Feasibility Analyses of Integrated Broiler Production

M. Firdaus[a] * & L. Komalasari[b]
[a]Faculty of Economics and Management, Bogor Agricultural University
Jln. Kamper, Kampus IPB Darmaga, Bogor
[b]Faculty of Animal Science, Bogor Agricultural University
Jln. Agatis, Kampus IPB Darmaga, Bogor 16680

ABSTRACT

The major obstacles in the development of broiler raising is the expensive price of feed and the fluctuative price of DOCs. The cheap price of imported leg quarters reduces the competitiveness of the local broilers. Therefore, an effort to increase production efficiency is needed through integration between broiler raising and corn farmers and feed producers (integrated farming). The purpose of this study is to analyze the feasibility of integrating broiler raising with corn cultivation and feed production. Besides that, a simulation was conducted to analyze the effects of DOC price changes, broiler price and production capacity. The analyses showed that integrated farming and a mere combination between broiler raising and feed factory of a 10,000 bird capacity is not financially feasible. Increasing the production to 25,000 broiler chickens will make the integrated farming financially feasible. Unintegrated broiler raising is relatively sensitive to broiler price decreases and DOC price increases compared to integrated farming.

Key words: broilers, financial feasibility, integrated farming

INTRODUCTION

Until the year 2008, the Indonesian livestock trade balance was deficit (BPS, 2009). As the income and the education of the people improves, the consumption of animal proteins, including chicken, is projected to increase. In the future, raising beef cattle will be attempted, but economically, the commodity that provides the largest contribution on gross domestic product for livestock sub sector is chicken (BPS, 2009). Chicken is undeniably the consumers' main choice in fulfilling their needs for animal proteins. This is because of its relatively cheap price compared to other meats.

Data from Direktorat Jenderal Peternakan (2007) showed that chicken consumption in Indonesia in 2005 was 824,560 tons. Domestic production in the same year was 779,106 tons. This lack of supply instigated the entry of broilers, mostly in the form of chicken leg quarters, from the US. This market opportunity should have been made the most of, because the development of poultry industries in developing countries has a significant role in building rural communities (Mack *et al.*, 2005).

Generally, the broiler industry is profitable due to the short cycle, which is less than two months. According to North & Bell (1990), broilers are chickens slaughter at the age of approximately seven weeks and weight 1.8 kg. The ever-present demand causes the quick capital turn-over.

The highest cost in broiler production is the expenses on feed. The feed itself takes up 70% of the total production cost. The 2% reduce in feed price will increase the profit up to 8% (Bahrends, 1990). The expensive price of feed is mainly caused by the imported ingredients, such as corn. The production cost of broiler using the corn as feed is more expensive compared to tofu and sago by-products (Nuraini, 2009). Chicken feed consists of 40%-50% corn; the remainder is bran, by products of copra, and fish meal. Therefore, corn price will determine chicken feed price. The fluctuations of input and global competition are currently the two factors affecting the development of the poultry industry (Chang, 2007).

On the other hand, data from the BPS 2009 showed an increasing trend of chicken leg quarter import. The lower price of imported chicken is becoming a challenge for local poultry industries to increase production efficiency. This effort not only concerns the poultry production, but also the raw material production (Ilham *et al.*, 2002).

Currently, the small scale broiler farms are still limited to broiler production alone. An alternative to

* Corresponding author:
Faculty of Economics and Management, Bogor Agricultural University
Jln. Kamper, Kampus IPB Darmaga, Bogor
E-mail: firdausfemipb@yahoo.com

increase broiler production efficiency is to integrate between chicken raising and corn cultivation and feed production. Chicken-produced feces that can be processed into fertilizer, the most expensive input in corn cultivation. According to Hayes (1996), chicken feces have a potassium-nitrogen ratio that is most suitable for corn cultivation. The corn harvested is then converted into chicken feed, which is the highest cost component of the feed. With a better management, the profit gained by the farmer will increase (Cyrilla *et al.*, 2010; Bojnec & Latruffe, 2008).

