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# CSIR-Funded Research in India: Insights from Bibliometric and Altmetric Analysis

Devanath P R[a] and Rupesh Kumar A[b]

[a]Research Scholar, Department of Library and Information Science, Tumkur University, Tumakuru, Pin 572103, India.
Email: devanath.pr@icts.res.in

[a]Scientific Assistant, Library, International Centre for Theoretical Sciences, Bengaluru, Pin 560089.
Email: devanath.pr@icts.res.in

[b]Associate Professor, Department of Library and Information Science, Tumkur University, Tumakuru, Pin 572103, India.
Email: a.rupeshkumar@gmail.com

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**Purpose**

This study investigated the scholarly productivity, citation impact, and Altmetric score of the research funded by the Council of Scientific and Industrial Research (CSIR), India, over the past decade (2014-2023). The purpose was to assess and understand the influence of CSIR-funded research among academia and its engagement on social media.

**Methodology**

Bibliographic and citation data of 70501 CSIR-funded publications published during 2014-2023 were extracted from the Web of Science using the authors' country affiliation (India) and funding agency - CSIR, India. Altmetric Explorer was used to retrieve Altmetric data. The citation and Altmetric data were then tabulated using Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS).

**Findings and Suggestions**

CSIR-funded research is being disseminated predominantly in the form of articles (91.97%). This approach is validated by the fact that 87% of total citations have been garnered by articles, highlighting the significant impact of publishing in standard journal formats.

The yearly average relative growth rate of CSIR-funded research during the last decade stands at 0.28, indicating a stable and gradual increase in research output. On the other hand, the citations of these publications have received an annual average of 1.35 lakh citations, with a 0.18 yearly average relative growth rate. To better understand the citation trends, citation data were divided into two five-year block periods: 2014-2018 and 2019-2023. During the first block period, the mean relative growth rate for citations was 0.34, while it decreased to 0.06 during the second. This trend highlights the most important factor, i.e., 'Time' associated with citation accumulation. The social engagement of CSIR-funded research was considerably high across platforms. X (formerly Twitter) emerged as the leading platform, accounting for 1.43 lakh mentions, followed by News mentions (9290), Patent mentions (4154), and 4019 Facebook interactions. Further, over 11 lakh Mendeley reads indicated substantial scholarly influence of the CSIR-funded research. As CSIR conducts cutting-edge research, leveraging Altmetrics is an effective way to reach a broader audience and enhance visibility. Only 24% of research funded by CSIR is published on open-access platforms, receiving an average of 22.46 citations per paper. There is an urgent need for stricter implementation of the open-access mandate to include all CSIR-funded research, regardless of author affiliation, to enhance its visibility and impact. Chemistry dominates in CSIR-funded research, comprising 43% of total publications. However, there is a need to adopt refined criteria for funding allocation to ensure a more balanced distribution across diverse scientific disciplines.

**Keywords:** CSIR-funded research, Research Evaluation, Citations, Publications, Altmetrics.

## 1. Introduction

The Council of Scientific and Industrial Research (CSIR) is a prominent research and development organization in India, equipped with a diverse network of 37 laboratories, 39 outreach centres, 3 units and one innovation centre, all of which are dedicated to advancing and delivering groundbreaking research in science and technology (CSIR, 2024). In 2022, CSIR published around 5800 papers in Science Citation Index (SCI) journals with an average impact factor per paper of 4.9 (CSIR, 2024) and holds over 10000 patents since its inception (CSIR-URDIP, 2024), underscoring the high-quality of research conducted at CSIR. In addition to the ongoing research at its facilities, CSIR also offers financial assistance (through fellowships, grants, schemes, etc.) to promote research work in the fields of science and technology (CSIR-HRDG, 2024). CSIR is a publicly

funded organization that has the responsibility to utilize its resources most efficiently and effectively, ensuring a strong impact of the investment. This requires regularly assessing and analyzing their performance to optimize resource allocation and maximize the impact of public funds. While CSIR has shown promising results in research, it is essential to understand that funding is allocated effectively. Research evaluation is a recommended approach for assessing the performance of research conducted. It involves assessing scientific outputs' quantity, quality, impact, and relevance. Bibliometrics is an effective way to quantify and analyze the "academic footprint" of research. Bibliometrics has been widely used for research evaluations globally for many years.

