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Article

Global Research Trends in Animal Feed Nutrition and Industry Development: a Bibliometric Analysis

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A B S T R A C T

The feed industry is a cornerstone of global livestock production and food security, with feed costs representing more than half of total production expenses. In response to rising demand for animal protein and growing sustainability concerns, research in animal feed nutrition has advanced rapidly. This study maps global research trends in feed nutrition and industry development through a bibliometric analysis of 747 publications retrieved from Scopus (2000–2025). Data were analyzed using the Bibliometrix R-package via Biblioshiny. Results show a marked increase in publications, particularly in the past decade. Core journals identified include Poultry Science, Animals, and Aquaculture, serving as key platforms for knowledge dissemination. Productive authors are largely from Asia, with China leading, while major institutions include China Agricultural University, Universiti Putra Malaysia, IPB University, and Universitas Brawijaya. Highly cited works address poultry nutrition, feed additives, and sustainable production. Collaboration networks reveal strong partnerships between China, the United States, and Europe. Trending topics indicate a shift from traditional themes (e.g., diet supplementation, phosphorus, physiology) to emerging areas such as sustainability, aquaculture, immunity, and animal models. Overall, findings highlight a paradigm shift in feed research toward integrated approaches that balance productivity, health, resource efficiency, and environmental impact, offering strategic insights for academia, industry, and policymakers.

1. BACKGROUND

1.1 Introduction

The livestock feed industry represents a strategic sector in supporting animal productivity and global food security (Baris, 2023). Feed accounts for more than 60–70% of total livestock production costs, making feed formulation efficiency and nutritional strategies critical to enhancing competitiveness and sustainability in the livestock sector (Begna & Masho, 2024). As the demand for animal protein continues to rise, research on animal nutrition has accelerated, with particular focus on innovations in raw materials, feed additives, precision formulation technologies, and advanced supplementation strategies (Cheremushkin et al., 2020).

In the past two decades, feed nutrition research has become increasingly shaped by global concerns such as sustainability, food safety, animal health, and environmental impact (Makkar, 2014), (Kohila et al., 2024). This shift requires a comprehensive mapping of research development, including the identification of emerging topics, leading contributors, and international collaboration patterns. Bibliometric analysis thus provides an effective approach to systematically capture the dynamics of knowledge in this field. Previous bibliometric studies have been conducted in related areas of animal science, such as immunotherapy in livestock, nanotechnology applications, and disease-focused research. However, studies specifically addressing global trends in feed nutrition and feed industry development remain limited. Therefore, this study aims to fill this gap by analyzing international literature from 2000 to 2025 through a bibliometric approach.

1.2 Research Purposes

Specifically, this research aims to:

1 Analyze scientific publication trends related to feed nutrition and the feed industry over time.
2 Identify core journals, prolific authors, leading institutions, and the most influential articles in the field.
3 Explore patterns of international collaboration among countries in feed nutrition research.
4 Reveal current research topics and future directions in feed nutrition.

Accordingly, the findings of this study are expected to provide a comprehensive overview of the evolution of knowledge in feed nutrition and the feed industry, serving as a strategic foundation for researchers, academics, and practitioners in formulating future research agendas and policies.

2. LITERATURE REVIEW

The animal feed industry plays a central role in livestock productivity and global food security, with feed accounting for 60–75% of production costs, making it the single most important input in animal agriculture (Kırkpınar & Açıkgöz, 2018). Over time, the industry has evolved from traditional formulations to complex nutritional systems that integrate precision feeding, alternative protein sources, and sustainability strategies (Coffey et al., 2016)

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2.1 Historical development of the feed industry

A historical review highlights that earlier practices—such as reliance on antibiotics and inorganic additives—are gradually being replaced by natural alternatives and advanced nutrient formulations (Coffey et al., 2016). This transition reflects not only scientific advancements in nutrient metabolism but also consumer-driven demand for safer and more sustainable feed systems.

2.2 Economic and industrial dimensions

From an economic perspective, efficiency in feed formulation and manufacturing remains a key factor influencing livestock competitiveness. Literature suggests that animal feed enterprises are significantly affected by raw material prices, supply chain dynamics, and the adoption of management innovations (Nguyen, 2023). The feed industry is also linked to broader food processing sectors by valorizing agro-industrial by-products, which contributes to circular economy practices (Yang et al., 2021).

2.3 Nutritional innovation and biotechnology

Recent literature emphasizes innovation in nutritional technologies, including solid-state fermentation, enzyme supplementation, and biotechnology-based feed enhancements to improve digestibility and nutrient utilization (Betchem et al., 2024). Biotechnology also offers solutions to common nutritional limitations by improving fiber digestibility, recycling nutrients, and reducing antinutritional factors in feed resources (Simas et al., 2024); (Khan et al., 2024); (Siad & Bouzid, 2023); (Habte-Tsion et al., 2018).

