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Improving Broiler Chicken Farming Management in Closed Houses

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ABSTRACT

Genetic improvements in broiler chickens represent a major advancement in the poultry industry. Through selective breeding techniques, broiler chickens now exhibit remarkably fast growth and improved feed conversion efficiency. Observations were conducted by comparing data from the previous period with suboptimal management and the new period with optimal management. The Coops with good management were observed over one period (approximately 6 weeks). The result were made by comparing the data between the suboptimal management with the improved management, and both sets of data were compared with the international Cobb 2021 standards. The measured variables included: depletion (%), feed consumption (g/bird), body weight (g/bird), feed conversion, performance index, and profit. Improvements in environmental conditions or milieu (temperature, humidity, feed management, water, ventilation, and litter) resulted to more optimal production performance. Depletion, feed consumption, body weight, and feed conversion met the company's standards (body weight 2.5 kg, feed conversion 1.45, and performance index 450). The final performance was categorized as excellent, with a performance index of 512. Additionally, the profit from the new management was higher at Rp. 9,772 per bird than the old management Rp. 2,570 per bird.

Keywords: Broiler, closed house, environmental, closed house, performance index

ABSTRAK

Kemajuan genetik ayam broiler merupakan salah satu terobosan signifikan dalam industri ayam broiler. Teknik pemulian yang selektif sehingga ayam broiler memiliki keunggulan pertumbuhan yang sangat cepat dan tingkat konversi pakan yang lebih baik. Pengamatan dilakukan dengan membandingkan data pada periode sebelumnya saat kondisi pemeliharaan yang kurang maksimal. Kemudian, pada periode sekarang dilakukan perbaikan manajemen pemeliharaan (manajemen baru). Kandang yang sudah diperbaiki diamati selama 1 periode pemeliharaan (± 6 minggu). Selanjutnya dilakukan perbandingan data antara manajemen yang belum diperbaiki dengan manajemen yang sudah diperbaiki serta data keduanya dibandingkan dengan data standar internasional *Cobb* 2021. Variabel yang diukur meliputi: deplesi (%), konsumsi pakan (g/ekor), bobot badan (g/ekor), konversi pakan, indeks performa, dan keuntungan. Perbaikan kondisi lingkungan atau *milieu* (suhu, kelembapan, manajemen pemberian pakan, air, ventilasi dan litter) mampu menghasilkan performa produksi yang lebih optimal. Deplesi, konsumsi pakan, berat badan serta konversi pakan memenuhi standar dari perusahaan (bobot badan 2.5 kg, konversi pakan 1.45 dan indeks performa 450). Peforma akhir dikategorikan sangat baik dengan indeks produksi sebesar 512. Serta keuntungan yang didapat pada manajemen baru lebih besar Rp. 9.772 per ekor sedangkan pada kandang lama sebesar Rp. 2.570 per ekor.

Kata kunci: Broiler, closed house, lingkungan, indeks peforma.

INTRODUCTION

The main objective of current developments in the livestock sub-sector is to ensure balanced nutritional intake and boost the consumption of animal protein. Broiler chicken farming plays a key role in meeting this demand for animal protein. Compared to other livestock, broiler chickens are the most cost-effective due to their ability to gain significant body weight in a relatively short time (Putra *et al.* 2018). In recent decades, the broiler chicken industry has rapid advancements, establishing it as a leading provider of high-quality meat protein worldwide. Technological progress over the years, improvements in production management, and increased knowledge about nutrition and animal welfare have brought significant changes to broiler chicken production.

Genetic improvements in broiler chickens are among the major advancements in the industry. Through selective breeding, broiler chickens now exhibit rapid growth and better feed conversion rates. These genetic enhancements, refined annually, help farmers achieve target weights more quickly, increasing production efficiency and lowering costs. Fadilah (2018) notes that current broiler strains are modern, with carefully selected genetic potential that can be fully realized if 70% of environmental conditions are favorable.

