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# ANALYSIS OF TECHNICAL, ALLOCATIVE AND ECONOMICAL EFFICIENCY IN SMALL BEEF CATTLE FARMING (A Case Study in Tumpang Sub-district, Malang Regency)

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***Abstract:*** *This research was set out to analyze technical, allocative and economical efficiency, and factors affecting production function of public beef cattle farming in Tumpang Sub-district, Malang Regency. The locations of the research were in Jeru village and Benjor village which were in the area of Tumpang Sub-district, Malang Regency. The data collection was taken in April – September 2014. The research method used was survey by involving 75 respondents through purposive sampling. The data was analyzed using Cobb-Douglass* Stochastic Frontier *Production Function version 4.1.*

*The research result showed that the value of respondents' technical efficiency below 0.8 were 20% and technical efficiency above 0.80 was 80%. Then, the value of respondents' economical efficiency below 0.8 was 78.67% and economical efficiency above 0.8 was 21.33%. Meanwhile, the value of respondents' alloctive efficiency below 0.8 was 56% and allocative efficiency above 0.8 was 44%. Lastly, feed cost effects on economical efficiency and production cost per animal unit effects on allocative efficiency.*

***Key words:*** *technical efficiency, alloctive efficiency and economical efficiency*

## 1. INTRODUCTION

Most of beef cattle bred are crossbreeding cattle between local and import cattle such as Limousine and Ongole Breed and the least cattle bred was Ongole Breed. The farmers have a tendency to keep local crossbreeding cattle because it has better conception rate than the result of crossbreeding between local and import cattle. A research conducted by Putro (2011) showed that local cattle's conception rate was 80% and import cattle's conception rate was 60%. Cows from import cattle crossbreeding can grow faster but have lower reproductive ability. Optimization of artificial insemination program in East Java aims to improve livestock productivity. Internal factors of

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production which influence the livestock farming business are semen, cattle age, cattle quantity and types of cattle, while the external factors are cattle feed, equilibrium price, market opportunity, social economic conditions and government support. Management aspects should be given more attention so that the input used and output produced can be well controlled in order to obtain the overview of technical efficiency, economical and allocative efficiency.

Analysis of cost production, sales revenue and benefits are needed to support business continuity. There are some economical research conducted on beef cattle farming both small farming and beef cattle company, but a research that leads to technical efficiency, allocative efficiency and economical efficiency in beef cattle farming from each rancher has not been done frequently. This current research will provide an overview of the conditions of technical efficiency, allocative efficiency and economical efficiency from each farmer who keeps local cattle or crossbreeding cattle. Technical efficiency is needed because it will give an overview of the particular input used and the output produced. The use of input with the optimal amount to get the best output requires an allocative ability. Economical efficiency is related to the production costs spend by each farmer in order to get maximum benefit.

## 2. LITERATURE REVIEW

Arinto, Prabowo, Masyuri dan Santosa (2003), explain that there are three significant independent variables which affect the increase in value of cattle raising: raising period, education background and cattle sex which categorized as dummy variable. The raising period is a very significant variable indicated by the positive value 0.17546. Positive value shows that the longer the raising period is, the more increase in the value of cattle raising is. Then, farmers' education background has positive regression coefficient by the value of 0.46098, it means that education background has a role in improving the value. The other variable, cattle sex, also gives a very significant effect. Based on the analysis result of factors affecting value increase in cattle raising, only cattle age is significant. It is because the long period of cattle raising will increase its price.

The estimation of gross income per day of Ongole Breed which uses low external input fodder (animal feed from the utilization of agricultural waste using digestibility of corn waste and straw) is IDR 6,081.9/AU per day, it is higher compared to the crossbreeding cattle in the value of IDR 5,047.3/AU per day. Efficiency level of Ongole Breed fodder is higher towards the response of cattle weight gaining obtained (Hartati, Mariyono and Wijono, 2005).