Altmetrics, or alternative metrics, have emerged as an important complement to traditional bibliometric measures, providing a broader understanding of the impact of academic work in the digital age. These metrics are designed to capture how research outputs are disseminated and engaged across platforms (such as X, Facebook, News, and so on). The rise of altmetrics can be attributed to the growing demand from researchers, funders, and institutions for more dynamic and diverse indicators of academic impact, especially as traditional citation-based measures, which often lag behind in reflecting real-time engagement and impact (Barbic et al., 2016; Sugimoto et al., 2017).

The present study is an effort to understand the growth trajectory of CSIR-funded research, while also evaluating both productivity and impact.

## 2. Review of Literature

A bibliometric analysis of CSIR-funded research provides valuable insights into the research output, impact, and trends associated with its scientific contributions. A study by Gupta B M et al., (1999) examined the applicability of Lotka's inverse power law to analyze the productivity patterns of CSIR scientists across various levels. This study provided insights into how various distributions effectively capture the productivity trends within the organization. A study by Sengar, (2012) on the CSIR-Institute of Microbial Technology's publications from 1991–1995 and 2005–2009 assessed research progress through quantitative and qualitative indicators, including publication impact, research areas, and international collaborations. Further, Gupta et al., (2015) conducted a comprehensive analysis of the publications and citation impact of various CSIR laboratories from 2007 to 2011. The findings reveal that CSIR has made significant contributions to Chemistry research. A study by Mukherjee, (2017) using data from Web of Science and Scopus databases analyzed the publications produced by CSIR from 2010 to 2015, revealing that the average citation rate of the publications was 7, and the authors mostly preferred to publish in foreign journals instead of Indian journals. The study also revealed that almost 10% of the articles did not receive any citations. Kappi et al., (2021) analyzed CSIR Chemical Science Laboratories' research publications from 2010 to 2019, based on 20601 records from the Web of Science database, highlighting key trends across collaboration metrics, discipline-specific output, and citation impact. Results reveal a predominant collaborative culture among researchers, with "RSC Advances" emerging as the most frequently chosen journal for publication.

While existing studies focus on CSIR's research contributions, most works indicate a lack of analysis of the impact of "CSIR-funded research". Besides, the "social engagement" of funded research remains underexplored. The present study seeks to fill that gap, incorporating an innovative approach by exploring the role of Altmetrics in complementing traditional research metrics.

## 3. Objectives

1. To trace the growth trajectory of CSIR-funded publications and citations over the past decade.
2. To understand authors' preferences in terms of document types in publishing their research.
3. To assess the social influence of scholarly research funded by CSIR, using Altmetrics.
4. To ascertain the highly preferred journals and focus areas of CSIR-funded research.

## 4. Methodology

Firstly, we collected the records of 70501 CSIR-funded research publications published between 2014 and 2023, indexed in the Web of Science (https://www.webofscience.com/). An advanced search was conducted using the authors' country of affiliation (India) to locate publications by Indian authors, which was then refined to focus on those funded by CSIR, India.

Secondly, we identified articles with Digital Object Identifiers (DOIs) and imported the DOIs into Altmetrics Explorer to retrieve Altmetrics data. We then exported the Altmetrics data into an Excel file

Table 1 — Growth Trajectory of CSIR-funded publications and citations.

