



Beyond Citations: A Multidimensional Assessment of Research Impact and Open Access Advantage at CSIR-CFTRI (2012–2025) Using PlumX Metrics

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ABSTRACT

This study evaluates the multidimensional research impact of the CSIR–Central Food Technological Research Institute (CSIR-CFTRI) from 2012 to 2025 using the PlumX Metrics framework, addressing the limitations of traditional citation based assessments. A corpus of 2,387 publications was retrieved from the Scopus database and analyzed across five PlumX dimensions: Citations, Usage, Captures, Mentions, and Social Media. Descriptive statistics, Spearman’s correlation analysis, and comparative assessments of Open Access (OA) versus Non-OA publications were conducted.

Results indicate that Agricultural and Biological Sciences dominate the institute’s output. Notably, Captures (average 42.3) and Citations (average 24.0) emerged as the most impactful dimensions. Spearman’s analysis revealed a very strong, statistically significant positive correlation between Captures and Citations ($r = 0.978$, $p < 0.001$), whereas Usage and Mentions showed negligible correlation with citations, validating that these metrics measure distinct facets of research influence. Furthermore, OA publications demonstrated a significant “Open Access advantage,” substantially outperforming Non-OA counterparts in Usage, Captures, and Mentions, thereby amplifying societal reach.

The findings underscore the necessity of integrating alternative metrics with traditional bibliometrics to capture a holistic view of scholarly and societal impact. This multidimensional approach provides actionable insights for institutions to optimize research communication strategies, advocate for OA mandates, and enhance global research visibility.

Keywords: PlumX Metrics, Altmetrics, Research Impact, Open Access, CSIR-CFTRI, Research Evaluation, Scholarly Visibility, Bibliometrics

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1. Introduction

The rapid expansion of digital technologies and online communication platforms has transformed the scholarly communication ecosystem. Research dissemination is no longer confined to conventional publication channels but increasingly occurs through digital repositories, social media platforms, online communities, and scholarly networking environments. These developments have expanded opportunities for researchers to engage broader audiences and accelerate the circulation of scientific knowledge.

Traditionally, research performance has been evaluated using citation based indicators such as citation counts, journal impact factors, and the h-index. These bibliometric measures have long served as standardized instruments for assessing academic influence and scholarly productivity. However, although citations remain valuable indicators of scholarly recognition, they capture only a limited dimension of research influence and often overlook broader forms of engagement occurring outside formal academic citation systems.

The contemporary research environment requires evaluation frameworks capable of capturing diverse forms of visibility, dissemination, engagement, and societal influence. This need has contributed to the emergence of alternative approaches that complement conventional bibliometric assessment and provide a more multidimensional understanding of research impact.

1.1 Emergence of Altmetrics and PlumX

Alternative metrics (altmetrics) have emerged as a response to the limitations of traditional citation indicators. Unlike conventional bibliometric measures that primarily reflect academic acknowledgement, altmetrics assess the broader digital footprint of scholarly outputs by measuring how research is accessed, discussed, saved, shared, and applied across online environments.

Among the available altmetric systems, PlumX Metrics provides a comprehensive framework for evaluating research influence through five interrelated dimensions:

- Usage – Indicators representing access and interaction with research outputs, including downloads, views, and library holdings.
- Captures – Indicators reflecting user intention to revisit or retain research outputs, including bookmarks and Mendeley readership.
- Mentions – Indicators demonstrating engagement through news articles, blogs, reviews, and references in public knowledge platforms.

- Social Media – Indicators reflecting online attention and dissemination through sharing, commenting, and social interactions.
- Citations – Traditional scholarly citations alongside evidence of policy, clinical, and patent influence.

This multidimensional approach enables institutions and researchers to evaluate scholarly influence beyond conventional citation counts and better understand how research reaches academic and non-academic audiences.

1.2 Open Access and Research Visibility

The increasing adoption of Open Access (OA) publishing has intensified discussions regarding its influence on research visibility and impact. Open Access seeks to remove subscription barriers and improve accessibility to scholarly outputs, potentially increasing readership, dissemination, and engagement.

