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Recent Study of Coccidiosis in Broiler Closed House: The Role of Some Aspects of Maintenance

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Abstract. This study aimed to determine the role of different factors in raising broiler chickens in closed-house cages that affect the increased cases of coccidiosis in partnership farms. These factors are cage management, the level of cage cleanliness, the chicken-rearing period, and the prevalence of coccidiosis in partnership farms. The research was conducted from May to December 2022 in 11 closed-house broiler farms in the Kalibagor Subdistrict, Banyumas Regency. This study applied survey method and a purposive sampling, and determined the sample size by the Slovin formula, collecting 100 samples in total. The materials were broiler chicken feces collected in the initial and final phases, and data on maintenance management were collected using a questionnaire. Data were subjected to descriptive analysis and Chi-square calculations. The results stated that the prevalence of coccidiosis in Kalibagor Subdistrict was 29%, and coccidiosis occurrence at the starter and finisher periods was 6% and 52%, respectively. The results of the Chi-square analysis show a significant difference in coccidiosis occurrence among broiler rearing periods. The effect of the level of cleanliness is also significant in the occurrence of coccidiosis in Kalibagor Subdistrict, Banyumas Regency. This study concludes that the occurrence of coccidiosis in closed-house broiler chickens on partnership farms is quite low, and the level of cleanliness and rearing period is very influential on the occurrence of coccidiosis.

Keywords: broiler chickens, maintenance, closed house, coccidiosis

Abstrak. Tujuan penelitian ini yaitu untuk mengetahui peran beberapa faktor pemeliharaan ayam broiler dalam kandang *closed house* yang mempengaruhi peningkatan kasus koksidiosis pada peternakan kemitraan. Faktor-faktor tersebut adalah manajemen perkandangan yang diterapkan oleh peternakan kemitraan, tingkat kebersihan kandang, periode pemeliharaan ayam serta prevalensi koksidiosis pada peternakan kemitraan ayam broiler. Penelitian dilakukan dengan metode survei menggunakan *purposive sampling* (untuk pemilihan peternakan yang disampling) di 11 peternakan *closed house* ayam broiler di Kecamatan Kalibagor Kabupaten Banyumas. Pengambilan sampel dalam kandang menggunakan *random sampling*. Penelitian ini dilaksanakan pada Mei hingga bulan Desember 2022. Besaran sampel yang diambil mengikuti rumus Slovin, sebanyak 100 sampel. Materi yang diambil adalah feses ayam broiler pada fase awal dan akhir serta data kuisioner tentang manajemen pemeliharaan. Analisis data menggunakan analisis deskripsi dan perhitungan *Chi-square*. Hasil analisis menyatakan bahwa prevalensi koksidiosis di Kecamatan Kalibagor sebesar 29%. Kejadian koksidiosis pada ayam broiler fase awal sebesar 6% dan fase akhir sebesar 52%. Hasil analisis *Chi-square* menunjukkan adanya perbedaan antara periode pemeliharaan ayam broiler fase awal dan fase akhir sangat signifikan terhadap kejadian koksidiosis. Pengaruh tingkat kebersihan juga signifikan terhadap kejadian koksidiosis di Kecamatan Kalibagor, Kabupaten Banyumas. Kesimpulan dari penelitian ini adalah kejadian koksidiosis pada *closed house* ayam broiler pada peternakan kemitraan ayam broiler cukup rendah. Tingkat kebersihan dan umur sangat berpengaruh terhadap kejadian koksidiosis.

Kata kunci: ayam broiler, pemeliharaan, *closed house*, koksidiosis

Introduction

Broiler is a meat-producing strain of chicken that is readily available and relatively cheap compared to beef and mutton. Due to these two factors, broiler chickens are the most liked meat in society (Ratnasari et al., 2015). However, broiler farmers face challenges in maintaining sustainable broiler farming and good broiler performance. Generally, broiler chickens can be sold before the age of five weeks when they weigh 1.5kg on average because broilers are relatively efficient livestock, meaning they can convert feed to meet and therefore increase

their body weight easily (Situmorang et al., 2013; Martinez et al., 2022).

