



Modernisation and Technological Adoption in Dairy Sector for Achieving Sustainable Development Goals: A Case Study on Indian Dairy Sector

Chandra Kr. Tiwari¹, Rachna Singh², Sakshi Shukla¹, Anand Kr. Chaturvedi³

10.18805/ajdfr.DR-2333

ABSTRACT

Background: India is undeniably the world's largest milk producer, commanding a market value of \$893 million (Sarkar and Gupta, 2024). With a staggering production of 239.3 million metric tons and a per capita availability of 471 grams per day (Annual Report, MoFAHD, DAHD 2024), the country has immense potential in the dairy sector. However, it is critical to address the significant challenges posed in the post-COVID era, including surging domestic consumption, an overreliance on traditional practices and a sluggish pace of digitalization.

Methods: The research aims to stress the need and impact of technology and modernisation in the dairy supply chain by reviewing published and unpublished articles through bibliometrics analysis.

Result: Indian dairy has a significant gap in maintaining an organised sector in terms of authentication and certification. Also, the perishable goods of dairy need extensive care in handling and processing, which requires adaptation of artificial intelligence and IoT-enabled systems. It would certainly enhance the shelf life, productivity and quality standards. Therefore, it can be concluded that the research would significantly impact the dairy market and aid agribusiness enormously in subsuming production, supply chain, waste management, quality control, animal husbandry, lifespan enhancement and SDG-12 attainment.

Key words: Artificial intelligence, COVID-19, Digitalisation, IOT, SDG-12.

INTRODUCTION

Clasping technological advancement is a necessity of the modern era, specifically in Indian dairy. Researches are advancing towards 'dairy 4.0' and showcasing the optimisation of robotics, 3D printing, Artificial Intelligence, the Internet of Things, Big Data, blockchain in the milk industry (Abdo Hassoun *et al.*, 2023). Although, irrespective of the utility, dairy stakeholders still rely on the conventional processes in production and management. A reason behind the resistant approach is fear of challenges and change, as innovation adheres to adaptation. The closer the dairy sector moves towards digitalisation, the harder it becomes to adapt, precisely, the unorganised sector, which accounts for nearly 62% of the established market. Where it must be noted that the unorganised sector is subsumed with ill-managed livestock, minimally skilled labours and unpaid aiders. This extends concern towards livestock management and sustainable production, along with the operations of the supply chain. Researchers have tried to address the mentioned issue by critically reviewing the present adaptation of digitalization in dairy with the help of precision livestock farming (PLF) technologies, that uses biosensors and data monitoring in livestock management (Neethirajan, 2023). The outcome of PLF technologies was positive, but the resistance towards its exploration turns out to be negative regarding the entire dairy industry. Even developed countries find it difficult to catch up with the pace of digital clock in the dairy sector, which makes 'advance technology' an unexplored realm in the dairy sector. To

¹Department of Management Studies, Harcourt Butler Technical University, Kanpur-208 002, Uttar Pradesh, India.

²Department of Management Studies, Rajasthan Technical University, Kota-324 010, Rajasthan, India.

³Department of Mechanical Engineering, Rajasthan Technical University, Kota-324 010, Rajasthan India.

Corresponding Author: Rachna Singh, Department of Management Studies, Rajasthan Technical University, Kota-324 010, Rajasthan, India. Email: rachnachannelpr840@gmail.com ORCID: 0000-0002-4724-8199; 0000-0003-2406-2487; 0000-0001-7643-0654.

How to cite this article: Tiwari, C.K., Singh, R., Shukla, S. and Chaturvedi, A.K. (2025). Modernisation and Technological Adoption in Dairy Sector for Achieving Sustainable Development Goals: A Case Study on Indian Dairy Sector. *Asian Journal of Dairy and Food Research*. 1-10. doi: 10.18805/ajdfr.DR-2333.

Submitted: 31-03-2025 **Accepted:** 05-08-2025 **Online:** 06-10-2025

counter the same, the following study focuses on a bibliometrics approach, that includes in-depth analysis of present literature with the statistical tool, 'Biblioshiny'. Sincere attempts have been made to highlight the contemporary functionality in dairy segment, concerning mechanisation and digitalization. By analysing the modernisation and technological adoption in dairy, present study magnifies its utility in encapsulating the Sustainable Development Goals. The various SDGs that could be achieved with the help of digital transformation are 'Zero

Hunger', 'Good Health and Well-being', 'Responsible Consumption and Production' and 'Sustainable Consumption'. However, the proportional relation of digital advancement and sustainable development is potentially unfathomable and the entire analysis endeavours the aforementioned.

