

The Analysis of Production Costs of Laying Hen Farms Using Semi Self-Mixing and Total Self-Mixing Feeds in Blitar Regency, East Java

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(Received 16-02-2019; Revised 01-07-2019; Accepted 26-07-2019)

ABSTRACT

Feed plays an important role in determining the success of livestock businesses and also as a significant cost factor. Feed contributes 60%-80% of the total production costs. The types of feed could have different effects on the cost, efficiency, and productivity of livestock business. Some laying-hen farmers in Blitar District use two kinds of feed, semi self-mixed feed, and total self-mixed feed. This study was conducted to compare the use of two types of feed on the net revenue of laying hen farmers in Blitar Regency. The research used the survey method. The sample in this research consisted of 100 laying-hen farmers in Blitar Regency, 50 of them used semi self-mixing feed and the rest used total self-mixing feed. Data were collected from several laying hen farms in Blitar Regency with a survey method. All data were then analyzed both qualitatively and quantitatively. The average feed price of semi self-mixed feed and total self-mixed feeds were IDR 5,143.38 and IDR 4,854.91 per kg, respectively. The results showed that the feed price, cost of medication/vaccine, the amount of feed, and egg production for semi self-mixed feed farmers had significant effects on the net revenue of the farmer ($p < 0.05$), with the average net revenue being IDR 12,785,471.68 per 1,000 birds/period. Whereas for total self-mixed feed, the medication/vaccine cost and feed amount had significant effects on the net revenue of the farmer ($p < 0.05$), with the average net revenue being IDR 18,467,373.76 per 1,000 birds/period. As a conclusion, the total self-mixed feed showed more optimal net revenue of laying hen than semi self-mixed feed.

Keywords: net revenue of laying hen farmers; semi self-mixed feed; total self-mixed feed

INTRODUCTION

Feed plays an important role in determining the success of livestock businesses, in addition to two other determinants: breed and management. A feed is the main source of energy for livestock. The provision of animal feed without considering the quality and quantity will result in the sub-optimal growth and productivity of the livestock. The main nutrients needed in ration of laying hens are metabolizable energy, crude protein, amino-acids, macro-elements, trace elements, vitamins, and essential fatty acids (Jeroch *et al.*, 2011; Liu *et al.*, 2015). Feed provided adequately, both in quality and in quantity, will significantly help in improving the productivity of livestock. Self-mixing is a technique for making feeds independently, which includes making formulas and mixing the raw materials. Laying-hen farmers recognize two types of feeds, namely semi self-mixing feed and total self-mixing feed. Semi self-mixing feed consists of mixing concentrate with milled corn and bran. In comparison with semi self-mixing feed, 50%-55% milled corn, 30%-35% concentrate, and 15%-20% bran are usually used in total self-mixing feed, where the total self-mixing feed is defined as the feed

produced by the farmers based on their formulations and feed raw materials.

Permatahati *et al.* (2019) explain that in the livestock industry, feed is a major cost factor. Feed cost contributes 60%-80% of the total production costs. The amount of expenses incurred by farmers to buy commercial feed is higher than to buy the local feed. This situation informs that the use of local feed can reduce the total production costs so that it can increase the amount of net revenue of livestock business. The high cost of feeding causes the high cost for laying-hen farms and often becomes an obstacle to the development of the laying-hen business in general. The types of feed provided have different effects on the cost, feed efficiency, and livestock productivity, which will ultimately have a direct impact on the net revenue of the farmers.

Tugiyanto *et al.* (2013) explain that the production factor consisting of the amount of feed, the number of livestock, egg production, labor, drugs, and medication simultaneously have effects on the net revenue and efficiency of laying-chicken breeding business in Wonosobo Regency. The amount of feed and egg production individually has a significant impact on the net revenue and efficiency of laying-hen farms (Osti *et al.*, 2016).

Data from the Central Bureau of Statistics of Blitar Regency up to 2016 showed that there were 15,213,000 laying hens in Blitar District with 154,260 tons of egg production. The results of the 2016 Agriculture Census showed that the egg production of East Java Province was 445,793 tons, so the proportion of egg production in Blitar Regency was 34.60% of the total egg production in East Java Province and 10.38% of the national total egg production. Therefore, it is not surprising that Blitar Regency is referred to as the parameters of East Java and domestic eggs.

