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Health and Production Performance of Broiler strain Cobb with Closed House IoT System in Cimahpar, Bogor

Performa Kesehatan dan Produksi Ayam Broiler strain Cobb dengan Sistem IoT Closed House di Cimahpar, Bogor

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Abstrak

Salah satu sumber protein yang terjangkau bagi masyarakat Indonesia adalah ayam pedaging/broiler. Peternak berlomba-lomba melakukan budidaya yang optimal untuk mencukupi kebutuhan di masyarakat. Bagi peternak mandiri, melakukan budidaya yang efisien semakin berat untuk dilakukan karena adanya *global warming* yang memicu kondisi mikroklimat yang cepat berubah sehingga meningkatkan stres pada ayam. Oleh karena itu, sistem *closed house* dapat menjadi alternatif bagi peternak mandiri. Tujuan penelitian ini adalah untuk melihat performa kesehatan dan produksi dari broiler strain cobb yang dipelihara dalam sistem *closed house* yang didukung *Internet of Things* (IoT). Sebanyak 12.000 DOC dibagi dalam 2 tipe kandang dan 2 periode pemeliharaan. Tipe kandang yang digunakan adalah *closed housed* dan *open house* serta periode pemeliharaan pada Januari-Februari dan April-Mei 2022. Masing-masing kandang pada setiap periode berjumlah 3.000 ekor dan dipelihara dengan sistem standar. Sistem IoT digunakan untuk memantau kondisi mikroklimat. Hasil pencatatan pemeliharaan menunjukkan sistem *closed house* memberikan hasil lebih baik. Perbandingan bobot badan rata-rata per ekor antara *closed house* dan *open house* pada hari ke- 4, 15, 25, dan 30 secara berurutan adalah 88 dan 86 g; 520 dan 495 g; 1.73 g dan 1.127; 1.630 dan 1.520 g. Berat total panen memberikan peningkatan sebesar 5.21% (4.259 menjadi 4.481.8 kg) dan FCR yang lebih baik dari 1,49 menjadi 1,40 pada sistem *closed house.* Sistem *closed house* untuk peternakan mandiri mampu meningkatkan efisiensi pemeliharaan karena memberikan mikroklimat yang nyaman sehingga ayam tumbuh lebih baik. Simpulan dari penelitian ini adalah peternak mandiri dapat memanfaatkan sistem *closed house* untuk budidaya broiler yang lebih menguntungkan.

Kata kunci: ayam pedaging; closed house; internet of things; performa

Abstract

One source of affordable protein for the Indonesian wis broiler chickens. Farmers were competing to do optimal broiler production. For independent farmers, it is difficult to carry out efficient production because of global warming which triggers rapidly changing microclimate condition. Therefore, the closed-house system can be an alternative. The purpose of this study was to observe the performance of strain cobb broilers reared in a closed house system supported by the Internet of Things (IoT). A total of 12,000 DOC was divided into two types of cages and two maintenance periods. The types of cages used were closed and *open house* and the maintenance period was January-February and April-May 2022. Each cage contains 3,000 individuals and were maintained with a standard system. IoT systems were used to monitor the microclimate conditions. The

results of the recording show that the closed house system gives better results. The comparison of the average body weight per chicken between closed and *open house* on days 4, 15, 25, and 30, respectively was 88 and 86 g; 520 and 495 g; 1.73 g and 1.127; 1,630 and 1,520 g. The total harvest weight gave an increase of 5.21% (4,259 to 4,481.8 kg) and a better FCR from 1.49 to 1.40 in the closed-house system. The closed-house system for independent farmer was able to increase the efficiency because it provides comfortable microclimate so that the chickens grow better. The independent farmers can use closed-house system for more profitable broiler production.

Keywords: broiler chickens; closed house; internet of things; performance

Introduction

Food needs have always been a basic need for humans, their availability must always be met and guaranteed. The main function of food is to meet the needs of the body's nutrients. One of the affordable protein source foods for the people of Indonesia is broiler meat. The poultry industry sector is experiencing very rapid development and demand. Based on statistical data from the Directorate General of Livestock and Animal Health in 2020, per capita chicken meat consumption in 2020 was 12.79 kg, which increased compared to 2019 consumption of 5,683 kg. The accumulated rate of need for broiler chickens is very high, until it reaches 1,450,715 tons (Dirjen PKH, 2020). Farmers are competing to carry out optimal production to meet the needs in the community. However, there are several factors that cause broiler chicken production to be less efficient, one of which is global warming which triggers rapidly changing microclimate conditions that increase stress in chickens. These microclimates include temperature, humidity, and wind speed (Hasibuan *et al*., 2021).

