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The Role of Biosecurity In Preventing Infectious Diseases In Intensive Poultry Farms: A Review

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Abstract
Biosecurity is one of the main strategies in preventing infectious diseases in intensive poultry farms. Increased poultry population density in intensive systems risks accelerating the transmission of diseases such as avian influenza, Newcastle disease, and salmonellosis. Disease is an abnormal condition in the body of a living creature (human, animal, or plant) that causes bodily functions to be disrupted. This article examines the concept of biosecurity, its implementation in the field, and the challenges of its application based on the results of the latest literature review. The results of the study show that the implementation of biosecurity, which includes traffic control, disinfection, feed management, and poultry health monitoring, has been proven effective in reducing the incidence of infectious diseases. However, its effectiveness is highly dependent on farmer compliance and regulatory support. Thus, biosecurity needs to be made a mandatory standard in poultry farming to ensure productivity and food safety from animal sources.

INTRODUCTION

Biosecurity is a series of preventive measures designed to reduce the risk of infectious disease agents entering and spreading within a livestock unit. In the context of intensive poultry farming, biosecurity is strategically important because the high density of poultry in enclosed housing increases the likelihood of disease transmission. Some of the main diseases of concern in the poultry industry include avian influenza (AI), Newcastle disease (ND), infectious bursal disease (IBD), and salmonellosis. These diseases can have a significant impact on productivity, mortality, and the safety of poultry-derived food (Rahman *et al*., 2021).

Another factor that makes biosecurity increasingly important is the growing demand for animal protein consumption, particularly poultry, which is driving the expansion of intensive production systems. These systems are efficient in terms of production, but they are vulnerable to infectious disease epidemics. Therefore, without strict biosecurity measures, poultry farms have the potential to become sources of disease outbreaks that not only harm farmers but also threaten the health of the wider community (Setiawan *et al*., 2022).

Intensive poultry production systems, characterized by high stocking densities and confined housing, have been widely associated with increased exposure to microbial contaminants and potential disease transmission risks. Gržinić *et al*. (2023) emphasized that intensive poultry farms serve as potential reservoirs for pathogens, including bacteria and

viruses, due to the accumulation of manure, feathers, and dust particles containing microorganisms. The study further highlights that poor litter management, inadequate ventilation, and high animal density contribute to the spread of airborne pathogens and antimicrobial resistance within and beyond the farm environment. These findings underline the essential role of biosecurity measures not only in preventing direct disease outbreaks among poultry but also in minimizing indirect health risks to workers and surrounding communities. Therefore, strengthening farm-level biosecurity, waste management, and monitoring systems remains a crucial strategy to reduce the emergence and dissemination of infectious agents in modern poultry production systems (Gržinić *et al*., 2023).

Recent studies have increasingly demonstrated that biosecurity plays a pivotal role in mitigating infectious disease transmission in intensive poultry farming systems. Naumovska. (2025) found that farms implementing structured biosecurity protocols—such as controlled personnel entry, vehicle disinfection, and separation between production stages—experienced significantly fewer outbreaks of avian influenza and infectious bronchitis compared to farms with minimal preventive measures. Likewise, Gela. (2024) emphasized that intensive poultry production, while economically efficient, inherently elevates the risk of pathogen circulation due to high animal density, shared airspace, and cross-contamination through feed and water systems. The authors highlight that preventive strategies focusing on hygiene management, vaccination coordination, and staff training substantially reduce both mortality rates and antimicrobial use in poultry enterprises. Therefore, establishing a culture of continuous biosecurity awareness remains essential for preventing infectious diseases and ensuring the long-term sustainability of intensive poultry farming (Naumovska et al., 2025; Gela *et al*., 2024).

