The level of rice bran usage in the growth of local chickens reared in rural areas

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Abstract. This study aimed to determine the level of rice bran usage in the growth of local chickens raised in rural areas. It was conducted using a Completely Randomized Design, consisting of 4 types of feed as treatments with 4 replications. Each replication consisted of 10 chickens of one week old so that the total number of chickens used was 160. The treatments were commercial feed mixed with rice bran as follows: a) T1: 50\% rice bran, b) T2: 60\% rice bran, c) T3: 70\% rice bran, d) T4: 80\% rice bran. This experiment lasted for 12 weeks, consisting of 3 weeks adaptation period and 9 weeks observation period. The parameters observed were a) daily weight gain (DWG), b) feed consumption ratio (FCR), c) protein efficiency ratio (PER), d) energy efficiency ratio , and e) revenue/cost (R/C) ratio. Data were analyzed using the computer program of SPSS version 24.0. In case a difference occurs between the treatments, data were further analyzed using Duncan’s Multiple Range Test (DMRT). The results of this study revealed that feed treatments had significant effects on all parameters observed. It can be concluded that the T1 feed ration had the best response to the DWG (17.2 g/bird/d), FCR (4.43) and R/C ratio (1.39).

1. Introduction
The increase in population, income, and societal awareness of nutritious food requires the availability of quality food, such as meat, eggs, and milk, as sources of animal protein, meat, eggs, and milk due to they contain high protein and biological value. One of the livestock commodities capable of contributing to the provision of nutritious food is the local chickens [1].

Local chickens are one kind of local poultry generally bred by society, particularly in rural areas. Their presence has a strategic function in the fulfillment of food and nutrition for the society. Local chicken functions to provide meat, eggs, employment opportunities, and a source of family income. Developing local chickens is being prioritized for farmers because it has simple technology, can be done on the sideline, is easily bred by low-income society, is suitable for the family business scale in rural areas, and is spread out throughout the country [2].
Local chickens have unique traits compared to other poultry, i.e. they are more resistant to diseases and can be simply bred, for example by being fed with leftovers. Local chickens have their market segment, as their meat and egg prices are higher than the broiler chickens or egg-laying chickens. It is a good business opportunity for rural breeders to conduct. Problems which are usually encountered in breeding local chickens are related to its small-scale business (breeders possess only less than 10 hens), low productivity (egg production ranges from 30–40 eggs/year), slow growth, high mortality, vulnerability to ND disease, mostly traditional breeding system, insufficient feed in terms of quality and quantity, and high chick mortality. The low productivity of local chickens is commonly due to low in the maintenance system and individual diversity [3].

Attempts to increase the productivity of local chickens can be undertaken through seven efforts including breed selection, disease prevention/health management, cage system, providing high-quality feed, reproductive system, post-harvesting, as well as marketing and business management [1,3]. The management may be improved by changing from an extensive breeding pattern to a semi-intensive or intensive breeding pattern. Several studies on both of the latter systems suggest that there is an increase in the productivity of local chickens that ultimately increase breeders’ income. Improving the maintenance system or the technology may result in better expectations for agricultural businesses, as reflected by the improvements in the technique efficiency and/or economics [4].

The high preference of the society, the highly increasing demand for local chicken products, as well as the emergence of the local chicken market are promising prospects for the development of local chicken farms. This condition is expected to be utilized to empower breeders in rural areas via more optimal resource utilization. If in the past, local chicken breeding was mostly done by breeders in rural areas, then with a semi-intensive or intensive breeding system done nowadays, local chicken farms are also largely done by the society in peri-urban/outlying areas [4].

The feed is a significant aspect to be considered as it influences the production result. The cost spent on poultry breeding is generally quite big, ranging from 60 to 70% of the total cost. The improvement in feed made by breeders in rural areas is commonly done by utilizing local feed mixed with commercial or concentrated feed. The purpose of mixing commercial feed with other local feed is to lower the feed prices, while still taking into account the nutritional content.

Rice bran is a local feed ingredient commonly used for poultry farms. Rice bran is proper to be used in feed composition due to its abundant availability, non-competitive nature for food, and relatively inexpensive. Rice bran contains energy, protein, vitamin B, and various minerals in high amounts. This research strives to discover the influence of using rice brand in the growth of local chickens reared in a rural area.