Broiler have widely spread almost evenly across the regions of Indonesia, especially Java Island, including Banyumas Regency. According to the Statistics of Banyumas Regency in 2021, the temperature in Banyumas is approximately 24^{o}C with 75-95% humidity. This climatic condition is the reason for the relatively large population of broiler chickens in Banyumas Regency. It is reported that Kalibagor Subdistrict has around 256,000 broiler (BPS Banyumas, 2021).

Indonesia has banned the use of antibiotics in feed known as antibiotic growth promoters (AGP), stipulated in Law No. 18/2009 juncto Law No.41/2014 concerning Animal Husbandry and Animal Health, stating the prohibition of using feed mixed with certain hormones and or antibiotic feed additives. This law aims to prevent the presence of antibiotic residues in food products and antibiotic resistance in consumers. This ban has led to speculations regarding the potential disease outbreaks among poultry. Diseases are one of the challenges in broiler maintenance because broiler chickens may contract multiple diseases like coccidiosis, colibacillosis, pullorum, and infectious coryza. These diseases have made broiler farming increasingly vulnerable, so it calls for special monitoring. Coccidiosis occurs when broiler cages are contaminated, and the morbidity level is up to 90%. Coccidiosis is caused by *Eimeria sp.* which farmers commonly call bloody diarrhea. Bloody diarrhea is chicken excreting stool followed by blood due to inflammation in the broilers' intestines or digestive organs. The clinical symptoms of coccidiosis among broilers are easily sleepy, droopy wings, coarse feathers, bloody diarrhea, and low feed intake. Consequently, broilers experience impending growth, weight loss, and increased mortality and morbidity by up to 80% (Agustin dan Ningtyas, 2020).

The preventive measure to ward off diseases from broiler is by providing a clean cage. Chickens kept in clean cages will not be prone to diseases, but unfortunately, most farmers often ignore this key factor. Cleanliness levels are overlooked, and efforts to maintain clean cages are under optimum. Cleanliness levels will affect broiler farming management and broiler health. Regularly sanitized cages have direct impacts on chicken health because it promotes a clean and healthy environment. It was in line with Rudiyansyah et al. (2015) that sanitation is the key factor in the environmental conditions of cages. Regular cleaning of cages and containers for food and drinking water and positioning the cage to have direct sunlight play crucial roles in preventing multiple diseases like coccidiosis that grow well in poorly maintained cages.

Broiler undergo two phases of the rearing period (age development): the starter phase and the finisher phase. The starter phase starts when the chicken is first put into the cage (chick in) until 21 days, while the finisher starts from 22 days of age until harvest time which usually comes at 35 days. Each phase is named differently in order to determine the broilers' development, growth, and needs. Coccidiosis disease infecting broiler brings challenges and loss to broiler farming. Coccidiosis-infected broilers will undergo impending growth, decreased production, and increased mortality rates. Recently, closed hose partnership farming is a popular broiler cage system among the community because the conditions in the cage are more controlled, thus expecting a maximum productivity from chickens. There has been limited information about the aspect of maintenance toward the occurrence of coccidiosis in closed houses in partnership farms after banning the use of antibiotics in feed. Therefore, the purpose of this study is to determine the role of several factors in raising broiler chickens in closed-house cages that affect the increase in cases of coccidiosis in partnership farms. These factors are the cage management

applied by partnership farms, the level of cage cleanliness, the age of chickens, and the prevalence of coccidiosis in partnership farms. In addition, the outcomes of this study are expected to provide benefits to society that needs reliable sources of reference for similar or future research.

