

Lotka's Law, Temporal Trends, Self-Citation Analysis and Inflibnet E-Shodhsindhu Coverage in Chemical Engineering Doctoral Dissertations: A Bibliometric Study of Universities in Andhra Pradesh, India

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Abstract

The present study reports the findings of Lotka's Law analysis, temporal trend analysis, self-citation analysis, and INFLIBNET e-ShodhSindhu library holdings comparison from a comprehensive bibliometric investigation of 61,121 citations drawn from 347 doctoral dissertations in Chemical Engineering awarded by five universities in Andhra Pradesh — Andhra University (AU), Sri Venkateswara University (SVU), Jawaharlal Nehru Technological University Anantapur (JNTUA), Jawahar Lotka's Law is applied to the distribution of supervisor productivity among 141 supervisors. The Kolmogorov-Smirnov (K-S) test produces $D = 0.1239$ against a critical value of $D_{0.05} = 0.1145$. The observed distribution demonstrates near-conformity with Lotka's Law with slight deviations at the middle productivity range. Prof. Pulipati King is the most prolific supervisor, with sixteen PhD dissertations. A temporal trend analysis from 1950–1979 to 2020–2026 shows statistically significant trends in all six citation behavior indicators (all $p < 0.001$): mean dissertation references increase from 110.2 to 211.2, online citations increase from 0% (pre-2010) to 42.5% (2020–2026), mean authorship increases from 1.77 to 2.99, and Price's Index increases from 12.8% to 29.5% at its peak in 2010–2019. The estimated self-citation rate is less than 5% of all citations. The INFLIBNET e-ShodhSindhu consortium (2021-22 portfolio) offers full access to 49 of the 55 Bradford Zone 1 journals (89.1%), accounting for 93.4% of Zone 1 citations; the combined fully and partially available journals account for 98.5% of Zone 1 citations. The findings demonstrate e-ShodhSindhu's transformative impact on the information environment of Chemical Engineering doctoral research in Andhra Pradesh, and they offer actionable recommendations for consortium portfolio management.

1. Introduction

Bibliometric citation analysis refers to a variety of analytical methodologies used to characterize research communities' information environments and scholarly communication practices. A comprehensive bibliometric study of doctoral dissertation citations must address the productivity distribution of doctoral supervisors (Lotka's Law), the temporal evolution of citation behaviour over extended study periods, self-citation patterns, and — in the Indian context — the ad. These analyses, taken together, provide a comprehensive picture of the information environment in which Chemical Engineering doctorate research in Andhra Pradesh is carried out.

The current work presents these four analytical dimensions from a wider bibliometric analysis of 347 Chemical Engineering PhD dissertations from five Andhra Pradesh universities (1950–2026), which included 61,121 citation data. According to the authors, this is the first comprehensive bibliometric investigation of Chemical Engineering doctoral dissertation citations in Andhra Pradesh, complementing related Indian studies in chemistry (Thanuskodi, 2010), physics (Sudhier, 2010), library science (Velmurugan and Radhakrishnan, 2015), and engineering (Pattanashetti and Harinarayana, 2015).

2. Review of Literature

Lotka's Law of Scientific output (1926) predicts that the number of writers adding n publications to a literature equals about $1/n^2$ of those making a single contribution, resulting in the inverse-square law of scientific output. Pao (1985) established the current methodology for estimating the Lotka exponent and determining conformance with the Kolmogorov-Smirnov test. Lotka's Law has been applied to supervisor productivity distributions in doctorate dissertation studies by Sudhier (2010) and Velmurugan and Radhakrishnan (2015), both of whom found approximate compliance. Sen (1996) observed that Indian bibliometric distributions frequently demonstrate partial conformance with Lotka's Law, with aberrations in the middle productivity range attributed to the unique institutional and supervisory culture of Indian universities.

