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Determinants of Technical Inefficiency in Sentul Chicken Farming in Ciamis Regency, West Java Province, Indonesia

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Abstract
This study was conducted to identify determinants of technical inefficiency among Sentul chicken farmers. This was investigated using the stochastic frontier production function which incorporates a model for the technical efficiency effect. Farm level survey data from 100 Sentul chicken farmers were obtained using well structured questionnaire. The parameters were estimated simultaneously with those of the model of technical efficiency effects. The result showed that age, education, experience, family size, number of chicken ownership, extension and credit have significant effect on technical inefficiency, while gender has no significant effect on technical inefficiency.
Keywords: Sentul, chicken, technical inefficiency

1. Introduction

Poultry has become an important business for small farmers and has a high contribution to the country's economy (Aboki, et al, 2013). One type of poultry is broiler that has an important role in meeting the needs of the people against meat (Rohmad, 2013). Local chickens have the potential to be an alternative source of provision of meat and eggs (Awaluddin, 2012), have an important role in meeting the economic needs and sources of animal protein (Mariandayani, et al, 2013), maintained primarily for family savings that can be sold when requiring cash (Suhardi, 2011; Mutombo, et al, 2015; Zewdu, et al, 2013), is one of the biological riches that have long been cultivated so as to adapt to the surrounding natural environment (Meyliyana, et al, 2013; Olanrewaju, et al, 2015), have the advantages of having quick returns to investment and relatively simple management practices (Miriam, et al, 2015), but they have poor productivity under traditional or extensive production system (Islam, et al, 2015).

The production system of indigenous chicken is often characterized by low input-low output productivity and low commercialization of the enterprise (Justus, et al, 2013; Sulistyoningsih, et al, 2013). Low productivity as the major constraints in village chicken production (Chisango, et al, 2015) is partly attributed to poor management practices (Kingori, 2010) and due to their inherent low genetic potential (Islam, et al, 2014). The low productivity of local chicken does not reduce the community's interest to cultivate it because of its great potential, such as resistant to disease and tasty flesh (Daryono, et al, 2012).

Development of local chickens today is still experiencing barriers caused by lack of maintenance, both in terms of food, chicken and chicken (Alam, 2005). Farmers were constrained by high disease outbreak, lack of fencing and housing, high feed costs, lack of markets, low productivity, lack of credit access, poor growth and maturity and low market prices (Siyaya, et al, 2013). Farmers facing problems in terms of capital shortage, lack of institutional credit facilities, medicine and veterinary services Dutta, et al (2013).

One type of local chicken in Indonesia is Sentul chicken that has been recognized as local chicken of Ciamis Regency through the Decree of the Minister of Agriculture RI No. 689/Kpts.PD410 / 2/2013 on the Establishment of Sentul Chicken Clump as Chicken Local Family of Indonesia Origin Ciamis. According to Nataamijaya (2005), Sentul chicken can spawn up to 26 eggs per laying period, whereas according to Baktiningsih, et al (2013) as much as 16-25 eggs/spawning period or about 150 eggs/year.

Sentul chicken business activities are conducted to drive the local economy and increase the income of farmers. Sentul chicken population is currently around 30,000 head and tends to decline due to an increase in demand for meat so endangered (Hartono, et al, 2013).

Local chickens are generally still traditionally maintained (Dewanti and Sihombing, 2012) and require little skill (Huque, 1992 in Dutta, et al, 2013), so must be increased productivity and technical efficiency (Alabi and Aruna, 2005).

2. Theoretical Framework

Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977), in Coelli, et al (2005) proposed the stochastic frontier production function model as follows:

$$lnq_i = x_i^{'}\beta + v_i - u_i \quad (1)$$

The model of equation (1) is called the stochastic frontier production function because the output value is limited from above by the stochastic random variable (eg, exp (x'iβ + vi). A random error v_i can be either positive or negative so that the output of the stochastic frontier varies around the deterministic model, exp ($x'_i\beta$).

