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Blockchain Technology in Poultry Farming: A Review

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Abstract

Blockchain technology is making waves in poultry farming by revolutionizing how the industry manages transparency, traceability, and food safety. With its ability to create decentralized, tamper-proof records, blockchain is improving the way poultry products move from farm to table.One of the standout benefits of blockchain in poultry farming is traceability. By using blockchain, every step of the poultry supply chain, from hatching to processing and packaging, can be tracked and recorded. This means that if there's ever a food safety issue or a product recall, the source of the problem can be quickly pinpointed. It's a game-changer in terms of preventing fraud and ensuring that consumers get the products they expect. Blockchain also offers a significant boost to food safety. It provides a transparent, unalterable record of every transaction in the supply chain, including details on how the poultry was raised, what it was fed, and the conditions under which it was processed. This level of transparency not only boosts consumer trust but also ensures that poultry products meet safety standards and regulations.On top of that, blockchain is improving efficiency. By automating parts of the supply chain with smart contracts, transactions are faster and more accurate, from payments to inventory management. While there are challenges, like the initial setup costs and the need for standardized practices across the industry, the future of blockchain in poultry farming is bright. As technology improves and more players in the industry adopt it, blockchain is set to help create a more sustainable and ethical poultry supply chain.

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1. Introduction

Poultry farming plays a crucial role in feeding the world, providing us with staple foods like eggs and chicken meat. As the global population continues to grow, the demand for poultry products is on the rise, making the poultry industry an essential part of ensuring food security. However, despite its importance, the industry faces several challenges, particularly when it comes to inefficiencies in supply chain management, food safety, and transparency. Traditional poultry supply chains often lack the real-time data, accountability, and traceability needed to effectively monitor products from farm to table. This creates a range of problems, including the spread of foodborne illnesses, fraud, and unethical practices in production (Kamilaris et al., 2019). With these issues in mind, there is a growing need for innovative solutions that can improve transparency, traceability, and safety in the poultry sector. One such solution gaining traction is blockchain technology, which has the potential to revolutionize the industry.

Blockchain, originally developed as the technology behind cryptocurrencies like Bitcoin, is now being explored for applications in a variety of industries, including agriculture. At its core, blockchain is a decentralized digital ledger that records transactions across multiple computers. These records are immutable, meaning that once a transaction is recorded, it cannot be altered, which ensures the integrity of the data. This characteristic makes blockchain an ideal tool for improving transparency and accountability in poultry supply chains. By providing real-time tracking and creating a secure, tamper-proof record of each step in the production process, blockchain can offer much-needed visibility into the poultry supply chain. This means that every movement of poultry products can be tracked from farm to table, ensuring they are safe, high-quality, and ethically sourced. Blockchain has the potential to address the inefficiencies that have plagued the industry for years, making it a promising solution to some of poultry farming's most persistent challenges.

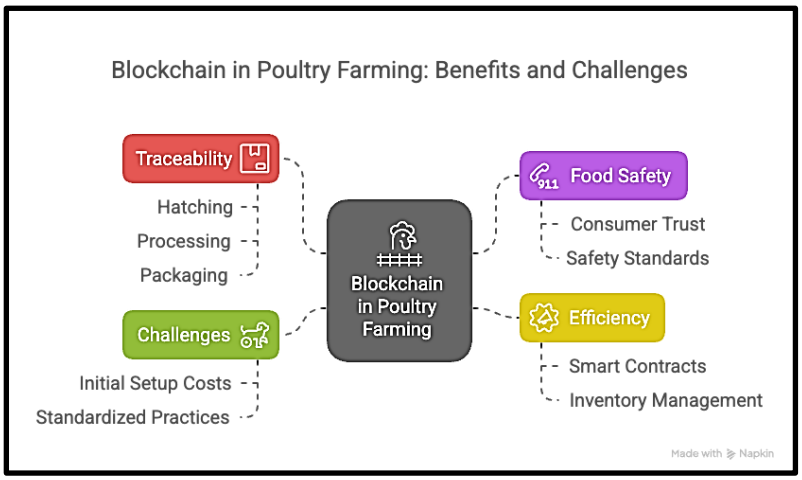

Figure 1 A: Visual overview of the benefits and challenges of integrating blockchain in poultry farming, highlighting key aspects like traceability, food safety, efficiency, and challenges such as setup costs and the need for standardized practices.