The adoption of closed house is becoming increasingly popular to optimize environmental conditions and animal welfare. Closed house are allows precise control of temperature, humidity, and ventilation, which is essential for the welfare and growth of broiler chickens. Despite the benefits of closed house, farmers still challenges in management failures. Proper housing management plays a crucial role in productivity, aiming for satisfactory outcomes in broiler farming (Fikrianti *et al.* 2023). Additionally, the design of the housing should be optimized, utilizing quality equipment and materials such as effective insulation, ventilation systems, air exchange mechanisms, and evaporative cooling celldecks. This ensures the housing can adapt to changing environments to create suitable conditions for chicken development (Ribet *et al.* 2018).

Management failures, including errors in regulating environmental conditions (temperature, humidity, feed, water, litter, and ventilation) and inadequate maintenance of housing equipment, present significant challenges. These issues can result in increased stress among chickens, reduced production, and a heightened risk of disease. Therefore, effectively managing broiler chicken operations necessitates a comprehensive approach that involves identifying, preventing, and resolving problems through a range of appropriate strategies**.**

The strategy to enhance the productivity of broiler chickens is to create a comfortable environment within the housing. Optimal environmental management poses a significant challenge. Controlled temperature and adequate ventilation are crucial for the healthy growth and development of chickens, enabling them to meet or even exceed performance standards. An optimal environment also plays a vital role in maintaining chicken health. Poor conditions can lead to stress, disease, and even high mortality rates among chickens. Furthermore, limitations in human resources and infrastructure can present obstacles to effective broiler chicken management. A shortage of skilled barn operators and insufficient technology can impede proper management practices. Inadequate infrastructure, such as the absence of tools to monitor humidity, wind speed, and drinking water pressure, exacerbates these challenges. The new management is to fix the problems that exist in the cage and replace it with a maintenance system that is made according to the guidelines that have been set by the chicken strain or company. This case study aims to provide insights into improving broiler chicken management in closed house systems.

MATERIAL AND METHODS

Observations were conducted at CV. Berkah Putra Chicken, Farm Sapri 2, located in Desa Bantarsari, Kecamatan Ranca Bungur, Kabupaten Bogor, West Java. The Sapri 2 has a closed-house type, featuring an asbestos roof, concrete flooring on the first level, and bamboo flooring covered with tarpaulin on the second level. The walls are constructed of permanent tarpaulin. The facility is equipped with celldeck and includes 50-inch fans, with five fans on each floor. There are two housing units: Unit 1 is 70 meters in length, 12 meters in width, and 2 meters in height, housing 17,000 chickens; Unit 2 measures 70 meters in length, 10 meters in width, and 2 meters in height, and accommodates 8,000 broiler chickens.

Data collection were conducted observations used instruments included observations, interviews, and the Kestrel Anemometer. Following the identification of issues impacting broiler chicken performance, solutions were implemented based on the competencies of livestock engineering.

Observations involved comparing data from a previous period, during which management conditions were suboptimal, with data from the current period, where management practices had been improved (new management). The improved housing was monitored over one management cycle (approximately 6 weeks). Subsequently, data from the pre-improvement management were compared with data from the improved management, and both datasets were also compared against the international standards provided by Cobb 2021.

Measured Variable:
Depletion Rate (Fadilah 2013)
Cumulative depletion (%) were calculated daily used the following formula:

$$depletion = \frac{\text{Number of dead chickens+culling (tails}}{\text{Initial population (tail)}} \text{x } 100\%$$

Feed Consumption (Fadilah 2013)
Cumulative feed consumption (g/tail) were calculated used the following formula:

$$\text{Feed consumption} = \frac{Total\ Feed\ per\ day\ (g)}{Total\ of\ live\ chicken\ (ekor)}$$

Body Weight (Fadilah 2013)
Body weight (g/tail) were weighed per week and the cumulation were calculated by the formula:

$$\text{Body Weight} = \frac{Weighning\ Weight\ (g) - Basket\ Weight\ (Kg)}{Number\ of\ chicken\ (kg)}$$

Feed Conversion Ratio/FCR (Fadilah 2013)
The value of the Feed Conversion Ratio were calculated by the formula:

$$\text{FCR}=\frac{\text{Feed Consumption (kg)}}{\text{Body Weight Produced (kg)}}$$

Performance Index (IP) (Fadilah 2013)
Index production were calculated at the end of maintenance:

$$\frac{\text{Initial population (\%)x body weight}}{\text{FCR X age of chicken}}\text{x100}$$

Data Analysis

All the experimentals value were collected and analyzed with Microsoft Excel.