The development of a model of integrated farming, combining broiler-raising with corn cultivation and feed plant, requires a lot of investment. This sort of industry needs precise planning so that the money invested gives proper profit to the parties involved. A business feasibility analysis is needed in developing the plans.

This study was carried out to analyze whether broiler-raising integrated with corn cultivation and feed production is financially feasible. Besides this, an analysis was done to evaluate the sensitivity of the industry towards broiler price and DOC price fluctuations in two production scales, the 10,000 bird and 25,000 bird scales. The 10,000 bird capacity was chosen because the majority of small scale farmers have this amount of chickens. Whereas the 25,000 bird expansion scale was chosen as it will probably give benefits from economies of scale. With a proper production scale, the livestock production efficiency is expected to increase. According to Alabi & Aruna (2005), one of the factors affecting the chicken-raising technical efficiency is increasing the production of live chickens through appropriate feeding and innovation.

METHODOLOGY

This study was conducted from 2008 to 2009. The technical coefficient for chicken-raising was obtained through a survey of small scale (10,000 birds) broiler farms in Caringin Village, Sub District Dramaga, Bogor. The data used in this study are both primary and secondary data. Primary data was collected by taking one case of broiler farms, two feed experts and two farm waste experts. Primary data includes broiler production data consisting of investment and operational cost components and also input and output prices. Secondary data was obtained from the Ministry of Agriculture and Central Statistical Agency. Secondary data consists of the corn cultivation aspect, export and import of chicken meat and other relevant data. The data obtained were processed qualitatively and quantitatively. Data processing was done by financial feasibility analysis. A descriptive method was used to discern the image of the corn cultivation, feed production, and broiler-raising production process. A financial analysis was done to analyze costs and benefits of the combination of businesses, conducted through investment feasibility criteria and switching value analysis.

There were three models of business combinations analyzed in this study, which are formulated based on the real data from broiler farms. They were:

Model 1. The Non-integrated Broiler Production
In this model, only the broiler production activities were analyzed. Feed, the largest cost component, was assumed to be bought from PT. Charoen Pokphand, composed of the starter feed with a protein content of 21%–23%, and the finisher feed with a protein content of 19%–21% and metabolizable energy of 3,000–3,200 kcal. Every year starting from year one, there were six cycles of broiler production.

Model 2. The Integrated Broiler – Feed Production
In this model, broiler production was combined with a feed plant. The feed plant processed raw materials into broiler feed with a 21% protein content and metabolizable energy of 3,100 kcal. The raw materials used for the feed, including the corn, were purchased from PT Eka Matra. In the first year, the feed plant had started to operate in the first month because the corn was imported, thus there was no need to wait or the corn harvest. The feed was then sent directly to the farms.

Model 3. Integrated Broiler Production
In this model, the corn cultivation, broiler production, and feed production activities were integrated. The corn cultivation activity produced dry, shelled corn which was used in the plant as the main ingredient in the broiler feed. The feed produced was directly used as the broiler feed, and the feces collected from the farm were used as a fertilizer in the corn cultivation. In the first year, the feed plant started to operate in the fourth month because the corn could only be harvested after three months.

For each model, both the 10,000 and 25,000 bird capacity were analyzed. The formulae used in the feasibility studies were:

1. Financial Feasibility Analysis
The criteria used in conducting investment feasibility were:

a. Net Present Value (NPV)
NPV is the difference between the current value of benefit and cost. The formula for NPV is:

$$NPV = \sum_{t=0}^{n} \frac{Bt - Ct}{(1 + i)^t}$$

Source: Kadariah & Clive (1999)

Explanation:
B_t = revenue at year t
C_t = costs at year t
i   = discounted factor
t   = year
n   = project duration
A project or investment is feasible if NPV is positive

b. Internal Rate of Return (IRR)
The IRR value is determined by finding the discounted factor value which will yield an NPV value of zero. To determine the exact interest rate interpolation method is utilized, which is inserting the interest rate between the interest rate that yields a positive NPV and the interest rate that yields a neg-

ative NPV. This method is formulated as follows:

$$IRR = i1 + \frac{NPV1}{(NPV1 - NPV2)} X(i2 - i1)$$

Source: Kadariah & Clive (1999)

