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Scientometric Analysis Of Research Publications Of Four Csir Laboratories In Uttar Pradesh, India

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Abstract

Purpose – The main objective of this study was to review the research literature of four CSIR laboratories in Uttar Pradesh. Nowadays, research performance has become one of the criteria (measure) to see the research productivity of a particular organization. Also, funding organizations look at the performance of an organisation before giving funds for a particular project.

Design/methodology/approach - The Scopus database has been selected for the data extraction for the present study because of its wide coverage. This study used a comprehensive literature review that included both bibliometric and scientometric analyses. A total of 3,195 publications were selected from the Scopus database as the sample of publications for the scientometric analysis.

Findings – A study on the publications and citations of four CSIR labs (CDRI, CIMAP, IITR, and NBRI) from 2011-2020 revealed that CDRI had the highest number of publications (48.03%). Dr. Karuna Shanker, a senior principal scientist from CSIR-CIMAP, had the most publications among the top-ranked scientists, but his citations were below the average. Yogeshwer Shukla, Chief Scientist at CSIR-IITR, had the most citations (1239) among the top ten authors and the highest citation impact ratio (1.45). Dr. Karuna Shanker had co-authored around three-fourths of his publications with international collaborators. Kumar, A., Chief Scientist of CSIR-CDRI, had the highest collaboration level with other authors and most citations among all authors. The study concluded that collaboration between scientists benefits scientific and industrial research for innovation and discovery.

Practical implications – As CSIR laboratories are specialized and play key roles in the development of the nation. These labs are working more in a collaborative manner through which they are boosting the productivity of their organization. Collaboration among industry practitioners, academics, and governmental authorities is crucial to bridge the gap.

Originality/value – The study provides insights into the research performance of CSIR laboratories and their collaborative efforts in conducting high-quality research. It offers a clear picture of research collaborations among the four CSIR laboratories.

Keywords: Scientometrics, Research Publication, Research productivity, research collaboration, VOSviewer

Introduction

In any developed society, research is the foundation for growth (Pal and Sarkar, 2020). Research output is one of the most important aspects in determining a country's growth (Singh et al., 2021). Quality research needs sufficient funding, evaluations, promotions, and/or a research facility (Singh and Singh, 2019). The prosperity of a country, on the other hand, is determined by how well researchers perform in meeting humanity's needs. Indeed, assessing research success is a necessary precondition for making decisions about potential investments, science governance, and academic administration. As a result, evaluating research output has become a clear

necessity, and it is now a fundamental part of R&D institutions all over the world (Pal and Sarkar, 2020).

The progress of a country is related to its research output (Ansari, Kumar, and Rahaman, 2019). Considering the importance of S&T in a country's development, India has made significant investments in R&D infrastructure in frontier fields such as biochemistry, genetics, and molecular biology research. Science and technology (S&T) are complementary in that science illustrates knowledge generation and discovery, while technology exemplifies knowledge-based inventions. People and society profit from science as a result of technological advancements (Pradhan and Ramesh, 2018).

Scientometrics, a sub-discipline of library and information science, is widely used in a variety of areas, including subject literature characteristics, collection and bibliographic evaluation, and social scientific applications. Since the last decade, scientometrics has been used to investigate an institution's overall growth and research discipline patterns. Research institutions are crucial for knowledge production and research worldwide. Evaluating the excellence of research systems has made significant progress in recent years. The assessment of research productivity and developmental activities highlights the contributions of institutions and individuals involved in research. This type of evaluation makes it easier to examine faculty productivity, which influences their tenure and promotion, as well as to understand where the institution stands in national and worldwide contexts (Sahoo, Sahu, and Mohanty, 2021). The study aims to assess the productivity of four Council of Scientific & Industrial Research (CSIR) laboratories in Uttar Pradesh, India. These laboratories include CSIR-CDRI, CSIR-CIMAP, CSIR-IITR, and CSIR-NBRI.

CSIR is a modern R&D agency with a cutting-edge knowledge base in various S&T disciplines and was established in 1942. It has 37 national laboratories, 39 outreach centers, three innovation complexes, and five pan-India divisions covering fields such as oceanography, geophysics, medicine, biotechnology, nanotechnology, and more. CSIR makes significant technological contributions to society in areas such as the environment, health, food, energy, agriculture, and non-farm sectors. The agency also plays a remarkable role in developing S&T human resources.

In the Scimago Institutions Ranking World Report 2021, the CSIR is ranked 37th among 1587 global government organizations and is the sole Indian institution in the top 100. It is also ranked seventh in Asia and first in India.

About the institutes

CSIR-CDRI is a leading drug research institute in India established in 1951 to enhance the country's drug research and development under CSIR. It has made notable contributions to developing affordable innovative drugs and technologies, created a knowledge base, and produced over 1,000 PhD graduates. It has published over 10,000 peer-reviewed articles and obtained more than 350 Indian patents and 90 international patents.

