

EXPLORING AUTHORSHIP PATTERN AND GROWTH OF SCHOLARLY CONTRIBUTIONS OF CSIR-CSMCRI, BHAVNAGAR DURING 2011-2020: A BIBLIOMETRIC STUDY

Dr. Jyotika Borthakur

Rakesh Trivedi

Dr. Jyotika Borthakur

Librarian

SMD College, Charing,
Sivasagar, Assam

Email Id:

sumki.jyoti@gmail.com

ORCID ID-0000-0002-9697-
7881

Rakesh Trivedi

Research Scholar

BKNMU, Junagadh, Gujarat

Email Id:

rakeshtri1986@gmail.com

ORCID ID-0000-0001-8124-
7117

ABSTRACT -

The use and calculation of scientific indicators like number of papers, growth rate of publications, impact factor, h-index, g-index, m- index etc., are now increasingly becoming popular. Calculation of these indicators requires large data from bibliographic datasets, requires different methodologies like scientometrics and bibliometrics for analyzing such datasets. To exploring authorship pattern growth of scholarly research of CSIR- CSMCRI, Bhavnagar the present study has consulted 1741 bibliographic records of the institute published during the period 2011 to 2020 indexed in SCOPUS database. The results showed that the research publications and citations received of CSMCRI have increased during the periods. The study shows 91.67% of research documents are published as article in the journal. Software's like MS-Excel, R-package and VOS viewer are applied for analysis of datasets. The study has counted Mean RGR (P) '0.27'; Mean Dt (P) '3.51' which shows the growth rate of publications. The average degree of collaboration for the periods is '1' and the total of 36534 citations were received for the periods with Mean RGR (C) '0.20 and Mean Dt (C) '9.25'.

Keywords : Authorship pattern, Bibliometric Study, CSIR-CSMCRI, Growth, Scholarly Contribution

INTRODUCTION

Scientific Productivity is frequently measured by year wise growth of productivity, by document type (articles, review, books etc.), most productive sources, most productive authors, citations received, relative growth rate of publications, co-authorship index and degree of collaborations etc. The present study is mainly focusing on Authorship pattern and growth of scholarly contributions of Central Salt & Marine Chemicals Research Institute (CSIR-CSMCRI), Bhavnagar.

The need of salt research was recognized by the Council of Scientific and Industrial Research (CSIR) and to develop production and utilization of salt, one salt research committee was established in 1940. This committee was later amalgamated with Heavy Chemicals Committee in July 1948. CSIR-CSMCRI was inaugurated in the year 1954. The major research areas of CSIR-CSMCRI are diverse and highly applied areas of salt and marine chemicals, water desalination and purification, membrane-based processes of separation and concentration, inorganic materials, catalysis etc. It also focuses on seaweeds and salinity tolerance and waste management.

Keeping in view the importance of salt and marine chemical research and development works of CSMCRI scientists indexed in SCOPUS database the present study gives emphasis to explore the productivity of the scientists in the field of salt and marine chemicals research. The study focuses mainly on growth of research productivity with authorship pattern for the periods of 2011 to 2020.

REVIEW OF LITERATURE

Mapping Library and Information Science research output of Panjab University (Chakravarty & Sharma, 2017) focuses on analyzing research output in the discipline during 1991 to 2014. The study deals with 152 publications of Panjab University and examined the relative growth rate of publications, doubling time for publications, annual growth rate (AGR) and compound AGR of publications. The study found that the relative growth rate of the university was highest in 1996 (0.442) and 61% of the publications were published with collaboration. A bibliometric analysis and science

mapping of scientific publications of Alzahra University has been conducted (Douhani, 2020) for the purpose of evaluating scientific productivity. The study focuses on evaluating scientific productivity of Alzahra University, Iran during 1986–2019. The study was conducted by using bibliometrics and visualization techniques. The data retrieved from SCOPUS database and Excel, VOS viewer and CR Explorer software were used to analyze the data. From the study it has been found that the number of publications and citation received by Alzahra University were increased during the periods. The study based on the authorship pattern and growth of scholar contributions of the M. S. University of Baroda (Dash & Chaudhary, 2021) has been conducted to analyze the growth of literature follows the exponential growth pattern for the periods 2016 to 2020. The study has been done based on the 1698 papers that are indexed in Scopus database. The study revealed that the major areas of research were Physics and Astronomy, Material Sciences, Chemistry and Biochemistry, Engineering, Genetics and Molecular Biology. The study concluded by giving more emphasis on to developing strategies to address the imbalance research output of various departments.

