209), S. K. Omnwar (143) and Anand S. Aswar (94) are the most prolific authors. It is noteworthy that Alka P. Yadav has got 3073 citations for her 17 paper. Most of the articles are published in the domain of Physics and Astronomy (356) followed by Engineering, Chemistry, Material Science, Biochemistry-Genetics-Molecular Biology and Computer Science. With regard to institutional collaboration, the faculty members of the SGBAU have confined themselves to the Maharashtra state most of the time. The frequency and co-occurrence of keywords denotes the core research areas in multitude subject fields in which the faculty members are engaged with. Data visualisation which is carried out using VOSviewer.

Keywords: Scientometrics; Sant Gadge Baba Amravati University; Amravati; SCOPUS; VOSviewer; International collaboration; Authorship pattern; Institutional collaboration

1. INTRODUCTON

Universities have to play a key role in imparting quality education and promoting research activities through its educational departments. This is important not only to develop particular subject field but also to quench scientific thirst of creative peoples who are mostly the academicians. It ultimately results in adding more knowledge, understanding particular phenomena, accelerating the business and scientific decision making. Scientometric is a very popular method to study the quantitative aspect of the research productivity and the same method has been adopted to study research output of Sant Gadge Baba Amravati University (SGBAU), Amravati.

The Sant Gadge Baba Amravati University (SGBAU), Amravati is established on 1st May, 1983, the auspicious Maharashtra Day and Worker's Day. This University graphically covers the western Vidarbha belt (i.e. five districts- Amravati, Akola, Yawatmal, Buldhana and Washim) of Maharashtra state. The University in its small span of two decades has contributed in many ways for economic, social and cultural upliftment of the society by offering quality education. The university has 10 faculties which include Arts, Commerce, Science, Engineering and Technology[1]. The University has 23 teaching department besides several study centers. The Knowledge Resource Centers (KRC) of the university has used SOUL 2.0 for library automation purpose. KRC provides web-OPAC facility, remote access facility and document delivery service. Even federated searching is enabled through Knimbus. During the year 2015-16, there were 1609 student (610 male and 999 female) enrolled in the various teaching departments of the university while there were 319 teaching faculty member including professors, associate professors, assistant professors and clock hour based teachers. 169 student registered themselves as candidates for the doctoral programs[2]. The university has also started post graduation courses in History, Commerce, Economics and Science from academic session of 2016-17.

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2. LITERATURE REVIEW

There are ample of studies in which scientometrics has been used to measure the scientometric productivity of universities. A few studies relevant in the present context have been enumerated as follows.

Khana, Sunaina et.al in their scientometric study[3] found

that Guru Nanak Dev University (GNDU) published total 652 publication in physics and astronomy during 2006-15, with an annual average growth rate of 9.6 per cent and overall research productivity increased from 277 during 2006-10 to 375 in 2011-15, calculating growth rate of 35.38 per cent. Considering the research output of 25 most productive Indian Universities in physics and astronomy GNDU ranked 23rd in terms of publication output (652) and ranked 7th in terms of h-index (29), 16th in average citation per paper (7.01 %) and 18th in high cited papers (1 %). The share of physics and astronomy output in the overall GNDU was 22.21 per cent.The largest number of collaborative 30 papers were found with Bhaba Automic Research Centre and international collaboration involved 108 (16.56 %). The faculty members mostly preferred the journal 'Advanced Functional Material' which has highest impact factor (11.38) followed by 'Advances in Colloid and Interface Science (7.813). Of the 160 author, the top 20 most productive author individually published 16 to 54 publication with 92.94 per cent share of total publications and 91.82 per cent share of total citations of GNDU in physics and astronomy. The top 15 highly cited papers appeared in citation range from 40-80 together account for 775 citation, leading to average citation per paper of 50.47 per cent. The authors concluded that the contribution of GNDU in physics and astronomy lagged behind other leading Indian universities given that publications output and citation impact.

