DOI: http://dx.doi.org/10.25181/jppt.v23i2.2615
Jurnal Penelitian Pertanian Terapan Vol. 23 (2): 183-196
Website: http://www.jurnal.polinela.ac.id/JPPT

pISSN 1410-5020
eISSN 2407-1781

Efisiensi Teknis, Ekonomis, dan Alokatif Usahatani Jagung di Kabupaten Lampung Selatan

Technical, Economic, and Allocative Efficiency of Corn Farming In South Lampung Regency

Sri Puji Lestari[1*], Dyah Aring Hepiana Lestari[2], Zainal Abidin[3], Fembriarti Erry Prasmatiwi[4]

[1] Department of Agribusiness, Faculty of Agriculture and Animal Science Universitas Muhammadiyah Kotabumi
[2] Department of Agribusiness, Faculty of Agriculture, Universitas Lampung
[3] Department of Agribusiness, Faculty of Agriculture, Universitas Lampung
[4] Department of Agribusiness, Faculty of Agriculture, Universitas Lampung
[*]E-mail : sri.puji@umko.ac.id

ABSTRACT

South Lampung Regency is the center of corn production in Lampung Province. However, the low productivity of corn due to the suboptimal allocation of production factors has affected the efficiency of corn farming production. This research aims to analyze the level of technical, allocative, and economical efficiency corn farming in South Lampung Regency. Two subdistricts in South Lampung Regency—Penengahan and Ketapang—that are major corn production hubs were used for data collection. The data collected in this study are primary and secondary. Primary data was obtained using a survey method, namely by directly interviewing corn farmers using a list of questions (a questionnaire) that has been provided. Secondary data were obtained from institutions or agencies related to this research. A simple random sampling method was used to choose up to 71 maize producers for the sample size. The Stochastic Frontier Cobb-Douglas production function is used in data analysis and is processed by the Frontier 4.1 application. The results show that corn farming was technically efficient but not allocatively or economically efficient.. The use of inputs appropriately and efficiently will reduce the use of excessive inputs, which can then be allocated to the purchase of other inputs that are less used, with the aim of achieving allocative and economic efficiency.

Keywords : *corn, efficiency, South Lampung, sthocastic frontier*

Disubmit : 30 Juli 2022; **Diterima :** 4 Mei 2023; **Disetujui :** 30 Mei 2023

INTRODUCTION

Increasing of broiler farming business has triggered an increase in animal feed industry activities. The raw material for the animal feed industry is corn. The total use of corn for animal feed industry activities in 2012 was 4.32 million tons and increased to 5.22 million tons in 2016 (Kementerian Pertanian, 2017). This shows that corn farming has prospects for continuous development, considering that corn has a fixed market.

The efforts to increase corn production have been carried out, but the results have not been as expected. This is due to efficiency problems in corn farming. Optimizing the use of production inputs is expected to be able to produce maximum corn production. Three concepts of efficiency in farming activities are: technical, economical, and allocative efficiency. Technical efficiency is capability of farming to produce maximum output from a combination of used inputs, while allocative efficiency is capability of farming activities to use inputs optimally to produce a certain amount of output. Economical efficiency is a combination of technical and allocative efficiency.

According to Fadwiwati & Tahir (2013), corn production can be increased by: the use of the recommended amount of fertilizer, the use of prime seeds, the use of pesticides, and labor. One of the problem in corn farming in South Lampung Regency is the problem of soil fertility. There has been a decrease in organic matter on sloping land due to intensive soil erosion. In fact, corn cultivation requires high P elements. The number of seeds, organic fertilizers, NPK fertilizers and labor are the variables that affect the increase in hybrid corn farming production in Madura Island. Although corn growing has been technically efficient, it has not been alocativelly and economically efficient.. This is caused by the use of inputs that are not proportional to the recommended dose (Firdaus & Fauziyah, 2020).

