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Technical efficiency of beef cattle production in the regency of Minahasa Tenggara, province of North Sulawesi, Indonesia

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Abstract

A fattening cultivation of beef cattle in the Province of North Sulawesi is managed by the backyard farming, characterized by a lower productivity, small-scaled business, and traditional management. This type of business has become priority to satisfy the need of beef consumption. Then, the objective of this research is to analyze the extent of technical efficiency of beef cattle fattening. In detail, data collection was conducted in both Districts of Belang and Tombatu Timur, Regency of Minahasa Tenggara on January-February 2022. Two villages of the respective District were selected purposively as the sampling village. Additionally, the research used primary data, obtained from 60 farmers and selected by purposive sampling method. The data, then, was analyzed using the production function of the Stochastic frontier. In sum up, the results of analysis demonstrate that the fattening industry of beef cattle was feasible to perform, but the output of technical efficiency of beef cattle industry was still low, by its average of efficiency index value of 0.670. Meanwhile, the determining factors of beef cattle production were labor, green feed, and weight of feeder cattle. The access, therefore, to information sources, such as technical training and access to the improvement of total beef by capital increasing, is necessary to be developed.

Keywords: Technical efficiency; Beef cattle; Fattening; Production

1. Introduction

Beef cattle is one of the superior commodities of sub-sector of husbandry in the Province of North Sulawesi. It is the first rank as the superior commodity, followed by broiler and goat [1]. Based on its market potency, some opportunities are available to satisfy demand of beef cattle since domestic production has not been able to satisfy national needs. Data obtained from [2] argued that the satisfaction of domestic beef is still deficit as 23,675 tons, or it increases than 2019, only achieving 20,800 tons. Further, based on its economic aspect, the fattening industry of beef cattle is classified as feasible by its benefit cost ratio (BCR) of 2.07 and internal rate of return (IRR) of 14.6% [3,4]. The results of the research from [5] concluded that the consumption increasing of meat and beef is the driving factors of the development of sub-sector of husbandry in the Province of North Sulawesi.It is demonstrated from the average value of Location Quotient (LQ) during 2010- 2015 in sub-sector of husbandry by 2.6 showing that this sub-sector has the comparative superiority than other sub-sectors.

According to the technical aspect, the Province of North Sulawesi still has an opportunity to improve the population of beef cattle up to 406,856-497,285 animal unit (AU) since the carrying capacity of green feed is over abundant [5]. Further, specifically in the Regency of Minahasa Tenggara, the increasing of the carrying capacity of beef cattle can reach 87,488 AU [6]. Based on the type of the cultivated cattle, such as ongole breeding (PO), has been suitable with the condition of North Sulawesi or Indonesia.

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Mostly, farmers of beef cattle located in the Regency of Minahasa Tenggara conduct the backyard farming. Data derived from [7] displayed that the averagely business scale of farmers is three cattle/farmer. Meanwhile, [8] argued that farmers of the backyard farming are characterized by low business productivity, small-scaled business, traditional business model, and not having oriented to profit. According to [9], it described that the husbandry productivity is largely influenced by factor of genetic (32%) and environment (68%). While the influencing factors of beef cattle productivity is feed, seed, and management [10].

In addition, the issues dealt with farmers of the fattening industry of beef cattle in the Regency of Minahasa Tenggara are not much different from other areas, such as: 1) it is typically side job; 2) the management is traditional; and, 3) feed given is mostly green feed, so it impacts on lower weight gaining of cattle in daily which is around 100-200 gr/cattle/day [11,12]. The orientation of the fattening industry of beef cattle is relatively side-job since farmers raise cattle for savings. Then, it will be sold if required. However, this orientation has not resulted the optimal production results. Related to relatively lower productivity, according to [13], it mentioned that there are three sources of productivity growth, such as technology changes, technical efficiency, and economic business scale. Thus, the productivity upgrading by increasing of the technical efficiency is possible. Moreover, the efficiency of agriculture is the primary driving force to the growth of agriculture productivity and allocation of efficient economic resources [14]. Similarly, it is supported by the previous research, stating that there is an opportunity to increase the technical efficiency of the fattening industry of beef cattle, about 23% [15].