Bebi and Kumar, Shailendra attempted[4] to assess research productivity of women faculty of physics from select institution from Delhi through scientometric study. The study revealed that there were less women faculties as compared to male faculties. Moreover, the value of collaborative coefficient indicated that they favoured to work in collaboration for the publication. It was again interesting to know that they preferred to be second author in most of the publications. While Ratnamala Chatterjee from IIT Delhi got the first position among the most prolific authors with 54 journal publication, a paper written as a co-author by Amita Chandra from university of Delhi received 120 citation in which 119 citation were received from foreign journals.

Kumar, Ashok et.al did the scientometric assessment[5] of Kurukshetra University research output during 2006-15 based on 2361 publication as covered in Scopus database. The average citation per paper registered by all the publications of Kurukshetra University was 4.85. The share of national collaborative publication in the total output was 38.54 per cent. The share of international collaborative papers was 9.11 per cent. Immunology and microbiology made the highest citation impact per paper (9.62 %), followed by pharmacology, toxicology and pharmaceutics (8.70 %). Seven author published more than the average productivity per paper (54.6 %) of all authors. The authors concluded that Kurukshetra University trailed behind compared to other North Indian universities.

A study by Noruzi, Alireza and Abdekhoda, Mohammadhiwa provided[6] an assessment of the scientific productivity of Iraqi-Kurdistan universities during 1970-2012. The study found that 379 of 459 publications appeared between 2004 to October, 2012 (82.57 %). Out of the 459 paper, 99 (22 %) appeared in the top 22 journal. Most of the publications (52 %) were co-authored with foreign countries. 211 paper (40 %) received 1020 citation while 248 (60 %) papers hardly received any citations. The majority of highly cited papers contributed by Iraqu-Kurdistan authors were in the field of medicine. The papers published in the journals received maximum citations as compared to conference proceedings.

Aswathy, S and Gopikuttan analysed[7] the scientific productivity of faculty members of three universities in Kerala viz, University of Kerala (UoK), Mahatma Gandhi University (MGU) and University of Calicut (UoC). The trend was seen towards multi-authorship with year wise growth in publications. The university wise degree of collaboration was 0.93, 0.84, and 0.85 for UoK, MGU and UoC respectively. The complete research output of universities of Kerala was not in conformity with Lotka's law. Collaboration for different subject ranges from 0.01 and 0.99.

Nagarkar, Shubhada and Kengar, Manisha carried out[8] the quantitative analysis of published research output of the department of physics during 1990 to 2014. The steady growth was seen in publications with the highest international collaboration with USA and national collaboration with Bhaba Atomic Research Centre (BARC), Mumbai. The collaborative papers increased during 2010-2014. Interestingly, 31 keyword were found which had been used more than 50 time.

Karpagam, R presented[9] his study on scientometric analysis of nanobiotechnology global research output for the years 2003-2012. A total 114,684 paper were published which received 2,503,795 citation with an average of 21.83 citation per paper. The United States with 30.29 per cent was the largest contributor followed by China and Germany. However, Canada registered highest citation impact with 23.27 citation per paper. United Kingdom shared largest collaborative papers (76.47 %). 85 per cent of the total research output was contributed by the top ten countries. Evaluating the countries by various indices, USA again held the first position with the highest h-index (120), g-index (541), h-index (434.52) and p-index (326.47). Joint authorship was seen as current trend. India, China, South Korea and China showed higher increasing publication, higher increasing activity index. Massachusetts Institute of Technology USA received the highest h-index (120) and stood first as leading contributor. Biomaterials (1631) were the top journal with regard to publication output. Journal of the American Chemical Society received the highest h-index (158) and Nano Letters made the highest impact with an average citation per papers (73.86 %).

No study has been conducted so far to study scientometric profile or measure the scientific output of SGBAU, Amravati. The present study is maiden attempt to accomplish that task with the help of the objectives mentioned as below.

3. OBJECTIVES

The study has been performed with the following objectives.