Differences in the supply of feed types have different effects on the net revenue of the farmers. Some types of feed used by laying-hen farmers in Blitar District include semi self-mixed feed and total self-mixed feed. This study was conducted to compare the use of two types of feed on the net revenue of laying-hen farmers in Blitar Regency.

MATERIALS AND METHODS

Data Collection

The research used the survey method. The survey was intended to obtain primary and secondary data. The sample in this research consisted of 100 laying-hen farmers in Blitar Regency, 50 of them used semi self-mixing feed and 50 of them used total self-mixing feed, with a minimum of 5 years of livestock experience and ownership of at least 10,000 birds. The data collected included feed prices, drug/vaccine costs, feed quantity, egg production, business scale, labor cost, livestock experience, and net revenue of the farmer. The sampling method used was the purposive sampling method.

Data Analysis

The data obtained were then processed using multiple linear regression analysis to determine the effect of the independent variable on the dependent variable. Then the results were then compared with the results of previous literature and research.

Analysis of production costs. Mathematically, the cost of production could be expressed as follows:

$$TC = TFC + TVC$$

Where: TC was total cost (IDR/farm/period), TFC was total fixed cost (IDR/kg), and TVC was total variable cost (IDR/farm/period).

Analysis of revenue. Niederhoff & Kouvelis (2019) described revenue by the formula:

$$R = P \times Q$$

Where: R was revenue (IDR/farm/period), P was the price (IDR/kg), and Q was the quantity of production (kg/farm/period).

Application of revenue formula in laying hen farming business was based on the general formula of farming revenue above, namely:

$$TR = (Py_1.Q_1) + (Py_2.Q_2) + (Py_3.Q_3) + (Py_4.Q_4)$$

Where: TR was total revenue (IDR/farm/period), Py_1 was viable eggs price (IDR/kg), Q_1 was viable eggs amount (kg/farm/period), PNR was cracked eggs price (IDR/kg), Q_2 was cracked eggs amount (kg/farm/period), Py_3 was compost/manure price (IDR/sack), Q_3 was compost/manure amount (Sack/farm/period), Py_4 was sacks price (IDR/sack), and Q_4 was sacks amount (Sack/farm/period).

Yusuf (2007) stated that to calculate the net revenue, the following formulas could be used:

$$NR = TR - TC$$

Where: NR was net revenue (IDR/farm/period), TR was total revenue (IDR/farm/period), and TC was total cost (IDR/farm/period).

Statistical Analysis

The collected research data were processed using the SPSS program and analyzed using the F test (ANOVA) from the multiple linear regression analysis. ANOVA test was used to determine the simultaneous effect of the factors of production on the net revenue. Then, the t-test was conducted to determine partially of the presence or absence of each effect of production factors on the net revenue.

The results of the data obtained were further analyzed by Multiple Linear Regression Analysis with SPSS 16 Software tools (Statistical Package for Social Science). With the estimator model as follows:

$$NR = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + \epsilon_i$$

Where: NR was net revenue (IDR/farm/period), a was constant, b was regression coefficient, x_1 was feed price (IDR/kg), x_2 was medication and vaccine cost (IDR/farm/period), x_3 was total feed consumption (kg/farm/period), x_4 was total egg production (kg/farm/period), x_5 was scale of enterprise (Dummy variable), x_6 was labor costs (IDR/farm/period), and x_7 was experience in raising laying hens (year).

The scale of the enterprise (x_5) was the livestock business category based on the number of productive laying hens owned by the farmers. The business scale was categorized into two groups, i.e. medium-scale businesses (10,000-50,000 hens) and large-scale businesses (> 50,000 hens). The medium-scale business had 0 score and large-scale business had one score for this variable.

RESULTS

Analysis of Feed

The respondents, farmers of laying hens in Blitar District, used two types of feed, namely the semi self-mixed feed type and the total self-mixed feed type. The type of semi self-mixed feed was made from raw corn, concentrate, and rice bran. In general, the feed raw materials used for the semi self-mixed feed type were 50%–55% milled corn, 30%–35% concentrate, and 15%–20% rice bran, while for the total self-mixed feed was more varied and diverse in the use of raw materials.

Table 1 showed that semi self-mixed feed used a simpler feedstuff combination, only corn, concentrate, and rice bran. On the other hand, the total self-mixed feed had more various feedstuffs combinations, and these various options could be adjusted based on their availabilities and price consideration.

