



Scopus Indexed Indian Journal of Extension Education: Crafting Improvement Strategy through Altmetric and Bibliometric Analysis

Priyanka Roy¹, Saikat Maji^{2*}, Basavaprabhu Jirli³, Prashish Singh⁴ and Manjeet Singh Nain⁵

^{1,2,4}Department of Extension Education, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005, Uttar Pradesh, India

³Director, Centre for Multi-Disciplinary Development Research (CMDR), Dharwad, Karnataka, India

⁵Professor, Division of Agricultural Extension, ICAR-Indian Agricultural Research Institute, New Delhi-110012, India

*Corresponding author mail id: saikatm@bhu.ac.in

ARTICLE INFO

Keywords: Altmetric analysis, Bibliometric analysis, Bibliometrix (biblioshiny), Indian Journal of Extension Education (IJEE), Research trends, Thematic map, VOSviewer

<https://doi.org/10.48165/IJEE.2024.60201>

Conflict of Interest: None

Research ethics statement(s):

Informed consent of the participants

ABSTRACT

The present paper includes a comprehensive bibliometric and altmetric analysis of the Indian Journal of Extension Education (IJEE), the first and only Scopus-indexed Indian journal from the discipline of Extension Education employing VOSviewer and R-packages. As the official journal of the Indian Society of Extension Education, IJEE covers diverse subject areas, including agricultural extension, rural sociology, information communication technology (ICT) application in agriculture, climate change, and other contemporary social issues. The study examined 543 authors and 263 organizations in co-authorship, considered 625 keywords in co-occurrence, evaluated 156 documents in the citation, and investigated 2849 cited references, 1416 cited sources, and 5203 cited authors in co-citation. The results highlighted the influential papers and authors, providing insights into research trends and areas of significance by R-packages. It also explained the thematic map showing the emerging, developing, and already developed research topics in modern trends. The altmetric analysis of the 5 most cited papers from IJEE looked into the research paper's citations, usage, captures, mentions, and social media penetration. While confirming conventional knowledge, the study identified unique situations indicating the growth of IJEE, contributing valuable perspectives for researchers and stakeholders in extension education and related fields.

INTRODUCTION

The development of any discipline can be judged by the quantity and quality of research being carried out by scholars in that subject area. In the enabling world of ICT social media and other interactive communication platforms became the central vehicle for dissemination of those research findings. Extension has been instrumental since the *green revolution* in realizing the potential of farming and rural development in India. Effective formulation and implementation of the extension strategy largely depend on research findings and their subsequent dissemination among the scientific community. The *Indian Journal of Extension Education*

is an open-access, peer-reviewed publication that serves as the official journal of the Indian Society of Extension Education (ISEE) since 1965. The journal covers various subject areas, including Agricultural Extension, Communication, Agricultural Entrepreneurship, Extension Management, Agricultural Education, Rural Sociology, Adoption and Diffusion of Farm Innovations, ICT Application in Agriculture, Planned Agricultural Change, Rural Development, and Contemporary Agricultural Extension issues related to agriculture sector. The journal has been included in the Scopus from November 2023 (Nain, 2024).

Bibliometric analysis is a research area gaining more attention in the scientific community, especially due to advancements in

ICT. It has become a crucial method for studying research trends and originally emerged from library and information science (Merigó & Yang, 2017). Recently, there has been a growing interest in using bibliometric methods to analyse specific scientific journals. Many journals have published studies examining their repositories (García-Merino et al., 2006; Walter & Ribière, 2013; Cobo et al., 2015). IJEE published papers from diverse fields within social science and thus provided great scope for comprehensive bibliometric overviews of agriculture and rural development. These analyses may help researchers understand the development and impact of studies in areas like farming, rural sociology, and agricultural science. This paper aims to give a general overview of the researches conducted and published in IJEE between 2023-24, using bibliometric methods with a tool called VOSviewer and R package (Bibliometrix). The publication data was accessed from the Scopus database (January 2023 to January 2024). The goal was to identify the most productive and influential research in IJEE and understand the current trends in the agricultural extension field by highlighting influential papers and authors. While most findings align with common knowledge, there are some unique situations indicating the growth of IJEE, with certain topics gaining popularity and high citations, while others don't receive as many citations.

On the other hand, altmetric analysis is a way of assessing the social impact of scientific articles. In the altmetric segment, performance was lacking in mention, usage and social media penetration of selected research papers having a high citation. Thus, this study makes an effort to consider a wide range of perspectives for the benefit of both researcher communities as well as the publisher. It delves deeply into popular research topics, exploring them thoroughly within their specific sub-domains to arrive at a clear, detailed, and succinct conclusion (Alsharif et al., 2020).