Measuring the productivity and output is a common practice for the institutions, when we discuss about research and publications (Dixit & Singh, 2021). For measuring research productivity of Bundelkhand University from the year 2000 to 2019, a bibliometric analysis has been conducted on total number 579 publication indexed in Scopus database. The study shows that the highest number of 57 papers published in the year 2019 and the highest citations were received in the year 2005 (1091) with ACCP of

10.71. Research Publications Trend of St Joseph Engineering College, Mangaluru, Karnataka (Dsouza, 2021) was conducted to examine the bibliometric analysis of the publications indexed in Scopus database during 2004 to 2019. Total number of 230 publications published during the periods. The study more research articles are expected to be published in future through collaboration. Research productivity of an educational institution provides an insight view of the research and development activity conducted to contribute to the more substantial and untouched areas (Gupta, Rajput & Gul, 2021) of research and promoting the researchers to conduct more research. The study mainly focuses on mapping the research productivity of University of Jammu during 2010 to 2019. Total number of 1641 papers have been analyzed and it was found that the annual growth rate of publications of University of Jammu was continuously increasing from 2010 to 2019.

Bibliometric Analysis of Prince Songkla University (PSU) (Kulkanjanapiban & Silwattananusarn, 2021) was aimed to explore the growth of research output, authorship patterns, collaboration trends, citation patterns over 14,644 publications indexed in Scopus database from 1978 to 2021. The study was conducted by using different bibliometric analysis and visualization software's like RStudio, MS-Excel and VOSviewer. The study revealed that the mean relative growth of publication is 0.20 and mean doubling time 5.01. The positive output of the study was the doubling time of authorship pattern and increasing trend of multiple authors in research publications Prince Songkla University. Covid-19 pandemic has created urgent need of more research in the areas of public

health (Mandalia, Chaudhary & Parmar, 2021). The study mainly focused on authorship patterns, degree of collaboration and growth of public health literature. They have conducted a study based on research conducted on public health with total of 1941 numbers of publications and authored by 12523 authors during the periods of 2011- 2020 which are indexed in SCOPUS database. The study mainly focuses on determination of chronological growth of publications, authorship pattern, finding out core sources of publication, citations received by using bibliometric laws mainly Bradford's Law of distribution, software's like MS-Excel, R-package and VOS viewer. The study reflects growth of public health literature during the study period.

Qualitative analysis of bibliographic datasets becomes advantageous to individuals and institutions (Patel & Bhatt, 2021) in gradation framework. Based on the qualitative analysis method of bibliographic datasets namely bibliometric analysis, a study has been carried out by consulting 1690 bibliographic records of Sardar Patel University (SPU) published during the year 2009-2018 that retried from Scopus database. The study identifies average yearly contribution is 169 and mean RGR (P) is 0.25; mean Dt (P) is 3.25 which reveals inconsistent growth of research output. The 'multi authorship' shows 51.30% indicating higher rate of collaborative research work. The study concluded with a suggestion to make more effort on promoting more research by implementing better policies to enhance and enrich the individual research performance.

Multiple authors have contributed 99.11% of total publications of Anna University indexed in Web

of Science whereas 0.88% contributed by single authored publications and the average author per paper is 4.01 (Thamaraiselvi, Lakshmi & Manthiramoorthi, 2021). Strong positive correlation has been seen between the publications and multiple authored during the study.

OBJECTIVES OF THE STUDY

The main objectives of the present study are

- To identify year wise growth of research productivity, Relative Growth Rate (RGR), Doubling Time (Dt) of CSIR-CSMCRI, Bhavnagar.
- To calculate the authorship pattern, Co-Authorship Index (CAI), Degree of Collaboration and most productive authors.
- To observe the most relevant source of publications.
- To identify the productivity in terms of citation receive.
- To find out most frequently used keywords.

RESEARCH METHODOLOGY

The study is founded on a quantitative examination of scientific research output that has been published as articles, books, book chapters, letters, reviews, conference papers, editorials, notes, and erratum, among other forms. The data has been extracted from Scopus database, which is the largest abstracting and citation database of peer-reviewed scientific literature (<https://www.scopus.com>). The search started with ‘affiliation’ as ‘CSIR and Bhavnagar’ and then it was limited to years 2011 to 2020. Data were retrieved on 17th July 2021. The following search string was used to collect the raw data, that is AFFIL (CSIR AND Bhavnagar) AND PUBYEAR>2011) AND PUBYEAR<2020). A total of 1741 articles were downloaded, and the collected data were analyzed with the help of MS Excel and the data were processed using the Biblioshiny from Bibliometrix for the R package. Mapping network analysis with VOS viewer was used to sketch visualization graphs of citations and the studied data results.