| Year | Np | CNp | Nc | CNc | Nlp1 | Nlp2 | RGRp | Mean RGRp | DTp | Mean DTp | Nlc1 | Nlc2 | RGRc | Mean RGRc | DTc | Mean DTc | ACP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014 | 8495 | 8495 | 259329 | 259329 | | 9.05 | | | | | | 12.47 | | | | | 30.53 |
| 2015 | 8227 | 16722 | 235133 | 494462 | 9.05 | 9.72 | 0.68 | | 1.02 | | 12.47 | 13.11 | 0.65 | | 1.07 | | 28.58 |
| 2016 | 7302 | 24024 | 204631 | 699093 | 9.72 | 10.09 | 0.36 | | 1.91 | | 13.11 | 13.46 | 0.35 | | 2.00 | | 28.02 |
| 2017 | 6439 | 30463 | 168380 | 867473 | 10.09 | 10.32 | 0.24 | | 2.92 | | 13.46 | 13.67 | 0.22 | | 3.21 | | 26.15 |
| 2018 | 6151 | 36614 | 134001 | 1001474 | 10.32 | 10.51 | 0.18 | 0.37 | 3.77 | 2.41 | 13.67 | 13.82 | 0.14 | 0.34 | 4.82 | 2.78 | 21.79 |
| 2019 | 6042 | 42656 | 122137 | 1123611 | 10.51 | 10.66 | 0.15 | | 4.54 | | 13.82 | 13.93 | 0.12 | | 6.02 | | 20.21 |
| 2020 | 6242 | 48898 | 102035 | 1225646 | 10.66 | 10.80 | 0.14 | | 5.07 | | 13.93 | 14.02 | 0.09 | | 7.97 | | 16.35 |
| 2021 | 6962 | 55860 | 81665 | 1307311 | 10.80 | 10.93 | 0.13 | | 5.21 | | 14.02 | 14.08 | 0.06 | | 10.74 | | 11.73 |
| 2022 | 7416 | 63276 | 42204 | 1349515 | 10.93 | 11.06 | 0.12 | | 5.56 | | 14.08 | 14.12 | 0.03 | | 21.81 | | 5.69 |
| 2023 | 7225 | 70501 | 10310 | 1359825 | 11.06 | 11.53 | 0.48 | 0.20 | 1.45 | 4.37 | 14.12 | 14.12 | 0.01 | 0.06 | 91.06 | 27.52 | 1.43 |
| Total/ Mean | 70501 | 397509 | 1359825 | 9687739 | | | 0.28 | | 3.49 | | | | 0.18 | | 16.52 | | 19.05 |

Np = Number of Publications
CNp = Cumulative Number of Publications
Nlp = Natural log of the first valve of CNp
Nlp2 = Natural log of the Last value of CNp
RGRp = Relative Growth Rate of Publications
DTp = Doubling Time of Publications
ACP = Average Citations per Paper
Nc = Number of Citations
CNc = Cumulative Number of Citations
Nlc = Natural log of the first valve of CNc
Nlc2 = Natural log of the Last value of CNc
RGRc = Relative Growth Rate of Citations
DTc = Doubling Time of Citations

and mapped the DOIs, consolidatinmg the Altmetrics & Citation data into a single file for the analysis.

Finally, tabulation, statistical analysis, and graph visualizations were done using Microsoft Excel and the Statistical Package for Social Sciences (SPSS).

## 5 Results and Discussion

### 5.1 Publications and Citations

Table 1 shows a fluctuating pattern in CSIR-funded publications over the past decade, with an average relative growth rate (RGR) of 0.28. The years 2014 and 2015 marked the highest productivity, reaching peak publication counts of 8495 and 8227, respectively. After 2015, there was a decline in the number of publications until 2019, followed by a gradual increase over the next three years. The doubling time analysis reveals that, on average, CSIR-funded publications require approximately 3.49 years to double in volume, highlighting a moderate pace of growth in research output.

On the other hand, the citations of these publications have received an annual average of 1.35 lakh citations, with a 0.18 yearly average relative growth rate. To better understand the citation trends, citation data were divided into two five-year block periods: 2014-2018 and 2019-2023. During the first block period, the mean relative growth rate for citations was 0.34, while it decreased to 0.06 during the second. This trend highlights the most important factor, i.e., 'Time' associated with citation accumulation. Similarly, the citation doubling time shows a striking shift between the two periods. In the first five-year block (2014-2018), it took only an average of 2.78 years for citations to double, but, in the second five-year block (2019-2023), this doubling time extended to 27.52 years. This shift may indicate that new publications require time to receive average citations.

