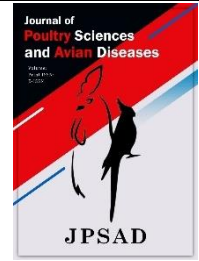


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The evaluation and importance of Newcastle disease's economic loss in commercial layer poultry



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ABSTRACT

Velogenic Newcastle disease virus (VNDV) causes a highly contagious and devastating disease in poultry and causes up to 100 percent mortality in susceptible populations during devastating outbreaks. Newcastle disease causes heavy economic losses to the global poultry industry by decreasing the growth rate, decreasing egg production, and increasing morbidity and mortality. The households face substantial economic losses throughout the year due to Newcastle disease. It is ranked first among other poultry diseases in village chickens. The economic losses caused by this disease in the poultry industry have given awareness about the importance of Newcastle disease and made it easier to justify the operations against this disease. So, estimating the economic losses caused by Newcastle disease is very important. Regarding the Newcastle disease's huge impact on production and causing a lack of eggs, we will have to compensate for this reduction by importing eggs from other countries. Hence, a tremendous amount of money will be needed to compensate for the shortage of eggs, which will result in a huge economic loss. Finally, these will directly affect the poultry industry and its financial resources, which clarifies the importance of correct and on-time vaccination and caring for Newcastle disease in poultry flocks to prevent enormous economic losses. In this study, the economic impact of Newcastle Disease on egg-laying farms was quantitatively assessed. Data were collected on the total number of egg-laying poultry monthly and annually. Subsequently, the economic loss for each period was calculated based on the total production period. The minimal damage caused by this disease is about 116,591 Tons. Summing all these periods' production decreases, the total loss will be 10538 Tons. To estimate the losses of the disease, it is necessary to estimate the losses in breeding herds and broiler herds so that the loss resulting from the endemic Newcastle disease of the country can be measured.

Keywords: Newcastle disease, Economic loss, poultry, layer.

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1 Introduction

Poultry production in Iran has experienced a continuous increase in recent years. However, the industry has faced significant challenges, including infectious diseases, that have caused a decrease in poultry production. Among these diseases, Newcastle Disease (ND) stands out as a major viral infection that has caused huge economic losses for farmers in the country.

Newcastle disease is a viral disease caused by the avian Paramyxovirus serotype 1 (APMV1) and is one of the most important poultry diseases worldwide (1). This virus is an enveloped, negative sense, single-stranded, non-segmented RNA virus (2). The virus spreads through direct contact with secretions of infected birds, principally via ingestion (fecal-oral route) and inhalation. It can also be transmitted through inanimate objects like feed, water, implements, premises, human clothing, boots, sacks, egg trays or crates (3). Newcastle Disease is highly contagious, and many bird species, both domestic and wild chickens, are susceptible to the disease (3). Affected birds develop respiratory, digestive, and neurologic symptoms with profound immunosuppression (4).

Since its first identification in 1926, ND has continued to present a significant economic threat to the poultry industry due to high mortality rates and production losses (5). The economic losses associated with ND are substantial and have multiple aspects. High mortality and morbidity rates, as well as decreased egg production in layer flocks and the production of lower-quality eggs in layer breeder flocks, contribute to these losses. Additionally, the treatment costs and the extra management required during the disease further compound the economic impact of ND (6).

Outbreaks of ND can result in devastating consequences. Depending upon the pathotype and susceptibility of the bird, the mortality rate varies from 0% to 100% (7). For instance, during one of the major outbreaks of Newcastle disease in the USA, in California, in 2002-2003, approximately 4 million birds died, resulting in a loss of around 162 million US dollars (8).

Newcastle disease not only threatens the livelihoods of poultry but also reduces food supplies, which affects human welfare (9). It can also impact the quality of poultry meat (3).

Prevention of ND primarily relies on vaccination and the implementation of strict biosecurity and quarantine measures. Effective disease control can be achieved through proper disposal of deceased birds, and the area's zoning can help control the disease in surrounding flocks (10). The main objective of any bird vaccination program is to create immunity that will protect them from a specific disease.

However, the poultry industry's large-scale production has made it difficult to achieve this goal with existing vaccines. Vaccination of poultry against NDV has been used extensively in many parts of the world to limit disease and enhance global food security. These vaccines, produced from live or inactivated lentogenic strains such as Hitchner B1 or La Sota, have historically been ineffective in controlling the spread of virulent viruses (2). As all NDV strains represent a single serotype, any ND vaccine should potentially induce protection from any virulent NDV viruses.

Understanding the economic impact of poultry diseases like Newcastle Disease (ND) is essential for developing effective strategies for disease control and prevention. By thoroughly examining the economic losses caused by ND, policymakers and stakeholders can allocate resources more effectively and minimize the negative consequences of this destructive poultry disease.

2 Materials and Methods

In this study, the economic impact of Newcastle Disease (ND) on egg-laying farms was quantitatively assessed. The analysis was conducted by considering the differential effects of the virus at each stage of the egg-laying process. Data were collected on the total number of egg-laying poultry monthly and annually. Subsequently, the economic loss for each period was calculated based on the total production period.

In addition, the probability of a flock contracting ND and the extent of its impact on production decline were evaluated. The economic loss at each of the four stages was computed by integrating these data and considerations. These values were then aggregated to estimate the total economic loss attributable to ND during the production period of egg-laying birds.

Finally, the number of eggs loss and the corresponding financial loss were calculated using appropriate formulas. This allowed for assessing the significance and necessity of further research and focus on ND. This study underscores the substantial economic burden of ND on egg-laying farms, highlighting the need for effective preventive measures and management strategies.