Materials and Methods

The object of this research was 11 closed-house partnership broiler farms in Kalibagor Subdistrict, Banyumas Regency. The farm had a range of 10,000-80,000 chickens. A purposive sampling was applied to collect 100 chickens (50 chickens at each starter and finisher phase) for measuring the infestation level of coccidiosis calculated using Slovin's formula (Ryan, 2013), and the feces was collected using random sampling method. The other factors to consider included the type of poultry (broiler), the type of cage (closed house), and farm location in Kalibagor subdistrict. Kalibagor has a large population of chickens to fulfill the demand for chicken meat in the Banyumas Regency. Based on the Statistics of Banyumas (2021), there were 256,000 broiler chickens in Kalibagor.

$$n = \frac{N}{1+\mathrm{Ne}^2} = \frac{256{,}000}{1+256{,}000\ (10\%)^2} = 100 \text{ chickens}$$

N: broiler chicken population in Kalibagor Subdistrict
e: error estimation (10%)
n: total sample

The measured variables in this research were the cage management applied by partnership farms, the level of cleanliness of the cages, the rearing period of chickens kept, and the prevalence of coccidiosis in partnership farms in Kalibagor, Banyumas Residence.

The researchers prepared and rechecked the research equipment, including a Ziploc bag, cooling box, plastic gloves, and ice block before heading to broiler farming sites. The samples of this research were the broiler feces and the responses to the interview questionnaire with broiler farmers in Kalibagor Subdistrict, Banyumas Regency. Exactly 3g of feces sample was put into a Ziploc bag and labeled with sample code consisting of the farmer's name, broiler's rearing period, and the sample number. The sample was stored in a cooling box prefilled with an ice box to maintain cold storage. The sample was brought to the Laboratory of Type B Animal Health for further analysis.

The presence of coccidiosis was determined by examining broiler feces to identify Eimeria sp. using a float test. Exactly 3g of broiler feces was put into a plastic glass, poured with 30 ml of water, and stirred using a mortar until homogenous, then filtered multiple times using a tea strainer, and put into a 15-ml sealed plastic centrifuge tube. The tube was centrifuged for 5 minutes at a speed of 1,500g and repeated until clear supernatant appeared. Then, sugar solution or saturated salt was gradually incorporated into the tube until the solution was on the top layer. After that, a cover glass was placed on the tube and let sit for 5 minutes, then the cover glass was removed and put inside an object glass for examination under the microscope with 10x magnification (Ananda et al., 2017)

Descriptive analysis is an analysis method to test the generalization of research findings using one sample. Descriptive analysis was conducted by testing the descriptive hypothesis. The analysis would conclude whether the hypothesis can be generalized or not. Using one or more independent variables, the descriptive analysis did not take the form of comparison or correlation (Nasution, 2017). The descriptive analysis in this study was to analyze the prevalence of coccidiosis in the Kalibagor Subdistrict and to analyze the maintenance aspects carried out by partnership farmers in the area.

The prevalence of coccidiosis was calculated using the formula below (Thrushfield, 2005).

$$\text{PoC} = \frac{\text{Total broiler chickens with coccidiosis}}{\text{Total samples observed}} x100$$

Note:
PoC = The prevalence of coccidiosis

Data of research findings was processed using the Chi-square method, one of the tools for non-parametric comparative tests to measure an effect on two variables. The measurement was conducted using an ordinal scale (Juanidi, 2010), namely a qualitative scale that categorized the measured data into different levels. The Chi-square analysis in this study was utilized to identify the effect of variables of rearing period and cleanliness levels on coccidiosis occurrence by observing whether the broiler feces were infested with oocyst of *Eimeria sp*). The levels of the ordinal scale for cleanliness level were very clean, clean, dirty, and very dirty on a scale of 1 to 4. The qualitative data were collected from the interviews with the respondents and the aspects of the levels of cleanliness were measured. The outcomes of this analysis were the score of observation frequency, while the expected frequency was calculated using the Chi-square formula according to Junaidi (2010) as follows:

$$X^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(Oij-Eij)^2}{Eij}$$

Note:
r = Number of line
c = Number of column
O_{ij} = Observed frequency in line I column j
E_{ij} = Expected frequency in line I column j