Nearly 9% (6174) of the articles received no citations, and 43.11% (30394) of the publications received ten or fewer citations. However, only a small fraction of 2.02% (1423) of the articles received more than 100 citations, collectively accounting for 20% (280689) citations.

### 5.2 Document Types

Table 2 shows the predominance of articles, 64843 (91.97%) in document types suggesting that most CSIR-funded research is being disseminated in standard journal formats, which are widely accessible and citable to peers. This approach is validated by the impressive fact that these articles account for over 87% (1193970) of total citations, highlighting the significant impact of publishing in standard journal formats. Reviews are the second most common document type, representing over 5% (3705) of total publications. Notably, they account for 11% (154226) of total citations, demonstrating that review papers achieve a high citation rate (Ho et al., 2017).

### 5.3 Preferred Journals

Table 3 highlights the most preferred journals for authors publishing CSIR-funded research. RSC Advances, a multidisciplinary journal in chemistry, leads the list with 2238 publications. Its fully open-

Table 2 — Authors' Preference of Document Types.

| Document types | Publications | Citations | Altmetrics data |
|---|---|---|---|
| Article | 64843 | 1193970 | 155124 |
| Review | 3705 | 154226 | 12817 |
| Article; Early Access | 1158 | 1715 | 3375 |
| Article; Proceedings Paper | 367 | 7329 | 151 |
| Others | 428 | 2858 | 1383 |

Table 3 — Top 10 Journals in which the CSIR-funded research was published.

| Journal | Number of Publications | Citations |
|---|---|---|
| RSC Advances | 2238 | 50247 |
| Chemistry Select | 1138 | 8746 |
| New Journal of Chemistry | 1024 | 14186 |
| Journal of Organic Chemistry | 1021 | 21191 |
| Scientific Reports | 887 | 23614 |
| Organic & Biomolecular Chemistry | 824 | 13149 |
| Chemical Communications | 741 | 21834 |
| Tetrahedron Letters | 738 | 10290 |
| Organic Letters | 718 | 20235 |
| Dalton Transactions | 702 | 15245 |

access (Gold) model likely contributed to its impressive reach, attracting a total of 50247 citations and an average of 22.45 citations per paper. It is interesting to note that RSC Advances is the only fully open-access journal among the top ten. Chemistry Select (published by Wiley) follows as the second most preferred journal, with 1138 publications and an average citation rate of 7.89 per paper. Overall, the top 10 journals accrued 14.61% of total citations, with an average of 20.06 citations per article.

#### 5.4 Social Engagement

The social engagement of CSIR-funded research, measured through Altmetrics, indicates considerably high influence across platforms. X (formerly Twitter) emerges as the leading platform, accounting for 1.43 lakh mentions, followed by News mentions (9290), Patent mentions (4154), and 4019 Facebook interactions. Further, over 11 lakh Mendeley reads indicate substantial scholarly influence of the CSIR-funded research. In terms of Document Types, journal articles had the highest social influence. Nearly 89% of the total Altmetrics score is attributed to articles, indicating broad online engagement. Reviews also reflect a strong online presence, with an Altmetrics score of 7.42%, ranking them as the second-highest type in Altmetrics data. As CSIR conducts cutting-edge research, leveraging Altmetrics is an effective way to reach a broader audience and enhance visibility.

#### 5.5 CSIR's Focus Research Areas

Deoghuria et al., (2015) state that "Chemistry has been the most preferred research area among Indian scientists for quite some time in terms of the total number of publications, global share, visibility, and citation impact are concerned". In support of this statement, the largest share of CSIR-funded research output is concentrated in chemistry-related fields, underscoring a strong emphasis on this area. Out of a total of 70501 CSIR-funded publications, a massive number of 37076 publications were focused on chemistry, highlighting the field's prominence within the CSIR-funded research. Within chemistry, multidisciplinary research leads with 8622 publications, followed by organic chemistry with 5662 publications. Physical chemistry, inorganic & nuclear chemistry, and medicinal chemistry also contributed significantly.