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The Challenges of Traditional Poultry Supply Chains

The poultry supply chain is a web of interconnected players, including farmers, feed producers, processors, retailers, and, of course, the consumers who eventually enjoy the final product. Each step in this chain contributes to the end result, but if one link breaks, it can create ripple effects that jeopardize the safety, quality, and integrity of the product. One of the major challenges is traceability. Poultry products often travel through several intermediaries before they reach the consumer, making it difficult to trace the product's entire journey—from farm to table (Leferink, 2022).This lack of visibility means that when problems arise, such as contamination or the discovery of unsafe products, identifying the source of the issue becomes a difficult and time-consuming process. Traditional methods of tracking and record-keeping are usually manual or fragmented, leading to inefficiencies, errors, and delays in addressing food safety concerns.

Another critical issue is biosecurity. The threat of disease outbreaks, such as avian influenza, can have severe consequences, not only on poultry populations but also on the broader food supply chain. Diseases often spread due to inadequate monitoring of poultry health, poor biosecurity practices, or contaminated feed. These outbreaks can harm animal welfare and pose significant risks to public health, leading to widespread economic losses (Serbessa et al., 2023).With the traditional farming methods in place, the lack of real-time data and a centralized monitoring system makes it difficult to consistently track flock health and respond quickly to emerging threats.

Fraud and counterfeit products also plague the poultry industry. From mislabeling products to using substandard feed or chemicals, these dishonest practices erode consumer trust, disrupt markets, and even pose health risks. For example, poultry products that claim to be “organic” or “antibiotic-free” may not actually meet the standards those labels imply (Bowman et al., 2016). Consumers are increasingly concerned about the ethics of the food they buy—especially in regard to animal welfare and the environmental footprint of farming. However, the lack of transparency in traditional supply chains makes it hard to verify these claims. Without a reliable way to confirm where the products come from or how they were produced, consumers are left uncertain about the true quality of what they are purchasing.

2. Applications of Blockchain in Poultry Farming

2.1 Traceability and Food Safety

Blockchain technology brings a transformative approach to poultry farming by providing complete traceability of products from farm to table. This end-to-end visibility is crucial for ensuring food safety and transparency in the supply chain. A prime example of this can be seen in the work of Wang et al. (2022), who designed and implemented a blockchain-based poultry supply chain

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management system. This system tracks important data points, such as feed quality, vaccinations, and growth metrics, all the way from the hatchery to the market.

By creating an immutable, transparent record of every step in the production process, blockchain helps to boost consumer confidence and ensure compliance with regulatory standards. If a food safety issue arises, such as a contamination or health concern, this system allows for quick identification of the affected products and their origin, enabling faster and more effective responses. Moreover, blockchain technology reduces the risk of fraud or mislabeling by providing a transparent record that can be easily accessed by consumers, regulators, and industry stakeholders. As a result, blockchain not only enhances the integrity of poultry products but also creates a more accountable and trustworthy supply chain (Majdalawieh et al., 2021).

In addition to improving consumer trust, blockchain's role in ensuring regulatory compliance is critical. With ever-stricter food safety standards, producers must be able to prove that their practices meet the necessary requirements. Blockchain facilitates this by automatically recording data that can be reviewed by regulators at any time, ensuring that poultry producers can demonstrate adherence to the highest food safety standards.

2.2 Halal Certification and Consumer Trust

The global poultry market is diverse, with consumer demands influenced by various cultural, religious, and ethical standards. One of the most significant considerations in poultry production is the adherence to Halal requirements, particularly in Muslim-majority countries. Halal certification ensures that food products comply with Islamic law, which dictates how animals must be raised, slaughtered, and processed (Rahman et al., 2024). As consumers become more conscious about the authenticity of Halal claims, the poultry industry faces increasing pressure to provide transparent, verifiable evidence that products meet these stringent standards. In this context, blockchain technology presents a solution by offering a secure, transparent, and immutable method of tracking poultry products throughout the supply chain.