CIMAP is a pioneering plant research laboratory of the CSIR established in 1959, centered in Lucknow and extending services and technologies to medicinal and aromatic plant farmers and entrepreneurs. It leads research in biological and chemical sciences with research centers in Bangalore, Hyderabad, Pantnagar, and Purara. It has international recognition as the International Centre for Science and High Technology- United Nations Industrial Development Organization (ICS-UNIDO) for South East Asia.

CSIR-Indian Institute of Toxicology Research (CSIR-IITR), Lucknow, is India's only institute of toxicology, established on November 4, 1965, under the Council of Scientific and Industrial Research (CSIR). Its mission is to ensure safety to the environment and health while serving the industry. With world-class toxicological facilities and personnel, it provides a one-stop solution for environmental and health problems, contributing to the knowledge base in the field of toxicity with 25 national and international patents and over 3800 research publications.

The CSIR-National Botanical Research Institute (NBRI) originated as a royal garden built in 1800 A.D. by Nawab Saadat Ali Khan in Oudh, which was converted into a botanic garden by plant scientists Prof. Birbal Sahni and Dr. S.K. Mukherjee. In 1953, it was taken over by the Council of Scientific and Industrial Research (CSIR) and later renamed the National Botanical Research Institute (NBRI) in 1978, focusing on research and development in botany.

Literature review

Evaluation of important institutions' research productivity is a popular topic of study among academics of various disciplines. Several research projects have been undertaken on this topic. The following is some important research that is relevant to the current study.

Gupta, Kshitig & Gupta (2015) conducted a comprehensive analysis of the performance of CSIR at the overall level as well as laboratory level in terms of various indicators during 2007-11 also identified the strengths and weaknesses of CSIR at the overall level as well as at the laboratory level under 13 broad subjects.

Gupta, Kumar & Aggarwal (1999) assessed the scientific productivity of male and female scientists in CSIR, India, across physical, biological, and engineering sciences at both the agency and laboratory group levels. Productivity was measured by the proportion of scientists not publishing, the average number of papers per scientist, and Lotka's approach. Results showed no significant difference in productivity between male and female scientists.

Shettar and Hadagali (2020) conducted a study on the research productivity of India's National Institutes of Technology from 2009 to 2018. The study revealed that 16 NITs produced over 100 articles per year, with NIT Rourkela leading in publications and citations with 5195 publications and 41399 citations. MANIT Bhopal ranked first in ACPP with 9.57 ACPP. NIT Rourkela and NIT Trichy were the top two institutes in terms of collaboration.

Singh and Singh (2019) looked at the research effects of numerous IITs and Indian universities that work in the field of computer science. They showed that, as compared to private universities that operate without government funding, most old Indian universities do not have a considerable research output.

Hasan and Singh (2015) analyzed the research output trend at five top-ranked Indian Institutes of Technology (IITs) from 2009-2013 using the Web of Science database. The study found that IIT Kharagpur had the highest research productivity with 5271 articles, and IIT Kanpur had the most collaborations with other IITs, accounting for 4.05% of its total articles. The study also revealed that India had research collaborations with 177 countries worldwide.

Research questions

This study is based on the analytical view of four labs of CSIR. For this study, there are some major research questions identified by the researcher, which are solved in the result section.

RQ1: What is the pattern of the output of the four CSIR labs in the U.P.?

RQ2: What is the correlation coefficient and does it fit the regression line?

RQ3: What is the distribution of citation patterns and how do you identify the most cited authors?

RQ4: Find the collaborative disciplines of research.

RQ5: Who are the most preferred journals communicated by CSIR labs (CDRI, CIMAP, IITR, NBRI)?

Methodology

Data Source

The researchers selected the four CSIR laboratories in Uttar Pradesh for the study and collected data from the Scopus database, which is a commonly used source for gathering bibliographic data.

Search strategy

The search string used for searching of data was AF-ID ("Central Drug Research Institute India" 60030536) OR AF-ID ("Central Institute of Medicinal and Aromatic Plants India" 60010922) OR AF-ID ("Indian Institute of Toxicology Research" 60101552) OR (AF-ID ("National Botanical Research Institute India" 60013111) OR AF-ID ("Indian Institute of Toxicology Research" 60101552) OR (AF-ID ("National Botanical Research InstituteIndia" 60013111))AND (LIMIT-TO (PUBYEAR , 2020)OR LIMIT-TO (PUBYEAR , 2019)OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011)) AND (LIMIT-TO (SUBJAREA , "BIOC"))on 23rd October 2021. A total bibliographic records was found during the data extraction.

Data analysis

To analyze the data across multiple dimensions, the researchers used several indicators, including publication templates, preferred publication format, prolific authors at pharmaceutical institutions, full collaboration with an author, most collaborating institutions, global collaborations, global collaborations. and cutting-edge sources. After data extraction, they were analyzed and visualized using MS excel and VOSviewer software (version 1.6.16) to better present the results.