Explanation:
i1= the discounted factor that yields a positive NPV
i2= the discounted factor that yields a negative NPV
NPV1 = positive NPV
NPV2 = negative NPV
A project or investment is feasible if the IRR is higher than the interest rate in effect.

c. Benefit Cost Ratio (Net B/C)

Benefit Cost Ratio (Net B/C) is the ratio of the sum of positive and negative present value benefit. Net B/C is used to see how much the net benefit a project might receive for each rupiah spent. To calculate Net B/C the discounted value net benefit for each year is ascertained beforehand. The formula used is:

$$NetB/C = \frac{\sum_{t=0}^{n} \frac{Bt - Ct}{(1+i)^t} > 0}{\left| \sum_{t=0}^{n} \frac{Bt - Ct}{(1+i)^t} \right| < 0} = \frac{PVPositive}{|PVNegative|}$$

Source: Kadariah & Clive (1999)

Explanation:
Bt = revenue at year t
Ct = cost at year t
i   = discounted factor
t   = year
n   = project duration
A project or investment is feasible if Net B/C is larger than one.

d. Payback Period

Payback period is the minimum time to return the initial investment in the form of a cash flow based upon the net revenue subtracted by all costs. The shorter the payback period, the faster the return of the investments will be. To calculate the payback period, the cash flow must first be ascertained, and then the net benefit is cumulatively calculated from year to year and the mean is found. The payback period can be calculated from the investment division with the subjective mean of the net benefit. The formula is:

$$Payback\ period = \frac{Investment\ value}{Subjective\ mean\ of\ net\ benefit}$$

Source : Pudjosumarto (1991)

The payback period can not be used to judge the feasibility of a project, but it is used to see how long the project needs to return its investment. Payback period calculations do not consider time value of money.

2. Switching Value Analysis

To see the effect of changes in costs or benefits caused by external factors, such as input and output prices, the switching value analysis can be utilized. These two variables were chosen because chicken-raising businesses in developing countries are usually very sensitive to changes in feed price and live-chicken price (Hayes, 1996; Sonaiya, 1995). In developed countries, such as the US, the poultry production is not sensitive to feed price. The elasticity of poultry production to the changes in feed price are only 0.06 (Eales & Unnevehr 1993). The study done by Udoh & Etim (2009) show that the factor that effects chicken-raising efficiency the most in urban areas in Nigeria is also feed price. The switching value analysis was done by trial and error method until a zero NPV is obtained. In this study, the changes in DOC and live-chicken prices were analyzed.

The prices of DOC and live-chicken in the market are prone to fluctuations. They often fluctuate highly and are difficult to predict. The cause of DOC price fluctuations is because the breeding farms often produce an unsuitable number of DOCs for the market demand. At times there are over-demands and at others over-supplies. For the broiler price, if there is a decrease in price at the consumer level, it is quickly transmitted to the farms, but if there is an increase, the transmission occurs slowly. This is one of the reasons why the price of live chickens at farm level often fall (Saragih, 2000).

Assumptions for All Models

In this study, some assumptions were made from field surveys and relevant secondary data were used. The assumptions were classified into two groups, assumptions for all models and assumptions for individual models.
1. The project duration is ten years, based upon the economical age of the coop buildings.
2. The interest rate used is the interest rate for loans from Bank Rakyat Indonesia (BRI) year 2008 which was 17%.
3. The main product is live chickens weighing 1.7 kg with a mortality rate of 4%.
4. The price of live chickens is assumed to be fixed at 12,500 IDR per kg for the ten years of study. This price was the market price when the study was conducted.
5. The broiler strain used was the Hubbard, with an FCR (feed conversion ratio) of 1.7, meaning in order to produce 1 kg of body weight, 1.7 kg of feed is needed.
6. In a single year, there are six production cycles. One production cycles lasts for 35 days.
7. In the raising period, a single chicken consumes 2.89 kg of feed.
8. All input prices in the analyses are constant.
9. The income tax rate is based upon *Undang-Undang Pajak* No. 17 year 2000 which is:
   a) For incomes up to 50,000,000 IDR, the tax rate is 10%.
   b) For incomes above 50,000,000 IDR up to 100,000,000 IDR the tax rate is (10% x 50,000,000

IDR) + (15% x (Total income – 50,000,000 IDR)).
c) For incomes above 100,000,000 IDR, the tax rate is higher than 100,000,000 IDR, the tax rate is (10% x 50,000,000 IDR) + (15% x 50,000,000 IDR) + (30% x (Total income – 100,000,000 IDR)).