The research of Sahara et al. (2019), shows that the variables that affect the production of corn farming in Wirosari Village (Kendal) are planting area, seeds, urea fertilizer, phonska fertilizer, and labor. Age, education, and experience of the farmer are among the elements that affect the degree of technical inefficiency. Corn farming has not been technically efficient because the average technical efficiency is 0.57. This shows that the allocation of inputs has not been efficient and the implementation of technological innovations is still low.

This study examines the level of technical, economic and allocative efficiency of corn farming in South Lampung Regency. The variables that are thought to have an effect on corn production to be studied are land area, seeds, element N, element P, element K, pesticides, and labor. Fertilizer variables are distinguished for each nutrient element. Factors thought to influence the level of technical inefficiency in corn farming are the age of the farmer, the number of family members, participation in counseling and access to credit. Based of the description, the purpose of this study is to evaluate the technical, economical, and allocative effieciency of corn cultivation in South Lampung Regency.

RESEARCH METHODS

The study used a survey methodology. South Lampung Regency served as the site of this study's research. A purposeful selection was made for the research region, taking into mind that South Lampung Regency is one of the major hubs for corn production in Lampung Province.

Table 1. Data on corn production and harvested land by sub-district in South Lampung Regency in 2017

Districts	Production (Ton)	Harvest Area (Ha)
Natar	63.587,90	2.252
Jati Agung	42.631,40	8.230
Tanjung Bintang	43.773,50	8.292
Tanjung Sari	27.484,40	5.405
Katibung	53.960,20	10.212
Merbau Mataram	15.817,50	2.985
Way Sulan	6.591,90	1.248
Sidomulyo	33.333,50	6.563

Candipuro	22.516,10	4.262
Way Panji	13.474,60	2.653
Kalianda	74.518,50	14.108
Rajabasa	1.895,20	352
Palas	5.801,20	8.645
Sragi	26.577,30	5.025
Penengahan	**98.573,00**	**18.655**
Ketapang	**78.461,10**	**14.846**
Bakauheni	23.464,70	4.355

Source : Lampung dalam Angka, 2018

Table 1 shows that Ketapang District and Penengahan District are the primary corn-producing subdistricts in South Lampung Regency. Therefore, this research was conducted in Ketapang District and Penengahan District , which are assumed to represent South Lampung Regency. The object of research is corn farmers who cultivate corn on dry land at the research location. The number of samples 71 peoples. Sample are selected by simple random sampling method. The information gathered for this study is both primary and secondary. Primary data was obtained using a survey method, namely by directly interviewing corn farmers using a list of questions (a questionnaire) that has been provided. Secondary data were obtained from institutions or agencies related to this research. The stochastic frontier Cobb-Douglas production function and the dual cost function from the homogeneous Cobb-Douglas production function are employed in the analytical method to address the study objectives.

Technical Efficiency and Inefficiency Analysis. The stochastic frontier Cobb-Douglas production function is used to study factors that affect corn output, technical efficiency, and factors that cause technical inefficiency. This function is used to determine the potential production of each farmer. The Cobb-Douglas Stochastic Frontier production function is converted to the following natural logarithmic linear form (Fadwiwati et al., 2014), then processed using the Frontier 4.1 program. :

$$\text{LnY} = \ln \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + v_i - u_i \text{ .... } (3)$$

Description :

- Y = actual production of dry shelled corn (kg)
- X_1 = land area (ha)
- X_2 = number of seeds (kg)
- X_3 = amount of N (kg) → Element N is calculated from the use of NPK and Urea fertilizers.
- X_4 = amount of P (kg) → Element P is calculated from the use of NPK an SP-36 fertilizers.
- X_5 = amount of K (kg) → Element P is calculated from the use of NPK fertilizers.
- X_6 = pesticide amount (gba)→ herbicides and insecticides
- X_7 = labor (HKP)→ 1 HKP = 7 hours of work/day
- v_i = unpredictable variables associated with environmental elements like weather, pests, and illnesses, as well as modeling flaws.
- u_i = random variable is non negative and is assumed to affect the level of technical inefficiency and is related to internal factors.
- β_0 = constant
- β_j = regression parameter/coefficient, j = 1,2,3,4,5,6, dan 7.

