

Epidemiological Investigation and Economic Loss Assessment of Newcastle Disease in Broiler Farms of Keshim, Badakhshan, Afghanistan

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ABSTRACT

Newcastle disease (ND) is one of the most economically important viral diseases affecting broiler production, particularly in developing countries. This study aimed to assess the epidemiological status and economic losses associated with reported ND outbreaks in broiler farms of Keshim District, Badakhshan Province, Afghanistan. A cross-sectional questionnaire-based survey was conducted among 75 broiler farm owners, supplemented by structured information obtained from the Provincial Directorate of Agriculture, Irrigation, and Livestock. Data were analyzed using SPSS through descriptive statistics, reliability analysis, and regression analysis. Results indicated that 93.3% of surveyed farms reported at least one ND outbreak during the previous year, with outbreaks most frequently reported among birds aged 21–30 days. Mortality rates commonly exceeded 16%, while indirect economic losses included reduced final body weight, prolonged production cycles, increased feed consumption, and additional treatment costs. Economic losses per outbreak generally ranged from 10,000 to 50,000 AFN, and many farmers reported income reductions of 26–50%. Despite relatively high vaccination coverage, recurrent outbreaks were associated with poor vaccine quality, inadequate biosecurity, high farm density, and limited diagnostic capacity. These findings demonstrate a considerable epidemiological and economic burden of reported ND outbreaks. Strengthening vaccine quality control, farm biosecurity, laboratory diagnostic services, and farmer training is essential for reducing disease occurrence, economic losses, and improving sustainable broiler production in the study area.

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INTRODUCTION

Poultry production is an important source of food and income for many families in developing countries. It provides animal protein and, compared with many other livestock activities, can generate income within a relatively short period. Broiler farming has become increasingly common because chickens reach market weight quickly and can be raised with relatively limited resources (FAO, 2021). In Afghanistan, poultry production has grown over the past

decade, partly in response to the increasing demand for poultry meat in urban areas and the need for additional income in rural and peri-urban communities (FAO, 2020). However, infectious diseases continue to be a major problem for broiler farmers and can reduce both production and farm income.

Newcastle disease (ND) is one of the important infectious diseases affecting poultry. It is caused by Newcastle disease virus (NDV), classified as avian paramyxovirus type 1, and can spread quickly among susceptible birds. The severity of the disease depends on factors such as the virus strain and the condition of the flock, and outbreaks can result in high morbidity and mortality (Alexander & Senne, 2020; N'Guessan Amoia et al., 2021). Broilers can be especially vulnerable when they are kept under intensive conditions. High stocking density, rapid growth and management-related stress may increase the risk of infectious disease in these birds. Newcastle disease can cause substantial mortality and economic losses in affected poultry populations (Mngumi et al., 2022).

Newcastle disease continues to be reported in many endemic areas even where vaccination is practiced. The reasons are not always the same and may include problems with vaccine storage and handling, weaknesses in the cold chain, inadequate biosecurity, high concentrations of poultry farms and limited access to diagnostic services (N'Guessan Amoia et al., 2021). Small-scale farmers may face additional difficulties because veterinary services and technical training are not always readily available. Weak disease surveillance and delays in diagnosis can also make disease control more difficult in smallholder poultry systems (FAO, 2021).

In Afghanistan, poultry farming is mainly carried out on small and medium-sized farms. The situation can be more challenging in remote and mountainous areas such as Badakhshan, where access to veterinary and laboratory services is limited. Shortages of trained veterinary personnel, limited laboratory facilities and irregular farmer training can affect the prevention and control of poultry diseases (FAO, 2020). Although ND vaccination is commonly practiced, farmers in these areas still report disease outbreaks. This may point to difficulties in the practical implementation of vaccination, biosecurity and other farm-management measures. Similar problems have been observed in other low-resource poultry systems, where vaccination may not be sufficient on its own without appropriate management and biosecurity practices (Shabbir et al., 2020; N'Guessan Amoia et al., 2021).

Information about Newcastle disease at the district level in Afghanistan is still limited. In particular, there is little documented information about reported outbreaks, their distribution among broiler farms and the economic losses experienced by farmers in Keshim District of Badakhshan Province. Most available information is presented at the national or broader regional level and may not reflect the conditions of farmers in this particular area. Local information is useful because farming practices, access to veterinary services and the effects of disease can vary considerably between locations.