Much of the measurement of the output-oriented technical efficiency is the ratio of the observed output to the frontier output of the stochastic:

$$TE_i = \frac{q_i}{\exp(x_i'\beta+v_i)} = \frac{\exp(x_i'\beta+v_i-u_i)}{\exp(x_i'\beta+v_i)} = \exp(-u_i) \quad (2)$$

This technical efficiency measures the output of the i firm relative to the output that can be produced with a fully efficient company using the same vector input. The first stage in predicting technical efficiency (TE) is to estimate the parameters of the stochastic frontier production model (1).

If the technical efficiency of the i-th activity is defined as $TE_i=\exp(-u_i)$, it involves the effects of technical inefficiency, u_i, which can not be observed. Although if the true value of the parameter vector, β, in model equation (1) is known, only the difference, $e_i \equiv v_i - u_i$, can be observed. The best predictor for u_i is the conditional expectation of u_i, given by the value of v_i-u_i. This result was first applied by Jondrow, et al (1982) in Coelli, et al (1998) which produced:

$$E\langle u_i|e_i\rangle = -\gamma e_i + \sigma_A\left\{\frac{\phi(\gamma e_i/\sigma_A)}{1-\phi(\gamma e_i/\sigma_A)}\right\} \quad (3)$$

Where: $E_i = \sigma_A = \sqrt{\gamma(1-\gamma)\sigma_S^2}$; $e_i = \ln(y_i)-x_i\beta$; and ϕ(.) is a density function of a standard normal random variable.

Battese and Coelli (1988) in Coelli, et al (1998) suggest that the best predictors of $\exp(-u_i)$ are:

$$E\langle \exp(-u_i|e_i\rangle = \frac{1-\phi(\sigma_A+\gamma e_i/\sigma_A)}{1-\phi(\gamma e_i/\sigma_A)} exp(\gamma e_i + \sigma_S^2/2) \quad (4)$$

The model proposed by Battese and Coelli (1995) in Coelli, et al (1998) concerns the specific influence of technical inefficiency on the stochastic frontier model assumed to be free (but not identical) from non-negative random variables. For the i-th activity of the period t, the effect of technical inefficiency, u_{it}, is determined by the distribution of $N(u_{it}, \sigma^2)$, where:

$$\mu_{it} = z_{it}\delta \quad (5)$$

Where z_{it} is a vector (1xM) of the observed explanatory variable, which has a constant value, and δ is a vector (Mx1) of unknown scalar parameters to be estimated.

The research of determinants of technical inefficiency was done by using TE Effect model developed by Battese and Coelli (1998) with the following equation:

$$\ln(Y_i) = \beta_0 + \beta_i \sum_{i=1}^{n} Ln(X_i) + V_i - U_i \quad (6)$$

Where Y is the output and X is the input.

Several studies have shown that factors affecting technical inefficiency are: experience, education, marital status, access to education, access to credit and sex (Ashagidigbi, et al, 2011); breeding experience, age, marital status, gender, education, credit and family size (Oleke and Isinika, 2011); age, production systems, farming experience, and educational status (Ike, 2011); education, extension contact, household size and family labour (Ezeh, et al, 2012); bird stock, feed, education (Todsadee, et al, 2012); experience, membership of cooperative society (Olanrewaju, et al, 2015), gender (Aboki, et al, 2013); credit accessibility, education level, farming experience, flock size, extension contact and farmers' associations membership (Adedeji, et al, 2013); credit access, age, education, experience, flock size, extension contact and membership of farmers association (Ohajianya, et, 2013b); access to credit (Likita and Ngozi, 2015); labour, feed (Bethel, et al, 2016).

3. Research Methodology

The study was carried out in Ciamis District in West Java Province. Data used for this study are mainly primary and were obtain from 100 Sentul chicken farmers were randomly selected. The study utilized stochastic production frontier, and the model is defined by:

$$\ln Y = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + v_i - u_i \quad (7)$$

where: Y = production (kg), X_1 = number of day-old chicken (tail), X_2 = labour (man-day), X_3 = feed (kg), X_4 = vaterinary cost (Rp), β = coefficient of regression, v_i = random error, and u_i = technical inefficiency effects in the model.