RESULT AND DISSCUSION

The broiler chicken industry has significant growth in recent years. However the challenges in broiler farming and management has become increasingly complex. To remain competitive and maintain optimal production quality, changes in broiler management practices are necessary. The transition from the old management practices at the Sapri housing (which lacked fan observation, feed management, water management, and had issues with leaking ventilation, litter management, and harvesting) to new management practices (which include fan and temperature observation, adjusting feed frequency, improving water management, fixing leaking ventilation, enhancing litter management, and optimizing the harvesting process) will be reflected in the following variables:

Depletion

Cumulative depletion during the first week up to 35 days of age under the new management was normal and close to standard values, at 2.87% (see Figure 1 and Table 1). The recommended standard for depletion in the first week is below 0.7%, or the company has set a maximum standard of 0.1% per day. High mortality during the first week under the old management was due to culling of stunted chickens, while mortality during the fourth week saw an increase, surpassing 0.07% per day up to 35 days of age (6.76%). To identify the causes of high mortality in the old housing, discussions with a veterinarian were conducted to ensure ethical standards were maintained and to achieve more accurate results. The high mortality in the old housing was attributed to respiratory infections. This elevated mortality was caused by a decrease in fan speed due to poor tarpaulin ceiling connections at several points during maintenance, leading to inadequate airflow with an average fan speed of 1.8 m/s from 5 fans, while the standard requirement for the fourth week is 2-2.5 m/s. The lack of adequate airflow led to an increase in harmful gases inside the housing, such as ammonia. High ammonia levels (ppm) irritated the respiratory tract, conjunctiva, and cornea, resulting in bacterial infections, particularly *E. coli* (TMC 2015).

Table 1. Depletion

Age (day)	Depletion (%)			
	Standard*	Old Management	New Management	Difference
7	0.70	0.81	0.51	-0.3
14	1.40	1.45	1.08	-0.37
21	2.10	2.21	1.6	-0.61
28	2.80	3.48	2.21	-1.27
35	3.50	6.76	2.87	-3.89

* Cobb 2021 Standard

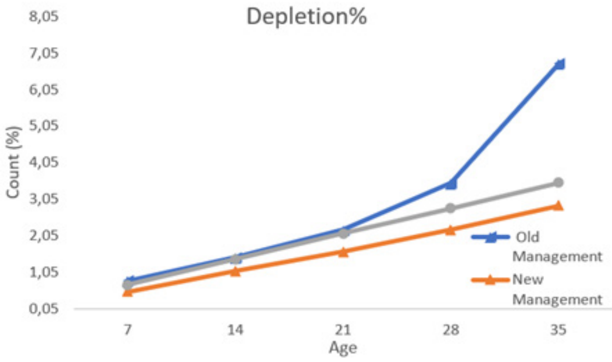

Figure 1. Depletion rate in 35 days

The respiratory infections often spread rapidly in farms. These infections can be caused by damp litter resulting from spilled drinking water or inadequate ventilation, leading to excessive ammonia buildup. According to Fadilah (2018), factors contributing to poultry illness include environmental conditions, the poultry themselves, pathogens (such as viruses and bacteria), and human resources.

The actions taken include replacing leaking ceiling tarpaulins and adding deflector curtains to improve airflow within the housing, maintaining wind speeds of 2.5-2.8 m/s with 5 fans of 50 inches each. Additionally, to ensure the health of the chickens, regular control of environmental factors (temperature, humidity, ventilation, water, litter, and lighting) is conducted, alongside monitoring feed consumption, improving water management, addressing stress factors, and continually monitoring the environment, the poultry, pathogens, and human resources. Healthy chickens are identified by their well-developed immune systems and performance that meets the target standards for the strain being raised. Furthermore, during preparation for cleaning and disinfecting the housing, strict adherence to safety and health standards is enforced. This includes using personal protective equipment such as masks, boots, gloves, and goggles to protect against hazardous substances during the disinfection process and to ensure that pathogens from the previous period are eradicated and do not spread to subsequent periods.

