Journal of Scientific Research and Reports

Volume 30, Issue 9, Page 448-456, 2024; Article no.JSRR.122794
ISSN: 2320-0227

Trends and Collaborations in Livestock Extension Research: A Bibliometric Analysis (2015-2024)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/jsrr/2024/v30i92368

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/122794

Original Research Article

Received: 26/06/2024
Accepted: 31/08/2024
Published: 02/09/2024

ABSTRACT

This study employs bibliometric analysis to investigate trends in livestock extension research from January 2015 to June 2024, utilizing data sourced from the dimension.ai database. The analysis encompasses a comprehensive review of publication trends, research categories, influential journals, collaborative networks among authors, and the impact of seminal studies. The findings reveal a notable increase of 51.55 per cent in scholarly interest and publications over the years, indicating growing attention towards enhancing livestock productivity, sustainability, and socio-economic outcomes. Key research domains such as agricultural, veterinary, and food sciences

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Cite as: *Manasa, Keesam, Sidharth S, MD. Saifuddin, K.T. Surya, and B. Srishailam. 2024. "Trends and Collaborations in Livestock Extension Research: A Bibliometric Analysis (2015-2024)". Journal of Scientific Research and Reports 30 (9):448-56. https://doi.org/10.9734/jsrr/2024/v30i92368.*

emerge as predominant areas of focus, with significant contributions observed in interdisciplinary fields like environmental sciences and human geography. Network analyses using tools like VOSviewer highlight robust collaborative relationships among researchers, identifying central figures and clusters that drive collaborative research efforts in livestock extension. The study also identified “Climate change vulnerability, adaptation and risk perceptions at farm level in Punjab, Pakistan” published in 2016, with nearly 294 citations as top-cited article and other affiliations, emphasizing their pivotal roles in advancing knowledge and practices within the field. Overall, this bibliometric analysis provides valuable insights into the evolving landscape of livestock extension research, demonstrating how such analytical approaches contribute to understanding research trends, fostering interdisciplinary collaborations, and guiding future research directions in agricultural sciences.

Keywords: Livestock extension; bibliometric analysis; research trends.

1. INTRODUCTION

Livestock sector being an important allied sector of agriculture, has an immense capacity to narrow down economic disparities among farmers apart from its contribution to food and nutritional security [1]. India's livestock sector, despite globally being the largest one, faces significant challenges. Low productivity, especially in milk yield, combined with high economic losses from preventable diseases, hinders growth [2]. Inadequate infrastructure, insufficient veterinary services, and poor adoption of advanced technologies further exacerbate the problem [3]. Severe feed and fodder shortages, along with underdeveloped and informal markets, limit commercialization [4,5]. Additionally, several factors like degradation of common grazing lands, raising competition between man and animals for land, frequent occurrence of diseases, climate change, poor livestock extension were found to be straining livestock production [6]. Numerous efforts are being made to generate and disseminate improved technologies to livestock farmers to increase the productivity and ensure food security at both household and national levels [7]. This responsibility is being taken up by Livestock extension which plays the role of dissemination of knowledge, technologies, and practices to farmers, aiming to improve their skills, productivity, and livelihoods. The term Extension is defined as an out of school education and services for the members of the farm family and others directly or indirectly engaged in farm production to enable them to adopt improved practices in production, management, conservation and marketing [8]. Livestock extension entails structured and methodical communication with livestock owners, aiming to assist them in gaining the knowledge and skills required to boost their production by lowering production costs. Despite of heavy investments in development of innovations and technologies from public and private sources, most of the research results and recommended technologies couldn’t make their way to the farmers’ fields [9].

