Berajah Journal
Published by: CV Lafadz Jaya | ISSN: 2797-1805 | E-ISSN: 2797-1882

Volume 6 No. 3 (2026)
Page: 1074 – 1083
https://ojs.berajah.com/index.php/go/

ARTIFICIAL INTELLIGENCE IN AGRIBUSINESS DEVELOPMENT: A LITERATURE REVIEW

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Received: 01-05-2026 | Revised: 20-05-2026 | Accepted: 01-06-2026 | Published: 04-06-2026

Abstract

Artificial Intelligence (AI) is increasingly developing as a technology that is able to support the transformation of the agribusiness sector through the use of data and business process automation. This study aims to analyze the opportunities, challenges, and directions of Artificial Intelligence development in agribusiness based on various relevant scientific literature. The research uses the library research method with data sources in the form of journal articles, books, proceedings, and other scientific publications obtained through documentation studies. The collected data was analyzed using content analysis techniques to identify key themes related to the application of AI in agribusiness. The results show that the use of AI makes a significant contribution to improving production efficiency, optimizing the use of resources, predicting the accuracy of crop yields, supply chain management, and data-driven decision-making. In addition, AI implementation still faces various obstacles, such as limited digital infrastructure, high technology adoption costs, low human resource capacity, and data security and privacy issues. This study also shows that future AI development needs to be directed towards more inclusive, affordable, and sustainable technologies to support the increase in the competitiveness of the agribusiness sector. Thus, AI has the potential to be a strategic instrument in encouraging the modernization and sustainability of agribusiness in the digital era..

Keywords: *Artificial Intelligence, agribusiness, digital transformation*

INTRODUCTION

Digital transformation has become one of the main drivers of change in various economic sectors in the era of the Industrial Revolution 4.0. The rapid development of information and communication technology allows various business activities to be carried out more effectively, efficiently, and data-based. One of the technologies that has undergone significant development in recent years is Artificial Intelligence (AI). This technology is able to mimic human cognitive abilities through the process of learning, pattern recognition, data analysis, and automated decision-making. The presence of AI has had a far-reaching impact on a wide range of sectors, including manufacturing, healthcare, education, finance, and agriculture (Alloghani, 2024).

The agribusiness sector is one of the strategic sectors that plays an important role in supporting food security, economic development, and community welfare. However, the sector still faces various challenges, such as climate change, limited natural resources, fluctuations in commodity prices, pest and plant disease attacks, and increasing food needs due to population growth (Ali et al., 2025). These challenges require innovation and the use of technology that is able to increase productivity, efficiency, and sustainability of the agribusiness system.

In this context, Artificial Intelligence is starting to be widely used to support various agribusiness activities. The application of AI can be found in precision farming systems (*Precision Agriculture*), crop yield prediction, plant disease identification, intelligent irrigation management, real-time monitoring of land conditions, and agricultural supply chain management (Akkem et al., 2023). AI's ability to process large amounts of data allows decision-making to be done faster and more accurately than conventional approaches. Therefore, AI is seen as one of the technologies that has the potential to increase the competitiveness of the agribusiness sector while supporting sustainable agricultural development.

DOI: https://doi.org/10.47353/bj.v6i3.560

Various previous studies have shown that the application of Artificial Intelligence has a positive impact on increasing the efficiency and productivity of agribusiness (Ali et al., 2025; Mana et al., 2024). AI is able to help optimize the use of fertilizers and water, improve the accuracy of production predictions, reduce the risk of crop failure, and improve the efficiency of agricultural product distribution. In addition, technological developments *Machine Learning*, *Deep Learning*, and *Computer Vision* further expanding opportunities for the use of AI in various agribusiness subsystems, from production processes to marketing agricultural products.

However, the implementation of Artificial Intelligence in agribusiness still faces various obstacles. The high cost of technology investment, limited digital infrastructure, low technological literacy among agribusiness actors, and data security and privacy issues are obstacles that are often found (Wu & Zhong, 2025). In addition, the gap in technology access between developed and developing countries has caused the adoption rate of AI in agribusiness to not be evenly distributed. These conditions show that the success of AI implementation is not only determined by technological sophistication, but also by supporting economic, social, institutional, and policy factors.