Feed Consumption

Feed consumption is a critical parameter in broiler chicken management as it directly correlates with growth, \production efficiency, and health. In the new management system, feed consumption from the start of rearing to harvest is not under the standard, as shown in Table 2. In contrast, feed consumption under the old management decreased below the standard from week 1 up to 35 days of age.

Table 2. Feed Consumption

Age (days)	Feed (g/bird)			
	Standard*	Old Management	New Management	Difference
7	145	142	203	61
14	541	518	665	147
21	1239	1186	1383	197
28	2209	2095	2440	345
35	3399	3038	3566	528

*Cobb Standard 2021

A decrease in feed consumption is attributed to environmental conditions such as temperature and humidity. Humidity is a critical factor in broiler chicken management, as it significantly impacts productivity. Optimal humidity levels range from 50-70%, but achieving this ideal range can be challenging for farmers, especially in regions with extreme climatic conditions. High humidity can cause litter to become wet quickly, which promotes the growth of bacteria and parasites that can lead to illness in chickens. Furthermore, elevated humidity can result in heat stress, as broiler chickens are highly sensitive to high temperatures, and the combination of high humidity can exacerbate their condition.

The heat stress index is a combination of two factors, namely temperature in Fahrenheit plus the percentage of humidity. This index has a significant impact on the success of broiler farming. If the heat stress index is not properly maintained, chicken performance may be affected, and it could even increase mortality rates (Yasa *et al.* 2019). According to Fadilah (2018), the Heat Index Score (HIS) values are categorized as follows: <150 indicates no heat stress issues, 155 signifies performance disturbances, 160 shows reduced appetite and increased water intake, 165 marks the onset of mortality, and 170 denotes high mortality rates. The HIS values (Table 3) for the old management system increased from the first week to the final week, reaching a final HIS value of 165. In contrast, under the new management system, the HIS value rose to 158 in week 3 but decreased to 147 by week 5. The increase in week 3 was due to the barn operator reducing the fan settings from two fans to one fan as a response to rainy conditions. Subsequently, education and improvements were implemented to ensure that fans operated according to minimum ventilation requirements, resulting in a decrease in HIS by week 4.

High temperatures can induce stress in broiler chickens, affecting their behavior and physiology, which leads to reduced feed consumption. Chickens may attempt to lower their body heat production by decreasing feed intake and increasing water consumption. According to Astuti and Jaiman (2019), at high temperatures, broiler chickens become more active in dissipating body heat and increase their water intake rather than consuming the provided feed. Water plays a crucial role in the physiology of broiler chickens, including supporting the function of hydrolytic enzymes in digestion and metabolism, regulating body temperature, facilitating membrane transport in target cells, maintaining blood osmolarity and viscosity, and aiding in the transport of nutrients, hormones, and other substances throughout the body (Sunarno and Nagari 2022).

One method to reduce heat within the housing is to maintain an effective ventilation system. According to Suasta *et al*. (2019), a closed house system equipped with proper ventilation helps keep the internal temperature lower than the external temperature. Additionally, good ventilation management controls humidity, wind speed, and light entering the housing, thus preventing heat stress in broiler chickens. However, if the ventilation is inadequate or does not meet the chickens' needs, the internal temperature can increase drastically, especially during the day.

Table 3 indicates that the effective temperature during the day from week 1 to week 5 in the old housing deviates significantly from the standards required for chickens. Fadilah (2013) suggests that the ideal temperature for chickens is between 23-26°C. According to Gussem *et al.* (2017), temperatures reaching 30°C in the housing by week 4 are considered extremely dangerous. High temperatures lead to heat stress in chickens. During heat stress, chickens increase their water intake and decrease feed consumption, resulting in reduced meat production, uneven growth, and higher depletion rates (Palupi 2015).