Over the years though significant efforts have been made to study and improve livestock extension methods, systematic analysis of the research trends in this field which is essential to understand its evolution, identify gaps, and direct future research efforts effectively was clearly neglected. Bibliometric analysis which is a rapidly expanding branch is an invaluable tool under this context to analyse and represent quantitative aspects of published scientific outputs in order to reveal how disciplines are conceptually and socially structured [10]. It can assist in evaluating the contributions of individual scientists, groups, countries or journals to the advancement of knowledge [11]. It further involves the quantitative analysis of academic literature to uncover patterns, trends, and insights within a specific research domain [12]. By examining various bibliometric indicators such as publication counts, citation analysis, keyword co-occurrence, and author collaborations, researchers can gain a comprehensive understanding of the research landscape [13]. This approach helps in identifying the most influential publications, prolific authors, key research themes, and emerging areas of interest. In the context of Livestock extension research in India, bibliometric analysis can provide critical insights into how the field has evolved over the past decade. It can highlight the growth in research output, the leading journals and institutions contributing to the field, and the most commonly addressed topics. Furthermore, it can identify research gaps by revealing underexplored areas or themes that require more

attention. Understanding these gaps is essential for guiding future research directions, ensuring that efforts are aligned with the needs of farmers and the agricultural sector at large. This study utilizes bibliometric methods to analyse the livestock extension research from January 2015 to June 2024. Dimensions.ai database was used to obtain the dataset. Dimensions, a subsidiary of Digital Science, (or Digital Science & Research Solutions Ltd) is a research grant database that connects grants to publications, clinical trials, and patents [14]. Network analysis tools such as VOSviewer were employed to map out the collaborative relationships among researchers, identifying key figures and clusters that drive collaborative research efforts in livestock extension. By examining the number of publications by year, author linkages, research domains, leading journals, and commonly used keywords, this analysis aims to provide a comprehensive overview of the current state of research in this field.

2. MATERIALS AND METHODS

The aim of our study was to bring this diverse literature together and present a bibliometric analysis of the field of livestock extension research science as a whole. We tried to provide metrics that track the progress of the field, along with the contributions of the most influential individuals, organizations, and countries to date, while also offering an analysis of emerging trends. Publication data were collected from the dimension.ai database. The database was chosen for the reasons that it provides a large corpus of more than 90 million publications and more than 4 billion references, offers a complete API to perform queries using their own DSL (Domain Specific Language) query language and most importantly it is freely available for academic purposes. Year range from January 2015 and June 2024 was preferred. Search was carried out by utilizing source title such as “Livestock Extension” search feature of the database. The number of publications by year, the network analysis between author linkage, research domain, articles from leading journals with high citations, and commonly used keywords was all used to evaluate articles. The data were analysed using MS Excel, Word Cloud generator, and VOSviewer. Keywords were searched in the title, abstract, and keywords. Papers were first evaluated for eligibility for inclusion as titles, and abstracts and full texts were also reviewed in case of ambiguity. Articles with their primary focus on agricultural extension or those related to agricultural extension in India are included. Studies published only in English are included. The analysis included 720 articles discovered through a systematic search on Livestock Extension Research.

3. RESULTS AND DISCUSSION

3.1 Distribution of Livestock Extension Research Publications by Year

Fig. 1 displays the distribution of year-wise Publications from January 2015 to December 2024. The data shows that a total of 720 articles were found in the Dimensions AI database during the mentioned period. In the year 2015, less than 50 were published in the database, whereas, in 2023 nearly 100 articles were published which depicts a substantial increase from 2015.

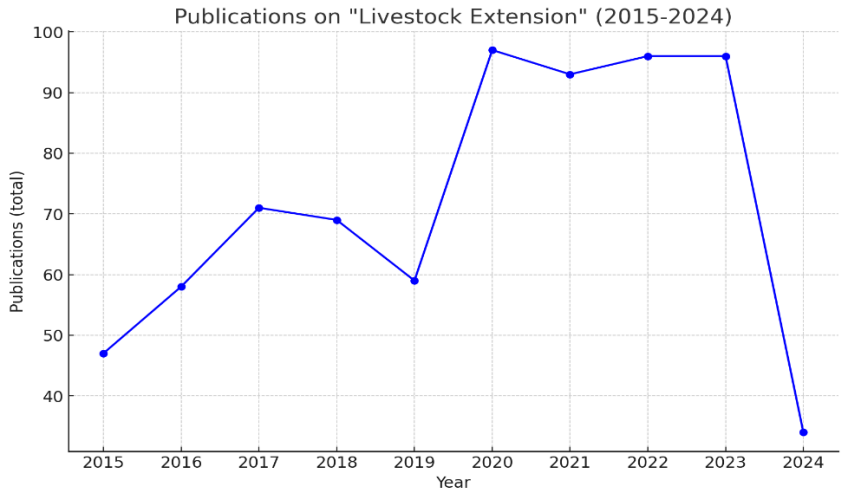

Fig. 1. Year-wise distribution of livestock extension research publications in India, 2015–2024