3 Results

The Ministry of Jihad- Agriculture Statistics has announced that the number of commercial layer birds is about 56,000,000. Therefore, the economic loss caused by

Newcastle disease can be estimated based on the following formula:

Economic loss = infected egg laying birds * average production (8 kg) * Production reduction percentage (40 percent)

Putting all these together, the minimal damage caused by this disease is about 116,591 Tons.

Also, the production period is from 20 weeks to 90 weeks (approximately 70 weeks). In a year, there will be 4.5 million egg-laying poultry per month in the country, so there are 14 million egg-laying poultry in each three months. The herd's age can be considered in four stages during the 70 weeks.

First period (14 million): week 20 to week 40

Second period (14 million): week 40 to week 60

Third period (14 million): week 60 to week 80

Fourth period (14 million): week 80 to week 90

From the data above, we conclude that there are 56 million egg-laying poultry in a year.

3.1 *The probability of herd contracting Newcastle disease*

3.1.1 *First period*

The probability in the first period is 10%, which will cause a 15% decrease in production in 2 months (until the herd returns to normal conditions). The formula for economic loss is the following:

Decrease in egg production = Number of poultry (14 million) * average production in normal condition (92%) * time (60 days) * production decrease (15%) = 6375.5 Tons

3.1.2 *Second period*

The probability in the second period is 15%, which will cause an 8% decrease in production in 2 months (until the herd returns to normal conditions). The formula for economic loss is the following:

Decrease in egg production = Number of poultry (14 million) * average production in normal condition (88%) * time (35 days) * production decrease (8%) = 1897.3 Tons

3.1.3 *Third and Fourth periods*

The probability in the third period is 10%, which will cause a 10% decrease in production in 2 months (until the herd returns to normal conditions). Moreover, the formula for economic loss is the following:

Decrease in egg production = Number of poultry (28 million) * average production in normal condition (70%) * time (21 days) * production decrease (10%) = 2263.8 Tons

Summing all these periods' production decreases, the total loss will be 10538 Tons.

Also, the average price of one kilogram of eggs is about 500 thousand Rials; therefore:

$10538 * 1000 \text{ kg} * 500,000 \text{ Rials} = 5,269,000,000,000 \text{ Rials}$

Lastly, there are 18 eggs in each kilogram; hence, the egg loss is counted by the following formula: $10,538,000 * 18 \text{ eggs per kg} = 189,684,000$

*All the above estimates are from the decrease or loss of production.

4 **Discussion**

The economic loss calculations estimate the losses resulting from the transmission of Newcastle disease only in relation to production reduction. The above calculations have not considered the costs before losses, losses of egg weight reduction after returning to production, and the cost of vaccination and treatment of infected flocks. Moreover, the above estimate is only for egg-laying poultry in the production stage. To estimate the losses of the disease, it is necessary to estimate the losses in breeding herds and broiler herds so that the loss resulting from the endemic Newcastle disease of the country can be measured.

The most widespread disease observed in Nigeria is Newcastle disease (ND), accounting for approximately 58% of the investigated outbreaks (11). During March 2017 and August 2017, a survey of 120 layer farms revealed that approximately 30.8% (n= 37) had been affected by Newcastle disease (12). In a study that investigated in India, a total of 13 flocks of 11 vaccinated layer farms, total economic losses were calculated at 3,719,223 rupees, where mortality contributed 2,998,105 rupees (13). In comparing affected and non-affected flocks, the total return was estimated at BDT 4530 and BDT 6099, respectively, for affected and non-affected farm households. According to research conducted on the ND epidemic, it was determined that each household experienced an average financial loss of approximately BDT 2,561 annually due to the outbreak and an average of eight poultry birds were forgone per household per annum. On average, the country incurred an annual economic loss of BDT 2.43802765*10¹⁰ (US\$ 288.49 million) (6). Several studies have underscored the importance of addressing the multifaceted economic impact of ND, particularly on egg-laying poultry. These findings highlight the necessity for a more rigorous surveillance program to mitigate substantial economic losses. This underscores the need for effective, comprehensive

preventive strategies to manage ND and its economic implications (14).

5 Conclusion

Vaccines made from live or inactivated lentogenic strains have not successfully controlled the spread of virulent viruses. The most effective approach to managing the Newcastle disease virus (NDV) is to prevent its spread, and vaccines have been unsuccessful in this objective. Implementing biosecurity protocols is essential in preventing the introduction and transmission of NDV and other poultry diseases. The essential components of poultry biosecurity involve safeguarding the birdhouses, feed and water sources and preventing access from wild birds (14). However, ND is considered the single most significant disease of poultry throughout the world.

These statistics clearly show that Newcastle disease significantly impacts production and causes a lack of eggs. Therefore, we must compensate for this reduction by importing eggs from other countries. Hence, a tremendous amount of money will be needed to compensate for the shortage of eggs, which will result in a huge economic loss. Finally, these will directly affect the poultry industry and its financial resources, which clarifies the importance of caring for Newcastle disease in poultry flocks to prevent enormous economic losses.

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Conflict of Interest

All authors declare that they have no conflicts of interest.

Author Contributions

All authors contributed to the original idea, study design, writing and editing the manuscript, which was approved as a final draft.

Data Availability Statement

Data are available from the 1st and the last (corresponding) author upon reasonable request.

Ethical Considerations

Ethical consideration: Ethical approval was not required for this study because it was based on farm production records and economic modeling, and no experimental procedures, sampling, or handling of animals were performed.

There were no ethical considerations to be considered in this research.

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