2.4 Sustainability and health implications

Sustainability concerns have become a driving force in feed research. A 360-degree view of animal nutrition highlights linkages to environmental sustainability, biodiversity, animal welfare, and food-feed competition, suggesting that the future of feed research must integrate both production efficiency and ecological responsibility (Makkar, 2016). Additionally, metabolites derived from feedstuffs—such as flavonoids, polyphenols, and essential oils—not only improve animal health but may also enhance the nutritional quality of animal-derived foods for humans (Cuchillo-Hilario et al., 2024).

2.5 Food safety and regulatory frameworks

Food safety remains a critical dimension of the feed industry, with frameworks such as HACCP and Good Manufacturing Practices (GMP) ensuring the safety of feed as part of the broader food chain (Hartog, 2003). Concerns regarding contamination and quality assurance emphasize the importance of transparency and traceability in feed production systems (Cesaro et al., 2020).

2.6 Conclusion

The literature indicates that animal feed research is transitioning from conventional cost-driven formulation towards a holistic framework integrating precision nutrition, sustainability, biotechnology, and food safety. This progression reflects the growing importance of feed not only in livestock production efficiency but also in environmental stewardship, global food systems, and human health outcomes.

3. METHODOLOGY

3.1 Data Source and Search Strategy

The research data were obtained from the Scopus database, which was selected due to its broad coverage and reputation as one of the most comprehensive repositories of international scientific literature. The search strategy was designed to capture articles focusing on feed nutrition and the feed industry, using the following query syntax:

TITLE-ABS-KEY ("feed formulation" OR "feed additive*" OR (precision W/2 feed*) OR (dietary W/2 supplement*) OR "nutritional strateg*")
AND TITLE-ABS-KEY ((feed W/2 industry) OR (feed W/2 manufactur*) OR (feed W/2 processing) OR (feed W/2 technolog*) OR (feed W/2 production) OR (sustainable W/3 feed) OR (life cycle W/3 feed))
AND TITLE-ABS-KEY (ruminant* OR cattle OR dairy OR beef OR sheep OR goat* OR poultry OR broiler* OR layer* OR swine OR pig* OR aquaculture OR fish* OR shrimp*)

AND PUBYEAR > 1999 AND PUBYEAR < 2026

AND LANGUAGE (english)

AND (DOCTYPE (ar) OR DOCTYPE (re))

AND NOT TITLE-ABS-KEY ("pet food" OR dog* OR cat*)

The search results yielded 747 relevant articles published between 2000 and 2025.

3.2 Data Extraction and Processing

The retrieved data were exported from Scopus in BibTeX and CSV formats and subsequently analyzed using the Bibliometrix package through the Biblioshiny interface in RStudio. This methodological framework is widely recognized for bibliometric studies as it allows robust quantitative analysis and science mapping of scholarly outputs (Aria & Cuccurullo, 2017). The process enabled the visualization of research trends, collaboration networks, thematic clusters, and keyword dynamics.

3.3 Dataset Characteristics

The dataset consisted of 747 publications, including 595 research articles and 152 review articles, published between 2000 and 2025 across 299 sources (journals, books, and conference proceedings). The analysis involved 3,376 authors, with an average of 5.43 authors per document, and 30.79% of publications were products of international collaboration.

In terms of content, the dataset included 5,752 author keywords and 4,086 indexed keywords (Keywords Plus). The publications showed an annual growth rate of 17.12%, an average of 26.28 citations per document, and an average publication age of approximately 5.94 years. These descriptive statistics provide a comprehensive overview of the scale, scope, and general trends of publications in animal feed nutrition and the feed industry.

3.4 Bibliometric Analysis

The analysis combined performance indicators (performance analysis) with science mapping, focusing on the following dimensions:

- Thematic Map: to identify and classify research themes into four quadrants (motor themes, niche themes, emerging/declining themes, and basic themes).
- Countries' Production Over Time: to evaluate the dynamics of publication contributions from different countries across the study period.
- Most Relevant Countries by Corresponding Author: to examine the role of countries in domestic publications (Single Country Publications) versus international collaborations (Multiple Country Publications).
- Source Production Over Time: to assess the productivity dynamics of key publishing sources.
- Dendrogram (Hierarchical Clustering): to identify clusters of research topics based on keyword co-occurrence.
- Factorial Map (Multiple Correspondence Analysis, MCA): to explore conceptual relationships among dominant terms in the literature.

3.5 Visualization

All results were visualized using graphs and conceptual maps generated directly from Biblioshiny. These visualizations included thematic maps, country-level publication trends over time,

collaboration maps based on corresponding authors, journal productivity trends, dendrograms, and factorial maps. Collectively, the visual outputs support the interpretation of results and the identification of global trends in animal feed nutrition and feed industry development.