Lariviere, Zuccala, and Archambault (2006) recorded temporal trend analysis in dissertation citation studies, discovering consistent disciplinary disparities in the rate of change of citation behaviour across time. Since the mid-2000s, when the INFLIBNET collaboration expanded its electronic journal portfolio, the change from print to electronic information access has been recorded as having a revolutionary impact on citation behaviour in Indian colleges. MacRoberts and MacRoberts (1989) and Snyder and Bonzi (1998) researched self-citation, which is the citation of one's own earlier work or that of one's doctorate supervisor. They consistently found self-citation percentages in the range of 5–15% for science and engineering publications. Broadus (1987) and Stinson and Lancaster (1987) supported comparing library holdings using citation analysis as a cornerstone of evidence-based collection creation. The INFLIBNET e-ShodhSindhu consortium's impact in closing the information access gap at regional Indian institutions has been reported by Kadli and Kumbar (2011) and Bavakutty and Abdul Majeed (2007).

3. Objectives and Hypotheses

The current paper addresses the following objectives: (i) to apply Lotka's Law to the supervisor productivity distribution of the Chemical Engineering doctoral research community in Andhra Pradesh and test conformity using the Kolmogorov-Smirnov test; (ii) to identify the most prolific doctoral supervisors in the corpus and analyse the concentration of supervisory output; and (iii) to analyse temporal trends in six key citation behaviour indicators across five chronological Two hypotheses are tested: H5—the supervisor productivity distribution adheres to Lotka's Law, and H6—the INFLIBNET. The e-ShodhSindhu collaboration provides extensive coverage of the Bradford core journals, with minimal gaps; and H7 – citation behaviour exhibits statistically significant temporal trends.

4. Methodology

The study corpus includes 347 Chemical Engineering PhD dissertations from five Andhra Pradesh universities (AU, SVU, JNTUA, JNTUK, and Vignan University) covering 1950–2026, totalling 61,121 citation records. For Lotka's Law analysis, the supervisor productivity distribution was generated from the dissertation database, with the number of doctoral theses supervised serving as the productivity measure. The Lotka exponent was determined using Pao's (1985) least squares method, with the classic

inverse-square exponent ($n = 2$) as a comparison. The Kolmogorov-Smirnov one-sample test was used to determine conformity, with a critical value of $D_{0.05} = 1.36/\sqrt{N}$. For temporal trend analysis, the corpus was separated into five time periods: 1950–1979, 1980–1999, 2000–2009, 2010–2019, and 2020–2026. Six citation behaviour indicators were calculated for each period: mean dissertation references, proportion of journal article cites, Price's Index, median citation age, proportion of internet citations, and mean authorship per cited document. Linear regression and chi-square testing were employed to determine trend significance. Self-citation was assessed using the citation database's Guide and Researcher fields. The e-ShodhSindhu coverage assessment compared the 55 Bradford Zone 1 journals to the INFLIBNET consortium journal list (2021-22 academic year), rating each publication as completely available, partially available, or not available.

5. Results and Discussion

5.1 Lotka's Law Analysis

Table 1 shows the empirical and theoretical (Lotka) distributions of supervisors by the number of doctoral dissertations supervised. The corpus contains 141 unique supervisors. Supervisors with a single PhD dissertation make up the largest group—78 supervisors (55.32%), which roughly matches the Lotka forecast of 55.32% by construction. The Kolmogorov-Smirnov test gives $D = 0.1239$, compared to a critical value of $D_{0.5} = 1.36/\sqrt{141} = 0.1145$. Since the observed D (0.1239) marginally exceeds the crucial value (0.1145), strict statistical conformity to Lotka's Law is not confirmed at the 0.05 level. However, the deviation is small and concentrated at the middle productivity range ($x = 5-13$), where the observed distribution shows a slight excess of supervisors relative to the Lotka prediction—a pattern consistent with the findings of Sen (1996) for Indian bibliometric distributions and attributable to the specific supervisory culture of Andhra Pradesh universities, where several faculty members have built research groups of intermediate size (5–13 doctoral graduates). As a result, the distribution closely follows Lotka's Law, with tiny but statistically noticeable variations in the middle range.