Literature review

Agriculture-based industries are significant within the Indian business environment, with many skilled and semi-skilled workers engaged in dairy and agriculture. Integrating conventional skills with high-efficiency tools and machinery can yield substantial benefits. Literature suggests a positive response to this integration, particularly through technologies like blockchain, smart farming and big data analysis. Farmers are keen on big data for better decision-making, though there are challenges with data security, especially among semi-skilled workers (Newton *et al.*, 2020). The Indian dairy sector has seen improved outcomes through the ISM-MICMAC approach, linking technology to enhance cattle production, herd management and efficient technology use (Kaushik and Rajwanshi, 2023).

The use of bio-sensing tools for real-time monitoring of livestock health is crucial, supported by government initiatives such as the national agricultural innovative project (NAIP), dairy entrepreneurship development scheme (DEDS) and Rashtriya gokul mission (RGM), which focus on technological advancement and social welfare in the dairy industry. Digitalization is essential not only for economic reasons but also for addressing broader social issues, as over 150 million households are involved in global dairy production.

Furthermore, digitalization in the food industry can help counter challenges like epidemics, war and economic instability. Researchers aim to transition the dairy sector to Industry 4.0, despite concerns about perishability and fraud (Malik *et al.*, 2024). Technologies such as IoT and blockchain are vital for reducing fraud and managing supply chains effectively (Kumar *et al.*, 2022; Himu *et al.*, 2024). Overall, the push for digital transformation in Indian dairy is crucial for modernizing the sector and addressing ongoing challenge.

In India, there is a strong emphasis on strengthening the supply chain through milk cooperatives by incorporating smallholder farmers into state milk federations. In addition to focusing on supply chain coordination and utilising technology at milk unions and logistics, the Dairy Development Board has recently initiated basic e-consultancy and services for farmers through technology (Chaturvedi, *et al.*, 2024).

Research indicates that encouraging the growth of organised dairy farms can help meet the anticipated future increase in demand for milk products both domestically and internationally.

In contrast to Asian countries, the Western world has well-established dairy farms that utilise technology in logistics and supply chain processes to deliver products from farms to consumers. The Indian dairy structure

comprises milk cooperatives, unorganised local suppliers and self-consumption. This reliance limits the adoption of farm technologies, hinders expansion and restricts financial recognition for the organised sector's contribution to GDP (Kaur and Toor, 2024).

The evolution of dairy farming is a testament to the remarkable progress from Industry 1.0 to Industry 4.0. Dairy 1.0 marked the beginning of this journey with fundamental mechanization, where reliance on manual labor was still prevalent. Mechanical milking machines and basic refrigeration systems set the stage for future growth, yet many traditional farming practices remained entrenched.

With the transition to Dairy 4.0, the landscape has transformed dramatically by integrating cutting-edge digital technologies like robotics, 3D printing, big data, IoT, AI and blockchain. These advancements have revolutionized the industry, driving significant sustainability, efficiency and productivity improvements. Automated milking systems enhance operational efficiency, reduce labor demands and minimize animal stress.

Moreover, 3D printing and big data have streamlined the production of machinery and enhanced farm management practices, while AI empowers farmers with predictive decision-making capabilities. Blockchain technology is a game changer for milk traceability, boosting customer trust and ensuring food safety. The healthcare approach in dairy farming has evolved, too, focusing on proactive disease management supported by IoT and AI (Sangode, 2025).

This research aims to explore the various literature available in this field. It also provides insights into future areas of study and trend analysis for researchers. To achieve these objectives, based on a review of existing literature on the theme of Artificial Intelligence, the following goals have been established:

1. To review the most cited authors and which are the most cited articles.
2. To identify countries that have contributed the most to this area of research.
3. To identify the trending topics over the period of years.
4. To examine the themes that are widely studied among academics.

MATERIALS AND METHODS

The secondary based database was collected from the digital library of Harcourt Butler Technical University Kanpur (U.P.), in between the time period of July 2024 to October 2024.

Over the past two decades, Scopus has emerged as a leading database for abstracts and citations, providing quantitative analyses of academic literature. The field of bibliometrics analysis has been enhanced through various tools, including citation counts, keyword analysis, co-citation counts, co-occurrence measures and bibliographic coupling (Lwesya and Achanta, 2022). This paper aims to develop techniques for extracting data from both published

and unpublished articles using VOSviewer for visualisation and Biblioshiny applications. Researchers prefer these applications because they offer a secure web interface for data importing, conversion, gathering and filtering from sources like Scopus. The primary focus is on identifying research papers related to the keyword phrase “Artificial Intelligence” within the multidisciplinary databases of Scopus.