#### 5.6 Highly Cited Publications

Table 4 highlights the top ten highly cited articles in the research funded by CSIR. Among these, nine are research articles, and one is a review article authored by Senapati, Sudipta et al. (2018). The most-cited article is by Abbott, B.P. et al. (2016), published in Physical Review Letters, has received 6570 citations and an Altmetric Score of 4699. Eight of the ten articles are related to the Laser Interferometer Gravitational-Wave Observatory (LIGO) project (consortium papers). LIGO is a facility dedicated to gravitational-wave research, enabling the broader scientific community to engage in detector development, observational studies, and data analysis (LIGO Laboratory, n.d.). India has also contributed to this frontier through the LIGO-India mega-science project, a significant initiative in astronomy on Indian soil (LIGO-India, n.d.).

These articles underscore the importance of international collaborations, as each paper involves a substantial number of co-authors, reflecting the collective effort of the global scientific community. The subject category "Physics" dominates, with the articles achieving significant attention within and beyond the academic community. Further, all ten articles are published as open access, enhancing their visibility and reinforcing the importance of open-access publishing in amplifying the impact of scientific research.

Table 4 — Top ten highly cited publications.

| Article (first author, title, and year) | Citations | Altmetrics Score | WoS Subject Categories |
|---|---|---|---|
| Abbott, B. P., Observation of Gravitational Waves from a Binary Black Hole Merger, 2016 | 6570 | 4699 | Physics, Multidisciplinary |
| Abbott, B. P., GW170817: Observation of Gravitational Waves from a Binary Neutron Star Inspiral, 2017 | 4409 | 1569 | Physics, Multidisciplinary |
| Abbott, B. P., GWTC-1: A Gravitational-Wave Transient Catalog of Compact Binary Mergers Observed by LIGO and Virgo during the First and Second Observing Runs, 2019 | 1895 | 526 | Physics, Multidisciplinary |
| Abbott, B. P., Gravitational Waves and Gamma-Rays from a Binary Neutron Star Merger: GW170817 and GRB 170817A, 2017 | 1849 | 769 | Astronomy & Astrophysics |
| Abbott, B. P., GW170104: Observation of a 50-Solar-Mass Binary Black Hole Coalescence at Redshift 0.2, 2017 | 1757 | 1594 | Physics, Multidisciplinary |
| Abbott, B. P., Directional Limits on Persistent Gravitational Waves from Advanced LIGO's First Observing Run, 2017 | 1757 | 22 | Physics, Multidisciplinary |
| Kim, Min-Sik, A draft map of the human proteome, 2014 | 1736 | 580 | Multidisciplinary Sciences |
| Abbott, B. P., GW170814: A Three-Detector Observation of Gravitational Waves from a Binary Black Hole Coalescence, 2017 | 1630 | 473 | Physics, Multidisciplinary |
| Aasi, J., Advanced LIGO, 2015 | 1433 | 210 | Astronomy & Astrophysics |
| Senapati, Sudipta, Controlled drug delivery vehicles for cancer treatment and their performance, 2018 | 1319 | 21 | Biochemistry & Molecular Biology; Cell Biology |

## 6 Findings

Over the past decade, the average relative growth rate (RGR) of CSIR-funded publications is 0.28, while that of citations is 0.18. The doubling time for publications is 3.49 years, indicating rapid growth, whereas citations take much longer, averaging 16.52 years. Citations for the initial five years (2014-2018) doubled in 2.78 years, whereas citations for the recent five years (2019-2023) require 27.52 years, underscoring the critical role of 'time' in citation accumulation, with earlier publications gaining recognition faster than recent ones.

A significant majority (91.97%) of CSIR-funded research is published as journal articles, which account for 87% of total citations, highlighting the dominant role of standard journal formats in ensuring visibility and scholarly impact.

