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The Impact of Vertical Integration Intensity on Broiler Farms Technical Efficiency: The Case of Contract Farming in West Sumatera

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ABSTRACT

Contractual arrangements of different types have increasingly found in West Sumatera not only in subsistence and commercial crops but particularly also in livestock sector. Contract farming in livestock agribusiness is generally defined as broiler farms under an agreement between farmers and a livestock inputs supplier. Within this broad definition, there are different variants of contracts depending on the formality and intensity of contractual arrangement. This study objective was to prove that the design of a contract, as representation of vertical integration intensity in broiler agribusiness, has different efficiency effects on production. The stochastic frontier production function was used in this study, and employed a regression method to estimate the level of technical efficiency. Data were collected from 87 broiler fattening farms consisted of 50 broiler fattening farms under formal contractual system and 37 broiler fattening farms under informal contractual system. The results showed that farm experience and improvement of the contract system would reduce the level of technical inefficiency of broiler farms. The study concluded that broiler farms under formal and detail contract farming had greater technical efficiencies compared to broiler farms under informal unwritten contract arrangement. However, the broiler farms under informal contract obtained higher net returns compared to the broiler farms under formal contract arrangement.

Keywords: broiler farming; contract-farming; technical efficiency; vertical-integration

INTRODUCTION

Broiler farming is increasing in West Sumatera, because it has some advantages compared to the other farms. The advantages of broiler farming include rapid capital turnover, chickens can grow quickly and be harvested in a short time, and have a genetic advantage that is capable of displaying optimal production performance. Broiler meat is much sought after by the consumers compared to other meat such as beef and lamb, because chicken price is relatively cheaper. These advantages are become the attractiveness to the farmers to do the business of broiler farming.

In 1981 the government issued a Presidential Decree number 50 which stipulated that broiler farming was a small-scale business. This regulation was considered as a failure to encourage the growth of the broiler industry in Indonesia, so the government replaced it with the Presidential Decree number 22 of 1990 which allows large-scale companies to enter the broiler industry with the condition that 65 percent of its production is for export and companies are required to partner with small-scale farmers. After the 1997 financial crisis and broiler farms performances declined, the Presidential Decree of 1990 was revoked and replaced by the Presidential Decree of 2000 which indicated that the government did not interfere with the structure of the livestock industry, but would act as a regulator. Based on data from the Central Bureau of Statistics (BPS), companies that produce parent stock grew from 19 companies in 2000 to 80 companies in 2017 in Indonesia. Conversely, large scale companies showed a tendency to decline from 834 companies in 2000 to only 97 in 2017. In the same period, broiler production in West Sumatera continued to grow from 10.4 million heads to 18.3 million heads. This information indicates that large scale companies are increasingly collaborating with small scale farmers to cultivate broilers until they are ready to be harvested and sold to the market.

The development of broiler farms in West Sumatera is more directed to contract farming and become fewer broiler farms with independent status. Contract farming that exist leads to vertical integration between the companies that provide production inputs and the farmers who use the inputs for broiler. Many studies have been conducted to assess the performance of

independent broiler farms (for example, Ali & Hossain, 2010; Mendes *et al*., 2014; Emokaro & Emokpae, 2014; Carvalho *et al*., 2015) or contract farming model farms (for example, Begum *et al*, 2012; Yunus, 2012; Tuan, 2012; Ajao & Oyedele, 2013), or to compare the performance of independent farms and contract farming farms (for example, Todsadee *et al*., 2012; Mahjoor, 2013; Wainaina *et al*., 2014; Gondalia *et al*., 2017). An in-depth study of 23 research articles conducted by Nguyen *et al.* (2015) concluded that contract farming has a positive influence on farm productivity and income.

The study objective is to prove that the different designs of contract, that is formal contract farming compare to informal contract farming as representation of vertical integration intensity in broiler industry, has different efficiency effects on production. The novelty of this study come out ahead not in the form of comparing the performance of independent farms and contract farming farms, but the novelty lies in how contract farming can have different vertical integrative properties and these differences have a real effect on broiler farm performance.