2. Method
This study was undertaken in Kalahiyang Village, Paringin District, Balangan Regency, South Kalimantan Province, Indonesia. The feed used were the available feed ingredients or ones that were easily obtainable, i.e. rice bran, concentrates, commercial feed as well as the minerals. Feed formulation was prepared based on available feed ingredients with iso protein and energy, using Least Cost Diet Formulation Program (table 1).

The experiment was designed using a Complete Randomized Design, consisting of 4 types of feed as treatments with 4 replications. Each replication consisted of 10 chickens of one week old, with the average initial weight of 168.75 g/head. The treatments were commercial feed mixed with rice bran as follows: a) T1: 50% rice bran, b) T2: 60% rice bran, c) T3: 70% rice bran, d) T4: 80% rice bran. This experiment lasted for 12 weeks, consisting of 3 weeks adaptation period and 9 weeks observation period.

The parameters observed were a) daily weight gain (DWG), b) feed consumption ratio (FCR), c) protein efficiency ratio (PER), d) energy efficiency ratio (EER), and e) revenue/cost (R/C) ratio. The DWG is the average weight gain of chickens for 9 weeks of the observation period. The FCR is the amount of feed needed to increase the body weight during the observation period. The PER is the ratio between DWG and the amount of protein consumed. The EER is the ratio between DWG and the amount of energy consumed.
Table 1. Feed ingredients and nutritional compositions of four feed treatments given to the local chicken.

| Feed ingredients | Treatment (%) | T1  | T2  | T3  | T4  |
|------------------|---------------|-----|-----|-----|-----|
| Bran             |               | 50.0| 60.0| 70.0| 80.0|
| Commercial feed  |               | 50.0| 30.0| 21.5| 7.0 |
| Concentrate      |               | -   | 5.0 | 5.5 | 10.0|
| Corn             |               | -   | 1.0 | 3.0 | 1.0 |
| Cooking Oil      |               | -   | 1.0 | -   | 1.0 |
| Filler           |               | -   | 2.0 | -   | -   |
| Minerals         |               | -   | 1.0 | -   | 1.0 |

Nutritional Contents:

| Metabolizable Energy (kcal/kg) | 2,650 | 2,600 | 2,600 | 2,600 |
|-------------------------------|-------|-------|-------|-------|
| Crude Protein (%)             | 15.5  | 15.0  | 15.0  | 15.00 |
| Fat (%)                       | 7.5   | 9.74  | 9.98  | 12.00 |
| Crude Fiber (%)               | 8.00  | 8.67  | 9.60  | 10.40 |
| Calcium (%)                   | 0.56  | 0.86  | 0.42  | 0.77  |
| Phosphorus (%)                | 0.36  | 0.28  | 0.26  | 0.20  |

Price (IDR/kg)                  | 4,195 | 4,000 | 3,790 | 3,670 |

The R/C is the ratio between the revenue and costs, to see the feasibility of the chicken farm, the greater the value of the R/C ratio, the more feasible the farm. If R/C ratio > 1, then it can be considered feasible. If R/C ratio < 1, then it can be considered infeasible. Then if R/C ratio = 1, it means there is an impasse (there is no gain or loss). The R/C ratio was calculated using the following formula [5].

\[
R/C \text{ ratio} = \frac{Py.y}{\sum_{j=1}^{n}Pxj} \\
\text{where:} \\
y = \text{output} \\
Py = \text{output price (IDR)} \\
Pxj = \text{input price (IDR)} \\
xj = \text{input (j=1, 2,3,……n)}
\]

Data were analyzed using the computer program of Statistical Package for Social Sciences (SPSS) version 24.0. In case a difference occurs between the treatments, the Duncan’s Multiple Range Test (DMRT) was further conducted [6].

3. Results and discussion

3.1. Body weight and weight gain

The statistical analysis indicates that feed treatments have a significant influence on the final weight, total weight gain, and the DWG (table 2). The treatment of feed which provides the best response was the T1 containing 50% commercial feed and 50% rice bran. It was indicated by the results of the average final weight of 1,248 g/head, total weight gain of 1,082 g/head, and the DWG of 17.2 g/head/day. The study results show that the average weight was much better (above 1 kg/head). The speed of growth in the poultry is greatly influenced by several factors, including heredity, hormones, sex, age, quality and quantity of feed, temperature, and cage system.

The use of rice bran in local chicken rations is somewhat limited because rice bran contains phytic acid which is not easily digested by chicken because there is no phytase enzyme in the digestive tract of chicken [7,8]. The results of this study are following the research reported by [8] which states that the best use of rice bran in local chicken rations is as much as 50%. But in contrast to [9] who stated that...
rice bran can only be used as much as 30% in egg-laying chicken rations unless it is used in the form of fermented bran which can be given as much as 50% in the ration.

