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Recommendation Systems for Agri-Food Supply Chains: A Systematic Literature Review

Sistemas de recomendación para cadenas de suministro agroalimentarias: revisión sistemática de la literatura

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ABSTRACT
Agri-food supply chains face challenges in efficiency, sustainability, and resilience. AI, IoT, and Blockchain-enabled Recommender Systems (RS) offer solutions. This systematic review uses PRISMA and eight research questions to synthesize applications, metrics, techniques, objectives, stakeholders, and gaps. Results show a dual application of RS: internal uses focus on operational optimization (logistics, traceability, waste reduction), while external uses target personalization in marketing and consumer nutrition. Emerging techniques include reinforcement learning, graph models, and digital twins. However, gaps limit scalable adoption: a lack of interoperability standards, a disconnect between academic validation and real-world contexts, data quality and integration issues, and insufficient understanding of collaborative business models. Future RS development requires a systemic, interdisciplinary approach prioritizing context-aware, user-centered design; holistic evaluation metrics; and inclusive adoption frameworks—especially for small-scale producers—to build smarter, fairer, and more resilient agri-food chains.
Keywords: agri-food intelligence, recommender system, supply chain.

RESUMEN
Las cadenas de suministro agroalimentarias enfrentan desafíos de eficiencia, sostenibilidad y resiliencia. Los Sistemas de Recomendación (RS) basados en IA, IoT y Blockchain ofrecen soluciones. Esta revisión sistemática utiliza PRISMA y ocho preguntas de investigación para sintetizar aplicaciones, métricas, técnicas, objetivos, actores interesados y vacíos de conocimiento. Los resultados muestran una doble aplicación de los RS: los usos internos se centran en la optimización operativa (logística, trazabilidad, reducción de desperdicios), mientras que los usos

externos apuntan a la personalización en marketing y nutrición del consumidor. Entre las técnicas emergentes destacan el aprendizaje por refuerzo, los modelos de grafos y los gemelos digitales. Sin embargo, diversos vacíos limitan su adopción escalable: la falta de estándares de interoperabilidad, la desconexión entre la validación académica y los contextos reales, problemas de calidad e integración de datos, y una comprensión insuficiente de los modelos de negocio colaborativos. El desarrollo futuro de los RS en este sector requiere un enfoque sistémico e interdisciplinario que priorice el diseño contextualizado y centrado en el usuario; métricas de evaluación holísticas; y marcos que favorezcan una adopción inclusiva —especialmente para los pequeños productores— con el fin de construir cadenas agroalimentarias más inteligentes, justas y resilientes.
Palabras clave: inteligencia agroalimentaria; sistema de recomendación; cadena de suministro.

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Introduction

Recommendation systems in the agri-food supply chain (AFSC)

The convergence of technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), and Blockchain[1][2][3] is driving the development of advanced recommender systems (RS) for decision-making[4] in agri-food supply chains (AFSC). It is known[5] that these systems have the potential to transform a sector traditionally driven by experience and intuition, improving operational efficiency and sustainability through the analysis of large data volumes. However, a prevailing assumption about their real-world applicability persists, due to implementation challenges and a fragmented understanding of their effective integration.[6]

Recent systematic reviews have examined the digital transformation of agri-food supply chains. For instance, [7] provides a comprehensive synthesis of how digital technologies—including AI, IoT, and blockchain—are reshaping agrifood systems, while [8] explores the role of spatial computing technologies in enabling more innovative and connected food supply chains. These works confirm the growing interest in intelligent, data-driven approaches to food chain management.

This systematic review is based on the hypothesis that hybrid recommender systems integrating AI, IoT, and Blockchain can significantly reduce uncertainty and waste in AFSCs. However, their impact depends on overcoming economic and technical barriers and on addressing the lack of metrics for assessing collaboration among supply chain stakeholders.[9] The main objective is to comprehensively analyze the state of the art to identify primary use cases, the most effective techniques, and the critical gaps hindering scalable adoption of these solutions.

This systematic review aims to establish theoretical and practical foundations for recommender systems (RS) in agri-food supply chains. It hypothesizes that analyzing the main application domains, enabling technologies, objectives, KPIs,

stakeholders, modeling variables, and theoretical gaps will clarify how each factor influences effective RS design.