The present study was carried out to describe the reported occurrence and distribution of Newcastle disease outbreaks among broiler farms in Keshim District and to assess the economic losses reported by farmers. It also aimed to describe the vaccination, biosecurity, farm-management and disease-control practices used in the study area. In addition, the study considered some of the difficulties reported by farmers and agricultural authorities, including access to veterinary and diagnostic services and opportunities for farmer training. The information obtained from the study is expected to provide a local basis for improving Newcastle disease prevention and control and for supporting broiler production in Keshim District and similar areas of Afghanistan.

METHODS AND MATERIALS

Study Area

The study was carried out in Keshim District of Badakhshan Province, Afghanistan. The district was selected because broiler farming is practiced in the area and Newcastle disease has been reported as an important problem by poultry farmers. The study focused on active broiler farms that were officially registered with the local agricultural authorities.

Study Design and Study Period

A cross-sectional, questionnaire-based study was conducted from September to December 2025. The study was designed to describe the reported occurrence and distribution of Newcastle disease outbreaks, the economic losses reported by farmers, and selected vaccination, farm-management and disease-control practices. Since information was collected at one period of the study, the results were interpreted as a description of the situation during the study period rather than as evidence of disease incidence or causation.

Study Population and Sampling

According to the records of the General Directorate of Agriculture, Irrigation, and Livestock of Badakhshan Province and the agricultural management office of Keshim District, 75 broiler farms were officially registered in the study area. All 75 active registered farms were included in the study. Thus, a census or complete-enumeration approach was used, and a separate sample-size calculation was not necessary. Unregistered farms were not included because they were outside the official sampling frame.

Data Collection

Data were collected through face-to-face interviews with broiler farmers using a structured questionnaire containing 14 items. The questionnaire covered farm and production characteristics, reported Newcastle disease outbreaks, flock age, mortality, economic losses, vaccination practices and disease-control challenges. The questionnaire was prepared with reference to relevant literature and the local conditions of broiler production. Before the field survey, it was reviewed and refined with the assistance of university professors and veterinary professionals.

Additional information was collected through structured interviews with relevant agricultural and veterinary officials. These interviews focused mainly on disease surveillance, vaccination services, veterinary support, farmer training and diagnostic capacity in the study area.

Questionnaire Reliability and Disease Classification

The internal consistency of the 14 questionnaire items was assessed using Cronbach's alpha in SPSS Version 26. The resulting coefficient was 0.713.

Because laboratory testing was not carried out during the study, Newcastle disease events were not classified as laboratory-confirmed cases. Instead, they were recorded as farmer-reported or suspected outbreaks based on the information provided during the interviews. This distinction was maintained when interpreting the results.

Data Analysis

The collected data were entered and analyzed using SPSS Version 26. Descriptive statistics were mainly used to summarize the information, including frequencies, percentages and appropriate summary measures for numerical variables. Reported Newcastle disease outbreaks were presented as frequencies and proportions rather than incidence rates. Similarly, the proportion of farms reporting at least one outbreak refers to the surveyed farms reporting a farmer-reported outbreak and should not be interpreted as individual-bird disease prevalence.

A SWOT framework was also used to organize the main strengths, weaknesses, opportunities and threats related to Newcastle disease control in the study area.

Interpretation of Findings

The findings were interpreted in light of the cross-sectional design and the nature of the information collected through questionnaires and interviews. Since the study used a census of registered active farms, no separate sampling procedure was applied. However, the study did not include unregistered farms, and no laboratory confirmation of Newcastle disease was available. Therefore, the results were treated as descriptive information on reported disease occurrence, farm practices and perceived economic effects. No causal relationship or conclusion about the endemicity of Newcastle disease was made from the study findings.

FINDINGS

Descriptive Analysis of Farmer Responses

Table 1. *Years of Experience in Broiler Farming*

Years of Experience	Frequency	Percent	Cumulative Percent
Less than 2 years	11	14.7	14.7
2–5 years	26	34.7	49.3
5–10 years	35	46.7	96.0
More than 10 years	3	4.0	100.0
Total	75	100.0	

Most respondents had moderate practical experience, with 61 (81.3%) reporting 2–10 years of experience in broiler farming. This suggests that the majority of farmers had several years of practical experience in broiler production and disease management.