ANALYSIS AND DATA INTERPRETATION

Year wise Growth of Research Publications

Table 1 : Year wise Relative Growth Rate and Doubling Time of Publications

Year	Publications	Rate (%)	CRP	Log ^{1p}	Log ^{2p}	RGR (P)	Mean RGR (P)	Dt	Mean Dt (P)
2011	136	7.81	136	-	4.91	-		-	
2012	115	6.61	251	4.91	5.53	0.62		1.12	1.98
2013	149	8.56	400	5.53	5.99	0.46	0.40	1.51	
2014	179	10.28	579	5.99	6.36	0.37		1.87	
2015	213	12.23	792	6.36	6.67	0.31		2.24	
2016	189	10.86	981	6.67	6.89	0.22		3.15	
2017	190	10.91	1171	6.89	7.07	0.18		3.85	5.03
2018	201	11.55	1372	7.07	7.22	0.15	0.14	4.62	

2019	182	10.45	1554	7.22	7.35	0.13		5.33	
2020	187	10.74	1741	7.35	7.46	0.11		6.30	
Total	1741	100							

*CRP: Cumulative of Research Publications; RGR: Relative Growth Rate; Dt: Doubling Time; (P): Publications

The study reveals that total number of 1741 research documents were published during 2011 to 2020 which was analyzed and shown in Table 1. The study found during 2011 a total of 136 documents was published from CSMCRI. After 2011, steady growth was seen for four years from 2012 to 2020. The highest occurrences have been observed in the year 2015 which was 213 (12.23%). Again from 2016 to 2018 steady growth have been in publications which was $\geq 10.86 + \leq 11.55$. The growth was decreases in the year 2019 with 182 (10.45%) publications and in 2020 it shown 187 (10.74%). The Relative Growth Rate (RGR) of publications were calculated by using following equation (Mahapatra, 1985):

$$RGR = \frac{\text{Log}^{2p} - \text{Log}^{1p}}{2p - 1p}$$

Here RGR is Relative Growth rate of research publications over specific period.

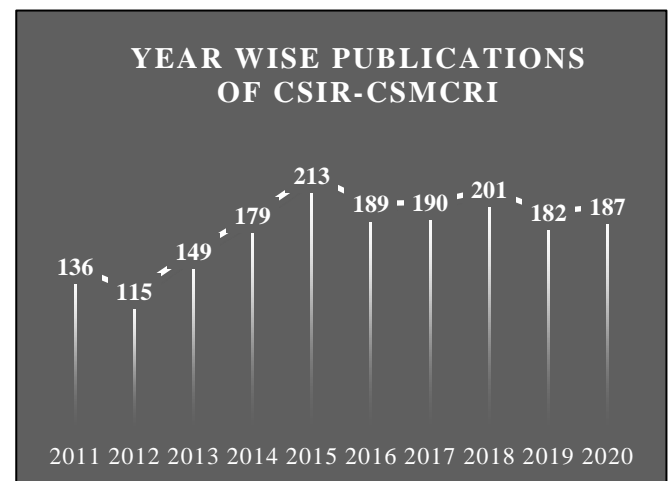
Log^{1p} = Log of initial number of research publications

Log^{2p} = Log of final number of research publications.

The study shows the RGR of research articles were decreased gradually from 0.62 to 0.11 during the periods 2011 to 2020. The doubling time growth of every year was also calculated in the study. Doubling Time of publications are the average doubling time of articles. From the table

1 it was found that doubling time of publications was gradually increased from 2011 to 2020 which was $\geq 1.12 \pm \leq 6.30$. The figure 1 shown the year wise publication rate of CSIR- CSMCRI. The figure shows highest number of papers has been published in 2015 which was 213 followed by 2018, 2017, 2016, 2020, 2019 respectively and the lowest number of papers have been published in 2012 that was 115.

Figure 1. Year Wise Publications of CSIR- CSMCRI



Document Type wise Research Publications

Here the authors have analyzed the contribution of publications in different documents. The Table 2 and Figure 2 shows the most commonly used document types for research publications. The study has analyses that most of the research documents were published as Articles contributing 1596 (91.67%) publications followed by Book Chapter 61 (3.50%) and Review with 43

(2.47 %) publications. The lowest numbers of research documents were published as Letter and Notes both contributing 01 (0.1%) publications.