METHODOLOGY

The main investigation was based on the publication data (Research Papers only) of the IJEE available in Scopus. This paper includes all the data from the 2023-24(5 issues). All 156 documents were analysed using the VOSviewer package as well as using the R package (bibliometrix). All 156 documents were then compiled and organized into an Excel file from the Scopus database for further processing. The Excel file was manually screened for homogeneity across the names of authors, co-authors, institution names etc. The analysis in VOSviewer was spanned through four sections namely Co-authorship, Co-occurrence, Citation and Co-citation. In the "Co-authorship" section under the "Author" sub-section, 543 authors were taken into consideration, same as in "Organisation", 263 organisations were taken into consideration. In "Co-occurrence", there were also two sub-sections namely "All Keywords" accessed 625 keywords and in "Author Keywords", also same 625 keywords were accessed. Under "Citation", there were two sub-sections "Documents", and "Organisations". In "Document" 156 documents were taken, in "Organisations" 263 organisations were taken. Lastly, under "Co-citation" there were also three sub-sections. In "Cited reference" 2849 references were considered. In "Cited Source" 1416 sources were accessed and under "Cited Author", 5203 authors were considered. The groups were examined

separately with all four sections of analysis to judge their impact. All the analyses using the created file in the VOSviewer were considered for the "Networking Visualisation". In the R package bibliometrix, 156 documents were assessed for generating the most relevant affiliation with the number of documents representing it. Most importantly multiple correspondence analysis and factor analysis were used to draw the conceptual structure. This methodology provided a systematic approach to comprehensively analyze and visualize the extension research landscape through the "IJEE" for the time frame 2023-24.

For altmetric analysis, the 5 papers with the highest number of citations were considered. The embedded *PlumX* metrics represent altmetric score through five submatrices i.e., Citations, Usage, Captures, Mentions, and Social media along with Field-Weighted Citation Impact (FWCI), a benchmarking indicator which compares an article's performance relative to its peers in the scientific literature was used.

RESULTS

Bibliometric analysis can be conducted using various software or package programs such as CoPalRed (Bailón Moreno et al., 2005), CiteSpace (Chen, 2006), BibExcel (Persson et al., 2009), Sci2Tool (Sci2Team, 2009), VOSviewer (van Eck & Waltman, 2010), SciMAT (Cobo et al., 2012), CitNetExplorer (van Eck & Waltman, 2014), Biblioshiny (Aria & Cuccurullo, 2017), and BiblioMaps (Grauwin & Sperano, 2018). The R package that powers the Biblioshiny tool primarily works with data from sources like Web of Science (WoS), Scopus, and Dimensions. It offers various analysis options grouped into seven categories, including Overview, Sources, Authors, Documents, Conceptual structures, Intellectual structure, and Social structure. This powerful library enables comprehensive bibliometric and scientometric analyses, allowing users to generate different types of graphs-an uncommon feature in other libraries (Moral-Muñoz, et al., 2020).

VOSviewer is claimed as the most user-friendly and popular tool among all bibliometric tools (Orduña-Malea and Costas, 2021). Unlike other tools, VOSviewer places a strong emphasis on graphical representation (van Eck & Waltman, 2010). The application of VOSviewer bibliometric mapping software was employed to generate a network visualization illustrating the most common terms used in the selected topics and the relationship between ethics and innovation in construction.

Impact of research through online interactions (Altmetric analysis)

Alternative metrics are getting more attention worldwide due to ever-increasing internet penetration and rising screentime among the world population (Kumar et al., 2016). It is a suitable tool to demonstrate the value and attraction of a researcher's work apart from traditional citation counts. It is also suitable to balance several misleading metrics tied to particular journals as it provides additional, supplementary information (Piwowar & Priem, 2013). Thus, the utility of bibliometric tools like Altmetrics has become increasingly important in measuring research output. For the present study, the Scopus-embedded *plumx* Metrics and FWCI scores of the top five research papers in IJEE in terms of citation were

Table 1. Research impact overview through altmetric scores (*PlumX* Metrics)

S.No.	Research Paper	Citation (Red)	Capture (Purple)	Visual Representation	FWCI
1	Determinants of Performance and Constraints Faced by Farmer Producer Organizations (FPOs) in India	3	3		3.45
2	Determinants of Climate Change Adaptation Strategies in Bundelkhand Region, India	3	4		3.45
3	Do Information Networks Enhance Adoption of Sustainable Agricultural Practices? Evidence from Northern Dry Zone of Karnataka, India	4	-		4.60
4	Assessing the Adoption of Climate Resilient Agricultural Technologies by the Farmers of Telangana State	4	5		4.60
5	Knowledge Test for Extension Personnel on Rashtriya Krishi Vikas Yojana	3	-		3.45

analysed till the time of writing this article. Among five metrics the performance was nil in the case of usage, mentions, and social media shares, likes *etc.* Only in citations and capture (*i.e.*, future citation) some performance was observed. The FWCI score, which indicates comparative performance with peers was all more than 1, which indicates higher than-expected citations based on the global average for similar publications. The fourth article has FWCI 4.60 indicating a 360 per cent higher citation than the global average.

Conceptual structure analysis

It was conducted through Co-occurrence analysis by looking at the keywords, titles, and common words in the abstract of documents. In this analysis, the unit under consideration is individual words. What sets this method apart is its use of the actual content of the documents for analysis, unlike other methods that rely solely on bibliographic details. However, it's worth noting that this approach doesn't consider the challenge of words being interpreted differently or having various meanings (Büyükkidik, 2022). Four larger clusters were identified and visualized in Figure 1. "Farmers' adoption, reliability, attitude, and constraints" were the major research words having interconnection. Several smaller and relatively detached clusters like "extension gap, farm income, climate change" were also words of interest for researchers who published in IJEE. A large number of research were being conducted on topics in the middle cluster of topics as presented in Figure 2. Research on livelihood security, food and COVID-19 were overlapping research areas. Also, paddy cultivation and adoption were overlapping areas. A higher number of published research were carried out in Haryana, Rajasthan, Uttar Pradesh and Telangana as found in the background clustering data of Figure 2. A separate distant cluster of research keywords was fishery, poultry, dairy mushroom and integrated farming system which was another interlinked research area.