Research questions

The research questions guiding this review are:
RQ1. What are the main application fields in agri-food supply chains?
RQ2. Which KPIs are most commonly used to evaluate Recommender Systems?
RQ3. How are Recommender Systems in agri-food supply chains described?
RQ4. What is the primary goal of implementing these systems?
RQ5. Which emerging AI techniques and algorithms are notable in developing these systems?
RQ6. Who are the main stakeholders intended to receive the recommendations?
RQ7. What variables and constraints must be modeled to tailor recommendations?
RQ8. What gaps does the literature identify in current research?

The following section outlines the organization and methods used in the document. To ensure a rigorous and unbiased literature synthesis, this study uses a Systematic Literature Review (SLR) following the PRISMA protocol [8]. It is combined with thematic modeling using BERTopic [9]. This approach allows a reproducible analysis of a large study corpus and reduces selection and interpretation bias. The document is structured around the five standard SLR sections: introduction, method, results, discussion, and conclusions. Through this framework, readers can examine how Recommender Systems (RS) may redefine resilience in the Agri-Food Supply Chain (AFSC). The review covers both technological innovation and a systemic view that balances digital potential with operational, social, and economic factors in the value chain.

Methods

A systematic literature review was conducted in three stages: planning (designing the review process), search and selection (identifying and choosing relevant sources), and information extraction (gathering key data from the selected references). These stages guided the discussion and synthesis of references that contribute to this research. The developed protocol for the review is summarized below:
This literature review was planned by defining a main objective, eight research questions (Table 1), and eligibility criteria. The review aims to identify studies on Recommender Systems (RS) that use advanced AI techniques in Agri-Food Supply Chains (AFSC).
Studies included examined RS in AFSC, with no language restrictions, focusing on data mining techniques and prediction algorithms, and emphasizing operational and RS performance metrics. Studies published before 2015, those from unrelated sectors (such as automotive, fashion, tourism, HR), or generic works without a clear link to agri-food or RS were excluded. Detailed criteria are provided in table 2.

Table 1 - Systematic literature review research questions.1

Research Questions	Motivation and expected results

RQ1. What are the main application fields in agri-food supply chains?	Map the main application areas within AFSC.
RQ2. Which KPIs are most commonly used to evaluate Recommender Systems?	Define the standard metrics for evaluating RS performance in AFSC.
RQ3. How are Recommender Systems in agri-food supply chains described?	Detail the common applications of implemented RS.
RQ4. What is the primary goal of implementing these systems?	Clarify the central strategic objective that justifies their use.
RQ5. Which emerging AI techniques and algorithms are notable in developing these systems?	Identify the most advanced AI techniques in the sector.
RQ6. Who are the main stakeholders intended to receive the recommendations?	Profile the key actors who utilize these recommendations.
RQ7. What variables and constraints must be modeled to tailor recommendations?	Specify the data needed to personalize recommendations effectively.
RQ8. What gaps does the literature identify in current research?	Summarize the main research opportunities and future needs.

Table 2 - Inclusion and Exclusion Criteria

Inclusion:

1. Articles in any language.
2. Publications from 2015 onward.
3. Scientific and conference articles.
4. Focus on agro-food supply chain recommendation systems.
5. Publications that include evaluation and optimization of models focused on agro-food supply chain recommendation.
6. Focus on agro-food supply chain recommendation based on user preferences, including artificial intelligence techniques, datasets, results, and challenges of fuzzy recommendation systems.
7. Selecting relevant articles on fuzzy recommendation systems applied to agro-food supply chains.
8. Highly cited articles on agro-food supply chain recommender systems, regardless of publication date.

Exclusion:

1. Reports on essential services in contexts unrelated to agro-food supply chains, or algorithms unrelated to agro-food supply chain recommendation systems.
2. Publications before the year 2015.
3. Reports, doctoral or master's theses.
4. Publications with algorithms unrelated to the context of agro-food supply chain recommendation.
5. Articles incorporating scenarios different from agro-food supply chain recommendations based on user preferences.
6. Any other forms of literature besides scientific articles and conference papers.
7. Studies that focus exclusively on essential services unrelated to agro-food supply chains or prediction algorithms for costs unrelated to supply chain optimization.

Figure 1 outlines the steps for selecting the primary articles. The process began by applying specific search strings across six academic databases to extract article metadata. Initial results were deduplicated and filtered by publication year to analyze temporal trends.



Fig. 1 - (PRISMA flow diagram) outlines the steps for selecting the primary articles.