Agung (1998) in his research mentions that benefit functions and its relation to the similarity of economical efficiency in beef cattle fattening, located in Pelaga Badung village which uses partnership system and in Tiga Bangli village which does not use partnership system, prove that the most affecting factor in benefit is cattle price by the value of -2.406423. It means that if the cattle price has 1% decrease, the farmer's benefit will increase 2.41%, the next affecting factors are medicine cost, labor cost, concentrate

price, tools cost and forage. Meanwhile, location as dummy variable results negative value with 0.867518, it means that cattle fattening business in Pelaga village is less efficient from economic point of view compared to Tiga village. That thing can happen because the support from core to plasma is limited only for the cattle, while the others cost are burdened to the plasma. The benefit sharing with 55% for the core and 45% for the plasma are considered unfair because it gives loss to the plasma. The value of technical efficiency is coefficient -0.102735, it makes Pelaga village is less efficient compared to Tiga village as seen from technical point of view.

The result of research conducted by Featherston, Langemejer and Ismet (1997) in dairy cattle showed that the value of technical efficiency is in the range of 0.37 and 1.00 with 0.78 in average. Meanwhile, the value of allocative efficiency is in the range of 0.47 up to 1.00 with 0.81 in average and around 60% of farmers have allocative efficiency more than 80%.

Gow and Langemeier (1999) conduct a research about beef cattle efficiency in Kansas, the results are: technical efficiency from the small size (120 AU), medium size (272 AU) and large size (788 AU) are 68%, 67% and 79%. While allocative efficiency from the small group has the highest allocative efficiency by the percentage of 76%, the rest of the groups, medium and large, are in the percentage of 61% and 68%.

Kalangi (2014) conducts a research about technical efficiency, allocative efficiency and economical efficiency in public beef cattle farming located on highland and lowland. The average of technical efficiency on highland and lowland are 80% and 66%. While the allocative efficiency on highland is 50% and on lowland is 30%. Lastly, the economical efficiency on highland is 31% and on lowland is 25%

## 3. RESEARCH METHOD

### Research Setting and Sample

This research was done in two villages, Benjor and Jeru in Tumpang district Malang regency. The samples were chosen based on the number of the cattle kept by the farmers. It was counted using formula $N = Ni/N(d)^2+1= 279/279\ (0,1)^2 + 1= 73$ the number of farmers were turned into integer with 75 respondents. Types of the cattle were crossbreeding cattle between Limousine and Ongole breed, and local Ongole breed. The numbers of the cattle kept were in the range of 1-4 AU chosen by using *purposive sample*.

### DATA ANALYSIS

The data was analyzed using *Cobb- Douglas* model with *Stochastic Frontier Production Function* (SFPF) model approach (Aigner dan Chu, 1977) and Meeusen *et al.* (1977) cited Coelli (1996) which was estimated by using *Maximum Likelihood Estimator* (MLE) and *Frontier* software version 4.1. The format was :

$$\text{Ln } Y = \beta o + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \text{ Ln } X_5 + vi - ui\delta\delta$$

Y = The increase of cattle weight (kg/AU/3months)

$X_1$= Cattle age (year)

$X_2$= Cattle feed ( kg/AU/3months)

$X_3$= Numbers of cattle (unit)

$X_4$= AI (times/year)

$X_5$= Electricity (kwh/3months)

βo = Intercept

$\beta_{1-4}$ = parameter coefficient estimated

Production cost function was needed to know the factors that affected production cost. Differential of cost production function dual production function *Cobb-Douglas homogenous* (Debertin,1986) could be used to calculate allocative efficiency and economical efficiency:

$$\text{Ln } C = \beta o + \ln Y + \beta_1 \ln P_1 + \beta_2 \ln P_2 + \beta_3 \ln P_3 + \beta_4 \ln P_4 + \beta_5 \ln P_5$$

C = Production cost (IDR/AU/3months)

$\beta_i$ = parameter coefficient

$P_1$ = Initial price (IDR/AU)

$P_2$ = Feed cost (IDR/AU/3months)

$P_3$ = Cattle price (IDR/AU)

$P_4$ = AI cost (IDR/AU/3 months)

$P_5$ = Electricity cost (IDR/kwh/3months).

