Elasticity Analysis of Production Cost Against Income of Broiler Business with Open-House and Closed-House System in Banyumas Regency

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Abstract. In this study, the elasticity of production costs to broiler business income with the partnership pattern in Banyumas regency and production costs and broiler business income with open and closed house systems were examined. The survey approach was used to conduct the research. As the research site, Banyumas regency, one of the hubs for broiler farming in Central Java, was deliberately chosen. Commercial broiler farmers were categorized according to their housing system when choosing the respondents, and 31 farmers used the open housing system, whereas 30 farmers used the closed housing system. The elasticity of production costs to revenue was examined using multiple linear regression while production costs and profits were assessed financially. According to the findings, commercial broiler farmers made an average of IDR 3,626,578 and IDR 4,896,844 each month for 1000 birds in open and closed houses, respectively. The price of DOC, the depreciation of housing, and the depreciation of the farmers' equipment all have a big impact on their revenue. This study's conclusion is that by lowering broiler mortality and making the best use of housing and equipment, farmers may increase their profitability.

Keywords: Broiler chicken, income, break even point, open-house system, closed-house system

Abstrak. Tujuan dari penelitian adalah untuk menganalisis biaya produksi dan pendapatan usaha ayam niaga pedaging sistem kandang terbuka dan sistem tertutup di kabupaten Banyumas dan menganalisis tingkat elasitisas biaya produksi terhadap pendapatan usaha ternak ayam niaga pedaging sistem kandang terbuka dan sistem tertutup Pola Kemitraan di Kabupaten Banyumas. Penelitian dilaksanakan dengan metode survei, pengambilan sampel wilayah menggunakan metode *Purposive Sampling,* yaitu memilih kabupaten Banyumas sebagai tempat penelitian karena merupakan salah satu sentra peternakan ayam niaga pedaging di Jawa Tengah. Sampel responden dipilih dengan menggunakan metode *Stratified Random Samping* peternak usaha ayam niaga pedaging dikelompokan berdasarkan sistem perkandangan, yaitu sistem kandang terbuka sebanyak 31 peternak dan sistem kandang tertutup sebanyak 30 peternak. Biaya produksi dan keuntungan dianalisis secara *financial*, sedangkan untuk mengetahui sensivitas biaya produksi terhadap pendapatan dianalisis dengan regresi linier berganda. Hasil penelitian menunjukkan bahwa pendapatan peternak ayam niaga pedaging rata-rata perperiode/1000 ekor untuk kandang terbuka dan tertutup adalah sebesar Rp. 3.626.578 dan Rp. 4.896.844 berturut-turut. Biaya pembelian DOC, penyusutan kandang dan penyusutan peralatan berpengaruh signifikan terhadap pendapatan peternak. Kesimpulan dari penelitian ini adalah peningkatan pendapatan peternak dapat ditingkatkan melalui menekan mortalitas ayam broiler dan mengoptimalkan pemanfaatan kandang dan peralatan.

Kata kunci: Ayam broiler, pendapatan*, break even point* (BEP), sistem kandang terbuka, sistem kandang tertutup

Introduction

Because it is more affordable than meat from any other animal source, broiler commercial chicken, also known as broiler chicken in the market, is a superior type of livestock product that is chosen and consumed by many customers as a food source of animal protein (Ayu et al., 2020). Most commercial broiler enterprises are operated as partnerships. These advantages are guaranteed availability of Day-Old Chick (DOC), feed, technical guidance on cultivation during the cultivation process, Chemical Drugs and Vaccines (OVK), as well as the marketing of aquaculture products (Nurihayanti, 2022).

Traditional broiler farms often employ an open-house system, which requires human administration and results in a less productive farming process even though the original investment was less than that of a closed-house modern house or housing system (Sutawi, 2013).

The biggest obstacle to the open-house system is the uncontrolled macro and micro climate from outside the housing which can affect the comfort level of commercial broilers so that productivity decreases. The open-house system is a housing system that has many drawbacks and causes many unfavorable responses when the weather conditions are unfavorable. When the conditions outside the enclosure are hot and rainy it will affect high temperatures and humidity, which can affect poor productivity and high livestock mortality rates (Pakage et al., 2020).