Subsequently, the BERTopic model was employed for thematic analysis. BERTopic is an unsupervised topic modeling technique that integrates SBERT (for semantic embeddings), UMAP (for dimensionality reduction), and HDBSCAN (for density-

based clustering) to identify latent themes by capturing contextual semantics. This approach offers advantages over methods such as Latent Dirichlet Allocation (LDA), as it does not require a predefined number of topics, effectively handles outliers, and uses class-based TF-IDF (C-TF-IDF) to generate interpretable keywords for each cluster. While highly modular, the model is computationally intensive [10].

Using this model, article abstracts were clustered into key thematic areas (e.g., "cold chain recommendation"). During the selection phase, a dual approach was adopted: manual screening of titles and abstracts was complemented by a custom R function. This function prioritized articles based on the predefined inclusion/exclusion criteria, assigning a relevance score to each (e.g., "High," "Medium"). Finally, data were systematically extracted and standardized from the selected primary articles to address the research questions.

Information extraction

Table 3 - Description of the information extraction criteria.

Criteria	Description
C1. Problem analysis	Identify the problem solved and its relationship to the SLR's purpose.
C2. Application scenarios	Identify use cases and scenarios across application contexts.
C3. Contribution	Analyze results and conclusions to find proposals that inform the study variables: Recommender Systems in agri-food supply chains.
C4. Artificial Intelligence Methods	Identify data mining techniques applied to machine learning.
C5. Technology used	Identify potential technologies, tools, and infrastructure for data processing.
C6. Advantages and limitations	State the study's contributions and outline their limitations.
C7. Future applications	Identify application frameworks for future research based on the primary studies' proposals.

During information extraction, we included criteria such as problem analysis, contribution, application scenarios, analysis of results and conclusions, input and output data, AI-based methods, technologies used, advantages and disadvantages, and future applications; Table 3 details each criterion.

Results

Descriptive analysis of the search results and selection of articles

The initial systematic search identified 1,791 studies. After removing 398 duplicates, 1,401 records were screened for titles, abstracts, and keywords, with initial filtering supported by an R function. From these, 248 studies were excluded for not meeting the eligibility criteria (Table 2), primarily because they used approaches unrelated to computer science and machine learning, lacked recommender systems or supply chain data, or had overly broad technological practice contexts. Subsequently, the full texts of 69 articles were analyzed, excluding 22 due to the lack of applied data mining techniques or concrete recommendations for agri-food supply chains (AFSC). Finally, 8 articles were included in the systematic review. Figure 1 (PRISMA flow diagram) and Table 4 detail this process, while figure 2 (Documents and topics) presents the distribution of the selected documents across the identified thematic categories, and Figure 3

(aluviagraph) complements the visualization of the systematic flow, showing the distribution by databases and years, ensuring methodological traceability and reproducibility.

These dimensions unfold across three main thematic axes: (1) traceability and transparency, capturing mechanisms and technologies ensuring product provenance; (2) operational optimization, focusing on improvements such as cold chain logistics and waste reduction; and (3) emerging technologies, highlighting advancements like AI/machine learning and 3D printing. Cross-cutting themes such as food security are also present.

The geographic analysis of research collaborations reveals a global distribution of research activity. Major hubs of high productivity and dense international cooperation networks are evident. This underscores the widespread, cross-cutting interest in supply chain optimization and recommender systems.

In the final selection stage (Step 3), after reading the introductions and conclusions of 77 candidate articles, 22 were excluded. The reasons for exclusión were primarily focused on the inapplicability of the research context (e.g., studies focused on automotive, fashion, or tourism sectors instead of AFSC).