From 2015 to 2023, there is a clear upward trend in the number of publications on Livestock Extension indicating growing research interest and activity in this area. Notable increases are seen, particularly from 2019 to 2020, where publications jumped from 59 to 97, suggesting heightened focus or increased funding during that period. From 2020 to 2023, the publication count remains relatively high and stable indicating sustained interest and productivity. The count for 2024 is currently 34, reflecting only part of the year's data.

3.2 Distribution of Livestock Extension Research Publications by Research Category

The data from Fig. 2 shows the distribution of research publications across various categories, with a total of 892 publications. It further reveals that the "Agricultural, Veterinary and Food Sciences" field dominates the research output, with 352 publications, accounting for nearly 40% of the total. This indicates a strong focus on agricultural and food sciences, reflecting their importance in research efforts. The second-largest category, with 222 publications was Human society, making up almost 25% of the total. This suggests significant research interest in social sciences, possibly related to societal impacts, development studies, or sociocultural issues. Next in the line was Environmental sciences category with 76 publications, which represents about 8.5% of the research output, highlighting a moderate focus on environmental issues, which may include sustainability, conservation, and climate change studies followed by biological sciences with 64 publications accounting only 7 per cent of the total. Further, biomedical and clinical sciences, Economics, Health sciences, Commerce, Management, and Tourism had 45, 39, 38, 19 publications respectively. Moving on Eart sciences contributed to a minor share of 1.79 per cent with 16 publications followed by Information and computing sciences with 14 publications (1.6%). The smallest category was education with just 7 publications, representing less than 1% of the total which suggests that education-related research is a very minor focus within the broader research landscape. Overall, the data indicates that the bulk of research efforts are concentrated in Agricultural, Veterinary, and Food Sciences, followed by Human Society studies. The remaining categories, while varied, show much smaller contributions to the overall research output.

3.3 Top 10 Journals on Livestock Extension Research

Analysing the bibliometric data for various journals reveals interesting patterns in research publication and impact within the field of "Livestock Extension." The "Tropical Animal Health and Production" journal leads with the highest number of publications (25), accumulating 221 citations with an average of 8.84 citations per publication, indicating consistent contributions to the field. "PLOS ONE" stands out for its high average citations per publication (19.88) despite having 17 publications, suggesting highly influential articles. Similarly, the "Journal of Rural Studies" has fewer publications (7) but achieves the highest citations mean (20.86), indicating significant impact per article. "African Journal of Agricultural Research" and "Sustainability" both have 13 publications with average citations of 11.23 and 11.46 respectively, demonstrating their relevance and impact. In contrast, journals like "IOP Conference Series Earth and Environmental Science" and "Journal of Animal Science" show lower average citations (1.08 and 0.71), which may indicate more niche or emerging areas of research with less immediate impact. This analysis highlights the diverse landscape of journals contributing to "Livestock Extension" research, with varying degrees of influence and specialization.

3.4 Network Analysis Based on Co-Authorship

The network visualization from VOSviewer highlights significant collaborative relationships among researchers in the field of "Livestock Extension." Distinct clusters, represented by different colours, show groups of authors who frequently collaborate. Central figures, such as Helena Aminiel Ngowi and Maria Vang Johansen, are marked by larger nodes and numerous connections, indicating their substantial influence and productivity. Authors like Blandina Theophil Mmbaga and Sarah Cleaveland form a strong collaborative network within their cluster. Additionally, some authors, like Davis Alicia L., serve as bridges between different clusters, fostering inter-group collaborations.