The weaknesses of the open-house system drive the development better housing system which is more closed and stricter which currently known as closed-house system. The advantages of the closed-house system are that it can control the climate inside the house, both macro and micro, prevent direct contact with organisms outside the housing, prevent heat stress and disease due to the climate outside the housing, and work on the cultivation process more efficiently because it is regulated automatically using machines or tools. In the opinion of Pakage et al. (2018) stated that one of the closed-house systems that could optimize the production of commercial broiler chickens is a housing system with a controlled ventilation system or closed-house system. The closed-house system is a housing system that is designed in such a way that can prevent broiler chickens from direct contact with other harmful microorganisms, with good ventilation system settings to minimize stress on broiler chickens. Based on this, the commercial broiler business using the closed-house system is growing rapidly.

The open and closed house had numerous distinctions, many of which were already noted above. The variations would affect the cost of producing broilers, which would turn affect farmers' earnings. The previous study conducted in Malang regency by Muharlien et al. (2020) mentioned that the broiler grown in the closed-house system showed better performance than in the open house system based on the FCR, body weight gain, carcass, and abdominal fat. Another study in Trenggalek by Laili et al. (2022) stated that broiler farming with closed house caging system would provide better FCR and lower mortality rate. That indicated that broiler farming with closed-house system was technically more profitable than utilizing the open house system. Susanti et al., 2016) mentioned that the broiler IP value correlated with the farming cost efficiency. Economically, closed-house system would increase the production cost that in line with the profit (Mukminah and Purwasih, 2020). The open-house system and the closed-house system have the differences mentioned above, which will have an impact on the difference in production costs incurred, the products produce, and the income of farmers, so that it will affect the income of farmers. Income is one of the evaluation tools for whether the business is running profitably or not. Because every business activity is very necessary to perform income analysis. Based on this, the researcher wants to examine whether there are differences in income in the open-house system and the closed-house system, which is more profitable between the two systems.

Costs associated with raising livestock, including those for feed, medicine, vitamins, depreciation on equipment, houses, and other farm machinery, are directly tied to the production of commercial broilers. The farmer must analyze the risk level of using the value of production inputs/production costs to maximize income. External changes can affect the price of production inputs, so changes in production

input costs can be expected to impact income levels. The previous studies only compare the productivity and cost differences without analyzing how the cost affect the farmers income. Therefore, in order to comprehend how changes in the cost variable affected the farmers' revenue, this study performed an elasticity analysis (Hafizah et al., 2021). The analysis is carried out on the flow of changes in costs and selling prices. Each of these elements or production costs has a varying amount of influence on the profit of the broiler business. This research is expected to provide information regarding the level of risk of using production costs in increasing the income of commercial broilers. Furthermore, it can be identified the level of production cost elasticity of commercial broiler business partnership pattern in Banyumas regency.

Materials and Methods

Cross-sectional survey methodology was employed for the investigation. Purposive random sampling is the method used to choose the sample, and Banyumas regency was chosen as the study's location since it is one of the hubs for commercial broiler farming in Central Java. The respondent's sample was determined using the stratified random method using commercial broiler farmers grouped in the housing system, namely the open-house system of 31 farmers and the closed-house system of 30 farmers, so that the total number of respondents was 61 farmers.

Income Analysis

Economic performance was analyzed quantitatively using a formula to determine the level of profit mentioned by Fauzan (2016).

I = TR – TC
where:
   I   : Income
   TR : Total revenue
   TC : Total cost

Multiple Linear Regression

The study's hypotheses were examined using multiple linear regression analysis, coefficient of determination (R2), F test, and t-test. The independent variables that affect the farmers' income in the partnership pattern of commercial broiler farming in Banyumas regency were identified using multiple linear regression analysis. The regression formula that can be employed, as per Ananta et al. (2015), is as follows:

Y = a + b1X1 + b2X2 + b3X3 + b4X4 + b5X5 + b6X6 + e
where:
   Y : Income (IDR)
   X1 : Cost of DOC (IDR)
   X2 : Cost of feed (IDR)
   X3 : Cost of drugs (IDR)
   X4 : Cost of housing depreciation (IDR)
   X5 : Cost of equipment depreciation (IDR)
   X6 : Dummy variable, housing system
   a : intercept
   e : Standard error
   b1, b2, b3, b4 : Regression coefficient of each independent variable

A good multiple linear regression model must not have conventional assumption issues as one of its prerequisites or also known as the best linear unbiased estimator (BLUE) model. The traditional assumption test, according to Mardiatmoko (2020), includes the F-test, t-test, determination analysis (R2), normality test, autocorrelation test, multicollinearity test, and heteroscedasticity test. The Jarque-Bera, Breusch-Godfrey, and White Heteroskedasticity tests can be used to assess the traditional hypotheses of normality, autocorrelation, and heteroscedasticity (Cahyo and Purwaningsih, 2022). A multicollinearity test can be run by looking at the variance inflation factor (VIF) value. There is no multicollinearity issue if the VIF value is greater than 10 (Ghozali, 2016).

