



iJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** IX **Month of publication:** September 2026

DOI: <https://doi.org/10.22214/ijraset.2026.84834>

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Webometric Analysis of Central Agricultural Universities in India: A Study of Web Impact Factor and Link Structure

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Abstract: *In the contemporary knowledge society, an academic institution's web portal functions as its primary digital gateway, reflecting its scholarly productivity, institutional visibility, and public communication efficacy. For agricultural universities, this digital presence is of paramount importance, as web platforms are mandated to bridge the gap between scientific researchers and agricultural stakeholders by disseminating critical agronomic data, weather advisories, and farming innovations. This study conducts an empirical webometric investigation into the official web portals of all three Central Agricultural Universities (CAUs) in India: Central Agricultural University (CAU, Imphal), Rani Lakshmi Bai Central Agricultural University (RLBCAU, Jhansi), and Dr. Rajendra Prasad Central Agricultural University (RPCAU, Pusa). The primary objective is to evaluate their digital presence, web visibility, hyperlink architecture, and website health. Quantitative data were gathered using Google Search engine queries for indexed web pages, Small SEO Tools Website Link Analyzer for link classification, and Dead Link Checker for detecting broken links. Key evaluative indicators analysed include the Simple Web Impact Factor (SWIF), Self-Link Web Impact Factor (SLWIF), External Link Web Impact Factor (ELWIF), and Broken Link (BL) percentages. The empirical findings reveal that all three universities operate under the standard.ac.in domain extension. While Dr. Rajendra Prasad Central Agricultural University exhibits the largest indexed web presence (65,300 pages), Central Agricultural University (Imphal) performed best on WIF ratios, with a SWIF of 0.1231, an SLWIF of 0.1019, and an ELWIF of 0.0212. Link health analysis identified an average broken link rate of 36.97% across the portals, with RLBCAU recording the lowest broken link density (27.38%) and CAU Imphal recording the highest (52.08%). The study underscores the necessity of continuous technical maintenance, link-repair strategies, and enhanced external scholarly collaborations to improve search engine discoverability and digital information dissemination for India's agricultural academic community.*

Keywords: *Central Agricultural Universities, Webometric Analysis, Web Impact Factor (WIF), Link Structure, Broken Links, Simple Web Impact Factor, Search Engine Optimization (SEO), Digital Visibility.*

I. INTRODUCTION

The rapid expansion of the internet and web technologies has fundamentally transformed higher education and scientific research systems globally. Academic websites no longer function merely as static digital brochures; they serve as dynamic communication gateways, administrative hubs, and central access points for research publications, educational resources, and institutional repositories. In the modern digital era, the visibility, structural design, and technical health of an institution's web portal are vital determinants of its global reach, search engine discoverability, and academic credibility.

In India, agricultural higher education plays a foundational role in national development, food security, and rural empowerment. India operates a vast agricultural research and education network comprising State Agricultural Universities, Deemed-to-be Universities, and specialized central institutions. Among these, Central Agricultural Universities (CAUs), established under Acts of Parliament and functioning under the Department of Agricultural Research and Education (DARE) and the Indian Council of Agricultural Research (ICAR), occupy a prestigious position. These apex institutions carry a dual responsibility: advancing cutting-edge agronomic education and research for faculty and students, while simultaneously delivering vital, time-sensitive knowledge—such as weather bulletins, crop advisories, seed varieties, and modern farming technologies—to the rural farming community and external stakeholders. Given this critical mandate, the web portals of Central Agricultural Universities must be structurally robust, richly interlinked, easily accessible, and free of technical defects such as broken links. However, academic web portals frequently face challenges relating to poor search engine optimization (SEO), inadequate link structures, low external connectivity, and navigational errors, which severely hinder user retention and digital visibility.

Webometrics offers a rigorous quantitative framework for assessing the effectiveness, visibility, and hyperlink patterns of web resources. Originally conceptualized by Almind and Ingwersen (1997) and Ingwersen (1998), webometrics applies informetric and bibliometric principles to the World Wide Web, enabling researchers to calculate the Web Impact Factor (WIF) through link and page analysis. By evaluating metrics such as indexed web pages, internal self-links, external links, and dead/broken links, webometrics provides actionable diagnostic insights into the digital reach and technological performance of university websites.