If the study involves instruments, tools, or materials, authors must include their specifications in detail—such as accuracy, sensitivity, and how they are relevant to the research. In quantitative research, it's important to explain how variables are measured and how experimental controls are applied. In qualitative studies (e.g., ethnography, phenomenology, case study, classroom action research), authors should describe the researcher's role, research participants, data sources (such as interviews or observations), research location, duration, and methods to ensure validity or trustworthiness.

4. RESULTS AND DISCUSSION

4.1 Publication Output by Journal Over Time

Figure 1 illustrates the cumulative publication output of six major journals related to feed nutrition and the feed industry from 2000 to 2025. The analysis shows distinct growth trajectories across journals, with Poultry Science emerging as the leading source of publications, while others such as Animal Feed Science and Technology, Aquaculture, Animals, Reviews in Aquaculture, and British Poultry Science display more moderate yet significant contributions. These differentiated publication trajectories reflect not only the maturity and specialization of certain journals but also the diversification of feed research outlets, which can be further contextualized in relation to broader research and industry trends.

An analysis of publication dynamics across journals reveals that several core outlets have consistently served as the primary platforms for disseminating research on feed nutrition and its industry applications from 2000 to 2025. The six journals include Animal Feed Science and Technology, Animals, Aquaculture, British Poultry Science, Poultry Science, and Reviews in Aquaculture. Overall, Poultry Science holds a dominant position throughout the study period. Since the early 2000s, the journal has demonstrated steady growth, followed by a marked acceleration after 2015. Its cumulative output surpassed 45 publications after 2020, consolidating its status as the most productive and influential outlet in this field. This aligns with its reputation as a specialized journal directly addressing poultry nutrition and industrial applications (Uyanga et al., 2023).

In comparison, Animal Feed Science and Technology and Aquaculture reveal more moderate but notable upward trajectories. Both journals began to exhibit growth after 2010, with sharper increases between 2020 and 2025. Notably, Aquaculture shows a strong surge in the last five years, reflecting the rising importance of feed nutrition not only in terrestrial livestock systems but also within aquaculture, where sustainable feed alternatives and nutrient efficiency are critical drivers of research (Razak et al., 2024).

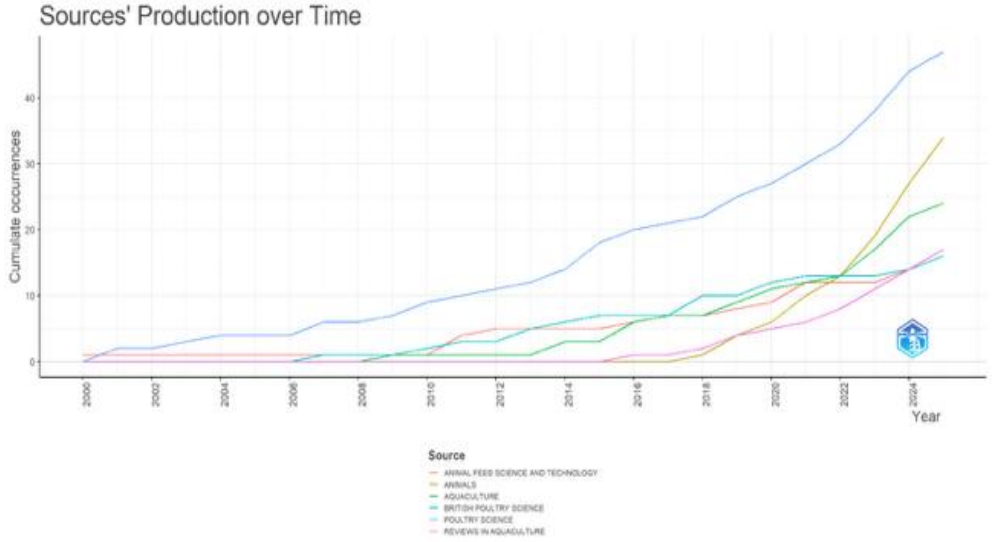

Fig. 1 Publication Output by Journal Over Time

Meanwhile, Animals and Reviews in Aquaculture are relatively recent but increasingly important contributors. Animals shows consistent growth after 2015, while Reviews in Aquaculture, although emerging later, displays a steady upward trajectory since 2018. This indicates that the latter journal is strengthening its role as a venue for review articles and knowledge synthesis in aquaculture nutrition. British Poultry Science, while still contributing, shows a relatively flat growth curve compared to other outlets. This may be due to its

narrower thematic scope compared with Poultry Science and a gradual shift of researchers toward journals with broader reach and impact potential (Çelik, 2021).