Result and discussion

1. Publication growth line of four CSIR labs

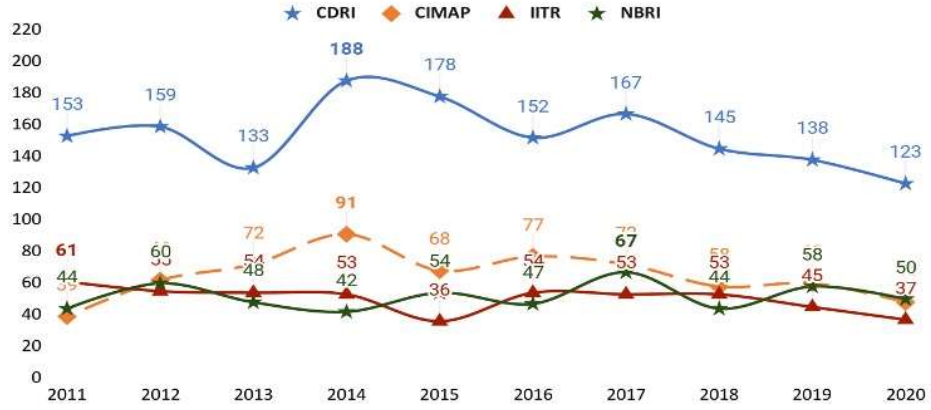

Figure 1: Publication Pattern of Research

The four CSIR labs in Uttar Pradesh published a total of 3198 publications from 2011 to 2022. CDRI had the highest percentage of publications (48.03%), followed by CIMAP (20.23%) and NBRI and IITR, which had similar publication numbers (Figure 1). The production of the labs fluctuated throughout the study period, with CDRI having the highest number of publications and the most significant variation. CDRI had an average of more than 100 publications per year, with a peak of 188 in 2014, followed by CIMAP with an average of 65 publications per year and a peak of 91 in 2014. The average publications per year for IITR and NBRI were about the same, with a minimum of 50 per year for IITR. Data was collected using the Scopus database, which is widely used for bibliographic data collection.

2. Correlation and regression line between publication and citations of CSIR labs

A specific association between variables is defined by correlation. In terms of the relationship between the variables, correlation and regression analysis are analogous (Patel et al., 2021). The correlation coefficient ranges from -1 through 0 to +1. In this case, -1 denotes very negatively correlated variables, +1 denotes extremely favourably correlated variables, and 0 denotes no correlation between variables. Simple/linear regression analysis also defines the relationship between two variables as independent and dependent variables. Regression analysis is a statistical tool that measures how much the dependent variable changes with any given change in the independent variable. A scatter plot is often used to graph the relationship between the two variables and to draw a regression line, which is usually a straight line. The slope of the regression line indicates the direction and strength of the correlation between the two variables. If the correlation is positive, the line slopes upwards from left to right, indicating that the two sets of observations rise or decline together. Conversely, if the correlation is negative, the line slopes downwards from left to right, indicating that one set of observations decreases while the other increases.

Table 1: Correlation and regression of CSIR labs

CSIR labs	CDRI	CIMAP	IITR	NBRI
Correlation	0.626	0.672	0.595	-0.157
R square	0.392	0.452	0.354	0.025

CIMAP has the highest correlation between publications and citations (0.672), i.e., it means CIMAP's publications and citations are highly correlated with each other. While NBRI has the least correlation (-0.157) between publications and citations, i.e., it represents that NBRI's publications and citations are less negatively correlated (Table 1). In figure 2, the regression lines of the CDRI, CIMAP, and IITR are similar upwards from

left to right, with different R2 values. But the regression line of NBRI is downwards, i.e. independent variables (publications) are increasing but dependent variables (citations) are slightly decreasing.