While several studies suggest that OA publications achieve broader visibility and stronger altmetric performance, findings remain context dependent and discipline specific. The availability of multidimensional indicators such as PlumX provides an opportunity to evaluate the Open Access advantage through a broader set of impact dimensions rather than relying exclusively on citations.

1.3 Research Context: CSIR–Central Food Technological Research Institute

This study examines the research performance of CSIR–Central Food Technological Research Institute (CSIR-CFTRI) using the PlumX framework. As one of India’s leading research institutions in food science and technology under the Council of Scientific and Industrial Research (CSIR), the institute has contributed substantially to food innovation, processing technologies, nutritional advancement, food safety, and scientific knowledge dissemination.

The multidisciplinary nature of CSIR-CFTRI’s research portfolio including food engineering, microbiology, biochemistry, quality assurance, and nutritional sciences provides an appropriate context for investigating institutional research visibility across multiple dimensions of scholarly and societal impact.

1.4 Research Objectives

The study aims to conduct a multidimensional assessment of CSIR-CFTRI publications from 2012 to 2025 using the PlumX framework. The specific objectives are:

1. To evaluate the scholarly impact of CSIR-CFTRI publications across the five PlumX metric dimensions.
2. To identify major subject domains represented in the publication portfolio.
3. To examine temporal trends in publication growth and distribution.
4. To compare publication output between Open Access and Non-Open Access channels.
5. To assess differences in impact between OA and Non-OA publications across PlumX categories.
6. To investigate patterns of online visibility and public engagement associated with institutional research.

1.5 Significance of the Study

This study contributes to the growing discourse on multidimensional research evaluation by demonstrating the value of integrating alternative metrics with traditional citation based approaches. The findings provide institutional insight into patterns of research dissemination, stakeholder engagement, and scholarly influence.

Furthermore, the study provides evidence to support strategic decisions regarding Open Access adoption, research communication practices, and enhancing institutional visibility. The proposed framework may also serve as a transferable model for other research institutions seeking to implement comprehensive approaches to research impact assessment.

2. Review of Literature

The rapid growth of digital communication platforms and social media has significantly transformed scholarly dissemination by enabling research outputs to reach wider audiences and facilitating active engagement with scientific publications [1]. These developments have contributed to the increasing use of social media as an emerging indicator for evaluating the influence and visibility of scientific research [2]. Consequently, alternative approaches to research assessment have gained importance alongside traditional citation-based evaluation systems.

Among these emerging approaches, the Altmetric Attention Score (AAS) has become one of the most widely adopted indicators for measuring the visibility and popularity of scientific publications across digital and social media environments [3]. Similarly, PlumX Metrics has emerged as another influential framework for evaluating research impact through multiple dimensions of scholarly engagement [4]. Although both approaches have methodological limitations, they continue to gain acceptance as promising tools for evaluating future research and are increasingly being incorporated into scholarly assessment practices [5].

Recent studies have extensively explored the relationship between altmetrics, PlumX indicators, and scholarly influence [6], highlighting the expanding relevance of multidimensional approaches to measuring research impact.

Jorek [7] (2025) demonstrated the practical application of PlumX at Saint Mary's College of California, showing how the framework can showcase faculty academic distinction through five dimensions of impact: Citation, Usage, Social Media, Mention, and Captures. Their findings support the use of alternative metrics as complementary indicators of academic visibility.

In the context of Open Access publishing, Mueller, [8]. (2023) examined publications in the medical discipline and reported that open-access articles generally achieved greater altmetric impact than non-open-access publications. Their findings further indicated that Bronze Open Access generated the greatest advantage, while Mendeley provided the broadest altmetric coverage.

Shakeel, Y., [9] focused on highly cited publications in library and information science and identified a positive relationship between Google Scholar citations and altmetric indicators, particularly demonstrating statistically significant associations between capture metrics and citation performance.