Business Analysis

Table 2 showed that the fixed costs of semi self-mixed feed type were higher than those of total self-mixed feed type but inversely proportional to variable costs and total costs where semi self-mixed feed types were lower than total self-mixed feed type. The costs of feeds for both types of feeds had the highest percentage compared to the other costs, namely 85.40% for semi self-mixed feed type and 86.90% for total self-mixed feed type, then followed by pullet depreciation cost and labor cost/salary.

Sales of viable eggs were the largest source of revenue, namely 98.98% for semi self-mixed feed type and 98.51% for total self-mixed feed type. Farmers who used a type of total self-mixed feed had higher revenues and net revenues than farmers using semi self-mixed feed type, i.e. revenue as much IDR 296,389,665.74 and net revenue as much IDR 18,467,373.76.

Regression Analysis

Table 3 showed that the simultaneous test results of the factors influencing the net revenue of semi self-mixing feed farmers and the function model together showed a real effect on the net revenue at the error level of 5%. The parameter estimation of the multiple regression model of laying hen farmers in Blitar Regency using the semi self-mixing feed type obtained a correlation coefficient of 0.893. A partial parameter test with a t-test of the function model of the semi self-mixing feed type

showed that the feed price, medication/vaccine cost, the amount of feed, and the egg production exerted real effects on the net revenue at the error level of 5%. The feed price of the total self-mixed feed was the factor that had the most significant negative impact on the profitability, with a coefficient value of - 3.182 (Table 3).

Table 3 showed that the results of a simultaneous test of the factors affecting the net revenue of the total feed mix function model together had a significant effect on the net revenue at the error level of 5%. The parameter estimation of the multiple regression models for laying hen farmers in Blitar Regency using total self-mixing feed obtained a correlation coefficient of 0.817. The partial parameter test with the t-test of the function model of the total self-mixing feed type showed that the feed price, medication/vaccine cost, and the amount of feed had significant effects on net revenue at the error level of 5%.

DISCUSSION

Analysis of Feed

The maximum profit will be obtained by efficient use of feed for the needs of livestock. Differences in feed prices affect the total cost and net revenue of farmers. The total feed cost of self-mixing feed is more optimal than the semi self-mixing feed type. This difference is related to the uses of a combination of several feed ingredients in a total self-mixing feed that meets the nutritional needs of laying hens at a low cost (Sul-toni *et al.*, 2006). The next highest total cost is the shrinkage of livestock (pullet), i.e. 5.90% for semi self-mixed feed and 5.21% for total self-mixed feed.

Both types of feed have their advantages and disadvantages. The benefits of the semi self-mixing feed type include the easier and more continuous material procurement, an easier process of feed mixing, and the presence of concentrate payout from the feed mill. The weaknesses of the semi self-mixed feed type include the feed price, which is more expensive, the limited use and farmer's inability to know the condition and quality of the feed ingredients, especially the concentrates used. The advantages of the total self-mixing type are the lower feed price (efficiency in the cost production ratio) and the fact that the condition and the quality of the feed are guaranteed because the farmers can directly monitor the quality of the ration and the ration formulation can be adjusted according to the requirements. In terms of sustainability of feed procurement, the total self-mixed feed is procured directly from the supplier, so the continuity is based on the supplier. For imported goods, the farmer can acquire directly from importer, either with contract system or not. In case the contract system is used, the sustainability of the feed is good. In the Blitar District, the continuity of feed supply is considered as sustainable. However, the total self-mixed feed type has some weaknesses. For instance, the purchase of feed ingredients is mostly carried out through the cash system or with a relatively short payment period, the feed-mixing process is more complicated, and the feed formula is temporary or adjusted to the field conditions.