Blockchain and Halal Verification

Blockchain technology enables the digitization of Halal certification records, which provides a transparent, tamper-proof system for tracking every step in the poultry rearing and processing process. Al-Shammari et al. (2021) demonstrated that integrating blockchain with Halal certification systems could enhance the credibility and trustworthiness of poultry products in Muslim-majority countries. In their study, they emphasized that blockchain offers a unique advantage by creating a decentralized ledger that records all relevant data—from the sourcing of feed to the slaughter process—ensuring that the entire poultry production process adheres to Halal standards. This system offers real-

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time tracking and traceability, providing stakeholders, including consumers, producers, and regulatory authorities, with access to detailed, immutable records about how the poultry was raised and processed. One of the primary benefits of blockchain in the Halal certification process is the assurance of transparency. With blockchain's distributed ledger, each transaction, including details on animal welfare, feed sources, and slaughter methods, is recorded and cannot be altered without the consensus of the network participants. This immutability helps prevent fraud or mislabeling of poultry products, which is particularly important in Halal certification (Ellahi et al., 2025). For example, a product labeled as Halal must meet strict requirements at every stage of its journey, from farm to table. Blockchain can capture each of these stages and provide consumers with verifiable proof that the poultry product they are purchasing is genuinely Halal. Consumers can use a simple QR code scan to access a digital record of the product's Halal status, enhancing their confidence in the authenticity of the product.

Moreover, blockchain-based Halal certification systems can streamline the auditing process (Ridho, 2025). Traditional methods of verification are often time-consuming and require physical inspection of records, which can be prone to errors or manipulation. With blockchain, regulatory authorities and certification bodies can access real-time, accurate data on poultry production without the need for repeated manual inspections. This not only reduces operational costs but also improves the efficiency and reliability of the certification process. Blockchain can also integrate with other technologies, such as IoT devices, to provide live data on poultry health, environment conditions, and processing standards, further enhancing the granularity and accuracy of Halal verification (Ahmad et al., 2025).

Enhancing Trust in Halal Poultry Products

In markets where Halal certification is a significant factor in consumer decision-making, blockchain can enhance the trustworthiness of poultry products. Muslim consumers often rely on Halal certification to ensure that the products they purchase meet religious dietary laws. However, concerns about the integrity of Halal claims—such as the potential for mislabeling or fraudulent certification—can lead to skepticism and hesitation among consumers. Blockchain can address these concerns by offering a transparent, unalterable record of the production process, ensuring that consumers can easily verify the authenticity of Halal claims (Mehmood et al., 2024).

In addition, blockchain's role in traceability plays a crucial role in improving food safety. In the event of a foodborne illness outbreak or contamination, blockchain can help trace the affected products back to their source, enabling rapid recalls and minimizing public health risks. This traceability, combined with Halal certification, ensures that poultry products are not only ethically and

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religiously compliant but also safe for consumption. As a result, blockchain-backed Halal certification has the potential to strengthen consumer confidence in the entire poultry supply chain, offering peace of mind that products adhere to both food safety standards and religious requirements (Ramli et al., 2024).

Regulatory Compliance and Efficiency

Blockchain also offers benefits in terms of regulatory compliance and efficiency in Halal certification. In many countries, Halal certification bodies have specific requirements that poultry producers must meet, and the certification process often involves numerous inspections and audits. By digitizing the entire certification process, blockchain can help streamline compliance procedures and reduce the risk of human error. Regulatory authorities can access the blockchain ledger to verify that poultry producers are following the appropriate procedures without needing to conduct time-consuming and costly audits (Lenjula, 2020). This integration of blockchain into regulatory processes not only ensures more efficient certification but also strengthens the overall reliability and accuracy of Halal claims in the poultry sector.

2.3 Supply Chain Optimization

Blockchain technology significantly enhances the efficiency and transparency of poultry supply chains by offering real-time tracking, traceability, and auditing capabilities. One of the key advantages of blockchain in poultry farming is its ability to enable real-time auditing of the entire production process. This means that stakeholders, including farmers, processors, and regulators, can access accurate data at any point in the supply chain. By digitizing the entire journey of poultry products, from farm to market, blockchain ensures that all transactions and movements are recorded securely and immutably. This reduces the chances of errors, fraud, and mislabeling, as each action is transparent and traceable, providing confidence to consumers and regulatory bodies alike (Bosona and Gebresenbet, 2023).