A conceptual map based on the authors' keywords was plotted (Figure 3) using two dimensions. The first dimension *i.e.*, density (y-axis) indicates the degree of development of the themes as measured by the internal associations among the keywords. The

second is centrality (x-axis). It indicates the significance of the themes as measured by the degree of interaction between the network clusters in contrast to the other clusters. "The map showed four quadrants: (a) motor themes (high density and centrality), (b) basic themes (low density and high centrality), (c) niche themes (high density and low centrality), and (d) emerging/declining themes (low density and centrality)" (Bretas & Alon, 2021). The first quadrant identified motor themes *i.e.*, central and developed themes. Five clusters formed under this quadrant which were mostly related to adoption, climate change women empowerment, constraints *etc.* In the fourth quadrant *i.e.*, emerging/declining themes; entrepreneurship, information utilization, capacity building, and motivation were identified as an emerging theme with an increasing degree of centrality and density. Areas like extension gap, technology gap, extension personnel, *etc.*, and techniques like knowledge test, and logistic regression were identified under niche themes having high development degree but decreasing relevance.

Intellectual structure analysis

It was carried out by utilizing citation and co-citation analysis supported by reference spectroscopy. Citation analysis is a method used to evaluate the impact of authors, documents, or journals by examining their citation rates. Its strengths lie in effectively identifying crucial studies in the field. However, a drawback is that newly published works may have lower cumulative citation rates, as older publications are more likely to receive higher citation counts (Büyükkidik, 2022). Co-citation analysis examines the connections between authors, documents, or journals by looking at reference lists. Similar to citation analysis, the units of analysis are authors, documents, and journals. One of the advantages is that it is considered as the most valid and commonly used bibliometric method (Büyükkidik, 2022). In these two analyses 156 documents, 2825 references, 1416 cited sources and 5203 cited authors were considered. Through citation analysis four thematic cluster formations were observed and visualized in Figure 4. The largest cluster depicted in green is related to research on information networks for adoption and the second largest cluster depicted in red is related to research on Farmer Producer Organization.

Figure 1. Co-occurrence analysis using Author Keywords (each node represents the keyword from research papers, the curved line represents the links with words based on co-occurrences, the colour of the clusters represents the themes having topics (words) and their interrelationship (links) in the thematic clusters)

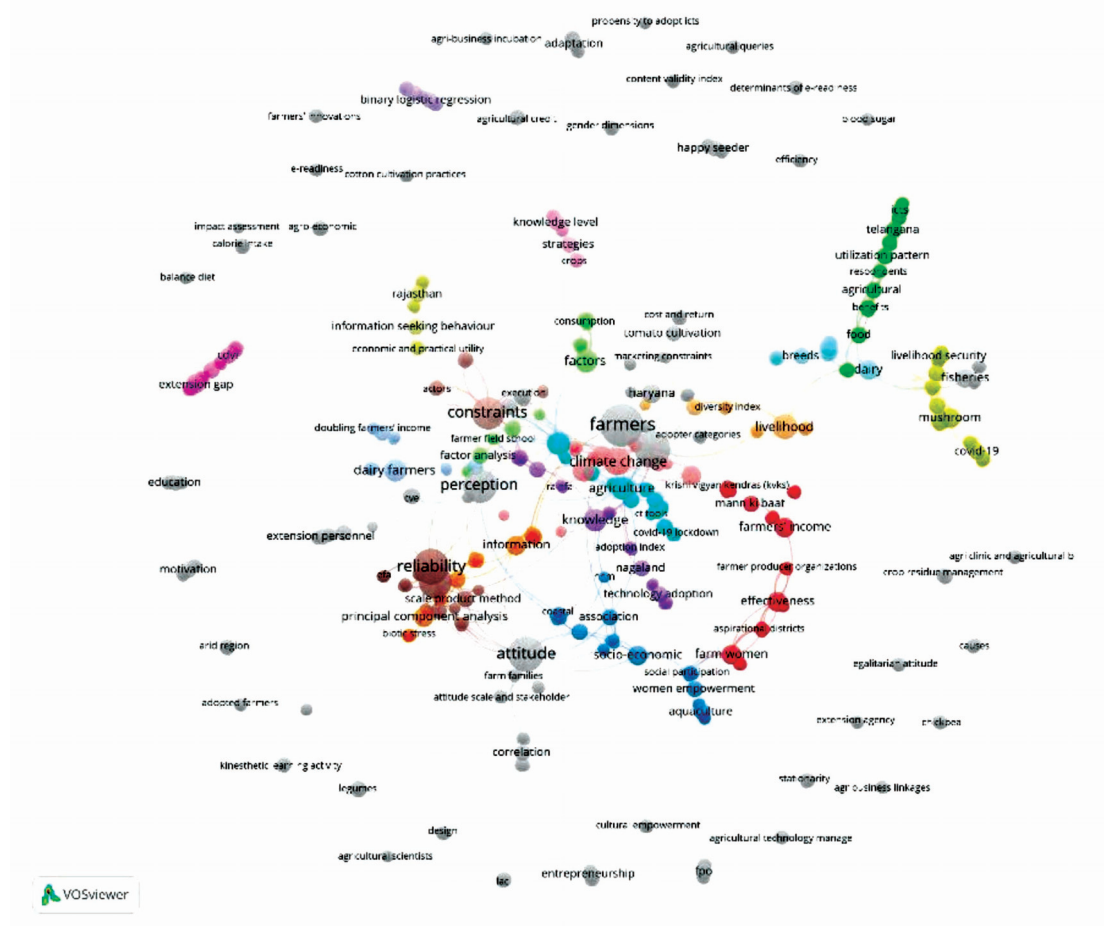


Figure 2. Multiple Correspondence Analysis (MCA)