The systematic literature review (SLR) involves three main steps: Data collection (which includes data loading and conversion), analysis and the development of descriptive and network matrices (co-citation, collaboration and co-occurrence). The final step is visualisation, which enables the creation of result maps. Relevant articles cited in the SLR contribute to a bibliometrics overview. Co-citation is defined as the occurrence of two documents being cited together by other documents (Small, 1973). The greater the number of co-citations that two documents receive, the stronger their co-citation relationship, indicating a higher likelihood of semantic connection. In this context, counting the frequency of keyword appearances allows for the analysis of research hotspots within disciplines (Huai and Chai, 2016). Co-authorship is a common practice in academia; thus, papers with multiple authors serve as indicators of collaborative activity within a field (Wagner and Leydesdorff, 2005). Table 1 shows the bibliometrix information of database.

Synthesis and analysis

The purpose of this paper is to conduct a descriptive and quantitative analysis of the role of Artificial Intelligence in dairy farming over the past twenty years, specifically from 2000 to 2020. Scopus, a citation and abstract platform established in 2004 and owned by Elsevier, has compiled an extensive collection of bibliographic databases, citations and references related to scientific publications across various fields, including science, technology, humanities and social sciences. Subsequently, each of the aforementioned categories are thoroughly analysed using the following elements (1) The document type, (2) Author impact analysis

(3) Citation analysis (4) Trend analysis, (5) Word frequency over period of time (6) Word cloud (7) Co-occurrence and (8) Thematic analysis.

Fig 1 shows author local impact by H-index and Fig 2 shows most cited authors in documents using vosviewer.

Author impact analysis

Refer to Fig 1, among the thirty authors in the database, the top ten authors who contributed the most to research on AI and modernisation in dairy farming have been identified. The complete publications of the three most

Table 1: Detailed bibliometrix information of database.

Description	Results
Main information about data	
Timespan	2016:2025
Sources (Journals, Books, etc.)	28
Documents	30
Annual growth rate %	22.03
Document average age	2.47
Average citations per doc	5.3
References	1453
Document contents	
Keywords Plus (ID)	442
Author's keywords (DE)	167
Authors	
Authors	108
Authors of single-authored docs	4
Authors collaboration	
Single-authored docs	4
Co-authors per doc	3.8
International co-authorships %	30
Document types	
Article	18
Book chapter	3
Conference paper	3
Note	1
Review	5

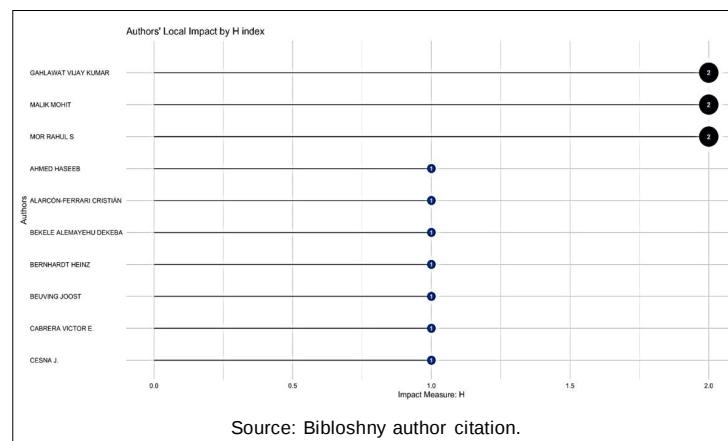


Fig 1: Author local impact by H-index.

productive authors during this period are from India, the United Kingdom and Italy. Researchers previously observed significant contributors who collaborated on multiple documents to identify the shared objectives of their partnerships. This approach is the most common method of investigating academic relationships in systematic research. The study was also conducted with the assistance of Biblioshiny. It was found that there are several strong co-author associations, with some pairs having collaborated on four publications together see in Fig 3 Cited Analysis for most cited countries.