3.5 Network Analysis Based on Citations

The network visualization from VOS viewer showcases the collaborative relationships among researchers in "Livestock Extension." Various

coloured clusters highlight different groups of researchers who frequently collaborate. For instance, the blue cluster, including prominent figures like Sarah Cleaveland and Blandina Theophil Mmbaga, signifies a strong collaboration network. The red cluster, with key researchers like Helena Aminiel Ngowi and Calvin Sindato, indicates another significant collaboration hub. Central nodes such as Hezron Emmanuel Nonga and Alicia L. Davis, who connect multiple clusters, underscore their pivotal role in facilitating interdisciplinary collaborations. The image also reveals smaller yet active clusters, like the purple group led by Cleto Mapiye and Tawanda Marandure, reflecting specific niche collaborations. This visualization emphasizes the intricate web of interactions and the central roles played by certain researchers in advancing the field through extensive collaboration.

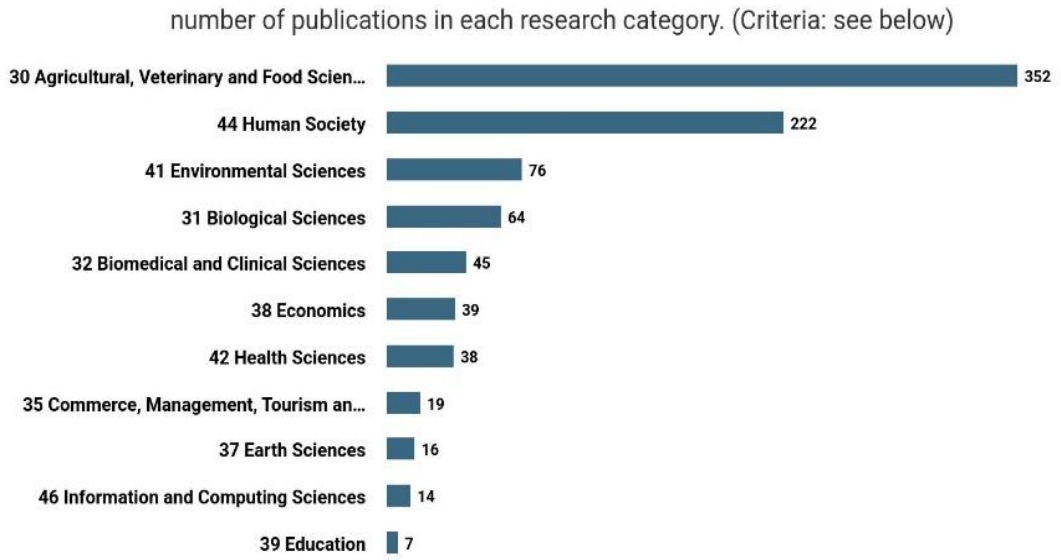

Fig. 2. Subject-wise distribution of livestock extension research publications, 2015–2024