The research related to the efficiency increasing of the fattening industry of beef cattle is necessarily performed since beef cattle is one of the strategic commodities as the concern of government, where the main business actor is dominantly the backyard farmers. Therefore, this study is expectedly to provide information regarding opportunity to improve production and productivity of beef cattle by the increasing of technical efficiency based on the available resources.According to above consideration, the research aims to know the determining factors of efficiency in the beef cattle production and measure the efficiency extent of beef cattle industry in the Regency of Minahasa Tenggara.

2. Material and methods

2.1. Site and period

The research was conducted in the District of Belang and Tombatu Timur, the Regency of Minahasa Tenggara, Province of North Sulawesi on January-February 2022. Then, the site was purposively determined by considering the largest population of beef cattle in the area (35.67%). Additionally, the trading intensity of beef cattle in both Districts was larger than other Districts in the Regency of Minahasa Tenggara.

2.2. Data type and sampling method

The collected data comprised of characteristics of farmers (age, education, duration of husbandry experience, and total members of family), production input and output of cattle (weight of beef cattle, total cattle, total feed, total working hours and fattening period), and price of production input-output expensed by farmers during the last one period between 2020-2021. Moreover, data collecting was performed using questionnaire instrument. The sampling of farmers was conducted by purposive method [16], which was 60 farmers of beef cattle as respondent, providing that famers conducting the fattening industry of beef cattle had minimally 2 cattle.

2.3. Data analysis

2.3.1. Analysis of the fattening industry of beef cattle

Income analysis of beef cattle industry was based on the calculation of cash costs and total costs. Then, the analysis of the fattening industry of beef cattle was calculated based on average raising period of respondents, which was 122 days (4 months). It was calculated for the last selling period on December 2021. The month was on the Christmas, so many farmers sold cattle. Further, the calculation of the fattening industry of beef cattle was analyzed by two calculations, such as: 1) business of one cattle and 2) business based on average ownership of cattle by respondent, which was three cattle as per respondent. According to [17], the income is calculated by the following formulation, as follows:

$$Y_t = R - B_t$$

$$Y_b = R - B_k$$

Where;

Y_t = Income to cash costs (Rp)Income
Y_b = to total costs (Rp)
R = Income (Rp)
B_t = Cash costs (Rp)
B_k = Total costs (Rp) = (B_t + B_D)
B_D = Calculated cost (Rp)

Revenue Cost Ratio (R/C) was counted by dividing income from the fattening industry of beef cattle with expensed costs. R/C was feasible if the value had more than one. While cash costs were measured based on real costs, the calculated cost was the real costs that had to be expensed by farmers to purchase production input within the fattening period of beef cattle.

2.3.2. Analysis of technical efficiency and its determining factors

In this research, the efficiency analysis of the fattening industry of beef cattle used the production function of stochastic frontier of Cobb- Douglas. Subsequently, the analysis of production function and technical efficiency was obtained by the assistance of Frontier version 4.1 software. According to [18], the production function of stochastic frontier is the production function displaying maximal output that can be achieved from each use of input. Some characteristics of this function are 1) homogenous, 2) simple form, 3) changeable into linear function, and 4) rarely causing issues and the most used [19]. The typical equation of production function of stochastic frontier of Cobb-Douglas is as follows:

$$\ln Q = \beta_0 + \beta_1 \ln X_i + v_i - \mu_i$$

$$Q_i = \exp(\beta_0 + \beta_1 ln X_i) + v_i - \mu_i$$

$$Q_1 = \exp(\beta_0 + \beta_1 ln X_i) \times \exp(v_i) \times \exp(-\mu_i)$$

Where;

Q = Production output
β_1 = Regression coefficient
x_i = Production factor-i
v_i = noise effect (related to external factors, such as weather and disease attack)
μ_i = inefficiency effect (derived from internal factors)