Table 2. *Production Capacity per Rearing Cycle*

Capacity Category (Birds)	Frequency	Percent	Cumulative Percent
Less than 5,000	64	85.3	85.3
5,000–10,000	7	9.3	94.7
10,000–20,000	4	5.3	100.0
Total	75	100.0	

The findings show that 85.3% of the respondents rear fewer than 5,000 birds per production cycle, demonstrating that broiler farming in the study area is largely dominated by small-scale operations.

Table 3. *Number of Farmer-Reported Newcastle Disease Outbreaks During the Previous 12 Months*

Production Cycles per Year	Frequency	Percent	Cumulative Percent
1–3 cycles	9	12.0	12.0
4–6 cycles	53	70.7	82.7
7–8 cycles	12	16.0	98.7
More than 8 cycles	1	1.3	100.0
Total	75	100.0	

A large proportion of farmers (70.7%) reported completing 4–6 production cycles annually, reflecting relatively intensive use of available production facilities throughout the year.

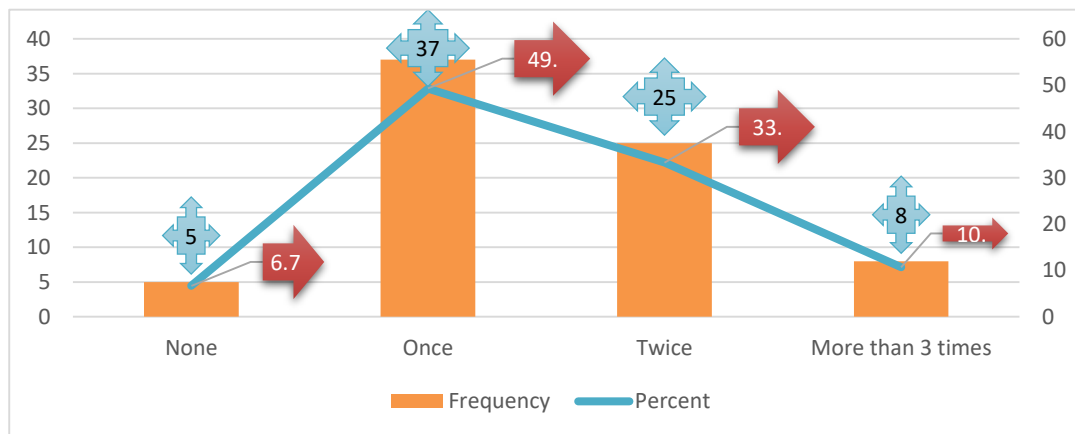


figure 1. Frequency of Newcastle Disease Occurrence in the Past Year

shows that most respondents experienced this once (49%), followed by twice (33%). Fewer respondents reported more than three times (10%), and only a small group never experienced it (6.7%). Overall, most people have experienced it at least once, with frequency decreasing as repetition increases.

Table 4. Age Distribution of Flocks at the Last Farmer-Reported Newcastle Disease Outbreak

Age of Flock (Days)	Frequency	Percent	Cumulative Percent
Less than 10 days	1	1.3	1.3
11–20 days	4	5.3	6.7
21–30 days	65	86.7	93.3
More than 30 days	5	6.7	100.0
Total	75	100.0	

Among the surveyed farms, 65 (86.7%) reported that their last farmer-reported Newcastle disease outbreak occurred when the flock was 21–30 days of age. This finding describes the age distribution of flocks at the last reported outbreak and should not be interpreted as age-specific disease incidence or as evidence of a higher risk of infection at this age.

Table 5. Direct Mortality Rate during the Last Farmer-Reported Newcastle Disease Outbreak

Mortality Rate	Frequency	Percent	Cumulative Percent
Less than 5%	6	8.0	8.0
5–15%	27	36.0	44.0
16–30%	20	26.7	70.7
More than 30%	22	29.3	100.0
Total	75	100.0	

More than half of the respondents (56.0%) reported mortality rates exceeding 16%, indicating a substantial impact of Newcastle disease on flock survival. Mortality rate was calculated using the following formula:

Mortality Rate (%) = (Number of birds that died during the last reported outbreak / Total number of birds at risk during the last reported outbreak) × 100.