Citation analysis

The term “citation,” also known as a bibliographic reference, refers to a formal acknowledgment of sources in research. Citation analysis is the study of how these references appear in bibliographies, lists or catalogs, particularly from sources outside the original context. This analysis is a commonly used bibliometric method that involves constructing citation graphs and networks, allowing researchers to explore the impact within their academic fields. Citations serve as a primary link between two documents: the one being cited and the one doing the

citing. They represent a unique relationship between the cited and citing papers, establishing a connection between authors whose work can be measured through literature. In citation analysis, the commonalities among associations are based on subject areas, methodologies used and research domains. The main reasons for citing documents include acknowledging previous work and providing critical commentary on it. In this paper explains the most cited top ten countries in publishing articles on artificial intelligence in dairy farming. The top most is Australia with forty five citations in this domain (Fig 3).

Trend analysis

The trend analysis is illustrated in Fig 4, which shows the distribution of publication years from 2022 to 2024. The analysis highlights that topics related to “Artificial Intelligence” are expected to have the highest frequency in 2024. Other topics covered in the literature include milk production, machine learning, dairy farming and agriculture related to these domains. The shift towards incorporating Artificial Intelligence (AI) in various operational and supply chain activities within the dairy farming sector presents both new opportunities and challenges. Additionally, AI-

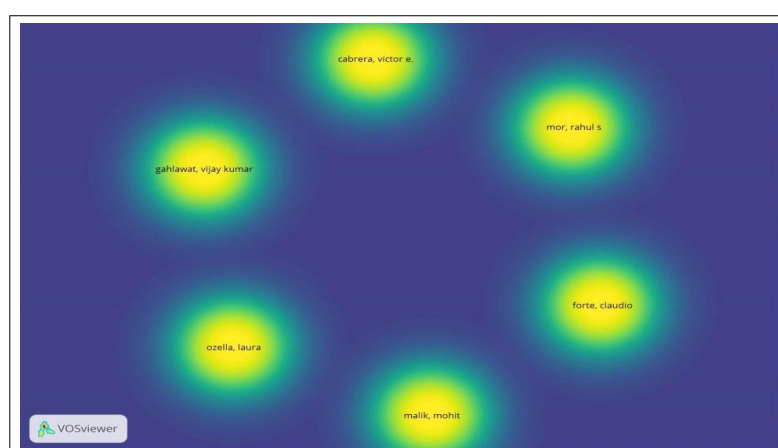


Fig 2: Most cited authors in documents using vosviewer.

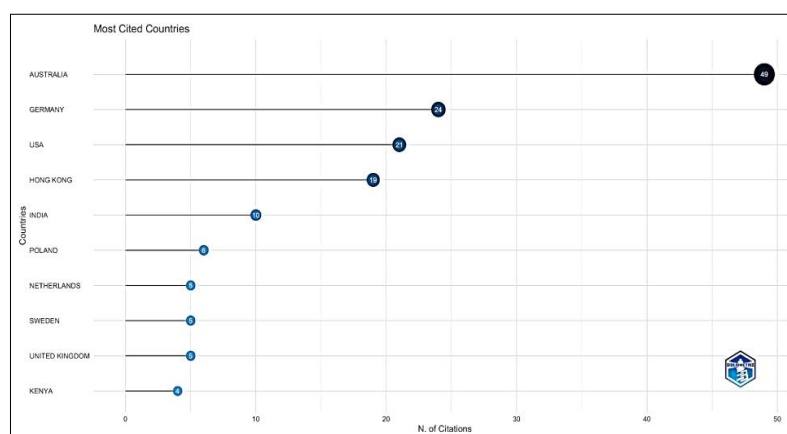


Fig 3: Cited analysis for most cited countries.

enabled technology is proving to be an effective solution for avoiding disruptions in the supply chain and minimising risks. It generates positive outcomes, leading to the development of more solutions for logistics and supply chain issues. It is evident that digital dairy farming practices will continue to evolve and grow over time (Fig 4).

Thematic analysis

A thematic map is organised into four quadrants, divided along the x and y axes, which represent centrality and density, respectively. Co-occurrence network clusters are visually represented as bubbles on a graph. This innovative visualisation technique is based on Callon's centrality and density rankings. Each bubble varies in size, reflecting the frequency of word occurrences within its cluster, which provides valuable insights into the prominence of specific themes in the research landscape. Each quadrant illustrates a different type of theme. The first quadrant focuses on niche themes related to animal husbandry and animal production, emphasising their relevance in terms of centrality. The second quadrant highlights main themes such as decision-making and future food supply, which are significant regarding development density. This quadrant includes prominent themes like artificial

intelligence and milk production. The third quadrant identifies emerging and decoding themes, featuring subjects like dairies and the adoption of digital technology. Lastly, the fourth quadrant presents foundational themes associated with modernisation and human health. Both the first and third quadrants share common themes, such as dairying, dairy cows and milking machines, which have a notable degree of centrality. In contrast, artificial intelligence and milk production exhibit a low development degree yet possess a high degree of centrality (Fig 5).