Table 1
Observed and Theoretical (Lotka) Distribution of Supervisors by Dissertation Output

Theses (x)	Observed (n)	Observed %	Theoretical*	Theoretical %	D (cum.)
1	78	55.32	78.00	55.32	0.0000
2	27	19.15	19.50	13.83	0.0532
3	10	7.09	8.67	6.15	0.0626
4	5	3.55	4.88	3.46	0.0635
5	6	4.26	3.12	2.21	0.0840
6	3	2.13	2.17	1.54	0.0899
7	5	3.55	1.59	1.13	0.1140
8	0	0.00	1.22	0.86	0.1054
9	1	0.71	0.96	0.68	0.1057
10	1	0.71	0.78	0.55	0.1072
11	2	1.42	0.64	0.46	0.1168
12	1	0.71	0.54	0.38	0.1201
13	1	0.71	0.46	0.33	0.1239
16	1	0.71	0.30	0.22	0.1236
Total	141	100.00	—	—	D = 0.1239

* Theoretical: $f(x) = C/x^2$; $C = 78/141 = 0.5532$. Critical value $D_{0.05} = 1.36/\sqrt{141} = 0.1145$.

$D = 0.1239 > 0.1145$: strict Lotka conformity not confirmed; near-conformity with minor mid-range deviations.

5.2 Most Prolific Supervisors

Table 2 lists the top fifteen most prolific supervisors in the corpus. Andhra University's Prof. Pulipati King leads with 16 doctorate dissertations (4.61% of the corpus), followed by Prof. P. Rajendra Prasad (13, 3.75%), and Prof. D. Sri Rami Reddy (12, 3.46%). All three are based at Andhra University, demonstrating the institution's dominance. The top 15 supervisors are responsible for 132 dissertations (38.04% of the corpus), demonstrating the typical skew in academic research production, in which a small cohort of highly active research group leaders creates a disproportionate amount of doctoral output. Supervisors at JNTUK are represented by Meena Vangalapati's joint supervision entry (11 theses), whereas CH represents JNTUA. Asha Immanuel Raju (eleven theses). Of the 141 supervisors, 78 (55.32%) have only overseen one dissertation in the corpus, demonstrating the broad base of doctoral supervision as well as the concentrated peak.

Table 2
Top 15 Most Prolific Supervisors in the Corpus

Rank	Supervisor Name	University	No. of Theses	% of Corpus
1	Prof. Pulipati King	AU	16	4.61%
2	Prof. P. Rajendra Prasad	AU	13	3.75%
3	Prof. D. Sri Rami Reddy	AU	12	3.46%
4	Prof. Meena Vangalapati	AU	11	3.17%
5	Prof. CH. Asha Immanuel Raju	JNTUA	11	3.17%
6	Prof. K.V. Ramesh	AU	10	2.88%
7	Prof. CH.V. Ramachandra Murthy	AU	9	2.59%
8	Prof. L. Ramachandhra Row	AU	7	2.02%
9	Prof. U. Murali Krishna	AU	7	2.02%
10	Prof. V. Nageswara Rao	AU	7	2.02%
11	Prof. V. Sri Devi	AU	7	2.02%
12	Prof. A.S.R. Anjaneyulu	AU	6	1.73%
13	Prof. K. Raghu Babu	AU	6	1.73%
14	Prof. P. Venkateswarlu	AU	6	1.73%
15	Prof. S.V. Naidu	AU	5	1.44%
Subtotal (Top 15)		—	132	38.04%

5.3 Temporal Trend Analysis

Table 3 shows the evolution of six major citation behaviour indicators over five time periods. All six trends are statistically significant ($p < 0.001$), supporting Hypothesis H7. A linear regression of dissertation references by year of award provides $\beta = 2.083$ ($R^2 = 0.075$, $p < 0.001$), indicating an average gain of 2.1 references per dissertation every calendar year across the study period.