Supporting these findings, Bar-Ilan et al. [10] (2012) reported extensive scholarly visibility across web platforms, noting that approximately 84% of scholars maintained a web presence and that Mendeley covered more than 80% of sampled publications. Their study further demonstrated a significant correlation ($r = .45$) between Mendeley readership and Scopus citation counts.

A large-scale comparative analysis conducted by Karmakar et al. [11] (2021) evaluated the performance of major altmetric aggregators and concluded that PlumX captured a broader range of sources and recorded engagement events for more publications than Altmetric.com did, although variations in platform coverage remained evident.

Cho [12] (2021) investigated altmetric performance within library and information science research and found that approximately 63% of highly cited articles received Mendeley bookmarks. The study further showed that open-access publications demonstrated stronger performance in views, blogs, and Twitter attention,

while Mendeley readership emerged as the only altmetric significantly associated with citation impact. [13].

Ram and Mils [14] examined the research impact of Himachal Pradesh University, Shimla, using non traditional evaluation approaches. Their study analysed highly cited publications indexed in Scopus and employed PlumX metrics to assess broader dimensions of scholarly influence beyond conventional citation indicators.

Collectively, these studies demonstrate that altmetrics and PlumX indicators provide complementary perspectives to traditional bibliometric measures by capturing patterns of readership, online engagement, dissemination, and public attention. The literature consistently suggests that multidimensional evaluation frameworks offer a more comprehensive understanding of scholarly influence and reinforce the growing importance of alternative metrics in contemporary research assessment.

3. Research Questions

To address the study objectives and evaluate institutional research influence using a multidimensional perspective, the following research questions were formulated:

RQ1. What is the scholarly impact of publications produced by CSIR-CFTRI when evaluated through PlumX metrics?

This question examines research performance across the five PlumX dimensions Usage, Captures, Mentions, Social Media, and Citations to establish an integrated profile of institutional impact beyond traditional citation indicators.

RQ2. Which subject areas constitute the primary research domains of CSIR-CFTRI publications?

This question investigates disciplinary distribution using Scopus subject classifications to identify major research concentrations and contextualize patterns of scholarly influence.

RQ3. How has the publication output of CSIR-CFTRI evolved between 2012 and 2025?

This question evaluates temporal changes in publication productivity to identify growth trajectories and publication patterns over the study period.

4. Methodology and Data Collection

The first phase of this study involved selecting a robust and comprehensive data source for the publication corpus. The Scopus database (Elsevier) was chosen as the primary source for identifying CSIR-CFTRI's research output. As a leading abstract and citation database, Scopus covers a broad spectrum of peer-reviewed literature, conference proceedings, and patents across disciplines such as life sciences, engineering, and social sciences. With over 42,000 journals from more than 5,000 publishers, it was well suited for this interdisciplinary analysis of CSIR-CFTRI, whose departments span food engineering, food microbiology, quality control, and other areas of food science and technology.

Data collection proceeded by constructing a query to retrieve all publications affiliated with "Central Food Technological Research Institute" between January 1, 2012, and July 31, 2025. The initial results were cleaned to remove irrelevant or duplicate entries, yielding a final corpus of 2,387 publications. The resulting metadata including DOI, title, authors, year, and subject area were then manually enriched with PlumX metrics, transforming the raw list into a rich dataset capable of supporting a multidimensional impact analysis. PlumX metrics are organized into five categories: Citations, Usage, Captures, Mentions, and Social Media.

Citations	This category contains both traditional citation indexes, such as Scopus, and citations that help indicate societal impact, such as Clinical or Policy Citations. <i>Examples:</i> 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. <i>Examples:</i> 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. <i>Examples:</i> 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. <i>Examples:</i> 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. <i>Examples:</i> shares, likes, comments