Figure 3. Conceptual map using authors' keywords in a 4-quadrant thematic area

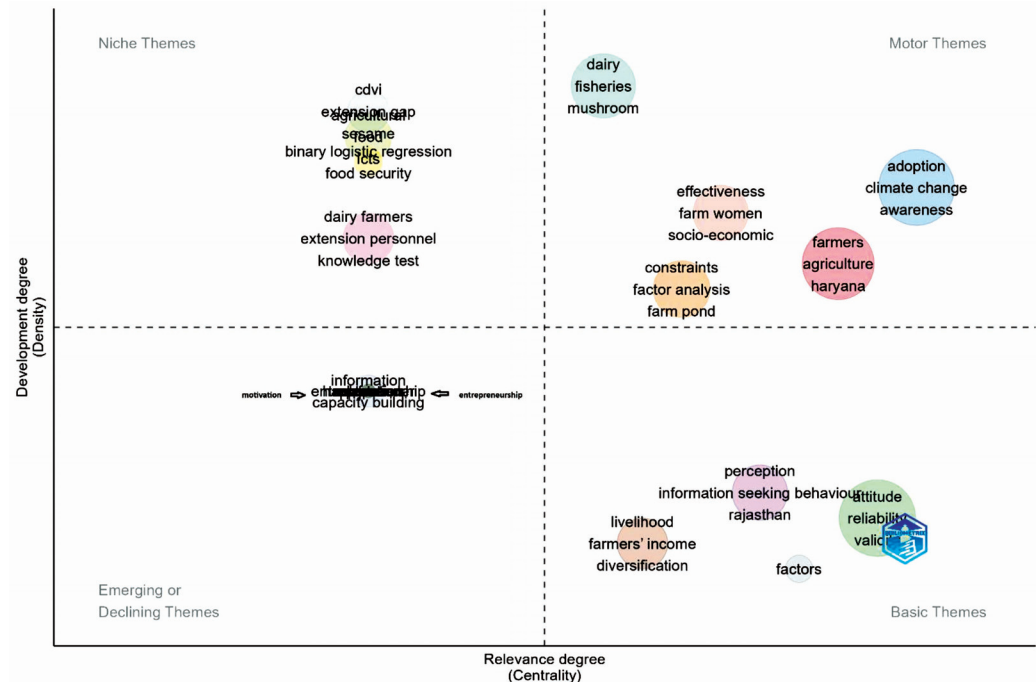
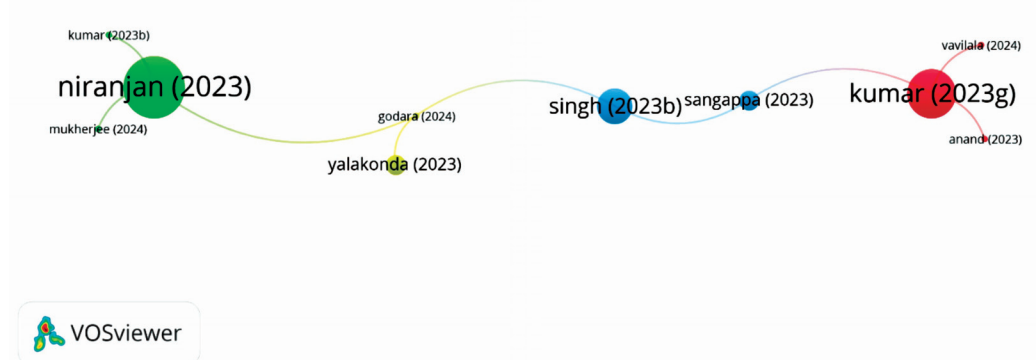


Figure 4. Citation analysis of documents published in IJEE (each node represents the name of the author of the document, the curved line represents the links, and the thickness of the line indicates the relatedness of documents, the alphabet succeeding year is merely for identification among many similar surnames)



The most relevant affiliation organization in terms of research contribution and citation received was also analysed and presented in Figure 5 and 6. They indicate the top-ranking ICAR Institutions followed by Central Universities and State Agricultural Universities as the main contributors both in terms of documents and citations received. The background data of Figure 6 also indicates that a total of authors from 261 organizations were involved in publishing their research findings in IJEE which is quite impressive. Among these 80 organizations have contributed at least 1 document and received at least one citation and visualized in Figure 6.

Co-citation analysis of cited sources (journals, books *etc.*) and cited authors depicted in Figure 7 and 8. Eight major clusters of journals were identified as being co-cited (with at least 05 citations). The visualization in Figure 7 highlighted the co-citation network of IJEE. It shows its intellectual network stretched to a variety of journals from core agriculture to dairy, to social science and economics, and the field of psychology indicating the improving strength of this journal. The visualizations in Figure 8 reveal the formation of eight major clusters in the case of authors (with at

least 05 citations per author). It also reveals a huge 5203 number of authors and co-authors received at least one citation.