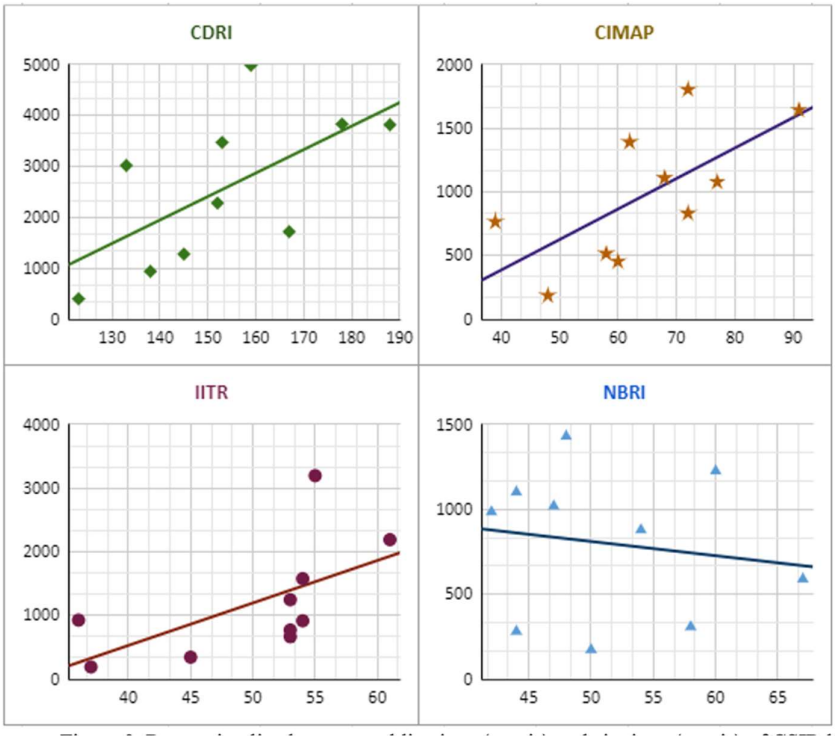

Figure 2: Regression line between publications (x-axis) and citations (y-axis) of CSIR labs.

3. Citation analysis with publication efficiency index (PEI)

The impact of research conducted by individual laboratories is assessed by the number of citations received, the ranking of the journal where the research was published, and the cooperation matrix of collaborating authors. Citation analysis is used to determine the significance of research output based on the assumption that higher-ranked or more prominent publications will be referenced more frequently in scientific literature. Counting citations can be used to evaluate the influence of individuals, groups, and institutions. Notable citations are used to measure the scientific dominance and exposure of a scientific publication. The credibility of an author can be determined by calculating how frequently their work is cited in subsequent publications.

Table 2: Publication pattern

Name of Institute	TP	TC	ACPP	PEI	h-index
CSIR-CDRI	1536	25745	16.76	0.97	59
CSIR-CIMAP	647	9779	15.11	0.37	44
CSIR-IITR	501	12024	24.00	1.38	49
CSIR-NBRI	514	7991	15.55	0.90	43
Total	**3198**	**55539**	**17.37**	**0.90**	

In the 2011-2020 period, four CSIR labs (CDRI, CIMAP, IITR, and NBRI) received 55,539 citations for their research publications. The highest percentage of cited articles belonged to CSIR-CDRI (46.35%), followed by IITR (21.65%), NBRI (14.39%), and CIMAP (13.61%) in table 2. Among the labs, CSIR-IITR had the highest average citation per publication (24) and the highest publication efficiency index (1.38). CSIR-CDRI had the most publications and citations and the highest h-index (59).

4. Distribution of output by authors with the impact of their output

Table 3 presents a list of the highest-ranked scientists affiliated with CSIR labs for the study. Dr. Karuna Shanker, a senior principal scientist from CSIR-CIMAP, has the most publications among the scientists listed, but his number of citations is below the average of total citations. Additionally, his average number of citations

per publication is 13.82, which is lower than the average value. The highest (1239) citations among the top ten predictive authors were obtained by Yogeshwer Shukla, Chief Scientist at CSIR-IITR and Principal Investigator of the Advanced Drug Delivery System (ADD) project, whose average citations per publication (27.53) and relative citation impact (1.45) were also highest. Shanker's most published works are internationally collaborative, approximately three-fourths of his publications. Among the top ten most productive authors, there were five authors from CSIR-CDRI, four authors from CSIR-CIMAP, and one author from CSIR-IITR.

Table 3: Most productive author

Sl. No	Name of author	Affiliation	TP	TC	ACPP	ICP (%)	h-index	RCI
1	Shanker, K.	CSIR-CIMAP	65	898	13.82	50 (76.92)	17	0.73
2	Khan, F.	CSIR-CIMAP	62	945	15.24	10(16.12)	18	0.80
3	Siddiqi, M.I.	CSIR-CDRI	61	744	12.2	10 (16.39)	17	0.64
4	Sharma, A.	CSIR-CIMAP	55	534	9.71	6 (10.90)	15	0.51
5	Chattopadhyay, N.	CSIR-CDRI	50	1210	24.2	5 (10)	21	1.27
6	Rajender, S.	CSIR-CDRI	48	880	18.33	10 (20.83)	17	0.96
7	Maurya, R.	CSIR-CDRI	47	1077	22.91	5 (10.63)	22	1.21
8	Sangwan, N.S.	CSIR-CIMAP	47	1190	25.32	4 (8.51)	18	1.33
9	Shukla, Y.	CSIR-IITR	45	1239	27.53	4 (8.89)	20	1.45
10	Dikshit, M.	CSIR-CDRI	44	945	21.48	7 (15.90)	16	1.13

- TP= Total Publications, TC= Total Citations, ACPP= Average Citations Per Publications, ICP= International Collaboration of Publications, RCI= Relative Citation Impact