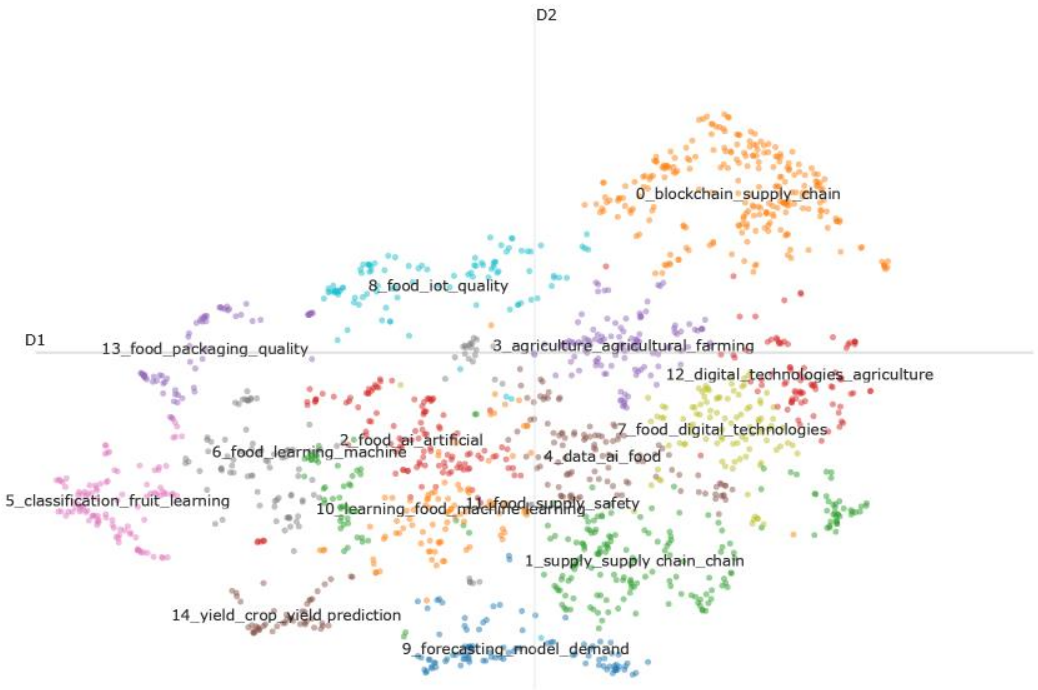


Fig. 2 - Documents and topics

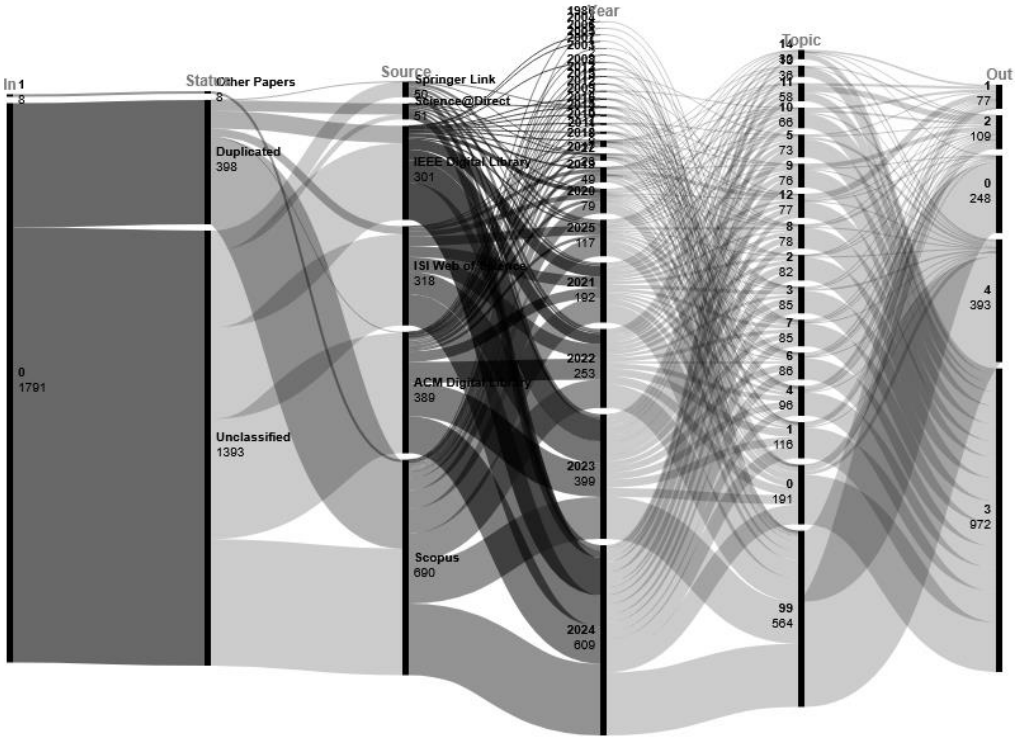


Fig. 3 - Procedures and results of article analysis.

