Evaluating the scholarly impact of open-access and non-open-access publications of CSIR-Central Food Technological Research Institute Using PlumX metrics: A multi-dimensional assessment

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ABSTRACT

Research impact is now evaluated using a more comprehensive, advanced understanding of how academic research is disseminated and used, going beyond conventional citation-based metrics. Altmetrics analysis provides further insights into the scope and impact of research across a wide range of societal and professional domains. This study examines the research productivity, scholarly influence, and online visibility of publications from CSIR Central Food Technological Research Institute (CFTRI) using the PlumX Metrics framework. Publication records from 2012 to 2025 were retrieved from the Scopus database and enriched with PlumX data. A total of 2,387 articles were identified and manually verified for analysis across the five PlumX categories: Usage, Captures, Mentions, Social Media, and Citations. To assess trends and patterns, descriptive statistics and time-series analysis were applied to publication output and impact. Normalised average values were compared across major research domains. Relationships between metric types were explored using Python libraries, and comparative analysis was conducted to evaluate differences between Open Access (OA) and Non-Open Access (N-OA) publications. The results reveal distinct variations across metric categories in Food Science research. Capture (Mendeley readers) shows the strongest activity, reflecting high visibility and serving as a leading indicator of future citations. In contrast, Mention metrics (e.g., blogs, news coverage) remain very low, indicating limited public or media engagement. Comparisons between OA and N-OA outputs show significant differences in Usage and Capture, with OA publications substantially outperforming N-OA, suggesting greater reach and discoverability. However, Citations, Social Media, and Mentions exhibit only marginal differences between the two groups. Statistics confirm that OA articles achieve significantly higher Usage than N-OA, though both groups perform similarly in terms of citations, social media attention, and media mentions.Overall, the findings demonstrate a growing trend in online visibility of CSIR-CFTRI research outputs over time. While Open Access clearly enhances readership and discoverability, it does not necessarily translate into proportionally higher citation impact or social media engagement compared to non-OA publications.

Keywords: PlumX Metrics, CSIR-CFTRI, Almetrics, Central Food Technological Research Institute, Citation Analysis, Research impact evaluation, Food Science, Open Access, Non-Open Access

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1. Introduction

Mankind has been greatly impacted by the emergence of the internet and social media. Every individual has benefited from it, whether we are aware of it or not. Not only has it been a part of our day-to-day life, but it has also majorly influenced scholarly communication as well. Researchers are using various media platforms to propagate academic ideas and results of their work. For a long time, the primary method used in academic assessment has been the traditional approach to research evaluation, which mostly depends on citation-based measures like the journal impact factor and h-index. This approach makes the assumption that citations are a reliable sign of scholarly quality and a direct measure of intellectual production. Numerous citation-based indicators, like total citation counts and the h-index, have been developed as a result of the use of citation counts to measure the impact and quality of research. But in this era of digital communication, where there is an increasing focus on societal impact, the conventional paradigm is proving to be less efficient as the only indicator of publication influence and impact. Despite its widespread use, citation analysis's validity and reliability may be affected by its inherent flaws. Due to these drawbacks, traditional bibliometrics have been critically re-examined, and other evaluation

Altmetrics (also known as alternative metrics) are introduced to capture the actual visibility of publications in the digital era and emerge in response to the limitations of traditional measures. PlumX metrics is an almetric tool developed by Plum Analytics (later acquired by Elsevier). PlumX organize almetrics into five categories like, usage (clicks, downloads etc.), Captures (bookmark, favourites, Mendeley readers etc.), Mentions (blog post, news, media, Wikipedia etc), social media (Facebook, X etc.), and Citations, this will give multidimensional overview of how articles are used, viewed, commented, discussed and cited etc.

There is an ongoing global debate about whether open-access or non-open-access publications receive greater visibility on the internet. Using PlumX metrics, we are attempting to find out which open-access or non-open-access articles are getting more visibility.