Table 2 : Research Publications by Document Type

Document Type	No. of Publications	Percentage (%)
Article	1596	91.67
Book Chapter	61	3.50
Review	43	2.47
Conference Paper	25	1.44
Erratum	12	0.69
Editorial	2	0.11
Letter	1	0.1
Note	1	0.1
Total	1741	100.00

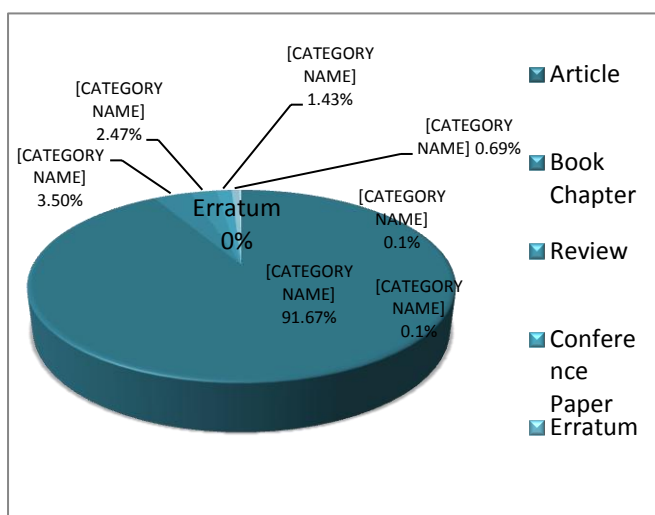


Figure 2. Research Publications by Document Type

Year Wise Authorship Pattern and Degree of Collaboration of CSMCRI

The evaluation of authorship pattern and degree of collaboration are most useful approach of calculating author’s scientific productivity, co-

authorship index and collaborative approach of authors. The table 3 described the year wise authorship distribution of research productivity of CSMCRI scientists. The study shows that highest number of 04 papers have been published by single author in the year 2017, in the year 2019 highest number of 27 double authored documents were published, in the year 2015, total of 51 three authored documents were published, in 2014 total of 55 four authored papers have been published. The study also found in the year 2019, highest number of 43 five authored documents were published and more than five authored documents were published highest in the year 2018 which was 60 numbers. From the study it was found that highest numbers of 461 documents have been published by more than five authors followed by 389 by both three and four authors, 282 by five authors and 213 by double authors. The documents published by single author is less (07) numbers in the list.

Table 3 : Year wise Authorship distribution of CSMCRI Publications

Year	Single Authored RP	Double Authored RP	Three Authored RP	Four Authored RP	Five Authored RP	More than Five Authored RP	Total
2011	0	20	33	26	18	39	136
2012	0	7	32	26	20	30	115
2013	0	26	31	33	22	37	149
2014	0	18	39	55	20	47	179
2015	1	19	51	53	38	51	213
2016	0	27	39	40	26	57	189
2017	4	23	35	42	40	46	190
2018	2	23	41	44	31	60	201
2019	0	27	41	32	43	39	182
2020	0	23	47	38	24	55	187
Total	7	213	389	389	282	461	1741

*RP – research Paper

5.3.1 Co-Authorship Index

In the study the co-authorship index was counted by the formula given by Garg and Padhi, in 2001.

$$CAI = \left(\frac{N_{ij}}{N_{io}} \right) \div \left(\frac{N_{oj}}{N_{oo}} \right) \times 100$$

Here,

N_{ij} = No. of publication for the authorship pattern for a particular country per year

N_{io} = total output for the authorship pattern

N_{oj} = total output of the particular year

N_{oo} = total output of the year

The table 4 evaluated the co-authorship index (CAI) of CSMCRI publications during the periods 2011 to 2020. Based on the above formula co-authorship index has been calculated. The highest CAI 523.7 has been found for single authorship in the year 2017, in two authorship 142.7 co-authorship index has been found in the year 2013, in 2012 highest number of 124.8 CAI was found for three authorships, in case four authorship publications highest of 137.8 CAI was found in 2014. Highest number of 145.8 CAI has been calculated for five authorships in the year 2019 and 113.8 CAI was found for more than five authorships in the year 2016.