Then, the formula to calculate E_{ij} was as follows:

$$Eij = \frac{ni - nj}{n}$$

Note:
ni = Total frequency in line i
nj = Total frequency in column j

The supporting factors of low disease occurrence in chickens included cage biosecurity and routine and frequent cleaning of the cage. However, some aspects related to litter were not given enough attention, for example, the handling of the husks with disinfectants, the addition of lime, and the timing for changing the husks. Some disinfectants that work wonders in non-sporulating and sporulating *E. tenella* oocysts were kilcox followed by chlorocresol, whereas quaternary ammonium and glutaraldehyde are less effective. Kilcox inhibition reaches 100% in non-sporulating *E. tenella* oocysts, and the destructive effect was up to 99% in oocysts. The inhibitory and destructive activity of disinfectant will increase significantly with concentration and contact time (El-Sherry et al., 2021).

Results and Discussion

Maintenance management of closed house cages on partnership farms

This research took place in Kalibagor subdistrict, one of 27 subdistricts in Banyumas Regency. Taking up an area of 3573.18 Ha or 2.6% of Banyumas Regency, Kalibagor is situated 36m above the sea. The selection of research sites in Kalibagor subdistrict was based on the population of broiler chickens in Kalibagor which, according to Banyumas Statistics (BPS) was relatively high up to 256,000 chickens. This research was conducted in four villages in Kalibagor: Srowot, Wogen, Suro, and Kaliori in which broiler farming sites were concentrated. Broiler farmers in Kalibagor had diverse backgrounds and characteristics and graduated from junior high school, up to undergraduate level. All of them shared a common purpose of farming, namely to earn a living.

The prevalence of coccidiosis occurence among broiler chickens in Kalibagor, Banyumas

Based on the BPS of Banyumas Regency, the population of broiler chickens in Kalibagor was 256,999. The survey and sampling collection were performed in some broiler farming that held partnership broiler farming communities in

four villages in Banyumas, namely Srowot, Wogen, Suro, and Kaliori. The sample of broiler feces was randomly collected from 100 broiler chickens owned by 11 farmers in Kalibagor Subdistrict, Banyumas Regency. Any blood spots on the broilers were the distinctive characteristic of coccidiosis infestation, and once chickens contracted this disease, they became contagious to other chickens and livestock (Ministry of Agriculture, 2014). The collected sample would be subjected to the float test to identify the presence of coccidiosis in the feces.

Table 1. Farmer's characteristics and maintenance management in Kalibagor partnership farms

No	Majority Farmer's Characteristics and Maintenance Management	Percentage (%)
1.	Education: Senior High School	45.45
2.	Farming is the main livelihood	100
3.	Long time farming: 1-2 years	45.45
4.	Optimistic business view	81.82
5.	Breed: Cobb	63.64
6.	Cage construction: cement wall	63.64
7.	Cage type: litter	54.55
8.	Floor cage material: cement	63.64
9.	Longitudinal from west to east for cage position	100
10.	Use disinfectants when maintaining and cleaning cages	100
11.	foot dipping	54.55
12.	Sanitary treatment of stable staff	72.73
13.	Biosecurity at the gate or entrance to the cage area is available where biosecurity is located	63.64
14.	Every cage operational vehicle or guest vehicle is sprayed with disinfectant	81.82
15.	The water used to feed the chickens comes from a well	100
16.	Cage cleaning 14 days before chick in	100
17.	mixture used to clean the cage: detergent/ formalin/ other disinfectant	100
18.	The cage has been rested for > 7 days after being cleaned	63.64
19.	Equipment cleaned	100
20.	The husks used as litter are sprayed with formalin or an anti-flea	81.82
21.	Lawn mowing around the stable area is done	54.55
22.	The area around the cage is cleaned using a disinfectant	63.64
23.	Spraying disinfectant on chickens	100
24.	Disinfectant composition: 1:10 liters	100
25.	Guests and employees who enter the area in the cage are sprayed with disinfectant	72.73
26.	Provision of chlorine in drinking water	45.46
27.	Special footwear or sandals are provided to enter the area in the cage	45.46
28.	Litter is turned or dredged daily	36.37
29.	Sprinkling lime on the wet litter every day	27.28