- To measure the growth of publication along with total citation impact for particular year
- To study the ongoing scenario concerning international collaboration
- To find out the citations received for various authorship

pattern
- To study the trend in authorship pattern
- To find out the source type used by the citing authors
- To identify most prolific authors from the institution
- To take an overview of distribution of research output in various subject categories
- To study the institutional collaboration of SGBAU within India
- To study co-occurrence of keywords and it's link strength

4. METHODOLOGY

The research output of the SGBAU faculty members required for the present study was extracted from the SCOPUS database. Though the university is established in 1983, the publications from 1996 are available in the SCOPUS. Hence the publication output from 1996 to 2017 has been considered for the study. In order to get appropriate data, the affiliation based search with the tag 'Sant Gadge Baba Amravati University Amravati' was made which resulted in availability of 1161 document. The affiliation city was 'Amravati'. In order to eliminate the documents of 2018 from the search, the search was limited to the year 2017, which gave the output of 1130 documents. The same data was filtered for 'Year', 'Author name', 'Subject Area', 'Document type' and 'Affiliation' based search to get the results for the concerning parameters. The Output of 1130 was exported as 'Microsoft Office Excel Comma Separated Value File' for getting appropriate results about authorship pattern and citation received for each pattern. The data of 1130 record were also used as an input to VOSviewer for data visualisation of international collaborations, co-authorship network and co-occurrence of keyword.

5. ANALYSIS OF DATA

5.1 Growth of Publication

The complete research output as shown in Table 1 of Sant Gadge Baba Amravati University, Amravati is 1130 during 1996 to 2017. During 1996 to 2006, 16.02 per cent paper were produced while 83.98 per cent document were published during 2007 to 2017 which can be regarded as highly productive block. The average citation per paper for publication is 10.65 per cent which scaled up 8.79 per cent to 11 per cent from 1996-2006 to 2007-2017. There seems the growth in publication output which ultimately resulted in the growth of total citation received. The year 2009 is remarkable in that 3825 (31.77 %) citation were received in one year. H-index (17) is also high in this year followed by15 in 2014 and 2015, 14 in 2007 and 2013. The years from 2013 to 2017 have been very productive with regard to international collaborative publication as 40, 44, 31, 24, 34 paper have been published consecutively during these years. 20.08 per cent documents were published through international collaboration. The increase in internationally collaborative papers is promoting growth to overall research output. However, the proportion is low when measured up by and large.

Table 1. Growth of publication

Publication Year	TP	TC	ACPP	H-Index	ICP	ICP (%)
1996	11	71	6.45	4	1	9.09
1997	9	49	5.44	4	0	0
1998	10	58	5.8	4	0	0
1999	15	55	3.66	5	0	0
2000	6	33	5.5	3	0	0
2001	20	141	7.05	6	1	5
2002	9	99	11	5	0	0
2003	34	231	6.79	9	1	2.94
2004	14	269	19.21	7	0	0
2005	17	200	11.76	6	2	11.76
2006	36	385	10.69	9	3	8.33
2007	48	425	8.85	14	3	6.25
2008	35	649	18.54	10	6	17.14
2009	69	3825	55.43	17	9	13.04
2010	70	774	11.05	13	6	8.57
2011	88	632	7.18	12	5	5.68
2012	73	886	12.13	12	9	12.33
2013	79	719	9.10	14	40	50.63
2014	94	922	9.80	15	44	46.81
2015	118	941	7.97	15	31	26.27
2016	161	510	3.16	11	24	14.91
2017	114	164	1.43	7	34	29.82
	1130	12038	10.65		227	20.08

TP-Total publication; TC-Total citation; ACPP-Average citation per paper; ICP-International collaborative papers

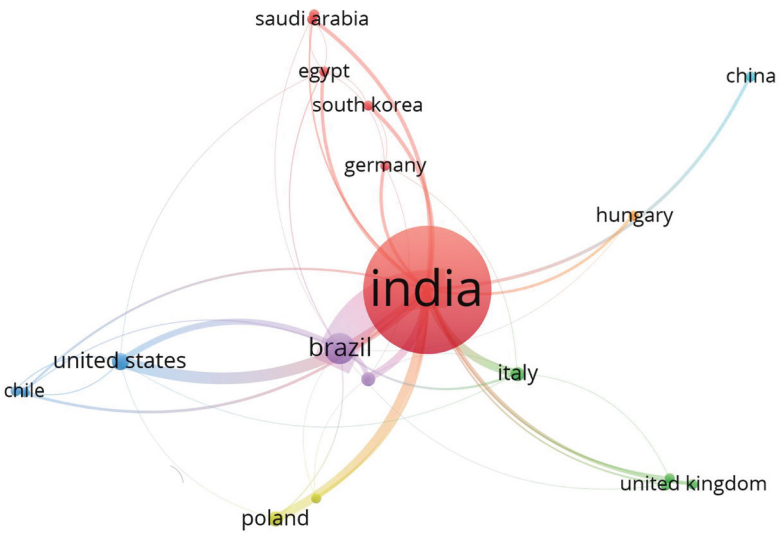

Figure 1. International collaboration.