Table 6. Proximity to the Nearest Broiler Farm

Distance (Meters)	Frequency	Percent	Cumulative Percent
Less than 100 m	17	22.7	22.7
100–500 m	38	50.7	73.3
500–1,000 m	15	20.0	93.3
More than 1,000 m	5	6.7	100.0
Total	75	100.0	

The majority of farms (73.3%) were located within 500 meters of another broiler operation, which may increase the likelihood of disease transmission between farms.

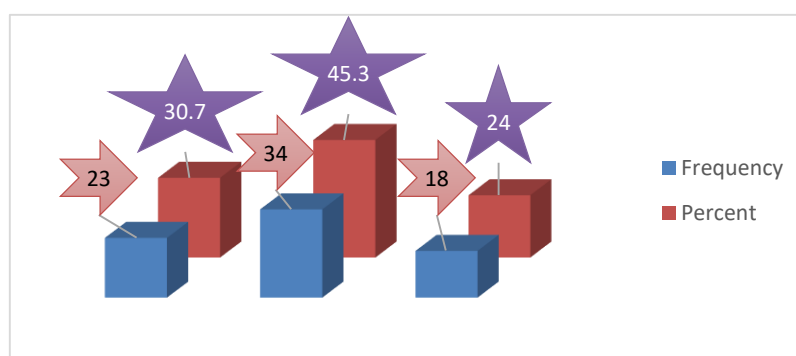


figure 2. Cost of Disease during the Last Outbreak

Most respondents fall in the **10–50** range (45.3%), followed by less than **10** (30.7%). The **50–100** category has the lowest proportion (24%), showing concentration in the mid-range.

Table 7. Reduction in Final Body Weight per Bird Relative to the Expected Final Body Weight under Normal Farm Conditions

Weight Loss (Grams)	Frequency	Percent	Cumulative Percent
Less than 100 g	7	9.3	9.3
100–200 g	23	30.7	40.0
200–350 g	23	30.7	70.7
More than 350 g	22	29.3	100.0
Total	75	100.0	

Weight reduction was determined by comparing the observed final body weight of Newcastle disease-affected birds with the expected final body weight under normal, unaffected farm conditions. Thus, the values shown represent the reduction in final body weight relative to the defined farm reference weight

Table 8. Increase in Production Cycle Duration Due to Newcastle Disease

Extension (Days)	Frequency	Percent	Cumulative Percent
4–7 days	63	84.0	84.0
8–14 days	9	12.0	96.0
More than 14 days	3	4.0	100.0
Total	75	100.0	

The normal production cycle was 35 days. Extension was calculated as the difference between the actual production-cycle duration and the normal 35-day cycle. Most farmers (84.0%) reported a 4–7-day extension following Newcastle disease outbreaks.

Table 9. Newcastle Disease Vaccination Program

Vaccination Practice	Frequency	Percent	Cumulative Percent
Regular scientific schedule	71	94.7	94.7
Single vaccination only	3	4.0	98.7
Irregular / risk-based	1	1.3	100.0
Total	75	100.0	

Although 94.7% of respondents reported following a regular vaccination schedule, defined as administering the recommended vaccines according to a planned schedule and recommended doses, disease outbreaks were still reported. Farmers perceived possible limitations related to vaccine handling, administration, and vaccine quality as contributing factors.

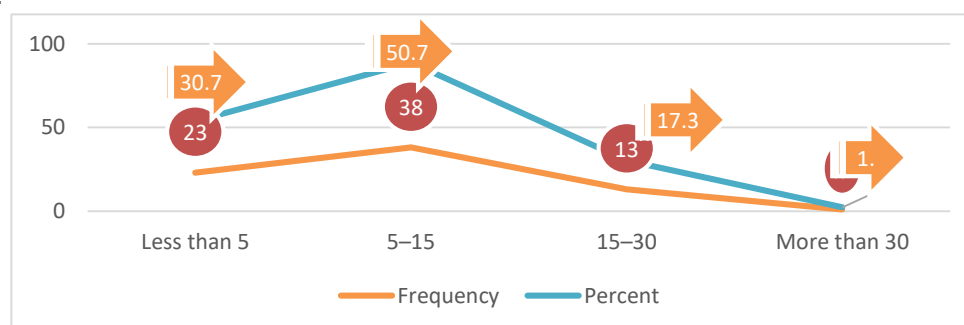


figure 3. Vaccination Cost per Production Cycle

The majority of respondents (81.4%) spent less than 15,000 AFN per production cycle on vaccination, indicating that preventive costs were relatively low compared to disease-related losses.