METHODS

Broiler agribusiness system in Indonesia can be categorized into the subsystem of agribusiness inputs or upstream subsystem, subsystem of broiler farms or on farm subsystem, and subsystem of marketing and processing of broiler products or downstream subsystem. Subsystem of agribusiness inputs provides inputs to the broiler farms subsystem.

If the company carries out all activities from downstream to upstream, it means that the company fully performs vertical integration perfectly. Conversely, if the company only runs a business on one subsystem and carries out buying and selling activities with other companies outside the subsystem, the company can be categorized as carrying out an arm's length market transaction. However, companies can act in between, namely by employing contract with companies in other subsystems.

Transaction activities that are fully through the market are the lowest intensity of integration. Conversely, companies that carry out their own activities from upstream to downstream are the highest intensity of integration. Formal contracts are more directed to the highest intensity of integration, while informal contracts are more towards the lowest intensity of integration. In summary, the conceptual framework employed in this research can be seen in Figure 1.

Broiler agribusiness in West Sumatera generally engaged in contract farming or otherwise chose to stand as independent farms. The contract was made in accordance with the agreement between the parties to the contract. The scope and content contained in the contract varied depending on the intent and purpose of the cooperation (Oya, 2012). The contract also evolved in the degree of formality (Chaddad & Cook, 2004). In an early of contract farming existed in Indonesia, cooperation was carried out without a written contract. Now days, cooperation between the two parties is based on a detail written contract.

In research area there were two categories of contract farming between the livestock inputs companies and broiler farms. The first category was contract farming with a formal contractual system. The formal contract was formulated in detailed and signed by two contracting parties. The livestock inputs company would provide day old chicken (DOC), chicken feed, vaccine, vitamins, and medicines to broiler farms. In the contract, each item of inputs broken down clearly according to its type and its price. The broiler farm would receive regular guidance and supervision from the company during the fattening period until harvesting. All broiler produced shall be sold to the company provider of pro-

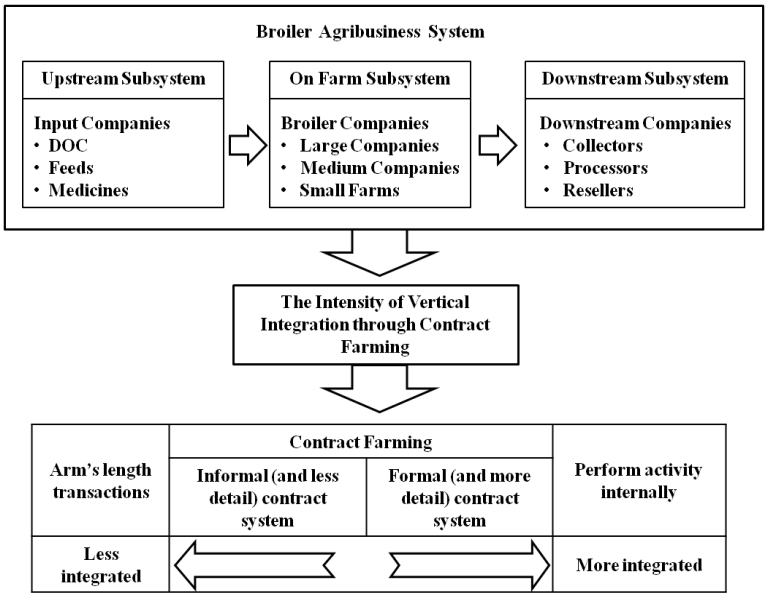

Figure 1. The conceptual framework of the intensity of vertical integration in contract farming of broiler agribusiness (Adaptation from Besanko *et al*., 2013).

duction inputs at the price specified in the contract. The proceeds of the sale were subtracted by all the costs of production inputs provided by the company to come up with broiler farm income.