Reference Publication Year Spectroscopy (RPYS) is utilized for an in-depth look into the historical origin of research fields and topics by using a quantitative method (Marx et al., 2014). The result has been visualized in Figure 9. It indicates the use of research work of relatively new origin (Within the last 5 to 7 years) by authors of research papers for critically evaluating their work, thus a continuity in doing more updated research having more contextual relevancy. Also, a significant deviation was noticed from 2020 onwards in the deviation from the 5-year median citation which may be attributed to digitalization and the inclusion of this journal to the ICAR e-pubs journal management site which is a positive sign for the journal.

Social structure analysis

It was done by analyzing the collaboration between authors and institutions. To get insight into the network of authors and their scholarly impact co-authorship analysis was conducted. Co-

Figure 5. Most relevant affiliations (based on number of research papers published)

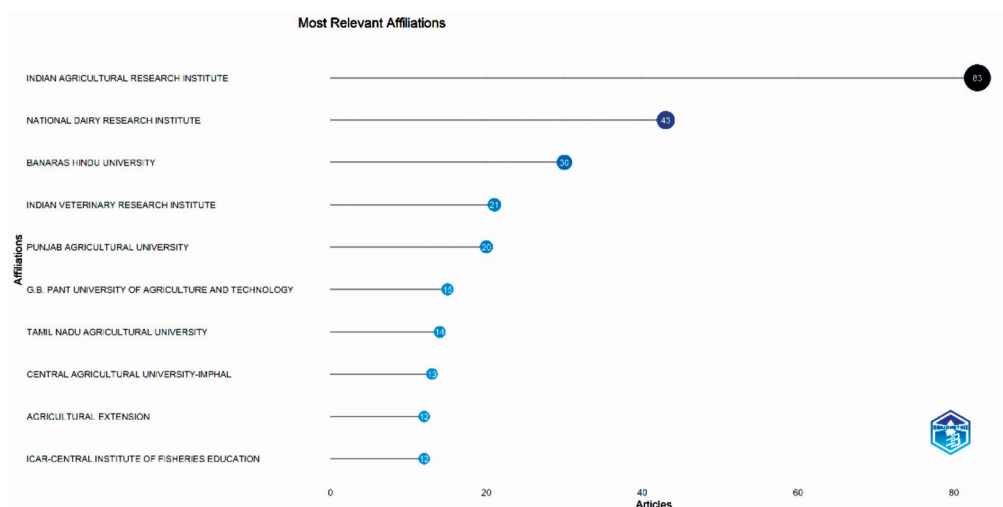
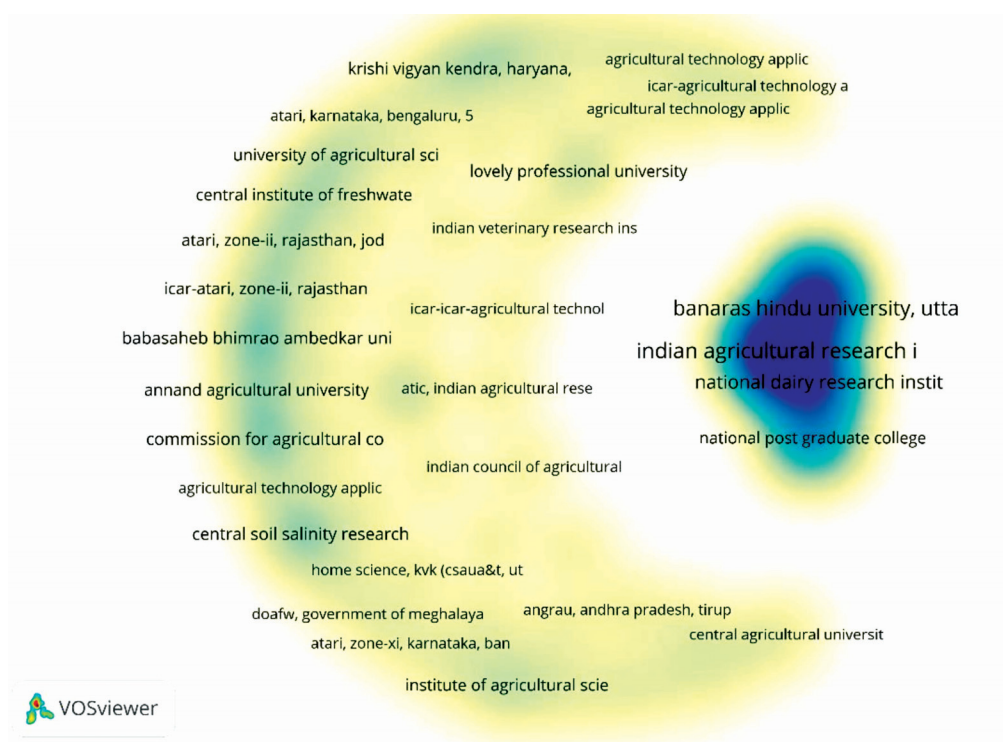


Figure 6. Citation analysis of organisations (Plotted as item density map where each item represents an organisation and its density reflected the number of citations received by an organisation)



author methods involve creating connections between authors who have collaborated on an article. The focus is on analyzing authors as the unit of study. This examination helps uncover networks and collaborations among authors, along with their respective institutions. However, it's important to note that co-authoring doesn't always guarantee collaboration, as highlighted by Büyükkidik (2022). Under the "Co-authorship", 543 "Author" and 263 "Organisations" were considered and visualized in Figure 10 and 11.