Elasticity Analysis

Elasticity analysis is a method for analyzing the percentage change in a variable's value caused by changes in other variables that affect the target variable. The elasticity test was performed on the independent variables that, at the 10% level of confidence, had a partially significant effect on the dependent variable. The elasticity formula according to Hairani et al. (2014) is as follows.

$$\varepsilon_i = b_i \times \frac{\bar{X}_i}{\bar{Y}}$$

where:

ε_i = Elasticity of the i independent variable

b_i = Regression Coefficient of Variable i

$\bar{X}_i$ = Average of the i independent variable

$\bar{Y}$ = Average of the dependent variable

The elasticity value obtained is then interpreted with the following criteria:

a. Elastic (Ei > 1)

b. Inelastic (0 < Ei <1)

c. Perfectly inelastic (Ei = 0)

d. Perfectly elastic (Ei = ~)

e. Unitary elastic (Ei = 1)

Results and Discussion

Characteristics of Respondents

The commercial chicken livestock business unit is listed as the main business by most respondents, and only a minor portion is listed as a side business. Because some farmers have employed the Closed House form of housing, the respondents' broiler farming operations have tended to be semi-modern. The advantages of the close house system are that it can control the climate inside the house both macro and micro, prevent direct contact with organisms outside the house, prevent heat stress and disease due to the climate outside the house, and work on the cultivation process more efficiently because it is regulated automatically using machines or tools. While the weakness of the Closed-house system is that it requires a large investment in housing and equipment, the impact will increase relatively large depreciation costs.

Economic traits make up the respondents' characteristics in this study. DOC expenses, feed costs, medicine and vitamin costs, labor costs, housing depreciation costs, equipment depreciation, revenues, and income from broiler farming business partnership patterns in Banyumas regency are just a few of the respondents' economic characteristics.

Revenue and Production Cost of Broiler Chicken Farmers

Income is the result of total revenue minus total financing during the production period or one period (Supartama, et al., 2013). Tables 1 and 2 show the income and production expenses for farmers using an open and closed housing arrangement for 1000 heads. The findings indicated that the closed house farm generated more money than the open house with over IDR 200,000. The sale of live birds generated the most revenue. The average income from the open house system per 1,000 birds presented in Table 1 shows IDR 3,626,578 or IDR 1,735/kg. The income of the open-house system was higher when compared to the research by Pakage et al. (2018) which shows that the income of the open-house system is only IDR 1,329/kg. The sale of live bird of closed-house system obtains higher than the open house because of the mortality rate in closed-house system was lower than the open house. This results in line with the statement of Evadewi and Sukmaningsih (2021) that the revenue from live bird selling of closed-house system was higher than the open house. The results of the above study show relatively large revenue when compared to the results of Azizah et al. (2013) research which showed that the average income for commercial broiler businesses was only IDR 27,273/head/period. The average income of a broiler business with a closed-house system per 1000 birds is IDR 4,896,844.

Table 1. Revenue and Production Cost of Broiler Chicken Farmers with Open and Closed-House System

Components	Amount (IDR/Year)	Percentage (%)	Amount (IDR/Year)	Percentage (%)	t-test p-value
	Open-house system		**Closed-house system**		
Revenue					
Sale of Live bird	37,394,269	99.29	37.651.037	99.21	-
Sale of Manure and Sack	266,774	0.71	298.667	0.79	-
Total Revenue (TR)	37,661,043	100.0	37.949.704	100.0	-
Fixed Costs					
Housing Depreciation	405,792	1.19	137.035	0.41	0.000
Equipment Depreciation	338,184	0.99	672.447	2.03	0.000
Workers	569,206	1.67	603.764	1.83	-
Total Fixed Cost (FC)	1,313,182		1.413.246		-
Variable Costs					
DOC	6,390,005	18.78	6.380.001	19.30	0.956
Feed	25,457,976	74.80	23.835.310	72.11	0.007
Drugs, Vaccine, and Chemicals (OVK)	417,958	1.23	420.534	1.27	0.96
Electricity + litter + Gas	420,999	0.12	968.000	2.93	-
Total Variable Cost (VC)	32,686,938	100.0	31.603.845	100	-
Total Costs	**34,034,465**		**33,052,860**		
Income	**3,626,578**		**4,896,844**		

The findings showed that while the closed-house system gave farmers a better income, the overall cost used to grow 1,000 heads of broiler chicken in the open-house system was higher than the closed one. The results showed that the total cost utilized to grow 1,000 heads of broiler chicken in the open-house system was higher than the closed one, but the closed-house system provided higher farmers income. The housing depreciation cost of closed-house system was lower than the open house, but for the equipment depreciation the open house was higher. It presumed because the materials used in the closed-house system have more durability than that used in the open house system, but it used more modern and expensive equipment that affecting the equipment depreciation is higher. Ismail et al. (2014) findings was different from this study, that stated the fixed cost utilize in closed-house system broiler farming was lower more than IDR 400.000 for every 1000 birds.