Analysis of the quality of primary studies

This section presents the results of the full-text assessment for the studies included in the systematic literature review (SLR). The initial pool contained 69 articles, to which 8 additional studies were added via complementary search methods, yielding a final corpus of 77 studies. Table 4 lists the titles and key metadata for these final studies. Figure 4 illustrates the distribution of studies by source database, while figure 5 shows their distribution by publication year, with approximately 50% published in 2021.

The general characteristics of the 77 studies analyzed in Step 3 are summarized in table 4. The table includes the sequential extraction identifier (IDS), the source database, the title and full bibliographic reference (TR), and the year of publication (Y). An annotation (*) indicates articles excluded after this analysis. The quantitative score (Score) measures their contribution to the research questions.

To clarify the basis for study exclusion, the main reason, indicated by an asterisk (*) in the table, was a focus on application domains irrelevant to this review. Specifically, studies from sectors such as automotive, fashion, tourism, or human resources did not address the research questions related to agri-food supply chains and were therefore removed.

The results of the subsequent quality assessment for the 77 primary articles are presented in table 4, which details their individual ratings and scores. Figure 6 visualizes the distribution of scores and shows that 56% of the articles received a score of 0.8. About 70% of the studies satisfactorily met the content evaluation criteria and achieved scores of 0.7 or higher.

Table 4 – Full texts included on the SLR

Paper Title	TR	Score	Year

Applying Internet information technology combined with deep learning to tourism collaborative recommendation system	[47]	0	2020
Implementing IoT-Adaptive Fuzzy Neural Network Model Enabling Service for Supporting Fashion Retail; Survey of Testing Methods of O2O Catering Platform	[27]	0	2020
The Role of Employees' Performance and External Knowledge Transfer on the Supply Chain Flexibility	[27]	0	2020
Impact of Managers and Human Resources on the Supply Chain Performance	[29]	0	2023
Tackling Climate Change with Machine Learning	[55]	0	2023
Continuous Integration and Delivery Practices for Cyber-Physical Systems: An Interview-Based Study	[56]	0	2023
Unified route representation learning for multi-modal transportation recommendation with spatiotemporal pre-training	[57]	0	2020
Matching Consignees/Shippers Recommendation System in Courier Service Using Data Analytics	[58]	0.1	2020
Automated digital cause-and-effect diagrams to assist causal analysis in problem-solving: a data-driven approach	[59]	0.3	2011
On-demand Feature Recommendations Derived from Mining Public Product Descriptions	[60]	0.2	2022
Implementation of Digitalized Technologies for Fashion Industry 4.0: Opportunities and Challenges	[61]	0.2	2022
Customer models for artificial intelligence-based decision support in fashion online retail supply chains	[62]	0	2021

Reducing retail supply chain costs of product returns using digital product fitting	[63]	0	2019
Web-Based Recommendation System for Smart Tourism: Multiagent Technology	[64]	0.2	2020
From product recommendation to cyber-attack prediction: Generating attack graphs and predicting future attacks	[65]	0.7	2020
Presenting a hybrid model in social networks recommendation system architecture development	[68]	0	2020
Product recommendation for e-commerce business by applying principal component analysis (PCA) and K-means clustering: benefit for the society	[69]	0	2022
Sonia: an integrated Indonesia online tourism system in new normal era	[70]	0.1	2020
Analysis of e-commerce usability and security factor based on multimodal business dimension in pharmaceutical supply chain and CBIR based textile recommendation system	[73]	0	2021
Applying Internet information technology combined with deep learning to tourism collaborative recommendation system	[75]	0.2	2021
Applications of Big Data Analytics in Supply Chain Management: Findings from Expert Interviews	[76]	0	2020
Effects of Personalized and Aggregate Top-N Recommendation Lists on User Preference Ratings; Joint Neural Collaborative Filtering for Recommender Systems	[80]	0.2	2018
A Decision Support System with Intelligent Recommendation for Multi-disciplinary Medical Treatment	[54]	0	2019

The synthesis of the primary articles was organized around the eight research questions guiding this review, grouped into eight thematic categories: (AP) Applications, (KPI) Key Performance Indicators, (TE) Emerging Technologies, (RS) Characterization of Recommender Systems, (OB) Recommendation Objective, (STK) Stakeholders, (FT) Features: Variables, and (Gap) Theoretical Gaps and Limitations. For each category, the key findings were extracted from the primary articles and linked to the specific studies supporting them, allowing the evidence to be traced back to its source.

