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Assessment of Economic Losses Due to Coccidiosis in Broiler Chickens in Balkh Province, Afghanistan

Sahab Mohammad Nasim[1]*, Miakhil Atiqullah[2], Abidi Mohammad Hasan[3] and Niazi Khalid[4]
[1]Department of Para Clinic, Faculty of Veterinary Science, Balkh University, Mazar-e-Sharif 1701, Balkh, Afghanistan
[2]Department of PreClinic, Faculty of Veterinary Science, Balkh University, Mazar-e-Sharif 1701, Balkh, Afghanistan
[3]Department of Animal science, Faculty of Agriculture, Takhar University, Takhar, Afghanistan
[4]Department of Clinic, Faculty of Veterinary Science, Balkh University, Balkh, Afghanistan
* Corresponding author email: sahab2018mnasim@yahoo.com

ABSTRACT

Understanding the losses caused by diseases leads to enhanced management practices and increased economic efficiency in poultry farming. Therefore, this research was conducted to assess the economic losses associated with coccidiosis in broiler chickens in Balkh, Afghanistan. Data were obtained from 37 broiler farms through direct communication with poultry farmers and veterinarian who are involved in the diagnosis, control, and treatment of poultry diseases. The findings of this study indicated that the average loss resulting from coccidiosis in a broiler farm with 1000 birds were up to 20,000 Afghani. Coccidiosis has been identified as a significant factor leading to direct losses (mortality and reduced body weight gains) and indirect losses (chemotrophy, coccidiostat costs and increased feed conversion ratio) across all poultry farms. Among these economic parameters, body weight loss had the greatest impact, accounting for 54.1% of the losses, followed by an increase in feed conversion ratio (35.7%). Considering the economic losses, it is necessary to explore the use of natural products, including extracts of fungi and plants, as well as probiotics, to alleviate the issues arising from coccidiosis. Additionally, poultry farmers should incorporate coccidiostat drugs and vaccination programs to prevent coccidiosis. The cumulative results of this study will inform farmers, policymakers, and other stakeholders about the potential impact of coccidiosis and aid in developing strategies to address it.

Keywords: Afghanistan, Balkh, Broiler chicks, Coccidiosis, Economic losses

INTRODUCTION

Among poultry diseases, coccidiosis is one that has a significant impact on the growth of the poultry industry (Williams, 1999), and it is recognized as the main parasitic disease caused by various types of the Eimeria genus, with a substantial negative effect on broilers (Allen and Fetterer, 2002). All major livestock species are susceptible to the enteric disease coccidiosis. Malabsorption enteritis, and, in extreme cases, death are the consequences of infection, which can have a negative detrimental impact on welfare of animals and economic output (Shirley *et al*., 2005). The annual global expense of avian coccidiosis has varied from three billion dollars in 1995 (Williams, 1999) to over thirteen billion dollars in 2016 (Blake *et al*., 2020). These losses include an increased rate of feed conversion, decreased feed consumption, and growth rate (Williams, 1999; Dalloul and Lillehoj, 2006), as well as the cost of preventing and treating coccidiosis (Blake *et al*., 2020). Control of coccidiosis in intensive chicken farming now

primarily depend on live vaccinations and Coccidiostats (Dalloul and Lillehoj, 2006; Jenkins *et al*., 2017). Without a specific preventive method for coccidiosis, poultry farming would not be feasible, and prevention primarily relies on the use of coccidiostats in feed (Peek and Landman, 2011), and live vaccines used only rarely (Williams, 2002).

