



Artificial Intelligence Applications in Poultry Production: Current Evidence, Challenges, and Implications for Afghanistan

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Abstract

Artificial intelligence (AI) is increasingly being investigated as a tool for improving poultry production, health monitoring, environmental management, and farm automation. This narrative review synthesizes scientific evidence on AI applications in poultry production and evaluates their potential applicability, infrastructure requirements, limitations, and future opportunities in Afghanistan. Literature was searched using Google Scholar, Scopus, PubMed, Web of Science, IranMedex, and Magiran using terms related to artificial intelligence, machine learning, poultry production, disease detection, computer vision, Internet of Things, robotics, animal welfare, and Afghanistan. The initial search identified 66 potentially relevant records, and 30 publications were included in the narrative synthesis after screening and eligibility assessment. Current evidence indicates that AI can support early disease and abnormal-behavior detection, environmental monitoring, precision management of feed and production, and robotic farm operations. However, successful implementation depends on data quality, reliable electricity and connectivity, suitable sensors and computing infrastructure, technical expertise, and economic feasibility. Importantly, the available literature does not provide sufficient evidence to conclude that AI is already widely adopted in Afghanistan's commercial poultry sector. Therefore, AI adoption in Afghanistan should be approached through locally validated, gradual, and economically appropriate applications, beginning with digital record keeping, environmental sensing, computer-vision monitoring, and decision-support systems. Future studies should evaluate these technologies under real Afghan poultry-farming conditions.

Keywords: Artificial intelligence, poultry production, machine learning, internet, robotics

کاربردهای هوش مصنوعی در تولید طیور: شواهد موجود، چالش ها و پیامدها برای افغانستان

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خلاصه

هوش مصنوعی؛ به گونه روز افزون به عنوان ابزاری برای بهبود تولیدات مرغداری، نظارت بر صحت، مدیریت محیطی و خودکارسازی فعالیت های فارم های مرغداری مورد بررسی قرار می گیرد. این مرور روایتی، شواهد علمی موجود در زمینه کاربردهای هوش مصنوعی در تولیدات مرغداری را جمع بندی نموده و قابلیت کاربرد، نیازمندی های زیربنایی، محدودیت ها و فرصت های آینده آن را در افغانستان ارزیابی می کند. برای جستجوی منابع علمی از پایگاه های Scopus، Google Scholar، Web of Science، PubMed، IranMedex و Magiran با استفاده از اصطلاحات مرتبط با هوش مصنوعی، یادگیری ماشین، تولیدات مرغداری، تشخیص بیماری، بینایی کمپیوتر، اینترنت اشیا، رباتیک، رفاه حیوانات و افغانستان استفاده شد. در جستجوی ابتدایی، ۶۶ منبع بالقوه مرتبط شناسایی گردید و پس از بررسی و ارزیابی معیارهای واجد شرایط بودن، ۳۰ مقاله در تحلیل روایتی مورد استفاده قرار گرفت. شواهد موجود نشان می دهد که هوش مصنوعی می تواند در تشخیص زودهنگام بیماری ها و رفتارهای غیرطبیعی، نظارت بر شرایط محیطی، مدیریت دقیق خوراک و تولید و انجام فعالیت های فارم توسط سیستم های رباتیک مؤثر باشد. با این حال، تطبیق موفقانه این فناوری به کیفیت ارقام، دسترسی به برق پایدار و اتصال مطمئن به شبکه، تجهیزات و حسگرهای مناسب، زیرساخت های محاسباتی، نیروی متخصص تخنیک و امکان پذیری اقتصادی وابسته است. مهم تر از همه، منابع علمی موجود شواهد کافی برای نتیجه گیری در مورد استفاده گسترده هوش مصنوعی در بخش مرغداری تجارتی افغانستان ارائه نمی کنند. بنابراین، پذیرش و تطبیق هوش مصنوعی در افغانستان باید به صورت تدریجی، متناسب با شرایط اقتصادی و بر اساس اعتبارسنجی محلی انجام شود و در گام نخست بر ثبت دیجیتال، معلومات، استفاده از حسگرهای محیطی، نظارت مبتنی بر بینایی کمپیوتر و سیستم های حمایت از تصمیم گیری تمرکز نماید. مطالعات آینده باید قابلیت و کارایی این فناوری ها را تحت شرایط واقعی فارم های مرغداری افغانستان ارزیابی کنند.