Table 3
Temporal Trends in Key Citation Behaviour Indicators (1950–2026)

Period	n	Mean Refs	JA %	Price Index %	Median Age (yr)	Online %	Mean Authors
1950–1979	47	110.2	68.1	12.8	17.0	0.0	1.77
1980–1999	43	99.7	79.1	11.6	29.0	0.0	2.35
2000–2009	38	272.0	92.1	13.2	24.5	0.0	2.26
2010–2019	146	177.4	80.8	29.5	11.0	15.8	2.58
2020–2026	73	211.2	84.9	20.5	11.0	42.5	2.99
Trend		↑ sig.	↑ sig.	↑ sig.	↓ sig.	↑ sig.	↑ sig.

All trends statistically significant at $p < 0.001$. ↑ = increasing trend; ↓ = decreasing trend (citation age).

The temporal study reveals some interesting trends. The most striking finding is the dramatic increase in online citations, from 0% in all three pre-2010 periods to 15.8% (2010–2019) and 42.5% (2020–2026), directly documenting the transformative impact of the INFLIBNET e-ShodhSindhu consortium's expansion on the information behaviour of Chemical Engineering doctoral researchers in Andhra Pradesh. This transition from a print-only information environment to one in which nearly half of all referenced sources are electronic constitutes one of the most significant structural shifts in this research community's scholarly communication practices over the study period.

The relatively high mean reference count from 2000 to 2009 (272.0 references per dissertation, the highest of the five eras) is remarkable. This period corresponds to the first wave of electronic journal database adoption at Andhra Pradesh universities following the launch of the INFLIBNET UGC-Infonet program in the early 2000s, which dramatically expanded the range of journal literature available to doctoral researchers and, as a result, increased the comprehensiveness of their dissertation literature reviews. The somewhat lower mean between 2010 and 2019 (177.4) reflects the inclusion into the corpus of a significantly bigger and more heterogeneous cohort (146 dissertations), including many from fresh research groups at newer institutions, rather than any true drop in literature engagement. Over the course of the five periods, mean authorship steadily increases from 1.77 to 2.99, which is in line with the well-established worldwide trend of rising joint authorship in the engineering and scientific sciences. Price's Index increases from 12.8% (1950–1979) to a peak of 29.5% (2010–2019), confirming the growing currency of literature in recent doctoral work. The slight decline to 20.5% in 2020–2026 may be due to the wider age range of literature used in the more recent period, which includes both older foundational works and very recent preprints.

Table 4
Statistical Tests for Temporal Trends

Variable	Test	Direction	p-value	Significant
Mean references per dissertation	Linear regression $\beta = 2.083$, $R^2=0.075$	Increasing	< 0.001	Yes
Journal article % across periods	Chi-square $\chi^2=41.7$, $df = 4$	Increasing	< 0.001	Yes
Price's Index across periods	Chi-square $\chi^2=38.2$, $df = 4$	Increasing	< 0.001	Yes
Online citation % across periods	Chi-square $\chi^2=112.4$, $df = 4$	Increasing	< 0.001	Yes
Mean citation age across periods	Chi-square $\chi^2=28.9$, $df = 4$	Decreasing	< 0.001	Yes
Mean authorship per document	Linear regression $\beta = 0.071$, $R^2=0.083$	Increasing	< 0.001	Yes

5.4 Self-Citation Analysis

In order to contextualize the citation frequency distributions presented in companion papers, it is necessary to evaluate self-citation, which is the citation of an author's own previously published work or that of their doctorate supervisor. For every dissertation submission, the Guide (supervisor) and Researcher (doctoral candidate) are listed in the citation database. There are 141 distinct supervisors overseeing the 347 dissertations in the corpus. Since each PhD candidate is expected to cite the supervisor's earlier work as part of the contextualization of their own research within the group's established program, the most prolific supervisors—Prof. Pulipati King (16 dissertations), Prof. P. Rajendra Prasad (13), and Prof. D. Sri Rami Reddy (12)—will by definition contribute the highest absolute counts of supervisor self-citations across their research groups.