Table 4 : Co- Authorship Index (CAI)

Year	Single (CAI)	Two (CAI)	Three (CAI)	Four (CAI)	Five (CAI)	More than Five (CAI)	Total
2011	0 (0.00)	20 (120.2)	33 (108.8)	26 (85.7)	18 (81.7)	39 (108.2)	136
2012	0 (0.00)	7 (49.8)	32 (124.8)	26 (101.4)	20 (107.4)	30 (98.4)	115
2013	0 (0.00)	26 (142.7)	31 (93.3)	33 (99.3)	22 (91.1)	37 (93.7)	149
2014	0 (0.00)	18 (82.2)	39 (97.7)	55 (137.8)	20 (68.9)	47 (99.1)	179
2015	1 (125.00)	19 (72.9)	51 (107.4)	53 (115.6)	38 (110.1)	51 (90.4)	213
2016	0 (0.00)	27 (116.8)	39 (92.5)	40 (94.9)	26 (84.9)	57 (113.8)	189
2017	4 (523.7)	23 (98.9)	35 (82.6)	42 (99.1)	40 (129.9)	46 (91.4)	190
2018	2 (247.5)	23 (93.6)	41 (91.5)	44 (98.2)	31 (95.2)	60 (112.6)	201
2019	0 (0.00)	27 (121.3)	41 (101.0)	32 (78.8)	43 (145.8)	39 (80.9)	182
2020	0 (0.00)	23 (100.6)	47 (112.7)	38 (91.1)	24 (79.2)	55 (110.9)	187
Total	7	213	389	389	282	461	1741

Degree of Collaboration

The Table- shows the Degree of Collaboration (DC) of the Authors from the year 2011 to 2020. The Degree of Collaboration has been calculated based on K. Subramanyam’s formula for Degree of Collaboration (Subramanyam, 1983) which is mentioned below:

$$DC = \frac{M_n}{S_n + M_n} \text{ where}$$

DC = Degree of Collaboration

S_n = Single Author

M_n = Multiple Authors

$$DC = \frac{1741}{7+1741} = \frac{1741}{1748} = 0.9959 \approx 1$$

The Degree of Collaboration of the authors of CSMCRI is calculated in the following table.

Table 5 : Degree of Collaboration of CSMCRI Author's

Year	Authorship Pattern		(Sn + Mn)	Degree of Collaboration (DC)
	Single (Sn)	Multiple (Mn)		
2011	0	136	136	1
2012	0	115	115	1
2013	0	149	149	1
2014	0	179	179	1
2015	1	212	213	1
2016	0	189	189	1
2017	4	186	190	0.98
2018	2	199	201	0.99
2019	0	182	182	1
2020	0	187	187	1
Total	7	1734	1741	1

In the table 5, highest degree of collaboration 1 has shown in the year 2011, 2012, 2013, 2014, 2015, 2016, 2019 and 2020 and lowest seen in the year 2017. The average degree of collaboration was 1 which reflects the collaborative approach of the CSMCRI authors.

Most Productive Authors (Top 20)

The most productive authors of CSMCRI have listed in the Table 6 and Figure 3. The table shows the top twenty most productive authors of CSMCRI indexed in the SCOPUS database.

Bajaj, H.C is the most productive author during the period with contribution of 178 articles, citations received 5261 and H index 37 which was in rank one. The others most productive authors are Jha B (articles 178, citations received 5035 and H index 42), Ganguly B (articles 111, citations received 1507 and H index 19), Suresh E (articles 93, citations received 2625 and H index 31) and Kureshy RI (articles 86, citations received 1441 and H index 22) and Srivastava DN is in the twentieth rank in the list with 43 articles, 535 citations and H index 11 in his credit.

Table 6 : Most Productive Author (Top 20)

Rank	Authors	Articles	Citations	H-Index
1	Bajaj HC	178	5261	37
2	Jha B	133	5035	42
3	Ganguly B	111	1507	19
4	Suresh E	93	2625	31
5	Kureshy RI	86	1441	22
6	Das A	82	2356	31

7	Shahi VK	81	2063	29
8	Kumar A	80	1755	26
9	Khan N-Uh	80	1326	23
10	Mishra S	76	2359	27
11	Reddy CRK	61	2505	30
12	Mishra A	61	2093	25
13	Abdi SHR	60	1113	14
14	Prasad K	59	1297	22
15	Ghosh A	57	1494	24
16	Panda AB	56	2056	27
17	Kulshrestha V	52	912	17
18	Adimurthy S	51	1724	21
19	Agarwal PK	46	914	14
20	Srivastava DN	43	535	11