Assumptions for model 1 and 2
1. The land for building the broiler farm and the feed plant were purchased for 100,000 IDR per m².
2. The secondary product is chicken droppings that sell for 1,500 IDR per 30 kg sack.

Assumptions for model 2 and 3
1. In order to fulfill the feed needs for 10,000 birds of chickens, the feed plant must manufacture at least 600 kg of feed daily. For 25,000 chickens, the minimum is 1,600 kg daily.
2. For the 25,000 chicken capacity, if there is a surplus of feed, it can be sold for 3,500 IDR per kg.

Assumptions for model 2
Corn, the main ingredient in broiler is purchased from PT. Eka Matra for 3,000 IDR per kg for the 10,000 bird production capacity and 2,700 IDR per kg for the 25,000 head capacity due to the larger amount bought.

Assumptions for model 3
1. The land used for the corn cultivation is leased.
2. The variety of corn used is the BISI 16 hybrid with an 8 ton per hectare productivity. The water content in the shelled corn is 11% (NRC, 1994). The corn seed is produced by PT. Bisi Internasional and distributed by PT. Tanindo Subur Prima.
3. In one year, there are three corn planting seasons. One planting season lasts for three months.
4. The land for corn cultivation for 10,000 birds of chicken is divided into two hectare plots. The planting seasons between the two plots are spaced by two months so that the corn harvest occurs every two months. For the 25,000 bird capacity, the land is divided into four 2.5 hectare plots. The plantings are spaced one month, so that the harvest occurs every month.
5. The planting distance for the BISI 16 hybrid is 65 x 15 cm.
6. Besides for feed, at the 25,000 bird capacity, shelled corn is also produced. It is sold for 2,500 IDR per kg.

Components on investment for running the corn cultivation, feed factory and broiler production are presented in Table 1.

RESULTS AND DISCUSSION

The Best Alternative Model

In this section, the results of financial analyses for each model are elucidated. The brief comparison of the investments of the three models is displayed in Table 2. In the 10,000 bird capacity, the model found to work

Table 1. Components of investment when running the corn cultivation, feed factory and broiler production, Caringin Village, Sub District Dramaga, Bogor, 2008-2009

Corn cultivation	Feed factory	Broiler production
Land	Land	Land
Building	Building	Chicken house
Drill well and pump	Power supply installation	Feed warehouse
Shelling machine	Water installation	Administration room
Drying machine	Telephone	Power supply installation
Sprayer	Machine	Water installation
Pair of scales	Lorry	Telephone
Bucket	Pair of scales	Feeder tray
Tarpaulin	Shovel, Bucket	Feeder tube
	Tarpaulin	Automatic drinker (SC 102)
	Furniture	Gasolec S-8
		Chicken guard
		Pair of scales
		Sprayer
		Curtain
		Water tank 500 lt, 1000 lt
		Water pump
		Self refilling syringe 1 ml
		Shovel
		Furniture

best is model 1 (only producing live chickens). From the financial analysis, an NPV of 59,454,837 IDR was discovered. This means that the current value of revenue received during the ten years with an interest rate of 17% is positive. The net B/C was 1.07. This value shows that every 1.00 IDR spent will generate a net benefit of 1.07 IDR. This net B/C proves that the broiler farm model with a 10,000 head capacity is financially feasible. Seen from the payback period, the model has a relatively quick payback period, which is four years, six months and ten days.