The expected parameter/coefficient value is positive, namely j > 0, because the addition of input will increase corn production. Measurement of the level of technical efficiency of corn farming using the following formula:

$$ET = \frac{E(Y|Ui, X_1, X_2, X_3, X_4, X_5, X_6, X_7)}{E(Y*|Ui=0, X_1, X_2, X_3, X_4, X_5, X_6, X_7)} \quad \ldots\ldots\ldots (4)$$

Description :

ET = technical efficiency

$E(Y|Ui, X_1, X_2, X_3, X_4, X_5, X_6, X_7)$ = observation output

$E(Y*|Ui = 0, X_1, X_2, X_3, X_4, X_5, X_6, X_7)$ = output limit (frontier)

The technical efficiency value is between $0 \leq ET \leq 1$.

Technical efficiency is only utilized for functions that have a specific number of outputs and inputs, and its value is inversely proportional to the value of the effect of technical inefficiency Coelli (1996) dalam Rohi, (2018) and Ismail et al., (2017). The effect of technical inefficiency is measured by the variable Ui, which has a normal distribution with N values and is considered to be independent. To determine the distribution parameter value (Ui) of the effect of technical inefficiency, the following formula is used:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + w_i \quad \ldots\ldots\ldots (5)$$

dimana :

U_i = technical inefficiency effect

Z_1 = farmer's age (years)

Z_2 = number of family members (person)

Z_3 = *dummy participation in counseling*

(1 = attending counseling, 0 = not participating in counseling)

Z_4 = *credit access dummy*

(1 = have access to credit, 0 = do not have access to credit)

Expected parameter/coefficient values : $\delta_1 > 0$, δ_2, δ_3 $\delta_4 < 0$. A positive coefficient indicates that this factor increases the technical inefficiency of farming. If the coefficient is negative, it indicates that this factor reduces the level of technical efficiency.

Allocative and Economic Efficiency Analysis. The dual cost function is derived from the homogeneous Cobb-Douglas production function to measure allocative efficiency and economy. This method has been used in several studies, there is Nursan (2016); Rohi (2018); Chiona et al. (2014); dan Abdulai et al. (2015). The Cobb-Douglas production function uses the following two inputs:

$$Y = \beta_0 X_1^{\beta 1} X_2^{\beta 2} \quad \ldots\ldots\ldots (6)$$

Input cost function:

$$C = P_1 X_1 + P_2 X_2 \quad \ldots\ldots\ldots (7)$$

The dual cost function is derived with the assumption of cost minimization with output constraints Y = Y_0 The dual cost function must be obtained from the value of the expansion path (expansion of business scale) through the langrange function as follows:

$$L = P_1 X_1 + P_2 X_2 + \lambda (Y - \beta_0 X_1^{\beta 1} X_2^{\beta 2}) \quad \ldots\ldots\ldots (8)$$

To obtain the values for X1 and X2 expansion paths, the langrange function is derived from the first order condition as follows:

$$\frac{dL}{dX_1} = P_1 - \lambda\ \beta_0\ \beta_1\ X_1^{\beta 1-1} X_2^{\beta 2} = 0 \quad \ldots\ (9)$$

$$\frac{dL}{dL_2} = P_1 - \lambda\ \beta_0\ \beta_2\ X_1^{\beta 1} X_2^{\beta 2-1} = 0 \quad \ldots\ (10)$$

$$\frac{dL}{d\lambda} = Y - \beta_0\ X_1^{\beta 2} X_2^{\beta 2} = 0 \quad \ldots\ (11)$$

From equations (9) and (10) the values of X1 and X2 expansion path are obtained, namely:

$$X_1 = \left(\frac{P_2}{P_1}\right)\left(\frac{\beta_1}{\beta_2}\right) X_2 \quad \ldots\ (12)$$

$$X_2 = \left(\frac{P_1}{P_2}\right)\left(\frac{\beta_2}{\beta_1}\right) X_1 \quad \ldots\ (13)$$