Furthermore, blockchain can help prevent health outbreaks by enabling quick and efficient product recalls. In the event of contamination or other issues with poultry products, blockchain allows for instant identification and tracking of affected batches. With the ability to trace the products' journey back to their source, producers and regulators can act swiftly to remove contaminated products from the market, reducing the risk of widespread health issues. This level of efficiency is especially important in ensuring food safety and maintaining consumer trust in the integrity of the poultry supply chain (Aslam et al., 2023).

Another significant application of blockchain is the use of smart contracts. These contracts automate processes such as payments and production agreements, especially between poultry

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integrators and smallholder farmers. Smart contracts allow for automatic execution of payment once certain conditions are met, such as the delivery of a specific quantity or quality of poultry products. This reduces delays and ensures timely payments, fostering stronger relationships between farmers and integrators. Additionally, smart contracts can streamline production planning and coordination, making the overall supply chain more efficient (Taherdoost, 2023).

3. Benefits of Blockchain in Poultry Industry

Blockchain technology is making a significant difference in poultry farming by improving transparency, food safety, certification, accountability, and consumer trust. Here's how:

1. **Transparency**: One of the biggest benefits blockchain brings to poultry farming is transparency. Every step in the poultry production process—from the farm to the consumer—is securely recorded on a decentralized digital ledger. This means that all information is tamper-proof and can be accessed by anyone involved in the process, from farmers to consumers. This open access reduces the chances of fraud or unethical practices, ensuring that the data you're seeing is accurate and trustworthy. Consumers and regulators can track products in real-time, ensuring that everything from how the poultry was raised to how it was processed is on the record and available for review (Wang, 2020).
2. **Food Safety**: When it comes to food safety, blockchain offers a game-changing advantage. In case of contamination or a health issue, blockchain makes it incredibly easy to trace the affected products back to their source. This quick identification helps to isolate the problem and prevent any further risk to consumers, allowing for a faster response to potential foodborne illnesses or recalls. With blockchain, the poultry industry can respond faster and more efficiently to ensure that only safe products reach consumers (Bafti et al., 2023).
3. **Certification**: In today's market, consumers want to know that their poultry is not only safe but also meets certain ethical standards, like being Halal, organic, or antibiotic-free. Blockchain helps make sure that the certifications companies claim are truly valid. By tracking every step of the production process, blockchain provides a verified record of compliance with these certifications. This ensures that consumers can trust the claims about the products they buy, making it easier for ethical shoppers to choose responsibly produced goods (Fowler, 2017).
4. **Accountability**: Blockchain also plays a role in holding poultry farmers and integrators accountable for their practices. The technology tracks everything from the quality of feed to the health of the poultry and the conditions they are kept in. By ensuring that every participant in the supply chain follows established standards, blockchain helps improve the overall

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practices of the industry, leading to more sustainable and ethical farming practices (Fennell, 2022).

5. **Consumer Trust**: Finally, blockchain builds trust between producers and consumers. By allowing consumers to scan a QR code and instantly access detailed information about the product, blockchain empowers shoppers to make informed decisions. This level of transparency ensures that consumers feel confident in the safety and ethics of the poultry products they buy, knowing exactly where their food comes from and how it was produced (Rejeb et al., 2020).

Summary Table:

Benefit	Impact
Transparency	Provides clear, tamper-proof data accessible to everyone
Food Safety	Quick identification of contamination or non-compliance
Certification	Validates Halal, Organic, or Antibiotic-Free claims
Accountability	Encourages better practices from farmers and integrators
Consumer Trust	Enables informed decisions through product tracking

Blockchain is making the poultry supply chain more transparent, secure, and efficient. By giving consumers access to detailed, trustworthy information, the technology enhances food safety, builds trust, and encourages ethical practices throughout the industry. In this way, blockchain is helping shape a more responsible and consumer-friendly poultry sector.

4. Challenges in Implementation

While blockchain technology presents significant potential to improve transparency, efficiency, and food safety in poultry farming, its widespread adoption faces several challenges. These barriers primarily stem from the high costs associated with implementation, limited technological knowledge among farmers, and the absence of standardized frameworks for integrating blockchain into the agriculture sector.