For model 2, the analysis for the 10,000 bird capacity showed that this model was not financially feasible. If carried out, it will result in loss. From the analysis, the NPV was found to be -404.398.629 IDR. This means that the current value of revenue received during the ten years with an interest rate of 17% is negative. The loss is due to the large operational cost of the feed plant, including plant maintenance. The Net B/C was 0.65. This means that for every 1,00 IDR spent, a net benefit of 0.65 IDR is generated. The company will spend a larger sum than is expected to be received. The IRR found in the 10,000 bird capacity is 7.12%, less than the current interest rate. In this model, the business' payback period is seven years, ten months and twenty seven days. Any agricultural business that has a payback period exceeding five years is considered unattractive.

The analysis of the 25,000 bird capacity broiler production showed that the best model is the integrated broiler production or model 3. The IRR for model 3 is higher than the two other models, 30.60%. The NPV was 1,481,498,164 IDR, meaning that the current value of revenue received during the ten years with an interest rate of 17% is 1,481,498,164 IDR. Both the NPV and the net B/C of this model exceed the other two models. The integrated broiler production has a quicker payback period than the 10,000 head capacity, a mere three years, two months, and twelve days. This means that even though the investment required for the corn cultivation and feed plant is huge, this farming model generates the largest economic benefit compared to the other two models if run at a 25,000 bird capacity.

Switching Value Analysis

The switching value analysis is a variation of the sensitivity analysis (Gittinger, 1986). In this study, this analysis is used to discover the effect of decreases in the broiler price and increases in the DOC price on the business' feasibility. The indicator is when the NPV is zero. The switching value analysis is done on businesses that are financially feasible. The results for the analysis of various models of broiler farm combinations can be seen in Table 3.

The Decreases in broiler price. In model 1 simulation 1: 10,000 bird production capacity, the maximum decrease in broiler price where the business is still profitable is 1.04%. This means that if the company sells the broilers for less than 12,375 IDR per kg, the business will be

Table 2. The comparison of investment criteria among models of broiler production, Caringin Village, Sub District Dramaga, Bogor, 2008-2009

Model	Investment criteria			
	NPV (IDR)	Net B/C	IRR (%)	Payback period (year)
Model 1 simulation 1	59,454,837	1.07	18.29	4.53
Model 1 simulation 2	260,368,929	1.12	20.83	4.30
Model 2 simulation 1	-404,398,629	0.65	7.12	7.91
Model 2 simulation 2	183,851,649	1.08	19.85	4.50
Model 3 simulation 1	-202,232,763	0.84	13.91	5.90
Model 3 simulation 2	1,481,498,164	1.59	30.60	3.20

Note: Model 1= the non integrated broiler production, Model 2= the integrated broiler-feed production, Model 3= integrated broiler production. Simulation of 1 and 2 are of the 10,000 and 25,000 bird capacity.

Table 3. The comparison of the switching value analysis for models 1, 2, and 3 of broiler production, Caringin Village, Sub District Dramaga, Bogor, 2008-2009.

Variable	Switching value (%)			
	Model 1	Model 1	Model 2	Model 3
	Simulation 1	Simulation 2	Simulation 2	Simulation 2
Broiler price	1.04	1.82	1.29	11.08
DOC price	5.91	10.35	7.31	62.73

Note: Model 1= the non integrated broiler production, Model 2= the integrated broiler-feed production, Model 3= integrated broiler production. Simulation of 1 and 2 are of the 10,000 and 25,000 bird capacity.

Table 4. Farm income analysis of non-integrated broiler production, Caringin Village, Sub District Dramaga, Bogor, 2008-2009 (IDR)

Item	Model			
	Model 1	Model 2	Model 1	Model 2
	Simulation 1	Simulation 1	Simulation 2	Simulation 2
Revenue				
Broiler	1,224,000,000	1,224,000,000	3,060,000,000	3,060,000,000
Feces	3,181,500	3,181,500	7,956,000	7,956,000
Feed				95,550,000
Total Revenue	1,227,181,500	1,227,181,500	3,067,956,000	3,163,506,000
Cost				
Fixed cost	92,239,062	212,095,895	191,688,205	317,557,038
Variable cost	976,680,000	944,447,436	2,439,600,000	2,366,913,600
Total cost	1,068,919,062	1,156,543,331	2,631,288,205	2,684,470,638
Income	158,262,438	70,638,169	436,667,795	479,035,362

Note: Model 1= the non integrated broiler production, Model 2= the integrated broiler-feed production. Simulation of 1 and 2 are of the 10,000 and 25,000 bird capacity.

unfeasible to run. For the same model having a capacity of 25,000 birds, the maximum decrease in broiler price is 1.82%, meaning that if the company sells the broilers for less than 12.275 IDR, it become no longer feasible.