Then equation (13) is substituted into equation (11) to become:

$$Y = \beta_0\ X_1^{\beta 1}\left[\left(\frac{P_1}{P_2}\right)\left(\frac{\beta_1}{\beta_2}\right) X_1\right]^{\beta_2} \quad \ldots\ (14)$$

$$Y = \beta_0\ X_1^{\beta 1} P_1^{\beta 2} P_2^{-\beta 2} \beta_2^{\beta 2} \beta_1^{-\beta 2} X_1^{\beta 2} \quad \ldots\ (15)$$

$$X_1^{\beta_1+\beta_2} = \frac{Y}{\beta_0\ P_1^{\beta_2} P_2^{-\beta_2} \beta_2^{\beta_2} \beta_1^{-\beta_2}} \quad \ldots\ (16)$$

From equation (16), the input demand function for X1 and X2 can be determined, namely:

$$X_1 = \left[\frac{Y}{\beta_0\ P_1^{\beta_2} P_2^{-\beta_2} \beta_2^{\beta_2} \beta_1^{-\beta_2}}\right]^{\frac{1}{\beta_1+\beta_2}} \quad \ldots\ (17)$$

$$X_2 = \left[\frac{Y}{\beta_0\ P_2^{\beta_1} P_1^{-\beta_1} \beta_1^{\beta_1} \beta_2^{-\beta_1}}\right]^{\frac{1}{\beta_1+\beta_2}} \quad \ldots\ (18)$$

Equations X1 and X2 are substituted into the cost equation, to obtain a dual frontier cost function:

$$C^* = P_1\left[\frac{Y}{\beta_0\ P_1^{\beta_2} P_2^{-\beta_2} \beta_2^{\beta_2} \beta_1^{-\beta_2}}\right]^{\frac{1}{\beta_1+\beta_2}} + P_2\left[\frac{Y}{\beta_0\ P_2^{\beta_1} P_1^{-\beta_1} \beta_1^{\beta_1} \beta_2^{-\beta_1}}\right]^{\frac{1}{\beta_1+\beta_2}} \quad \ldots\ (19)$$

The ratio of the observed minimum total production costs (C*) to the actual total production costs (C) is what is known as the economic efficiency, and this is how the equation looks:

$$EE = \frac{C^*}{C} = \frac{E(C_i \mid \mu i = 0, Yi, Pi)}{E(Y_i \mid \mu i, Yi, Pi)} = E\left[\exp(Ui)/\varepsilon i\right] \quad \ldots\ (20)$$

Description :

EE is worth $0 \leq EE \leq 1$

Allocative efficiency (EA) of farming per individual is obtained from technical efficiency and economic efficiency as follows:

$$EA = \frac{EE}{ET} \quad \ldots\ (21)$$

EA is worth $0 \leq EA \leq 1$.

RESULTS AND DISCUSSION

Characteristics of Respondents. Table 1 describe that most of the farmers are of productive age (23-44 years), but the majority of their education is elementary school graduates. Most of the farmers' experience in corn farming is not too long, which is < 12 years. This shows that the knowledge and skills of farmers in corn farming are not very good. The agricultural family's number of dependents is not excessive. Mostly 3-4 people per family, so the burden of spending for family needs is not too big. The majority of the land used by farmers to grow corn is in the range of 0.25 to 1.17 ha. The area of land to cultivate corn depends on the amount of capital owned by the farmer and the land available for planting.