Coccidiostats have been employed globally for decades to control coccidiosis. However, the utilization of these products has led to the emergence of drug resistance (Peek, and Landman 2011). Coccidiosis is likely the most frequently reported disease in chickens worldwide, and in terms of economic importance, it ranks among the top three poultry diseases in the United Kingdom (Bennett *et al*., 2005), and is included in the list of the top ten veterinary diseases due to its significant impact on the poverty in south Asia (Perry *et al*., 2002). The comprehension of economic losses resulting from diseases holds significant importance. While numerous studies have assessed the economic losses due to coccidiosis in various countries, so far, no study has been reported on the estimation of economic losses attributable to coccidiosis in Afghanistan. Therefore, this study represents the first time that the calculation of economic losses due to coccidiosis in broiler chickens has been conducted in Balkh, Afghanistan.

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MATERIALS AND METHODS

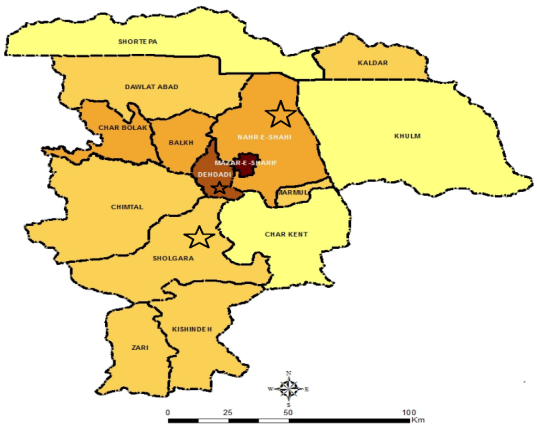
Study Area

Balkh is a densely populated province in the northern region of Afghanistan, consisting of 14 districts (Figure 1). The province covers an area of approximately 16,186.3 km^2, which accounts for 2.5% of the total area of Afghanistan (CSOA, 2015). The climate in Balkh exhibits seasonal and monthly variations. Summers are characterized by hot, arid, and clear weather, while winters are very cold, snowy, and partly cloudy. The typical temperature range spans from 33°F to 103°F, with rare occurrences of temperatures below 23°F or above108°F(https://weatherspark.com/y/106417/Average-Weather-in-Balkh-Afghanistan-Year Round). Over the past decade, there has been significant growth in the broiler industry in Balkh province. According to the Balkh poultry union, there are approximately 400 broiler farms. The most populated districts in this province are SHOLGARA, DEHDADI, NAHR-E-SHAHI and BALKH. The research was conducted in three districts of Balkh (SHOLGARA, DEHDADI, and NAHR-E-SHAHI) from October 2022 to August 2023.

Figure 1. Map of Balkh province, Northern Afghanistan (Balkh Province Socio-Demographic and Economic Survey Highlights).

Samples Collection

Economic losses caused by coccidiosis in broiler chickens were calculated for the first time in this province. To estimate these losses, models



developed by Bera (2010) and Ahmadpanah (2022) were utilized. However, it should be noted that certain modifications were made to the mentioned models to account for the specific conditions in Afghanistan. One such modification was the exclusion of coccidiosis vaccine calculations, as coccidiosis vaccines are not used in broiler chickens in Afghanistan. The data used to evaluate

the losses caused by coccidiosis were obtained through direct communication (interview) with poultry farmers and veterinary doctors. The data was obtained from 37 broiler farms that were randomly selected. These farms consisted of 11 large-scale farms (with 4000 to over 12000 chicks per farm) and 26 small-scale farms (with 1000 to 4000 chicks per farm). The total population of broiler chicks during the study period was 140,200. The chicks studied were approximately 25-30 days old, and an average of 28 days was considered to ensure accurate evaluations. To facilitate comprehension, the costs in this study were expressed in Afghan currency. Certain characteristics necessary for calculating the economic losses in broilers were assumed and presented in Table 1.

Table 1: aAssumed economic and management characteristic suitable for estimation of economic losses in broilers.