5.2 International Collaboration

Collaborative research is the current trend and desirable feature in the academic world. International collaboration has been one of the vital sources to share thoughts, technology and ideas concerning specialised topics. Figure 1 throws light on SGBAU's collaboration with leading countries across the world. The links around the circle indicate research collaboration. The large circle around India shows that maximum (1123) research documents have been collaborated within India. SGBAU, Amravati has the largest (69) collaboration with Brazil followed by United States (21), Poland (16), Italy (15) and Ukraine (14). These countries share more than 50 per cent international collaboration with SGBAU, Amravati.

5.3 Citations Received for Authorship Pattern

Table 2 gives an idea about citation received for various authorship patterns. It is categorised into two blocks of eleven years period considered in the study. Research productivity has been increased in the second block. It directly affected in receiving more citations. For all kinds of authorship pattern, 12038 citation were observed. It seemed from the study that from 1 to maximum 13 author have contributed for the publication output. As compared to the first block, single authorship has increased in the second block, but received a fewer citations. The result confirms that collaborative authorship is gaining the ground. 91.95 per cent documents are contributed by two author, three author, four author, five authors and six authors grabbing 89.17 per cent citations. Earlier studies have confirmed collaborative authorship is preferred over single authorship[4,7-10]. Maximum papers are contributed by two authors and they received 1757 citations. The papers written by three author are 315, but they got maximum citations. Although papers contributed by 7 author and onwards are less in numbers, yet it gives a glimpse that collaborative research is spreading out.

Table 2. Citations received for authorship pattern

Author	1996-2006		2007-2017		Total	
	Papers	Citations	Papers	Citations	Papers	Citations
1	11	140	35	131	46	271
2	73	319	297	1438	370	1757
3	56	466	259	3978	315	4444
4	22	202	166	1658	188	1860
5	13	253	95	1127	108	1380
6	4	164	54	1130	58	1294
7	1	42	14	332	15	374
8	1	5	16	490	17	495
9	0	0	8	124	8	124
10	0	0	3	32	3	32
11	0	0	0	0	0	0
12	0	0	1	5	1	5
13	0	0	1	2	1	2
Total	181	1591	949	10447	1130	12038

5.4 Degree of Collaboration for Authorship Pattern

Collaboration is the result of working together of two or more than two authors to resolve issue in terms of scientific output. The collaborative index denotes the extent of collaboration existing in particular field or particular year[11]. Table 3 shows the degree of collaboration and modified collaborative coefficient for collaborative patterns among the authors of SGBAU, Amravati. DC was calculated based on a formula discussed by K. Subramanyam. Average DC during 1996 to 2017 is 0.96. There is almost 100 per cent degree of collaboration in the year 2000, 2002, 2006, 2008, 2009 and 2010, though there is controversy regarding 100 per cent DC among the authors[13]. There is hardly any single author paper in these years. The DC is minimum (0.9) in the year 1998 and 2001. However, it is almost high as compared to single authorship. Kiran Savanur and R. Shrikant have proposed[13] 'Modified Collaborative Coefficient' which is a slight modification over 'Collaborative Coefficient' and hence used in the present study. The average Moderate Collaborative Coefficient is 0.6289. It is high (0.75) in the year 2000 followed by 2008, 2015 and 2017.

5.5 Source Type

Table 4 reflects proportion of source type of document in percentage. Research article (839) has been the dominant source selected by the academic community for research expression. This is followed by conference paper (174), review (50), book chapter (35), book (12), editorial (11), articles in press (4), note (2), erratum (1), letter (1) and short survey (1).