Table 10. *Estimated Income Reduction Due to Disease*

Income Reduction	Frequency	Percent	Cumulative Percent
Less than 10%	24	32.0	32.0
10–25%	18	24.0	56.0
26–50%	30	40.0	96.0
More than 50%	3	4.0	100.0
Total	75	100.0	

Approximately 44.0% of respondents reported estimated income reductions of more than 25%, highlighting the perceived negative economic impact of Newcastle disease on farm profitability. These figures were based on farmers' self-reported estimates rather than independently calculated financial records and may therefore be subject to information and recall bias.

Table 11. *Major Constraints in Disease Control*

Main Constraint	Frequency	Percent	Cumulative Percent
Lack of quality vaccines	43	57.3	57.3
High cost of vaccines and drugs	2	2.7	60.0
Lack of technical supervision	3	4.0	64.0
Lack of follow-up awareness	27	36.0	100.0
Total	75	100.0	

Perceived poor vaccine quality (57.3%) and insufficient farmer awareness (36.0%) were identified by respondents as the main constraints in controlling Newcastle disease, emphasizing the need for improved vaccine supply and farmer education.



Figure 4. A view of a farm in Keshim District. Source: Author's own photograph.

Quantitative–Qualitative Analysis of Newcastle Disease Management Status in Keshim District Based on Officials’ Perspectives

Table 12. Descriptive Analysis Based on Officials’ Responses

Indicator	Selected Option (Officials’ Estimates/Responses)	Interpretation
Number of broiler farms	51–100 units (75 farms)	The district has a moderate concentration of broiler farms.
Laboratory status	Sample collection only	Diagnostic capacity is limited, with no full testing facilities.
Number of veterinarians	More than 5 (15 veterinarians)	Approximately one veterinarian per five farms.
Disease prevalence	Estimated high (31–50%)	Officials estimated a high occurrence of Newcastle disease in the area.
Mortality in affected flocks	Estimated 21–40%	Indicates substantial mortality among affected flocks.
Vaccination coverage	Estimated 50–74%	Represents officials’ estimated bird-level vaccination coverage.
Training programs	1–2 times per year	Training activities are limited and irregular.
Farm supervision	Regular and continuous	A key strength of regional disease management.
Main constraint in disease control	Lack of specialized personnel	Shortage of skilled human resources is a primary challenge.
Disease control priority	First priority	Indicates strong awareness of the importance of Newcastle disease among officials.

Note: The information presented in this table was obtained from officials’ responses and represents descriptive estimates rather than independently verified surveillance data. The reported disease prevalence of 31–50% was based on officials’ estimates and was not calculated from observed or laboratory-confirmed cases. The reported vaccination coverage of 50–74% represents officials’ estimated bird-level vaccination coverage, whereas the vaccination information reported by farmers elsewhere in the manuscript reflects farm-level vaccination practices. Therefore, these two measures are based on different data sources and indicators and should not be considered directly equivalent. Officials’ responses were collected using a structured questionnaire and summarized descriptively.

Table 13. SWOT Analysis of Newcastle Disease Management in Keshim District

Strengths	Weaknesses
Regular and continuous supervision of farms	Shortage of specialized veterinary personnel
High prioritization of Newcastle disease control	Laboratory limited to sample collection only
Relatively good vaccination coverage	Limited training programs (1–2 per year)
	High disease prevalence (31–50%)
Opportunities	Threats
Potential recruitment of specialists from academic institutions	Risk of widespread outbreaks due to high farm density
Laboratory strengthening through institutional support	Declining farmer income and regional economic losses
Development of structured annual training programs	Risk of antimicrobial resistance under improper disease management

The SWOT analysis was developed based on information obtained through interviews with veterinary and livestock officials. The strengths, weaknesses, opportunities, and threats were identified from the interview responses and subsequently organized and interpreted by the authors according to their relevance to Newcastle disease prevention and control.

Analysis of Factors Affecting Disease Control

The potential factors influencing Newcastle disease control were assessed descriptively based on information obtained from the farmer and official interviews. Factors such as vaccination practices, farmer awareness, availability of vaccines, veterinary supervision, and access to veterinary services were considered relevant to disease control.