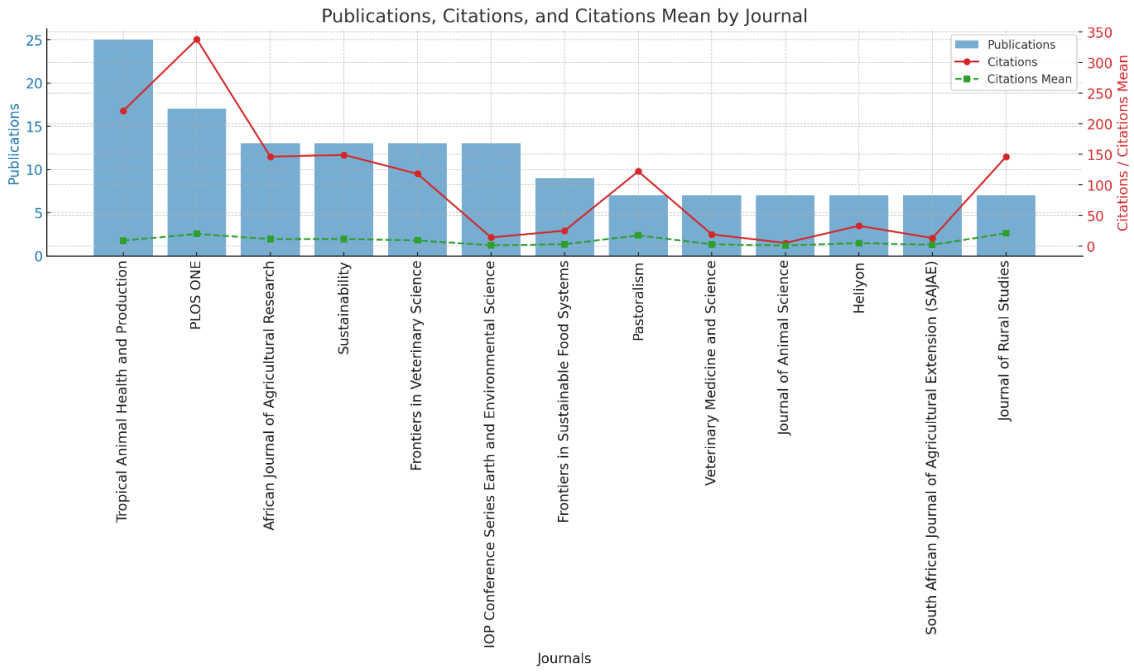

Fig. 3. Top journals on livestock extension with their total citations

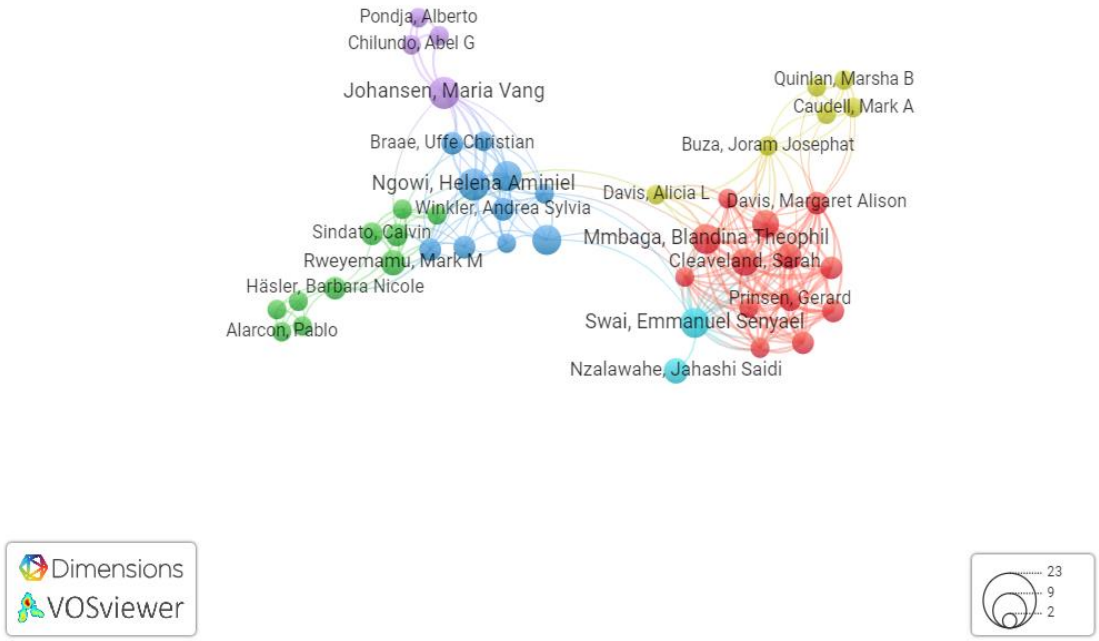

Fig. 4. Network linkage between authors based on Co-authorship

**The networks between the two bubbles represent their co-occurrence of authors and the size of the bubble relates to the number of times that author has appeared in all the publications*