Parameters	**Amount/number**	**Source**
Length of life(day)	40	Poultry Farmers
One day-old chickens(Afghani)	29	Balkh poultry union
Value of dressed broiler meat/kg(Afghani)	220-250	Balkh poultry union
Value of 45-day-old chicken/kg(Afghani)	120-140	Balkh poultry union
Cost of feed/kg (afghani)	44	Balkh poultry union
Mortality due to Coccidiosis	2-6%	Farmers
Number of chicks/flock	Small scale size 1000-4000 Large scale size 4000-12000	Farmers
Body weight gain (g/day)	80-100 gr	Farmers (It is related to age)
Body weight at slaughter (kg)	2-2.7	Balkh poultry union and farmers
FCR	1.66-1,78	Balkh poultry union and farmers
Overhead costs	15%	Williams (1999)
Amount of feed in 40 days/bird(gr)	3690	Farmers
Amount of feed consumption in 28 days/bird(gr)	1827	Farmers
Coccidostat (kind and price/ton)	Salinomycin/480000 Afghani	Feed mill

The characteristics mentioned in Table 1 are not fixed and can vary depending on seasons, months, weeks, and even daily fluctuations. In this research, we considered the lifespan of broiler birds to be 40 days, although it is important to note that the actual lifespan of broilers can range from 32 days to sometimes 60 days. The variation in the lifespan of broilers is influenced by factors such as genetics, management practices, and market requirements. Regarding the overhead cost, it encompasses all expenses excluding feed and one-day-old chick costs. Since accurately collecting overhead cost data is challenging, a general practice is to consider it as 15% of the total cost of raising a broiler (Williams, 1999). This estimation method provides a reasonable approximation for overhead expenses in broiler production.

Economic Models

Reduced Body Weight Gain

Estimating the impact of coccidiosis on broiler weight gain can indeed be challenging. In this study, it was assumed that 80% of the broilers

would experience the subclinical form of the disease, resulting in a decrease of 0.1 kg in their final live weight per bird. Based on this assumption, the following model was used:

TLRBG (Total loss due to reduced body weight gain) = [{C (count of placed chickens) × F (the frequency of occurrence of the subclinical form of coccidiosis)} – count of broiler chickens that died due to clinical coccidiosis] ×RBW (Reduced body weight gain, kg) ×RM (Rate of poultry meat price, Afghani/ kg) (equation 1).

Increased feed conversion rate

The feed conversion rate (FCR) is undoubtedly a vital economic parameter utilized globally in the broiler industry to assess the potential for profitability or loss. In this research, it was assumed that in eighty percent of chickens, the FCR increased by a rate of 0.1. However, it is important to note that the standard FCR for broilers at the end of rearing period is 1.75. In the specific context of Balkh province, the average conversion feed ratio for broilers ranges between 1.66 and 1.8, with an average of 1.75 as obtained in this research. Therefore, the economic model used was as follows:

TLIFCR (Total loss due to increased feed conversion rate) = (count of sub clinically affected chickens – count of died birds) × LW (Live weight per bird) × DifFCR (Difference of FCR in affected birds) × FC (broiler feed Cost, Afghani/kg) (equation 2).

Chemotherapy

The outbreak of clinical coccidiosis in broilers can occur at any age. In Balkh Province, various drugs from different companies are used to combat clinical coccidiosis, each with its own price and recommended dosage. In this research, we evaluated the price and quantity of COXID, a specific drug from Hilton Pharma, which contains 2.4-diamino-5-verartylpyrimidine 225 gr, Sulphabenzapyrazine USP 100 gr, Vitamin A 1250 MIU, and Menadione Sulphite sodium (vitamin K3) 2.50 gr. The recommended dosage involved administering 1 gr of COXID per liter of drinking water for a duration of 2 days, followed by a 2-day gap, and then repeating the same drug at a half dose for the next 2 days. The model used for calculating the economic impact was as follows:

TCCT (total cost of chemotherapy) = CTB (count of treated birds) × RW (Requirement of water, Litter/day/bird) × 2 [M1 (requirement of medicine in first half of treatment, kg/L) + M2 (requirement of medicine in second half of treatment, kg/L)] × CM (Cost of medicine in Afghani/kg/ the cost of the medicine obtained from pharmacies in Balkh province) (equation 3).