Table 2. Prevalence of coccidiosisoccurence in Kalibagor Subdistrict, Banyumas Regency

Coccidiosis occurence	Number of infestated broilers (chickens)	Prevalence
Infested	29	29,0%
Non infested	71	71,0%

Table 2 shows that 29 out of 100 broiler chickens (29.0%) contracted coccidiosis. It was fewer than previous findings, which reported 31.1% prevalence of *Eimeria spp* infestation in Tanaban, Bali (Arsyitahlia et al., 2019) and coccidiosis prevalence among 36% of broiler chickens in Surabaya (Pradana et al. 2015), 20% in Bandar Lampung, and 52.5% in West Lombok (Agustin dan Novarina, 2020). The high prevalence of coccidiosis is reportedly related to different rearing periods and the cleanliness of the cage. It was in line with Wardani et al. (2021) that the main factors in the spread of gastrointestinal parasites (including coccidia) are environmental conditions, temperature, cage density, age group, and poor farming management. In this study, the contributing factors to low occurrence of coccidiosis in Kalibagor were routine cage biosecurity and high frequent cleaning of the cage.

The Effect of broiler's age on coccidiosis occurrence in Kalibagor Subdistrict, Banyumas Regency

The figure above indicates that at the starter phase (1-21 days), 3 out of 50 broiler samples (6.0%) were infested with coccidiosis, while the finisher phase had 26 out of 50 broilers (52%) infested with coccidiosis. It was in line with Simamora et al. (2017) that *Eimeria sp* infestation is common among chickens older than two weeks old because finisher chickens have lower body immunity than > 20-week-old chickens. According to Soulsby (1982), chickens at the starter phase exhibit better immunity against coccidiosis because the oocyst is undegradable due to weak gizzard movement and under-maximum performance of enzymatic digestion, leading to non-optimum degradation of the oocyst wall. Sulistiono et al. (2017) reported that broilers aged 3-4 weeks are more susceptible to coccidiosis.

Based on Table 3, the results of Chi-square analysis with a 95% confidence interval shows that there was a significant relationship between the broiler's rearing period and coccidiosis occurrence ($p<0,05$) in Kalibagor Subdistrict, Banyumas Regency. The result of *Chi-square* analysis (X2) showed that the X2count > X2table 0,05 (25,692>3,841), and therefore, it was concluded that a significant relationship existed between broiler's rearing period and coccidiosis occurrence.

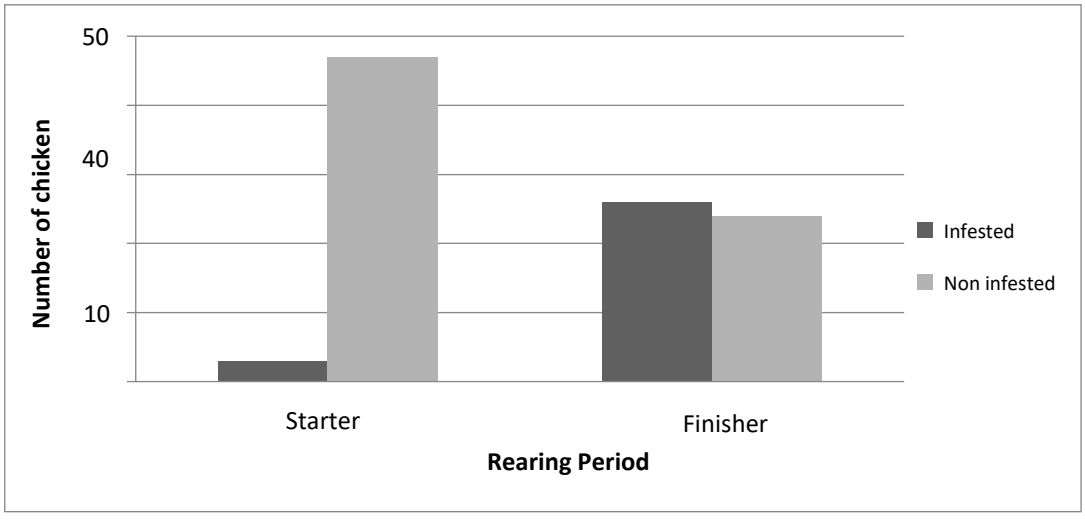

Figure 1. Prevalence of coccidiosis occurence at different rearing period in Kalibagor Subdistrict, Banyumas Regency