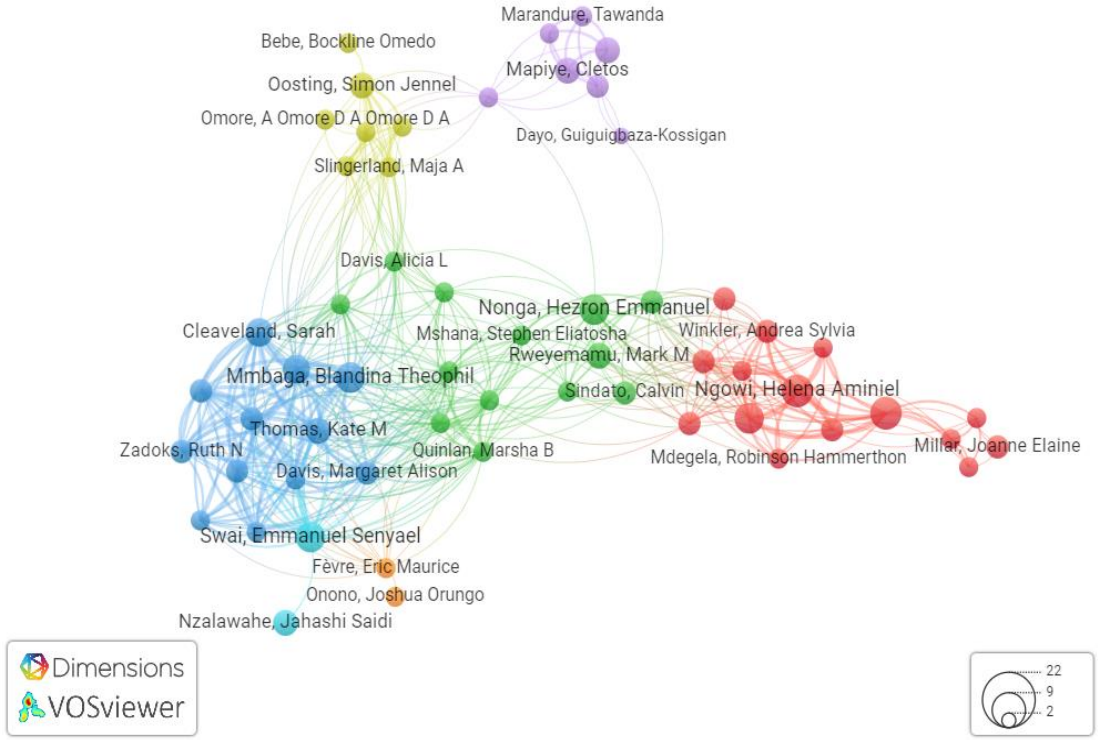

Fig. 5. Network linkage between authors based on citations

3.6 Top 10 livestock Extension Publications in Terms of Total Citations

Fig. 6 interprets the top 10 articles in livestock extension based on the citations. The article entitled “Climate change vulnerability, adaptation and risk perceptions at farm level in Punjab, Pakistan” published in 2016, had nearly 294 citations closely followed by another article “Spatial variations of household food insecurity in East Gojjam Zone, Amhara Region, Ethiopia: implications for agroecosystem-based interventions” authored by Belay et al (2017) with 280 citations. Moderately cited documents among the list were authored by Wong J (2017) with 182 citations and Tibesigwa B (2016) with 105 citations. It is clear that the documents related to environmental science, agriculture, and food security were highly cited, reflecting significant global interest and influence in these fields. The higher citation counts indicate these documents have had a substantial impact on research in their respective areas.

3.7 Top 10 Most Relevant Affiliations in India in Terms of Total Citations

The chart highlights the most relevant affiliations based on the number of articles published, with the Indian Council of Agricultural Research (ICAR) leading with 13 articles, followed by the Indian Agricultural Research Institute (IARI) with 12 articles. The Central Agricultural University contributed 10 articles, while Kerala Agricultural University and the International Food Policy Research Institute published 7 and 6 articles respectively. The International Maize and Wheat Improvement Center and Tamil Nadu Agricultural University each contributed 5 articles, and Central Research Institute for Dryland Agriculture along with the Indian Council for Research on