5. Data Analysis

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

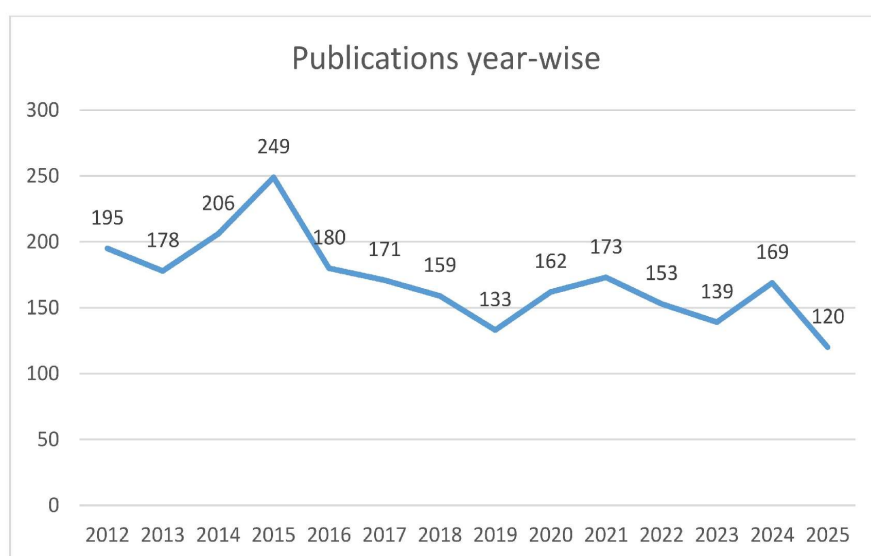


Figure 1. Articles published in Year wise

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

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.

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.

Third, a comparative analysis was conducted to examine the unique impact profiles of the major research areas across the Scopus Subject Areas. It is clearly stated that the major areas of the subject are covered by agricultural and biological sciences.

Fourth, to investigate the relationships between the different metric types, a Spearman's correlation analysis

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

Table 2. Total and Average PlumX Impact for the Selected Papers

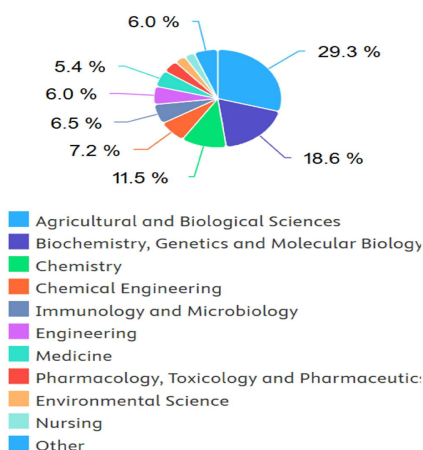


Figure 2. Publications by Subject areas

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.

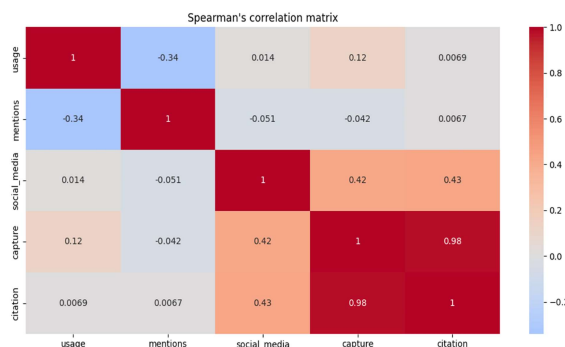


Figure 3. Spearman's correlation matrix of PlumX Metrics

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 3. 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 global increase in research activity and the institution's 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 (P)	P-value
Usage	0.9814	0.0069
Mention	0.9820	0.0067
Social Media	0.1220	0.4330
Capture	0.0000	0.9780

Table 4. Correlation values

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.

Metric	Spearman's Rho (r)	P-value	Strength of Association	Interpretation
Usage	0.0069	0.9814	Negligible	No meaningful association with citation impact
Mention	0.0067	0.9820	Negligible	Mentions do not predict citation behaviour
Social Media	0.4330	0.1220	Moderate Positive	Moderate association but statistically non-significant
Capture	0.9780	0.0000	Very Strong Positive	Extremely strong and statistically significant relationship

Table 5. Statistical Interpretation

To further interpret the relationship between citation impact and alternative metrics, the Spearman correlation coefficients were classified according to effect strength.