In co-authorship analysis, authors with at least one document and one citation were considered. It also utilized fractional counting as fractional counting acknowledges that collaboration involves shared credit among multiple authors and aims to provide a more equitable representation of each author's contribution. 18 major

clusters of authors were found (minor clusters were merged) who share the authorship of publications mostly. Better insight about co-authorship can be visualized in Figure 11 where the authors/co-authors organization has been presented.

DISCUSSION

Altmetric analysis provides a measurement of scholars or scholarly content derived from Web 2.0 & social media platforms (Kumar et al., 2016). It is being widely used by researchers for complementing reading by instantly visualising papers. The publishers can use it to showcase the research impact of authors over readers. In the Indian context, which is the home of the second highest number of internet users in the world, with 692 million people using the internet and 32.8 per cent of its population

Figure 7. Co-citation analysis of cited sources (each node represents the journals or books, the line represents links between the sources co-cited, the thickness of the link signifies the strength of the co-occurrence of sources in research publication, colour represents the thematic cluster of co-occurrences)

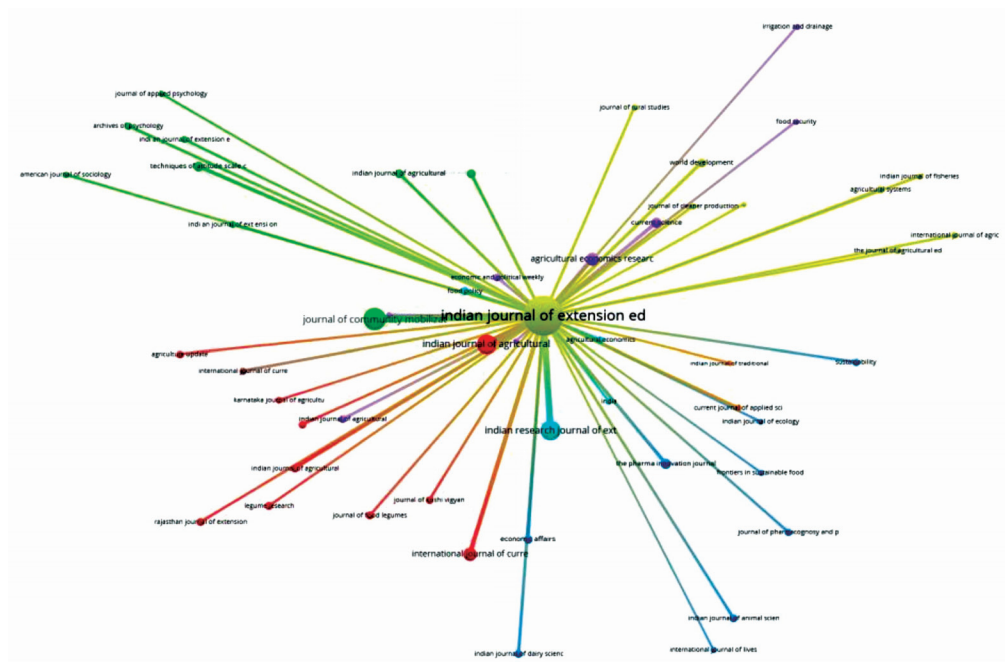
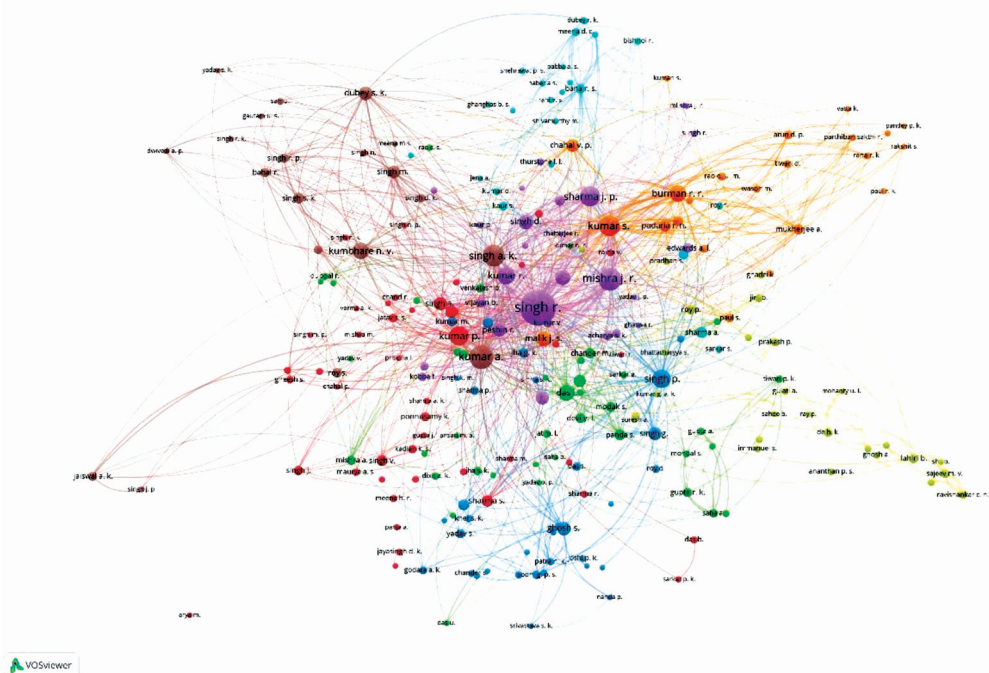


Figure 8. Co-citation analysis of cited authors



are social media users as of January 2023 (<https://www.forbes.com/advisor/in/business/social-media-statistics/>). These emerging non-traditional metrics are acquiring more importance for tracking the online impact or influence of the work. The altmetric analysis score indicates that there is a need for authors' side intervention for especially improving mention (*i.e.*, blog posts, comments, reviews, news media) and social media (*i.e.*, sharing like, comments *etc.*) score by sharing their articles in various social media and researchers' community sites (like Research Gate, Academia Edu) to improve visibility. The open access policy of IJEE is particularly supportive of it.