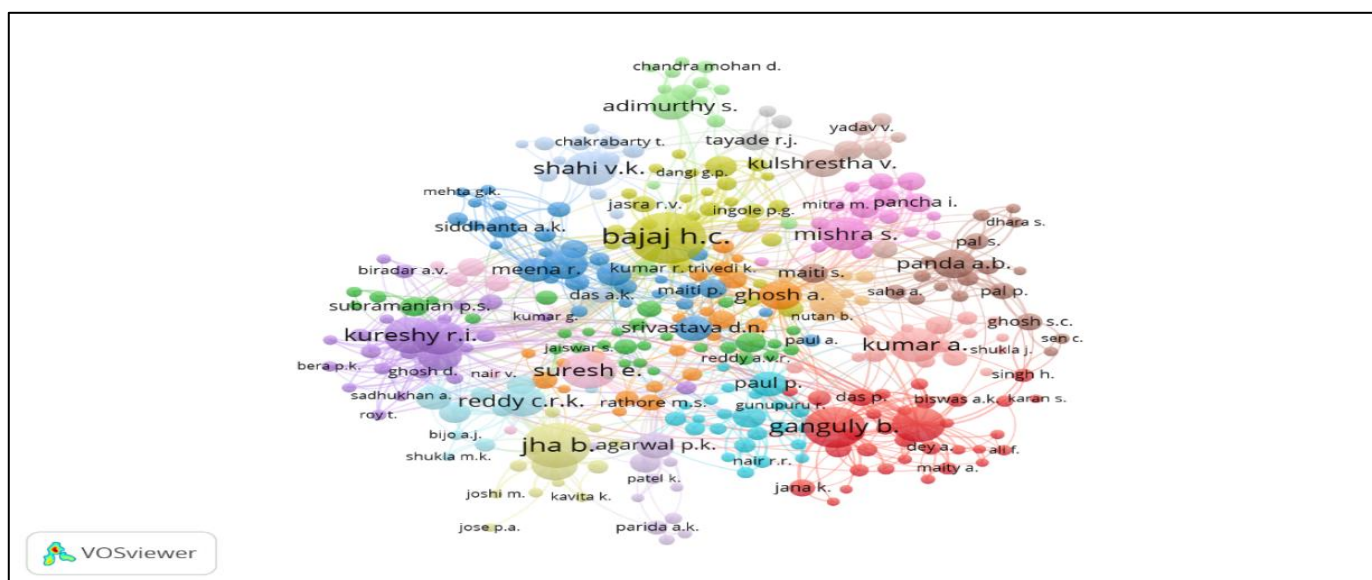


Figure 3. Map of Most Productive Authors of CSMCRI

Most Preferred Source of Research Publications

Table 7 : Bradford’s Law Distribution of most preferred

Zone	RPS	CRPS	Rate (%)	RP	CRP	Rate (%)
Zone 1	21	21	4.56	580	580	33.31
Zone 2	76	97	16.49	589	1169	33.83
Zone 3	364	461	78.96	572	1741	32.85

RPS: Research Publication Source, CRPS: Cumulative of Research Publication Source,

RP: Research Publication, CRP: Cumulative of Research Publication

Bradford in 1934 described a scattering pattern of periodicals. The Bradford's distribution can be applied to various objects, not only the distribution of articles or citation across journals (Yatsko, 2012). The table 8 has been the Bradford's law of scattering has been calculated based on their zones. In 'zone 1', 21 (4.56%) CRPS publishes 580 (33.31%) research publications. In 'zone 2', 97 (16.49%) cumulative

of research publication sources publishes 1169 (33.83%) research publications and in 'zone 3' 461 (78.96%) CRPS publishes 1741 (32.85%) research publications. The number of sources in each zone increases and research publications was decreases (32.85%) in zone 3 as compared to 'zone 1' and 'zone 2'.

Most Productive Journals

Table 8 : Most Productive Journal (Top 10)

Rank	Journal Title	Frequency
1	RSC Advances	100
2	Chemistryselect	42
3	Journal of Membrane Science	37
4	Journal of Applied Psychology	32
5	Carbohydrate Polymers	31
6	ACS Sustainable Chemistry and Engineering	30
7	Bioresource Technology	27
8	Chemical Communications	26
8	Desalination	26
9	New Journal of Chemistry	24
10	Journal of Materials Chemistry A	23

The table 8 and figure 4 indicates the top ten most productive journals where highest numbers of research publications of CSMCRI have been published. With 100 frequency RSC Advances was in the top of the list during 2011 to 2020 followed by Chemistryselect (42), Journal of Membrane Science (37), Journal of Applied Psychology (32), Carbohydrate Polymers (31), ACS Sustainable Chemistry and Engineering (30), Bioresource Technology (27), Bioresource Technology and Chemical Communications with frequency 26. The Journals of Materials Chemistry A (23) is ranked in tenth position