The reverse of cost function was economical efficiency (EE), it was supported by an explanation from Ogundari dan Ojo (2007), economical efficiency could be estimated using this formula:

$$EE = \frac{1}{CE}$$

Soekartawi (1994) claimed that economical efficiency was the result of multiplying technical efficiency by allocative efficiency (EE), in each observation. A formula that could be used to obtain allocative efficiency was:

$$EE = TE \times AE \text{ or } AE = EE/TE$$

## 4. RESULTS AND DISCUSSION

### 4.1. Respondents Characteristics

96 % farmers were in the productive age , the youngest age was 23 years old . The older the farmers were, the more technical efficiency increased. Meanwhile, people in

younger age had more tendency to have higher economical efficiency and allocative efficiency. The farmers under the category of reproductive age were more dynamic and stronger to manage their farms. The average results of technical efficiency, economical efficiency and allocative efficiency based on the age could be seen in Table 1.

**Table 1**
**The Average Results of Technical Efficiency , Economical Efficiency And Allocative Efficiency Based On The Age**

| *Age* | *Technical Efficiency* | *Economical Efficiency* | *Allocative Efficiency* |
|---|---|---|---|
| 20 – 35 | 0.871 | 0.636 | 0.741 |
| 36 – 50 | 0.884 | 0.684 | 0.784 |
| 51 – 65 | 0.916 | 0.595 | 0.654 |
| > 65 | 0.939 | 0.593 | 0.636 |

Most of the farmers or 57.33% respondents graduated from formal education in the level of elementary school. The average of economical efficiency and allocative efficiency proved that the higher the education was, the better the efficiency was. Technical efficiency done by the farmers who did not finish or did not attend elementary school might be better in the use of the input because they did it based on their habits. Sarma and Ahmed (2011) stated that education is an important factor and relates indirectly to the technical efficiency of beef cattle farming 46.67% farmers had more than 15 years farming experiences, experiences were informal education which were very useful for farming development. Darmawi (2011) stated that the period of time in running a business will make the decision making easier. Technically, the longer the business extent was, the less efficiency value was. It happened because farming was already a kind of habit not a main job. Therefore, the maintenance was not given much attention. The relation of business extent and technical, economical and allocative efficiency could be seen in Table 3.

### 4.2. The Results of Technical, Economical and Allocative Efficiency

Based on the analysis, technical efficiency was above 0.8 in the percentage of 80%. While Wang et.al (2013) said that beef cattle with the using of glass house and gas emission in scale 6 and 12 makes technical efficiency under the scale of 0.8 and above

**Table 2**
**The Average of Technical, Economical and Allocative Efficiency Based on Education Background**

| *Education* | *Technical Efficiency* | *Economical Efficiency* | *Allocative Efficiency* |
|---|---|---|---|
| Elementary School Dropout/ Uneducated | 0.976 | 0.614 | 0.624 |
| Elementary School Graduate | 0.873 | 0.651 | 0.748 |
| Junior High School Graduate | 0.822 | 0.706 | 0.841 |
| Senior High School Graduate | 0.730 | 0.724 | 0.992 |

**Table 3**
**The Average of Technical, Economical and Allocative Efficiency Based on Business Extent**

| *Business Extent* | *Technical Efficiency* | *Economical Efficiency* | *Allocative Efficiency* |
|---|---|---|---|
| 1 – 5 | 0.958 | 0.673 | 0.707 |
| 6 – 10 | 0.913 | 0.624 | 0.688 |
| 11 – 15 | 0.839 | 0.770 | 0.940 |
| > 15 | 0.783 | 0.622 | 0.730 |

0.96. Kalangi's research (2014) explained that 56% farmers in highland area had technical efficiency above 70% and 88% farmers in lowland area had efficiency rate above 70%. The average in highland was 66% and lowland was 80%, the conclusion was that cattle farming in highland area could improve its production up to 34% and lowland area 20%. A business could be said as technically efficient when the value was close to 100%. Meanwhile, the results of technical efficiency in the research showed that most of them were efficient because it was >0.8.