There was no significant cost for DOC and OVK purchasing in the open and closed-house systems, but the cost utilized to purchase feed in the closed-house system was lower than the open-house house. There was no significant cost for DOC and OVK purchasing in the open and closed-house systems, but the cost utilized to purchase feed in the closed-house system was lower than the open-house house. The closed-house system has automatic feeding system that distribute feed precisely. The system could prevent and minimize scattered because of human distribution. Feed consumption and FCR were two indicator of feed efficiency. Broiler farming with closed-house system resulting more efficient FCR and lower feed consumption (Muharlien et al., 2020; Susanti et al., 2016) which lead to the lower feed cost.

Elasticity of Variable Costs Affecting the Business Income of Broiler Farmer

Multiple linear regression techniques were used for the data analysis in the study (Arikunto, 2006). The classical assumption test must be passed for a multiple linear regression model to be considered good. The results of the normality, autocorrelation, multicollinearity, and heteroscedasticity tests are presented in Table 3. The factors analyzed were the quantitative

independent variable (X) which consisted of the cost of buying DOC (X1), the cost of feed (X2), the cost of drugs and vitamins (X3), housing depreciation costs (X4), and equipment depreciation costs (X5). While the dependent variable (Y) is income. The complete regression analysis results can be seen in Table 4. The elasticity test results are shown in Table 5.

Based on the autocorrelation, multicollinearity, and heteroscedasticity tests, the traditional assumption tests presupposed that the model did not have the traditional assumption difficulties. Because the results of the Breusch-Godfrey and White tests are nonsignificant,

Table 3. Classic Assumption Test

Classic Assumption Test	Name of Test	Probability	Explanation
Normality	Jarque-Bera	0.001941	Significant
Autocorrelation	Breusch-Godfrey	0.05678	Non-significant
Heteroscedasticity	White	0.7331	Non-significant
Classic Assumption Test	Name of Test	Value	Explanation
Multicollinearity	VIF		
Variables			
Cost of DOC	VIF	1.9005	<10
Cost of Feed	VIF	1.6830	<10
Cost of Drug	VIF	1.3670	<10
Cost of Housing Depreciation	VIF	3.2971	<10
Cost of Equipment Depreciation	VIF	1.7930	<10

Table 4. Regression Analysis of Production Cost to Broiler Farm Income in The Partnership Pattern

Variables	Coefficient of Regression	t-value	Sig.
Constant	4014210	1.237681	0.221189
Cost of DOC (X_1)	-0.60807	-1.93785	0.057878*
Cost of Feed (X_2)	0.099692	1.170383	0.246986
Cost of Drug (X_3)	4.70878	0.928098	0.3357487
Cost of Housing Depreciation (X_4)	-3.2839	-1.91703	0.060531*
Cost of Equipment Depreciation (X_5)	0.091931	2.328281	0.023672**
Dummy variable (D)	87998.09	0.131222	0.896088
R Square	0.393571	*	Significance level 90%
F-test significance	0.000095***	**	Significance level 95%
		***	Significance level 99%

Table 5. The Elasticity Test

Variables	Elasticity	Explanation
Cost of DOC	0.08693	Inelastic
Cost of housing depreciation	0.003896	Inelastic
Cost of equipment depreciation	0.034767	Inelastic

the autocorrelation and heteroscedasticity tests show that the model has no issues with autocorrelation or heteroscedasticity. The VIF value was also lower than 10, which indicates there is no multicollinearity problem. Even though the normality test showed a significant result, the regression model with more than thirty respondents then the result of normality test could be ignored (Ajijia et al., 2011). The R^2 is 0.393571 which means the independent variables used in this regression model affect the dependent variables as much as 39.36% and the other 60.64% are influenced by other variables outside the model. The F-test significance was 0,000095 which indicates the independent variables affect the independent variables significantly affect the dependent variables. The significantly affecting variables, which were the cost of DOC, housing depreciation, and equipment depreciation did not elastic to the broiler farmers' revenue.

