Review Article

Climate Change and Poultry Farming: A Systematic Review of Environmental, Health, and Production Impacts

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Abstract

Climate change is increasingly threatening poultry farming through rising temperatures, heat stress, irregular rainfall patterns, disease outbreaks, and disruptions in feed and water availability, resulting in reduced productivity and compromised poultry health. This systematic review evaluated the impacts of climate change on poultry farming, focusing on production, health, environmental sustainability, resource availability, and adaptation strategies based on studies published between 2020 and 2026. Using PRISMA 2020 guidelines, 328 studies were identified across multiple databases; 30 met the inclusion criteria after systematic screening, and 4 of which were review articles. A narrative synthesis approach was employed due to methodological and outcome heterogeneity among the selected studies. Findings revealed that heat stress is the most significant climate-related challenge in poultry production, contributing to reduced feed intake, slower growth, decreased egg production, impaired immune function, and increased mortality. Climate change also exacerbates the spread of infectious diseases, including Avian Influenza and Newcastle Disease, while limiting feed and water resources and increasing production costs. Environmental impacts included increased pressure on natural resources and reduced farm efficiency. Common adaptation strategies identified were improved housing design, cooling technologies, nutritional interventions, enhanced biosecurity, and the use of heat-tolerant poultry breeds. However, implementation remains limited in developing

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countries due to high costs and restricted access to climate-resilient technologies. Across the reviewed studies, heat stress consistently emerged as the most severe climate-related stressor, with some studies reporting mortality increases of up to 30% under extreme heat conditions. These findings underscore the urgent need for practical, scalable, and climate-resilient adaptation strategies to sustain poultry productivity and food security under changing climatic conditions.

Keywords: climate change, climate-smart agriculture, disease outbreaks, environmental impacts, poultry health

1. Introduction

The global poultry industry has expanded rapidly in recent decades, driven by rising demand for affordable, high-quality animal protein, particularly meat and eggs (Ezihe et al., 2020). This growth has accelerated the adoption of intensive and semi-intensive production systems, which are highly vulnerable to environmental disturbances, particularly those associated with climate change (Ngongolo & Mrimi, 2024). Rising global temperatures, irregular rainfall patterns, and increasing frequency of extreme weather events have emerged as major threats to poultry production systems worldwide, directly affecting bird performance, welfare, and overall farm productivity (Sztandarski et al., 2025).

Among the various climate-related stressors, heat stress remains one of the most significant challenges in poultry farming. Elevated ambient temperatures reduce feed intake, impair growth performance, lower egg production, and weaken immune responses in poultry (Attia et al., 2024). Broiler chickens exposed to prolonged heat stress often exhibit reduced weight gain and poor feed conversion efficiency, while laying hens experience declines in both egg quantity and quality (Neethirajan, 2026). These physiological disruptions ultimately reduce farm profitability and increase production costs (El Sabry et al., 2023)

Climate change also contributes to the emergence and spread of poultry diseases by creating favorable environmental conditions for pathogens, including bacteria, viruses, and parasites, to survive and transmit more effectively under altered temperature and humidity conditions (Biswal et al., 2021). Consequently, diseases such as Avian Influenza, Newcastle Disease, and Coccidiosis have been increasingly associated with climate-related stress, posing serious threats to poultry productivity, food safety, and public health (Liu et al., 2020).

In addition to health-related impacts, climate change affects critical production resources. Rising temperatures and erratic rainfall disrupt the availability of key feed ingredients such as corn and soybeans, leading to increased feed costs and supply instability (Ezihe et al., 2020). Water scarcity during prolonged dry periods further

compromises poultry welfare, sanitation, and on-farm biosecurity (Andretta et al., 2021). At the same time, poultry production contributes to environmental degradation through greenhouse gas emissions, including methane, carbon dioxide, and nitrous oxide, thereby reinforcing the climate change cycle and intensifying environmental pressures on agricultural systems (Godde et al., 2021).