From these analyses it can be concluded that both the 10,000 bird and 25,000 bird capacities are very sensitive to the decreases in broiler price. Nevertheless, in a single year, the broiler business can have six production cycles, so due to the fluctuations in broiler price, the loss in one period can be covered by other profitable periods.

For model 2, the maximum decreases in broiler price where the 25,000 bird capacity business is still feasible is 1.29%. This means that the lowest financially feasible broiler price is 12,350 IDR per kg.

Table 3 shows that for model 3, the maximum limit for broiler price decrease is where the business is still financially feasible is 11.08%. This means that if the company sells the broilers for less than 11,150 IDR per kg, the integrated broiler production is no longer feasible. The results show that the integrated model is relatively resilient towards price fluctuations compared to the non-integrated models.

Increases in DOC price. The switching value analysis for the 10,000 bird capacity broiler production shows that the maximum increase in DOC price that generates a zero NPV is 5.91%. This means that if the DOC price exceeds 3,800 IDR, model 1 is no longer financially feasible. For model 2, a 7.31% increase in DOC price generates a zero NPV. The highest feasible DOC price is 3,875 IDR per bird.

In model 3 simulation 2, an increase up to 62.73% can still be tolerated. As the normal price is 3,600 IDR per chick, if the price increases to 5,850 IDR, the business is no longer feasible. This shows that the integrated broiler production is relatively resilient to significant fluctuations in the DOC price.

Farm Income Analysis

The comparison of farm income analysis between integrated and non-integrated broiler production is presented in Table 4 and 5. The revenue in model 1 comes from the broiler and waste. In model 2 with 25,000 head capacity, the feed also contributes on the revenue. In model 3 with 10,000 head capacity, the main product is broiler however the corn also contributes on the revenue. In this case, there is no feed sold to the market. In this model, if the capacity is 25,000, both corn and feed contribute on the revenue. The last model will give the highest revenue of 3,179,550,000 IDR.

In model 1, the largest variable cost is contributed by the feed. It spends 70 percent of total operational cost.

Table 4. Farm income analysis of non-integrated broiler production, Caringin Village, Sub District Dramaga, Bogor, 2008-2009 (IDR)

Item	Model	
	Model 3 simulation 1	Model 3 simulation 2
Revenue		
Broiler	1,224,000,000	3,060,000,000
Corn	22,500,000	24,000,000
Feed		95,550,000
Total revenue	1,246,500,000	3,179,550,000
Cost		
Fixed cost	217,542,562	327,340,371
Variable cost	833,209,500	1,869,134,000
Total cost	1,050,752,062	2,196,474,371
Income	195,747,938	983,075,629

Note: Model 3= integrated broiler production. Simulation of 1 and 2 are of the 10,000 and 25,000 bird capacity.

In model 2 and 3, the raw materials in feed manufacture spend the largest cost. In model 2, about 70 percent of total variable cost. From all model discussed, model 3 (integrated broiler production) gives the highest income of 983,075,629 IDR.

The Obstacles in Applying the Integrated Broiler Production

The financial feasibility analysis shows that the integrated broiler model is the best model to employ and it is relatively insensitive to changes in broiler and DOC prices. The reasons why this model is not yet applied by the small scale farmers are:

1. It requires more complex management
   The management of an integrated broiler farm is more complex than managing a single production because it involves many business activities which depend on each other. It requires human resources who have comprehensive managerial and technical abilities in running an integrated farm. The aspects to be considered are not only the husbandry, but also the corn cultivation and feed plant operation.
2. It requires a large investment
   A business involving various integrated activities unquestionably needs a larger investment than a single business activity. The integrated broiler production with a 25,000 head capacity needs more than 2,5 billion IDR investment. This is why only medium to large scale businesses can operate the integrated farm model.
3. It requires a larger acreage
   The implementation of the integrated farm model needs a larger acreage, especially for the corn cultivation. For the 25,000 head capacity, ten hectares are needed.