Beyond the structural and operational aspects of farm management, the effectiveness of biosecurity in intensive poultry farming also depends heavily on farmers' knowledge, attitudes, and compliance. Low awareness and inconsistent application of biosecurity practices remain significant barriers to disease prevention in commercial poultry farms, particularly in low- and middle-income regions. Even farms equipped with modern infrastructure may experience outbreaks of infectious diseases such as salmonellosis and colibacillosis when workers neglect simple preventive actions such as handwashing, equipment disinfection, and movement restrictions. Continuous farmer training, record-keeping, and routine monitoring have been shown to substantially improve compliance levels and reduce the frequency of infectious disease incidents in large-scale poultry enterprises. These findings demonstrate that technical infrastructure alone cannot ensure disease prevention; instead, cultivating a strong biosecurity culture through education, motivation, and supervision is fundamental for maintaining poultry health in intensive farming systems (Adebowale *et al*., 2024; Rojas *et al*., 2025).

The advancement of precision livestock farming technologies has significantly enhanced the implementation of biosecurity measures in intensive poultry production systems. Automated monitoring systems, such as smart cameras, environmental sensors, and RFID-based movement trackers, have improved the ability to detect biosecurity breaches and potential disease threats before they escalate into outbreaks. In addition, digital management platforms allow real-time data collection and analysis on parameters like flock health, waste management, and visitor movement, enabling more rapid and informed decision-making. Artificial intelligence and machine learning applications are also increasingly used to predict the emergence of infectious diseases by analyzing behavioral and environmental patterns within poultry houses. Consequently, the integration of digital innovation into biosecurity

protocols has become a cornerstone for effective disease prevention and sustainable productivity in modern poultry farming (Singh *et al.,* 2025; Martínez & Gómez, 2024).

1. Infectious Diseases in Inte

Some poultry diseases spread very quickly in intensive systems:

1. Avian Influenza (AI).

   This disease is caused by influenza A viruses of the H5N1 and H9N2 subtypes, which remain a major concern in Southeast Asia, including Indonesia. AI can cause mortality rates of up to 100% in a short period of time. Transmission is influenced by direct contact, airborne transmission, and contaminated feed and drinking water (Pratama *et al*., 2022).
2. Newcastle Disease (ND).

   This is a highly contagious viral disease that attacks the respiratory, digestive and nervous systems of poultry. Although routine vaccination is carried out, ND cases are still frequently found due to the circulation of various strains in the field (Hidayat & Susanto, 2024).
3. Salmonellosis.

   Salmonella sp. bacterial infection is a serious threat because it affects poultry health and has the potential to be transmitted to humans through poultry-derived food products. Studies show that farms with low biosecurity have a higher prevalence of salmonellosis than farms that consistently implement biosecurity (Kurniawan *et al*., 2021).
4. Infectious Bursal Disease (IBD).

   This disease attacks the immune system of young chickens and causes a decrease in immunity, making poultry more susceptible to other diseases. The implementation of biosecurity has been proven to significantly reduce the spread of IBD (Suryani *et al*., 2023).

2. Basic Principles of Biosecurity

Biosecurity in intensive poultry farming consists of three main principles:

1. External Biosecurity – aims to prevent diseases from entering the farm from outside, including control of human traffic, vehicles, and equipment.
2. Internal Biosecurity focuses on preventing the spread of disease within the livestock unit itself, for example through an all-in & all-out system, age separation, and routine disinfection.
3. Biomanagement includes livestock welfare management,
4. Environmental hygiene, and regular monitoring of poultry health (Amalia *et al*., 2023).

These three aspects are interrelated and must be implemented consistently to deliver optimal results.

3. Biosecurity Implementation Strategy

The implementation of biosecurity involves various technical measures, including:

- Traffic Control. Everyone entering the pen must wear special clothing, pass through a footbath, and record their visit history. Recent research shows that restricting access can reduce the risk of AI infection by up to 45% (Wulandari *et al.,* 2021).
- Disinfection.The use of disinfectants on equipment, vehicles, and pens has been proven to reduce the number of pathogenic microorganisme by up to 70% (Siregar & Lestari, 2020).