These findings highlight the increasingly differentiated landscape of publication outlets in feed nutrition. Specialized journals such as Poultry Science remain central publication hubs, but the growing presence of interdisciplinary journals like Animals and aquaculture-focused outlets such as Aquaculture and Reviews in Aquaculture underscores the diversification of research directions, reflecting the expanding relevance of feed science to sustainability, health, and global food security (Colombino et al., 2021).

4.2 Country Production Over Time

Figure 2 depicts the longitudinal trend of publication output by the five most productive countries—China, the United States, India, Egypt, and Indonesia—in the field of feed nutrition and the feed industry between 2000 and 2025. The figure highlights a notable surge in publication activity, particularly after 2015, with distinct trajectories across countries. The overall analysis indicates a significant rise in the number of publications over the past two decades. The five leading contributors are China, the United States, India, Egypt, and Indonesia.

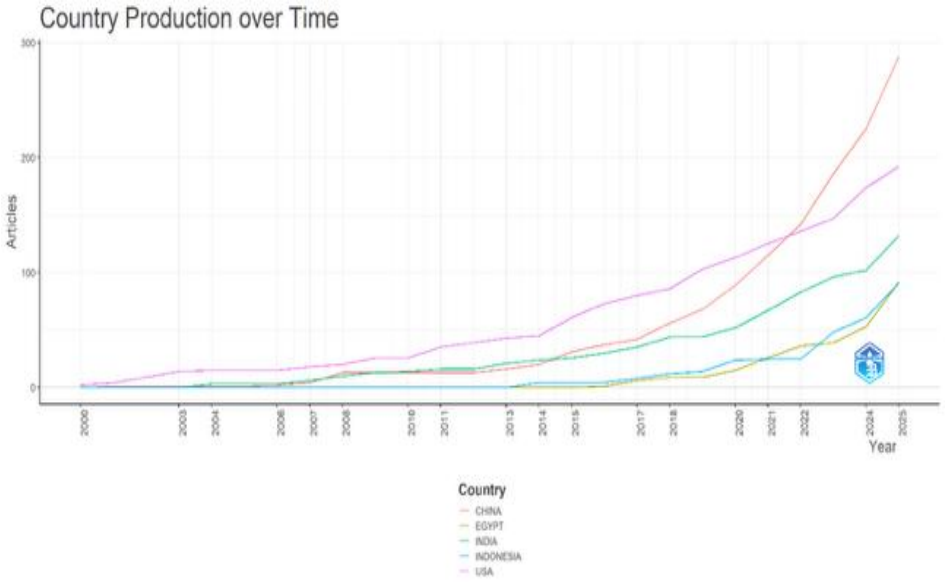

Fig. 2 Country Production Over time

China occupies a dominant position, with a sharp increase beginning in 2018 and surpassing 280 articles by 2025, establishing itself as the central hub of research in this field. The United States, in contrast, demonstrates steady and consistent growth throughout the period, reaching nearly 200 publications by 2025, reflecting its strong research tradition and sustained influence in animal nutrition science (Uyanga et al., 2023). India shows progressive growth beginning in 2015, exceeding 130 articles by 2025. This underscores its growing importance in South Asia's feed nutrition research landscape. Egypt and Indonesia reveal more recent developments. While their contributions remain smaller compared to China and the United States, both countries show sharp increases after 2020. Indonesia, in particular, experienced a significant rise after 2022, with nearly 90 publications by 2025, signaling the strengthening of Southeast Asia's role in this research domain (Razak et al., 2024).

Overall, these patterns reflect a geographic shift of research activity toward Asia, with China, India, and Indonesia emerging as major growth drivers. This shift can be linked to rising demands in livestock and aquaculture production, combined with strong policy support and industry-driven initiatives for feed innovation and sustainability (Colombino et al., 2021)
.

4.3 Corresponding Author Countries

Figure 3 illustrates the distribution of corresponding authors by country, distinguishing between Single Country Publications (SCP) and Multiple Country Publications (MCP). The figure clearly highlights China as the leading contributor in feed nutrition and industry research, with the largest number of publications, most of which fall under SCP. India and the United States also rank among the top contributors, although the United States demonstrates a greater share of MCP, indicating stronger international collaboration.

The analysis confirms that China dominates both in terms of publication volume and the proportion of independent research, reflecting substantial national investment in livestock, feed nutrition, and related industrial technologies. Its strong representation in SCP suggests that a large share of Chinese research is conducted domestically, supported by robust infrastructure and policy backing (Xiang et al., 2022). In contrast, the United States shows a higher share of MCP, reflecting its long-standing role as a hub for global collaboration. This suggests that the strength of the U.S. lies not only in its domestic research capacity but also in its leadership and networking in international feed research collaborations (Uyanga et al., 2023).