The second category of contract farming was an informal contract system and without any written documents to be signed by two contracting parties. The company would provide all inputs (i.e. DOC, chickens feed, vaccines, vitamins, and medicines) needed by broiler farm through credit scheme. The company supply of inputs to broiler farm at market price was available at the time of transaction take place. The broiler farm must sell the broiler chicken it produced to the company. The selling price of the product corresponded to the market price at the time of sale. The values of proceeds were then deducted by the company according to the amount of loans made by broiler farm.

Hypothesis

Based on the conceptual framework stated above, the hypothesis of this study was that the production technical efficiency of broiler farm under formal contract farming system was greater compared to technical efficiency under informal contract farming system.

Data

The research was conducted in Limapuluh Kota Regency in West Sumatera Province. Site selection was done purposively with the consideration that Limapuluh Kota was the area that has the largest population of broiler farms and was the center of broiler production in West Sumatera. The data used in this study were the primary data obtained from the questionnaire guided interviews with selected farmers. Primary data collected included data relating to broiler farming business activities and socio-economic data of respondent farmers. Data relating to broiler farming activities included the quantity and price of inputs used in the production (DOC, chicken feed, labor, vaccines, medicines, vitamins, and litter) and the quantity and price of output produced. While the socio-economic data of farmers included age, years of education, broiler farming experience, the number of family members, experience of obtaining guidance, status of broiler farming activities). This study only recorded the business activities of broiler farms in one production period. The production period data taken was one production period before the interview was conducted, so that the production data provided by broiler farmers were expected to be in the same time period.

The broiler farming respondents were obtained through two step process of sampling method. The first step was to select the livestock inputs companies or inputs suppliers purposively based on their willingness to provide the information regarding the identity of broiler farm they invited to cooperate with. Two categories of livestock inputs companies or inputs suppliers included in this research. First category was the companies that drew up formal and detailed written agreement in contract farming, that were PT. Jaya Sakti, PT. Multi Sentosa, and PT. Menara Pratama. The second category was the poultry shop Torang, poultry shop Garuda, and poultry shop without name, that carried out informal and without written contract in contract farming.

The list of identity of broiler farms provided by the companies and poultry shops became sampling frame for the second step of sampling process. The second step of sampling process was to choose randomly the broiler farms from sampling frame. The study selected 87 broiler farms from sampling frame which composed of 50 broiler farms under formal and written detail contractual system and 37 broiler farms under informal and unwritten contractual system. The number of sampling of 87 broiler farms were expected to represent the population in the sampling frame and sufficient for data analysis of research model.

Research Model and Methods of Analysis

The analysis of broiler production function in this study employed stochastic frontier production function. It employed a Cobb-Douglas production function to simultaneously estimate the random disturbance term (v_i) which was outside the control of the production unit and the inefficiency effects (u_i) as was proposed by Battese *et al.* (1996). The Cobb-Douglas form is widely used in the analysis of input-output data in the field of agriculture. This is because the function has some well-known properties that justify its wide application in agriculture. It is a homogeneous function that provides a scale factor enabling one to measure the returns to scale and interprets the elasticity coefficients with relative ease. The Cobb-Douglas production function for this study is shown in the following equation:

$$lnQ = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + \beta_6 lnX_6 + (v_i - u_i)$$

where *ln* represents the natural logarithm (i.e. to the base e), Q is the weight of broiler chicken produced in one period (kg), X_1 is the number of chicken fledgling (DOC) in one period (head), X_2 is the amount of feed in one period (kg), X_3 is the value of vaccines in one period (IDR), X_4 is the amount of medicines in one period (g), X_5 is the amount of vitamins in one period (g), X_6 is labor employed (person), β_0 is intercept or constants, β_i is production factor regression coefficient / parameter estimator, where (i = 1,2, ..., 6), and v_i - u_i is error term (v_i is noise effect, u_i is the technical inefficiency effect of the model).

All variables in the model were converted into logistic forms.

Expected coefficient value $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6 > 0$, meaning that the result of stochastic frontier production function estimation gave positive value of all parameters. The positive value of parameter meant that by increasing the amount of day-old chicken (DOC), chicken feed, labor used, vaccines, medicines, vitamins, and vaccines, it would increase the production of broiler chickens.