Despite growing research on climate-related challenges in poultry farming, current evidence remains fragmented across environmental, health, production, and adaptation dimensions. A comprehensive synthesis is therefore needed to understand better the overall impacts of climate change on poultry systems and to identify effective adaptation strategies. This systematic review addresses this gap by critically evaluating recent literature (2020–2026) on climate change impacts on poultry farming, with emphasis on production performance, poultry health, environmental sustainability, resource availability, and climate adaptation strategies. This review also contributes to broader global sustainability priorities, particularly SDG 2 by supporting resilient food production systems, SDG 12 through sustainable livestock management, and SDG 13 by identifying strategies to improve climate resilience and reduce environmental vulnerability in poultry production systems.

2. Methodology

2.1 Search Strategy

This systematic review was conducted in accordance with the PRISMA 2020 guidelines to ensure methodological transparency, rigor, and reproducibility. A comprehensive literature search was performed to identify relevant studies examining the impacts of climate change on poultry farming published between 2020 and 2026. Multiple electronic databases were searched, including Scopus, ScienceDirect, PubMed, and Google Scholar. The search strategy used combinations of the following keywords and Boolean operators: “climate change,” “heat stress,” “poultry farming,” “broiler,” “layer production,” “environmental stress,” and “poultry production systems.” The initial search yielded 328 records, of which 74 duplicate articles were removed, leaving 254 studies for title and abstract screening.

2.2 Screening and Study Selection

The screening process was conducted in sequential stages following the PRISMA framework. First, titles and abstracts of the 254 retrieved studies were screened for relevance, resulting in the exclusion of 162 records that did not directly address climate change impacts on poultry farming. Subsequently, 92 full-text articles were assessed for eligibility based on predefined inclusion and exclusion criteria. After full-text review, 62 studies were excluded due to insufficient relevance, incomplete data, or focus on unrelated livestock systems. Ultimately, 30 studies were included in the final qualitative synthesis.

2.3 Eligibility Criteria

Studies were included if they:
(i) examined the impacts of climate change on poultry farming;
(ii) addressed at least one of the following themes: production performance, poultry health, environmental conditions, feed and water resources, or adaptation strategies; and
(iii) were published in English between 2020 and 2026.

Both original empirical studies and review articles were eligible, provided they presented clear, relevant findings on poultry systems under climate-related stress conditions. Due to the limited number of current studies, review articles were considered; however, to make this review robust, a strict inclusion criterion was imposed.

Studies were excluded if they:
(i) focused on non-poultry livestock systems;
(ii) addressed topics unrelated to climate change;
(iii) lacked sufficient methodological or outcome data; or
(iv) were duplicate publications.

2.4 Data Synthesis

Due to heterogeneity in study design, geographical settings, and reported outcome measures, a narrative synthesis approach was employed rather than meta-analysis. Findings were synthesized and categorized into five major thematic areas:
(1) climate stressors identified,
(2) environmental and production impacts,
(3) health impacts on poultry,
(4) adaptation and mitigation strategies, and
(5) regional trends

This thematic approach enabled systematic comparison of climate change impacts across diverse poultry production systems and geographic regions, while highlighting emerging adaptation pathways for sustainable poultry farming (Figure 1).