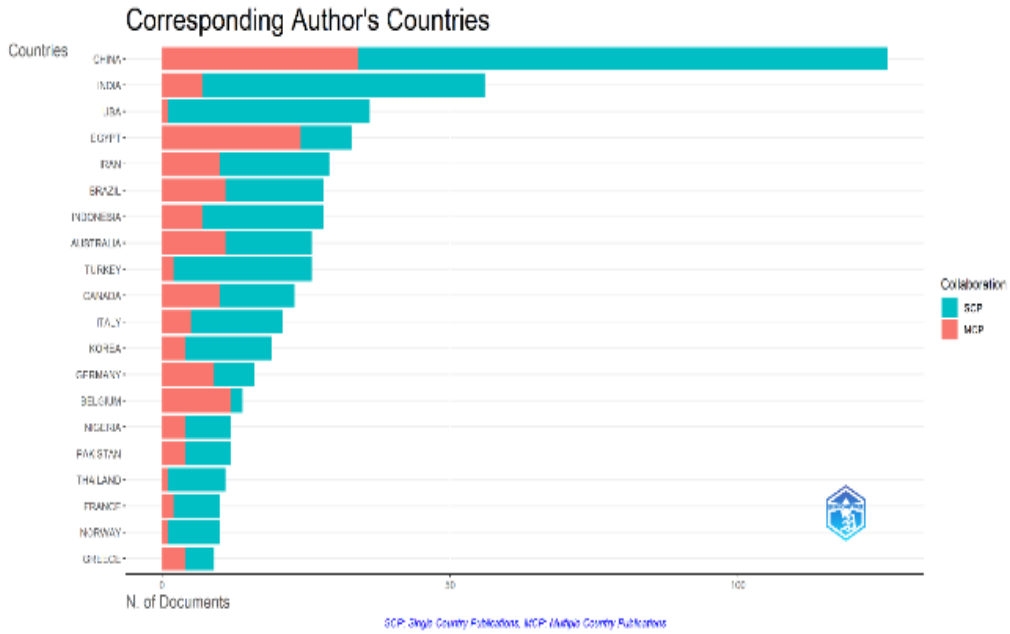

Fig. 3 Corresponding Author Countries

India and Egypt represent important contributors from the developing world, with India playing a strategic role due to its large domestic demand for livestock products, while Egypt leverages international partnerships to expand its scientific impact (Razak et al., 2024). Indonesia stands out due to its relatively high proportion of MCP, suggesting that Indonesian researchers are increasingly integrated into global networks, even though its domestic capacity is not yet at the level of China or India. This pattern highlights opportunities to strengthen Indonesia's role in feed research through the development of local research capacity.

Countries such as Australia, Turkey, and Canada show a balance between SCP and MCP, while European nations including Italy, Germany, Belgium, France, and Greece are more heavily oriented toward MCP. This aligns with the European Union's research policy framework, which strongly promotes international cooperation across member states. Such collaboration underscores that innovation in feed nutrition and its industry is not solely dependent on domestic research but also on knowledge exchange and cross-border partnerships (Colombino et al., 2021).

Taken together, the analysis highlights two dominant patterns:

1 Countries with strong domestic research output (SCP-dominant), such as China and India, indicating robust national research capacity.
2 Countries with collaboration-driven output (MCP-dominant), such as the United States and European nations, underscoring the importance of international networking in advancing feed nutrition research.

4.4 Thematic Map Analysis

Figure 4 presents the thematic map derived from bibliometric analysis, positioning research topics in animal feed nutrition and the feed industry along two dimensions: relevance degree (centrality) and development degree (density). The analysis identifies four clusters of themes—motor themes, niche themes, basic themes, and emerging or declining themes—providing insights into the structure and evolution of this research field.