No regression analysis was conducted because a clearly defined quantitative outcome variable and an appropriate statistical model were not established in the present study. Therefore, statistical significance and regression coefficients are not reported. Further studies using appropriately defined outcome variables and individual-level data are recommended to quantitatively evaluate the relationships between these factors and Newcastle disease control effectiveness.

Table 14. Gap Analysis of Newcastle Disease Control Measures

Indicator	Current Status	Proposed Target	Identified Gap	Basis for Proposed Target
Veterinarian-to-farm ratio	Approximately 1:5	Improved veterinary coverage	Limited veterinary support relative to the number of farms	Proposed based on the current veterinary service capacity and officials' assessment of local needs
Vaccination coverage	50–74% (officials' estimate)	≥90%	Incomplete vaccination coverage	Proposed target reflecting the need for substantially improved coverage as part of an effective vaccination and disease-control programme
Farmer training	1–2 sessions/year	≥4 sessions/year	Limited training frequency	Proposed based on the training needs identified during interviews with officials and the need for regular farmer education
Farm supervision	Regular and continuous	Maintain regular supervision	No major gap identified	Based on officials' reports and the existing disease-control structure
Laboratory diagnostic capacity	Sample collection only	Improved diagnostic capacity	Limited laboratory testing facilities	Based on the existing diagnostic limitations identified by officials
Availability of specialized personnel	Insufficient	Adequate specialized personnel	Shortage of skilled personnel	Based on the main constraint identified during interviews with officials

Note: The proposed targets are indicative targets rather than official national or international standards. They were developed based on the current conditions of the study area, information obtained from interviews with veterinary and livestock officials, and the authors' assessment of practical requirements for improving Newcastle disease control. The targets are therefore intended to indicate areas for improvement rather than represent

formally established regulatory thresholds. Effective Newcastle disease control should also include appropriate vaccination, surveillance, diagnostic capacity, and veterinary-service support.



Figure 5. A view of a farm in Keshim District. Source: Author's own photograph

DISCUSSION

The results of this study show that small-scale broiler farming is common in Keshim District. Most of the surveyed farms kept fewer than 5,000 birds per production cycle, which is similar to the situation described in many developing countries. Smallholder poultry farming remains an important source of food and income, but farmers often work with limited veterinary support and face difficulties with disease prevention, biosecurity and disease surveillance (N'Guessan Amoia et al., 2021; Mngumi et al., 2022).

One of the main findings was the high level of reported Newcastle disease occurrence. More than 93% of the respondents reported at least one outbreak during a year. This figure is important, but it needs to be considered in relation to the way the information was collected. The outbreaks were reported by farmers retrospectively and were not confirmed through laboratory testing. Therefore, the result describes the frequency of reported outbreaks among the surveyed farms rather than the true prevalence of Newcastle disease in the bird population. The largest number of reported outbreaks occurred when birds were between 21 and 30 days old. This may be a period of increased vulnerability in broilers, particularly as maternal antibody protection changes and the birds experience rapid growth and greater physiological demands. Previous epidemiological studies have demonstrated substantial variation in Newcastle disease occurrence according to poultry production systems, geographic region and diagnostic approach (Mngumi et al., 2022; N'Guessan Amoia et al., 2021).

Vaccination was commonly reported by the farmers, yet outbreaks were still reported in the study area. This does not necessarily mean that vaccination was ineffective. Several practical factors can affect the protection provided by a vaccine, including storage conditions, handling, administration, timing of vaccination and maintenance of the cold chain. Conditions on individual farms may also influence the outcome. Since vaccine quality and effectiveness were not directly examined in this study, these factors should be regarded as

possible explanations rather than confirmed reasons for the reported outbreaks (N'Guessan Amoia et al., 2021).

The economic effects reported by the farmers also show why ND is an important concern for broiler production. Many respondents estimated losses between 10,000 and 50,000 AFN, and a considerable proportion reported income reductions of more than 25%. Newcastle disease has been associated with substantial economic losses in commercial poultry production, particularly through mortality and reductions in production performance. Recent evidence from commercial broiler farms has also documented measurable economic effects following ND outbreaks (Kalaria et al., 2021). In the present study, however, the figures were based on farmers' own estimates. They were not compared with farm accounts or other financial records, so they should be considered perceived or estimated losses. In addition, the study did not separately calculate costs related to mortality, reduced body weight, additional feed, treatment or longer production cycles.