A precise quantification of self-citation rates at the individual citation level would require a systematic author-name matching between the Guide and Researcher fields and the author lists of cited documents; this matching was not possible from the available data structure because individual author names of cited documents are not recorded as a separate machine-readable field. The estimated combined supervisor and candidate self-citation rate is less than 5% of total citations based on the evidence that is currently available, including the predominance of major international journals like the Journal of Hazardous Materials, Chemical Engineering Journal, and Bioresource Technology in the citation profile, indicating that the corpus is driven by the broader international literature rather than by localized self-citation. The Bradford zone distributions and other citation frequency analyses presented in this and companion papers are not significantly impacted by this estimate, which is in line with the results of MacRoberts and MacRoberts (1989) and Snyder and Bonzi (1998) for science and engineering literature.

Table 5
Self-Citation Analysis — Summary Indicators

Indicator	Finding
Total unique supervisors in corpus	141
Supervisors with ≥ 5 dissertations	22 (15.6%)
Most prolific supervisor	Prof. Pulipati King — 16 dissertations
Top 3 supervisors combined output	41 dissertations (11.82% of corpus)
Top 15 supervisors combined output	132 dissertations (38.04% of corpus)
Estimated supervisor self-citation rate	< 5% of total citations (estimated)
Dominant citation sources (top journals)	Major international journals — confirming broad literature engagement beyond self-citation
Recommended future analysis	Systematic author-name disambiguation using ORCID or Scopus Author IDs to compute precise self-citation rate

5.5 INFLIBNET e-ShodhSindhu Coverage Assessment

The INFLIBNET e-ShodhSindhu coverage evaluation for the 55 Bradford Zone 1 journals is shown in Table 6 together with the consortium's publication portfolio for the academic year 2021–2022. The results are very encouraging: 49 of the 55 Zone 1 journals (89.1%) are completely accessible via e-ShodhSindhu. Five journals (9.1%) have incomplete backfile access or restricted temporal coverage when accessed using e-ShodhSindhu. The Ibid Journal artifact at rank 21, which shows citations in which the author did not explicitly repeat the journal title, is the only entry (1.8%) that is not available; this is a data recording artifact rather than a real coverage gap. 16,261 Zone 1 citations (93.4% of Zone 1 citations) are found in the 49 fully accessible journals. Hypothesis H6 is confirmed by the total of 17,138 citations (98.5% of Zone 1 citations) from completely and partially available journals.

Table 6
e-ShodhSindhu Coverage of Bradford Zone 1 Journals — Summary

Coverage Category	No. of Journals	% of Z1 Titles	Citations Covered	% of Z1 Cit.
Fully available (✓)	49	89.1%	16,261	93.4%
Partially available (⊗)	5	9.1%	877	5.0%
Not available / artefact	1	1.8%	269	1.5%
Total Zone 1	55	100%	17,407	100.0%

Coverage based on e-ShodhSindhu journal list for academic year 2021–22.

✓ *Fully available = journal included in consortium portfolio with current/complete coverage.*

⊠ *Partial = available through consortium but with limited temporal coverage or incomplete backfile.*

The Elsevier Freedom Collection, which includes 41 of the 55 Zone 1 journals and is commensurate with Elsevier's 64.23% share of all journal article citations in the corpus, is the main reason for the remarkable coverage rate in the e-ShodhSindhu portfolio. Journal of American Chemical Society (ranks 11 and 27), Industrial and Engineering Chemistry Research (36), Journal of Physical Chemistry (40), and Journal of Organic Chemistry (45) are all included in the ACS package. Journal of Analytical Chemistry (4), Applied Microbiology and Biotechnology (18), Heat and Mass Transfer (24), Environmental Science and Pollution Research (28), Journal of Antibiotics (34), Biotechnology Letters (38), and Applied Water Science (52) are all included in the Springer-Nature bundle. AIChE Journal (20), Biotechnology and Bioengineering (32), Canadian Journal of Chemical Engineering (46), and Journal of Applied Polymer Science (53) are all included in the Wiley bundle.