Tree map analysis

The TreeMap below (Fig 6) illustrates the combination of potential keywords related to Artificial Intelligence and modernisation in dairy farming. This milk production and agriculture theme is also prominent to address the issue of the article.

Word frequency

Word frequency is the intensity that author keywords refer to a selection of terms selected by authors to represent the relevant content of their articles. The frequency of the keywords is a valuable tool for researchers, search engines and indexers to discover relevant studies. The five most

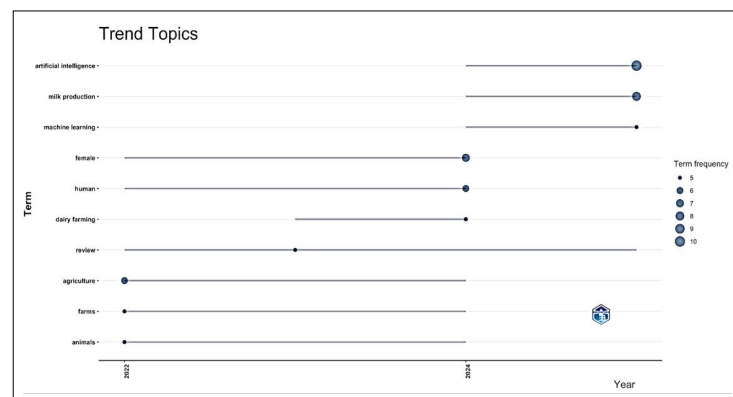


Fig 4: Trends analysis on topic vice of database.

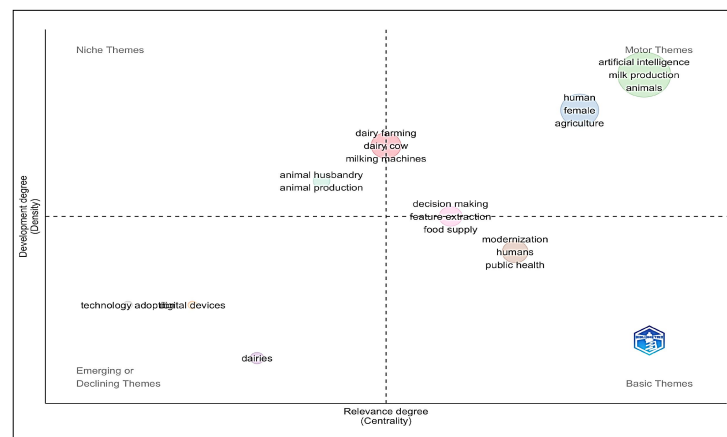


Fig 5: Thematic map representing the development and relevance of theme.

commonly used author keywords in this field are Artificial Intelligence, Agriculture, dairy farming and machine learning (as illustrated in Fig 7). Artificial Intelligence, an emerging concept, gained importance in the database in 2000 and has since risen to prominence as the most frequently used keyword in a database spanning from 1956 to 2024. Furthermore, while Digitalisation was recognised as an important keyword in the past, its significance has notably increased since 2015, Fig 7 shows word frequency over time (Source: Authors elucidation using biblioshiny and Fig 8 shows occurrence of most cited words).

Word cloud

The most frequently visualised keywords, presented in Fig 9, were generated using the Biblioshiny application interface in R-studio. This application extracts specific keywords based on the co-occurrence of author keywords, helping to identify the most significant and influential keywords based on their popularity. The top 20 keywords, which are strongly linked and high-impact, are more likely to be cited by future researchers compared to less-cited keywords. Important keywords such

as “Artificial Intelligence,” “milk production,” and “Agriculture” should be explored alongside “modernisation,” “female animals” and “dairy farming” to uncover new insights and relationships. Countries like India, Australia and Italy connect to the “Dairy Farming” keyword. Bibliometric analysis is a visualisation tool for identifying current and future research trends (Pesta *et al.*, 2018) Fig 9 shows the word cloud of most frequent keywords [Software: Biblioshiny (R-studio)].

Co-occurrence

Content co-occurrence analysis involves studying the content of publications, which can include topic areas such as titles and abstracts, as well as metadata like keywords. Literature reviews that utilise publication content allow researchers to distill various findings and contributions. This type of analysis enables the extraction and identification of theories, methods, contributions, samples, contexts, trending themes, highly cited themes, concepts and other valuable research data.