کلیمات کلیدی: اینترنت، تولیدات مرغداری، هوش مصنوعی، رباتیک، یادگیری ماشین

Introduction

The poultry industry is considered one of the most important pillars of agriculture and livestock production worldwide, playing a fundamental role in providing animal protein, ensuring food security, creating employment opportunities, and supporting economic development. In many developing countries, including Afghanistan, this sector has gained particular importance due to rapid population growth, increasing demand for meat and eggs, and limited natural resources. However, poultry production systems in the country are largely based on traditional methods and face numerous challenges, including poor farm management, the spread of diseases, and serious production constraints. These issues have led to increased production costs, reduced product quality, and heightened vulnerability of small-scale producers (Taleb et al., 2025).

In recent years, rapid advancements in digital technologies—particularly artificial intelligence—have attracted the attention of researchers and policymakers in the livestock sector. Artificial intelligence refers to a set of methods capable of analyzing data, identifying patterns, and learning from experience to make intelligent decisions. Review studies indicate that the application of AI in the poultry industry can bring about significant transformations in production management, reduce mortality rates, improve animal welfare, and enhance economic returns Bahçeci et al. (2025).

One of the most important applications of artificial intelligence in the poultry industry is the management and early detection of diseases. Poultry diseases are among the primary causes of reduced production and economic losses. Ramírez Morales et al. (2019) demonstrated that the use of machine learning algorithms can detect abnormal changes in egg production curves before the appearance of clinical symptoms. This study highlights the critical importance of analyzing production data for disease prevention and management (Ramírez Morales et al., 2019).

In addition to disease detection, computer vision and deep learning play a significant role in monitoring poultry behavior and physical condition. Scientific studies show that analyzing images and videos recorded in poultry houses can provide valuable information about activity levels, abnormal behaviors, and signs of stress in birds. These innovations enable farm managers to make data-driven and timely management decisions (Natsir et al., 2025).

Furthermore, the integration of artificial intelligence with the Internet of Things (IoT) allows environmental sensors to collect data such as temperature, humidity, air quality, and light intensity, which are then analyzed by intelligent algorithms. Research findings indicate that smart control of environmental conditions not only improves poultry growth and performance but also reduces stress and enhances animal welfare (Natsir et al., 2025).

From an animal welfare perspective, recent studies place particular emphasis on the use of multimodal artificial intelligence systems. Essien and Neethirajan (2025) demonstrated that combining visual, auditory, and environmental data can provide a more accurate and comprehensive assessment of the health and welfare status of laying hens. These approaches enable the early detection of behavioral and physiological issues and are aligned with modern sustainable production practices (Essien & Neethirajan, 2025).

In Afghanistan, despite the importance of the poultry industry, the level of utilization of artificial intelligence-related innovations remain very limited. Factors such as weak digital infrastructure, a shortage of skilled human resources, the absence of systematic data collection systems, and financial constraints are among the main barriers to the development of these

innovations. Nevertheless, review studies emphasize that even the gradual and small-scale adoption of smart technologies can have a significant impact on improving farm management and increasing productivity (Taleb et al., 2025).

On the other hand, the gradual development of communication technologies, increased access to smartphones, and growing awareness of the importance of innovation in agriculture have created a favorable opportunity for introducing AI-based solutions in Afghanistan's poultry industry. The targeted use of these technologies can help reduce dependence on poultry imports, increase domestic production, and improve the country's food security Ahmer et al. (2022).

Accordingly, examining the application and use of artificial intelligence in Afghanistan's poultry industry appears essential. Such an assessment can provide a scientific framework for policymaking, planning, and investment in this field. The objective of this review article is to comprehensively analyze the applications of artificial intelligence in the poultry industry, identify its potential opportunities and benefits, and evaluate the feasibility of implementing these innovations under the specific conditions of Afghanistan based on reliable scientific evidence.