Based on the common formulation above, the assuming equation model of production function of Stochastic- frontier Cobb-Douglas in the fattening industry of beef cattle is formulated as follows:

$$\ln Y = \ln \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + (vi\text{-}\mu i)$$

Where;

Y = Final weight of beef cattle (kg)
X_1 = Total labor outflows (Man days)
X_2 = Total green feed (kg)
X_3 = Initial weight of feeder cattle (kg)

β_0 = Intercept
β (1-3) = Regression coefficient of production function
Vi-μi = error term (Vi is noise effect; μi is inefficiency of technic model)

The expected coefficient values were β1, β2, and β3 > 0, depicting that the coefficient value of assuming function of frontier production in the fattening industry of beef cattle expectedly provided positive assumption of the parameter value. Hence, the increasing of total labor outflows, green feed, and initial weight of feeder cattle would expectedly increase the final weight of beef cattle.

Meanwhile, the technical efficiency based on [18] was a relative size between production output of a producer with output that can be produced in the perfectly efficient condition in the similar input usage. The value ranged between zero and one. Particularly, the technical efficiency is counted by the following equation, as follows:

$$TEi = \frac{yi}{\exp(xi\beta)} = \frac{\exp(xi\beta - ui)}{\exp(xi\beta)} = \exp(-ui)$$

In addition, the technical efficiency is production output resulted efficiently from some input combinations [20]. The following illustration of the technical efficiency curve can be seen in Figure 1 below.

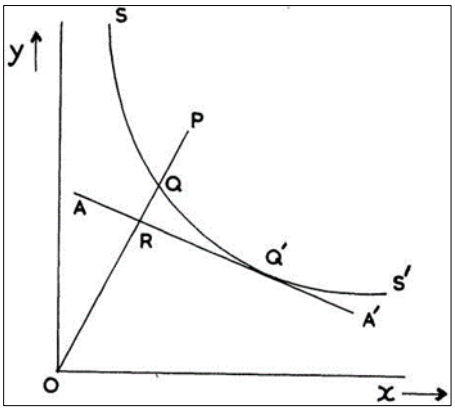

Figure 1 Isoquant curve of technical production and efficiency (Source: Farrel, 1957)

In the illustration above, P represented the use of both factors of input and output by a producer, and SS' curve (isoquant frontier) represented total similar production units, resulted from the combination of two perfectly efficient factors. Additionally, Q depicted efficient condition of producer using two input factors similar to P producer. Therefore, Q produced the similar output with P, but it used input by OQ/OP times. The technical efficiency of P producer was defined as OQ/OP ration, using unit or percentage.

Furthermore, the use of the Stochastic frontier function will provide two results at once, such as the determining factors of the technical business efficiency and inefficiency. For each of the-i farmer under output aspect, the technical efficiency was obtained from observation output to its output of the Stochastic frontier. The technical efficiency had inverted correlation with the effects of the technical efficiency. In addition, farmers' technical efficiency was classified as efficient if the value was ≥ 0,7 and it was inefficient if the value was <0,7 [18]. To determine the parameter value of distribution (μi) of the technical inefficient effects of the fattening industry of beef cattle, it uses the following formulation, as follows:

$$\mu i = \delta_0 + \delta_1 N_1 + \delta_2 N_2 + \delta_3 N_3 + \delta_4 N_4$$

Where;

μ_1 = Technical inefficiency effects
δ_0 = Intercept or constant
N_1 = Age of farmers (years old)
N_2 = Dummy of following counseling (d1= 0, farmers have not followed counseling and d2=1, farmers have followed counseling)
N_3 = Husbandry experience (years)
N_4 = Dummy of ownership (d1=0, private cattle and d2=1, others cattle)

If the inefficient assuming parameter had positive value, the variables had impacted on the increasing of business inefficiency. Contrastingly, if the inefficient assuming parameter had negative value, the variables decreased business inefficiency or increased business efficiency having been performed [20]

3. Results and discussion

3.1. Characteristics of farmers

Averagely, age of farmers was around 41 years old, and the oldest was 67 years old. Hence, the average age of farmers was still in the productive age. The research conducted by [21,22] concluded that someone's ability will be faster in line with the age increasing, but it will decrease as his or her age increases. With the more productive age of farmers, their ability to accept and adopt technological innovation expectedly grew faster. It was due to an opportunity to obtain knowledge of cattle raising at past and present was similar.