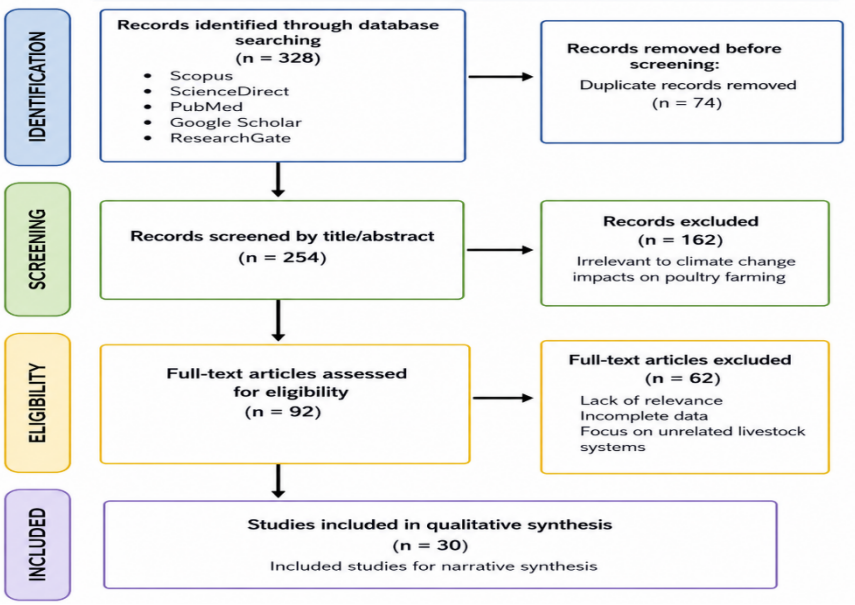

Figure 1. Schematic diagram of the data synthesis of the review.

3. Results

3.1 Study Characteristics

The studies included in this systematic review spanned diverse geographic regions, including Asia, Africa, Europe, and North America, as well as global-level analyses, providing a broad perspective on how climate change affects poultry farming under varying environmental and production conditions. Most selected studies were review articles that synthesized existing evidence on climate-related impacts, while others were experimental, field-based, or observational investigations evaluating the direct effects of heat stress, environmental changes, disease outbreaks, and adaptation strategies on poultry production systems.

The reviewed literature primarily focused on broiler chickens and laying hens due to their substantial economic importance in commercial poultry production worldwide. Several studies also examined the responses of indigenous and local poultry breeds to climate-related stress, particularly in developing countries where traditional and low-input production systems remain prevalent. Across the included studies, a wide range of methodological approaches were employed, including laboratory experiments, farm surveys, simulation models, and observational analyses.

This methodological diversity strengthened the overall evidence base; however, variations in study design, environmental conditions, and outcome measures limited direct comparisons across studies.

3.2 Climate Stressors Identified

Across the reviewed literature, heat stress emerged as the most prevalent and severe climate-related stressor affecting poultry farming. Rising temperatures, prolonged heat exposure, elevated humidity, irregular rainfall patterns, drought, and extreme weather events such as floods and heat waves were consistently reported across different regions and production systems (Mijgar, 2024).

Poultry are particularly vulnerable to thermal stress due to their limited physiological capacity for heat dissipation. Prolonged exposure to elevated temperatures was associated with increased respiratory distress, dehydration, metabolic imbalance, and reduced behavioral comfort. In addition, climate variability disrupted water availability, feed production, and routine farm management practices, further complicating operations. Extreme weather events also damaged poultry housing infrastructure and increased the risk of disease outbreaks, contributing to substantial economic losses and reduced long-term sustainability within the poultry sector.

3.3 Environmental and Production Impacts

The reviewed studies consistently demonstrated that climate change has significant adverse effects on poultry production performance and farm efficiency. Heat stress was strongly associated with reduced feed intake, slower growth rates, poor feed conversion efficiency, lower body weight gain, and decreased egg production (Kheiralipour et al., 2023; Cheng et al., 2022).

Broiler chickens exposed to elevated temperatures showed increased mortality, reduced carcass quality, and lower meat yield, whereas laying hens experienced declines in egg production, egg weight, and shell quality under heat-stress conditions (Wasti et al., 2020; Gržinić et al., 2022). Beyond these direct physiological effects, climate change also disrupted the availability and affordability of major feed ingredients such as corn and soybeans due to climate-sensitive crop production and declining agricultural yields (Kennedy et al., 2022). Rising feed costs placed additional financial pressure on poultry producers, particularly smallholder farmers with limited adaptive capacity.

Furthermore, increased water demand, greater energy consumption for cooling systems, and higher levels of environmental pollution from poultry waste collectively threaten the long-term sustainability and profitability of poultry farming systems.

3.4 Health Impacts on Poultry

The reviewed studies consistently reported that climate change negatively affects poultry health by weakening immune function and increasing susceptibility to infectious diseases. Heat stress suppresses immune responses, reduces disease resistance, and elevates physiological stress, thereby increasing vulnerability to infection and mortality (Oke et al., 2024; Kpomasse et al., 2021b).