Studies on application *Artificial Intelligence* (AI) in the agriculture and agribusiness sectors continues to grow in line with the increasing use of digital technology in production and farm business management. However, Bhat said that most of the research is still oriented towards technical aspects, such as the development of prediction models, plant disease detection, and automation of production processes (Bhat et al., 2025). Research that systematically examines the opportunities, challenges, and trends of AI development in agribusiness is still relatively limited. Therefore, a study that is able to synthesize various research findings is needed to provide a more comprehensive picture of the development, potential, and direction of AI research in the agribusiness sector.

Based on these conditions, this study seeks to fill the research gap through a literature review that integrates various findings regarding opportunities, challenges, and directions for the development of Artificial Intelligence in agribusiness. In contrast to previous research that tended to focus on specific technical aspects, this study presents a more comprehensive synthesis of the development of the use of AI in the agribusiness sector. Thus, this research is expected to make a conceptual contribution to the development of digital agribusiness literature as well as a reference for academics, business actors, and policymakers in formulating Artificial Intelligence implementation strategies to increase the competitiveness and sustainability of the agribusiness sector in the digital era.

LITERATURE REVIEW

The use of Artificial Intelligence in agribusiness is growing along with the increasing need for more efficient production and management systems. Various studies show that AI can be applied to various agribusiness subsystems, ranging from production, processing, distribution, to marketing of agricultural products (Indra & Wijaya, 2025). AI's ability to process data and produce accurate predictions provides opportunities for agribusiness actors to improve productivity, operational efficiency, and decision-making quality.

At the production stage, AI is widely used in the concept *Precision Agriculture* or precision agriculture. Through the use of sensors, drones, satellite imagery, and the Internet of Things (IoT), AI can help monitor crop conditions, detect pest and disease attacks, manage irrigation needs, and predict crop yields. The application of this technology allows for more efficient use of resources while increasing

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agricultural productivity. In addition, various studies show that the utilization of *Machine Learning* and *Computer Vision* able to improve the accuracy of plant disease detection so as to support a faster and more precise decision-making process (Handoko et al., 2024).

Not only at the production stage, AI also plays a role in the management of the agribusiness supply chain. This technology can be used to predict market demand, optimize inventory management, improve distribution efficiency, and analyze consumer behavior. Indra and Wijaya's findings show that the application of AI in the agribusiness supply chain can increase operational efficiency and strengthen business competitiveness (Indra & Wijaya, 2025). The results of Oktavianus' research also indicate that AI's ability to process data quickly and accurately contributes to increasing the effectiveness of business processes and the quality of decision-making (Oktavianus et al., 2023).

Despite offering various benefits, the implementation of AI in agribusiness still faces a number of challenges, such as high investment costs, limited digital infrastructure, low technology literacy, and data security issues (Cahyati et al., 2025). In addition, Sasongko and Ni'mah explained that most of the research on Artificial Intelligence in the agribusiness sector still focuses on the technical aspects of technology application, such as crop yield prediction, plant disease detection, and production process automation (Sasongko & Ni'mah, 2025). The focus of studies that tends to be limited to certain subsystems causes the understanding of the role of AI in the overall agribusiness system to be comprehensively depicted.

Based on these various studies, it can be understood that Artificial Intelligence has an increasingly important role in supporting the development of modern agribusiness. Its utilization includes not only aspects of production, but also supply chain management, marketing, and decision-making. However, the implementation of AI still faces various challenges that need to be overcome so that the benefits of technology can be optimally felt by all agribusiness actors.

METHOD

This study uses a library research method with a qualitative approach to review various literature related to the use of Artificial Intelligence (AI) in the agribusiness sector (Scott, 2017). Research data is in the form of secondary data obtained from journal articles, books, proceedings, research reports, and various other scientific publications relevant to the research topic. The selection of literature sources is carried out based on the relevance of the theme, the credibility of the source, and its suitability with the research objectives.

Data collection is carried out through documentation techniques by searching, identifying, and collecting various literature that discusses the application of Artificial Intelligence in agribusiness (Arikunto, 2010). The collected literature is then selected and classified based on the focus of the research study, namely the opportunities for the application of AI in agribusiness, the challenges of AI implementation, and the direction of AI development in the future. This stage is carried out to obtain relevant data and in accordance with the focus of the research.

Data analysis uses content analysis techniques, which are by identifying, grouping, and interpreting information contained in various literature sources (Moleong, 2018). Furthermore, the findings that have thematic relevance are synthesized descriptively so as to produce a more comprehensive understanding of the opportunities, challenges, and directions of Artificial Intelligence development in the agribusiness sector. The results of the analysis are then presented systematically in accordance with the focus of the research discussion.