Table 1. Formulation of semi self-mixed feed dan total self-mixed feed

Feed composition	Type of feed			
	Semi self-mixed feed		Total self-mixed feed	
	Total (kg)	%	Total (kg)	%
Corn	500	50	450	43.02
Concentrate	350	35		
Rice bran	150	15	150	14.34
Soy bean meal (SBM)			260	24.86
Meat bean meal (MBM)			75	7.17
Poultry meat meal (PMM)			15	1.43
Grit			90	8.6
Salt			3	0.29
Premix			3	0.29
Total (kg)	1000	100	1046	100
Price per kg (IDR)	5,143.38		4,854.91	

Source: Primary data, processed (2016)

Table 2. Analysis business of laying hen per 1,000 hens/period based on feed type

Description/ Remarks	Farmers			
	Semi self-mixed feed		Total self-mixed feed	
	IDR	%	IDR	%
A. Cost				
Fixed Cost				
1. Depreciation cost				
a. Warehouse	174,617.98	0.06	190,426.58	0.07
b. Equipments				
* Mixer	65,951.48	0.02	58,650.41	0.02
* Hummer mill	37,632.09	0.01	43,815.82	0.02
c. Cages	3,190,495.06	1.17	3,304,638.46	1.19
d. Pullet	16,837,147.19	6.17	13,037,649.00	4.69
e. Office Building	19,817.28	0.01	16,667.06	0.006
2. Bank interest	3,107,557.04	1.14	107,390.26	0.04
3. Labor cost/salary	8,279,116.08	3.03	12,181,576.58	4.38
4. Donations for village treasury	404,064.36	0.15	447,367.39	0.16
5. Egg tray	25,589.89	0.01	34,228.08	0.01
Total Fixed Cost	32,141,988.46	11.77	29,422,409.64	10.59
Variable Cost				
1. Feed	233,214,546.93	85.40	241,513,459.07	86.90
2. Electric & waters	1,649,984.49	0.60	1,983,750.57	0.71
3. Phone bill	136,654.36	0.05	111,957.10	0.04
4. Transportation	785,368.65	0.29	639,230.96	0.23
5. Labor cost/salary	411,383.98	0.15	399,356.50	0.14
6. Medication/vaccine	4,021,754.77	1.47	3,119,251.54	1.12
7. Disinfectant	365,647.69	0.13	409,220.11	0.15
8. Cage repair	341,908.45	0.13	323,656.48	0.12
Total Variable Cost	240,927,249.32	88.23	248,499,882.33	89.41
Total Cost	273,069,237.78	100.00	277,922,291.98	100.00
B. Revenue				
1. Sales of viable eggs	282,934,415.84	98.98	291,964,121.84	98.51
2. Sales of cracked eggs	1,662,003.46	0.58	3,600,967.27	1.21
3. Sales of compost/hens waste	642,626.66	0.22	546,874.08	0.18
4. Sales of sacks	615,425.72	0.22	277,702.54	0.09
Total revenue	285,854,471.68	100.00	296,389,665.74	100.00
C. Net Revenue	12,785,233.90		18,467,373.76	

Source: Primary data, processed (2016).

Table 3. Result of net revenue parameter test and estimation (semi self-mixed type of feed and total self-mixed type of feed)

Model of function of net revenue							
Model	Semi self mixed (concentrate)			Total self mixed			
	Coefficient of regression	Value of $T_{calculated}$	p-value	Model	Coefficient of regression	Value of $T_{calculated}$	p-value
Constant	- 22.229	- 3.413	0.001*	Constant	31.038	4.381	0.000*
Ln(X1)	3.541	4.688	0.000*	Ln(X1)	- 3.182	- 3.715	0.001*
Ln(X2)	0.350	2.469	0.018*	Ln(X2)	- 0.331	- 4.842	0.000*
Ln(X3)	- 2.241	- 2.245	0.030*	Ln(X3)	2.700	3.397	0.002*
Ln(X4)	2.708	2.685	0.010*	Ln(X4)	1.446	1.775	0.083
Ln(X5)	0.035	0.251	0.803	Ln(X5)	0.014	0.089	0.930
Ln(X6)	0.045	0.341	0.735	Ln(X6)	0.162	0.617	0.541
Ln(X7)	0.090	1.010	0.318	Ln(X7)	0.075	0.853	0.398

Note: Source: Primary data, processed (2016); *= Significant at $\alpha = 5\%$; **= Significant at $\alpha = 1\%$; ***= Significant at $\alpha = 10\%$.

Business Analysis

This result is parallel to the results obtained in the other studies. The contribution of feed costs in the total cost was reported to be 67.82%. Baki & Yuçel (2017) reported that the percentage of feed cost in the total average production cost was 73.4%. Saran & Gayol (2010) state that the feed cost is the main cost in the overall livestock cost components, which accounts for about 88.08% of the total cost. The cost of feed in a laying hen farm consists of 79.48% for layer feed and 8.60% for the starter and grower phase. This suggests that about 80% of the total cost is spent only on feed. The high percentage of feed costs due to the rising prices of feed-ingredient commodities, especially corn reaching the price of IDR 7,000 per kg.