In a closed house system, the utilization of wind chill is crucial as it results in an effective temperature, or the temperature perceived by the chickens, being lower than the actual temperature of the housing. The effective temperature is important because it helps achieve the ideal environmental conditions. The effective temperature is influenced by wind speed, which can be calculated using

Table 3. Effective Temperature Conditions During the Day

Age	Standard	Old Management		His	New Management		His
		Temperature	RH		Temperature	RH	
7	34-32°C	33.5	63	155	31.8	64	153
14	31-27°C	31.4	68	157	28.8	69	153
21	27-25°C	30.2	75	161	26.9	78	158
28	25-23.5°C	28.8	80	164	24.2	75	151
35	23.5-20.5°C	26.7	85	165	21.7	76	147

*TNZ (Thermonetralzone)

the following formula:

Effective temperature = Actual temperature – *Wind Chill* (WE)

In the old management system, the effective temperature perceived by the chickens exceeded the standard TNZ (Thermoneutral Zone) from week 1 to week 5, resulting in the chickens experiencing excessive heat. The high effective temperature during the brooding period (1-21 days) was caused by improper fan settings, which led to a sensation of heat for the chickens. This error in settings occurred due to the lack of guidelines on the required fan operation.

The corrective measures implemented included fan observations conducted before the chickens were introduced. Fan speeds were measured at nine different points within the housing, at heights of 40 cm and 120 cm, starting with one fan and progressing to all operational fans. Following these measurements, calculations were made to determine the fan capacity. This assessment is critical for establishing the number of fans needed based on factors such as the weight, population size, and age of the chickens.

To reduce the temperature inside the housing, cooling pads were utilized. The closed house system includes cooling pads that act as a cooling mechanism to maintain optimal internal temperatures. Air is drawn into the housing by exhaust fans through a water-moistened cell deck, which helps regulate both temperature and humidity according to the chickens' requirements (Fadilah 2013). Additionally, ensuring proper air quality is vital for maintaining a comfortable temperature for the chickens. Effective ventilation prevents the accumulation of ammonia and aids in regulating temperature and humidity, particularly during high temperatures that could lead to heat stress. The results from the new management system, as shown in Figure 2, indicate that temperatures are nearing the Thermoneutral Zone (TNZ), providing a comfortable environment for the chickens.

Regulating the frequency of feedings is highly beneficial for increasing feed consumption. During this period, the feeding frequency was adjusted to 3-4 times daily, up from the previous 2-3 times daily. Proper management of feeding frequency helps minimize feed wastage and maintains feed quality, which in turn enhances feed consumption by the chickens.

Another factor contributing to decreased feed consumption is the condition of the litter. Litter serves as the flooring material that absorbs waste and moisture, providing comfort for the chickens. The litter used in the Sapri housing is rice husk. Ideal rice husk should be new, clean, and free from mold and contaminants. To maintain ammonia levels below 10 ppm, the litter is turned every two days. Clumped litter is removed and replaced with fresh material, and disinfection is performed before chick introduction and during the rearing process. According to Marang *et al.* (2019), ammonia levels can be reduced by enhancing feed efficiency, which decreases nitrogen excretion, and by improving litter conditions, temperature, and humidity. The results after implementing these improvements are illustrated in Figure 3.

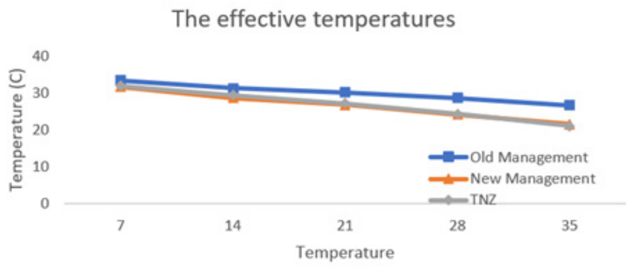

Figure 2. The effective temperature during 35 days

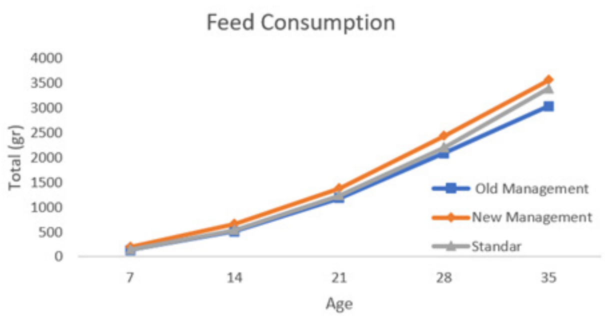

Figure 3. Feed Consumption in 35 days

Body Weight

Body weight is a critical measure during the broiler chicken rearing period. The body weight of chickens should continuously increase each day. Body weight is considered optimal when the daily growth reaches the established standards. According to Qurniawan *et al.* (2016), factors affecting body weight growth include gender, feed consumption, environmental management, breed, and feed quality.