5.6 Top 20 Most Productive Authors

Table 5 indicats top twenty most productive authors from SGBAU. Rai, Mahendra is the leading authors with 209 document, 6692 citation, 32 average citation per paper and H-index of 33. He even collaborated with 150 author. S. K. Omanvar, Anand Aswar, Gajanan Muley, Kishor Adhav, S. D. Katore, Vasant Jamode, Dilip Tambekar, Anandrao Waghuley, Nikhiliesh Bajaj and Nikhelesh Bajaj are also among the list of prominent authors. However, it is noteworthy that A. P. Ingle for 62 document received 2440 citation. He is also second in the list to have highest collaborative authors. Same is the case with Alka Yadav. She has 17 document to her credit. But she received 3073 citations with an average of 180.80 per paper.

Figure 2 bring out co-authorship network based on Scopus data and generated thorough VOS viewer. It is based on full counting method and maximum leading 25 authors with at least minimum 5 papers have been considered. Of all 1157 authors, 157 met the criterion. For each of the 157 authors, the total strength of the co-authorship link with the other author has been calculated. The authors with greatest total link have been selected.

5.7 Distribution of Research Output based on Subject Areas

Table 6 reflects the distribution of research output in various subject areas. Subject category provided in the Scopus is different as a single document may come under various subject categories. Hence the total score of these documents exceeds the actual number of document which is

Table 3. Degree of collaboration

Year	Number of Authors													Total	DC	MCC
	1	2	3	4	5	6	7	8	9	10	11	12	13			
1996	1	2	6	2	-	-	-	-	-	-	-	-	-	11	0.91	0.65
1997	1	6	2	-	-	-	-	-	-	-	-	-	-	9	0.89	0.5416
1998	1	5	2	2	-	-	-	-	-	-	-	-	-	10	0.9	0.5925
1999	1	4	7	3	-	-	-	-	-	-	-	-	-	15	0.93	0.6369
2000	-	2	3	1	-	-	-	-	-	-	-	-	-	6	1.00	0.75
2001	2	8	9	-	1	-	-	-	-	-	-	-	-	20	0.9	0.6210
2002	-	4	4	1	-	-	-	-	-	-	-	-	-	9	1.00	0.6770
2003	2	15	7	5	4	1	-	-	-	-	-	-	-	34	0.94	0.6045
2004	2	1	6	4	-	1	-	-	-	-	-	-	-	14	0.86	0.6410
2005	1	11	3	1	-	1	-	-	-	-	-	-	-	17	0.94	0.5677
2006	-	15	7	3	8	1	1	1	-	-	-	-	-	36	1.00	0.6680
2007	2	14	13	11	4	2	-	1	1	-	-	-	-	48	0.96	0.6490
2008	-	11	11	5	3	3	1	-	-	-	-	1	-	35	1.00	0.6840
2009	-	24	15	16	3	8	2	1	-	-	-	-	-	69	1.00	0.6714
2010	-	22	22	13	8	3	-	2	-	-	-	-	-	70	1.00	0.6676
2011	11	25	19	25	6	1	1	-	-	-	-	-	-	88	0.87	0.5793
2012	6	37	15	11	3	-	-	1	-	-	-	-	-	73	0.89	0.5559
2013	5	30	21	9	5	4	1	1	1	1	-	-	1	79	0.94	0.6093
2014	2	32	28	14	8	5	2	3	-	-	-	-	-	94	0.98	0.6459
2015	3	29	39	20	16	5	2	1	1	2	-	-	-	118	0.97	0.6815
2016	2	45	50	28	23	10	1	-	2	-	-	-	-	161	0.99	0.6700
2017	4	28	26	14	16	13	4	6	3	-	-	-	-	114	0.96	0.6797
Total	46	370	315	188	108	58	15	17	8	3	0	1	1	1130	0.96	0.6289

DC-Degree of collaboration; MCC- Modified collaborative coefficient

Table 4. Source type of publication

Source	Percentage
Article	74
Conference Paper	15
Review	5
Book Chapter	3
Book	1
Editorial	1
Other	1