Authors' Collaborations

Collaboration among authors is essential for the advancement of research in any field. When it comes to industrial and scientific research, collaboration among scientists is particularly beneficial for innovative research and exploring new theories (Kuri et al., 2023). In this study, the researchers examined author collaborations from four CSIR labs: CDRI, CIMAP, IITR, and NBRI. Kumar, A., Chief Scientist in the Division of Medicinal and Process Chemistry at the CSIR-Central Drug Research Institute, has the highest collaboration with other authors and the most citations among all authors from the four labs. The researchers created a network visualization of the authors from these labs (Figure 3) and found that out of 4,573 authors, the top 20 most productive authors collaborated with each other, forming four clusters.

The thickness of the joining line defines the level of collaboration. After Kumar, A., it was followed by Kumar, S., Sharma, A., and Singh, S., etc.

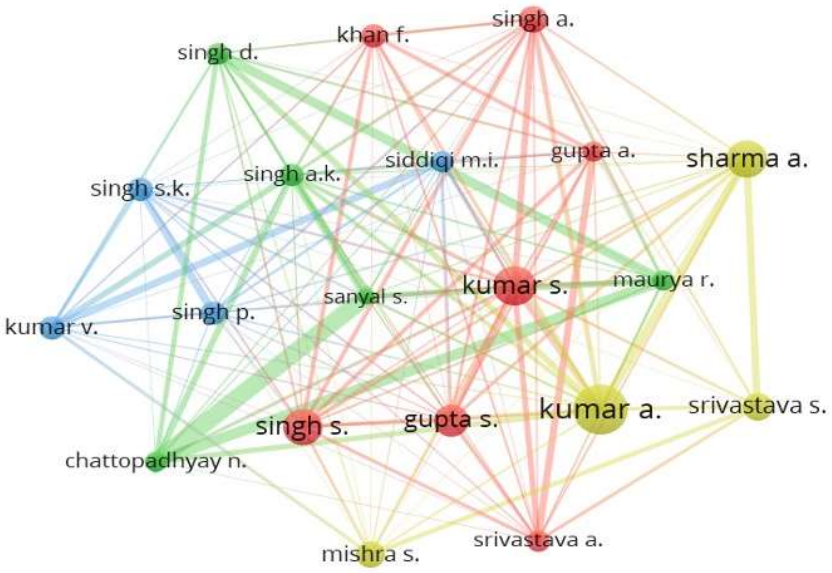

Figure 3: CSIR authors' collaborations

The researchers created network visualizations of authors from four different CSIR labs (Figure 4). CDRI had the most author collaborations (2729) and the top 20 most productive authors had at least 33 publications and 470 citations. Kumar, A. was the most published and highly cited author in the CDRI lab, followed by Kumar, S., Gupta, S., Singh, S., Siddiqi, M.I., among others. CSIR-CIMAP had 1081 author collaborations and the top 20 most productive authors had at least 16 publications and 233 citations. Khan, F. was the most published author in the CIMAP lab, followed by Sharma, A., Shanker, K., Sangwan, N.S., Luqman, S., etc. CSIR-IITR had 982 author collaborations and the top author, Shukla, Y., had the highest number of publications and citations. In CSIR-NBRI, there were 983 author collaborations with a minimum of 18 publications and 193 citations. Trivedi, P.K., was the most productive and highly cited author in the NBRI lab, followed by Nautiyal, C.S., Chauhan, P.S., Srivastava, S., Singh, P.K., etc.