DOI: https://doi.org/10.47353/bj.v6i3.560

RESULTS AND DISCUSSION

Artificial Intelligence Opportunities in Agribusiness Development

The results of the literature review show that Artificial Intelligence (AI) is one of the technologies that has the potential to drive the transformation of the agribusiness sector in the digital era. Indra and Wijaya explained that AI's ability to process data quickly, accurately, and sustainably allows various agribusiness activities to be carried out more effectively than conventional approaches (Indra & Wijaya, 2025). In addition, Jayanto and Suparwata emphasized that the use of AI not only increases operational efficiency, but also supports the creation of an agribusiness system that is more adaptive to changes in the environment, market, and technology (Jayanto & Suparwata, 2025). Thus, AI is seen as a strategic instrument that is able to strengthen the competitiveness of the agribusiness sector amid the demands of modernization and digitalization.

The main opportunity for the application of AI is seen in increasing agricultural productivity. Rahmadina explained that the integration of AI with technologies such as machine learning, computer vision, digital sensors, and the Internet of Things (IoT) is able to improve the accuracy of monitoring plant conditions and support more precise cultivation management (Rahmadina et al., 2025). The technology allows the identification of plant needs, early detection of pest and disease attacks, and prediction of crop yields based on the analysis of historical data and environmental conditions. The findings show that AI contributes to increased productivity through more measurable and data-driven production management. This condition indicates a shift in agricultural management patterns from conventional approaches to more accurate and efficient data-driven approaches.

In addition to supporting productivity, AI also provides opportunities in optimizing the use of agricultural resources. Nurani revealed that the application of AI is able to help manage water, fertilizers, and pesticides more efficiently through the concept of precision agriculture (Nurani et al., 2025). The use of resources that are more targeted not only reduces production costs, but also reduces the potential for waste which has been one of the problems in agricultural activities. Therefore, the use of AI not only provides economic benefits for agribusiness actors, but also supports the realization of more sustainable agricultural practices.

Another opportunity is related to the ability of AI to support the risk management of agribusiness businesses. Maulia Usni explained that the agricultural sector has a high level of uncertainty due to weather changes, attacks by plant pest organisms, and fluctuations in market prices (Maulia Usni, 2025). Through predictive analysis, AI is able to help identify potential risks early so that agribusiness actors can formulate more appropriate anticipatory steps. This ability shows that AI not only functions as a production support technology, but also as a risk mitigation instrument that can increase the resilience of agribusiness businesses.

In the management aspect, Gunawan and Marina emphasized that AI has an important role in optimizing the agribusiness supply chain. AI's ability to analyze market demand patterns allows businesses to manage inventory, plan distribution, and forecast consumer needs more accurately. The use of this technology contributes to reducing losses due to excess or undersupply and increasing the efficiency of the logistics process (Gunawan & Marina, 2025). Thus, the benefits of AI are not only felt at the production level, but also at the entire agribusiness system from upstream to downstream.

Furthermore, Listy and Ilham stated that AI's ability to process large amounts of data can produce more accurate information about market conditions, demand trends, business risks, and business

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development opportunities (Listy & Ilham, 2025). This information is the basis for agribusiness actors in determining strategies that are more effective and responsive to the dynamics of the business environment. In this context, AI functions as a decision support system that is able to improve the quality of agribusiness planning and management in a more measurable and data-based manner.

Although these opportunities show promising prospects, Jayanto and Suparwata emphasized that the effectiveness of AI utilization is still influenced by data quality, infrastructure readiness, and the ability of human resources to operate available technology (Jayanto & Suparwata, 2025). Therefore, the benefits of AI cannot always be obtained optimally in all agribusiness conditions. However, various findings in the literature show that the opportunities offered by AI are far greater than the existing limitations, especially in supporting the increase in productivity, efficiency, and competitiveness of the agribusiness sector.

Based on these findings, it can be understood that Artificial Intelligence has wide opportunities to support agribusiness development, ranging from increasing productivity, resource use efficiency, risk management, supply chain optimization, to strengthening decision-making systems. Therefore, AI has the potential to be a key technology in the transformation of modern agribusiness because it is able to increase productivity, resource use efficiency, decision-making accuracy, and sustainable competitiveness of agricultural businesses.