Table 1. Respondents' Characteristics

No	Item	Number of respondents (people)	Proportion (%)
1	Age of farmer		
	23-44 years	36	50.70
	45-66 years	34	47.89
	67-89 years	1	1.41
2	Academic level		
	< Elementary School	2	2.82
	Elementary School	48	67.61
	Junior high school	14	19.72
	Senior high school	6	8.45
	College	1	1.41
3	Farming experience period		
	1-12 years	36	50.70
	13-24 years	23	32.39
	25-36 years	12	16.90
4	Number of family dependents		
	≤2 peoples	27	38.03
	3-4 peoples	36	50.70
	≥5 peoples	8	11.27
5	Land size of farm (Ha)		
	≤0.50	21	29.58
	0.51-1.00	28	39.44
	>1.00	22	30.98

Source : Processsed data, 2019

Use of Corn Farming Input. According to Table 2, farmers do not use seeds in accordance with the suggested rate of 20 kg/ha. This is due to the high price of corn seeds. The average price of corn seeds reaches IDR 88,380.28 per kilogram. Urea fertilizer should be used at a rate of 250 kg per hectare, but farmers often use it at a rate of 544.48 kg per hectare. The use of Urea fertilizer is far above the recommendation because Urea fertilizer is a subsidized fertilizer so the price is the cheapest. In addition, farmers consider the use of Urea fertilizer to be very good for corn plants, because corn plants are greener. The use of SP-36 fertilizer is also excessive, that is as much as 243.53 kg/ha, even though the recommendation is 100 kg/ha. However, the use of NPK fertilizer is still less at 206.31 kg/ha compared to the recommended 250 kg/ha. Lack of use of NPK fertilizers causes corn plants to lack K elements, even though K plays a role in improving the quality of corn seeds.

Table 2. Use of inputs and amount of corn production

No	Input Type	Average Input Usage	Input Usage Recommendations	Input Price
1	Seed (Kg/ha)(Rp/Kg)	17.46	20	88,380.28
2	Fertilizer (Kg/ha)(Rp/Kg)			
	Urea	544.48	250	2,218.31
	SP-36	243.53	100	2,362.88
	NPK	206.31	250	2,695.24
3	Labor (HKP/Ha)(Rp/HKP)			66,338.03
	Land preparation	7.72		
	Tillage	8.94		
	Planting	13.17		
	Fertilization	11.73		
	Spraying	6.71		
	Harvest	9.95		
	Stripping and rafting	18.46		
	Shelling and wading	16.64		
	Corn Production (Kg/Ha)	5,324.16		

Source : Processsed data, 2019

Estimating the Stochastic Frontier Production Function of Cobb-Douglas. The South Lampung Regency corn farming production function model has seven inputs: land area, number of seeds, quantity of element N, quantity of element P, quantity of element K, quantity of pesticide, and quantity of labor. Element N comes from Urea and NPK fertilizers, where the N content in Urea fertilizer is 46% and the N content in NPK fertilizer is 15%. Element P were obtained from SP-36 fertilizer and NPK fertilizer, where the SP-36 fertilizer content was 36% and the P content in NPK fertilizer was 15%. Element K comes from NPK fertilizer, where the K content in NPK fertilizer is 15%. Calculation of the amount of element N used by each farmer was obtained from the use of Urea and NPK fertilizers per farmer. Element N from Urea fertilizer is 46% of the average use of Urea fertilizer per farmer, while the amount of element N from NPK fertilizer is 15% of the average use of NPK fertilizer per farmer. The calculation of the amount of element P used by each farmer is 36% of the average use of SP-36 fertilizer per farmer, while the P amount of NPK fertilizer is 15% of the average use of NPK fertilizer per farmer. The total use of P fertilizer per farmer is element P from SP-36 fertilizer plus element P from NPK fertilizer. Calculation of the amount of element K used by each farmer is 15% of the average use of NPK fertilizer. Estimating the Stochastic Frontier Cobb-Douglas production function model using the Maximum Likelihood Estimator (MLE) method with the help of the Frontier 4.1 program. The results of the approximation of the Stochastic Frontier production function are presented in Table 3. The significant of the effect of each variable is based on two levels of significant, namely the 1% and 5% significant levels. The use of these two levels of significant shows that a variable with a significant level of 1% is more influential than a variable with a significant level of 5%.