1130 in the present study. Same is the case with the citations received under various subject categories. The highest numbers of documents are seen in the field of Physics and Astronomy (356) while h-index is 24 with 2700 citation. The authors in this subject are ahead in terms of scientific productivity. Engineering and Chemistry is at the second (284) and third (251) position with 2630 and 2093 citation share respectively. Biochemistry, Genetics, Molecular Biology though appears at the fifth place has the largest h-index (31) with highest citation impact (5711) in all the disciplines. The next subject to be followed is Computer Science (158), Pharmacology, Toxicology and Pharmaceutics (95), Agriculture and Biological Science (90). A very less number of papers can be seen in the field of social science and humanities. The remaining details can be viewed though the table.

5.8 Collaborative Institutes and Organisations

Table 7 throws light on top 15 institutional collaborators of SGBAU, Amravati within the India. The Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur has been top most collaborators for SGBAU and stands at the first position with 61 collaboration. Shri Shivaji Science College, Amravati is at the second position with 37 document followed by Dr. Babasaheb Ambedkar Marathwada University, Aurangabad and Millia Arts, Beed are at the third and fourth position respectively. National Environmental Engineering Research Institute, Nagpur, Hislop College, Nagpur and Prof. Ram Meghe College of Engineering and Technology are at the fifth, sixth and seventh position consecutively. The important feature of this institutional collaboration is that all these leading 15 institution are from Maharashtra and maximum 7 institution are from Nagpur city. It is surprising that there is hardly other state which could get place in the above chart. Faculty member seem to choose co-researcher from the Maharashtra state only.

5.9 Co-occurrence of Keyword

Figure 3 shows co-occurrence of keywords with greatest total links strength based on full counting method given in the VOSviewer. The criteria of the keywords having appeared five times or more than five times have been selected. Out of 8441 keyword, 635 met the threshold. Out of 635, leading 50 keyword were chosen. Insignificant keywords, such as article, nonhuman were eliminated. The keywords most frequently occurred and having more links keywords are

Table 5. Most productive authors

Author	TP	TC	ACPP	Co-authors	HI
Rai, Mahendra	209	6692	32	150	33
Omnwar, S. K.	143	1052	7.36	51	17
Aswar, Anand S.	94	608	6.47	76	15
Muley, Gajanan G.	67	485	7.16	51	13
Adhav, Kishor S.	64	366	5.72	38	11
Katore, S. D.	54	196	3.63	23	7
Jamode, Vasant S.	51	290	5.69	40	8
Tambekar, Dilip H.	47	256	5.45	58	10
Waghuley, Anandrao	52	371	7.13	17	10
Bajaj, Nikhilesh	47	295	6.28	14	11
Gade, Aniket Krishnrao	67	295	4.40	92	22
Anis, Mohd	54	485	8.98	36	12
Ingle, A. P.	62	2440	39.35	88	20
Singh, Kamal	37	894	7.71	50	18
Dudul, Sanjay Vasant	48	369	7.69	16	10
Pahurkar, Vikas G.	19	95	5	14	7
Pawar, B. H.	14	125	8.93	22	6
Rathod, Dnyaneshwar P	16	133	8.31	34	5
Yadav, Alka P	17	3073	180.76	19	9
Bhatkar, V. B.	15	116	7.73	17	4