Challenges of Implementing Artificial Intelligence in Agribusiness

Although Artificial Intelligence (AI) offers various opportunities for agribusiness development, its implementation still faces a number of challenges that can hinder the process of adoption and its optimal utilization. Anggraini and Latifah explained that the success of AI implementation is not only determined by the capabilities of the technology itself, but also by the readiness of the ecosystem that supports its use (Anggraini & Latifah, 2025). Therefore, the various obstacles that arise need to be comprehensively understood so that the implementation of AI can provide maximum benefits for the agribusiness sector.

One of the main challenges in the implementation of AI is the limitations of digital infrastructure. Setiawan and Rahadian explained that the application of AI requires the support of a stable internet network, adequate technological devices, and an integrated data management system (Setiawan & Rahadian, 2025). However, infrastructure conditions in various agricultural areas still show considerable gaps, especially in rural areas that have limited access to technology. This condition causes the use of AI to not be carried out evenly so that the benefits of technology are more felt by regions that already have better digital readiness.

The next challenge is related to the high cost of investment and technology operations. Wanda said that the implementation of AI requires various supporting devices such as sensors, software, computing systems, and data processing services that require a relatively large cost (Wanda et al., 2024). According to them, cost barriers are one of the factors that most often influence technology adoption decisions, especially for smallholders and micro-scale agribusiness actors. As a result, there is a potential gap in the use of technology between business actors who have adequate financial resources and those who have limited capital.

In addition to economic factors, the quality of human resources is also an equally important challenge. Gunawan and Marina emphasized that the use of AI requires the ability to operate digital technology, understand data, and interpret information generated by AI systems. However, the level of digital literacy and technological readiness among agribusiness actors still varies (Gunawan & Marina, 2025). In many cases, limited knowledge and skills cause the available technology to not be optimally

DOI: https://doi.org/10.47353/bj.v6i3.560

utilized. These findings show that human resource capacity development is just as important as the provision of technology itself.

Cahyati explained that Artificial Intelligence relies heavily on accurate, complete, and relevant data to produce accurate analysis and predictions. However, data management in the agribusiness sector still faces various obstacles, such as limited data, inconsistencies in information, and low integration between systems (Cahyati et al., 2025). This condition has the potential to reduce the level of accuracy and effectiveness of AI technology in supporting decision-making.

Limbong highlighted that the risk of data leakage, misuse of information, and weak data protection systems can reduce users' trust in AI technology. Along with the increasing use of digital data in agribusiness, data security and privacy issues are becoming increasingly important concerns (Limbong et al., 2026). Therefore, strengthening data security systems and drafting clear regulations are aspects that need to be considered to support the safe and sustainable application of AI.

Rani revealed that resistance to change, low levels of trust in new technologies, and limited policy and institutional support are obstacles in the process of adopting innovations (Rani, 2024). In some situations, agribusiness actors tend to maintain conventional methods because they are considered more appropriate for their experiences and conditions. The findings show that digital transformation is not only related to technological aspects, but also requires a change in mindset, work culture, and supporting institutional systems.

Ali explained that limited infrastructure, low digital literacy, and high investment costs are interrelated factors in hindering the implementation of AI (Ali et al., 2025). Limited infrastructure can hinder quality data management, while low digital literacy can reduce the effectiveness of the use of available technology. On the other hand, the high cost of investment limits access to technology, thereby slowing down the digital transformation process. The findings show that the biggest challenge in implementing AI lies not only in the technology, but also in the readiness of the supporting environment that allows the technology to be optimally utilized.

Based on these findings, it can be understood that the challenges of implementing Artificial Intelligence in agribusiness are multidimensional and interrelated. The obstacles that arise are not only from the technological aspect, but are also influenced by economic factors, the quality of human resources, data availability, institutional readiness, and policy support. Therefore, the development of AI in agribusiness requires a holistic approach through collaboration between governments, academics, technology providers, and business actors so that the benefits of technology can be felt more broadly and sustainably.

Future Research Directions of Artificial Intelligence in Agribusiness

The results of the study in the previous section show that Artificial Intelligence (AI) has a great opportunity in increasing the productivity, efficiency, and competitiveness of the agribusiness sector. However, its implementation still faces various challenges related to digital infrastructure, investment costs, quality of human resources, data management, and institutional support (Aijaz et al., 2025). These conditions indicate that future research will not only need to focus on developing more advanced technologies, but also on efforts to improve the effectiveness of AI implementation in various agribusiness contexts.