Using readily available software that employs algorithms to analyse data, such as VOSviewer and Bibliometrics,

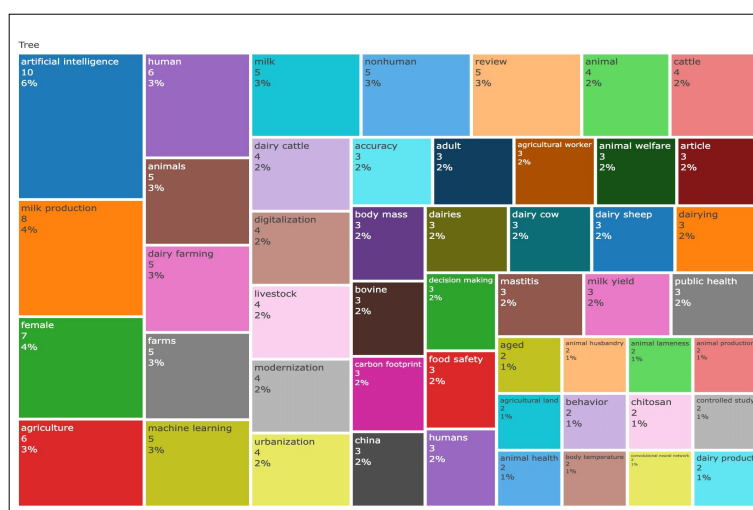


Fig 6: Word tree map visualisation using biblioshiny R studio.

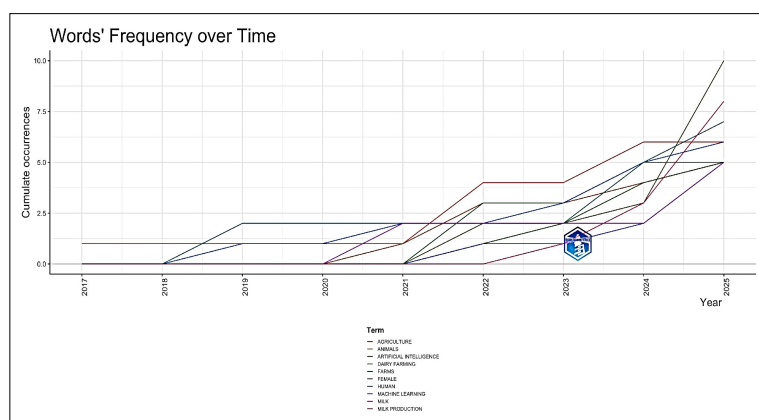


Fig 7: Word frequency over time (Source: Authors elucidation using biblioshiny).

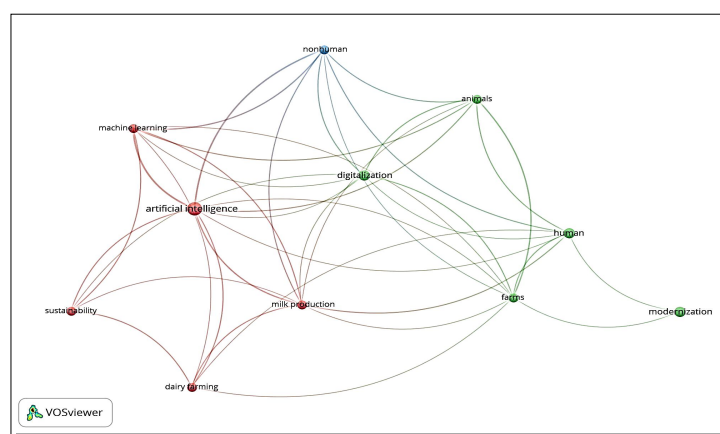


Fig 10: Co-occurrence of sources in database using VOS viewer.

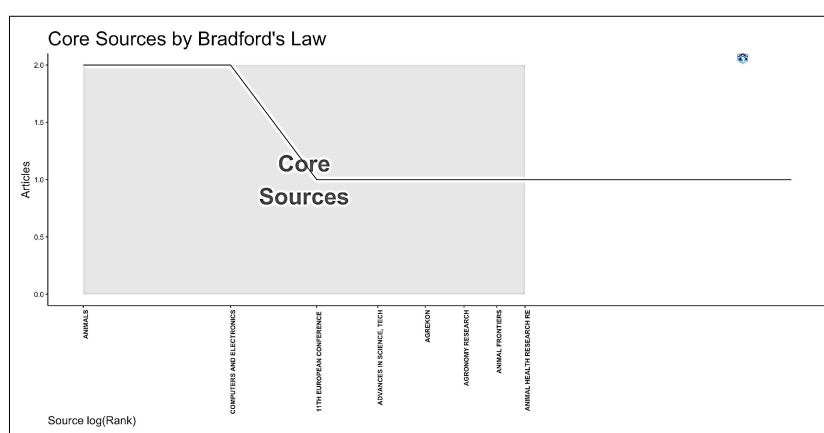


Fig 11: Diagrammatic representation of bradford's law.