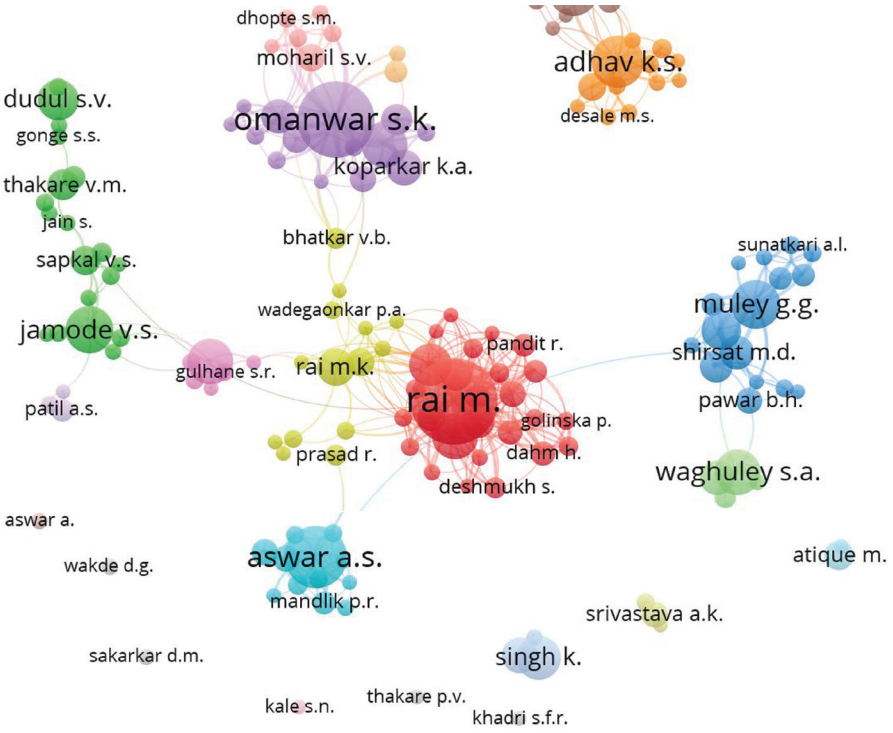

Figure 2. Co-authorship network.

nanoparticles (occurrence-84, link strength (697), escherichia coli (occurrence-84, link strength (655), silver (occurrence-61, link strength-637), metal nanoparticles (occurrence-58, link strength-619), staphylococcus aureus (occurrence-56, link-584), unclassified drug (occurrence-89, link strength-548 and antibacterial activity (occurrence-49, link strength-516). Besides these keywords are followed by anti ineffective agent, metal nanoparticles, silver nanoparticles, and synthesis (chemical) pseudomonas aeruginosa and transmission electron microscopy. These keywords throws light on the research areas in which faculty members are engaged with.

6. CONCLUSIONS

The scientometric profile of SGBAU, Amravati gives an idea that the research output has been increasing each year. However, this output is lopsided as the most prolific authors and scientific expression by them are from science domain only. The university has post graduate departments in social sciences and humanities. Their share must also be reflected in scientific productivity. Hence the university needs to design some policy to improve the research writing in the field of social science and in the areas where research activities are lagging behind. Although collaborative research is increasing, yet the collaboration should be extended beyond Maharashtra state because research collaboration at national and international level leads to publication in mainstream and core journals[6]. The study is limited in that the results are not compared with other state universities or other epoch making institutions so as to have a perfect view of scientific productivity or profile comparison of the university. Further data generated through SCOPUS has its own limitations. The Scopus does not take into account publications in regional languages and many other national journals which have been selected by the faculty member for research expression. Inspite of this the present scientometric study keeps special significance as it offers an opportunity for introspection about the research output of the university and frame better policy for better performance in the future.

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Table 6. Subject wise Distribution of Research Output and Citations Received

Subject Area	Share of Document	H-index	Citations Received
Physics and Astronomy	356	24	2700
Engineering	284	22	2630
Chemistry	251	21	2093
Material Science	248	25	3034
Biochemistry, Genetics, Molecular Biology	175	31	5711
Computer Science	158	13	683
Pharmacology, Toxicology and Pharmaceutics	95	16	1388
Agriculture and Biological Sciences	90	14	681
Chemical Engineering	81	16	1681
Medicine	80	15	1261
Environmental Science	74	9	267
Immunology and Microbiology	72	17	1526
Mathematics	62	10	365
Earth and Planetary Sciences	53	12	537
Energy	31	9	322
Social Sciences	20	3	29
Multidisciplinary	13	5	203
Business Management and Accounting	4	2	16
Economics, Econometrics and Finance	3	1	5
Health Profession	3	2	44
Veterinary	2	2	9
Decision Sciences	1	-	0
Neuroscience	1	1	4