The stochastic frontier approach produced two conditions simultaneously, that wer the level of technical efficiency and the factors that affected the technical inef-

ficiency of a production process. The level of technical efficiency for each broiler farm was measured through the observation output compared to the stochastic frontier output. The level of technical efficiency for each broiler farm was calculated employing the following formula:

$$TE_i = Q_i / [\exp(x_i,\beta)] = \exp(-u_i)$$

where *TE* is technical efficiency of farmer *i*, Q_i is output observed (i = 1, 2, ..., 87), and *exp* (x_i, β) is output estimated (i = 1, 2, ..., 87).

The technical efficiency value was between 0 ≤ TE ≤ 1. The technical efficiency value was inversely related to the technical inefficiency effect value and was only used for functions that had a certain number of outputs and inputs. The farmers' technical efficiency value was categorized as efficient enough if it was ≥ 0.7 and categorized as inefficient if it was <0.7 (Coelli *et al.*, 2005).

The u_i variable was a random variable that described technical inefficiency in production and was related to internal factors, the greater the value of u_i, the greater the farming inefficiency of farmers. The inefficiency term *u* was assumed to follow a half-normal distribution with mean zero and a heteroskedastic variance N (0, σ^2_u). The variance of inefficiency was expected to vary with farm characteristics. Variables farm characteristics included in the model followed previous researches, especially those related to farm production efficiency (Begum *et al*., 2012; Ali & Hossain, 2010; Akhter, 2008). To determine the distribution of the technical inefficiency effect (u_i) of broiler farms and the factors that influenced it, the model employed in this research was follows:

$$u_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 D_1 + \delta_6 D_2 + \delta_7 D_3 + \varepsilon$$

Where u_i is effect of technical efficiency, δ_0 is constant, Z_1 is age (year), Z_2 is education (year), Z_3 is broiler farming experience (year), Z_4 is number of family members (person), D_1 is dummy supervision (D_1= 1 there was guidance and D_1= 0 for no guidance), D_2 is dummy broiler farm status (D_2= 1 as a main job and D_2= 0 as a side job), D_3 is dummy contract system (D_3= 1 formal and D_3= 0 informal), and ε is residual element (error).

The expected parameters were $\delta_1 > 0$, whereas δ_2, δ_3, δ_4, δ_5, δ_6, $\delta_7 < 0$. If the predicted parameter was positive then increasing the value of variable could lead to the increase in technical inefficiency of broiler farms. On the contrary, if the sign of predicted parameter was negative then the increase in the value of variable would decrease the technical inefficiency of the broiler farms. The maximum likelihood estimate (MLE) for all the parameters of the stochastic frontier production function and the inefficiency model defined above and the technical efficiency was obtained using the Frontier 4.1 computer program (Coelli, 1994) at a confidence level until 20%.

RESULTS

The independent variables employed in the production function model included the number day old chicken (DOC), feed, vaccines, medicines, vitamins, and labor. The dependent variable in the model was the amount of broiler produced in one period of production. The results of maximum likelihood estimates for Cobb Douglas production function of broiler farm are presented in Table 1. All the coefficients in the production function model were interpreted as elasticity of output produced with respect to inputs (i.e. DOC, feed, vaccines, medicines, vitamins, and labor), because all variables in the model were changed into logarithm forms. Table 1 showed that the number of DOC and quantity of feed had positive input elasticity of production 0.536 and 0.423 respectively, and were highly significant. The coefficients on vaccines, medicines, and labor were statistically insignificant.

Table 1 also provided the results of the maximum likelihood estimator in which the parameters γ and σ^2 were parameters in the stochastic frontier analysis used for hypothesis testing. The value of sigma square (σ^2) was 0.0263 and highly significant different from 0. This indicated a good fit and correctness of the specified distribution assumption of the composite error term. If $\sigma^2 = 0$ it indicated there was no difference between actual production (*Q*) and maximum production possibility ($Q_{frontier}$). Thus, from estimated value of σ^2 it indicated that the broiler farms in West Sumatera had not yet 100 percent technically efficient.