According to Table 3, the gamma value of 0.97 has a considerable impact with a 99% significance level. which means that 97.6% of the variation in production between farmers is caused by differences in technical efficiency, while the remaining 2.4% is due to stochastic effects that are out of the model, there is: climate influence, natural disasters, pests and plant diseases, and others. This study has a gamma value that is smaller than the research of Sahara et al., (2019) on corn farming in Kendal Regency that is 0.99, but it is greater than the gamma value in Rohi (2018) research on corn farming in East Kupang District, Kupang

Regency which is equal to 0.68. The value of the Generalized Likelihood Ratio (LR) in the stochastic frontier corn production model is 19,179. Compared to the Code and Palm tables, this value is higher, which is 11.91 which is significant at = 5%. This demonstrates the effects of farming's technical efficiency and inefficiency.

Tabel 3. The results of the estimation of the Stochastic Frontier production function on corn farming in South Lampung Regency

Variable	Coefficient	Standard-error	t-ratio
Intersep	5,378	0,605	8,887
Land area (X1)	0,249**	0,112	2,229
Seed (X2)	0,373**	0,145	2,577
Fertilizer N (X3)	0,111	0,089	1,255
Fertilizer P (X4)	0,021	0,066	0,317
Fertilizer K (X5)	0,014***	0,005	2,701
Pesticide (X6)	-0,026	0,063	-0,420
Labor (X7)	0,392***	0,106	3,688
Sigma squared	0,802	0,439	1,827
Gamma	0,976***	0,012	80,284
LR Test			19,179****

Description : *** Significant level with $\alpha = 1\%$ (t tabel = 2,66028)
** Significant level with $\alpha = 5\%$ (t tabel = 2,00030)

Land area (X1) has a significant effect with significant level 95% and a coefficient value of 0.249. If the land area is added by 1%, it will increase corn production by 0.249%. This is in accordance with research by Nursan (2016); Fadwiwati & Tahir (2013); Suprapti et el.(2014); Sahara et al. (2019); Rohi (2018); Sisay et al., (2015); Bati et al. (2017); Prasetyo & Fauziyah (2020); Sihlongonyane et al. (2014); Musaba & Bwacha (2014); and Abdulai et al. (2015), that land area has a positive effect on corn production. Thus corn production can be increased by escalate the area of arable land for corn farming.

The number of seeds (X2) has a significant effect with significant level 95%, and the coefficient value is 0.373. This shows that, increasing the number of seeds by 1% will increasing corn production by 0.373 %. These results are in accordance to research by Situmorang et al. (2020); Nursan (2016); Rohi et al. (2018); Abdulai et al. (2015); Bati et al. (2017); and Sahara et al. (2019), that corn output is positively impacted by the amount of seeds. The recommended use of corn seed is 20 kg/ha (Paeru & Dewi, 2017), but the average use of seed by farmers is 17.46 kg/ha. Increasing the use of corn seeds in appropriate with the recommended dose can increase corn production at the research site. The use of corn seeds which is still below the recommendation is due to the high price of corn seeds, with an average price of around Rp. 98,486.49 per kilogram.

Element K (X5) is significantly influential, with a significant level of 99% and a coefficient value of 0.014. If the amount of element K is increased by 1%, it will increase corn production by 0.014%. Increasing element K by using NPK fertilizer (K content 15%) The average use of kalium (K) elements by farmers is 30.95 kg/ha, while the recommended K element is 37.5 kg/ha. The function of element K is to improve the quality of crop yields, increase plant resistance to pests, diseases, and drought, facilitate photosynthesis, and harden plant stems. The highest K element is found in KCl fertilizer, which is as much as 60%. However, KCl fertilizer is not subsidized, so farmers prefer to use NPK fertilizer, which contains small amounts of K elements (15%).