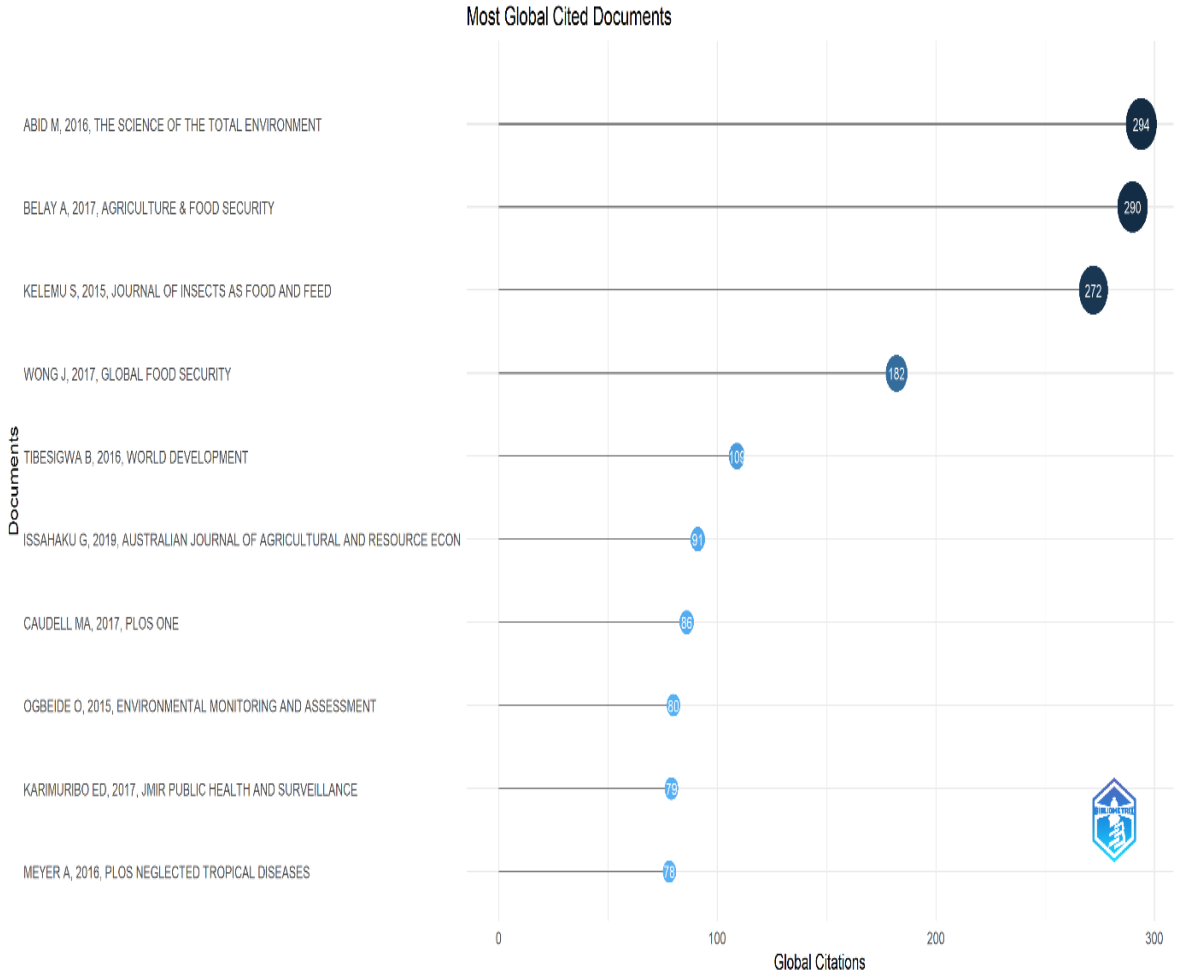

Fig. 6. Top 10 articles on livestock extension with their total citations

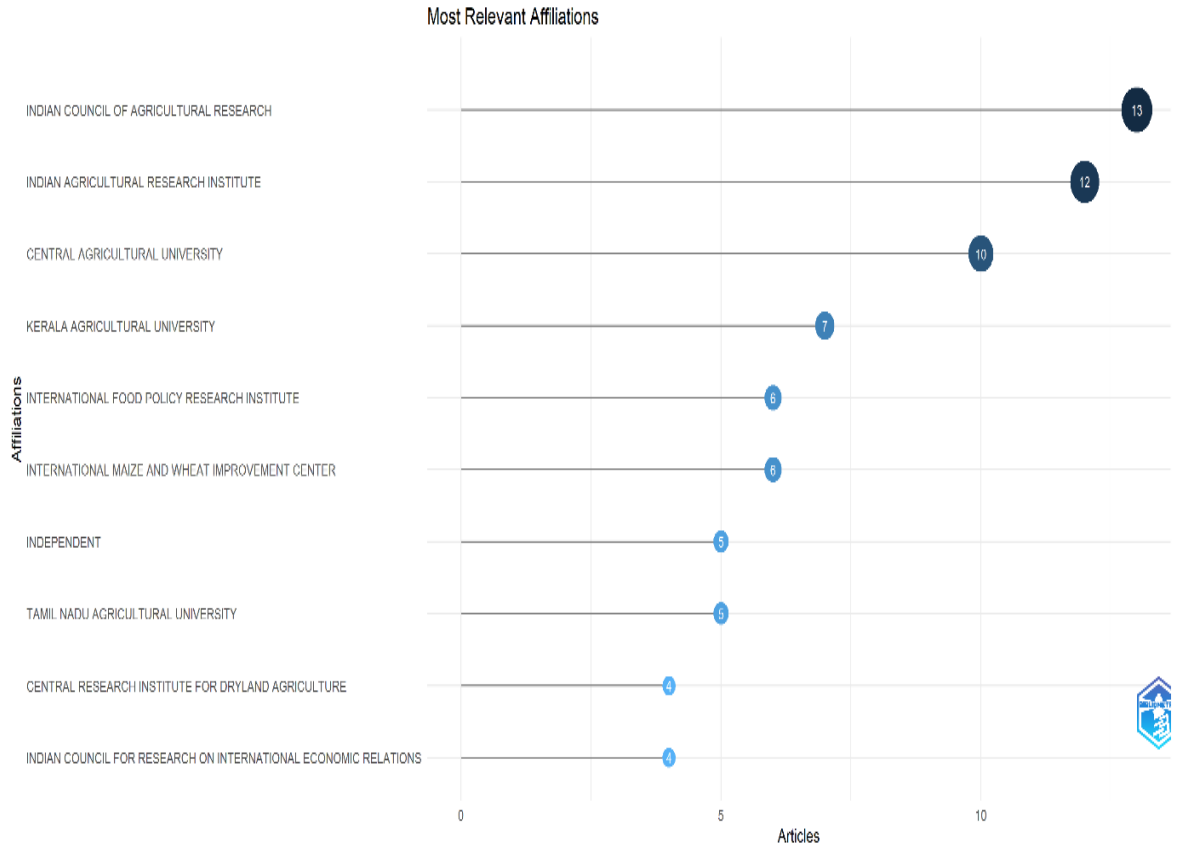

Fig. 7. Top 10 most affiliated organisations in India in livestock extension research with their total citations

International Economic Relations contributed 1 article each. Additionally, independent researchers accounted for 8 articles, indicating a significant input from unaffiliated individuals.

4. CONCLUSION

In conclusion, this bibliometric analysis provides a comprehensive overview of livestock extension research from 2015 to mid-2024, revealing significant insights into its evolution, impact, and collaborative dynamics. The study identified a robust increase in research output over the years, underscoring heightened scholarly interest and contributions towards improving livestock productivity and sustainability. Key findings highlight the dominance of agricultural, veterinary, and food sciences as primary research domains, with notable impacts observed in interdisciplinary fields like environmental sciences and human geography. The analysis of top journals and highly cited articles underscores the diverse avenues of research within livestock extension, emphasizing both the breadth and depth of contributions from various scholarly publications. Network analyses depicted vibrant collaborative networks among researchers, illustrating the pivotal roles of influential authors and institutions in fostering interdisciplinary research and knowledge dissemination. Moving forward, continued emphasis on collaborative research efforts and interdisciplinary approaches will be crucial in addressing complex challenges and leveraging emerging opportunities in livestock extension. By fostering partnerships across disciplines and institutions, researchers can further advance sustainable practices, policy frameworks, and innovations that benefit livestock farmers and contribute to agricultural resilience in India and beyond. This study not only informs future research directions but also reinforces the importance of strategic collaborations and knowledge-sharing in advancing livestock extension practices and achieving sustainable agricultural development goals. Lastly to mention, like every other study, this study also has its own limitations which implies selection of dimension. ai database over others which suffers from coverage bias, temporal limitations like

delay in indexing, limited metadata, dependence on external data sources etc., Also the study fails to use advanced indicators of bibliometric analysis which can be explored in future bibliometric livestock extension researches.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/122794