Inefficiency model was defined to estimate the influence of some farmer's socio-economic variables on the technical efficiency of the farmers. The model is defined by:

$$\mu_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 D_1 + \delta_7 D_2 + \delta_8 D_3 \quad (8)$$

where: μ_i = technical inefficiency, Z_1 = age (years), Z_2 = education (years), Z_3 = experience (years), Z_4 = family size (persons), Z_5 = number of chicken ownership (tail), D_1 = gender (dummy, 1 if man and 0, otherwise), D_2 = extension (dummy, 1 if involved and 0, otherwise), and D_2 = credit (dummy, 1 if has an access to credit and 0, otherwise), δ = regression coefficient.

4. Results and Discussion

The model specification is estimated using the maximum likelihood method using Frontier 4.1 software as can be seen in Table 1.

Result on Table 1 shows ML estimates and inefficiency determinants. The sigma square 0.005 statistically significant at the 1% level that indicates a good fit and correctness of the specified distribution assumption of the composite error term. The estimated value of the parameter (γ) in the model of 0.950 is statistically different from zero at the 1% level. These results indicate a systematic effect that can not be explained by the production function in the form of the dominant sources of stochastic random error. Approximately 95.00% of the variation in the output level of Sentul chicken farming attributed to the presence of technical inefficiency in resource use. The generalized likelihood ratio test (307.633) is statistically significant at the 1% level indicating the present of a one-sided error component. The results of the diagnostic analysis therefore confirm the relevance of stochastic parametric production function and maximum likelihood estimation.

Table 1 shows that number of day-old chicken and labour are statistically significant at 1% and 5% levels and have positive signs. Feed is statistically significant at 5% levels and have negative signs, while veterinary cost are not significant and have negative signs.

The model employs a log linear equation so the regression coefficient showed the production elasticity of each input. For example, 1% increase in number of day-old chicken usage will increase production by 1.037%. The sum of the elasticities was 1.02, indicating that Sentul chicken farmers were operating in the region of increasing returns to scale.

Table 1. Maximum likelihood estimates and inefficiency functions

Variable	Parameter	Coefficient	Standard Error	t-ratio
Production function				
Constant	β_0	-0.030	0.012	-2.489**
Number of day-old chick	β_1	1.037	0.014	74.253*
Labour	β_2	0.033	0.014	2.282**
Feed	β_3	-0.041	0.013	-3.069**
Veterinary cost	β_4	-0.009	0.006	-1.421
Inefficiency function				
Constant	δ_0	0.113	0.503	0.224
Age	δ_1	-0.515	0.307	-1.676***
Education	δ_2	0.515	0.276	1.869***
Experience	δ_3	0.388	0.198	1.964***
Family size	δ_4	0.328	0.128	2.562**
Number of chicken ownership	δ_5	-0.699	0.156	-4.482***
Gender	δ_7	0.038	0.163	0.234
Extension	δ_8	-0.300	0.135	-2.222**
Credit	σ^2	-0.252	0.060	-4.211*
Sigma square		0.005	0.001	5.444*
Gamma	γ	0.950	0.013	73.077*
Log likelihood function	= 307.633*			
LR Test	= 21.281*			

(*) significant at 1%, (**) significant at 5%, (***) significant at 10%

The estimated coefficients of the inefficiency function provide some explanations for the relative technical efficiency levels among the individual farms. Age, education, experience, family size, number of chicken ownership, extension and credit had significant effect on the level of technical inefficiency, while gender had no significant effect.

The estimate of the parameter for age variable have negative and significant effect to technical inefficiency. This suggests that older farmers are more technically efficient than younger farmers. This result is consistent with the findings by Oleke and Isinika (2011) and Bethel, et al (2016).

The estimate of the parameter for education variable have positive and significant effect to technical inefficiency. This suggests that the higher the formal education of the breeder will decrease the level of technical efficiency achieved. This result is consistent with the findings by Kiprop, et al (2015).