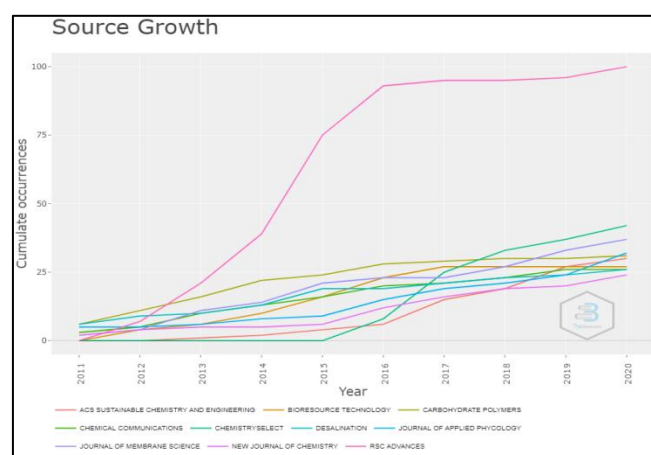


Figure 4. Growth of Journals (Top 10)

Relative Growth Rate (RGR) and Doubling Time (Dt) for Citations received by CSMCRI

Like Relative Growth Rate of Publications, in case of citations (Table 9) the RGR for citations decreased from 0.63 in 2012 to 0.02 in 2020. The value of doubling time (Dt) increased from 1.10 in 2012 to 34.65 in 2020. The mean RGR of

citation from 2012 to 2016 (five years) was 0.33 and for the four years from 2017 to 2020 the mean RGR of citations is 0.07. Similarly, the doubling time (Dt) for citations lowest 2.86 for five years since 2012 to 2016 and it was highest (15.63) for the last four years from 2017 to 2020.

Table 9 : Relative Growth Rate and Doubling Time for Citations

Year	Publications	CR	CCR	Log ^{1c}	Log ^{2c}	RGR (C)	Mean RGR (C)	Dt (C)	Mean Dt (C)
2011	136	5489	5489	-	8.61	-		-	
2012	115	4775	10264	8.61	9.24	0.63		1.10	2.86
2013	149	4550	14814	9.24	9.60	0.36	0.33	1.93	
2014	179	5163	19977	9.60	9.90	0.30		2.31	
2015	213	4806	24783	9.90	10.12	0.22		3.15	
2016	189	3354	28137	10.12	10.24	0.12		5.78	
2017	190	3159	31296	10.24	10.35	0.11		6.30	15.63
2018	201	2795	34091	10.35	10.44	0.09	0.07	7.70	
2019	182	1762	35853	10.44	10.49	0.05		13.86	
2020	187	681	36534	10.49	10.51	0.02		34.65	
Total	1741	36534					0.20		9.25

CR: Citation Received; CCR: Cumulative of Citation Received; RGR (C): Relative Growth Rate for Citation and Dt (C): Doubling Time of Citation

Most Frequently Occurred Keywords

The most frequently occurred keywords of CSMCRI are discussed in the table 10 and figure 5. Heterogeneous catalysis is in the top of the list with 24 occurrences followed by electro dialysis,

halophyte, microalgae, salinity (22 occurrences) are second in the list, photocatalysis with 21 occurrences is rank in 3rd number. Antioxidant, heterogeneous catalyst, kappaphycus alvarezii and oxidative stress were in 10th highest occurred keywords in CSMCRI research publications.

Table 10 : Most Frequently Occurred Keywords

Rank	Key Words	Occurrences
1	heterogeneous catalysis	24
2	electro dialysis	22
2	halophyte	22
2	microalgae	22
2	salinity	22
3	photocatalysis	21

4	adsorption	20
4	ionic liquids	20
5	biomass	19
5	ionic liquid	19
6	abiotic stress	18
7	seaweed	16
8	chitosan	15
8	graphene oxide	15
9	fluorescence	14
9	kinetics	14
10	antioxidant	13
10	heterogeneous catalyst	13
10	kappaphycus alvarezii	13
10	oxidative stress	13