Several studies documented an increased prevalence of diseases such as Avian Influenza, Newcastle Disease, Coccidiosis, and Salmonellosis under high-temperature, high-humidity conditions. Climate-related environmental changes also created favorable conditions for pathogens, parasites, and disease vectors to survive and spread more efficiently within poultry production systems (Goswami et al., 2026; Tasmaganbetov et al., 2025).

Additional stressors, including poor air quality, overcrowding, and inadequate ventilation during extreme weather events, further increased the risk of disease transmission. These health-related challenges reduced productivity and animal welfare while increasing mortality, veterinary expenses, and overall economic losses, emphasizing the urgent need for strengthened poultry health management under changing climatic conditions.

3.5 Adaptation and Mitigation Strategies

Several adaptation and mitigation strategies were identified as effective approaches for reducing climate-related risks in poultry farming. Frequently recommended measures included improved housing design, enhanced ventilation systems, evaporative cooling technologies, shading systems, optimized litter management, and efficient water supply infrastructure to minimize heat stress and improve bird comfort (Vandana et al., 2020; Sasi & Harikrishnan, 2026)

Nutritional interventions—including electrolyte supplementation, antioxidant use, probiotics, vitamin supplementation, and modified feeding schedules—were also shown to improve physiological resilience and production performance during periods of thermal stress. In addition, the development and use of heat-tolerant and disease-resistant poultry breeds were highlighted as important long-term adaptation strategies, particularly in tropical and resource-limited settings.

Biosecurity enhancement, vaccination programs, and disease surveillance systems were consistently identified as essential for controlling disease outbreaks under climate-stress conditions (Nissa et al., 2023). Several studies further emphasized that sustainable practices, such as renewable energy integration, improved waste management, precision farming technologies, and water conservation, are important tools for reducing greenhouse gas emissions and improving environmental sustainability. Overall, integrated climate-smart poultry management was identified as the most effective pathway toward long-term resilience (Kumar et al., 2021; Abbas et al., 2025).

3.6 Regional Trends

Significant regional differences were observed in both the severity of climate change impacts and the adaptive capacity of poultry production systems. Poultry farms in tropical and developing regions, particularly in Asia and Africa, were disproportionately affected by persistently high temperatures, limited access to cooling technologies, inadequate infrastructure, and financial constraints (Cheng et al., 2022).

Small-scale poultry farmers in these regions were identified as the most vulnerable due to limited access to capital, climate information, veterinary services, and modern production technologies. In contrast, poultry systems in developed countries demonstrated greater adaptive capacity through controlled-environment housing, automated ventilation and cooling systems, advanced feeding technologies, and stronger disease management programs (Osuji et al., 2024)

However, even highly industrialized poultry systems continue to face challenges associated with rising energy demand, increasing production costs, and the growing frequency of extreme weather events. These findings highlight the need for region-specific adaptation strategies tailored to local climatic conditions, available resources, and production systems to improve resilience and sustainability across the global poultry sector effectively (Table 1).

Table 1. Summary of climate change impacts and adaptation strategies in poultry farming.

Author(s)	Poultry Type	Climate-Related Stressor	Key Findings	Adaptation Strategies
Liu et al. (2020)	Broilers	Heat stress	Heat stress significantly reduced growth performance, feed intake, and feed efficiency while increasing mortality rates.	Environmental cooling, improved ventilation, nutritional supplementation
Wasti et al. (2020)	Broilers and Layers	Heat stress	Heat stress impaired immune function, productivity, and welfare of poultry.	Electrolyte supplementation, dietary antioxidants, housing modifications
Vandana et al. (2020)	Poultry	Heat stress	Elevated ambient temperatures reduced production performance and increased physiological stress responses.	Genetic selection, cooling systems, management interventions