Generally, farmers' education was low, which was 8 years or not graduated from junior high school (SMP). Even, there are some farmers not graduated from elementary school. The higher the education, the higher the technological adoption of cattle fattening [23]. It was assumed due to better understanding and ability of study by the high-educated farmers. In contrast, [24] argued that the education level of farmers in the Regency of Konawe has negative correlation with farmers' competency since the higher the education of farmers, the more reluctant the farmers to manage their cattle business. It was because they wanted to seek for reputable occupation.

Based on experience in the fattening industry of beef cattle, the period was 4.8 years, but there was a farmer having experience more than 10 years. The experience in husbandry would have positive impact on the fattening industry of beef cattle since farmers would know better methods how to raise cattle. However, the results of study performed by [25] depicted that farmers' experience does not have positive correlation with the gap of technological adoption in the development of beef cattle production or farmers' competency. Assumedly, it was related to relatively stable management of beef cattle fattening. In short, the cattle raising, from the past up now, has not been intensive. It is herded in prairie and side job oriented (non-economy oriented).

Other farmers' characteristics were total members of family. The average total members of family from respondents were relatively small, which was three people. The amount of family members could provide positive support to the improvement of technological adoption in the fattening industry of beef cattle. By the accurate adoption, it would improv family's income. However, the previous results of study showed that none of correlation between total of dependents family with income of beef cattle or technological adoption exists [26].

Table 1 Characteristics of farmers in the Regency of Minahasa Tenggara

Characteristics of Respondents	Minimal	Maximal	Average
Age (years old)	34	67	41.2
Education period (year)	5	13	8.0
Experience of cattle industry (year)	1	12	4.8
Family dependents (people)	1	5	3.0

3.2. Characteristics of the fattening industry of beef cattle

The business characteristics is highly related to managerial ability of farmers that will affect the efficiency of fattening business. The portray of labor outflow and fattening business of beef cattle can be seen in the following Table 2.

Specifically, Table 2 displays that most of labor allocation in the fattening industry of beef cattle in the research site was to look for grass by 45.2%, or it was equal with 15.1 man days/cattle/period. Followingly, the time outflow was allocated relatively equal, such as feeding (16.7%), cleaning cages (13.5%), and giving drink (12.3%). Overall time allocation required to raise beef cattle was 33.4 man days/cattle/period. By considering average one period of fattening 4.2 months or equal with 124 days, the required labor outflow was 0.268 man days/cattle/day. Then, if it was converted into one man days, it could handle about four cattle.

Table 2 Allocation of labor in the fattening industry of beef cattle in the Regency of Minahasa Tenggara

Activity	Labor Outflow	
	Man days/cattle/period	%
Looking for grass	15.1	45.2
Feeding	5.6	16.7
Cleaning cages	4.5	13.5
Giving drink	4.1	12.3
Showering	3.8	11.4
Selling	0.3	0.9
Total	33.4	100.0

Table 3 Total cattle, raising duration and feeding in the fattening industry of beef cattle in the Regency of Minahasa Utara

Description	Total	
	Average	Sides
Total cattle (cattle)	3.0	1.1
Raising duration (day)	124.0	72.8
Green feed (kg/cattle/day)	29.7	8.3
Concentrate feed (kg/cattle/day)	2.5	2.0

The value was smaller than the findings of [27], stating that one man days can handle 47 cattle. However, other results of study argued that one labor can manage 2-5 cattle [28]. The different management ability in handling total cattle was assumedly due to different actors of fattening. Typically, the backyard farming had not had private grass field, so the availability of grass would depend on climate or nature as well as distance of grass taking. Figure of characteristics related to other fattening industries can be seen in Table 3.