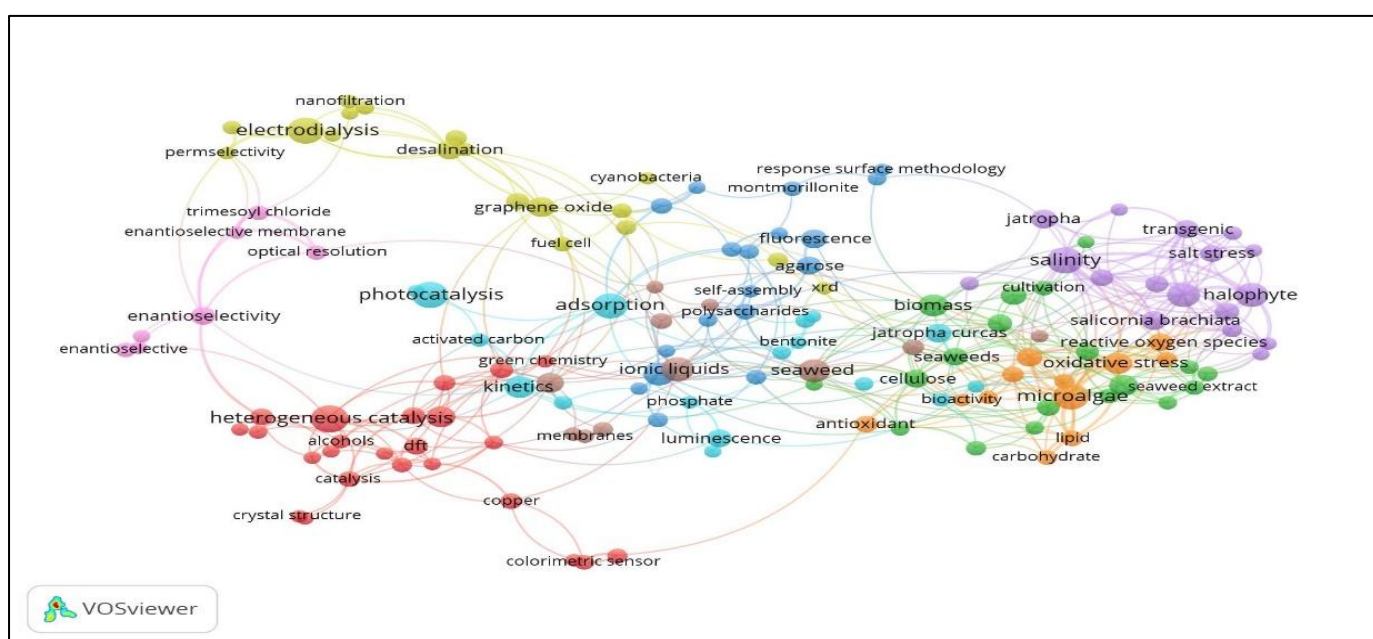


Figure 5. Map of Most frequent keywords

FINDINGS

- The study examined that total number of 1741 research documents were published during 2011 to 2020. The highest number of documents have been published in the year 2015 which was 213 (12.23%).
- The study shows that doubling time of publications was gradually increased from 2011 to 2020 which was $\geq 1.12 \pm \leq 6.30$.

- The study reflects that most of the maximum number of 1596 (91.67%) research documents were published as Journal article.
- From the study it was found that highest numbers of 461 documents have been published by more than five authors which was higher than five authored, four authored, three authored, double authored, and single authored documents.

- The highest Co-Authorship Index (523.7) has been found for single authorship in the year 2017.
- The average degree of collaboration was 1 which shows an increasing growth in collaborative approach.
- The most productive author of CSIR-CSMCRI was Bajaj, H.C with contribution of 178 articles, citations received 5261 and H index 37.
- The number of sources in each zone increases gradually and research productivity decreases (32.85%) in zone 3 as compared to 'zone 1' and 'zone 2'.
- From the study it was found that RSC Advances was the most productive journal with 100 frequencies during 2011 to 2020.
- From the study it was found that the value of RGR for citations has been decreased from 0.63 in 2012 to 0.02 in 2020 and the value of doubling time (Dt) increased from 1.10 in 2012 to 34.65 in 2020.
- Heterogeneous catalysis was the most frequently occurred keywords with 24 occurrences.

CONCLUSION

The present study attempted to examine the research productivity of the scientists and research scholars of CSIR- CSMCRI, Bhavnagar indexed in SCOPUS database. The study found that the main areas of their research are salt and marine chemicals and sub areas are heterogeneous catalysis, electro dialysis, halophyte, microalgae, salinity, photocatalysis, adsorption, etc. The growth in publications and citations received were fluctuated over the

periods. The study resulted that scientific productivity of CSIR-CSMCRI has progressed during this period. The study found that average of 174.1 documents have been published every year during 2011 to 2020. The study shows most of the articles have been authored by multiple authors as compared to single author and it promotes more collaborative research.

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