This paper explores a more comprehensive, multidimensional framework to assess the full spectrum of research impact, using the CSIR-Central Food Technological Research Institute (CSIR-CFTRI) as a specific case study. Also, evaluate whether open-access or non-open-access publications are getting more visibility on the internet. CSIR-CFTRI, a constituent laboratory of the Council of Scientific and Industrial Research (CSIR), is one of the Premier institutes dedicated to Food science and Technology. Over the decades, CFTRI has played a significant role in advancing India's food processing industry through innovative research, the development of new technologies, food safety, policy making, and the dissemination of knowledge.

1.1 Research Objectives

This study aims to provide a comprehensive and exhaustive evaluation of the research impact of the CSIR-CFTRI from 2012 to 2025.

This will be accomplished by using the PlumX metrics framework to do a thorough, multifaceted examination of the research output produced by the institution in five different categories: Citations, Usage, Captures, Mentions, and Social Media. The analysis is intended to go beyond conventional citation counts and offer a more comprehensive view of the ways in which the institution's scholarship is used and interacted with in a range of professional and societal contexts. The analysis will compare impact across major research areas, explore the relationships between different metric types, and assess the differential impact of Open Access versus non-Open Access publications.

This study adds to the larger body of knowledge on research assessment by offering a real-world, empirical illustration of how a comprehensive strategy might produce more insightful and useful information than only standard techniques. The results will assist the institution in understanding the various target groups it deals with, establishing distinctive strengths in its multiple research outputs, and shaping future policy on Open Access, research communication, and dissemination. This case study illustrates how useful a multifaceted viewpoint is for contemporary institutional strategy planning and self-evaluation.

2. Review of Literature

These studies explore the value and relevance of PlumX metrics as an alternative metric to replace traditional citation metrics when measuring scholarly impact. Elise & Sarah (2025) explain the use of PlumX at Saint Mary's College of California to highlight faculty academic distinction through capturing their impact across five measures: Citation, Usage, social media, Mention, and captures. Simley et al. (2023) investigated the benefits of open access in the medical sector. They found that open-access articles are receiving more altmetric impact than non-open-access articles overall, with Bronze Open Access getting the most significant advantage, and Mendeley having the most comprehensive coverage (97.12). Manika et al. (2020) examined computer science disciplines publications from Indian central universities, finding a strong correlation between dimensions citation and Mendeley readership, and Twitter showing maximum almetric coverage. Mehiri (2021) revealed that Iranian social science articles were most present on Mendeley, Twitter, and Facebook, with a positive correlation between almetric activity and scientific collaboration, open access publishing and journal quality. Saberi & Ekhtiyari (2019) investigated highly cited library and information science papers, finding a positive correlation between Google Scholar citations and almetric indicators, with a statistically significant relationship for capture and citation metrics. Bar-Ilan et al. (2012) found extensive web presence among scholars, with 84% having homepages and Mendeley covering over 80% of sample articles, showing a significant correlation (r=45) with Scopus citations. Karmakar et al. (2021) analysed a large-scale comparison of almetric aggregators, revealing that PlumX tracks more sources and captures events for more articles than Almetric.com, although coverage varies across platforms. Cho (2021) analysed almetrics for Library and information science research, finding that 63% of highly-cited papers had Mendeley bookmarks, while open access papers showed greater sensitivity in views, blogs, and tweets, with Mendeley being the only almetric significantly correlated with citations. Ram & Mils (n.d) focused on assessing the research impact of Himachal Pradesh University, Shimla, using non-

Their study analysed articles with more than 100 citations from the Scopus database, utilizing the PlumX tool to evaluate research impact through alternative metrics rather than relying solely on traditional citation measures

3. Research Questions

Research questions of the study are as follows:

1. To analyze the scholarly impact of articles published by CSIR-CFTRI using PlumX metrics.

2. To identify the subject areas in which the majority of articles are published.

3. To examine the year-wise growth and distribution of publications.

4. To compare the number of publications in Open Access and Non-Open Access journals.

5. To assess, through PlumX categories, whether Open Access or Non-Open Access articles receive greater impact.

6. To evaluate the internet visibility of the published articles.

4. Methodology and Data Collection

The initial step in this study involved the selection of a robust and comprehensive data source for the publication corpus. The Scopus database, developed by Elsevier, was chosen as the primary source for identifying CSIR-CFTRI's research output. Scopus is a comprehensive abstract and citation database that covers a wide range of peer-reviewed literature, conference proceedings, and patents across various disciplines, including the life sciences, engineering, and social sciences. Its extensive coverage, encompassing over 42,000 journals from more than 5,000 publishers, made it a suitable choice for this interdisciplinary study of CSIR-CFTRI, which has diverse departments spanning across the spectrum of Food Science & Technology, including food engineering, food microbiology, and quality control.