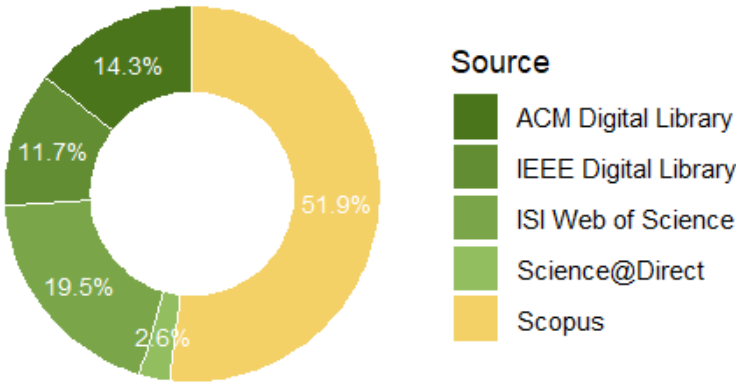


Fig. 4 - Articles organized by source4

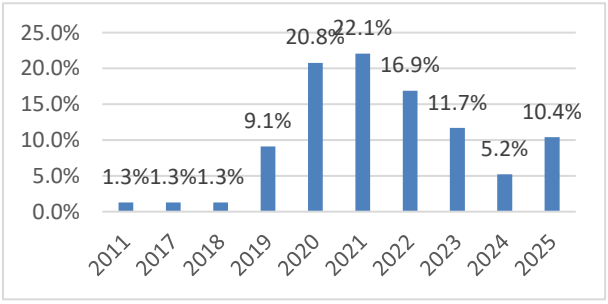


Fig. 5- Primary articles published by year

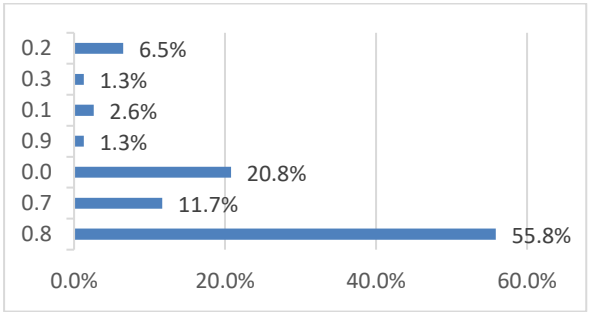


Fig. 6 - Scoring of primary articles

The literature review gathered findings from eight key areas related to the use of Recommender Systems (RS) in Agri-Food Supply Chains (AFSC). These findings are organized around the answers to the eight research questions that guided this review.

RQ1: AP (Application Field)

Systems are deployed across a spectrum from global to specific contexts. Six core groups were identified: (1) Global and Specific Chains (e.g., perishables, grains). These focus on traceability and risk management. (2) Logistics and Inventory Optimization for agri-food goods. (3) E-commerce and Consumer Recommendation for nutrition and agricultural product sales. (4) Traceability in Specific Sectors such as wine, dairy, and coffee. (5) General Supply Chain Management with an emphasis on retail. (6) Cross-Sector Applications such as pharmaceuticals and finance. Applications in unrelated sectors, such as pure fashion or tourism, were excluded. Within internal applications, cold-chain logistics has benefited from the integration of generative AI and blockchain. One study proposes a multi-agent framework that combines GenAI with blockchain to enhance the resilience and sustainability of fruit cold-chain logistics [10]. Similarly,[11] demonstrates through agent-based simulation how "GenAI + blockchain" coordination can improve quality trust in agricultural supply chains. These studies highlight the potential of hybrid architectures to address traceability and coordination challenges.

KPI (Key Performance Indicator)

KPIs were categorized into eight strategic groups. Metrics of (1) Operational Efficiency and Loss Reduction (food waste, MSE in forecasts) are predominant. Other key groups are: (2) Precision in Traceability and Safety (disease detection, immutability). (3) Recommendation/AI Model Performance (nDCG, RMSE, F1-Score). Also relevant are KPIs for (4) Commercial and Financial Impact (satisfaction, revenue). (5) Sustainability (carbon footprint). (6) Logistics Optimization (shelf availability, picking distance). (7) Data Quality and Fairness (algorithmic bias). (8) Performance in Specific Contexts (e.g., electronic market efficiency).