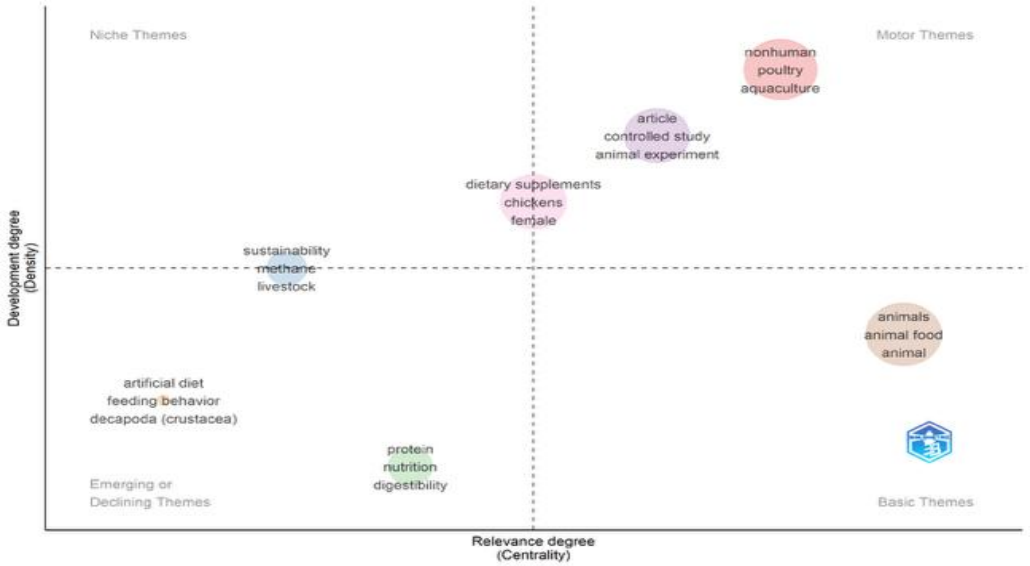

Fig. 4 Thematic Map Analysis

a. Motor Themes

The upper-right quadrant represents topics with both high centrality and density, signifying that they are well developed and highly relevant in the research network. Keywords in this cluster include nonhuman, poultry, and aquaculture. This indicates that feed nutrition research is strongly oriented toward practical applications in poultry and aquaculture systems. The global demand for animal protein continues to drive research in these sectors, emphasizing feed efficiency, animal health, and product quality. These themes are expected to remain the primary drivers of future feed nutrition research (Godfray et al., 2018).

b. Niche Themes

The upper-left quadrant includes topics with high density but low centrality, reflecting specialized areas that are well developed but relatively isolated from the mainstream. Dominant keywords include sustainability, methane, and livestock. These themes represent research efforts to mitigate greenhouse gas emissions from livestock through nutritional interventions. While not yet the central focus of feed research, they are increasingly relevant given growing global concerns regarding sustainability and the environmental impacts of livestock production (Gerber et al., 2013). With stronger environmental policy frameworks, these niche themes may evolve into strategic research areas.

c. Basic Themes

The lower-right quadrant highlights themes with high centrality but low density, representing foundational but conceptually underdeveloped topics. Keywords such as animals, animal food, and animal fall into this category. These themes reflect the conceptual backbone of feed research, emphasizing fundamental links between animals and feed resources. However, their descriptive nature suggests that further development is needed to address specific industrial and research demands (Makkar, 2016).

d. Emerging or Declining Themes

The lower-left quadrant contains topics with low centrality and density, indicating areas that are either emerging fields or declining in relevance. Keywords include artificial diet, feeding behavior, decapoda (crustacea), protein nutrition, and digestibility. This dual positioning reflects uncertainty: studies on artificial diets and feeding behavior in crustaceans may be linked to aquaculture diversification but remain underexplored, while classic topics such as protein nutrition and digestibility may be losing prominence as attention shifts toward functional additives, feed biotechnology, and sustainable feed solutions (Khan et al., 2020).

Overall, the thematic map highlights that current feed nutrition research is primarily driven by applications in poultry and aquaculture (motor themes), while environmental sustainability emerges as a specialized niche. Basic concepts around animals and feed remain central but require deeper development, and several themes either represent new opportunities or areas of declining focus. These findings open the door for cross-theme integration, such as linking sustainability issues with feed innovation in poultry and aquaculture, to strengthen the field's relevance in addressing global food security challenges.

4.5 Dendrogram: Conceptual Clustering Structure in Feed Nutrition Research

Figure 5 displays the results of a hierarchical clustering analysis, which visualizes the conceptual relationships among research topics in animal feed nutrition and its industry. The dendrogram highlights at least four major clusters, each reflecting distinct yet interconnected streams of research.