The local chicken weight reported by other researchers at the age of 12 weeks for chickens intensively bred in the laboratory were between 575–739 grams with a mortality rate of 14%, and feed conversion between 4 and 6.5 [10].

Table 2. The final weight, weight gain dan daily weight gain of local chickens up to 12 weeks old given four types of feed treatments.

| Treatment | Final weight (g/bird) | Total weight gain (g/bird/9 wks) | Daily weight gain (g/bird/d) |
|-----------|------------------------|---------------------------------|----------------------------|
| T1        | 1,248a                 | 1,082a                          | 17.2a                      |
| T2        | 1,072b                 | 924b                            | 14.7b                      |
| T3        | 1,131ab                | 938b                            | 14.9b                      |
| T4        | 1,005b                 | 837b                            | 13.3b                      |
| SEM       | 29.4                   | 29.1                            | 0.46                       |
| P         | 0.01                   | 0.01                            | 0.01                       |

Description: Different letters in the same column indicate a significant difference (P<0.01). SEM = Standard Error of Mean

The observations in this study until 12 weeks old chickens are similar to research reported by [11] where the growth of local chickens up to 12 weeks of age with an intensive system can accelerate to achieve slaughter weight of between 1.0 to 1.3 kg/head. The results of this study indicated that the feed used is of good quality because it can produce a body weight that is more optimal than the previously reported studies.

The local chicken weight produced in this study provides better results compared to the research reported by [12] who reported that the average weight local chicken at 12 weeks old, given commercial feed, was 884 g/bird. Meanwhile, range chickens given feed containing 25% palm kernel meal, with a feed protein content of 16% and calories of 2,700 kcal/kg, weighed only 829 g/bird. The research results as reported by [1] revealed the average weight of local chickens up to 12 weeks old was between 740–1,116 g/bird, with a feed conversion from 2.95 to 4.79. While research by [13] conveyed that the range chicken weight at 6 months old at the introduction technology group was 1,177 kg/bird; 1,292 kg/bird for the improvement technology; and 0.732 kg/bird for the control group.

3.2. Feed consumption and conversion ratio

The research results indicated that feed treatments provide a significant effect on total feed consumption, daily feed consumption, and the FCR (table 3). The FCR value suggests the efficiency of feed usage on weight gain produced. The lower the value, the more efficient it is. According to [14] the relationship between feed consumption and weight gain is determined by the FCR. The value of chicken FCR depends on the type, structure, and nutritional content of feed as well as the environmental condition. Factors affecting the growth and FCR are not only the protein and energy of the feed but also the balance of protein-energy as well as the concentration in the feed as a biological constraint in feed consumption.

The data obtained in this study that the T1 ration was the most efficient feed compared to other rations. The FCR value obtained in this study was not too high or the use of feed was quite efficient when compared to other studies. Results of the study reported by [12] have FCR values for local chickens aged 12 weeks were between 5.4 and 6.1.

The protein consumption obtained was significantly higher for the T1 feed ration (50% rice bran) and the T3 ration (70% rice bran). The protein consumption was between 714–738 g/head and the energy consumptions was between 12,614–13,037 kcal ME/bird. The energy consumption was significantly higher in local chickens given the T3 feed ration, with a value of 13,040 kcal ME/bird. The data obtained in this research indicated that both protein and energy consumptions were higher than those reported by
[11] in which the protein consumption of local chickens aged 4–12 weeks was between 327–374 g/bird, and the energy consumption ranged from 6,059 to 6,691 kcal ME/bird.

Table 3. Feed consumption and feed efficiency of local chickens up to 12 weeks old given four types of feed treatments.

| Treatment | Cumulative feed consumption (g/bird) | Daily feed consumption (g/bird/d) | Feed conversion ratio | Protein consumption (g/bird) | Energy consumption (kcal ME/bird) | Protein efficiency | Energy efficiency |
|-----------|-------------------------------------|----------------------------------|-----------------------|------------------------------|---------------------------------|-------------------|-------------------|
| T1        | 4,763b                              | 75.6b                            | 4.43b                 | 738a                         | 12,621b                        | 1.46a             | 1.09a             |
| T2        | 4,760b                              | 75.6b                            | 5.15a                 | 714b                         | 12,614b                        | 1.30a             | 0.93b             |
| T3        | 4,919a                              | 78.1a                            | 5.29a                 | 738a                         | 13,037a                        | 1.27b             | 0.94b             |
| T4        | 4,809b                              | 76.3b                            | 5.75a                 | 721b                         | 12,744b                        | 1.16b             | 0.84b             |
| SEM       | 21.3                                | 0.34                             | 0.16                  | 0.07                         | 0.00                            | 0.01              | 0.02              |
| P         | 0.01                                | 0.01                             | 1.00                  | 1.00                         | 1.01                            | 1.00              | 1.00              |