TE (Emerging Technology)

Techniques were grouped according to their core purpose. Notable groups include: (1) Blockchain and Smart Contracts integrated with IoT for traceability. (2) Classic Recommendation Methods (collaborative filtering, data mining). (3) Factorization and Tensor Models (SVD, NMF) for complex data. (4) Deep Learning and Representations (LSTM, GNN, Transformers) for contextual recommendations. (5) Reinforcement Learning and Optimization (DRL, genetic algorithms) for autonomous decisions. (6) Traditional ML (Random Forest, ARIMA). (7) Computer Vision (CNN). (8) IoT and Digital Twins for simulation and monitoring. A key emerging technique is the integration of blockchain with recommender systems. [12] presents a survey of blockchain-based recommender systems, proposing an integration architecture and taxonomy that addresses trust, transparency, and decentralization. This aligns with the broader trend of combining distributed ledger technologies with intelligent recommendation mechanisms in supply chains.

RS (Recommender System)

Systems are conceptualized as integrated tools for various operational and strategic purposes. Eight roles were recognized: (1) Monitoring and Early Warning for food safety, (2) Decision Support (DSS) for risk and demand prediction. (3) Real-Time Logistics Optimization. (4) Consumer Personalization (FRS) and nutrition. (5) B2B Collaboration Platforms for Industrial Symbiosis. (6) Marketing and Sales tools in retail. (7) Assistants for Supplier Selection and Financing. (8) Specialized Systems for health or cultural heritage.

OB (Recommendation Objective)

Objectives are oriented towards optimizing different layers of the supply chain. The main ones are: (1) Optimize Transportation and Distribution (routes, logistics costs). (2) Manage Operations and Inventories (reduce waste, balance stock). (3) Ensure Safety and Compliance (traceability, early detection). (4) Personalize the Consumer Experience and promote healthy habits. Other aims include: (5) Boost Sales and Marketing. (6) Foster Sustainability and Collaboration within the network. (7) Improve Financial and Human Resource Management. (8) Enable Predictive Analysis for strategic planning. Recommender systems have also been positioned as enablers of supply chain agility. [13] argues that RS can improve responsiveness and adaptability in supply chain management by supporting decision-making under uncertainty. This perspective reinforces the dual role of RS identified in this review: optimizing internal operations while enhancing external personalization. On the external side, food recommender systems have gained attention for their potential to personalize consumer choices. [14] provides a systematic review of food recommender systems, highlighting advances in nutritional personalization, user profiling, and preference modeling. This body of work illustrates how RS can simultaneously serve operational and consumer-facing objectives in agri-food chains.

STK (Stakeholders)

The stakeholders form a multi-level ecosystem. These include: (1) Primary Actors (producers, farmers). (2) Logistics Operators (carriers, warehouse managers). (3) Retailers and Distributors (e-commerce platforms). (4) End Consumers and the Community. (5) Regulatory and Governmental Entities. (6) Support Providers (banks, IT, pharmaceuticals). (7) Internal Managers and Analysts. (8) Academia and R&D. This diversity underscores the need for designs that balance the perspectives of all links in the chain.

FT (Feature Variables)

Users exhibit heterogeneous profiles that condition RS design. Eight profiles were identified: (1) Health and Personalized Nutrition-Oriented. (2) Those Operating in Resource-Limited Environments (infrastructure, connectivity). (3) Motivated by Transparency and Ethics. (4) Defined by Quantifiable Purchasing Behavior. (5) Professional B2B Stakeholders. (6) Sensitive to Economic Factors and Value. (7) In Specific Interaction or "Cold-Start" Situations. (8) With Diversified and Complex Social Preferences. This taxonomy is crucial for effective personalization.

GAP (Theoretical Gaps)

The review revealed eight categories of gaps for future research. (1) Lack of Interoperability Standards and robust infrastructure for technologies like blockchain. (2) Disconnect between Academic Validation and Real-World Application contexts. (3) Critical Problems in Data Quality, Integration, and Management. (4) Limitations in Algorithms for handling complex dynamics and providing interpretability. (5) Insufficient Understanding of Coordination Dynamics and Business Models in multi-platform ecosystems. (6) Gap between Theoretical Development and Practical Adoption, including social impacts. (7) Immature Integration of Emerging Technologies (e.g., DRL, meta-learning) into sustainability frameworks. (8) Lack of Advanced Methods for Risk Assessment, Governance, and Consideration of Human Factors in algorithmic design.