The variance ratio of gamma (γ) which was associated with the variance of technical inefficiency was estimated to be 0.924 with a significance level of 1 percent. This showed that the term error was largely derived from inefficiency (u_i) and only a small amount came from noise (v_i). This indicated that 92.4% of the total variation in the production of broiler farms was due to differences in technical efficiency. If the value of γ was near zero, then most of the error term was as a result of noise (v_i) such as weather, climate, pests and diseases, etc. not the result of inefficiency. Table 1 also shows the value of the generalized likelihood ratio (*LR*), that is 34,037. This calculated value of *LR* value was greater than the value of Kodde & Palm (1986) at a significance level of 1% of 19,384, meaning that the amount of broiler

Table 1. The estimated results of stochastic frontier production function of broiler fattening farms in West Sumatra

Variables	Coefficient	Std. error	t-ratio
Constant	0.382	0.296	1.290
Fledgling (DOC)	0.536	0.069	7.726***
Feeds	0.423	0.033	12.768***
Vaccines	0.001	0.002	0.525
Medicines	0.005	0.012	0.366
Vitamins	0.004	0.003	1.462*
Labor	0.041	0.039	1.042
Sigma equare (σ2)	0.026	0.009	2.853***
Gamma (γ)	0.924	0.051	17.964***
Log likelihood function	88.369		
LR test of the one-side error	34.037		

Note: *** significant at 1% level; *significant at 20% level.

farms production in West Sumatera was influenced by the technical efficiency as well as technical inefficiency factors.

Table 2 presents the descriptive statistics (mean, minimum, and maximum) of the estimated broiler farms technical efficiency according to contractual system categories in West Sumatera. The estimated sample mean of technical efficiency of broiler farms under formal contract system was 0.953, while the mean for broiler farms under informal contract system was 0.790. This finding confirmed the hypotheses of the study that the production technical efficiency of broiler farm under formal contract farming system was higher compared to technical efficiency under informal contract farming system.

The technical inefficiency of broiler farms in West Sumatera was predicted to be influenced by internal factors of farmers and factors other than inputs production. Table 3 provides the estimated results of the source of technical inefficiency of broiler farms. Results indicated that older farmers were more likely to be less efficient than the younger farmers in managing broiler farms. This finding was similar to the results found by Bahari *et al*. (2012) that the increase in age made the technical inefficiency of broiler farms worsen. Older farmer households generally engaged in more than one farm activities or also pursuing more profitable non-farm activities. Msuya *et al*. 2005 showed that younger farmers in sugarcane production could produce more efficiently than aged farmers. Young and healthy farmers have greater physical ability and longer working time than older ones.

Variable of education or schooling years did not significantly affect the broiler farms efficiency. The lack of different use of improved inputs and tools across the broiler farms might explain why there were no discernible differences among farmers with different levels of education. However, the study indicated, with 20% significant level, that the inefficiency of production decreased as the years of broiler farming experience increased. This result was in line with the study expectation that learning by doing would increase the efficiency of production. These results implicitly reinforce the results of Burhanuddin's study (2013) which found that production efficiency was an important indicator that reflected entrepreneurship.

The success of contract farming is certainly not only to be evaluated solely base on the improvement of production technical efficiency, but more importantly has to be judged base on its ability to increase farms profitability. Table 4 shows that in terms of revenue the broiler farms under formal contract system have higher average revenue than broiler farms under informal contract system. Broiler farms in formal contract farming obtained higher revenue because the price incentive given by the company if the farmer was able to produce chickens

Table 2. Distribution of technical efficiency level of broiler fattening farms based on contract system category in West Sumatra

Level of technical efficiency	Formal contract system		Informal contract system	
	Frequency	Percentage	Frequency	Percentage
TE < 0.70	0	0	6	16.22
0.70 ≤ TE < 0.80	0	0	13	35.14
0.80 ≤ TE < 0.90	3	6	12	32.43
0.90 ≤ TE ≤ 1.00	47	94	6	16.22
Total	50	100	37	100
Mean TE	0.953		0.790	
Maximum TE	0.986		0.975	
Minimum TE	0.812		0.608	