The data collection process involved the construction of a query to retrieve all publications where the affiliation field included "Central Food Technological Research Institute" for the period January 1, 2012, to July 31, 2025. This search yielded an initial set of records, which was then cleaned to remove any irrelevant or duplicate entries

Citations	This category contains both traditional citation indexes, such as Scopus, and citations that help indicate societal impact, such as Clinical or Policy Citations. Examples: citation indexes, patent citations, clinical citations, policy citations
Usage	A way to signal if anyone is reading the articles or otherwise using the research. Usage is the number one statistic researchers want to know after citations. Examples: clicks, downloads, views, library holdings, video plays
Captures	Indicates that someone wants to come back to work. Captures can be a leading indicator of future citations. Examples: bookmarks, code forks, favorites, readers, watchers
Mentions	Measurement of activities such as news articles or blog posts about research. Mentions are a way to tell that people are truly engaging with the research. Examples: blog posts, comments, reviews, Wikipedia references, news media
Social Media	This category includes the shares, likes, etc., that reference the research. Social Media can help measure ''buzz" and attention. Social media can also measure how well a particular piece of research has been promoted. Examples: shares, likes, comments

Table 1. PlumX Categories

resulting in a final corpus of 2,387 publications. The resulting dataset of publication metadata (e.g., DOI, title, authors, year, subject area) was then manually enriched with the PlumX metrics. This step transformed the raw publication list into a rich dataset suitable for a multidimensional impact analysis.

PlumX metrics are categorized into five categories: Citations, Usage, Captures, Mentions, and Social media(7):

5. Data Analysis

The data analysis followed a systematic, multi-step process to address the study's core objectives.

First, descriptive statistics were employed to examine the overall publication volume and trends in research output over the specified 14-year period. This provided a macro-level view of the institution's scholarly productivity.

Year	No. of documents		
	Open Access	Non-Open Access	Total
2012	27	168	195
2013	49	129	178
2014	71	135	206
2015	97	152	249
2016	52	128	180
2017	49	122	171
2018	44	115	159
2019	49	84	133
2020	53	109	162
2021	54	119	173
2022	55	98	153
2023	39	100	139
2024	22	147	169
2025 (Until July)	7	113	120
Total	**668**	**1719**	**2387**

Table 2. Distribution of CSIR-CFTRI Publications by Year: Scopus Data from 2012 to 2025

The second table determines which Plumx Metrics categories have a higher impact. It is clearly indicated that Capture and citations are the most impactful areas, showing a 42.32 and 24.00 average impact, while mention seems to be the least impactful, with 0.12. Usage and Social media show a moderate average impact value while evaluation

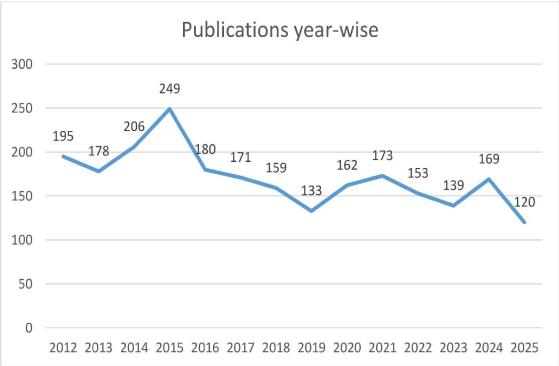

Figure 1.0 Articles published in Year wise

PlumX Metrics	Impact	Total Articles	Average Impact
Usage	14518		6.082111
Mention	297		0.124424
Social media	11087	2387	4.644742
Capture	101023		42.32216
Citation	57294		24.00251

Table 3. Total and Average PlumX Impact for the Selected Papers

Third, a comparative analysis was performed to explore the unique impact profiles of the major research areas according to the Scopus Subject Areas. It is clearly mentioned that major areas of subject are covered by agricultural and biological sciences.