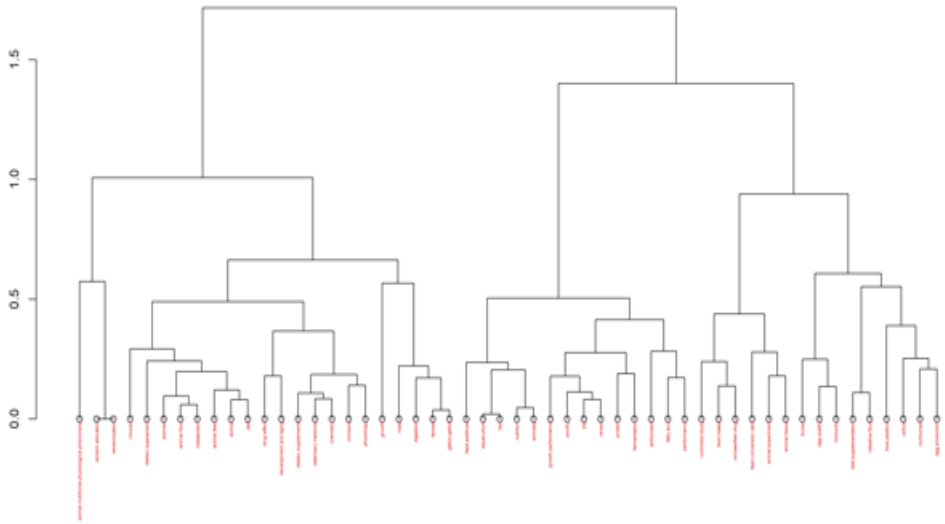

Fig. 5 Thematic Map Analysis

a. Nutrition and Metabolism Cluster

This cluster includes keywords such as dietary supplements, metabolism, physiology, digestion, chickens, Gallus gallus, and animal feed. The main focus is on the direct relationship between feed formulation and physiological functions in livestock, particularly poultry. Studies within this group emphasize how feed composition and dietary supplementation influence metabolism, digestive health, and nutrient utilization efficiency (Kogut & Arsenault, 2016).

b. Feed Additives and Production Performance Cluster

This cluster contains terms such as feed additives, fermentation, protein, growth performance, fatty acid, poultry, fish, aquaculture, and nutrition. Research in this domain explores synthetic and natural feed additives aimed at improving productivity. Current trends highlight probiotics, prebiotics, essential oils, and functional fatty acids, reflecting the growing interest in sustainable nutritional strategies for both terrestrial livestock and aquaculture.

c. Animal Health and Experimental Studies Cluster

This cluster comprises terms such as controlled study, animal experiment, immunity, antioxidant, intestinal flora, egg quality, and drug effects. Research here is primarily laboratory- and trial-based, focusing on the health impacts of feed interventions. Key areas include immune system enhancement, oxidative stress reduction, and improvements in product quality such as egg characteristics. This demonstrates a shift from purely performance-driven objectives to broader health and product-quality outcomes in feed nutrition research (Borda-Molina et al., 2018).

d. Methodology and Foundational Studies Cluster

This cluster includes keywords like randomization, random allocation, development and aging, and animal nutritional physiological phenomena. While less dominant compared to other clusters, these themes provide the methodological foundation for testing feed interventions, ensuring the scientific validity and robustness of feed nutrition research (Aria & Cuccurullo, 2017).

In summary, the dendrogram demonstrates that feed nutrition research is multidimensional, spanning fundamental feed formulation, animal health, and methodological rigor. These clusters complement one another, illustrating how the field is moving toward the integration of nutrition, health, and sustainability in the animal feed industry.

4.6 Factorial Map: Conceptual Structure of Feed Nutrition Research

Figure 6 illustrates the factorial map generated through Multiple Correspondence Analysis (MCA), which visualizes the conceptual relationships among research topics in feed nutrition. The mapping organizes keywords into several broad domains, each reflecting the thematic orientation of ongoing research in the field.

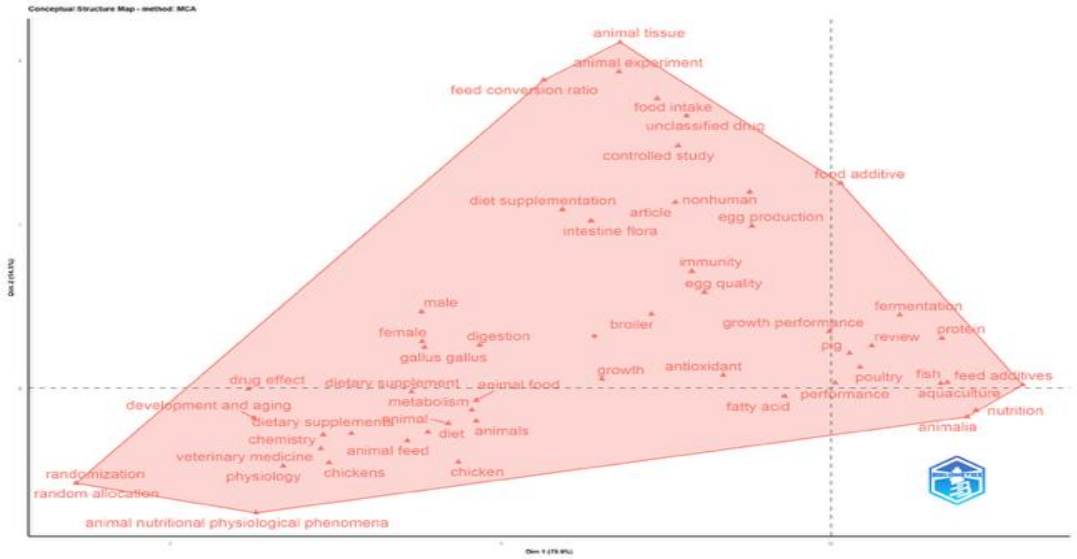

Fig. 6 Factorial Map: Conceptual Structure of Feed Nutrition Research

a. Domain of Nutrition and Production Performance

This domain includes keywords such as growth performance, broiler, egg production, feed conversion ratio, and animal feed. The research focus in this cluster centers on improving animal productivity—particularly in poultry—through optimized feed formulation. The strong interconnection among these terms highlights that feed efficiency and production outcomes remain core priorities in animal nutrition research (Leeson & Summers, 2009).