Table 3. The estimated results of sources of production technical inefficiency of broiler fattening farms in West Sumatra

Variables	Coefficient	Std. Error	t-ratio
Constant	0.380	0.296	1.290
Age	0.096	0.030	3.247***
Education	-0.037	0.084	-0.441
Broiler farming experience	-0.057	0.042	-1.366*
Number of family members	0.006	0.077	0.082
Farming supervision	-0.052	0.124	-0.418
Farming status	-0.055	0.062	-0.879
Contract system	-0.603	0.239	-2.528**

Note: *** significant at 1% level; ** significant at 5% level; ***significant at 20%.

Table 4. Broiler fattening farms profitability under formal and informal contract system base on average scale size of 3000 chickens in West Sumatra

Description	Formal contract system		Informal contract system	
	Value (IDR)	Percentage	Value (IDR)	Percentage
A. Revenue	83 796 324	100.00	54 796 677	100.00
B. Total variable cost	78 964 158	94.23	46 861 806	85.52
DOC	15 673 620	18.70	13 711 719	25.02
Feed	58 825 458	70.20	29 125 173	53.15
Vaccines, vitamins, medicines	643 455	0.76	507 963	9.27
Hired labor	1 898 046	2.26	2 856 612	5.21
Others	1 863 579	2.22	661 161	1.20
C. Total fixed cost	1 058 337	1.26	634 902	1.16
D. Net return (A-B-C)	3 773 829	4.50	7 299 969	13.32

with the standard feed conversion ratio (FCR) as specified in the contract. If the farmer was able to produce chicken better than the standard, the company would give a higher purchase price than that was agreed in the contract.

However, the broiler farms under informal contract system obtained higher net return compared to the broiler farms under formal contract system. Farmers with informal contracting system had a higher flexibility in determining the source of DOC, the type of chicken cage and equipments, feed, vitamins, and medicines. Table 4 shows that the broiler farms under formal contract bear much higher total variable cost compared to the broiler farms under informal contract. The variable cost consists of cost allocated for DOC, feed, vaccines, vitamins, and medicines, hired labor, and litter, and cage heater electricity.

The biggest difference source of total variable cost came from chicken feed. Feed for broilers was divided into three types of feed, namely feed starter, feed grower, and feed finisher, in accordance with the stage of chicken growth until ready to be harvested. The value of feed used in broiler farms under formal contract was more than twice the feed value used in the broiler farms under informal contract. The higher feed costs in broiler farms incorporated in formal contract farming were caused by higher prices of feed. The price of feed in contract farming included the costs for supervision and technical guidance that was periodically provided by the provider input companies at broiler farms location. Intensive guidance provided by inputs company or input supplier to broiler farmers not only produced a higher level of efficiency, but also reduced the risk of production. In the formal contract farming, input prices and output prices were also set and agreed before the production process began, so broiler farm also carried a lower price risk than informal contract farming whose inputs and output prices depended on the prices prevailing in the market. The price of feed paid by broiler farmers under formal contract which was relatively higher than broiler farmers under informal contract also reflected the lower risk of production and the lower risk of inputs and outputs prices.

DISCUSSION

The results presented in Table 1 indicate that DOC and feed become the major driver of broiler farms production. The results of this study are consistent with several studies such as Akhter & Rashid (2008); Ohajianya *et al*. (2013), and Ezeh *et al.* (2012) where DOC and feed are an influential factor in production. The results also in line with the research conducted by Pakage *et al.* (2014) that revealed the number of DOC was the most influential factor of production of broiler farms with closed house cage system.

Feed was the second most influential variable after DOC in broiler farms in West Sumatera. The results of this study are in accordance with the results reported by Umboh *et al*. (2014) which state a decrease in feed use because of the increased price of corn causes a decrease in chicken meat production. Livestock growth is determined by the quantity and quality of feed. Growth or weight gain is also an interaction between feed, genetic potential, and environmental factors. If everything interacts well, then the growth of livestock will be optimal.