Eggs production (viable eggs and cracked eggs) are the largest sources of revenue in the laying-hen farming business. In this study, the contribution of egg production to the total revenue was 99.56% in semi self-mixed feed type farmers and 99.72% in total self-mixed feed farmers (Table 2). These results are parallel to the results obtained in the other studies. Emam & Hassan (2010), Emam *et al.* (2010), and Yusuf & Malomo (2007) reported that egg sales contributed the largest amount of the total revenue in laying-hen farming. In UD Balebat farming, the primary revenue comes from the sales of viable eggs, and the side incomes are obtained from the sales of cracked eggs, rejected chickens, manure, and burlap sacks (Ulfa *et al.*, 2014). The next income is contributed by the selling of compost or manures and sacks. These results are in line with the results obtained in the study of Malarvizhi & Geetha (2015) reporting that the proportion of revenues from the sales of manure or compost and sack were 1.82% and 0.62%, respectively.

The maximum profit will be obtained by the efficient use of feed to meet the requirement of the livestock. Differences in feed prices affect the total cost and net revenue of the farmers. The total feed cost of total self-mixing feed type is more optimal than that of the semi-self-mixing feed type. This difference is because the total self-mixing feed uses a combination of several feed ingredients that meet the nutritional requirement of laying hens at a low cost (Sultononi *et al.*, 2006). The next highest total cost is the shrinkage of livestock (pullet) and labor cost or salary (de Azevedo *et al.*, 2015).

Regression Analysis

The high price of feed for semi self-mixed feeds has an impact on the low net revenue of laying-hen business using this type of feed compared to farmers using a total self-mixed feed type (Table 2). This result suggests that the provision of compulsory quality feed will maximize production. Feed prices have a substantial impact on the profitability, as feed price varies by brand, the amount of purchased feed, and several additional transport costs (Altahat *et al.*, 2012).

The feed-price regression coefficient on semi self-mixed feed types is positive, implying that the higher the feed prices, the better will be the quality of feed, especially concentrate. The better quality of feed

will be characterized by the increased feed digestibility (Prawitasari *et al.*, 2012; Mateos *et al.*, 2012) that will optimize the production performance that eventually maximizing the net revenue of farmers. The feed-price regression coefficient in the total self-mixed feed type farming is negative. This negative regression coefficient implies that the higher the feed price, the lower the quality of feed. Increase in feed prices is related to the addition of feed additives in the form of AGP. The excessive addition of AGP will reduce production performance and FCR so that it will reduce the revenue that ultimately reduces the net revenues of the farmers.

Therefore, in laying hen business, feed is the main component determining the level of efficiency of operational cost. Malarvizhi & Geetha (2015) explain that feed is the main problem faced by laying-hen farmers since the feed price is high, but the selling price of eggs is low. High feed prices have often been raised as the main cause of losses in poultry farms because most of the feed ingredients used are still imported. Feed is one of the important factors in the chicken breeding business. Optimal production will be achieved if the available feed provides the necessary nutrients required by the laying hens. The feed costs will increase with the increased quality of feed to meet the requirements of laying hens for egg synthesis and production. When the quality of feed consumed by the laying hens is reduced or disrupted it will harm the egg production. Feed is the essential requirement for laying hens, while the high need for feed is not proportional to the price of feed. Feed prices always increase. The increase in the feed price is caused by the rise in the cost of the raw materials.

Verbeke *et al.* (2013) explain that the health of livestock is the critical determinant of the success of a livestock business. The addition of the cost of medication/vaccines will make the chickens in a healthy condition and be able to utilize feed consumed to support production optimally. The low cost of medication/vaccines for farmers using a total self-mixed feed type is due to the addition and use of antibiotic growth promoters (AGP). In addition to boosting production, AGP also promotes the prevention of diseases, both respiratory and digestive diseases. Costs incurred for one chicken are determined by the health of the chicken (Table 2).