The distance between farms also deserves some attention. In this study, the distance from one farm to the nearest broiler farm was measured. This provides information about how close farms were to each other, but it does not by itself measure farm density. Farms located close together may have more opportunities for disease transmission through people, vehicles, equipment and other forms of contact, especially when biosecurity is weak. Newcastle disease virus can be transmitted through direct contact as well as contaminated materials and fomites, making biosecurity an important component of disease prevention. However, because no formal spatial analysis was performed, the results should not be taken as evidence that high farm density was responsible for the reported disease occurrence (N'Guessan Amoia et al., 2021).

Another issue emerging from the study was the limited availability of veterinary and diagnostic services. Farmers and officials reported shortages of trained veterinary personnel and difficulties in accessing diagnostic services. These limitations can make it harder to recognize disease early and respond to outbreaks in a timely manner. Similar challenges have been described in poultry production systems where disease surveillance and veterinary support are limited (FAO, 2022; Häslar et al., 2022). Improving access to veterinary advice and basic diagnostic facilities could therefore be useful for disease surveillance and control in the study area.

The findings should also be viewed with some caution because of the limitations of the study. Much of the information came from farmers' recollection of previous outbreaks, mortality, economic losses and vaccination practices. Such information can be affected by recall or information bias. In addition, the study covered the 75 active registered broiler farms in the official sampling frame. Unregistered farms were not included, and the results therefore represent the surveyed registered farms rather than all poultry farms in Keshim District. The absence of laboratory confirmation is another important limitation. For these reasons, the findings should not be generalized directly to other districts or regions of Afghanistan.

Taken as a whole, the results suggest that controlling ND in Keshim District will require more than vaccination alone. Better vaccination management, reliable veterinary support, improved access to diagnostic services, practical training for farmers and stronger farm-level biosecurity may all contribute to better disease control. Future studies could provide stronger evidence by including laboratory confirmation of suspected outbreaks, verified farm financial records and more detailed assessment of biosecurity and spatial relationships between farms. Such work would help clarify the factors associated with Newcastle disease and provide a stronger basis for disease-control planning in Keshim District and other poultry-producing areas of Afghanistan. These approaches are also in line with broader animal health and disease-control principles promoted by WOA and FAO.

CONCLUSION

This study provides a local picture of Newcastle disease and its effects on broiler farming in Keshim District, Badakhshan Province. Newcastle disease was frequently reported by the surveyed farmers and was associated, according to their reports, with mortality, lower final body weight, longer production cycles and financial losses. Since much of the information was based on farmers' previous experiences and no laboratory confirmation was available, the results should be understood as reported occurrence and reported impact rather than a definite measure of disease prevalence or endemicity.

Most farmers reported routine vaccination and had practical experience in broiler production. Even so, several problems were identified, including limited access to diagnostic services, shortages of trained veterinary personnel, insufficient farmer training and difficulties with disease-control practices. The study did not directly assess vaccine quality or effectiveness, and biosecurity was not measured using a standardized score. These factors therefore cannot be considered confirmed causes of the reported outbreaks.

The economic effects reported by farmers also show the importance of ND to broiler production in the study area. Farmers described losses related to mortality, reduced body weight and longer production periods, but the financial estimates were based on their own reports rather than verified farm records. They should therefore be interpreted with caution.

Overall, the findings suggest that better control of Newcastle disease in Keshim District will require cooperation between farmers and veterinary authorities. Regular practical training, improved access to veterinary and diagnostic services, proper vaccine management, early recognition of disease and stronger attention to farm biosecurity may help reduce the problems associated with ND. Future studies with laboratory-confirmed cases, verified farm financial records and more detailed assessment of biosecurity would provide stronger evidence for planning disease-control measures.

A practical and locally adapted approach is likely to be more useful than relying on vaccination alone. Improving veterinary support and farmer knowledge, while taking into account the economic and working conditions of local poultry producers, could contribute to

healthier flocks and more sustainable broiler production in Keshim District and similar areas of Afghanistan.

Authors Contributions

Author 1 conceptualized and designed the study, conducted the data collection, performed the data analysis, interpreted the findings, and prepared, organized, edited, and revised the manuscript. **Author 2** contributed to the study design and interpretation of the findings. **Both authors** reviewed and approved the final version of the manuscript before submission.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to appropriate considerations regarding participant confidentiality and ethical requirements.

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