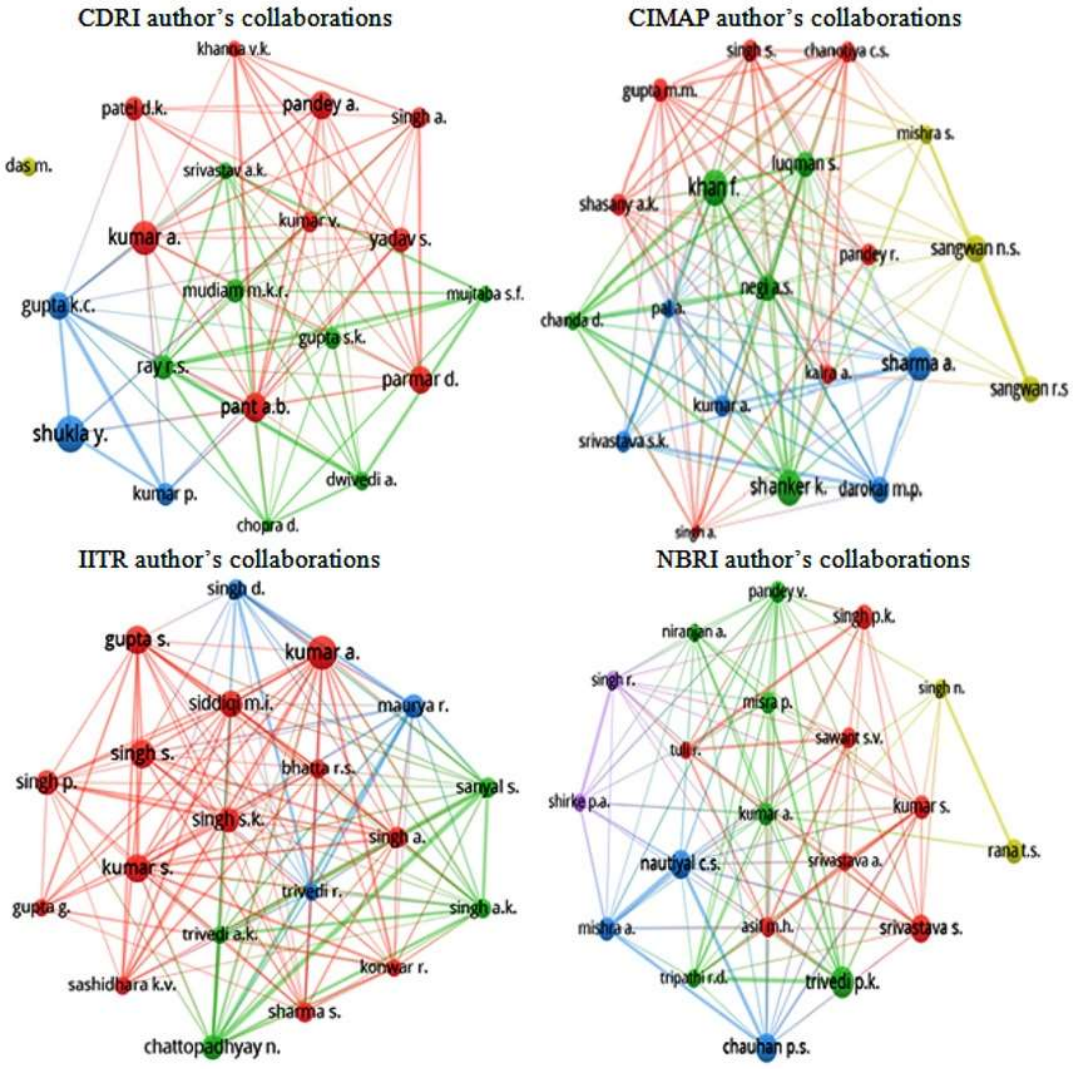

Figure 4: Network visualizations of authors from CSIR-CDRI, CSIR-CIMAP, CSIR-IITR and CSIR-NBRI labs

Geographical Variations

The researchers describe the geographical variations in the publications of these CSIR labs (Figure 5). In this study, researchers found that the United States has the highest collaboration (177 publications and 714 total link strength) with India, followed by Germany with 69 publications and 355 total link strength, the United Kingdom

with 44 publications and 228 total link strength, Saudi Arabia with 42 publications and 64 total link strength, etc. These Indian CSIR labs are collaborating with a total of 73 countries in the world. CSIR-CDRI's and CIMAP's publications collaborated with 44 countries each, while CSIR-IITR's publications have 43 country collaborations, and NBRI's publications have 39 country collaborations. The United States, a developed country, has well-defined laboratories, whose scientists are highly collaborative with Indian scientists. Indian scientists have collaborations with a huge number of European and Asian countries.