RESULTS AND DISCUSSION

From our extensive findings and bibliography, we can draw significant conclusions: Articles published in scientific journals are the most utilised format for sharing research results. In the past five years, over 60% of published papers have appeared in established databases. However, it's important to note that many authors contribute only a single article, reflecting a lower than expected average productivity.

Our co-authorship analysis reveals a compelling trend: the majority of articles are written by two or three authors, leading to a co-authorship index of 2.1. Remarkably, nearly 90% of these authors are affiliated with prestigious universities in countries such as Australia, the USA, India and Italy. This indicates a strong collaborative effort in research that is pivotal for driving advancements in the dairy industry, particularly in the context of digital transformation.

Scientific journals remain the primary vehicle for disseminating research findings, with over 60% of papers published in databases in the last five years. However, it's noteworthy that most authors have contributed only a single article, pointing to a low average productivity rate. Our co-authorship analysis underscores that most publications

are indeed the result of collaboration between two or three authors, reinforcing the co-authorship index of 2.1. The institutions representing these authors predominantly include universities from Australia, the USA, India, Italy and similar countries.

These insights align with, which emphasizes that a small number of journals dominate the landscape of articles on specific topics. By harnessing the keywords derived from our research, we can effectively identify and connect with prior studies in our focus area of digitalization within the dairy industry, paving the way for future innovations and collaborations.

CONCLUSION

Our analysis is detailed in the literature review on the dairy sector focussing on distinctive and comprehensive search terms on the subject. This process resulted in the retrieval of 31 documents from the Scopus database over the last five years, following our refinement procedures. It should be noted that using different keywords could have yielded a significantly larger number of results. Additionally, the parameters established to select the relevant papers present another limitation of this study. The research relies

on a single database for data collection, which further constrains the findings.

ACKNOWLEDGEMENT

The current research benefited immensely from the contributions of Sakshi Shukla and Dr. Chandra Kumar Tewari from HBTU Kanpur, who played a pivotal role in crafting the introduction and literature review sections. Additionally, under the expert guidance of Dr. Anand Kishore Chaturvedi from RTU Kota, Rachna Singh successfully authored the results and completed the remaining sections of the article.

Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

No human and animals participated or involved in this study.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish or preparation of the manuscript.