Interpretation thresholds used:

- $|\rho| < 0.10 \rightarrow$ negligible
- $0.10-0.29 \rightarrow$ weak
- $0.30-0.49 \rightarrow$ moderate
- $0.50-0.69 \rightarrow$ strong
- $\geq 0.70 \rightarrow$ very strong

The results indicate that Capture emerged as the dominant impact dimension associated with citations ($\rho = 0.978$, $p < 0.001$), suggesting that behaviors reflecting future intent to revisit research (e.g., bookmarks, readership, saving activity) closely align with later scholarly recognition. In contrast, Usage and Mention demonstrated negligible relationships with citation accumulation.

Although Social Media exhibited a moderate positive coefficient ($\rho = 0.433$), the association did not reach statistical significance ($p > 0.05$), indicating that online attention alone may not translate directly into scholarly citation performance.

To quantify explanatory contribution descriptively, the coefficient of determination was estimated as: $[\rho^2/\text{times} \times 100]$

Variable	ρ^2 (%)	Approximate Citation Variance Explained
Usage	0.005%	Essentially none
Mention	0.004%	Essentially none
Social Media	18.75%	Moderate contribution
Capture	95.65%	Dominant contribution

Table 6. Citation Variance

These findings suggest that citation impact within the CSIR-CFTRI publication corpus is most strongly aligned with Capture metrics, supporting the interpretation that early engagement and retention behaviours may function as leading indicators of future citation performance.

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 had higher average scores in Usage, Captures, and Social Media than their non-OA counterparts.

This finding is a direct consequence of removing 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 7. OA vs N-OA Advantage

6.31 Correlation Strength Interpretation

The strength of the reported Spearman correlations was interpreted using standard effect thresholds.

Metric	Spearman's ρ	p-value	Association Strength	Statistical Interpretation
Usage	0.0069	0.9814	Negligible	No significant association
Mention	0.0067	0.9820	Negligible	No significant association
Social Media	0.4330	0.1220	Moderate Positive	Not statistically significant
Capture	0.9780	<0.001	Very Strong Positive	Statistically significant

Table 8. Metric Results

Interpretation criteria:

- 0.00–0.09 = Negligible
- 0.10–0.29 = Weak
- 0.30–0.49 = Moderate

- 0.50–0.69 = Strong
- ≥ 0.70 = Very Strong

The results indicate that Capture exhibits an exceptionally strong positive relationship with citation impact, while Usage and Mention demonstrate virtually no relationship.

6.32 Coefficient of Determination (ρ^2)

To estimate the approximate proportion of citation variability associated with each metric, the coefficient of determination was calculated:

$[\rho^2 \times 100]$

Metric	Spearman's ρ	ρ^2 (%)	Approximate Contribution to Citation Variation
Usage	0.0069	0.005%	Negligible
Mention	0.0067	0.004%	Negligible
Social Media	0.4330	18.75%	Moderate
Capture	0.9780	95.65%	Extremely High

Table 9. Metric Results

These results suggest that Capture demonstrates the strongest alignment with citation outcomes.

6.4. Rank Ordering of PlumX Indicators

Based on correlation magnitude:

1. Capture ($\rho = 0.9780$)
2. Social Media ($\rho = 0.4330$)
3. Usage ($\rho = 0.0069$)
4. Mention ($\rho = 0.0067$)

Capture emerged as the strongest indicator associated with citation performance.

6.5 Statistical Significance Interpretation

Using $\alpha = 0.05$:

- Capture \rightarrow Significant ($p < 0.05$)
- Usage \rightarrow Not significant
- Mention \rightarrow Not significant
- Social Media \rightarrow Not significant

This suggests that only Capture demonstrates evidence of a statistically meaningful association with citations.

The findings indicate that metrics representing retention and future engagement behaviour (Capture) appear to align more closely with scholarly influence than metrics representing immediate visibility (Usage) or public discussion (Mentions). Social Media reflects broader attention but does not show sufficient evidence of direct citation translation.