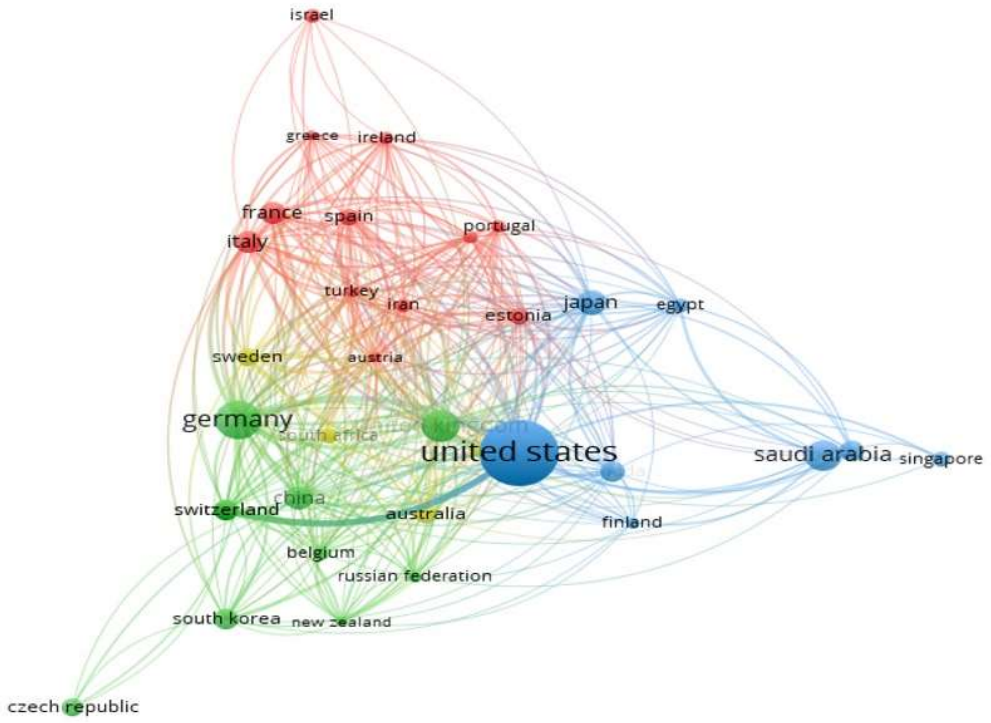

Figure 5: Geographical variations

Research Output by types of publication

The study also illustrates the CSIR labs' research output by breaking down how different labs distributed different sources over the time period of the 2011–2020 study period. The inferred data showed that journals dominated with 84.45% (n = 2701) of publications being articles for disseminating the research output. The review came in second, making up 6.34% (n = 203) of the publications. Other source types include book chapters with 5.09% (n = 163), books with 0.28% (n = 9), and conference proceedings with a proportion of 0.50% (n = 16) (Table 3).

Table 3: Document type

Item	CSIR-CDRI	CSIR-CIMAP	CSIR-IITR	CSIR-NBRI	Total
Article	1355 (88.21%)	541 (83.61%)	372 (74.25%)	433 (84.24%)	2701 (84.45%)
Book	2 (0.13%)	1 (0.15%)	3(0.59%)	3 (0.58%)	9(0.28%)
Book Chapter	37 (2.40%)	46 (7.10%)	41(8.18%)	39 (7.58%)	163(5.09%)
Conference Paper	5 (0.32%)	4 (0.61%)	4(0.79%)	3 (0.58%)	16(0.50%)
Editorial	6 (0.39%)	3 (0.46%)	7(1.39%)	1 (0.19%)	17(0.53%)
Erratum	24 (1.56%)	7 (1.08%)	21(4.19%)	4 (0.77%)	56(1.75%)
Letter	6 (0.39%)	2 (0.30%)	NA	2 (0.38%)	10(0.31%)
Note	1 (0.06%)	NA	2(0.39%)	NA	3(0.09%)
Retracted	3 (0.19%)	4 (0.61%)	4(0.79%)	NA	11(0.34%)
Review	94 (6.11%)	38 (5.87%)	44(8.78%)	27 (5.25%)	203(6.34%)

Short Survey	3 (0.19%)	1 (0.15%)	3(0.59%)	2 (0.38%)	9(0.28%)
Total	**1536**	**647**	**501**	**514**	**3198**

RGR and Dt of CSIR labs

The researchers calculated the relative growth rate of the research output of the CSIR labs separately with the help of the formula given below (Hunt, 1990):

RGR= [ln(W2)-ln(W1)]/(T2-T1)]

Where,

ln(W1) = Logarithms of no. of publications published until the previous year

ln(W2) = Logarithms of no. of publications published until the present year

T2-T1 = Difference between the initial year and the final year.

Doubling time (Dt)= 0.693/RGR

The data in Table 4 shows the RGR (relative growth rate) and Dt (doubling time) of research output in the CSIR labs. The RGR of CSIR-CDRI has decreased as the Dt has increased over time. The relationship between RGR and Dt is inversely proportional. In 2020, CSIR-CDRI, CIMAP, and IITR had the lowest RGR of 0.08 and the highest doubling times of publications at 8.30, 8.99, and 9.03, respectively.

Table 4: Comparison of RGR and Dt of publications CSIR

YEAR	CSIR-CDRI		CSIR-CIMAP		CSIR-IITR		CSIR-NBRI	
	RGR	DT	RGR	DT	RGR	DT	RGR	DT
2011								
2012	0.71	0.97	0.95	0.73	0.64	1.08	0.86	0.81
2013	0.36	1.95	0.54	1.29	0.38	1.81	0.38	1.83
2014	0.35	1.97	0.42	1.64	0.27	2.55	0.24	2.84
2015	0.25	2.80	0.23	3.02	0.15	4.63	0.25	2.82
2016	0.17	4.03	0.21	3.32	0.19	3.66	0.17	3.99
2017	0.16	4.33	0.16	4.27	0.16	4.43	0.20	3.39
2018	0.12	5.74	0.11	6.09	0.14	5.12	0.11	6.04
2019	0.10	6.74	0.11	6.57	0.10	6.79	0.13	5.19
2020	0.08	8.30	0.08	8.99	0.08	9.03	0.10	6.77

Authorship pattern

The authorship pattern of these four CSIR labs (CDRI, CIMAP, IITR, and NBRI) has multi authored dominated publications each. All labs have a small number of single-authored publications. CSIR-CDRI has the highest multiauthored publications, while CSIR-IITR has the lowest single-authored publications. The degree of collaboration of these CSIR labs is approximately 0.99 (Table 5).