The number of workers (X8) has significantly influential with significant level of 99%, with a coefficient value of 0.392. If the use of labor is added by 1%, it will increase corn production by 0.392 %. This is in appropriate with the research of Fadwiwati et al. (2014); Sahara et al. (2019); Prasetyo & Fauziyah (2020); Sisay et al. (2015); Bati et al. (2017); and Nursan (2016). The addition of labor can be done in soil processing activities. The majority of farmers in the research location carry out farming activities without tillage. Farming without tillage is carried out because tillage activities require a lot of labor, so it will increase labor costs if tillage is done manually. The use of agricultural machinery such as plows and tractors has not been evenly distributed, because the number of plows and tractors owned by farmer groups is limited, so farmers must take turns to use them.

The estimation of the Stochastic Frontier production function indicate that optimal land use is required. The use of seeds and K elements in accordance with the recommendations is expected to increase corn production. In addition, it is necessary to optimize the use of labor for land management activities so that the land is ready to be planted and can provide maximum results.

Corn Farming Technical Efficiency and Inefficiency. Technical efficiency in this research was analyzed by using the Cobb-Douglas Stochastic Frontier production function, namely by using the Maximum Likelihood Estimate (MLE) estimation method, with Frontier 4.1 program. The distribution of technical efficiency is divided into 3 categories based on the area of arable land, namely narrow, medium and large land.

Table 4. Distribution of corn farming technical efficiency based on cultivated area

Scatter of Technical Efficiency	Number of farmers							
	Narrow Field ≤ 0.50 ha		Medium Field 0.51-1.00 ha		Large Field > 1.00 ha		Total	
	Amount Of farmer (people)	Percentage (%)	Amount Of farmer (people)	Percentage (%)	Amount of farmer (people)	Percentage (%)	Amount of farmer (people)	Percentage (%)
0.31 - 0.40	0	0	3	10.71	0	0	3	4.23
0.41 - 0.50	0	0	0	0	1	4.55	1	1.41
0.51 - 0,60	1	4.76	1	3.57	0	0	2	2.82
0.61 - 0.70	3	14.29	2	7.14	2	9.09	7	9.86
0.71 - 0.80	3	14.29	2	7.14	2	9.09	7	9.86
0.81 - 0.90	4	19.05	13	46.43	9	40.91	26	36.62
0.91 - 1.00	10	47.62	7	25.00	8	36.36	25	35.21
Total	21	100.00	28	100.00	22	100.00	71	100.00
Average	0.84		0.79		0.83		0.82	
Minimum	0.54		0.36		0.49		0.36	
Maximum	0.94		0.96		0.95		0.96	

Table 4 shows that the technical efficiency's average level on medium land is the lowest, while the highest average technical efficiency on narrow land is 0.84 which exceeds the overall average technical efficiency. So there is a tendency that the narrower the corn farming area, the more efficient it will be technically, because the production factors uses is not too much, so it is still within the limits of the ability of farmers to provide production factors. The value of the technical efficiency ranges from 0.36 - 0.96, with an average of 0.82. The average technical efficiency > 0.70 indicates that most of the corn farming has been technically efficient. So corn farming in South Lampung Regency can increase technical efficiency at the level of technology and existing inputs by 15% (1-0.82/0.96). The achievement of different levels of technical efficiency in each farmer shows the level of mastery and application of technology that differs between farmers.

Table 5. The results of the estimation of the parameters of the technical inefficiency effect on the production function of the Stochastic Frontier corn farming in South Lampung Regency.

Variable	Coefficient	Standar-error	t-ratio
Intersep	-15,579	7,731	-2,015
Umur Petani (Z_1)	2,617**	1,178	2,221
Jumlah Anggota Keluarga (Z_2)	-0,217**	0,105	-2,063
Dummy Keikutsertaan Penyuluhan (Z_3)	0,661	0,421	1,572
Dummy Akses Kredit (Z_4)	2,886	1,734	1,664

Description : ** Significant level with α 5 % (t tabel = 2,00030)
Source : Processed Data, 2019