In this research, the amount of drug consumption was considered for the age of 28 days, while the amount of drug consumption increases with age.

Chemoprophylaxis

In the prevention of coccidiosis, two common approaches are chemoprophylaxis (medicine used in feed) and immunization through vaccination. However, in Balkh Province, the prevention of coccidiosis is exclusively dependent on chemoprophylaxis. Diclazuril and salinomycin are commonly used for this purpose. The economic model used to calculate the total cost of chemoprophylaxis is as follows:

TCCP (Total cost of chemoprophylaxis) = C (count of chickens placed) × CFR [Cumulative feed requirement for forty days for one chick (tons)] × MU [Medicine used, kg/tons of feed] × CM [cost of medicine (Afghani/kg)] (equation4).

Mortality

Evaluating mortality caused by a specific pathogen can indeed be challenging, as multiple simultaneous infections can contribute to the death

of a bird. In this research, it was assumed that 5% of the chickens would experience the clinical form of coccidiosis, out of which 5% would die as a result of the disease. Therefore, the model used to estimate mortality was as follows:

LM (Loss due to mortality) = CD (count of birds died) × [CC (cost of one day-old chicks) + CCF (Cost of cumulative feed consumed by one chick in 28 days) + OC (Overhead cost)] Overhead cost are included, excluding the cost of chicken and feed. (equation 5).

RESULTS

1 - Reduced Body Weight gain: Reduced body weight gain and Increased FCR are significant economic parameters for subclinical coccidiosis. The equation (1) was used to estimate the reduced body weight gain.

Equation (1): [(140200 × 80%) – (140200 × 5% ×5%)] × 0.1 × 140 (140/kg of broiler live weight) = **Afghani 1565333**.

2 - Increased FCR: Equation (2) was used to estimate the loss due to increased FCR:

Equation (2): [(140200 × 80%) – (140200× 5% × 5%)] × 2.1 × 0.1 × 44 = **Afghani 1033118**.

3 – Chemotherapy: When the disease spreads, the, entire flock is treated. Generally, the drug is dissolved in drinking water. The water consumption of broiler is considered to be twice that of feed, and during the 4th week of life, it is approximately 224L/1000 chicks/day. The cost of chemotherapy is estimated using Equation (3)

Equation (3): 140200 × 0.224 × 2 (0.001 + 0.0005) × 2000 (Afghani 2000/kg of anticoccidial) = **Afghani 188428**.

4 – Chemoprophylaxis: To estimate the cost of chemoprophylaxis, equation (4) was used.

Equation (4): 140200 × 0.00369× 0.25 × 480 = **Afghani 62080**.

5 – Mortality*:* We assumed that five percent of the chickens suffer from the clinical form, out of which five percent die due to the disease. The number of broilers died due to clinical coccidiosis was: 140200 × 5% × 5% = 350.5. At the age of 28 days, the cumulative feed consumption per bird was 1827 gr, and the cost of broiler feed per kg was 44 Afghani. Equation (5) was used to estimate the cost of mortality.

Equation (5): 350.5× (29 + 80 + 15%) = **Afghani 43935.**

The total economic losses due to coccidiosis in broilers of Balkh province, along with the percentage of each parameter is presented in Table 2.

Table 2. The total cost of coccidiosis in broilers of Balkh province, along with the percentage of each parameter Shown.

Parameters	Amount/number	Cost /Afghani	Cost/US dollars	Percentage
Reduced body weight gain	11180.9 kg live weight	1565333	22047	54.1%
Increased FCR	-	1033118	14551	35.7%
Chemotherapy	94.2 kg drug	188428	2654	6.51%
Chemoprophylaxis	130.94 kg coccidostate	62080	874.3	2.14%
Mortality	350.5 birds	43935	618.8	1.51%
Total		2892894	40745.1	100%

The results show that the average body weight at the end of the rearing period is 2.1 kg, and the food conversion rate is 1.75.