Table 5: Authorship pattern

Institute	One A.	Two A.	Three A.	Four A.	Five & + A.	TA	DC	RSA
CSIR-CDRI	12	98	174	206	1046	1536	0.99	0.01
CSIR-CIMAP	12	42	99	105	389	647	0.98	0.02
CSIR-IITR	3	34	83	69	312	501	0.99	0.01
CSIR-NBRI	6	39	64	86	319	514	0.99	0.01
Total	**33**	**213**	**420**	**466**	**2066**	**3198**	**0.99**	**0.01**
*A.= Authors, TA= Total Authors, DC= Degree of Collaboration, RSA= Rate of Single Authorship								

Distribution of publication sources

The most productive sources in the field include Plos ONE, Bio-Organic and Medical Chemistry Letters, Protoplasma, International Journal of Biological Macromolecules, and Organic and Biomolecular Chemistry. Table 6 lists these top sources, and it shows that CSIR-CDRI typically has a higher number of publications in these journals compared to the other CSIR labs. CSIR-IITR has the lowest number of publications in most journals, while CSIR-CIMAP has the highest number of publications in the Protoplasma journal.

Furthermore, the researchers also identified the most referenced journals in the field, which include International

Journal of Nanomedicine, Mutation Research-Reviews in Mutation Research, Cell Death and Disease, Seminars in Cancer Biology, and PLoS ONE (Table 7). These top-cited journals are predominantly cited by publications from the CSIR-CDRI lab.

Table 6: Top productive journals

Source Title	CSIR-CDRI	CSIR-CIMAP	CSIR-IITR	CSIR-NBRI	Total	IF
Plos One	46	16	18	19	99	3.24
Bioorganic and Medicinal Chemistry Letters	75	10	0	0	85	2.823
Protoplasma	0	33	0	14	47	3.356
International Journal of Biological Macromolecules	33	7	3	3	46	6.953
Organic and Biomolecular Chemistry	46	0	0	0	46	3.876
Tetrahedron	44	2	0	0	46	2.457
Natural Product Research	13	26	0	5	44	2.861
Organic Letters	43	0	0	0	43	6.005
Tetrahedron Letters	38	4	0	0	42	2.415
Life Sciences	24	3	10	2	39	5.037

Table 7: Top citable journals

Source title	CSIR-CDRI	CSIR-CIMAP	CSIR-IITR	CSIR-NBRI	Total	IF
International Journal of Nanomedicine	589	0	9	0	598	6.4
Mutation Research - Reviews in Mutation Research	186	0	154	0	340	5.657
Cell Death and Disease	110	83	23	83	299	8.469
Seminars in Cancer Biology	274	0	0	0	274	15.707
PLoS ONE	171	23	12	33	239	3.24
Biochemical and Biophysical Research Communications	90	11	94	1	196	3.575
Journal of Cellular Biochemistry	154	10	6	0	170	4.429
Current Drug Targets	8	32	2	118	160	3.465
Cancer Biology and Medicine	79	0	79	0	158	4.248
Cytometry Part A	69	0	87	0	156	4.355

Findings and conclusion

The CSIR Labs were created to conduct important scientific and industrial research and coordinate efforts in Uttar Pradesh, India. A Scientometric analysis was conducted on research publications from four of these labs to assess their performance over a ten-year period (2011-2020). The data was obtained from the Scopus citation database, and the four labs (CDRI, CIMAP, IITR, and NBRI) produced a total of 3198 publications and received 55539 citations. The CSIR-CDRI published the highest number of papers (1536) and received the most citations (25745) compared to the other labs. Dr. Karuna Shanker from CSIR-CIMAP had the most publications, but his citations and average number of citations per publication were both below average. Yogeshwer Shukla from CSIR-IITR had the highest number of citations (1239) and citation impact ratio (1.45) among the top ten authors. International collaboration was found to be beneficial for scientific and industrial research. Kumar, A. from CSIR-CDRI had the most citations and highest level of collaboration among all authors from the four labs. The researchers noted a change in the geographical distribution of the labs' publications, with the United States having the highest collaboration with India. The study also revealed changes in authorship patterns, with multiple authors becoming more common in the four labs. CSIR-CDRI had the most multi-authored papers, while CSIR-IITR had the fewest single-authored papers. The degree of collaboration among the labs was found to be approximately 0.99. Overall, the study utilized a Scientometric approach to evaluate the research

productivity of the four CSIR Labs, which are dedicated to conducting important scientific and industrial research.

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