Methodology

The present study was conducted as a narrative review focusing on artificial intelligence and related digital technologies in poultry production, with particular consideration of their potential applicability to Afghanistan. Literature searches were conducted using Google Scholar, Scopus, PubMed, Web of Science, IranMedex, and Magiran. Search terms included "artificial intelligence," "machine learning," "deep learning," "computer vision," "Internet of Things," "precision poultry farming," "poultry disease detection," "poultry welfare," "robotics," "poultry production," and "Afghanistan," used individually and in combination. The initial search identified 66 potentially relevant records. Duplicate records were removed, followed by title and abstract screening and full-text assessment. Publications were eligible when they addressed AI, machine learning, computer vision, IoT, robotics, or related intelligent technologies in poultry production; reported applications relevant to poultry health, welfare, environmental management, feeding, production, or automation; and provided sufficient bibliographic and scientific information for interpretation. Publications unrelated to poultry production, duplicate records, and sources with insufficient bibliographic information were excluded. Thirty publications were included in the final narrative synthesis. Because direct peer-reviewed evidence documenting AI adoption in Afghanistan's poultry sector was limited, international studies were synthesized to identify potential applications and requirements, while Afghanistan-specific agricultural and poultry information was used to contextualize feasibility. The review is narrative rather than a systematic review or meta-analysis; therefore, no quantitative effect-size synthesis was undertaken.

The initial search using these keywords retrieved 66 articles relevant to the topic. Research articles with similar variables were selected, and after reviewing titles and abstracts and removing duplicate records, they were further screened. Following the initial selection, the full texts of relevant articles were carefully examined. Ultimately, 30 articles focusing on the application and use of artificial intelligence in the poultry industry were included in this study.

Results

The global poultry production industry faces several challenges, including reduced profitability, high production costs, and management inefficiencies. A review study by Abbas et al. (2022) examined how smart and digital technologies can contribute to improving poultry production and management. The study indicates that the use of intelligent tools in poultry farms offers multiple advantages. These include simplifying feed and water management, as smart systems can monitor and regulate consumption, thereby preventing resource wastage. Additionally, environmental control is enhanced through sensors and automated systems that regulate temperature, humidity, and ventilation, creating a healthy and low-stress environment for birds. The adoption of such technologies also reduces the need for manual labor and minimizes human error, leading to lower operational costs. Furthermore, smart technologies improve animal welfare by continuously monitoring the health and behavior of birds, providing better conditions for growth and production while reducing mortality rates Depuru et al. (2024).

Early Disease Detection in Poultry Using Artificial Intelligence

Early disease detection in poultry farms is essential for preventing disease spread, reducing mortality, and increasing profitability. Traditional disease detection methods often rely on the observation of visible physical symptoms, which leads to delayed responses. In contrast, artificial intelligence and machine learning can utilize digital data to identify early patterns of disease before the appearance of clinical symptoms (Taleb et al., 2025). One important approach in advanced disease detection is the use of thermal imaging (thermography) combined with artificial intelligence. This technique is non-invasive compared to traditional methods and can detect changes in the body temperature of birds as indicators of disease (Sadeghi et al., 2023; Ben Sassi et al., 2016). Thermal data are processed using machine learning algorithms to identify common diseases such as avian influenza and Newcastle disease within the first 24 hours after infection (Sadeghi et al., 2023).

Innovations in computer vision and deep learning are widely used to analyze images and videos of animals in poultry houses. These technologies can detect changes in behavior, movement, body condition, and natural activity patterns, which serve as early indicators of disease or health problems (Astill et al., 2020; Cakic et al., 2023). Studies have shown that computer vision systems are capable of counting, tracking, and behavior analysis of birds and can generate early warning signals for diseases (Liu et al., 2023). Various machine learning algorithms, such as Artificial Neural Networks (ANN), Support Vector Machines (SVM), and Convolutional Neural Networks (CNN), have been applied in disease detection (Taleb et al., 2025; Sadeghi et al., 2023). These algorithms can accurately identify disease symptoms from complex datasets, including behavioral, thermal, and image-based data. The integration of traditional methods with deep learning significantly improves the sensitivity and accuracy of disease detection systems (Taleb et al., 2025). Furthermore, the integration of the Internet of Things (IoT) with artificial intelligence plays a significant role in disease detection in smart poultry farms (Cakic et al., 2023). Systems equipped with continuous sensors, smart cameras, and edge AI devices can collect and analyze environmental and physiological data in real time, enabling fast and accurate predictions of poultry health conditions (Cakic et al., 2023).

