The estimation of economic losses due to coccidiosis in broiler chickens in Central Java, Indonesia

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Abstract. Coccidiosis is an intestinal parasitic disease caused by Eimeria. The investation of Eimeria can negatively alter poultry health and reduce the productivity of poultry. Decreasing of broiler production can cause economic loss to the farmer and further to the domestic economic. This paper aimed to estimate the economic loss due to coccidiosis in broiler chicken in Central Java Province. The calculation was made based on two parameters: epidemiologic parameter and economic parameter. The data for calculation was based on previous research data and current data. The estimation was calculated using two approaches: direct and indirect method. The direct loss related to the production system cost and extra cost due to coccidiosis cases while indirect loss related to the economic loss in Central Java that could be affected by coccidiosis. The result showed that the direct loss estimation was Rp 3,371,408,383,426,- and indirect loss was Rp 141,430,086,- with a total estimation of economic loss in Central Java due to coccidiosis was Rp 3,371,549,813,512,-. This estimation indicates the importance of coccidiosis control program in poultry industry.

1. Introduction

Chicken coccidiosis is one of the most important parasitic diseases in the poultry industry worldwide [1]. It caused by apicomplexan parasite of the genus Eimeria [2]. Seven species of Eimeria have been found in chickens: E. tenella, E. maxima, E. necatrix, E. acervulina, E. praecox, E. mitis, and E. brunetti [3]. Among these species, Eimeria tenella is the most common and pathogenic species found in poultry that associated with high mortality, morbidity, and hemorrhagic lesion [4]. These pathological effects decrease the production of poultry and eventually cause economic loss. The reduction of production and economic income is found to be higher in commercial broiler chicken compare to layer due to the number of died individuals, lower weight gain and higher feed conversion rate (FCR) [5].

In Central Java, broiler was found to have higher prevalence of coccidiosis (34%) than other breeds (layer 26.26% and local breed 10.45%) [3]. These numbers should have impact to the production cost and income. However, the information about economic losses due to coccidiosis in Indonesia is rarely found.

In 2018, total chicken population in Indonesia is 2.4 billion approximately that consists of local chicken, broiler, and layer (Table 1). Around 75% of total chicken population in Indonesia is broiler chicken (1.8 billion) and more than 100 million broiler chickens are from Central Java. These numbers
emphasized the importance of broiler chicken industry in Central Java as the third largest broiler population in Indonesia. Thus, estimation of economic loss due to coccidiosis is important to be calculated as it can be used by farmer, stakeholder, or government as basis information to create a proper management action or policy related to control and prevention strategies for coccidiosis. Therefore, this paper aimed to provide the estimation of economic loss due to coccidiosis in Central Java.

2. Materials and Method

Economic loss of poultry industry due to coccidiosis in Central Java, Indonesia was estimated based on epidemiologic and economic parameters. The secondary data to estimate economic losses were obtained from scientific publications, government data, expert opinions, market data, and assumptions based on expert discussion. Survey and data collection were conducted in July-September 2019 which were obtained through personal communication and discussion with poultry farms owner, veterinarian, and the management personnel.

2.1 Material

The information of chicken population in Central Java used in this paper (Table 1) retrieved from the data of Ministry of Agriculture 2018 [6]. The epidemiologic parameters that were used in this calculation were obtained from other studies about coccidiosis, government, and farms in Central Java (Table 2) and the economic parameters based on current field price (Table 3).

2.1.1 The population of broiler chicken. Table 1 shows the population of chicken in Central Java per year. In this case, we used the data of chicken population in 2018 [6]. We use 2018 data as the most updated data can be found [6]. The population of broiler chicken was the highest (73.5%) compare to other chicken breeds in Central Java.

Table 1. Chicken population in Central Java, Indonesia

| No | Chicken type | Population |
|----|--------------|------------|
| 1  | Broiler      | 180,935,555|
| 2  | Layer        | 22,754,001 |
| 3  | Local        | 42,446,187 |

2.1.2. Epidemiologic parameters. We used information from previous research and results of interview with expert and farmer as the assumption for epidemiologic parameters. The following (Table 2) is the epidemiologic parameters to estimate economic losses caused by coccidiosis.

Table 2. Epidemiologic parameters in chicken coccidiosis

| Epidemiologic Parameter | Symbol | Unit | Amount | References |
|-------------------------|--------|------|--------|------------|
| Prevalence of coccidiosis | Prev   | %    | 34     | [3]        |
| Mortality               | Mo     | %    | 38.5   | [7]        |
| Average body weight     | BW     | Kg   | 2      | [8]        |
| Weight loss             | WL     | %    | 22     | [2]        |
| Chicken export          | Ex     | %    | 0.005  | [6]        |

2.1.3. Economic parameters. Economic parameters consist of live broiler price, disinfection cost, and treatment cost. The economic parameters used current costs. These costs were gained from interviewing farmer under partnership system that was mostly used in Central Java and provide relatively stable price.
Table 3. Economic parameters in chicken coccidiosis

| Parameters                          | Symbol | Price  |
|-------------------------------------|--------|--------|
| Chicken/kg                         | Pr     | 17,000 |
| Disinfection costs/head            | DP     | 1,000  |
| Control disease (drug/treatment)   | CP     | 2,000  |

2.2  Methods

The analysis of economic loss due to coccidiosis in this study following Basri and Sumiarto (2017) [10] methods consist of direct and indirect calculation.