Various literature shows that research on AI in agribusiness is still dominated by technical aspects, such as crop yield prediction, plant disease detection, and automation of production processes (Despita Maharani et al., 2025). Although the research makes a significant contribution, studies on the social, economic, and institutional factors that influence the success of AI implementation are still relatively limited.

DOI: https://doi.org/10.47353/bj.v6i3.560

This gap shows the need for more multidisciplinary research so that the understanding of the use of AI in agribusiness focuses not only on technological aspects, but also on the factors that determine its successful adoption.

One of the research directions that is expected to continue to develop is the integration of Artificial Intelligence with the Internet of Things (IoT), big data, and other digital technologies. Various studies reveal that the integration of this technology has the potential to produce a smart farming system that is able to monitor and manage production in real-time (Rahmadina et al., 2025). Therefore, research on technology integration models that are effective and in accordance with the needs of the agribusiness sector is an important agenda in the development of digital agribusiness in the future.

The next direction of research is related to the development of AI to support sustainable agriculture. A number of studies show that AI can help improve the efficiency of water, fertilizer, and pesticide use so that it can reduce negative impacts on the environment (Purnama Mendrofa, 2025). However, research on the long-term effects of AI applications on economic, social, and environmental sustainability still needs further attention (Insirat et al., 2025). Thus, studies that link AI with the principles of sustainable development are one of the important research opportunities to be developed.

In addition, various literature confirms that research on the use of AI for small-scale farmers is still relatively limited (Hadi et al., 2026). Most AI technology innovations are developed for users who have access to adequate capital, infrastructure, and resources. In fact, smallholders are a group that dominates the agricultural sector in many developing countries. Therefore, future research needs to be directed towards the development of AI technology that is simpler, affordable, easy to use, and in accordance with the needs of users at the grassroots level so that the benefits of technology can be felt more inclusively.

The development of generative technology and AI-based analytics also opens up new research opportunities in the agribusiness sector. AI's ability to generate recommendations, perform simulations, and process large amounts of data has the potential to support faster and more accurate decision-making (Aijaz et al., 2025). Therefore, research on the use of generative AI in business management, digital marketing, supply chain management, and agricultural information systems is expected to be one of the growing topics in the future.

In addition, research on AI policy and governance in agribusiness also needs to receive greater attention. The results of the study show that the success of AI implementation is not only determined by technological aspects, but also influenced by regulations, data protection, institutional support, and collaboration between stakeholders (Rani, 2024). Therefore, research that focuses on the development of policies and governance models that are able to support the safe, effective, and sustainable use of AI is highly relevant to be conducted.

Based on these findings, the future research direction of Artificial Intelligence in agribusiness needs to shift from a focus that is solely oriented towards technological innovation to a more integrative approach. Research not only needs to develop AI technical capabilities, but also pay attention to aspects of accessibility, sustainability, institutional readiness, and socio-economic impact. With this approach, the use of AI in agribusiness is expected to provide broader, inclusive, and sustainable benefits for all agribusiness actors.

CONCLUSION

Based on the results of a literature review, Artificial Intelligence (AI) has developed into one of the technologies that plays an important role in the transformation of the agribusiness sector. The results show

that the use of AI contributes to increasing agricultural productivity, resource use efficiency, strengthening risk management, supply chain optimization, and data-driven decision-making. The findings show that AI not only functions as an operational support tool, but also as a strategic instrument in increasing the competitiveness of the agribusiness sector in the digital era.

On the other hand, the implementation of AI in agribusiness is still faced with various interrelated challenges. Limited digital infrastructure, high investment costs, low technological literacy, data quality and security, and institutional support that is not optimal are factors that affect the level of technology adoption. The results of the study show that the success of AI implementation is not only determined by technological aspects, but also by the readiness of human resources, the institutional environment, and policies that support the digital transformation process.

The study also shows that the development of AI in agribusiness requires a more integrative approach in the future. Research not only needs to focus on technological innovation, but also on aspects of accessibility, sustainability, socio-economic impact, and governance of AI implementation. Thus, the use of Artificial Intelligence is expected to provide broader, inclusive, and sustainable benefits in supporting the development of the agribusiness sector.

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