While general Central Universities and State Agricultural Universities have been examined in broad webometric surveys, the specialized cluster of Central Agricultural Universities in India has not received targeted empirical evaluation. Therefore, the present study conducts a comprehensive webometric analysis of all three Central Agricultural Universities in India: Central Agricultural University (CAU, Imphal), Rani Lakshmi Bai Central Agricultural University (RLBCAU, Jhansi), and Dr. Rajendra Prasad Central Agricultural University (RPCAU, Pusa).

II. REVIEW OF LITERATURE

Webometrics, the quantitative evaluation of web-based information, hyperlink architecture, and search engine visibility—provides an established framework for assessing the digital presence, usability, and communication efficiency of academic institutions. Academic website services and essential communication channels for disseminating scholarly output, offering administrative services, and providing access to institutional digital repositories. Over the past two decades, webometric investigations have evolved from broad search-engine indexing audits to granular assessments of institutional sub-domains, technical link health, and interactive web tools.

The conceptual foundation of webometrics was established by Almind and Ingwersen (1997) and Ingwersen (1998), who adapted traditional bibliometric citation models to the World Wide Web by introducing the Web Impact Factor (WIF). In the Indian higher education system, Jalal, Biswas, and Mukhopadhyay (2009, 2010) conducted comprehensive webometric evaluations across 23 Central Universities. Using search engine query syntaxes (such as site: and link domain:) across Yahoo!, AltaVista, and Google, they analyzed indexed web pages, internal selflinks, and external inlinks. Their link topology analysis using Pajek software demonstrated that inter-university academic linking was relatively sparse and confined primarily to geographically contiguous or premier institutions. Furthermore, their investigation into multiindicator ranking models, specifically the Web Indicators for Science, Technology, and Innovation Research (WISER) index, demonstrated a strong correlation ($r = 0.72$ to 0.85). with formal academic accreditation grades granted by the National Assessment and Accreditation Council (NAAC).

Recent webometric studies have increasingly prioritized hyperlink integrity, link categorization, and search engine optimization (SEO) diagnostics within institutional subspaces. Shinde and Hadagali (2025) conducted a webometric assessment of 56 Indian Central University library websites utilizing Google Search syntax, the Small SEO Tools Website Link Analyzer, and the Dead Link Checker. Their study evaluated three distinct Web Impact Factors—Simple Web Impact Factor (SWIF), Self-Link Web Impact Factor (SLWIF), and External Link Web Impact Factor (ELWIF)—alongside broken link (BL) percentages. The findings revealed notable performance disparities: while premier institutions like Aligarh Muslim University demonstrated strong link architecture with minimal broken links, several underperforming institutions exhibited broken link proportions exceeding 90%. The authors emphasized that proactive link maintenance, internal link structuring, and the elimination of dead links are critical for improving search engine discoverability and institutional credibility.

In agricultural higher education, institutional web portals carry a vital dual mandate: delivering scholarly resources to researchers and disseminating timely agronomic practices, weather bulletins, and crop advisories to farmers and rural stakeholders. Thilakar, Kalaiselvan, and Balasubramani (2016) evaluated 70 Indian agricultural universities and colleges using Alexa Traffic Rank and Google PageRank over a six-year longitudinal span (2010–2016). Their analysis revealed a general decline in global web traffic rankings across several agricultural institutions, attributing this drop to infrequent updates, static layouts, and inadequate web hosting of dynamic, region-specific farm resources. Addressing technological integration, Panwar, Nain, and Gorla (2024) assessed 53 Indian agricultural institutions for their adoption of 15 essential Web 2.0 interactive features. Their study identified an overall low adoption rate across the sector (10% to 25% on average), showing that while basic asynchronous features like webmail (67%), Web-OPAC library search (37%), and site-search bars (31%) were present, interactive participatory tools like farmer mobile advisories, collaborative wikis, and blogs were virtually absent. While general Central Universities have been comprehensively analyzed as a collective (Jalal et al., 2009, 2010; Shinde & Hadagali, 2025) and State Agricultural Universities have been evaluated broadly (Thilakar et al., 2016; Panwar et al., 2024), the specialized category of Central Agricultural Universities (CAUs) established under Acts of Parliament has not been investigated as an independent, focused group. Absence of Hyperlink Impact Ratios and Broken Link Diagnostics in Agricultural Portals: Existing research on Indian agricultural university websites has focused primarily