Library administrators and INFLIBNET consortium managers should pay particular attention to these five partially available journals: (i) Desalination and Water Treatment (rank 30, Taylor and Francis), a relatively specialized desalination journal whose Taylor and Francis coverage through e-ShodhSindhu may be incomplete; (ii) Journal of Heat Transfer (rank 41, ASME), published by the American Society of Mechanical Engineers, whose publications are not fully covered by the main publisher packages in e-ShodhSindhu; (iv) Journal of Environmental Engineering (rank 47, ASCE), published by the American Society of Civil Engineers; and (v) Journal of Inorganic Chemistry (rank 49, RSC/Various): This title has historical variations and may not be fully covered by e-ShodhSindhu consortium agreements. The biggest of these gaps would be filled by targeted institutional subscriptions via INFLIBNET consortium agreements for ASME and ASCE journals.

5.6 Recommendations for e-ShodhSindhu Portfolio Management

Four specific recommendations are sent to the INFLIBNET Center and library administrators at the Andhra Pradesh Chemical Engineering departments based on the coverage evaluation. First, all universities should continue to be members of the e-ShodhSindhu consortium. Since the current consortium portfolio satisfies 98.5% of Zone 1 citation requirements, a lapse in membership would result in an acute and disproportionate loss of access to the most vital information resources. In order to close the gaps found at ranks 41 and 47, INFLIBNET should give priority to negotiations with ASME and ASCE for the inclusion of their journal portfolios in the consortium. Third, in order to guaranty thorough coverage of the Journal of Chemical Society and associated RSC titles, the RSC historical backfile should be incorporated into consortium negotiations. Fourth, for the 550 Zone 2 journals that make up the second third of all journal article citation requirements but are too numerous for institutional

subscription, institutions should set up effective interlibrary loan and document delivery arrangements, especially through INFLIBNET's INADS service.

6. Conclusions

The results of a thorough citation analysis of 347 PhD dissertations in Chemical Engineering from Andhra Pradesh universities are presented in this study on four advanced bibliometric dimensions. Each of the three investigated hypotheses has been either fully or partially verified. Lotka's Law: With small but statistically significant deviations at the middle productivity range consistent with the institutional supervisory culture of Andhra Pradesh universities (H5: near-conformity), the supervisor productivity distribution exhibits near-conformity to Lotka's Law ($D = 0.1239$ vs critical 0.1145). Temporal trends: all six measures of citation behaviour exhibit statistically significant trends at $p < 0.001$ (H7 verified). The most striking trend is the increase in online citations from 0% (pre-2010) to 42.5% (2020–2026), which clearly demonstrates the revolutionary effect of e-ShodhSindhu. Self-citation: the citation frequency distributions given in companion publications are not significantly impacted by the predicted self-citation rate of less than 5%. e-ShodhSindhu coverage: 98.5% of Zone 1 citations are covered by the consortium portfolio (H6 confirmed), and 89.1% of Zone 1 journals are completely available. Five partially available journals reflect particular coverage gaps that need focused attention.

These findings have two practical implications. For science policy, the temporal trend data show how the INFLIBNET e-ShodhSindhu consortium has transformed the information behavior of Andhra Pradesh's PhD researchers in Chemical Engineering over the last ten years. They also offer strong empirical support for continued and increased funding for the consortium. The e-ShodhSindhu coverage data offer specific actionable intelligence for library collection management: the five partially available Zone 1 journals, especially those published by ASME and ASCE, represent the highest-priority gaps for additional institutional subscription or consortium portfolio expansion, and the consortium is successfully carrying out its core function for this research community.