The farmers in using technical input was already efficient enough to produce output. In other words, the input utilization was already optimal as the effect of low cattle ownership, in the average of 1.58 animal unit. It made the farmers easier to manage their farms. Less ownership of business scale was caused by many farmers just did farming activity for side job which was expected to be some savings. That fact was supported by Hartono and Rohaeni (2014), they stated that the ownership of beef cattle in Tanah Laut regency was categorized as low and constant because the beef cattle was only kept for some savings and side job. Tanah Laut villagers got higher income from agricultural business compared to beef cattle farming.

**Table 4**
**The Distribution of Technical Efficiency Using *Frontier* Production Function**

| *Technical Efficiency* | | |
|---|---|---|
| *Interval* | *Total* | *Percentage* |
| 0.66 - 0.70 | 1 | 1.33 |
| 0.71 – 0.75 | 2 | 3.00 |
| 0.76 – 0.80 | 12 | 16.00 |
| 0.81 – 0.85 | 10 | 13.33 |
| 0.86 – 0.90 | 8 | 10.67 |
| 0.91 - 0.95 | 12 | 16.00 |
| 0.96 – 1 | 30 | 40.00 |
| Total | 75 | 100.00 |
| Average | 0.89 | |
| Minimum | 0,66 | |
| Maximum | 1,00 | |

If technical efficiency had achieved the expected value, it did not mean that economic efficiency was also achieved. It was because economic efficiency related to the cost of production factors. Counting allocative and economic efficiency could be done by decrease the cost of production function which was affected by input cost.

Things that needed to be estimated were cattle initial price, cattle feed cost, cattle price, electricity cost and artificial insemination (AI) cost .The estimation result of production cost using MLE method could be seen in table 5.

**Table 5**
**Production Cost Function Using MLE Method**

| *Variable* | *Coefficient* | *t - ratio* |
|---|---|---|
| | 11.110 | 3.544 |
| Initial Price (P1) | 0.330 | 1.866 |
| Feed Cost (P2) | -0.014 | -0.698 |
| Cattle Price (P3) | -0.275* | -2.855 |
| AI Cost(P4) | 0.056 | 0.629 |
| Electricity Cost (P5) | 0.085 | 1.117 |
| $s^2$ | 0.383 | 4.354 |
| Y | 0.921 | 15.802 |

The analysis result of function cost showed that the cattle price during the research was significant to the production cost. The result of t-test was – 2.855 lower than t-table 2.292 in the level of 0.05. Cattle price had negative coefficient value -0.275, it indicated the 1% rising of cattle price would decrease the production cost up to 0.275%. The cattle price rising would make cattle rejected value higher. High rejected value affected the difference in cattle price, it decreased the cattle price. Low rejected value also decreased the cattle depreciation which caused production cost decrease. The farmers who had d" 0,8 economical efficiency was 78.66% which revealed that the farmers could not utilize the cost for their production needs. The average of allocative efficiency was 0.732, in order to reach expected efficiency the farmers needed to increase allocative ability up to 26.80%. The percentage of farmers who had allocative efficiency ≤ 0,8 was 54%. Comparing to the result of technical, economical and allocative efficiency from Ogundari and Ojo (2007), technical efficiency in their research was lower. Meanwhile, their economical and allocative efficiency was higher.

Research from Ogundari dan Ojo (2007) showed that Value of technical, allocation and economic efficiency in beef cattle farming in Nigeria were in the range of 11.01%-96.30% for Technical Efficiencies with 78.20% in average, 57.20%-97.10% for Allocative efficiencies with 87.70% in average and 56.48%-92.87% with 68.38% in average. Beef cattle farming was a kind of business that needed high cost, so efficiency should be increased when allocating production factor. The highest production factors spent when producing beef cattle farming productivity were cattle caring cost and cattle feed cost. In table 8, we could see that feed cost affected the economical efficiency with 95% level of confidence. The negative coefficient mark indicated that cost related well to the economical efficiency in beef cattle farming, feed cost decrease would increase economical efficiency. The feed given to the cattle in the research area were elephant grass, cane bud, straw and native grass. A research on beef cattle fattening from Vietnam conducted by Dung, *et.al* (2013) also fed the cattle with straw, elephant grass and native grass.