Description: Different letters in the same column indicate a significant difference (P<0.05)

This study indicated that the feed treatments had significant influences on the PER, and EER values (table 3). The PER ranged from 1.16 to 1.46, while the EER ranged from 0.84 to 1.09. The feed treatments which generate the best PER values were the treatment T1 and T2, while the highest EER was for the treatment T1. This PER result in this study was lower than the research result reported by [15] who stated that the PER value obtained from local chickens was between 1.63 and 1.74.

3.3. Cost and revenue analysis

Based on the cost and revenue (R/C) ratio analysis which was calculated with the assumption that the price of chicken feed is IDR 8,000/bird, IDR 3,000/kg for rice bran, and IDR 30,000/kg for the chicken selling price. It was found that the range chicken breeding business until the age of 12 weeks in an intensive system with a scale of 40 chickens per treatment (160 in total) provides a profit with an R/C value was above 1 (table 4).

Table 4. Cost and revenue (IDR) analysis of 12-week-old local chickens given four types of feed treatments.

| No | Description                      | T1     | T2     | T3     | T4     |
|----|----------------------------------|--------|--------|--------|--------|
| 1  | Expenses:                        |        |        |        |        |
|    | Feed for 7-21days old            | 55,000 | 55,000 | 55,000 | 55,000 |
|    | Feed for 3-12 weeks old          | 698,887| 742,560| 688,109| 635,365|
|    | 7 days old Chicken               | 320,000| 320,000| 320,000| 320,000|
|    | Vitamins and Medicines           | 15,000 | 15,000 | 15,000 | 15,000 |
|    | Vaccines                         | 15,000 | 15,000 | 15,000 | 15,000 |
|    | Total expenses                   | 1,103,887| 1,147,560| 1,093,109| 1,040,365|
| 2  | Total income                     | 1,529,118| 1,463,579| 1,464,075| 1,301,591|
| 3  | Revenue                          | 425,231| 316,019| 370,966| 261,226|
| 4  | R/C                              | 1.39   | 1.28   | 1.34   | 1.25   |

The number of chickens calculated to be sold alive for treatments T1, T2, T3 and T4 were 35, 39, 37, and 36 respectively. Feed treatment T1 (50% rice bran) had the best R/C value, i.e. 1.39 by the growth produced, followed by treatment T3 (70% bran) with the R/C value of 1.34. The profit produced from the range chicken breeding until the age of 12 weeks ranged from IDR 261,226 to IDR 425,231 per 40 chickens, or equal to IDR 6,530 to IDR 10,630 per bird per period.
The research results as reported by [16] found that breeding of range chickens until the age of 12 weeks was feasible to be conducted because it had an R/C value greater than 1 with 60% rice bran contained in the feed. The research results reported by [13] revealed that the value of R/C generated from range chickens until the age of 6 months with protein ranged from 15.1 to 15.8% were between 1.09 and 1.66. These results were similar to those reported by [17] The data suggests that the range of chicken breeding is profitable and feasible to be conducted.

The profit level of a local chicken agribusiness with an intensive maintenance system was higher than the semi-intensive maintenance system [18]. Factors influencing the profit level of the local chicken agribusiness are egg prices, meat prices, seed prices, feed prices, egg-laying hen investment, and broiler chicken investment; each with a coefficient value of -1.2344, 0.3413, -0.0470, -0.0529, 1.6563, and 0.9735 respectively. The local chicken agribusiness may be considered as a profitable business. Changes that need to be enacted are the breeders should determine their business goals, either egg-laying hens or broiler chickens, separately; increase their business scale; and become integrated [4].

4. Conclusion
The use of rice bran for local chickens raised in rural areas can reach up to 70% in the ration. However, the best use was as much as 50% because it produced a higher DWG and R/C value and a lower FCR than giving more rice bran in the ration. However, the use of rice bran as much as 80% is not recommended as it produced a DWG, FWR and R/C value which was opposite to giving as much as 50% in the ration.

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