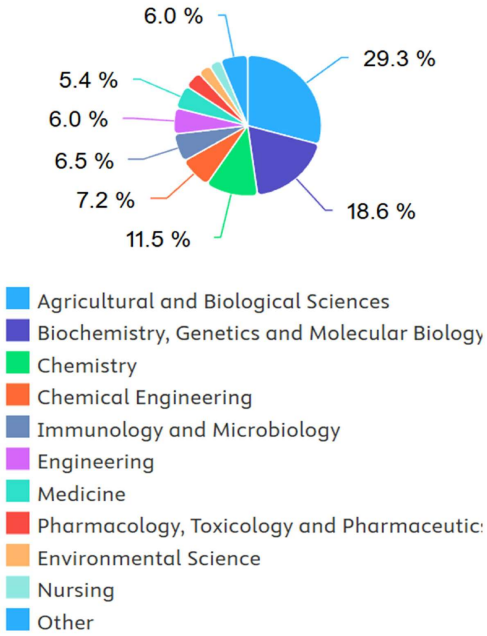

Figure 2. Publications by Subject areas

Fourth, to investigate the relationships between the different metric types, a Spearman's correlation analysis was conducted. This non-parametric test was chosen to explore the strength and direction of the relationships between Citations and the other non-citation PlumX categories (Usage, Captures, Mentions, Social Media). The purpose of this analysis was to determine whether these metrics measure distinct aspects of impact or if they are largely redundant.

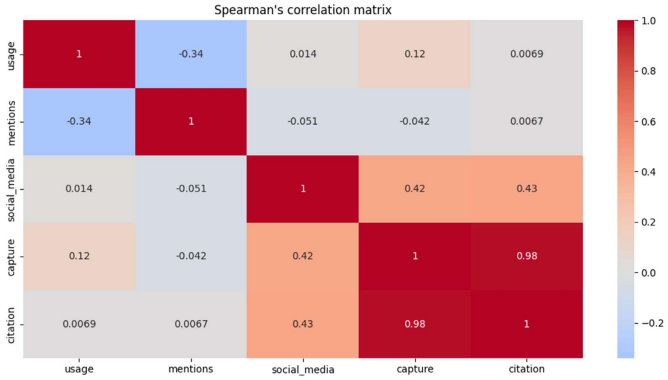

Figure 3. Spearman's correlation matrix of PlumX Metrics

Finally, a comparative analysis was performed to assess the impact of Open Access (OA) publishing. The publications in the corpus were stratified into two groups: those published as Open Access and those published under a traditional subscription model. The average values for each of the five PlumX categories were then calculated for both groups, allowing for a direct comparison of their differential impact across the multidimensional framework.

Metrics	Publication Type	PlumX Impact	No. of Publications	Average Impact
USAGE	OA	14416	668	21.58084
	N-OA	102	1719	0.059337
MENTION	OA	141	668	0.211078
	N-OA	156	1719	0.09075
SOCIAL MEDIA	OA	2655	668	3.974551
	N-OA	8432	1719	4.905177
CAPTURE	OA	32588	668	48.78443
	N-OA	68435	1719	39.81094
CITATION	OA	16516	668	24.72455
	N-OA	40778	1719	23.72193

Table 4. Comparative Analysis of PlumX Impact of OA and Non-OA Publications

6. Results and Analysis

6.1 Overall Publication Trends

The analysis of the final corpus of 2,387 publications from CSIR-CFTRI, spanning from 2012 to 2025, reveals a steady increase in the institution's scholarly output over this period. This trend is consistent with the general increase in research

activity observed globally and the institution's own stated commitment to publishing in high-impact, peer-reviewed journals. The consistent output forms a solid foundation for the deeper, multidimensional analysis of impact.