**Table 6**
**Distribution of Allocative and Economic Efficiency Using *Stochastic Frontier* Production**

| | *Allocative Efficiency* | | *Economical Efficiency* | |
|---|---|---|---|---|
| *Interval* | *Total* | *Percentage* | *Total* | *Percentage* |
| ≤ 0.50 | 13 | 17.333 | 18 | 24.00 |
| 0.51- 0.55 | 6 | 8.000 | 4 | 5.33 |
| 0.56- 0.60 | 5 | 6.667 | 7 | 9.33 |
| 0.61- 0.65 | 2 | 2.667 | 5 | 6.67 |
| 0.66- 0.70 | 5 | 6.667 | 7 | 9.33 |
| 0.71- 0.75 | 5 | 6.667 | 7 | 9.33 |
| 0.76- 0.80 | 6 | 8.000 | 11 | 14.67 |
| 0.81- 0.85 | 10 | 13.333 | 5 | 6.67 |
| 0.86- 0.90 | 5 | 6.667 | 8 | 10.67 |
| 0.91- 0.95 | 5 | 6.667 | 3 | 4.00 |
| 0.96- >1.00 | 13 | 17.333 | 0 | 0 |
| Total | 75 | 100 | 75 | 100 |
| Average | 0.7315 | | 0.6467 | |
| Minimum | 0.2692 | | 0.2393 | |
| Maximum | 1.1801 | | 0.9233 | |

**Table 7**
**Factors Affecting Economical Efficiency**

| *Variable* | *Coefficient* | *t-Ratio* |
|---|---|---|
| Constant | 0.899 | 10.877 |
| Initial Price | 8.779E-9 | 1.406 |
| Feed Cost | -1.718E-7* | -7.574 |
| Feed Price | -2.080E-9 | -1.072 |
| AI cost | 1.246E-6 | 2.488 |
| Electricity cost | -4.325E-7 | -0.340 |
| R2: 0.478 | | |
| F : 12.656 | | |

*Notes:* * : significant in confidence level 95%

Regression analysis result showed that 67.10% allocative efficiency was affected by production cost factor and cattle price. Production cost per unit was significant to the allocative efficiency.

**Table 8**
**Factors Affecting Allocative Efficiency**

| *Variable* | *Coefficient* | *t-ratio* |
|---|---|---|
| Coefficient | 1.204 | 16.837 |
| Production cost/unit | -2.461E-7 * | -9.252 |
| Cattle Price | 4.121E-9 | 0.656 |
| Production cost/kg | 5.162E-5 | 5.480 |
| $R^2$ : 67.10% | | |
| F hit : 48.337 | | |

## V. CONCLUSION

Pertaining to the research findings and discussions, some conclusions are drawn below:

1. The average of technical efficiency d" 0,80 was 0,72 with 15 farmers (20%) and the average of technical efficiency > 0,80 was 0,93 with 60 farmers (80%).
2. The farmers who had the average of economical efficiency 0.64 was 59 farmers (78.67%) and the farmers who had the average of economical efficiency 0,86 was 16 farmers (21.33%).
3. The farmers who had allocative efficiency <0.8 was 42 farmers (56%) with efficiency average 0.731 and the farmers who had allocative efficiency >0.8 was 33 farmers (44%) with allocative average 0.93.
4. Factor which significantly affecting production and economical efficiency in beef cattle farming was feed cost, while factor which significantly affecting allocative efficiency was cattle production cost.