on third-party traffic metrics (Thilakar et al., 2016) or static feature checklists (Panwar et al., 2024). There is a lack of empirical literature calculating specific Web Impact Factors (SWIF, SLWIF, ELWIF) or diagnosing broken link densities within agricultural academic web domains. Methodological Transition to Modern Web Crawling Utilities: Early foundational studies on Indian universities relied on search engine syntaxes and tools that are now deprecated, such as AltaVista and Yahoo! Site Explorer (Jalal et al., 2009, 2010). Consequently, there is an urgent need for contemporary empirical evaluations that utilize active web analyzers, real-time HTTP broken link auditors, and current Google search indexing commands.

The present study addresses these identified gaps by conducting a quantitative webometric analysis, computing multi-dimensional Web Impact Factors, and evaluating hyperlink health across the official websites of all three Central Agricultural Universities in India (CAU Imphal, RLBCAU Jhansi, and RPCAU Pusa)

III. OBJECTIVES OF THE STUDY

- 1) To evaluate the web presence and domain structure of the Central Agricultural Universities in India.
- 2) To determine the total number of Google-indexed web pages (NWP) for each university.
- 3) To analyze the link architecture by calculating total links (LWP), internal/self-links (SLWP), and external links (ELWP).
- 4) To compute and compare the Simple Web Impact Factor (SWIF), Self-Link Web Impact Factor (SLWIF), and External Link Web Impact Factor (ELWIF), and establish an institutional ranking based on web impact.
- 5) To audit website health and identify the prevalence of dead or broken links (BL) across the institutional portals.
- 6) To provide targeted recommendations for optimizing hyperlink structures, search engine visibility, and digital content delivery for Indian agricultural universities.

IV. METHODOLOGY

The study adopted a quantitative webometric approach to analyze the official websites of all three Central Agricultural Universities in India. Data collection was executed systematically using web search syntaxes, online hyperlink analyzers, and link validation software.

A. Selection Of Sample Institutions

The sample consists of all three Central Agricultural Universities established under parliamentary legislation and functioning under the Indian Council of Agricultural Research (ICAR) / DARE:

- 1) Central Agricultural University (CAU), Imphal, Manipur
- 2) Rani Lakshmi Bai Central Agricultural University (RLBCAU), Jhansi, Uttar Pradesh
- 3) Dr. Rajendra Prasad Central Agricultural University (RPCAU), Pusa, Bihar

B. Tools and Search Strategies For Data Collection

- 1) Google Search Engine: Utilized to determine the total number of indexed web pages (NWP) for each university using the Boolean search command: `site:[domain]` (e.g., `site:cau.ac.in`).
- 2) Website Link Analyzer (SmallSEOTools): Used to crawl and extract the hyperlink architecture of each portal, recording total link web pages (LWP), internal self-link web pages (SLWP), and external link web pages (ELWP).
- 3) Dead Link Checker: Employed to audit each university portal to identify and tally the exact count of broken or non-functioning links (BL).
- 4) Methodological Details & Handling Rules: To ensure reproducibility, all data extraction and web crawls were conducted on 19 August 2026, with standardized handling rules applied uniformly to ignore temporary session IDs and dynamically generated URL parameters.
- 5) Tool Validation: The repeat audit yielded 98% agreement between the two tools regarding total link counts, with a minor variance of +4 links attributed to dynamic session generation, confirming the high reliability of the broken link detection.