In the new management system, body weight growth per week was significantly improved, exceeding the standard, with a body weight of 2,571 grams per chicken at 35 days of age (standard is 2,273 grams per chicken). In contrast, the old management system showed a decline in body weight from the first week until 35 days, with a body weight of 1,950 grams per chicken at 35 days (below the standard of 2,273 grams per chicken). The decrease in body weight under the old management was attributed to mismanagement during brooding and inadequate ventilation, leading to stress in the chickens and resulting in reduced body weight. These results are presented in Table 4.

Table 4. Body Weight

Age (days)	Body Weight (g/bird)			
	Standard*	Old Management	New Management	Difference
7	193	178	211	33
14	528	463	555	92
21	1018	900	1050	150
28	1615	1406	1740	334
35	2273	1950	2571	621

*Cobb Standard 2021

The actions taken focused on maximizing attention to four critical phases in the rearing period: the cleaning phase, brooding phase, post-brooding phase, and harvesting phase. Emphasis was placed on the brooding phase, as this period (also known as the golden period) is crucial for the development of body organs and skeletal structure through hyperplasia and hypertrophy, the formation of an optimal immune system, and the most efficient feed conversion (Fadilah 2018). During this phase, chickens must be kept warm because their thermoregulation system is not yet fully functional, making them susceptible to stress.

The results showed that the body weight of the chickens met the target standards (Figure 4). Additionally, after 28 days, improvements were made to the harvesting system to minimize stress on the chickens. Harvesting began from the back of the coop or from the smallest weight chickens, with careful handling. Chickens were transported from inside to outside through the rear door. During the harvesting process, the door should not be kept open for too long, except when moving chickens out of the coop to the harvest truck, after which the door should be closed again. This open-close door system is crucial to prevent stress among the chickens at the front and middle due to insufficient air circulation.

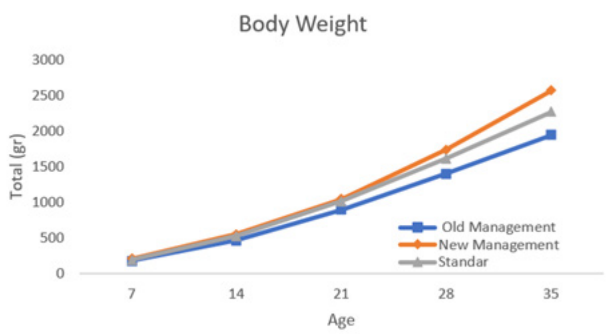

Figure 4. Body Weight in 35 days

Feed Conversion

Feed conversion ratio (FCR) indicates the efficiency with which chickens convert feed into body weight. A lower FCR value signifies more efficient broiler production. FCR is a key parameter for the success of broiler rearing because it directly impacts production costs.

Improvements in air ventilation, transitioning from old management practices to new ones, significantly influenced the FCR value (Table 5). Subkie *et al.* (2012) identified several factors contributing to a high FCR, including overfeeding, damaged feed containers, chickens contracting diseases (particularly respiratory infections which reduce appetite), high ammonia levels, and temperatures and humidity within the coop exceeding the chickens' comfort zone. The increase in FCR under the new management was short-lived, as corrections were made by optimizing air ventilation to meet the established standards (2 direct fans) and utilizing the windchill effect to reduce the heat index score.