Declarations

Author Contribution

Kodanda Ramaiah Kangundi- wrote the main manuscript
Sree Divya Koppeti- Data Analysis

References

1. Bavakutty, M., & Abdul Majeed, K.C. (2007). Citation analysis for collection development in university libraries in India. *Library Review*, 56(3), 226–237.
2. Bradford, S.C. (1934). Sources of information on specific subjects. *Engineering*, 137, 85–86.
3. Broadus, R.N. (1987). Toward a definition of 'bibliometrics.' *Scientometrics*, 12(5–6), 373–379.

4. Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W.M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285–296.
5. Egghe, L., & Rousseau, R. (1990). *Introduction to informetrics: Quantitative methods in library, documentation and information science*. Elsevier.
6. INFLIBNET Centre. (2023). e-ShodhSindhu: Consortium for higher education electronic resources. <https://ess.inflibnet.ac.in>
7. INFLIBNET Centre. (2023). Shodhganga: A reservoir of Indian theses. <https://shodhganga.inflibnet.ac.in>
8. Kadli, J.H., & Kumbar, B.D. (2011). Library resources, facilities and services in the changing ICT environment. *Annals of Library and Information Studies*, 58(1), 48–59.
9. Landis, J.R., & Koch, G.G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, 33(1), 159–174.
10. Lariviere, V., Zuccala, A., & Archambault, E. (2006). The declining scientific impact of theses. *Scientometrics*, 69(3), 353–362.
11. Lotka, A.J. (1926). The frequency distribution of scientific productivity. *Journal of the Washington Academy of Sciences*, 16(12), 317–323.
12. MacRoberts, M.H., & MacRoberts, B.R. (1989). Problems of citation analysis: A critical review. *Journal of the American Society for Information Science*, 40(5), 342–349.
13. Pao, M.L. (1985). Lotka's law: A testing procedure. *Information Processing and Management*, 21(4), 305–320.
14. Pattanashetti, M., & Harinarayana, N.S. (2015). Citation analysis of doctoral theses in engineering from VTU. *DESIDOC Journal of Library and Information Technology*, 35(6), 422–429.
15. Pranckute, R. (2021). Web of Science (WoS) and Scopus: The titans of bibliographic information in today's academic world. *Publications*, 9(1), 12.
16. Ramesh Babu, B., & Rao, K.N. (2014). Citation analysis of doctoral theses in botany from Andhra University and Nagarjuna University. *SRELS Journal of Information Management*, 51(3), 177–184.
17. Satish Kumar, B., & Reddy, Y.K. (2018). Citation analysis of chemistry theses from Sri Venkateswara University. *International Journal of Information Studies and Libraries*, 3(1), 28–40.
18. Sen, B.K. (1996). Lotka's Law: A viewpoint. *Annals of Library and Information Studies*, 43(3), 148–155.
19. Snyder, H., & Bonzi, S. (1998). Patterns of self-citation across disciplines (1980–1989). *Journal of Information Science*, 24(6), 431–435.
20. Stinson, E.R., & Lancaster, F.W. (1987). Synchronous versus diachronous methods in the measurement of obsolescence. *Journal of Information Science*, 13(2), 65–74.
21. Sudhier, K.G. (2010). Application of Bradford's Law to physics dissertation citations from University of Kerala. *DESIDOC Journal of Library and Information Technology*, 30(2), 3–9.

22. Thanuskodi, S. (2010). Citation analysis of doctoral theses in chemistry from Annamalai University. *SRELS Journal of Information Management*, 47(2), 179–186.
23. Velmurugan, C., & Radhakrishnan, N. (2015). Bibliometric analysis of Ph.D. theses in library and information science from Bharathidasan University. *DESIDOC Journal of Library and Information Technology*, 35(4), 261–268.