C. Web Impact Factor Formulations

To assess digital visibility and web connectivity, three Web Impact Factors and the broken link percentage were computed:

- 1) Simple Web Impact Factor (SWIF): $SWIF = LWP / NWP$
- 2) Self-Link Web Impact Factor (SLWIF): $SLWIF = SLWP / NWP$
- 3) External Link Web Impact Factor (ELWIF): $ELWIF = ELWP / NWP$
- 4) Broken Link Percentage (BL %): $BL (\%) = (BL / LWP) \times 100$

V. RESULTS AND DISCUSSION

A. Domain-wise Distribution

All three Central Agricultural Universities (100%) utilize the academic country-code toplevel domain (.ac.in), which is standard practice for accredited educational and research institutions in India.

B. Web Pages and Link Distribution Analysis

The raw data collected for indexed web pages (NWP), total links (LWP), internal self-links (SLWP), and external links (ELWP) are summarized below:

Sl. No.	University Name	Location	NWP	LWP	SLWP	ELWP
1	Central Agricultural University (CAU)	Imphal, Manipur	1,560	192	159	33
2	Rani Lakshmi Bai Central Agricultural University (RLBCAU)	Jhansi, Uttar Pradesh	39,000	336	293	43
3	Dr. Rajendra Prasad Central Agricultural University (RPCAU)	Pusa, Bihar	65,300	318	299	19
—	Total / Mean Average	—	35,287	282	250.33	31.67

Table 1: Distribution of Web Pages and Links of Central Agricultural Universities

Table 1 shows that Dr. Rajendra Prasad Central Agricultural University (RPCAU) has the highest number of Google-indexed web pages with 65,300 pages, followed by Rani Lakshmi Bai Central Agricultural University (RLBCAU) with 39,000 pages, and Central Agricultural University (CAU, Imphal) with 1,560 pages. In terms of total links (LWP), Table 1 reveals that RLBCAU recorded the highest link volume (336 links), followed by RPCAU (318 links) and CAU (192 links). Furthermore, Table 1 indicates that internal self-links (SLWP) constitute the primary portion of total hyperlinks across all three universities (averaging 250.33 links), whereas external links (ELWP) remain limited, averaging only 31.67 links per institution.

C. Web Impact Factor (WIF) Analysis and Institutional Rankings

Sl. No.	University Name	SWIF	SWIF Rank	SLWIF	SLWIF Rank	ELWIF	ELWIF Rank
1	Central Agricultural University (CAU)	0.1231	1	0.1019	1	0.0212	1
2	Rani Lakshmi Bai Central Agricultural University (RLBCAU)	0.0086	2	0.0075	2	0.0011	2
3	Dr. Rajendra Prasad Central Agricultural University (RPCAU)	0.0049	3	0.0046	3	0.0003	3
—	Average / Mean Value	0.0455	—	0.0380	—	0.0075	—

Table 2 : Web Impact Factor (WIF) Analysis and Institutional Rankings

Table 2 shows that Central Agricultural University (CAU, Imphal) performed best on WIF ratios across all three-impact metrics, achieving a SWIF of 0.1231, an SLWIF of 0.1019, and an ELWIF of 0.0212. Table 2 also shows that RLBCAU occupied the 2nd rank (SWIF: 0.0086, SLWIF: 0.0075, ELWIF: 0.0011), while RPCAU was placed in the 3rd rank (SWIF: 0.0049, SLWIF: 0.0046, ELWIF: 0.0003). Because Web Impact Factors represent the ratio of links divided by the total number of indexed web pages, CAU attained higher scores due to a smaller web page denominator relative to its link density, whereas institutions with extensive web repositories (RPCAU and RLBCAU) received lower WIF values.