The regression coefficient of medication/vaccine costs in semi self-mixed feed types is positive implying that the increasing cost of medication/vaccines will have an impact on the rising production performance and will ultimately increase the net revenue of the farmers. The addition of medication/vaccine fees in this type of laying-hen farming is vital because the feed used does not contain AGP. The regression coefficient of medication/vaccine costs for the kind of total self-mixed feed is negative, which implies that the increased cost of medication/vaccines will have an impact on the decline of production performance and ultimately will reduce the net revenue of the farmer. The addition of medication/vaccine costs would be counter-indicative with the AGP already supplemented in the feed. Therefore, the use of AGP in this type of feed mixing will reduce livestock performance that will reduce production performance

that eventually will reduce the revenues and ultimately reduces the net revenue of farmer.

Yang *et al.* (2015) report that the addition of Areca powder as a substitute for antibiotics to the feed can control and limit the growth and colonization of various varieties of pathogenic and non-pathogenic bacteria in the chicks colons. Therefore, the biota population present in the gut will be more balanced and the efficiency of feed intake will increase, resulting in better growth performance and improved FCR. The significant benefits of antibiotic supplementation observed in chicken growth and food conversion in this study are similar to those reported extensively in newly published and consistent reviews at all ages (Mehdi *et al.*, 2018).

The regression coefficient of the amount of feed consumption in the type of semi self-mixed feed is negative meaning that the higher the increase in the amount of feed consumption the lower the net revenue received by the farmer. The level of daily feed consumption, in general, is 120 g/head/day so that the feed consumption higher than this normal feed consumption will decrease feed efficiency. The addition of feed consumption without being followed by the increase in egg production will increase FCR so that eventually it will reduce the net revenue. The regression coefficient of the level of feed consumption in the total type of self-mixed feed is positive meaning that the higher the amount of feed consumed, the higher the net revenue received by the farmer. This result indicates that the farmers should consider a lot of things before preparing feed, including the environmental temperature of the cage, strain, and metabolic condition of the laying hen. Available reports state that the energy requirements of poultry vary from one environment to the others and environmental condition will affect the achievement of high productivity in poultry production (Batonon-Alavo *et al.*, 2015). Nzioka *et al.* (2017) explain that high temperatures are one of the most critical factors affecting egg production, feed intake, and egg weight in tropical countries. An optimum and comfortable environment will support an optimum metabolism that will produce a better level of feed efficiency that eventually will increase revenue.

Baki & Yücel (2017) explain that feed cost has the highest contribution to the total cost during the production period. Giving excessive foods without being followed by the increase in egg production will have an impact on the increase in feed conversion ratio that eventually reduces the net revenue of the farmer. The cost of feed partially has a very significant effect on the benefits of laying chicken breeders (Vony Kanaga) in Tawaan Village of Bitung City (Floros *et al.*, 2010).

The result of selling eggs (viable eggs and cracked eggs) for the maintenance of 1,000 hens/period with the type of semi self-mixed feed reached the amounts of IDR 284,596,419.30, while for the total self-mixed feed type the number was IDR 295,565,089.11 (Table 2). The total result of selling eggs from the total self-mixed feed type is higher, IDR 10,968,669.81, so the net revenue is also higher than in the semi self-mixed feed type. The production of eggs using semi self-mixed feed has a significant effect on the net revenue, whereby the higher the amount of egg production, the higher the amount of

net revenue that will be accepted by the farmers. In contrast, in the total self-mixed feed type, egg production does not significantly affect the net revenue. Besides, the net revenue received by the farmer is influenced by the price of eggs and whether the price of chickens is favorable when the hens are culled and furthermore, it will be emphasized that production cost affects the amount of net revenue received by the farmer (Lestarisaih & Sudiana, 2019).

CONCLUSION

Price of feed, the cost of medication/vaccines, the amount of feed, and the egg production of the semi self-mixed feed farm has a significant effect on the net revenue of laying hen farmers, with the average net revenue received by the farmer is IDR 12,785,471.68 per 1,000 birds/period. In contrast, in the total self-mixed feed farm, the price, medication/vaccine cost, and feed amount have a significant effect on the net revenue of laying hen farmers, with the average farmer's earnings equal to IDR 18,467,373.76 per 1,000 birds/period. Moreover, total self-mixed feed farm also leads to a better net revenue of laying hen farmers compared to semi self-mixed feed farm.

CONFLICT OF INTEREST

The authors declare no conflict of interest regarding this research and publication.

ACKNOWLEDGEMENT

Authors thank to Brawijaya University for approved and facilitated this research.

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