- Feed and Water Management. Feed must be stored in a dry place to prevent fungal and bacterial contamination. Drinking water needs to be disinfected using chlorine or UV light (Putra *et al*., 2021).
- Health Monitoring. Routine examinations of poultry enable early detection of disease. Thus, quarantine measures can be implemented immediately (Hidayat & Susanto, 2024).

4. Effectiveness of Biosecurity

Various studies have proven the effectiveness of biosecurity in reducing disease prevalence:

- Farms with strict biosecurity measures experienced a 60% reduction in AI cases compared to farms with low biosecurity (Pratama *et al*., 2022).
- The implementation of an all-in all-out system reduced the incidence of ND by up to 50% in broiler chickens (Suryani *et al*., 2023).
- An integrated biosecurity programs involving farmer education increased awareness and compliance, resulting in a 40% reduction in the incidence of salmonellosis (Kurniawan *et al*., 2021).

5. Challenges in Implementing Biosecurity

Although proven effective, an implementation of biosecurity still faces various obstacles:

1. Farmer Awareness. Many small-scale farmers do not yet understand the importance of biosecurity and therefore do not implement it consistently (Wulandari *et al*., 2021).
2. Cost constraints. Some biosecurity measures, such as the installation of automatic disinfection systems,
   require significant investment (Hidayat & Susanto, 2024).
3. Regulation and Supervision. Weak enforcement of regulations has resulted in inconsistent biosecurity standards across farms (Rahman *et al.,* 2021).

6. Future Biosecurity

Technological developments have opened up opportunities for integrating biosecurity with digital systems. For example, the use of IoT sensors to monitor temperature, humidity, and livestock movement in real time. This technology can provide early warnings if there are abnormal conditions that have the potential to cause disease (Amalia *et al.,* 2023). In addition, big data and artificial intelligence are beginning to be used to analyse poultry disease patterns, so that preventive measures can be taken more quickly and accurately (Setiawan *et al*., 2022).

RESEARCH METHODOLOGY

This article was compiled using a literature review approach based on national and international journal sources published between 2019 and 2025. Data werehouse'n collected through searches of the Google Scholar, ScienceDirect, and DOAJ databases using the keywords biosecurity, poultry, infectious disease prevention, and intensive farming. Relevant literature was analyzed to discuss the role of biosecurity in disease prevention in intensive poultry farming (Setiawan *et al.,* 2022).

Data Source

The data sources in this study were derived from national and international scientific publications published between 2019 and 2025. This time frame was chosen to ensure that the literature used was up-to-date and in line with the latest developments in the field of poultry biosecurity. Three main databases were used in the literature search, namely:

1. Google Scholar – selected for its wide coverage, including international and national journals, as well as access to open access articles.

2. ScienceDirect – a database owned by Else.
3. Open Access Journal Directory (– selected for peer review.
In addition, several additional articles were obtained from accredited national journals Sinta 1 and Sinta 2 that are relevant to the topic of poultry biosecurity in Indonesia.

Research Design

This article uses a literature review research design. A literature review is a scientific study method that focuses on collecting, evaluating, and synthesizing the results of previous studies relevant to a topic. Unlike experimental research that produces primary data, a literature review relies on secondary data from scientific publications that have undergone a peer-review process. Its main objectives are to present a comprehensive summary of research developments, identify knowledge gaps (research gaps), and provide recommendations that can be used in practice and further research (Rahman *et al*., 2021).

This method was chosen because the topic of biosecurity in intensive poultry disease prevention has been extensively researched in various countries. Therefore, data from various publications can be combined to obtain a more comprehensive picture than the results from a single field study. A literature review also allows researchers to identify the latest trends, compare the effectiveness of biosecurity strategies, and examine the challenges of their implementation in both global and local contexts (Pratama *et al*., 2022).