2.2.1. Direct economic loss analysis. This approach calculated the production system loss and extra loss. The production system loss consisted of total loss due to number of death animal and low body weight gain; while the extra loss included biosecurity and disease control cost. The formulas we used to estimate direct economic losses due to coccidiosis were written bellow:

Production system costs

Economic losses formula due to mortality

\[
\text{Chicken Population (Po)} \times \text{Mortality (Mo)} \times \text{Body Weight (BW)} \times \text{Chicken Price/kg (Pr)}
\]

Economic losses formula due to weight loss

\[
\text{Chicken Population (Po)} \times \text{Prevalence of Chicken Coccidiosis (Prev)} \times \text{Body Weight (BW)} \times \text{Weight Loss (WL)} \times \text{Chicken Price/kg (Pr)}
\]

Economic losses in extra costs

Biosecurity and Disinfectant

\[
\text{Chicken Population (Po)} \times \text{Disinfection Costs (DP)}
\]

Control of Disease

\[
\text{Chicken Population (Po)} \times \text{Drug/treatment (CP)}
\]

2.2.2. Indirect economic losses analysis. Indirect loss analysis was calculated based on economic loss related to lower export rate from Central Java to other provinces due to mortality rate, and decreasing broiler body weight due to Coccidiosis. The formula to estimate the indirect economic losses in chicken:

Chicken Export to Other Area

Economic losses formula due to chicken mortality

\[
\text{Chicken Export (Ex)} \times \text{Chicken Population (Po)} \times \text{Mortality (Mo)} \times \text{Body Weight (BW)} \times \text{Chicken Price/kg (Pr)}
\]

Economic losses formula due to weight loss

\[
\text{Chicken Export (Ex)} \times \text{Chicken Population (Po)} \times \text{Prevalence of chicken coccidiosis (Prev)} \times \text{Body Weight (BW)} \times \text{Weight Loss (WL)} \times \text{Chicken Price/kg (Pr)}
\]

3  Result and Discussion

3.1  Direct economic loss.

Based on the calculation, direct economic loss in Central Java broiler production system caused by coccidiosis was more than 2.5 trillion rupiah (Table 4) and extra cost for disease prevention and
control up to 500 billion rupiah (Table 5). Total direct economic loss due to coccidiosis in Central Java broiler chicken industry was more than 3 trillion rupiah.

### 3.2 Indirect economic losses.

The estimation of economic loss indirectly due to lower income from exporting broiler chicken to other provinces was 141 million rupiah approximately. Detail calculations were showed in Table 6.

**Table 4. Economic losses calculation in production system costs**

| Type of Losses | Formula | Po | Prev | Mo | BW | WL | Pr(Rp) | Costs (Rp) |
|----------------|---------|----|------|----|----|-----|--------|------------|
| Mortality      | Po x Mo x BW x Pr | 180,935,555 | 0.385 | 2 | 17,000 | 2,368,446,414,950 |
| Weight Loss    | Po x Prev x BW x WL x Pr | 180,935,555 | 0.34 | 2 | 0.22 | 460,155,303,476 |
| **Total Loss** | **2,828,601,718,426** | | | | | |

**Table 5. Economic losses calculation due to extra costs**

| Type of Losses | Formula | Po | DP(Rp) | CP(Rp) | Costs (Rp) |
|----------------|---------|----|--------|--------|------------|
| Disinfection Costs | Po x DP | 180,935,555 | 1,000 | 180,935,555,000 |
| Control of Disease | Po x CP | 180,935,555 | 2,000 | 361,871,110,000 |
| **Total Loss** | **542,806,665,000** | | | |

**Table 6. Indirect economic losses calculation in chicken export**

| Type of Losses | Formula | Ex | Po | Prev | Mo | BW | WL | Pr (Rp) | Costs (Rp) |
|----------------|---------|----|----|------|----|-----|-----|--------|------------|
| Mortality      | Ex x Po x Mo x BW x Pr | 0.00005 | 180,935,555 | 0.385 | 2 | 17,000 | 118,422,321 |
| Weight Loss    | Ex x Po x Prev x BW x WL x Pr | 0.00005 | 180,935,555 | 0.34 | 2 | 0.22 | 23,007,765 |
| **Total Loss** | **141,430,086** | | | | | | |

**Table 7. The calculation of total economic losses due to coccidiosis**

| Type of Losses | Price |
|----------------|-------|
| Direct economic losses | 3,371,408,383,426 |
| Indirect economic losses | 141,430,086 |
| Total loss | 3,371,549,813,512 |

Economic loss estimation due to coccidiosis in Central Java broiler chicken was up to 3.3 trillion rupiah (Table 7) which was 32% higher approximately than the economic loss due to coccidiosis in 2016 (Rp 2,562,774,091,706,-). With the current average US dollar currency to rupiah (1 USD = Rp
14,000), the value of total loss due to coccidiosis in Central Java was up to 240 million dollar approximately. These amount was equal to 54% total annual profit that can be up to Rp 6,151,808,870,000,- (equivalent to 439 million USD). Globally, Coccidiosis was estimated to cause up to 3 billion USD economic loss per year [11]. In small scale poultry farm, this disease contributed to an average 11.86% and in large scale farm 8.40% extra loss to control the disease [12].

The increasing of economic loss indicates that in the past three years coccidiosis control programs had not reduced the prevalence. Therefore, a proper management strategy should be conducted. So far, the strategies used to control this disease consist of biosecurity management, addition of coccidiostat agents in feed and drink, and vaccination. However, these strategies were not resulting in optimize and efficient protection broiler chicken from coccidiosis. It is shown in high prevalence of coccidiosis in broiler which is fed with commercial feed compare to local breed which were not fed with commercial feed [3]. In addition, there are concerns related to coccidiostats resistance due to prolong use. Nevertheless, considering the potential economic loss due to coccidiosis, it is important to create a better strategy to control this disease.

4 Conclusion
Coccidiosis in Central Java can cause economic loss up to more than half of annual profit. Thus, it is important to take a necessary action to control and prevent the disease through implementing proper strategy to control the disease.

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