Kumar et al. (2021)	Poultry	Climate change and heat stress	Heat stress negatively affected growth, reproduction, and production efficiency.	Genetic improvement and heat-tolerant breeding programs
Kpomasse et al. (2021)	Broilers	Tropical heat stress	High temperatures in tropical regions constrained broiler growth and productivity.	Improved housing, ventilation, and management practices
Biswal et al. (2021)	Poultry	Heat stress	Heat stress caused reduced feed consumption, lower productivity, and increased disease susceptibility.	Environmental control and nutritional interventions
Andretta et al. (2021)	Poultry and Swine	Environmental sustainability	Poultry production contributes to environmental burdens through resource use and emissions.	Sustainable feeding strategies and resource optimization
Godde et al. (2021)	Livestock including poultry	Climate change	Climate change threatens livestock supply chains through production and resource disruptions.	Climate adaptation planning and resilient production systems
Kennedy et al. (2022)	Poultry	Heat stress	Heat stress is expected to intensify under climate change, threatening poultry productivity in Africa.	Genetic selection for heat tolerance
Gržinić et al. (2022)	Poultry	Environmental impacts	Intensive poultry production affects environmental quality and may increase public health risks.	Sustainable waste management and biosecurity measures
Sabry et al. (2023)	Poultry	Water scarcity	Water shortages may become a critical limitation to poultry production under climate change.	Water conservation technologies and efficient water management
Kheiralipour et al. (2023)	Commercial Poultry	Environmental sustainability	Poultry systems generate environmental impacts through energy use, emissions, and waste production.	Life-cycle-based sustainability improvements
Oke et al. (2024)	Broilers	Climate change and heat stress	Climate change reduces broiler performance, health, and productivity.	Precision management, improved housing, and nutritional strategies
Ngongolo & Mrimi (2024)	Poultry	Climate change	Climate-smart poultry production improves	Climate-smart agricultural practices

			resilience and sustainability under changing climates.	
Abbas et al. (2025)	Poultry	Climate change and food security	Climate change threatens poultry meat production and economic resilience, affecting food security.	Sustainable production systems and resilience planning
Sasi & Harikrishnan (2026)	Poultry	Climate change	Poultry systems face increasing challenges from rising temperatures and resource constraints.	Climate-resilient production systems and adaptation technologies

4. Discussion

4.1 Effective Adaptation Mechanisms

The findings of this review indicate that climate-smart poultry farming represents one of the most effective approaches for mitigating the adverse impacts of climate change on poultry production systems. Key adaptive strategies identified across the reviewed literature included improved housing design, enhanced ventilation, evaporative cooling technologies, balanced nutritional management, and the use of heat-tolerant poultry breeds, all of which help reduce heat stress and sustain productivity under rising temperatures (Sasi & Harikrishnan, 2026).

Importantly, the evidence suggests that integrated management approaches combining environmental control, optimized nutrition, strengthened biosecurity, and proactive disease prevention are more effective than single interventions alone in improving poultry health and welfare, and in long-term farm sustainability (Abbas et al., 2025). In addition, sustainable resource management practices, including efficient water use, improved waste management, and the adoption of renewable energy systems, can further enhance resilience by reducing environmental vulnerability and improving production efficiency. These findings reinforce the importance of transitioning toward holistic, climate-resilient poultry production systems.

4.2 Strengths and Limitations of Evidence

A major strength of this systematic review is the inclusion of recent studies representing diverse geographic regions, climatic conditions, and poultry production systems, which provides a comprehensive understanding of how climate change affects poultry farming globally. Additionally, the review synthesizes multiple dimensions of climate change impacts, including production performance, poultry health, environmental sustainability, resource availability, and adaptation strategies, thereby offering a multidimensional perspective on the issue.

Despite these strengths, several limitations in the available evidence were identified. Variability in study design, climatic conditions, and methodological approaches limited direct comparisons across studies and prevented quantitative synthesis through meta-analysis. Furthermore, many studies relied on simulation models, short-term experimental trials, or review-based evidence rather than long-term field investigations, which may limit the generalizability of findings (Kennedy et al. 2022). Geographic research gaps were also evident, particularly in developing countries where climate vulnerability is greatest, but locally relevant evidence remains limited. Addressing these gaps through long-term, region-specific studies will be essential for improving future climate adaptation planning in poultry systems.