Control of Environmental Conditions in Poultry Farms Using Artificial Intelligence

Recent studies indicate that artificial intelligence plays a key role in the automatic and precise control of temperature and humidity in poultry housing systems. Machine learning algorithms, by analyzing real-time sensor data, can regulate environmental conditions in a way

that minimizes thermal stress on birds (Eskioğlu & Özdemir, 2025). Recent review studies have reported that the use of AI-based systems reduces temperature fluctuations and maintains stable environmental conditions even during sudden climate changes, which is directly associated with improved growth performance and enhanced bird health (Wu et al., 2025). In addition, historical environmental data enable algorithms to predict undesirable patterns and implement corrective actions before critical conditions are reached (Kalita et al., 2025). Findings from several recent studies show that thermal imaging using infrared technology combined with artificial intelligence is an effective tool for evaluating farm environmental conditions. This innovation allows for the rapid detection of heat or cold stress through changes in the surface body temperature of birds (Sadeghi et al., 2023). Studies have also demonstrated that deep learning algorithms can interpret thermal data and determine the relationship between birds' body temperature and the quality of environmental conditions within poultry houses (Yang et al., 2024). These findings indicate that AI-based thermal control systems are more accurate and faster compared to traditional methods.

Ventilation and air quality control are among the most critical environmental factors in poultry farms. Recent studies show that artificial intelligence can analyze data related to ammonia, carbon dioxide, humidity, and airflow, and automatically adjust ventilation systems accordingly (Cakic et al., 2023). Nikoukar et al. (2025) reported that intelligent ventilation control reduces respiratory diseases and improves animal welfare. These systems can adjust ventilation based on flock density and real-time farm conditions, making them more efficient than traditional fixed systems (Eskioğlu & Özdemir, 2025).

Furthermore, recent findings indicate that AI-based lighting design and smart lighting regulation can significantly improve behavior, feed consumption, and egg production. Artificial intelligence algorithms generate dynamic lighting programs by considering bird age, species, and environmental conditions (Kalita et al., 2025). Review studies have shown that optimized lighting reduces stress behaviors and improves flock uniformity, playing an important role in increasing farm productivity (Natsir et al., 2025).

Artificial Intelligence in Feed and Pharmaceutical Management in Poultry Farms

Findings indicate that the use of machine learning algorithms and predictive systems enables more precise formulation of poultry diets based on age, weight, breed, environmental conditions, and health status. This improves feed efficiency, reduces unnecessary feed consumption, enhances the feed conversion ratio (FCR), and increases the economic profitability of farms (Taleb et al., 2025; Olori et al., 2025). Studies also show that artificial intelligence systems are capable of determining the exact timing, dosage, and type of medication based on clinical, behavioral, and environmental data. Through early disease detection, these systems enable targeted treatment and reduce the need for preventive drug use (Hosny et al., 2023; Taleb et al., 2025). AI-based decision-support systems, when integrated with health and feed data, contribute to reducing dependence on antibiotics and replacing them with more precise nutritional, managerial, and therapeutic strategies. This approach plays an important role in controlling antimicrobial resistance (AMR) (Hosny et al., 2023). Research results further demonstrate that the combination of sensors, computer vision, and data analytics enables continuous monitoring and improvement of feed quality. These systems can detect fungal contamination, humidity changes, and spoilage of raw feed materials. As a result, they help reduce mortality, maintain poultry health, and prevent the consumption of contaminated feed (Panagi et al., 2025; Taleb et al., 2025).

Applications of Robotics in Artificial Intelligence for the Poultry Industry

Recent studies indicate that AI-powered robots play an important role in improving operational efficiency and enhancing poultry welfare in poultry farms. According to Özentürk et al. (2024), robotic systems equipped with sensors and intelligent algorithms are capable of continuously monitoring environmental conditions, detecting abnormal poultry behavior, managing litter, and automatically collecting eggs fallen on the floor of poultry houses. These capabilities reduce dependence on human labor and increase environmental safety by minimizing direct human–poultry contact. In addition, comprehensive data collection by robots enables more accurate managerial decision-making (Özentürk et al., 2024). The findings of da Rocha Balthazar et al. (2025) show that the use of robots in broiler production systems leads to improved flock uniformity, reduced stress in birds, and better environmental control. The presence of autonomous robots in poultry houses helps regulate the spatial distribution of birds, thereby improving production indicators such as uniform growth and production efficiency. These results suggest that robots are not only monitoring tools but also active components in optimizing poultry production (Da Rocha Balthazar et al., 2025).

One of the major challenges in applying robotics in poultry farms is precise navigation in complex indoor environments. Lu et al. (2025), by proposing a hybrid navigation method based on computer vision and laser sensors, demonstrated that this approach significantly improves the movement accuracy of robots in poultry houses with variable lighting, dust, and multiple obstacles. This technical advancement enables the sustainable use of robots for inspection, monitoring, and automated farm management (Lu et al., 2025). According to Khanal et al. (2025), the integration of robotics with artificial intelligence, machine learning, and the Internet of Things has facilitated the development of smart poultry production systems. These systems play a key role in feed management, early disease detection, mortality reduction, and resource optimization. In this context, intelligent robots act as decision-support tools and contribute to increasing the sustainability and productivity of poultry farms (Taleb et al., 2025).