Table 3. Chi-square analysis of the effect of broiler's rearing period on coccidiosis occurence in Kalibagor Subdistrict, Banyumas Regency

	Coccidiosis occurence			Score	Score	
Rearing Period	Infested	Non-infested	Total	X^2count	X^2table	P
Starter	3	47	50			
	6,0%	94,0%	100%			
Finisher	26	24	50	25,692	3,841	0,000
	52,0%	48,0%	100%			
Total	29	71	100			
	29,0%	71,0%	100%			

Effect of cleanliness levels on coccidiosis occurence in Kalibagor Subdistrict, Banyumas Regency

Coccidiosis occurrence among 26 samples identified at the very clean level was 100% non-infested oocysts of coccidia, while at the clean level (53 samples) were 39 (73.6%) negatives and 14 (26.4%) infested. At the dirty level (15 samples), 12 (80%) samples were positive and 3 (20%) samples were non-infested, while at the very dirty level (6 samples), 3 (50%) samples were infested and 3 (50%) were non-infested. These results were obtained from the responses of broiler farmers during the interviews. They maintained good sanitation to keep the litter dry and biosecurity at the optimal level. It was in line with Tamalluddin (2012) that biosecurity is a series of programs embodied in policies and designed to prevent the spread of disease agents in chickens. Further, Tamalluddin (2012) stated that the constantly wet litters create humidity inside the cage and produce high levels of ammonia in the cage.

Based on the Chi-square test at $p<0.05$, X2count is higher than X2table at 0,05 (31,025>7,185), and therefore, a significant relationship existed between the cleanliness levels and coccidiosis occurrence in Kalibagor Subdistrict, Banyumas Regency.

It was in line with Indrasanti et al. (2021) that cleanliness is a crucial part of health which is significantly influential in poultry management.A clean and comfortable environment contributes to warding off contagious diseases from other livestock. Also, Indrasanti et al. (2021) reported that while coccidiosis prevalence can be affected by some factors including feeding system and cage systems, coccidiosis occurrence can be controlled or prevented through the implementation of good livestock management.

Broiler chicken farming that was categorized as dirty or very dirty was apparently absent in implementing a good biosecurity system. Dirty and very dirty cages did not provide a sanitation place for the staff nor a spraying booth for trucks that entered the cage area. In addition, the area around the cage was poorly sanitized and overgrown grass was covering the place. In the area, no foot dipping could be seen and the cage staff did not have special equipment like specific slippers or attire to enter the cage. The inside of the cages was also poorly sanitized without the regular schedule of disinfectant spraying to broilers, the humidity was very high because the wet litter was not removed and changed with the new one, therefore accumulating ammonia. This finding was in line with Tamalluddin (2012) that poor management of cages is responsible for the susceptibility of broilers to diseases. The samples of broiler feces showed that three out of six broilers kept in very dirty cages were contracting coccidiosis. These samples were at the starter which should have higher body immune than the finisher to ward off coccidiosis.