Moreover, the business scale of beef cattle in the research site was relatively small, where total raised cattle was three cattle for each farmer, averagely. This tendency was in line with data in the previous table, showing that the fattening industry of beef cattle is side job of family utilizing limited labor from family members. The small-scale business is common condition of beef cattle husbandry in Indonesia. The research conducted by [29] postulated that the ownership scale of cattle in Indonesia is varied with the intensive raising pattern by 1-3 cattle/farmers; while in the area with the extensive raising pattern, the business scale can be hundred cattle, though such business scale is not possessed by many farmers. Further, it was stated also that total private cattle have significant impact on income of beef cattle industry.

The results of study from [30] mentioned that the determining factors in increasing the business scale of beef cattle is by Tobit equation model. It concluded that there is positive correlation between family labor and expectation to increase income of the beef cattle business. It means that the increasing of business scale of beef cattle has higher opportunity if family labor and expectation to increase income is more increasing. Contrastingly, the improvement of business scale has negative correlation with cattle ownership, education level, annual income, and business risk. It shows, then, that the lesser total raised cattle, lower education, smaller annual income and business risk, the higher the opportunity to improve business scale. Also, the conclusion from the previous study described that business scale has significantly positive association to the welfare extent of farmers and technological adoption of beef cattle industry [31,32]. Therefore, efforts in increasing business scale of beef cattle, mainly the backyard farming, is necessarily supported, such as by improving access to bank or financial institutions, non-collateral credit or low interest rate of credit.

The raising period of beef cattle was depended on age of the raised feeder cattle. The younger the age of feeder cattle, the longer the fattening period of beef cattle to obtain the final weight to be sold. Table 3 displays that the raising period

of beef cattle was averagely 124 days, and the small portion of other farmers fattened more than six months with the highest raising period of 365 days. In detail, the fattening period of beef cattle was varied according to age of the raised feeder cattle, such as: 1) 8-9 months if the age of feeder cattle was less than 1 year; 2) 6-7 months if the age of feeder cattle was 1-2 years, and 3) between 4-6 months if the age of feeder cattle was 2-2.5 years [15].

Feed was one of the significant factors in determining the success of beef cattle industry, besides seed and management. The feed given in the research site consisted of green and concentrate. Specifically, the green feed used was elephant grass, and energy sources were derived from bran and tofu dregs. Table 3 demonstrates that farmers provided the green feed by 29.7+8.3 kg/cattle/day, and the concentrate was 2.5+2.0 kg/cattle/day. It was given 2-3 times/day. The research performed by [33] showed that the green feed and concentrate have positive correlation with weight gaining.

3.3. Analysis of the fattening industry of beef cattle

The calculation of the fattening industry of beef cattle during one year fattening program was 124 days for one cattle. Moreover, the analysis of the fattening industry was performed by averagely each respondent or it was equal with three cattle within the similar period. The average structure of expenses and income obtained by farmers within one fattening period is shown in the following Table 4.

Particularly, the main operating costs for the fattening industry of beef cattle was expensed for purchasing feeder cattle over cash costs, which was 91.41%. While, if based on the analysis of total costs, it was 62.58%. Subsequently, the largest expenses were labor (12.78%) and feed (18.72%). According to the analysis of cash cost, the following largest expenses were concentrate (5.55%) and fuel for transportation (1.66%). The structure of expenses dominated by purchasing of feeder cattle, feed, and labor is, then, in the same vein with the previous research, concluding that the expense of feeder cattle is the main operating costs of the fattening industry of beef cattle, where its percentage is 64.25-86.42%, and the costs of feed is between 12.46%-29.73%[34].

Those costs were the main expenses, so farmers necessary considered to make their fattening industry more efficient, by taking into account that farmers' income was more sensitively influenced by those costs. In the previous research, it concluded that the price of feeder cattle has negative correlation with income, so the increasing price of feeder cattle will eventually decrease farmers' income. The increasing of purchasing price of feeder cattle by one unit will decrease income as 0.98 unit [28].