b. Domain of Animal Health and Product Quality

Keywords such as immunity, antioxidant, intestinal flora, egg quality, and fermentation dominate this cluster. Studies in this domain emphasize the role of nutrition in enhancing immune function, gut health, and overall product quality. This reflects the growing alignment of feed research with consumer concerns about food safety and the demand for higher-quality animal products (Borda-Molina et al., 2018).

c. Domain of Feed Additive Innovation and Alternative Ingredients

This group contains terms such as food additive, protein, fatty acid, fish, aquaculture, and nutrition. The cluster represents the advancement of research into alternative feed resources and natural additives, aimed at reducing dependence on conventional raw materials while promoting sustainability. Such innovations are critical in addressing challenges of feed resource scarcity and supporting environmentally responsible industry practices (Khan et al., 2020).

d. Domain of Experimental and Methodological Foundations

Keywords in this domain include animal experiment, controlled study, drug effect, randomization, and random allocation. These terms underscore the methodological backbone of feed nutrition studies, reflecting the use of experimental designs to validate nutritional interventions. The dispersed position of this cluster across the map suggests its cross-cutting role in supporting diverse thematic areas (Aria & Cuccurullo, 2017).

Overall, the factorial map demonstrates the evolution of feed nutrition research from conventional feed formulation toward a more interdisciplinary approach encompassing productivity, animal health, food safety, and sustainability. These findings highlight opportunities for further exploration, particularly the integration of sustainability concerns, alternative protein sources, and the role of natural additives in improving animal health and product quality.

4.6 Thematic Map Analysis

This study's findings carry several important implications across academic, industrial, and policy contexts.

First, the shift in publication dominance from Western countries toward Asia—particularly China, India, and Indonesia—indicates that the center of feed nutrition research is increasingly concentrated in regions with high demand for animal protein. This underscores the need for more balanced international collaboration, where developing countries act not only as consumers of research outputs but also as significant producers of scientific knowledge.

Second, patterns of research collaboration reveal two main approaches: strong domestic publication output, as seen in China and India, and international collaborative publications, which dominate in the United States and Europe. This suggests that while building domestic research

capacity remains crucial, international networks are key to accelerating the diffusion of innovation. Indonesia, with its relatively high share of collaborative publications, holds the potential to play a strategic role as a connector in the global feed nutrition research network.

Third, the thematic orientations identified in this study demonstrate that animal productivity remains a central focus, but increasing attention is being directed toward animal health, product quality, and sustainability. This reflects a paradigm shift in feed nutrition research—from a narrow emphasis on production efficiency to a more holistic approach that incorporates food safety and environmental sustainability. For the feed industry, this implies the necessity of adjusting strategies to integrate formulation innovations, natural feed additives, and sustainable practices in order to remain competitive in an increasingly selective global market (Makkar, 2016).

Finally, important implications also emerge for research and education policy. University curricula need to adapt to the latest developments, such as precision nutrition, greenhouse gas mitigation, and the utilization of alternative protein sources. At the same time, funding agencies and governments should prioritize research that supports food security and feed industry sustainability. Ultimately, stronger integration among academia, industry, and policymakers will reinforce a feed nutrition research ecosystem that is more responsive to global challenges in the future (Godfray et al., 2018).

5. CONCLUSION

This study maps the global development of research in animal feed nutrition and the feed industry using a bibliometric approach. The results show that scientific publications in this field have experienced consistent growth since the early 2000s, with significant acceleration over the past decade. Several journals, such as Poultry Science, Aquaculture, and Animal Feed Science and Technology, have become central outlets for knowledge dissemination, reflecting a research focus on poultry productivity and diversification into the aquaculture sector.

From a geographical perspective, a shift in dominance is observed from Western countries to Asia, particularly China, India, and Indonesia. The contrasting patterns between strong domestic publication output and intensive international collaboration indicate two complementary models of research. This demonstrates that both national research capacity and global networks play important roles in shaping the trajectory of knowledge development in feed nutrition.

Thematic analysis reveals that research is not only focused on improving production efficiency but also encompasses animal health, product quality, and environmental sustainability. The emergence of new themes such as artificial diets and alternative proteins illustrates the increasingly dynamic nature of the field in responding to global challenges, particularly food security and industry sustainability.

Overall, this study highlights that feed nutrition and the feed industry represent a rapidly expanding and increasingly complex research domain. The findings not only provide a comprehensive overview of global research trends but also suggest directions for future studies, including strengthening domestic research capacity and expanding international collaborations to address the needs of both industry and society worldwide.

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