1. **High Setup Costs**: One of the primary obstacles to blockchain adoption in poultry farming is the high initial setup cost. Blockchain systems often require the integration of Internet of Things (IoT) sensors and digital platforms to collect and record real-time data from the farm. These sensors, which track variables such as feed quality, animal health, and environmental conditions, can be expensive to install and maintain. Additionally, establishing a blockchain-based platform to store, process, and manage the data requires significant investment in both hardware and software infrastructure. For smallholder farmers, the cost of these technologies

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can be prohibitive, limiting their ability to benefit from blockchain solutions (Kamilaris et al., 2019).

2. **Low Digital Literacy among Farmers**: Many farmers, especially in rural areas, may lack the technical knowledge required to implement and operate blockchain systems effectively. Blockchain, IoT, and digital record-keeping may be unfamiliar to those who have traditionally relied on manual methods to track and manage poultry production. The lack of digital literacy among farmers presents a significant barrier to blockchain adoption, as it requires training and education to equip farmers with the skills needed to use these technologies. Without adequate support, farmers may be hesitant to adopt blockchain, fearing that the technology is too complex or difficult to integrate into their daily operations (Gokhale et al., 2023).
3. **Lack of Standardized Frameworks**: Another major challenge is the absence of standardized frameworks for implementing blockchain in the agriculture sector. Without a clear set of guidelines and best practices, different stakeholders may struggle to adopt and integrate blockchain technologies seamlessly. The lack of standardization leads to fragmented efforts in blockchain adoption, making it harder for the industry as a whole to benefit from the technology. A unified approach that includes standardized protocols, regulations, and interoperability guidelines is essential for ensuring the successful integration of blockchain into poultry supply chains (Mirabelli and Solina, 2020).

Despite these barriers, the potential benefits of blockchain in poultry farming are immense, and addressing these challenges could pave the way for more widespread adoption in the future. Efforts to lower costs, improve digital literacy, and create standardized frameworks will be critical in overcoming the obstacles to blockchain's implementation.

5. Future Prospects

Blockchain technology can be significantly enhanced by integrating it with Internet of Things (IoT) devices and Artificial Intelligence (AI) to create a highly automated, data-driven poultry farming system. IoT sensors can be used to collect real-time data on various aspects of poultry farming, such as temperature, humidity, feed consumption, and animal health. This data can be securely recorded on a blockchain ledger, ensuring its integrity and accessibility (Gouiza et al., 2024).

With AI, this data can be further analyzed to predict potential diseases, monitor animal growth patterns, and generate personalized feed schedules tailored to the specific needs of each bird. For instance, AI could analyze patterns in the poultry's health data to forecast outbreaks of disease before they spread, enabling preventive actions to be taken swiftly. Additionally, personalized feed schedules could optimize growth and reduce waste, improving farm efficiency (George and George, 2023).

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Future systems could also incorporate blockchain tokens to reward farmers for adopting sustainable practices. These tokens could be awarded for actions like reducing waste, using eco-friendly feed, or adhering to ethical animal welfare practices. Blockchain could also be used to trace and calculate the carbon footprint of poultry farming, ensuring that farms meet environmental regulations. Furthermore, it could support government initiatives, such as distributing subsidies for sustainable poultry practices, incentivizing environmentally-conscious farming practices (Camel et al., 2024).

By combining blockchain, IoT, and AI, the poultry industry can become more efficient, sustainable, and accountable (Chauhan & Sahoo, 2024).

6. Conclusion

Blockchain technology has the potential to revolutionize poultry farming by addressing long-standing issues related to traceability, food safety, and consumer trust. With its secure, transparent, and immutable ledger system, blockchain offers an efficient way to track poultry products throughout their journey from farm to table. This level of traceability ensures that every step, from how the animals are raised to how they are processed, is recorded and available for review. As a result, it becomes easier to pinpoint any source of contamination, making recalls faster and more efficient, and ultimately improving food safety.

For consumers, blockchain offers a sense of assurance that the products they purchase are safe and meet the standards they expect. With increasing concerns about food quality and ethical sourcing, being able to verify the authenticity of poultry products through blockchain could rebuild trust in the industry.

However, large-scale adoption of blockchain in poultry farming requires more than just technological integration. It calls for interdisciplinary research and the development of policies that address regulatory challenges, establish standards, and promote collaboration across the industry. By combining innovation, research, and thoughtful policy implementation, blockchain can become a cornerstone of a more transparent, accountable, and sustainable poultry industry.

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