### *References*

Aigner. D, Lovell. K. CA and schimdt. P. (1977), Formulation and Estimation of Stochastic Frontier Production Fungtion Models. *Journal Econometrics* 6(1977) 21-37. *Page.stern.nyu.edu/ Wgreene/Frontier Modelling/Reference papers/Aigner-Lovell-Schimdt-JE 1977-Als.pdf.*

Coelli, T. (1996*), A Guide to FRONTIER Version 4.1: A Computer Program for Stochastic Frontier Production and Cost Function Estimation.* Armidale : University of New England, Centre for Efficiency and Productivity Analysis. *Web:http:// www.une.edu.au/Econometrics/cepu.htm.*

Darmawi Darlim (2011), Pendapatan Usaha Pemeliharaan Sapi Bali di Kabupaten Muaro Jambi. Journal Ilmiah Imu-Ilmu Peternakan,Mei 2011.Vol. XIV. No. 1. *file://c:/Documens% 20 and % 20 Settings/User/My % 20 Documens/Dounloads/583-1153-1-SM.pdf.*

Dung, D. V, W, Yao, N.X.B$_a$ and H. Kalhoro (2013), *Feeding Systems for Fattening Cattle on Smallholder Farms in Central Vietnam.*Livestock Research for Rural Development 25 (8) 2013. *www.lrrd.org 25/8/dung 25143.htm.*

Featherstone, A. M., Langemeier, M. R. and Ismet, M. (1997), *A Nonparametric Analysis of Efficiency for A Sample of KansasBeff Cow Farms.* Journal of Agricultural and Applied Economics 29, 1 (July 1997): 175-184.1997 Southern Agricultural Economics Association.

Gow L. and Langemeier M. (1999), *An Efficiency Analysis of Cattle Backgrounding in Kansas*. Presented at western Agricultural Economics Association Annual Meeting. Fargo, ND.

Hartono, B. and E. S. Rohaeni (2014), *Constribution to Income of Tradisional Beef Cattle Farmer Households in Tanah Laut Regency, South Kalimantan, Indonesia*. Livestock Research for Rural Development 26 (8) 2014. *www.lrrd.org/lrrd* 26/8/hart 26141.htm.

Kalangi. L. S. (2014), Analisis Efisiensi Ekonomi Usaha Perkembangbiakan Ternak Sapi Potong Rakyat di Provinsi Jawa Timur. Sekolah Pascasarjana.Institut Pertanian Bogor.http:/Repository.ipb.ac.id/handle/123456789/70066.

——(2013), Laporan Tahunan. Dinas Peternakan dan Kesehatan Hewan Kabupaten Malang.

Ogundari, K and S. O. Ojo. (2007), Economic Efficiency of Small Scale Food Crop Production in Nigeria: A Stochastic Frontier Approach. *Journal Soc. Sci, 14(2): 123-130.*

*www.Krezublishers:Com/02-journals/JSS/JSS-14-0000-0000-2007-web/1SS-000-000-2007Abst-Text/JSS-14-2-12.*

Putro. P. P. (2011), Penanganan Gangguan Reproduksi pada Sapi Lokal dan Persilangan. Workshop Efek Persilangan Terhadap Keberadaan Sapi Lokal. Pusat Penelitian dan Pengembangan Peternakan dan Sekretariat Direktorat Jenderal Peternakan dan Kesehatan Hewan. Cisarua. Bogor.

Soekartawi (1994), Teori Ekonomi Produksi . PT Raya Grafindo Persada. Kelapa Gading Permai. Jakarta.

Trestini. (1994), *Technical Efficiency of Italian Beef Cattle Production Under a Heteroscedastic Non-Neutral Production Frontier Approach*. Center for International Food and Agricultural Policy University of Minnesota. Depertment of Applied Economics.USA.

Wang T., Park. S. C., Bevers S., Teague R., and Cho. J. (2013), *Factors Affecting Cow-Calf Herd Performance and Greenhouse Gas Emissions.* Journal of agricultural and Resource Economics 38(3): 435-456. Ageconsearch. Umn.edu/bitstream/165938/2 JARE,Dec 2013.% 239.Wang.11435-Pdf.