The estimate of the parameter for experience variable have positive and significant effect to technical inefficiency. This suggests that the longer the farmers experience in keeping Sentul chickens will decrease the level of technical efficiency achieved. This result is consistent with the findings by Haider, et al (2011), Ogunniyi and Ajao (2011), and Olanrewaju, et al (2015). Olanrewaju, et al (2015) stated that farmers who have more years in the farming business are more inefficient technically compares with the less experienced ones. This may be due to the fact that the younger farmers may tend to learn more and look forward to embracing the new technologies and ideas so may tend to be more efficient than the older respondents.

The estimate of the parameter for family size variable have positive and significant effect to technical inefficiency. The results show that farmers with more size of family achieved lower levels of technical efficiency. This result is consistent with the findings by Haider, et al (2011), Oleke and Isinika (2011), Ohajianya, et al

(2013) and Olanrewaju, et al. (2015). Mango, et al (2015) stated that smaller farming households are more efficient, possibly because, as noted, larger household sizes exert pressure on the limited resources available to the smallholder farmer and seem to exacerbate poverty. Poverty-stricken farmers are more likely to be inefficient, as they cannot afford to buy productivity-enhancing inputs such as certified seed and fertilizer.

The estimate of the parameter for number of Sentul chicken ownership variable have negative and significant effect to technical inefficiency. This results show that farmers who raised a higher number of Sentul chicken achieved a higher level of technical efficiency. This result is consistent with the findings by Isyanto, et al (2013) and Ohajianya, et al (2013). Omar (2014) stated that the large scale farms are more efficient than small and medium farms due to the least total costs and best management methods and recommended the small and medium farms to follow up feeding programs and veterinary services that applied in these farms that in turn decrease the total costs and increase profits.

The estimate of the parameter for gender variable has a positive but insignificant effect on technical inefficiency. This result shows that men are more efficient than women. This result is consistent with the findings by Addison, et al (2016). Hong and Yabe (2015) stated that in reality, women farmers lack access to inputs, credit, and extension training because most of their time spends on doing housework like cooking, cleaning, washing, and caring children, apart from plucking and weeding possible during the lean season. Most of work in cultivation re done by male farmers.

The estimate of the parameter for extension variable have negative and significant effect to technical inefficiency. These results indicate that farmers who follow extension activities can achieve a higher level of technical efficiency compared to farmers who do not follow extension activities. This result is consistent with the findings by Ezeh, et al (2012), Ohajianya, et al (2013), Begho and Ogisi (2014), Bethel, et al (2016) and Elias, et al (2017). Mango, et al (2015) stated that more frequent extension services tend to increase technical efficiency, as extension agents provide advice on issues such as new technologies and production-related information.

The estimate of the parameter for credit variable have negative and significant effect to technical inefficiency. This results shows that the farmer who obtains credit is higher in the level of technical efficiency compared to the non-credited farmer. This suggests that increasing credit use would enhance technical efficiency of sample farms. This result is consistent with the findings by Oleke, et al (2011), Javed, et al, (2012), Ohajianya, et al (2013), Bethel, et al (2016) and Elias, et al (2017). Isyanto, et al (2013) stated that access to credit permit farmers to enhance efficiency by overcoming liquidity constraints which may effect their ability to purchase and apply inputs and implement farm management decisions on time hence increasing efficiency.

5. Conclusion

The inefficiency model showed that age, education, experience, family size, number of Sentul chicken ownership, extension and credit have significant effect on technical inefficiency, while gender has no significant effect on technical inefficiency on Sentul chicken farming.

6. Recommendation

Number of Sentul chicken ownership, involvement in extension activities and access to credit have a significant effect in improving technical efficiency in Sentul chicken raising business. Therefore, it is necessary to consider increasing the number of Sentul chicken ownership through credit assistance to farmers supported by the implementation of extension activities to farmers in an effort to improve the technical efficiency and income of farmers.

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