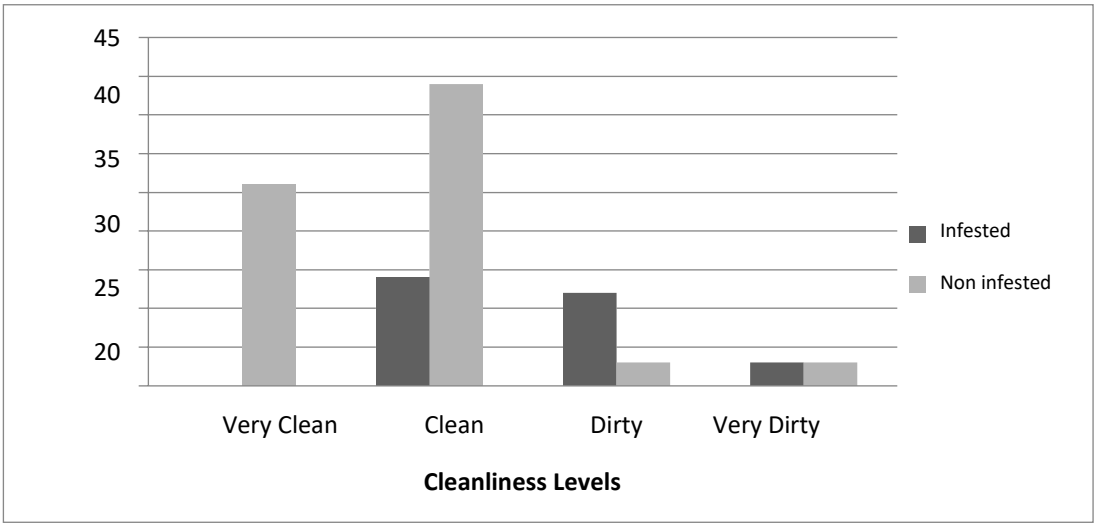

Figure 2. Coccidiosis occurence at different levels of cleanliness in Kalibagor Subdistrict, Banyumas Regency

Table 4. *Chi-square* analysis of the cleanliness levels in Kalibagor Subdistrict, Banyumas Regency

Cleanliness Levels	Coccidiosis occurenc		Total	X^2count	X^2table	P
	Positive	Negative				
Very Clean	0	26	26	31,025	7,815	0,000
	0%	100%	100%			
Clean	14	39	53			
	26,4%	73,6%	100%			
Dirty	12	3	15			
	80%	2%	%			
Very Dirty	3	3	6			
	50%	50%	100%			

Similarly, Simamora et al. (2017) reported that coccidiosis is prevalent in chickens older than two weeks old and rare in younger chickens because the latter have better immunity.

Some broiler farmers in Kalibagor Subdistrict, Banyumas Regency performed proper and regular sanitation by spraying disinfectant inside and outside of the cage, and the cars coming inside the area of the cage. Narantaka (2022) mentioned that both outside and inside parts of the cage must be disinfected regularly every 2-3 days, and there should be a quota to allow a limited number of staff and cars coming in and out of the farming, they must be sprayed regularly in order to anticipate the spread of diseases and germs.

The survey and sample collection were performed in broiler farming that implemented a closed-house cage system. Technology development has enabled the construction of two types of broiler chicken cages, open-house, and closed-house. A closed house may yield optimum results because the technology inside the closed house is far different from that in the open house. Package et al. (2015) reported that closed-house caging can improve farmers' efficiency in obtaining the final body weight gain properly and quickly, and enable the staff to adjust the temperature in accordance with the needs and conditions of the broiler chickens.

Broiler farming in Kalibagor Subdistrict had their cages cleaned and rested. Five farming had <7 days of resting and six farming had >7 days of resting. According to Huneau-Salaun (2010), the resting period equals preparation time for the cage. During this time, the cages will be cleaned and disinfected and the equipment will be washed. Cleaned cages are ready for the next

period of activities. This preparation time generally takes seven days until the DOCs re-enter the cages. However, it may take longer than seven days if the chickens from the previous period are contracting diseases. In other words, the duration of cage resting depends on the severity of the disease. Coccidiosis is endemic in commercial poultry farms due to poor management. Thus, every poultry farmer is expected to practice strict biosecurity on the farm, apply routine vaccinations against coccidiosis, and educate poultry farmers about the need to maintain good standards of hygiene and health management (Lawal et al., 2016; Fatoba et al., 2018).

Conclusions

The prevalence of coccidiosis occurrence among broiler chickens in Kalibagor Subdistrict, Banyumas Regency was as low as 29%. While coccidiosis occurrence among broiler chickens at finisher period was higher than that at starter period, the highest coccidiosis occurrence was 80% identified at the dirty level of cleanliness

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