Broiler chickens selected for high growth so will be related to high-speed metabolism and fast body heat production. High ambient temperatures exceeding the comfort level of broilers will have an impact on decreasing metabolism and feed consumption, resulting in poor and unfavorable performance of broiler chickens (Marom *et al*., 2017). In addition, changes in microclimate will affect the quality of the litter, including litter water content, litter temperature, and litter pH which will have an impact on ammonia production. Microclimatic ammonia increases due to low wind speeds, due to which the air entering from the inlet becomes slow to be carried towards the outlet. High ammonia levels cause chicken stress, decrease feed consumption, and drinking consumption increase so that excreta become diluted and cause litter to get wet quickly. This condition will have an effect on temperature, cage humidity, the amount of air in the cage, chicken stress, disease and fungal development (Hasibuan *et al*.,, 2021). Macroclimate and microclimate conditions relate to the cage system.

One of the main determinants of the success of livestock is the cage. The optimum ambient temperature for broiler chicken growth is 19 - 21^{o}C, while the temperature in Indonesia can reach 33 - 35^{o}C in the dry season (Andreas 2016). Therefore, a cage is needed to provide comfortable temperature. The type of broiler chicken cages can be divided into two design, namely open houses and closed houses. The maintenance of broiler chickens in open house and closed house cage systems greatly affects FCR, feed consumption, and body weight. An open house cage is a cage with an open wall and is usually made of wood or bamboo. Microclimates in open house cage systems tend to be unruly, so optimum broiler growth is difficult to achieve. Unlike the case with the type of closed house system, this cage has closed walls and a system to control the ideal microclimate inside the cage. Close house cages also usually added with Internet of Things (IoT) technology that can support the system.

Internet of Things (IoT) is a technology that can control an electronic system that is connected through the internet network (Wicaksono dan Kamal 2020). The farmer can control the microclimates inside the cages, so that the optimum temperature and comfortable environment of broilers can be achieved. In addition, the farmer can monitor the condition of the cage remotely, so that the microclimate

state remains stable even the outside temperature dynamically changed, as is the influence of global warming. Therefore, a cage with closed house system and added by IoT technology can be an alternative for independent farmers to increase the performance of broilers management and production.

Materials and methods

Time and place

The study was carried out in two period cycles, in the January-February and April-May 2022. The research site was located in a broiler cage owned by PT Zara Propertifarm Indonesia on Jln. Sapeha, RT 03 RW 11, Cimahpar, North Bogor District, West Java. Cimahpar and has average daily temperature of 30^{o}C. The height of the place from sea level is 500 meters above sea level.

Animals and Research Variable

The animals used in this study were 12,000 broiler chickens which were divided into two types of cages. Each cage was filled with 3000 broiler chickens. This research has been approved in our main topic research with ethical approval number 041/KEH/SKE/XI/2021. This breed of broiler chickens comes from the cobb strain. All of the chickens were given the same standard feed and drinking. The variables observed in this study include body weight (week 1-4), total weight of the harvest, total feed intake, feed conversion ratio, and average of mortality. All the data recorded is a routine carried out during the process of raising chickens in general.

Management system

The maintenance system is carried out on two different types of cages, namely open house and closed housed cages system. The closed house cage is added by the Internet of things (IoT) technology to support temperature and humidity control. The IoT system used includes monitoring and control functions of air temperature and humidity inside the cage. The monitoring system is observed in real-time which is then used as data input to control the cooling system to be active or in active like turning on the fan and activating water flow. The sensor used to monitor temperature and humidity is the DHT11 sensor mounted in the center of the cage. For the actuator function, the system also can be controlled manually to prevent bad conditions, for example, power failure situations. With the IoT system, the temperature and humidity inside the cage will be maintained and give a more comfortable microclimate to the chickens.

Open house

The cage is made with a standard construction, measuring 5 x 70 m with a height of 2.5 m which is made of a wooden frame without being given curtains /covers. The floor is covered with litter made from rice husks. Microclimates such as temperature and humidity in the cage tend to depend on the environmental conditions around the cage.