Variable that also significantly affect the production of broiler farms is vitamins. Although it has a relatively small effect compared to DOC and feed, vitamins are needed in the prevention of disease and to support optimal growth of broiler. The effect of vitamin on the amount of broiler production in this study is relatively lower than the results of the other studies. Udoh & Etim (2009) found that vitamin significantly affected broiler production in Nigeria, with elasticity of 0.34. While Pakage *et al.* (2014) discovered that medicines and vitamins had positive and significant effects on the production with elasticity value of 0.02, which meant an increase in the use of medicines and vitamins by 10% would increase the amount of broiler production by 0.2%.

Table 2 shows that all the broiler farms under formal contract system can be categorized as technically efficient farms because the level of their efficiency already above 0.70. Meanwhile, in informal contract system category, 16.2% of broiler farms can be categorized as technically inefficient. The range of maximum and minimum technical efficiency level in the broiler farms under informal contract were also larger than in the broiler farms under formal contract system. This indicates that the broiler farms under informal contract system face a greater production risk compare to the broiler farms under formal contract system.

Table 3 also shows clearly that the broiler farms under formal written contract are associated with a higher farm efficiency as are indicated by the negative and significant coefficient. This result confirms the results of analysis of technical efficiency based on production function that the broiler farms under formal contract are more efficient than those under informal contract. The broiler farms under formal contract receive technical assistance from company provider inputs of production as well as better access to inputs timely. Poultry companies that have legal entity status and provide formal contracts to farmers can improve farm efficiency compared to poultry shops that do not have legal status. This result is in line with research findings of Resti *et al*. (2017) in dairy cooperatives in West Bandung Regency, where cooperative institutions that are active and large-scale are able to improve the quality of milk produced by the farmers compared to less active and small-sized cooperative institutions.

In formal contract farming systems, broilers farmers receive more intensive technical guidance and the opportunity to have better access to production inputs on timely basis. Begum *et al*. (2012) and Issa & Chrysostome (2015) explain that contract will provide several benefits for farmers, namely input supply, market access, risks sharing, managerial access, technical assistance, and production credit. The results of the present study also support the results found by Roopa *et al*. (2013) that contract farming contributes to improve productivity of agricultural production. Through formal and detail contract agreement and frequent supervision

by inputs company or inputs supplier, the broiler farmers may learn more skills and methods of employing input efficiently, record keeping, and the significance of product quality and characteristics.

Table 4 shows the high cost of feed is a major cause of the much smaller profits gain on formal contract farming compared to informal contract farming, although in terms of revenue the formal contract system has higher revenue than the informal contracting system. Formal contract farming systems are technically more efficient, but do not guarantee higher returns than informal contract farming systems. Ragasa *et al*. (2018) found the similar results when examining contract farming in corn agribusiness in West Ghana. They showed that these schemes led to yield increases. However, on average, the impact of the contract farming schemes on profitability is negative, even when the input diversion is accounted for. Yield increases are not high enough to compensate for higher input requirements. Despite the higher yields, the costs to produce one metric ton of maize under contract farming schemes are higher than on maize farms without contract farming schemes. In West Ghana, the implicit cost of guidance and technical supervision in contract farming apparently also imputed in the cost of feed. Wang *et al*. (2014) showed that the contract system had a positive impact on income of vegetable farming in Vietnam, but provided a lower level of profit compared to direct selling.

CONCLUSION

The broiler farms under formal contract farming system have greater technical efficiencies compared to broiler farms under informal contract. The average value of technical efficiency of broiler farms under formal contract is 16 percent higher than broiler farms under informal contracts. However, net return of the informal contract broiler farms is 48 percent higher compared to net return of broiler farms under formal contract. The higher price of output for formal contract broiler farms is not enough to offset higher price of feed used during the production process compared to feed price paid by broiler farms under informal contract.

CONFLICT OF INTEREST

The authors confirm that there are no conflicts of interest associated with this paper and there has been no financial support for this research that could have influence its outcome.

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