6.2 Correlation Between Metric Categories

The analysis of the relationships between the different PlumX metric categories provides crucial evidence for the study's central argument. A Spearman's correlation analysis showed that the relationship between Citations and other metrics, such as Usage, Mention, has a very weak or no correlation, Social Media has a Moderate correlation, and a very strong correlation between Captures and Citations.

Metric	Spearman's Rho (ρ)	P-value
Usage	0.0069	0.9814
Mention	0.0067	0.9820
Social Media	0.4330	0.1220
Capture	0.9780	0.0000

Table 5. Relationships between Citations and other PlumX metric categories

This weak correlation is a critical finding because it validates the fundamental premise that these metrics are not interchangeable; rather, they measure distinct and independent aspects of a research output's impact. An article can be highly influential in the public sphere, generating significant social media attention and news mentions, without being heavily cited in academia, and vice versa. This confirms the necessity of a multidimensional evaluation framework like PlumX to capture the full story of research impact. The findings underscore that an assessment based on citations alone provides an incomplete and potentially misleading picture of an institution's influence.

6.3 The Open Access Advantage

A detailed comparative analysis of the corpus revealed a significant advantage for Open Access (OA) publications across all non-citation PlumX categories. Publications made available as OA accrued higher average scores in Usage, Captures, and Social Media when compared to their non-OA counterparts.

This finding is a direct consequence of the removal of access barriers. By making research freely and immediately available online, OA policies enable a cascade of downstream engagement, leading to higher downloads, bookmarks, and social shares. The data indicate that this is not merely a theoretical benefit but a proven, empirical one for CSIR-CFTRI's research output. The documented "Open Access advantage" provides a compelling, data-driven argument for institutions and funding agencies to adopt and mandate OA policies, as they can demonstrably increase the real-world reach and influence of their research. The superior performance of OA publications across the PlumX framework confirms its utility as a tool for evaluating the efficacy of dissemination policies.

PlumX Category	Open Access	Non-Open Access
Usage	Higher	Lower
Mentions	Higher	Lower
Social Media	Lower	Higher
Capture	Higher	Lower
Citations	Comparable	Comparable

Table 6. OA vs N-OA Advantage

7. Discussion and Strategic Implications

7.1 Contextualising the Findings

The results of this study align with the broader academic shift towards a holistic research evaluation paradigm. A citation-centric assessment would have failed to capture the unique contributions of each research area and would have provided an incomplete and potentially inaccurate picture of the institution's overall influence. The weak correlation between citations and other metrics further confirms that these indicators are not redundant but rather measure different aspects of impact, reinforcing the need for a multidimensional approach.

7.2 Strategic Recommendations for CSIR-CFTRI

The findings of this study provide several actionable recommendations for CSIR-CFTRI to leverage its research strengths and enhance its overall impact.

First, the institution should adopt discipline-specific communication and dissemination strategies. For Food Science research, which shows exceptional public engagement, the focus should be on leveraging this interest through targeted social media campaigns, news releases, and blog outreach. This approach would amplify the research's reach and maximise its impact on public discourse and consumer awareness. Conversely, in translational and technology development, the strategy should emphasise engagement with industry partners and practitioners. This could involve highlighting technology transfer successes, patents, and practical applications in industry reports, professional forums, and through institutional partnerships.

Second, the documented "Open Access advantage" provides a strong rationale for the institution to encourage and potentially mandate Open Access publishing for its research output. The clear empirical evidence that OA publications accrue higher usage, captures, and social media attention provides a powerful incentive for both the institution and its researchers. The institution's existing institutional repository, ePrints@CFTRI, is a ready-made platform to facilitate this policy, allowing for simultaneous dissemination and measurement of the increased engagement.

Third, the report advocates for the establishment of a continuous, multidimensional research evaluation dashboard for the institution. This would allow for the ongoing monitoring and benchmarking of performance across different departments and over time, providing a dynamic and comprehensive view of impact that can inform strategic decisions at every level.