Table 7. Institutional Collaboration

Institutes and Organisation	Research Output	% of Total Research Output
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur, India	61	5.40
Shri Shivaji Science College, Amravati, India	37	3.27
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, India	30	2.65
Milliya Arts, Beed, India	21	1.86
National Environmental Engineering Research Institute, Nagpur	12	1.06
Hislop College, Nagpur, India	12	1.06
Prof. Ram Meghe College of Engineering and Management, Amravati	12	1.06
Dr. B.N. College of Engineering and Technology, Yawatmal	11	10.97
Government Institute of Science, Aurangabad	10	0.88
G. H. Raisoni College of Engineering, Nagpur	10	0.88
Priyadarshani Institute of Engineering and Technology, Nagpur	10	0.88
Toshniwal ACS College, Hingoli	9	0.79
Bhaba Automic Research Centre, Mumbai	9	0.79
Shri Ramdeobaba College of Engineering and Management, Nagpur	9	0.79
Shri Hanuman Vyayam Prasarak Mandal's College of Engineerign and Technology, Amravati	9	0.79

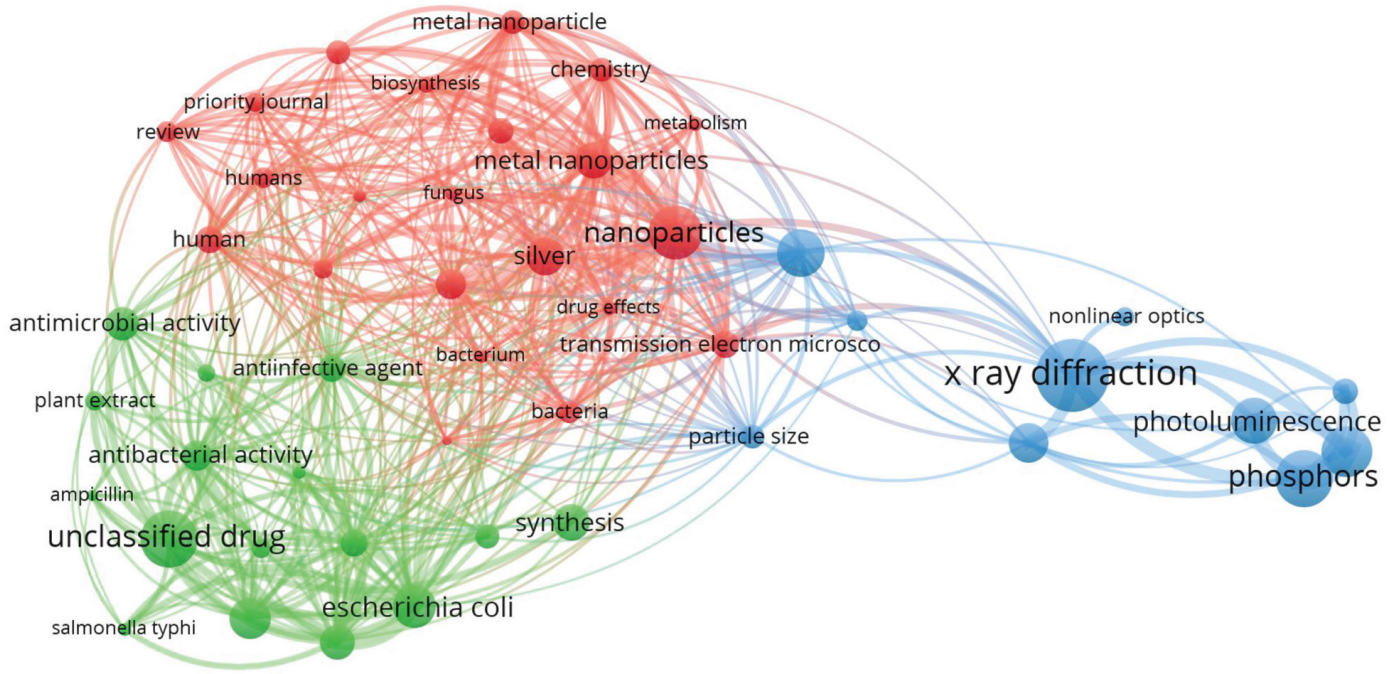

Figure 3. Co-occurrence of Keyword.

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She has contributed for getting results about authorship pattern and degree of collaboration in the present study.