Closed house

The closed house cage system has the same construction and size as the open house cage. The difference lies in the closing curtain. The closed house cage has a closing curtain and is also equipped with Internet of Things technology that helps regulate the microclimate condition inside the cage. The temperature was set in the range of 30 - 33^{o}C for the starter period and 26 – 27^{o}C for the finisher period chickens with humidity ranging from 68 – 84%.

Result and Discussion

The sample measurement body weight of chicken to be carried out every week. With good recording, it will be easy to evaluate every day. The comparison of body weight of chickens between open and closed house provided in Table 1.

Table 1. Comparison of body weight between open and closed house

Week	Open house	Closed-house
1 (day 4)	86 g	88 g
2 (day 15)	495 g	520 g
3 (day 25)	1.073 g	1.127 g
4 (day 30)	1.520 g	1.630 g

The results showed that different cage systems greatly affect production results. The average value of sample weight on the closed

house cage and open house on day 4th is 88 and 86 g, on the 15th day it is 520 and 495 g, then on the 25th day the body weight of the chicken in the closed house cage system is 1.073 g, while the body weight of the chicken in the open house cage system is greater, which is 1,127 g. On the 30th day, the body weight of chickens with the closed house cage system is again higher than the weight of chickens with the open house system, respectively 1,630 g and 1,520 g. The results of this study are in line to the literature of Marom et al., that different cage systems have a significant effect on weight gain (Marom *et al.,* 2017). And also supported by the statement of Ismail et al., (2013) that broiler farms with a closed house system are more profitable than open house even in the same chicken population. Then, the performance of broiler between open and closed house is shown in Table 2.

Table 2. Broiler performance between open and closed house

Variable	Open house	Closed-house
Total weight of the harvest	4.259 kg	4.481,8 kg
Feed intake	6.325 kg	6.275 kg
Feed conversion ratio	1.49	1.40
Average mortality	10.16%	8.30%

The closed house system provided an increase in the total weight of the harvest by 5.21%, from 4,259 to 4,481.8 kg (Table 2). The cage system is one of the determining factors affecting the total harvesting weight of broiler chickens. Chickens will produce optimally if they are in the comfort zone (comfort zone) (Umam *et al.,* 2017). This convenience is created from a closed house enclosure system supported by Internet of Things technology. Chickens can always be in the comfort zone because the system can maintain the microclimate in the cage is always stable according to the suitable temperature and humidity, namely the temperature in the cage ranges from 26 - 27^{o}C during the finisher period and 31 - which is 33^{o}C during the starter period, the humidity in the cage ranges from 68 – 84%. In addition to the cage factor, the feed consumption factor is also very influential on body weight gain. Microclimate control using IoT technology make the situation inside the closed house to be comfortable for the chicken as shown in Picture 1 (a). And also the central system of IoT can be seen in Picture 1 (b) as a control panel. This panel serves to receive data from the sensors, record the data, and send data into IoT platform. The IoT technology can be a support system to get more efficient for monitoring and controlling the cage condition (Katiyar and Kumar, 2021).

Picture 1. (a) The condition inside closed house using IoT system; (b) Panel control for IoT system

Feed consumption is one of the determining factors for the success of the production of broiler chickens, because almost 70% of the cost is allocated to feed. The tabulation of research data (Table 2) shows that the total consumption of broiler feed with a closed house system is 6,275 Kg, while in open houses it is 6,325 Kg. The data show that closed house system gives more efficient number of feeding so it can be directly reducing the costs. Animal productivity can be measured by feed conversion / Feed Conversion Ratio (FCR). FCR is defined as a comparison between ration consumption and daily weight gain gained over a period of time (Jeremiah *et al*., 2015). The Feed Conversion Ratio value obtained was 1.49 in the open house cage system and 1.40 in the closed house system. Small ratio conversion rate means that the number of rations used to produce one kilogram of meat is less, but the higher the ration conversion the more wasteful the ratio used (Widjaya *et al*., 2022). So the lower the feed conversion value the better, this shows that the consumption of feed consumed is more efficient in converting rations into meat. Low feed conversion value can be used as a measure of the success of ration efficiency in livestock production (Muharlien *et al*., 2020). This means that in the closed house system, the feed conversion is better than the open house management system. From three parameters above, the results show that the closed house system gives better results

than open house system. This fact can be consideration for independent farmer to change their system management from an open house system to closed house equipped with an IoT system.

Conclusion

The conclusion of this study is that independent farmers can take advantage of a closed house system supported by Internet of Things technology for more efficient and profitable broiler management.

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