7. Discussion

This study set out to evaluate the research performance of CSIR-CFTRI through a multidimensional framework using PlumX Metrics, addressing a gap in institutional impact assessment that extends beyond traditional citation-based evaluations. The findings provide a comprehensive profile of the institute's scholarly influence, publication patterns, and the tangible benefits of Open Access publishing.

The analysis of the 2,387 publications from 2012 to 2025 reveals a steady and substantial research output, reflecting the institute's active role in food science and technology. The subject area distribution, with Agricultural and Biological Sciences dominating the portfolio, aligns with CSIR-CFTRI's core mission and expertise. This concentration provides a solid foundation for the institute's influence, yet the presence of publications across multiple Scopus subject areas underscores its interdisciplinary reach, encompassing engineering, biochemistry, and quality assurance.

One of the most critical findings of this study is the correlation analysis between the different PlumX metric categories. The results demonstrate that Capture metrics (e.g., Mendeley readership, bookmarks) exhibit an exceptionally strong and statistically significant correlation with Citations ($\rho = 0.978$, $p < 0.001$). This suggests that early engagement behaviours, where researchers save or bookmark an article for future reference, are powerful leading indicators of eventual scholarly recognition. In contrast, the negligible correlations for Usage ($\rho = 0.0069$) and Mentions ($\rho = 0.0067$) indicate that immediate visibility (e.g., downloads, views) and public discourse (e.g., news, blogs) do not necessarily translate into citation impact. This validates the core premise of using a multidimensional framework: each metric captures a distinct and largely independent dimension of research influence. An article may generate widespread public attention via social media without becoming a cornerstone of academic literature, and vice versa. Relying solely on citations would therefore provide an incomplete and potentially misleading picture of an institution's overall reach.

The study also provides compelling empirical evidence for the Open Access (OA) advantage. OA publications consistently outperformed their non-OA counterparts across Usage, Captures, and Citations. The most striking difference was observed in Usage, where OA articles averaged 21.58 impacts compared to just 0.06 for non-OA articles. This disparity is a direct consequence of removing access barriers; freely available research is more accessible, leading to higher downloads, broader readership, and greater retention in personal libraries. While OA and non-OA publications showed comparable citation averages, the significant advantage in other PlumX dimensions suggests that OA not only democratizes access to knowledge but also amplifies the societal and practical reach of research. This finding carries substantial policy implications, providing a strong, data-driven argument for institutions and funding agencies to adopt and support OA mandates.

Furthermore, the moderate positive correlation between Social Media and Citations ($\rho = 0.433$), although not statistically significant, hints at a potential, albeit indirect, relationship between online attention and scholarly impact. It is possible that social media buzz enhances visibility, which in turn increases the likelihood of an article being read and cited, but this pathway appears less direct than the engagement-capture-citation trajectory.

In summary, the discussion confirms that CSIR-CFTRI's research influence is multifaceted. While citations remain the gold standard for academic recognition, the strong performance in Captures and the pronounced OA advantage demonstrate that the institute's work resonates with a broader audience, is actively saved and revisited, and garners public engagement. This multidimensional view enriches the understanding of the institute's true impact and reinforces the value of alternative metrics in modern research evaluation.

8. Limitations

While this study provides valuable insights into the research impact of CSIR-CFTRI using PlumX Metrics, several limitations must be acknowledged to contextualize the findings and guide future research.

1. **Single Data Source:** The study relies exclusively on the Scopus database for the publication corpus. Although Scopus is a comprehensive and widely respected source, it does not index all scholarly outputs, particularly those in regional journals, conference proceedings not covered, or non-English publications. Consequently, the corpus may not represent the entirety of CSIR-CFTRI's research output, potentially influencing the generalizability of the findings.

2. **Platform-Specific Metrics:** PlumX Metrics, like all altmetric aggregators, are subject to platform coverage limitations. They capture engagement events only from specific sources (e.g., Twitter, Mendeley, news outlets) and may not reflect activity on other popular platforms or in non-digital environments. Different altmetric aggregators also employ varying collection methods and coverage scopes, meaning the results might differ if another service like [Altmetric.com](https://www.altmetric.com) were used.