Collectively, these results outline a vibrant and multifaceted field of research. The convergence of AI with AFSC is generating innovative solutions. Significant challenges remain that require an interdisciplinary and systemic approach for their resolution.

Discussion

This literature review brings together current knowledge on the use of Recommender Systems (RS) in Agri-Food Supply Chains (AFSC). It shows that this is a fast-changing area of research that brings together many fields. The discussion highlights key findings, what they mean, and the main issues that come up when computer science, operations management, and the agro-industry meet.

This review synthesizes a complex and emerging field of research. Specifically, it identifies a fundamental tension between two predominant paradigms: (1) RS for internal operational optimization, which targets areas like logistics, traceability, and inventory management; and (2) RS for external interaction and personalization, which focuses on marketing and consumer nutrition. Internal RS emphasizes efficiency and process improvements within agricultural operations, leveraging factors such as weather, soil, and pest management, whereas[15] external RS prioritizes tailoring experiences and products to end users at the retail and consumer levels. This duality is evident across objectives and performance metrics in the literature, revealing a persistent gap. Our systematic review reveals a broader, more fragmented landscape than prior work on blockchain-based recommender systems [12] , highlighting this contrast. The divergence underscores the need for a hybrid and integrated RS that connects supply chain constraints with market personalization drivers. Bridging these paradigms could close the loop between efficient production and sustainable consumption.

A crucial finding is that the effectiveness of any RS is severely conditioned by the operational context and user characteristics, demanding specialized rather than universal solutions. Specifically, the identified gaps—scarcity and poor quality of data, limited infrastructure, and the extreme heterogeneity of stakeholders—require that AI methodologies be selected through a design centered on the specific context, not merely for their abstract technical sophistication. This principle is exemplified by recent research seeking to overcome the limitations of generic approaches. For instance, the SC-TKGR model, proposed for recommendations[16] in the electrical supply chain sector, recognizes that even advanced architectures

such as Graph Neural Networks (GNNs) are insufficient for capturing temporal variability and data sparsity. In response, its design explicitly incorporates temporal knowledge graphs, external market factors, and contrastive learning, thereby achieving a robust model for monthly demand trends. Ultimately, this case reinforces our conclusion: progress does not lie in adopting the most complex technique, but in adapting and hybridizing it to solve the operational constraints and the specific nature of the data and actors in a domain, thereby aligning algorithmic innovation with the realities of the agri-food or industrial supply chain. This review is limited by its reliance on six academic databases and English-language publications, which may have excluded relevant regional or non-indexed studies. The exclusion of grey literature may have introduced publication bias, and the heterogeneity of objectives, contexts, and metrics across the reviewed studies prevented quantitative synthesis. Additionally, although PRISMA guidelines were followed, screening decisions involved researcher judgment. These limitations should be considered when interpreting the findings.

Conclusions

This review systematically maps how Recommender Systems intersect with Agri-Food Supply Chains. By analyzing evidence across eight key dimensions, this analysis clarifies the field's complexity and highlights its potential to advance agri-food solutions.

The findings show that RS are evolving. They are moving from isolated marketing or optimization tools into strategic parts of an integrated digital ecosystem. This ecosystem can intelligently and in real time connect all actors in the chain, from smallholder farmers to end consumers, including logistics operators, regulators, and financial institutions. Identifying specific applications, emerging methods and technologies—such as deep reinforcement learning, digital twins, and blockchain—and relevant KPIs for each layer provides a solid reference for future design and evaluation.

The core value of this synthesis lies in its guidance for building more effective, sustainable, and equitable agri-food RS. Clarifying conflicting objectives like efficiency versus personalization, thoroughly characterizing stakeholders and needs, and mapping theoretical and practical gaps together offer a prioritized roadmap for research and development. For these systems to be truly transformative, technological advances must become tangible improvements in environmental sustainability, operational resilience, and integration and equity across the chain.

A critical need from this review is to localize and contextualize system applications. General frameworks must be adapted to integrate local actors, especially small and medium-scale producers and regional value chains. This means developing low-cost, easy-to-adopt RS, designing governance models that empower producers, and creating value metrics that include both economic efficiency and the strengthening of social capital and local sustainability.

This review finds that the future of agri-food supply chains hinges on the creation of human-centered, system-value-oriented recommender systems. These must actively foster trust, collaboration, and transparency to close gaps and advance smarter, fairer, and more sustainable chains.

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