Bibliometric analysis provides insights into both the intellectual structure and conceptual framework of research. It helps us to understand the progress made on specific topics and aids journal editors in decision-making and evaluations (Zupic & Cater, 2015). In the context of the *IJEE*, which recently started its journey in Scopus, several observations and suggestions can be made based on bibliometric findings. Firstly, the scope of this important national journal on the Agricultural Extension field is diverse enough to accommodate research from diverse social fields having relevance to agricultural education, research and extension. Most of the articles are on topics like “adoption, climate change, scale

Figure 9. Reference Publication Year Spectroscopy (The black line represents the number of cited references per year and the red line represents the deviation from the 5-year median)

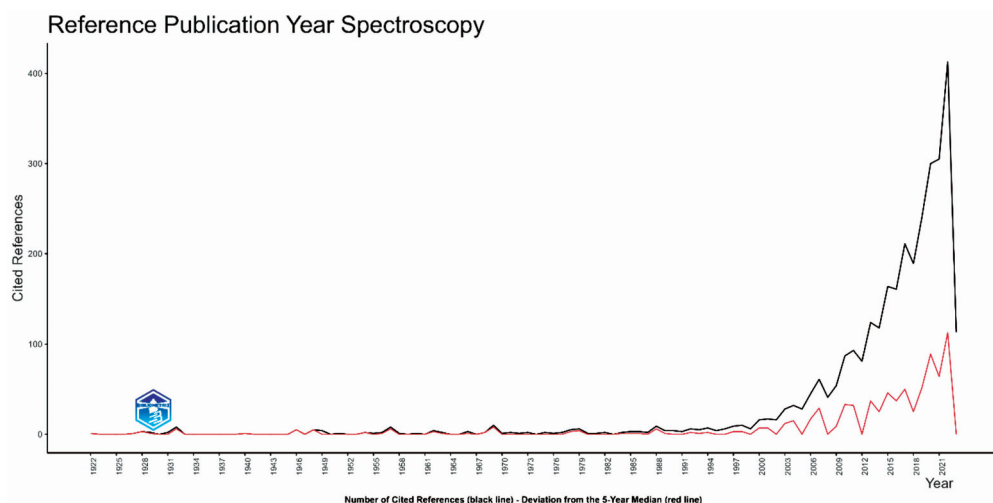


Figure 10. Co-authorship analysis of authors using fractional counting

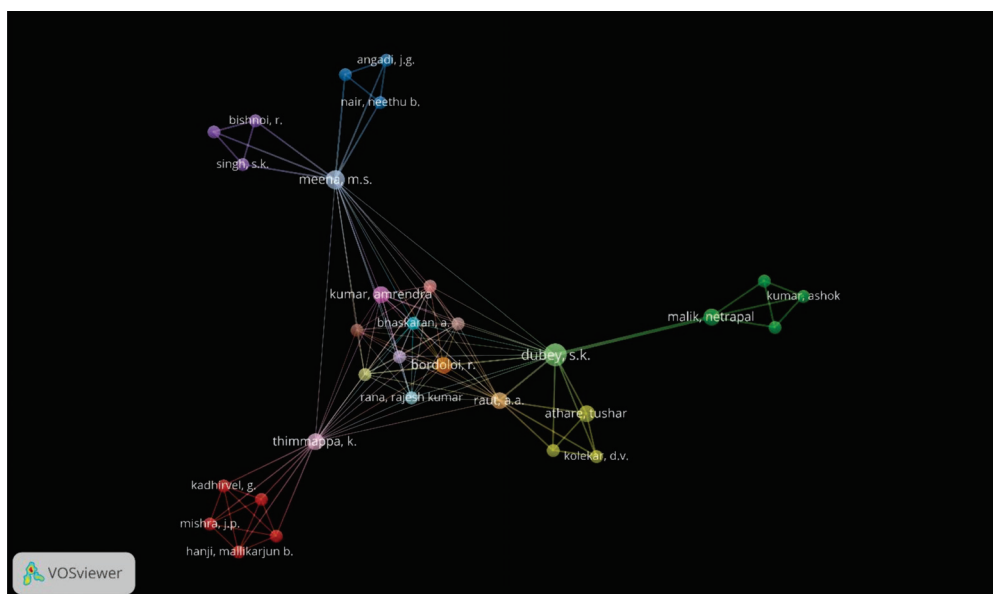
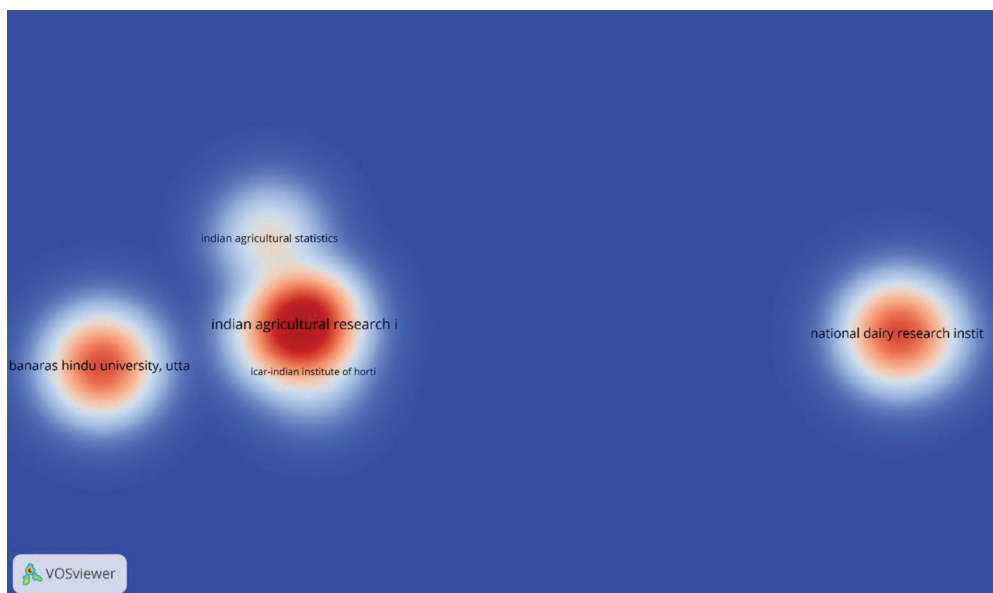