The income analysis demonstrates that the fattening industry of beef cattle could result benefit. In detail, the benefit value obtained by farmers based on total costs was IDR 404,217 /cattle/period. This profit was slightly smaller than the profit based on cash costs, achieving IDR. 4,091,213/cattle/period. Thus, totally, the fattening industry of beef cattle was feasible to perform due to its positive income value.

Table 4 Structure of average cost and income of the fattening industry of one beef cattle and one farmer in the Regency of Minahasa Tenggara

Production input/output	Quantity	Price (IDR/unit)	Value (IDR)	% of cash costs	% of total costs
Income (A) Sales of cattle	1 cattle	12,108,714	12,108,714		
Cash cost					
Feeder cattle	1 cattle	7,324,856	7,324,856	91.41	62.58
Concentrate	278 kg	1,600	444,800	5.55	3.80
Tofu dregs	15 kg	425	6,375	0.08	0.05
Worm medicine	1.2 tablet	14,500	17,400	0.22	0.15
Vitamin	6.5 cc	250	1,625	0.02	0.02
Salt	0.5 kg	5,700	2,851	0.03	0.02
Mineral mix	1.0 kg	9,000	9,000	0.11	0.08
Fuel	12.70 liter	10,500	133,350	1.66	1.14

Cages and tools depreciation			76,640	0.95	0.65
Leasing land			604	0.01	0.01
Total cash costs (B)			8,017,501	100.00	
Calculated cost					
Family labor	18.7 Man days	80,000	1,496,000		12.78
Grass feeding	4,382 kg	500	2,191,000		18.72
Total calculated costs (C)			3,687,000		
Total costs (D = B+C)			11,704,501		100.00
Income of cash costs (A-B)			4,091,213		
Incomes of total costs (A-D)			404,217		
R/C to cash costs (A/B)			1.51		
R/C to total costs (A/D)			1.03		
Average income of cash cost per farmer (3 cattle)			12,271,497		
Average income of cash cost per farmer (3 cattle)			1,212,651		

The R/C analysis based on cash costs or total costs displays that the fattening industry of beef cattle in the Regency of Minahasa Tenggara was feasible to perform by the R/C value of 1.51 for cash costs and 1.03 for total costs, respectively. Both respective value of 1.51 and 1.03 depict that every expense of one Rupiah for cash costs would obtain additional incomes as IDR 1.51. Additionally, every expense of total costs for one Rupiah would achieve additional income by IDR 1.03. However, if both R/C value was compared, the value of RC ratio for cash costs was higher than the value of RC ratio for total costs. This was due to the RC ratio of total costs had higher total expenses since it had inserted expenses for feed and labor, where farmers did not actually pay for such expenses.

Furthermore, the R/C value to total costs, which was only 1.03, indicates that farmers had risk of loss if there was a change in the input costs or production declining. In doing so, farmers can perform some efforts to solve it, such as production increasing by providing nutritious feed, so that the final weight of beef cattle can be higher than the currently average output (359 kg/cattle). This finding, then, is in line with the previous research, stating that RC ratio or benefit cost ratio (BCR) of the fattening industry of beef cattle is more than one [35].

The assumption of the production function in the fattening industry of beef cattle in the research site under the Stochastic frontier model with the Maximum Likelihood Estimation (MLE) model is displayed in the following Table 5.

Table 5 depicts that the production function by the MLE method was better and suitable with the field condition. It was represented by the value of log-likelihood function by the MLE method by 24.480, which was higher than the value of log-likelihood function with the OLS method by 18.201. Also, the analysis results demonstrates that the distribution of inefficiency term error was normally allocated. It was due to the squared sigma value was small, which was 0.01. Regarding none of inefficiency effects reflected by the gamma value, it can be concluded that the error term in the production function was derived from the inefficiency effects. This was based on the gamma value, approaching one by 0.988. The gamma value by 98.8% means that 98.8% of the error term in the production function was sourced from the inefficiency effects, and the rest was derived from climate, weather, diseases, and so forth.