The obstacles above can be overcome by making clusters of broiler farms. Several broiler farms can form a partnership to manage the corn cultivation and feed plant. This of course needs the government's assistance, so that the Indonesia's livestock and poultry husbandry can become more competitive in the future.

CONCLUSION

For the integrated farm model, the 25,000 bird capacity is more feasible than the 10,000 bird capacity. The 25,000 bird integrated broiler business is more resilient to decreases in broiler price and increases in DOC price compared to the other models.

REFERENCES

Alabi, R. A. & M. B. Aruna. 2005. Technical efficiency of family poultry production in Niger-Delta, Nigeria. J. Cen. Eur. Agric. 6: 531-538.

Badan Pusat Satistik. 2009. Statistik Ekspor Impor. Jakarta.

Bahrends, B. R. 1990. Nutrition economics for layers. Poult. Int. 29: 16-20.

Bojnec, S. & L. Latruffe. 2008. Measures of farm business efficiency. Journal of Industrial Management and Data System 108: 258-270.

Chang, H. S. 2007. Analysis of Philippines chicken industry: commercial vs. backyard sectors. Asian Journal of Agriculture and Development 4: 41-56.

Cyrilla, L., Z. Moesa, & S. M. P. Putri. 2010. Efisiensi produksi usaha peternakan domba di Desa Cibunian Kecamatan Pamijahan Kabupaten Bogor. Med. Pet. *33: 55-60.*

Direktorat Jenderal Peternakan. 2007. Buku Statistik Peternakan. Departemen Pertanian, Jakarta.

Eales, J. S. & L. J. Unnevehr. 1993. Simultaneity and structural change in U. S. meat demand. American Journal of Agricultural Economics 75: 259-268.

Gittinger, J. P. 1986. Analisa Ekonomi Proyek-Proyek Pertanian. UI Press, Jakarta.

Hayes, D. J. 1996. The Feasibility of Broiler Production in Iowa. CARD Briefing Paper 96-BP 13. Iowa State University.

Ilham, N., S. Hastuti, & I. K. Karyasa. 2002. Pendugaan parameter dan elastisitas penawaran dan permintaan beberapa jenis daging di Indonesia. JAE 20: 1-23.

Kadariah, L. K. & G. Clive. 1999. Pengantar Evaluasi Proyek. Lembaga Penerbit Universitas Indonesia, Jakarta.

Mack, S., D. Hofman, & J. Otte. 2005. The contribution of poultry to rural development. World's Poultry Science Journal 61:7-14.

National Research Council. 1994. Nutrient Requirements of Poultry. 9th Rev. Ed. National Academy Press, Washington, DC.

North, M. O. & D. D. Bell. 1990. Commercial Chicken Production Manual. 4th Ed. An Avi Book. Van Nostrand Reinhold, New York.

Nuraini. 2009. Performa broiler dengan ransum mengandung campuran ampas sagu dan tahu yang difermentasi dengan *Neurospora crassa.* Med. Pet. 32: 196-203.

Pudjosumarto, M. 1991. Evaluasi Proyek. Liberty, Yogyakarta.

Saragih, B. 2000. Agribisnis Berbasis Peternakan: Kumpulan Pemikiran. Edisi Milenium. Pustaka Wirausaha Muda, Bogor.

Sonaiya, E. B. 1995. Feed resources for smallholder poultry production in Nigeria. World Animal Review 82: 25-33.

Udoh, E. J. & N. A. Etim. 2009. Measurement of farm level efficiency of broiler production in Uyo, Akwa Ibom State, Nigeria. World Journal of Agricultural Sciences 5(s): 832-836.