The profit of commercial broiler farming in Banyumas regency is considerably affected by the variable cost of acquiring DOC at a level of 90% (P<0.01). According to the regression coefficient of -0.60807, each additional rupiah spent on DOC causes the farmer's income level to fall by IDR 0.60807. This means that the higher the price of DOC, the lower the income received by farmers because production costs are higher. Based on the results of the study, the cost of purchasing DOC was second after the cost of feed, which was 18.78% of the total production costs for open-house systems, while for closed-house systems, it was relatively larger, namely 19.30%.

The commercial broiler farming profit under the Banyumas regency partnership pattern is not considerably impacted by the feed cost variable. This is caused by two factors: first, the generally consistent price of animal feed; and, second, the fact that feed standards, both in terms of quality and quantity, have been established from the nucleus enterprise. This causes the data for each respondent to be relatively the same for both open and closed-house systems, so that the feed factor is not sensitive to farmer income. Feed costs for open and closed-house systems occupy the highest position of all variable costs.

The partnership pattern in Banyumas regency's commercial broiler farming is not greatly impacted by the variable cost of medications and vitamins in terms of revenue. This is due to the relatively small cost of drugs and vitamins, namely 1.23% of the total production cost for open-house system and 1.27% for closed-house system. So that the variable cost of drugs and vitamins does not really have an impact on the profits of farmers.

The cost variable for depreciation of housings significantly affects the broiler business income in Banyumas regency with a significant level of 99% (P<0.01). The regression coefficient is -3.2839 indicating that each additional rupiah of one rupiah in the depreciation cost of the stable will reduce the income level of livestock by IDR 3.2839. This means that the higher the cost of depreciation of the housing will have an impact on the income received by the breeder which decreases because production costs are higher. Based on the results of the study, the cost of depreciation of the housing is relatively small, but the data of all respondents shows variations because the costs incurred by farmers in building houses vary quite a lot for the raw materials so the investment spent is also different. This causes depreciation costs to affect the breeder income.

With a significant level of 95% (P<0.05), the variable cost of equipment depreciation has a considerable effect on the broiler industry income in Banyumas regency. According to the regression coefficient of 0.091931, the income from livestock will grow by 0.091931 IDR for every additional IDR of equipment depreciation expenses. This means that the higher cost of depreciation of equipment will have an impact on the income received by farmers, the higher. This is because the higher the depreciation cost means the more sophisticated the equipment.

The more sophisticated the technology of the equipment, the more it will reduce labor costs, so that the costs incurred will be more efficient. Higher equipment technology will also have an impact on livestock productivity so it will increase breeder acceptance.

Although the study indicated a difference between the open-house system, which was IDR 3,626,578, and a closed-house system, which was IDR 4,896,844, the dummy variable for the open -house system and the closed-house system showed no significant difference in the income obtained by the farmers. This is due to the investment costs in closed housing systems requiring a large enough investment, so it will have an impact on increasing production costs that must be incurred by farmers. Based on the results of the study, the achievement of business weight for live commercial broiler chickens in the breeder group with an open-house system was 2.09 kg/head while in the group with a closed-house system it was higher, namely 2.11 kg/head. This shows that the productivity of livestock in the closed pen system is relatively higher compared to the open-house system.

The expense for DOC purchasing discovered in this study was less than the study of Setianto et al. (2021) in Kebumen, which reached 22.26 percent of the cost, but the cost distributes to purchase feed was less than this study with only 68.07 percent. The study by Istikomah et al. (2018) utilizing multiple linear regression to analyze production factors in broiler farming stated that DOC, electricity, land, and medicine significantly affect broiler production, but the feed did not affect the production. Another study by Lestari et al. (2019) reported that DOC and feed purchasing costs significantly affect the farmers' income, however, the OVK, worker, and electrical costs did not significantly affect the income. Another study by Widjayanti and Rizal (2016) reported different results from this study that feed and OVK significantly affect the farmers' profit. Alfa et al. (2016) reported that feed costs significantly affect farmers' income and the DOC cost was also significant.

Conclusions

It could be concluded that costs of DOC, equipment, and housing depreciation significantly affect the broiler farmers' income in both open and closed-house system farming. It is suggested to maintain a low mortality rate to increase the number of harvested live birds in order to increase the farmers' income based on the cost of DOC variable. On the other hand, upgrading quality and equipment as well as maximizing housing use are also required to optimize revenue.

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