D. Broken Link (BL) Analysis and Website Health

Sl. No.	University Name	Total Links (LWP)	Broken Links (BL)	Broken Link % (BL %)	Link Health Rank
1	Rani Lakshmi Bai Central Agricultural University (RLBCAU)	336	92	27.38%	1
2	Dr. Rajendra Prasad Central Agricultural University (RPCAU)	318	100	31.45%	2
3	Central Agricultural University (CAU)	192	100	52.08%	3
	Average / Mean Value	282	97.33	36.97%	

Table 3: Broken Link (BL) Analysis and Website Health

Table 3 shows that Rani Lakshmi Bai Central Agricultural University (RLBCAU) secured the 1st rank in link health, having the lowest broken link density at 27.38% (92 broken links out of 336 total links). Table 3 shows that RPCAU ranked 2nd with a broken link rate of 31.45% (100 broken links out of 318).

Table 3 further reveals that CAU Imphal occupied the 3rd rank with the highest broken link proportion of 52.08% (100 broken links out of 192), indicating that more than half of its crawlable hyperlinks are non-functional. On average, Table 3 demonstrates that 36.97% of links across the three portals are broken, indicating an urgent need for regular hyperlink maintenance and automated link repair audits.

VI. RECOMMENDATIONS

Based on the empirical findings of this webometric evaluation, the following actionable measures are recommended to enhance the digital visibility, link architecture, and website performance of Central Agricultural Universities in India:

- 1) Regular Broken Link Audits and Remediation: All three institutions recorded high broken link proportions, averaging 36.97% (and reaching 52.08% for CAU Imphal). Web administrators must conduct periodic, automated link-crawling audits using tools like Dead Link Checker to identify and repair dead hyperlinks or configure proper 301 redirects, ensuring uninterrupted user navigation and preserving search engine ranking equity.
- 2) Augmenting External Academic and Institutional Linkages: External link counts remain substantially low across all portals (averaging only 31.67 links per institution). Universities should establish reciprocal hyperlinks with national research bodies (e.g., ICAR institutes, DARE, UGC), international agricultural organizations (e.g., FAO, CGIAR), and peer agricultural universities to build external domain authority and enhance ELWIF scores.
- 3) Optimizing Internal Site Architecture and Navigational Pathways: Self-links currently comprise the bulk of all hyperlinks. Restructuring website menus, internal sitemaps, and breadcrumb navigation will enable search engine bots and users to discover deeply nested educational resources, departmental research repositories, and student portals more efficiently.
- 4) Dynamic Content Dissemination for Agricultural Stakeholders: Central Agricultural Universities must expand beyond static institutional profiles by actively publishing real-time agricultural advisories, weather updates, crop management schedules, seed distribution notifications, and extension bulletins to fulfill their mandate toward farming communities and researchers.

- 5) Adopting Modern Web 2.0 and Search Engine Optimization (SEO) Standards: Portals should incorporate interactive tools—such as mobile advisory push notifications, multimedia e-learning resources, interactive search filters, and mobile friendly responsive designs—to enhance digital engagement and accessibility.

VII. CONCLUSION

This webometric study evaluated the digital visibility, hyperlink architecture, Web Impact Factors, and link integrity of the three Central Agricultural Universities in India: Central Agricultural University (Imphal), Rani Lakshmi Bai Central Agricultural University (Jhansi), and Dr. Rajendra Prasad Central Agricultural University (Pusa).

The empirical analysis revealed noticeable variations among the universities. Central Agricultural University (CAU, Imphal) performed best on WIF ratios (SWIF: 0.1231, SLWIF: 0.1019, ELWIF: 0.0212), driven by a high link-to-page ratio, whereas RPCAU demonstrated the largest volume of indexed content with 65,300 Google-indexed pages. However, link health diagnostics indicated significant deficiencies, with an average broken link density of 36.97% across the portals, led by CAU Imphal (52.08% broken links) and RPCAU (31.45% broken links).

It is important to emphasize the strictly descriptive scope of these findings. Due to the intrinsically small sample size of Central Agricultural Universities in India ($n=3$), interpretations should be viewed as an exploratory baseline rather than definitive sector-wide generalizations. Addressing these technical bottlenecks through continuous link maintenance, active external networking, and dynamic agricultural content publishing will strengthen the web presence of India's Central Agricultural Universities, supporting their mission of advancing agricultural education, research, and grassroots extension services.

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