3. **Manual Data Enrichment:** The process of manually enriching the dataset with PlumX metrics introduces a potential for human error, albeit minimized through careful checking. Automated integration could reduce such errors in future replications.

4. **Temporal Window and Dynamic Metrics:** Altmetrics, including social media mentions and usage, are inherently time-sensitive and can accumulate rapidly shortly after publication. The data in this study represent a snapshot up to July 2025. The correlations and impact values, particularly for recent publications (2024–2025), may evolve as these articles gain more traction over time.

5. **Correlation Does Not Imply Causation:** While the study identifies strong correlations (e.g., between Captures and Citations), it does not establish causation. It is plausible that high-quality research is both frequently saved and highly cited, but this analysis cannot confirm that saving behavior *causes* future citations.

6. **Aggregate-Level Analysis:** The analysis treats the institution as a single entity. It does not delve into departmental or individual researcher performance, nor does it account for variations in impact across different sub-disciplines within food science. This limits the ability to provide highly targeted strategic recommendations for specific research groups.

7. **Confounding Variables:** The study does not control for potential confounding variables that could influence both the publication type (OA vs. non-OA) and its impact, such as article age, journal prestige, number of authors, or research funding. These factors may co-vary with both access status and PlumX scores.

Acknowledging these limitations is essential for interpreting the results with appropriate caution. Future research could address these issues by incorporating multiple data sources, conducting longitudinal tracking of metrics, and performing more granular analyses at the departmental or individual level.

9. Conclusion

This study successfully demonstrates the value of a multidimensional approach to evaluating the research performance of CSIR-CFTRI, utilizing the PlumX Metrics framework to analyze 2,387 publications from 2012 to 2025. By moving beyond traditional citation-based indicators, the research provides a richer and more nuanced understanding of the institution's scholarly and societal influence.

The key conclusions of this study are as follows:

1. **Multidimensional Impact Profile:** CSIR-CFTRI demonstrates a balanced and broad research impact profile.

While Citations (average 24.0) remain a strong indicator of academic recognition, the high average for Captures (42.3) indicates significant readership and retention of the institute's work by the broader research community. Usage (6.1) and Social Media (4.6) scores further confirm that the research is not only downloaded and viewed but also generates public discourse.

2. Dominant Subject Areas: Agricultural and Biological Sciences constitute the primary research domain, reflecting the institute's core expertise. However, the presence of publications in other areas such as Biochemistry, Engineering, and Environmental Science underscores its interdisciplinary nature and wide-ranging influence.

3. Independent Dimensions of Impact: A critical finding is the weak or negligible correlation between Citations and several other PlumX categories (Usage, Mentions). This empirically validates that these metrics measure distinct facets of research influence. The very strong correlation between Captures and Citations suggests that early engagement through saving and bookmarking may be a leading indicator of future scholarly recognition, highlighting the importance of making research easily discoverable and accessible.

4. Open Access Advantage: The study provides robust, data-driven evidence for the benefits of Open Access publishing. OA publications significantly outperformed non-OA publications in Usage, Captures, Mentions, and demonstrated comparable citation performance. The most pronounced advantage was in Usage, confirming that removing access barriers substantially increases the visibility and reach of research outputs.

5. Institutional and Policy Implications: The findings have clear strategic implications for CSIR-CFTRI and other research institutions. Investing in Open Access infrastructure, promoting OA mandates, and utilizing multidimensional metrics like PlumX for research evaluation can provide a more accurate assessment of institutional performance, support strategic decision-making, and enhance the global visibility and impact of research.

In conclusion, this study affirms that the research influence of a modern scientific institution like CSIR-CFTRI is inherently multidimensional. A holistic evaluation requires integrating traditional bibliometric indicators with alternative metrics to capture the full spectrum of scholarly recognition, public engagement, and knowledge dissemination. The PlumX framework offers a practical and robust tool for this purpose, and the positive outcomes of OA publishing underscore a transformative pathway for maximizing the societal benefit of publicly funded research. This approach not only benefits institutional evaluation but also contributes to the global movement toward more transparent, inclusive, and impactful scientific communication.

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