A review study by Hamrani et al. (2025) indicates that the poultry industry is one of the most suitable sectors for the application of AI-based robotics in agriculture. Closed poultry environments allow better control, accurate data collection, and effective implementation of intelligent algorithms. Additionally, Sajid et al. (2024) reported that the integration of robots with smart sensors improves the management of feed, water, ventilation, and flock health, while significantly reducing operational costs and human errors.

Overall, the findings of these studies suggest that AI-based robotics have strong potential to transform the poultry industry by increasing production efficiency, improving animal welfare, and enhancing environmental safety. Although challenges such as high initial costs and technical complexity still exist, continuous advancements in robotics and artificial intelligence are expected to facilitate the broader adoption of these systems in commercial poultry farms (Özentürk et al., 2024; Hamrani et al., 2025).

Discussion

The findings of this review indicate that artificial intelligence has substantial potential to support poultry production through disease and health monitoring, environmental control, production and feed management, and automation. Recent reviews show that machine learning applications in poultry increasingly cover growth prediction, disease detection, behaviour analysis, environmental monitoring, and productivity enhancement (Naeem et al., 2025). Ad-

vanced detection technologies, including computer vision, infrared thermography, RFID, and sound analysis, have also been investigated for behaviour monitoring, early disease detection, and environmental assessment (Fan et al., 2025). Robotics represents a further development of these technologies, with applications in environmental monitoring, disease control, floor-egg collection, and animal-welfare assessment (Özentürk et al., 2024). However, evidence generated in technologically advanced production systems cannot automatically be interpreted as evidence of current AI adoption in Afghanistan.

Comparison of AI Application Areas

The available evidence indicates that AI applications in poultry production are concentrated in several interconnected domains rather than a single technological pathway. Machine learning applications have been reported across growth prediction, disease detection, behaviour analysis, environmental monitoring, and productivity enhancement, while advanced detection technologies include computer vision, infrared thermography, RFID, and sound analysis (Naeem et al., 2025; Fan et al., 2025). Computer vision and deep learning are particularly relevant to disease detection, bird counting, tracking, and behavioural assessment, whereas IoT-based systems are primarily associated with continuous environmental monitoring and automated management (Natsir et al., 2025). Robotics extends these capabilities by providing physical interaction with the production environment, including inspection, sanitation, floor-egg collection, and monitoring. Recent evidence suggests that integrating AI/ML with IoT and other sensing technologies can support real-time decision-making and improve the comprehensiveness of poultry monitoring systems (Natsir et al., 2025; Fan et al., 2025). However, integration also increases system complexity, data requirements, maintenance needs, and initial investment, while challenges related to data quality, model generalizability, infrastructure, and real-world validation remain important considerations (Naeem et al., 2025; Fan et al., 2025; Natsir et al., 2025).

Applicability and Feasibility in Afghanistan

For Afghanistan, this distinction is particularly important. The transfer of AI technologies to Afghanistan should be evaluated according to local infrastructure, farm size, electricity reliability, connectivity, data availability, technical capacity, and expected economic return. Current reviews identify limited infrastructure, high initial costs, data-quality problems, model generalizability, and limited real-world validation as important constraints on broader AI adoption in poultry production (Naeem et al., 2025; Fan et al., 2025; Natsir et al., 2025). Accordingly, highly autonomous robotic systems may require greater infrastructure and technical capacity than are currently available on some Afghan farms. Lower-cost applications such as digital farm records, temperature and humidity sensors, camera-assisted monitoring, and simple decision-support tools may provide feasible entry points, particularly where they can operate with limited connectivity and generate useful local datasets (Natsir et al., 2025). These technologies can generate local datasets that may subsequently support development and validation of more advanced AI models. Economic evaluation should be performed at farm level before large-scale investment because technical performance reported under other production conditions does not by itself demonstrate economic feasibility under Afghan conditions.