Table 5 Assumption of production function of the Stochastic frontier-Cobb Douglas in the fattening industry of beef cattle in the Regency of Minahasa Tenggara

Variables	Coefficient	Error standard	t-ratio
Constanta	-0.506	0.681	-0.616
Labor	0.275*	0.042	4.728
Green feed	0.469*	0.961	4.823
Initial weight	0.841*	0.133	7.181
Sigma-squared	0.01		
Gamma	0.988		
Log-likelihood function OLS	18.201		
Log-likelihood function MLE	24.480		
LR test of the one-sided error	11.530		

Note: * having the real impact on α = 0,01

The impacts of respectively independent variables can be noticed by performing t-test. Based on the results of t-test, the respectively independent variables had the real effect on the final weight of beef cattle. It was shown by the value of t-calculation of labor (4.728), green feed (4.823), and the initial weight of beef cattle (7.181) was higher than the value of t-table by 2.81 at α=1% and df=56.

Coefficient of labor outflow was 0.275, stating that the increasing of labor outflow by 10% would improve the production of beef cattle by 2.75%. Similarly, it is in line with the study of [15] and [36] arguing that the increasing of labor can improve business production. Meanwhile the coefficient of green feed was 0.469, depicting that the green feed by 10% would increase the final weight of cattle by 4.69%. Further, the coefficient of the initial weight was 0.841, describing that the increasing of the initial weight by 10% would increase the production of beef cattle by 8.41%.

The efficiency distribution of the fattening industry of beef cattle can be seen in the following Table 6.

Table 6 Efficiency distribution of technical production in the fattening industry of beef cattle in the Regency of Minahasa Tenggara

Efficiency distribution	Total (farmers)	(%)
0.50-0.69	33	55.4
0.70-0.89	25	41.4
>0.90	2	3.2
Total	60	100.00
Average	0.670	
Minimal	0.538	
Maximal	0.967	

From Table 6 above, it shows that the distribution of the highest efficiency was within the range of 0.50-0.69, which was 33 farmers or 55.4%; while the lowest was between > 0.90 by 3.2%. Previous study postulated that a business is efficient if the efficiency index value is higher than 0.7 [37,38]. Based on the results, 33 farmers had not been efficient in their business. It was proven by smaller inefficiency value than 0.7, and 27 farmers had been efficient in the fattening industry of beef cattle. The average of technical efficiency value of beef cattle was 0.670. Thus, it can be concluded that the business of beef cattle had not been efficient since its average value was under 0.70.

The value also depicts that there were opportunities to improve the efficiency of beef cattle industry by 33.0%. The increasing of such efficiency can be performed by improving management in the affecting independent variables, such

as labor outflow, green feed, and the initial weight of beef cattle, or improvement of the factor of inefficiency sources. Significantly, the most considered issue is condition of the given feeder cattle and feed. The selected feeder cattle are thin yet healthy. This aims to obtain higher weight during fattening process if it is compared with fat feeder cattle. Also, the giving of feed does not only satisfy its total intake, but also consider the quality of feed. Then, the available nutrition for life and the meat formation is more guaranteed.

4. Conclusion

The fattening industry of beef cattle in the Regency of Minahasa Tenggara has provided benefits for farmers. However, the income of total costs is relatively small (R/C approaching one), so farmers have indication to suffer loss if there is increasing of input price or production decreasing. The condition is in line with analysis of technical efficiency, depicting those farmers have not been efficient technically. Thus, farmers necessary perform efficiency of the utilized production resources management or increase their production output. The production of beef cattle industry in the Regency of Minahasa Tenggara has been influenced by labor, green feed, and the initial weight of beef cattle.

Compliance with ethical standards

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Disclosure of conflict of interest

None of the conflicts of interest among the research teams exists.

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