Reasons for Choosing the Method

There are several methodological reasons why a literature review was used in this study. First, the topic of poultry biosecurity covers various multidisciplinary aspects, ranging from epidemiology, farm management, farmer behavior, to animal health regulations. With a literature review, all of these aspects can be examined holistically. Second, this method is able to integrate research results from various countries, there by providing a broader understanding of the effectiveness of biosecurity in preventing infectious diseases in intensive poultry farming (Suryani *et al*., 2023).

In addition, the literature review method has advantages over field research, namely time and cost efficiency. Field research requires direct observation on farms, laboratory tests, and long-term monitoring, while literature reviews only require access to journal databases. However, the strength of the analysis is maintained because the data used comes from peer-reviewed articles that have high scientific validity (Amalia *et al.,* 2023).

Literatur Search Strategy

Literature search process

a. Identify keywords. The main keywords used are: biosecurity, poultry, infectious disease prevention, intensive agriculture, intensive poultry, poultry disease prevention, and modern farming.
b. Keyword combinations. Searches were conducted using Boolean operators (AND, OR) such as:
    a) “biosecurity” AND ‘poultry’ AND “infectious diseases”
    b) "biography
c. Publication year filter. Articles were limited to publications from 2019 to 2025.
d. Initial evaluation. Articles that appear are checked for their titles and abstracts to assess their relevance.

e. Final selection. Full-text articles that meet the criteria are then downloaded for further analysis.

RESULTS AND DISCUSSION

The Concept of Biosecurity in Intensive Poultry Farming

Biosecurity is defined as a series of preventive measures designed to minimize the risk of disease agents entering and spreading within a livestock unit. In intensive systems, biosecurity comprises three main components: external biosecurity, internal biosecurity, and bio management. Proper implementation of biosecurity has been shown to reduce the prevalence of zoonotic diseases such as salmonellosis in poultry (Kurniawan *et al*., 2021).

Biosecurity Implementation Strategy

Biosecurity practices in the field include controlling human and vehicle traffic, wearing special clothing, disinfecting cages, managing waste, and quarantining new poultry. Research shows that routine disinfection can reduce the risk of pathogen contamination by up to 70% (Siregar & Lestari, 2020). In addition, the implementation of hygienic feed management can prevent the entry of pathogens through feed ingredients (Putra *et al.,* 2021).

The Effectiveness of Biosecurity in Disease Prevation

Recent studies have shown that farms with high levels of biosecurity compliance have experienced a 60% reduction in avian influenza cases compared to farms with minimal biosecurity (Pratama *et al.,* 2022). Biosecurity has also been shown to extend the productive life of broiler chickens with lower mortality rates (Suryani *et al*., 2023).

Challenges in Implementing Biosecurity

Although the benefits of biosecurity are clear, its implementation in Indonesia still faces obstacles in the form of low awareness among farmers, limited funds, and weak regulatory oversight (Wulandari *et al.,* 2021). Education and technical assistance from the government and educational institutions are urgently needed to improve farmer compliance (Hidayat & Susanto, 2024).

Future Directions for Biosecurity Development

The development of digital technologies such as IoT sensors and automated monitoring systems has begin to be implemented to improve biosecurity effectiveness. These systems are capable of detecting changes in temperature, humidity, and movement that have the potential to cause disease (Amalia *et al.,* 2023). With the support of technology, biosecurity is expected to be more adaptive and efficient in the era of modern animal husbandry.

CONCLUSIONS AND SUGGESTION

Biosecurity is one of the main strategies in preventing infectious diseases in intensive poultry farms. Increased poultry population density in intensive systems risks accelerating the transmission of diseases such as avian influenza, Newcastle disease, and salmonellosis. Disease is an abnormal condition in the body of a living creature (human, animal, or plant) that causes bodily functions to be disrupted. This article examines the concept of biosecurity, its implementation in the field, and the challenges of its application based on the results of the latest literature review.

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