The subsequent improvement involved adjusting feed distribution after the brooding period. Feed was provided in the morning, evening, and night, with 30% given in the morning and 70% in the evening and night. Feeding is not recommended during the day because the nutrients absorbed by the chickens are more likely to be used as energy rather than for growth. Additionally, daytime feeding can lead to heat stress. This adjustment resulted in a decrease in feed conversion ratio from week 3 until harvest. As shown in Figure 5, after implementing the new feeding regimen, feed consumption under the new management decreased after the brooding period.

Tabel 5. Feed Conversion

Age (days)	Feed Conversion (%)			
	Standar*	Old Management	New Management	Difference
7	0.76	0.82	0.96	0.14
14	1.03	1.13	1.20	0.07
21	1.22	1.33	1.32	-0.01
28	1.37	1.49	1.40	-0.09
35	1.50	1.56	1.39	-0.17

*Cobb standar 2021

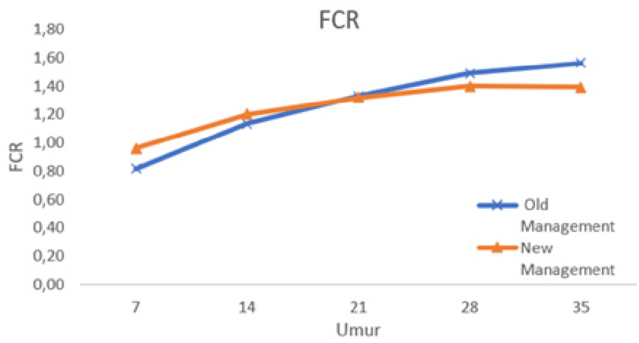

Figure 5. Feed Conversion in 35 days

Performance Index

The Performance Index (PI) is a parameter used to measure productivity and provide farmers with an understanding of the effectiveness of broiler chicken management. The higher the PI value, the better the management performance. As shown in Figure 5, the new management system experienced a weekly increase in PI, whereas the old management system's PI value remained stagnant around 300.

The comparison of PI between the old and new management systems is presented in Table 6. Improvements from the old to the new management system resulted in better depletion rates, feed consumption, body weight, and FCR, achieving a PI of 512 with an average age of 35 days (exceeding the established standard) and classified as very good. Enhancement in management are significantly contributed to more efficient and optimal chicken growth. According to Fadilah (2018) the commonly used PI values are <300 (poor), 300–350 (normal), 350–400 (good), and >400 (very good).

Revenue Analysis

Revenue represents the difference between total receipts and the total production costs incurred by the farmer (Susan *et al.* 2023). Production costs include expenses for resources used to generate output, such as the

Table 6. Performance Index

Age (days)	Performance Index		Difference
	Old Management	New Management	
7	315	312	-3
14	291	326	11
21	317	372	55
28	325	434	109
35	333	512	179

cost of purchasing DOC (Day-Old Chicks), gas, husks, feed, electricity, repairs, medications, and labor. The production costs for the Sapri 2 farm with the old management system amounted to Rp. 844,842,020, while the new management system incurred Rp. 1,004,338,602. The higher production costs under the new management are attributed to differences in the prices of DOC, feed, husks, operational expenses, and labor.

Revenue for the Sapri 2 farm is derived from the sale of chickens. Under the new management system, the revenue amounted to Rp. 1,248,631,860, compared to Rp. 909,090,000 under the old management. This difference is due to a higher percentage of chickens sold under the new management (97.13%) compared to the old management (93.24%), and the average weight of chickens sold under the new management was also higher (2.571 kg per bird) than under the old management (1.950 kg per bird).

The income from Sapri 2 farm under the new management system was Rp. 244,293,258 or Rp. 9,772 per bird, compared to Rp. 64,247,980 or Rp. 2,570 per bird under the old management system. The results indicate that revenue under the new management system is significantly higher than the old Management. This demonstrates that implementing improvements from the old management to the new management can yield greater profits.

CONCLUSION

Improving environmental conditions or *milieu* (temperature, humidity, management of feeding, water, ventilation and litter) can produce more optimal production performance. Depletion 2.87%, feed consumption 3566 g/bird, body weight 2571 g/bird and feed conversion 1.39 The final performance was categorized as very good with a production index of 512. And the profits obtained from the new management were greater by Rp. 9,772 per head, while in the old Management it was Rp. 2,570 per head.

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