DISCUSSION

In the poultry industry, coccidiosis is a serious problem (Blake *et al*., 2020) that causes significant economic losses (Gilbert *et al*., 2020). Due to inadequate management, coccidiosis has multifold negative economic impact, particularly in hot and humid area (Rashid *et al*., 2019). The mentioned factors inflict significant economic losses exceeding $3 billion annually on the global poultry industry (Dalloul and Lillehoj, 2006).

In the united states alone, the economic impact of coccidiosis amounted to $ 450 million, with $ 100 million allocated for medication (Mohammed and Sunday, 2015). The main losses include chemotherapy, prevention cost, mortality, reduced body Wight gain and poor feed conversion rates (Allen and Fetterer, 2002). The result of the research showed that the economic impact of coccidiosis on the broiler industry is high. The frequent occurrence of the disease can be attributed to the specific management system in place, absence of prevention practices, and resistance against coccidiostate. (Bera *et al*., 2010) estimated the economic losses due to coccidiosis at 95.6% in India, while Williams (1999) estimated it at 98.1% in the UK. It indicates that the economic impact of coccidiosis is high at the global level. Based on De Gussem (2007) observations, the shuttle and rotation program can prevent clinical and subclinical coccidiosis.

The results indicated that an increased FCR and reduced weight gain, are the most significant parameters in broiler and coccidiosis adversely affects these parameters. According to current finding decreased body weight gain and increased FCR share 54.09% (1565333 Afghani) and 35.7% (1033118 Afghani) respectively in the total loss due to coccidiosis. Chemotherapy and mortality are important parameters during the outbreak of coccidiosis, constitutes about 6.51% (188428 Afghani) and 1.51% (43935 Afghani) of total losses caused by coccidiosis. Chemoprophylaxis is a common practice for broilers, that it is the only method of prevention in Balkh province, contributing 2.14% (62080 Afghani) of the total. The total loss of broilers in the studied broiler farm has been found to be

2,892,894 Afghanis. If this is expanded to obtain a national estimate, a significant number will be obtained. These results were consistent with the findings reported by some researchers. Reduced body weight gain as most important parameter, which is consistent with the data reported in broiler chickens in India and Pakistan (Bera *et al*., 2010 and Rashid *et al*., 2019), while in Romania and Iran (Ahmadpanah and Safari, 2022 and Györke *et al*., 2016), the majority of losses are mortality.

In Balkh Province, compared to neighboring countries, a small number of chickens are reared in one flock. This allows for better and more accurate management of chickens during diseases outbreaks. As a result, the share of mortality in the economic losses incurred due to coccidiosis is likely to be low. However, despite implementing best management practices and adhering to health principles, additional measures are required to achieve complete control over the disease. Efforts are being made to develop anti coccidial compounds that effectively target both the sexual and asexual stages of the parasite, which occur within the host organism. Currently, there is interest in utilizing natural products such as mushroom, extracts of plant, and probiotics to alleviate the challenges caused by coccidiosis. Numerous natural compounds, utilized as dietary supplements, possess diverse effects, including immune system stimulation, anti-inflammatory properties and antioxidant activities **(**Quiroz-Castañeda *et al*., 2015).

CONCLUSION

The primary source of losses in broiler chickens due to coccidiosis are associated with chemotherapy, body weight loss and an increase in feed conversion rate. Factors such as drug resistance, alongside management practices, contribute to the higher prevalence of this disease. Collectively, it is reasonable to conclude that coccidiosis cause major losses to the poultry industry. Furthermore, these findings highlight the importance of management in reducing the impact diseases on poultry production. In the present study, it was assumed that all types of Eimeria occurred within the flock. In future studies, it is advisable to differentiate the type of infection and collect data from various climates in Afghanistan to obtain a more accurate estimate of the losses caused by coccidiosis.

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