4.3 Implications for Poultry Farmers

The findings of this review emphasize the urgent need for poultry farmers to adopt climate-resilient management practices to reduce production losses and improve bird welfare under increasingly variable climatic conditions. Practical interventions such as improved ventilation, optimized housing orientation, cooling systems, adequate water provision, and heat-stress management can significantly improve poultry performance and survival during periods of elevated temperatures (Oke et al. 2024).

In addition, the use of nutritional supplements, probiotics, and heat-tolerant poultry breeds can strengthen physiological resilience and reduce vulnerability to environmental stress (Liu et al. 2020). However, widespread adoption of these climate-smart strategies may be constrained by limited financial resources, inadequate technical knowledge, and restricted access to modern technologies, particularly among small-scale and resource-limited farmers. Therefore, targeted farmer training, extension support, and improved access to affordable adaptation technologies are critical to strengthening the long-term sustainability of poultry production.

4.4 Implications for Policymakers

Policymakers play a crucial role in supporting climate adaptation and sustainable development within the poultry sector. The findings suggest that governments and agricultural institutions should strengthen agricultural extension systems and farmer education programs to improve awareness and adoption of climate-smart poultry farming practices.

Financial support mechanisms, including subsidies, low-interest loans, and targeted investments in climate-resilient technologies, are essential for enabling poultry producers, particularly smallholders, to adopt effective adaptation measures. Furthermore, increased investment in research and development is needed to accelerate innovation in heat-tolerant poultry genetics, sustainable housing systems, disease prevention strategies, and environmentally sustainable production technologies. Policies promoting efficient resource management, reduced

environmental emissions, and resilient food production systems are equally important to ensuring the long-term sustainability of the poultry sector. These policy priorities directly support United Nations Sustainable Development Goals 2, 12, and 13, emphasizing the broader global significance of climate adaptation in poultry farming.

5. Conclusion

This systematic review demonstrates that climate change poses a significant and growing threat to poultry farming by affecting production performance, poultry health, resource availability, and overall system sustainability. Across the reviewed literature, heat stress emerged as the most critical climate-related challenge, contributing to reduced productivity, increased disease vulnerability, higher mortality, and rising production costs. These impacts are particularly severe in developing and tropical regions, where smallholder poultry farmers face greater exposure to climate risks due to limited adaptive capacity, restricted access to technology, inadequate infrastructure, and insufficient institutional support.

The findings further highlight that poultry farming exists within a complex climate feedback system, as the sector is both vulnerable to climate change and a contributor to environmental pressures through greenhouse gas emissions and waste generation. Several adaptation strategies, including improved housing systems, cooling technologies, nutritional interventions, enhanced biosecurity, vaccination programs, and the use of heat-tolerant breeds, have demonstrated potential to reduce climate-related losses and improve farm resilience. However, their adoption remains limited in resource-constrained settings due to financial, technological, and logistical barriers.

This review should also be interpreted in light of several limitations. The included studies varied considerably in methodology, geographic coverage, production systems, and outcome measures, limiting direct comparisons across studies. In addition, much of the available evidence was derived from controlled experimental settings and commercial poultry operations, while relatively few studies focused specifically on smallholder production systems in developing countries, where climate vulnerability is often greatest. The heterogeneity of the literature also prevented quantitative synthesis of outcomes across studies.

Future research should prioritize long-term field-based studies that evaluate the effectiveness, affordability, and scalability of climate adaptation strategies under real-world farming conditions. Greater attention should be given to smallholder and backyard poultry systems in developing countries, particularly in tropical regions where climate-related risks are expected to intensify. Research on low-cost cooling technologies, locally available feed alternatives, climate-resilient housing designs, and the genetic improvement of heat-tolerant poultry breeds is especially needed. Strengthening the evidence base in these areas will support the development of practical and context-specific adaptation strategies that enhance food security, farmer livelihoods, and the sustainability of poultry production. Such efforts directly

contribute to the achievement of Sustainable Development Goals (SDGs) 2, 12, and 13 by promoting resilient agricultural systems and climate-smart livestock production.

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Conflict of Interest Statement

The authors declare no conflict of interest.

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