REFERENCES

- Abdo Hassoun, Guillermo Garcia-Garcia, Hana, T., Sandeep, J., Carlos Parra-López *et al.* (2023). Birth of dairy 4.0 opportunities and challenges in adoption of fourth industrial revolution technologies in the production of milk and its derivatives. *Current Research in Food Science*. **7**: 100535.
- Ali, M.A., Kamal, M.M., Rahman, M.H., Siddiqui, M.N., Haque, M.A., Saha, K.K. and Rahman, M.A. (2022). Functional dairy products as a source of bioactive peptides and probiotics: Current trends and future perspectives. *Journal of Food Science and Technology*. **59**(4): 1263-1279.
- Alkhamash, R. (2022). Bibliometric, network and thematic mapping analyses of metaphor and discourse in COVID-19 publications from 2020 to 2022. *Secondary Psychology of Language*. **13**. doi.org/10.3389/fpsyg.2022.1062943.
- Ashok Babu, Ch., Saratchandra, A., Harikrishna, Ch., Reddy, M.S. (2024). Study on housing management practices followed by dairy farmers in northern Telangana State of India. *Asian Journal of Dairy and Food Research*. **43**(5): 162-166. doi: 10.18805/ajdfr.DR-1676.
- Barnes, F.A. (1958). The evolution of the salient patterns of milk production and distribution in England and Wales. *Transactions and Papers (Institute of British Geographers)*. **25**: 167-195.
- Chaturvedi, A.K., Singh, R., Tiwari, C.K. (2024). Consumer behavioural patterns towards milk and dairy products: An analytical investigation of an indian dairy supply chain. *Asian Journal of Dairy and Food Research*. **43**(4): 774-783. doi: 10.18805/ajdfr.DR-2175.
- Esho, H. (2022). Dairy Industry Modernization and the Changing Rural Economy of India. *The Rural-Urban Nexus in India's Economic Transformation*. Routledge Publishers, First Edition, ISBN No. 9781003311898, 27.
- Faslu, C.K. and Kumar, R.R. (2021). Strategic interventions of dairying developing countries an indian model. *E-Pashupalan*. **10**(2): 20-34.
- Glover, J.I., Champion, D., *et al.* (2014). An institutional theory perspective on sustainable practices across dairy supply chain. *International Journal of Production Economics*. **152**: 102-111.
- Himu, H.A. and Raihan, A. (2024). Digital transformation of livestock farming for sustainable development. *Journal of Veterinary Medicine and Science*. **1**(2): 1-8.
- Huai, C. and Chai, L. (2016). A bibliometric analysis on the performance and underlying dynamic patterns of water security research. *Scientometrics*. **108**(3): 1531-1551.
- Kaushal, N., Kaurav, R.P.S., Sivathanu, B., Kaushik, N. (2021). Artificial intelligence and HRM: Identifying future research agenda using systematic literature review and bibliometric analysis. *Management Review Quarterly*. doi.org/10.1007/s11301-021-00249-2.
- Kaushik, H. and Rajwanshi, R. (2023). Examining the linkages of technology adoption enablers in context of dairy farming using ISM MICMAC approach. *Research on World Agricultural Economy*. **4**(4): 68-78.
- Kaur Napinder, J.S. Toor J.S. (2024). Determinants of the milk marketing channel options among the dairy farmers of Punjab. *Asian Journal of Dairy and Food Research*. **43**(1): 181-185. doi: 10.18805/ajdfr.DR-2003.
- Kumar, T.N., Das, S. and Gulati, A. (2022). Dairy value chain. *Agricultural Value Chains in India*. 195.
- Lwesya, F. and Achanta, J. (2024). Mapping research trends on food supply chain: A bibliometric analysis. *Journal of Agribusiness in Developing and Emerging Economies*. **14**(3): 496-518.
- Michael, G., Carina, C., Christian, H., (2021). Digitalisation in agriculture: Knowledge and learning requirements of german dairy farmers. *International Journal for Research in Vocational Education and Training*. **8**(2): 208-233.
- Malik, M., Gahlawat, V.K., Mor, R.S. and Hosseinian-Far, A. (2024). Towards white revolution 2.0: Challenges and opportunities for the industry 4.0 technologies in Indian dairy industry. *Operations Management Research*. **17**(3): 811-832.
- Malik, M., Malik, A., Gahlawat, V.K. and Mor, R.S. (2023). Traceability in the Indian dairy industry: Concept and practice. *International Journal of Dairy Technology*. **76**(4): 758-778.
- Madeleine, R.H., Olumide, E.O., Jan, O.S. (2019). Exploring the challenges with applying tracking and tracing technology in dairy industry. *IFAC*. **52**(13): 1727-1732.
- Neethirajan, S. and Kemp, B. (2021). Digital livestock farming. *Sensing and Bio-Sensing Research. E-Pashupalan*. 32.

- Neethirajan, S. (2023). Artificial intelligence and sensor technologies in dairy livestock export: Charting a digital transformation. *Sensors*. **23(16)**: 7045.
- Newton, J.E., Nettle, R. and Pryce, J.E. (2020). Farming smarter with big data: Insights from the case of Australia's national dairy herd milk recording scheme. *Agricultural Systems*. **181**: 102811.
- Pesta, B., Fuerst, J. and Kirkegaard, E.O. (2018). Bibliometric keyword analysis across seventeen years (2000-2016) of intelligence articles. *Journal of Intelligence*. **6(4)**: 46.
- Singh, N. and Bagade, P. (2022). Quality, food safety and role of technology in food industry. *Thermal Food Engineering Operations*. pp: 415-454.
- Sangode, Baldeo, P. (2025). Dairy 4.0: Embracing digital technology for sustainable farming: A review. *Asian Journal of Dairy and Food Research*. **44(2)**: 169-178. doi: 10.18805/ajdfr.DR-2242.
- Small, H. (1973). Co citation in the scientific literature: A new measure of the relationship between two documents. *Journal of the American Society for information Science*. **24(4)**: 265-269.
- Wagner, C.S. and Leydesdorff, L. (2005). Network structure, self-organization and the growth of international collaboration in science. *Research Policy*. **34(10)**: 1608-1618.