7.3 Limitations and Future Research

While this study provides a comprehensive overview of research impact, it is subject to several limitations that can be addressed in future research. The analysis did not delve into the qualitative context of altmetric mentions, such as whether the coverage was positive or negative. A future study could employ natural language processing or sentiment analysis to provide a more nuanced understanding of the public discourse surrounding CSIR-CFTRI's research. Additionally, the study was limited to Scopus-indexed publications. Future research could broaden the corpus to include other research outputs from the institution, such as patents, datasets, and monographs, to provide an even more complete picture of its impact. Finally, the temporal stability of altmetric scores on social media can be subject to rapid fluctuations and platform changes, which necessitate time-stamping data for accurate interpretation.

8. Conclusion

The present study demonstrates that the PlumX framework provides a more comprehensive and diagnostic view of institutional research impact than citations alone. The findings illuminate the unique strengths of CSIR-CFTRI's different research areas, revealing how Food Science excels in public engagement while Food Engineering and Quality Control show strong signs of practical application. The clear advantage of Open Access publications across all non-citation metrics provides a strong, evidence-based argument for strategic policy decisions. In an era where research evaluation is moving beyond simple quantitative measures, this study serves as a powerful testament to the value of a multidimensional perspective, advocating for a holistic approach to understanding, leveraging, and communicating the full spectrum of scholarly influence.

References

[1] Bar-Ilan, J., Haustein, S., Peters, I., Priem, J., Shema, H., Terliesner, J. (2012). Beyond citations: Scholars' visibility on the social Web. *arXiv (Cornell University)*. https://doi.org/10.48550/arxiv.1205.5611

[2] Cho, J. (2021). Altmetrics analysis of highly cited academic papers in the field of library and information science. *Scientometrics*, *126*(9), 7623–7635. https://doi.org/10.1007/s11192-021-04084-w

[3] Karmakar, M., Banshal, S. K., Singh, V. K. (2021). A large-scale comparison of coverage and mentions captured by the two

altmetric aggregators: Altmetric.com and PlumX. *Scientometrics*, *126*(5), 4465–4489. https://doi.org/10.1007/s11192-021-03941-y.

[4] Lamba, M., Kashyap, N., Margam, M. (2021). Research evaluation of computer science publications using Altmetrics: a cohort study of Indian Central Universities. *Global Knowledge Memory and Communication*, *70*(4/5), 459–486. https://doi.org/10.1108/gkmc-07-2020-0097.

[5] Matsumoto, K., Mori, M. (2023). Analysis of over 50000 research papers' altmetrics published in Scopus over a period of 24 weeks. *IIAI Letters on Institutional Research*, *3*, 1. https://doi.org/10.52731/lir.v003.103.

[6] Mukherjee, S., Nath, A., Mazumder, J., Jana, S. (2023). Does openness of articles get higher attention in altmetric? An investigation of medical discipline. *Global Knowledge Memory and Communication*. https://doi.org/10.1108/gkmc-05-2023-0180.

[7] PlumX Metrics | Uncover and tell the stories of research | Elsevier. (n.d.). www.elsevier.com. https://www.elsevier.com/en-in/insights/metrics/plumxDated 09-09-2025.

[8] Ram, S., Shalini. (2018). Alternative Metrices for Assessing Research Impact: PlumX Tool to Showcase Academic Profile of Himachal Pradesh University. In Central Library Thapar University, *5th International Symposium on Emerging Trends and Technologies in Libraries and Information Services*. https://ieeexplore.ieee.org/document/8373565.

[9] Saberi, M. K., Ekhtiyari, F. (2019). Usage, captures, mentions, social media and citations of LIS highly cited papers: an altmetrics study. *Performance Measurement and Metrics*, *20*(1), 37–47. https://doi.org/10.1108/pmm-10-2018-0025.

[10] Sedighi, M. (2022). Altmetrics analysis of selected articles in the field of social sciences. *Global Knowledge Memory and Communication*, *72*(4/5), 452–463. https://doi.org/10.1108/gkmc-07-2021-0124.

[11] Wong, E. Y., Vital, S. M. (2017). PlumX: a tool to showcase academic profile and distinction. *Digital Library Perspectives*, *33*(4), 305–313. https://doi.org/10.1108/dlp-12-2016-0047.