Early Detection of Poultry Diseases Using Artificial Intelligence

One of the most important findings of this study is the positive impact of artificial intelligence on the early detection of poultry diseases. Numerous studies have shown that innovations such as computer vision, thermal imaging, and deep learning algorithms are capable of

identifying physiological and behavioral changes in poultry before the appearance of clinical symptoms (Ben Sassi et al., 2016; Astill et al., 2020; Sadeghi et al., 2023). These findings are consistent with the results of the present study and highlight the importance of non-invasive methods in preventing severe diseases such as highly pathogenic avian influenza (Nikoukar et al., 2025; Yang et al., 2024).

In the context of Afghanistan, where access to advanced veterinary services is limited in many regions, the use of intelligent early warning systems can serve as an effective monitoring tool and help prevent large-scale economic losses. However, challenges such as weak digital infrastructure, lack of organized data systems, and shortage of skilled professionals remain major barriers to the implementation of these technologies in the country (Taleb et al., 2025; Abbas et al., 2022).

Control of Environmental Conditions in Poultry Farms

The results of this study indicate that artificial intelligence plays an effective role in controlling environmental conditions in poultry farms, including temperature, humidity, ventilation, and air quality Ma et al. (2025). Previous studies have reported that systems based on smart sensors and machine learning can reduce heat stress and improve poultry production performance (Astill et al., 2020; Wu et al., 2025). These findings are consistent with the results of the present study and demonstrate that precise farm environment management has a direct impact on poultry health and productivity.

Given the diverse climatic conditions in Afghanistan, the use of intelligent environmental control systems can help poultry farms better adapt to temperature fluctuations. However, high initial costs, the need for stable electricity supply, and the lack of proper maintenance systems are among the key challenges that limit the implementation of these technologies (Abbas et al., 2022; Sajid et al., 2024).

Feed and Pharmaceutical Management Using Artificial Intelligence

The findings of this study indicate that artificial intelligence can play an important role in improving feed management and the use of pharmaceutical products in poultry production. Research has shown that intelligent algorithms are capable of analyzing feed consumption patterns and adjusting poultry diets based on their actual nutritional needs (Taleb et al., 2025; Hosny et al., 2023). This can lead to reduced feed waste as well as a decrease in the overuse of antibiotics.

In Afghanistan, where feed costs account for a major portion of poultry production expenses, the use of smart feed management systems can provide significant economic benefits. However, the lack of local data and organized information recording systems may reduce the accuracy of these models in the early stages of implementation.

Applications of Robotics and AI-Based Systems in the Poultry Industry

The use of robots in the poultry industry, particularly in areas such as health monitoring, farm sanitation, and data collection, is another important finding of this study. Research indicates that the integration of robotics and artificial intelligence can enhance farm operational efficiency while reducing direct human contact with poultry (Özentürk et al., 2024; da Rocha Balthazar et al., 2025). This, in turn, can also lower the risk of disease transmission.

Despite these advantages, the implementation of robotic systems in developing countries is associated with challenges such as high costs, the need for technical maintenance, and limited acceptance among farmers (Hamrani et al., 2025). Therefore, in Afghanistan, the adoption of

these technologies should be carried out gradually and in alignment with the country's economic and technical capacities.

Overall, the findings of this study indicate that artificial intelligence can play a fundamental role in improving Afghanistan's poultry industry. However, to effectively benefit from these technologies, simultaneous attention to infrastructure development, human resource training, and the localization of technologies is essential. Future studies can focus on the practical evaluation of artificial intelligence systems under real poultry farming conditions in Afghanistan.

Conclusion

Artificial intelligence is increasingly being investigated and applied across several areas of modern poultry production, particularly disease and health detection, behavioral monitoring, environmental control, precision feeding and production management, and farm automation and robotics. Recent literature demonstrates substantial progress in computer vision, machine learning, IoT-based sensing, thermal imaging, and robotic systems for poultry production. However, the level of technological maturity differs among applications, and the availability of scientific evidence does not necessarily indicate widespread commercial adoption. Important limitations include the quality and availability of datasets, model generalizability, high initial costs, technical complexity, infrastructure requirements, and the need for trained personnel.

For Afghanistan, the available evidence supports the potential relevance of AI technologies to poultry production, but does not currently provide sufficient evidence to conclude that AI has been widely adopted in the country's commercial poultry sector. Therefore, AI adoption should be approached as a gradual process based on local validation, economic assessment, infrastructure development, and human-resource capacity building. Initial efforts could focus on low-cost digital data collection, environmental sensors, computer-vision monitoring, and decision-support systems, followed by more advanced applications as local data and technical capacity develop.

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