X (formerly Twitter) emerges as the leading social media platform for discussing CSIR-funded research, with 1.43 lakh mentions, followed by News mentions (9290), Patent mentions (4154), and Facebook interactions (4019). Over 11 lakh reads on Mendeley further demonstrate the significant scholarly influence of CSIR-funded research, bridging traditional and digital platforms to reach diverse audiences.

Among journals, RSC Advances leads with 2238 publications, accumulating 50247 citations at an average of 22.45 citations per article. The top 10 journals contributed 14.61% of total citations, with an average citation rate of 20.06 per article, emphasizing the importance of publishing in high-impact journals.

Chemistry dominates in CSIR-funded research, comprising 43% of total publications. This highlights the need for refined funding criteria to promote a more balanced allocation of resources across diverse scientific disciplines.

## 7 Suggestions

Only 24% of research funded by CSIR is published on open-access platforms, receiving an average of 22.46 citations per paper. A substantial portion (76%) of research has been published in closed-access platforms, averaging 18.29 citations per paper. CSIR Open Access Mandate states that "All research papers published from all CSIR laboratories and supported by a grant from CSIR will be made open access by depositing the full text and the metadata of each paper in an institutional repository" (CSIR-CENTRAL, n.d.). Previous studies have suggested that the publications in peer-reviewed journals generally enjoy greater visibility than those archived in institutional repositories (Björk et al., 2014; Borrego, 2017). To enhance the impact of CSIR-funded research, policies should prioritize the dissemination of research findings in open-access journals, and not just archiving in institutional repositories. Open access at the publication stage brings better visibility than open

access at post-publication stage through institutional repositories. Such an approach ensures greater visibility and influence in the academic community. This further helps in attracting higher Altmetric Attention scores, as open-access articles receive higher Altmetric Attention than subscription-based publications (Coyne & Regan, 2022; Holmberg et al., 2020; Zhang et al., 2021).

Interestingly, an examination of CSIR-funded publications reveals that 48233 (68.41%) publications are authored by researchers not affiliated with CSIR institutions, indicating the need for stricter implementation of the open-access mandate to include all CSIR-funded research, regardless of author affiliation, to increase accessibility and consequently, visibility and impact.

Our findings reveal that chemistry publications comprise 43% of its total output. This aligns with the observations made in an earlier study that the Indian chemical industry has benefited from advancements in research and development, particularly in the pharmaceutical sector. Indian companies have leveraged expertise in synthetic organic chemistry to develop cost-effective generic medicines, which have had a significant impact on healthcare outcomes both domestically and globally (Sindkhedkar et al., 2020). CSIR plays a key role in this. However, there is a need to adopt refined criteria for funding allocation to ensure a more balanced distribution across diverse scientific disciplines.

CSIR should actively promote the dissemination of research through social engagement platforms like X, academic social networks, and other digital tools to amplify visibility and foster engagement.

## 8 Conclusion

This study provides a comprehensive analysis of CSIR-funded research over the past decade (2014–2023), highlighting notable trends. In terms of publications, the growth has not been consistent but has fluctuated. Chemistry research dominates CSIR's portfolio, aligning with its strong influence on India's pharmaceutical industry and healthcare advancements.

Despite the benefits of open-access publishing, only 24% of CSIR-funded research is freely accessible, highlighting the need to prioritize open-access dissemination at the publication stage. Such efforts would not only increase visibility but also enhance the scholarly and societal impact of CSIR-funded research. Further, with 68.41% of CSIR-funded publications authored by non-CSIR researchers, stricter enforcement of the open-access mandate is essential to ensure that all funded outputs are publicly accessible.

To amplify its impact, CSIR may adopt a multi-faceted approach of (a) Promoting open-access publishing; (b) Encouraging researchers to leverage social media and digital platforms; and (c) Balancing funding across disciplines.

These strategies will help maximize the visibility, accessibility, and influence of CSIR-funded research, fostering greater recognition and societal benefits.

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