Figure 11. Co-Authorship analysis of organisations using cluster density map



construction, programme evaluation, food security and constraints *etc* based on keyword analysis. Though many of these are classified under highly relevant topics through thematic analysis (MCA), there is a need to conduct research more on emerging topics like entrepreneurship, and information networks, capacity building as identified by the same thematic analysis. In the last 5-10 years agri-entrepreneurship ecosystem in India has gone through major changes with having the world's third-largest start-up ecosystem and also become a focus area for all government initiatives to solve farm distress (Kumar et al., 2022; Kademani et al., 2024). Similarly, in the case of information networks with the ever-increasing penetration of ICT-mediated interactive communication (especially social media), the role of traditional mass media is in decline (Mishra et al., 2021). Also, unlike traditional mass media these new interactive media give opportunities to participants for co-creation and co-learning thus need to be studied independently by the researchers. Although IJEE can't have a say in the research interest of researchers, it can surely mould itself towards ensuring diversification by categorizing its publication content into several broad subject areas and gradually limiting the number of articles in these areas. Ensuring diversity will improve the quality of the journal significantly (Gendron 2008; Balstad et al., 2020). The diversity should not only be limited to topics but also articles' sources. At present top ICAR institutes, central universities and state agricultural universities are the most active contributors to research work in IJEE. Thus, there are vast unexplored potential contributors like more than 80 state agricultural universities, 732 KVKs and a huge number of traditional universities, also researching on extension education or sister fields. Also, the representation of agricultural universities in the North-Eastern and eastern parts of India was found comparatively less. So, a targeted strategy is needed to improve the penetration of this journal in the universities of these less-touched regions. A regular registration drive and inclusion of research scholars from these universities in journal management may improve emotional attachment to the journal. Also, the number of publications from the home science, fisheries and veterinary extension fields needs to be encouraged more to increase discipline-wise diversity. The international researchers' presence in authors list is likely to be inducted with inclusion in Scopus database.

Citation analysis has confirmed the wider disciplinary reach of the authors of the journal but improvement may be achieved in citation count of documents to sustain the growth trajectory the IJEE is presently in. Publishing a limited number of review articles may be contemplated and will improve the journal's impact (cite score in Scopus) score and citation count further. As, review articles tend to get more citations than other articles (Miranda & Garcia-Carpintero, 2018). However, the number of review articles should be limited and should be rigorously screened for quality and knowledge contribution (Aksnes, 2003; Vanclay, 2013). Also, there is a need to improve the diversity of theoretical orientation of authors who are publishing in IJEE beyond scale construction. Interpreting gathered information of research without a theoretical framework is the main reason for the limited use of findings and conclusions (Sarter, 2006). Despite these facts, most researchers begin the research process without a clear reference theoretical

framework (Grant & Osanloo, 2014), though it is another author-side intervention but may be highlighted by IJEE in different discussion forums to sensitize the researchers in the extension field. Lastly, given several (mostly) authors' side suggested interventions which may help this journal to improve upon its current quantitative and qualitative growth rate, it can be said that, as a sole Scopus-indexed journal from the agricultural extension field in India, IJEE has fared well so far as pointed out in the FWCI scores, indicating higher than expected performance. Most of these improvements happened in the last 3-4 years suggesting a positive momentum for IJEE which findings of this research will strengthen further.

CONCLUSION

A comprehensive bibliometric analysis of the IJEE for the year 2023-24 (5 issues), utilizing VOSviewer and R package on data obtained from the Scopus database, offers valuable insights into the landscape of extension education research. The combination of VOSviewer's network visualizations and Bibliometrix's impact and thematic metrics provides a holistic understanding of the journal's impact and relevance. The thematic map reveals the dynamics of research topics, categorizing them based on development and relevance degrees. The analysis also identified several intervention areas, a further improvement in those will enable this only Scopus-indexed journal on Agricultural Extension from Indian origin to provide Extension Researchers with a strong global platform. Thus, the findings not only confirm existing knowledge but also uncover unique situations, providing researchers and stakeholders with valuable perspectives for future exploration and engagement in extension education and related fields.

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