Based on Table 5, the coefficient of farmer age, participation in extension, and dummy access to credit are positive and the factor coefficient of the number of family members is negative. The age of the farmer and the number of family members have a 95% significant impact on the inefficiency of maize growing. The farmer's age factor has a positive effect, meaning that the older the farmer, the higher the inefficiency of corn farming. This is related to the physical ability of farmers which decreases with age. Deteriorating physical conditions can increase the use of labor outside the family, so that it will increase the cost of farming. This is in accordance to the research by Sahara et al. (2019), on corn farmers in Kendal Regency and research by Chiona et al. (2014) on corn farming in the Central Province of Zambia, which states that the farmer age variable has a positive effect on corn farming inefficiency. The factor of the number of family members has a negative effect on the inefficiency of corn farming, meaning that farmers who have more family members will decrease the level of technical inefficiency or increase the technical efficiency of corn farming. Corn farming activities require a lot of labor, because of the many activities that must be carried out from planting preparation to harvesting. The large number of family members can be used to help corn farming activities. The use of labor in the family will reduce the cost of farming corn. This is in accordance with the research of Anggraini et al. (2016) regarding the efficiency of cassava farming production in Central Lampung Regency, Yoko et al. (2017) regarding the efficiency of rice farming production in Central Lampung Regency, and Sihlongonyane et al. (2014) on the economic efficiency of corn farming.

Economic Efficiency and Allocative Efficiency of Corn Farming. Allocative and economical efficiency were analyzed from the input side using input prices prevailing at the farm level, by deriving the stochastic frontier production function by using equation (17), the equation of the frontier cost function was obtained as follows:

$$\text{Ln } C = 0{,}962 + 0{,}862 \text{ Ln } Y + 0{,}215 \text{ Ln } P_1 + 0{,}322 \text{ Ln } P_2 + 0{,}096 \text{ Ln } P_3 + 0{,}018 \text{ Ln } P_4 + 0{,}012 \text{ Ln } P_5 + 0{,}338 \text{ Ln } P_6$$

Description :

- C = corn production cost (Rp)
- Y = corn production (Kg)
- P_1 = average land rent (Rp/Ha)
- P_2 = the average price of corn seeds (Rp/Kg)
- P_3 = the average price of N (Rp/Kg)
- P_4 = the average price of P (Rp/Kg)
- P_5 = the average price of K (Rp/Kg)
- P_6 = labor average wage (Rp/HKP)

Economic efficiency's level of corn farming in South Lampung Regency were showed in Table 6.

Table 6. Distribution of corn farming economic efficiency based on cultivated area

Scatter of Economic Efficiency	Number of farmers							
	Narrow Field ≤ 0.50 ha		Medium Field 0.51-1.00 ha		Large Field > 1.00 ha		Total	
	Amount Of farmer (people)	Percentage (%)	Amount Of farmer (people)	Percentage (%)	Amount of farmer (people)	Percentage (%)	Amount of farmer (people)	Percentage (%)
0.11 - 0.20	0	0	3	10.71	2	9.09	5	7.04
0.21 - 0.30	20	95.24	25	89.29	19	86.36	64	90.14
0.31 - 0,40	1	4.76	0	0	1	4.55	2	2.82
Total	21	100	28	100	22	100	71	100
Average	0.23		0.22		0.22		0.22	
Minimum	0.21		0.20		0.20		0.20	
Maximum	0.34		0.29		0.34		0.34	

Source : Processed Data, 2019

Table 6 shows that the average economic efficiency of corn farming is 0.22 with the value of economic efficiency in the range of 0.20 – 0.34. If farmers want to get maximum economic efficiency, they must save costs by (1-0.22/0.34) which is 35 percent. The value of economic efficiency based on land area shows that narrow land area has a higher average value of economic efficiency compared to narrow land and medium land. This is because the ability of farmers to reduce farm production costs is higher than farmers with larger lands. Narrow land area will make it easier for farmers to manage land, where farming on narrow land does not require too much labor, so farmers can maximize the use of labor in the family. In addition to saving on the use of labor, farmers can save on the use of herbicides. Narrow land makes it easier for farmers to control weed growth, weeds can be eradicated manually by hoeing. Based on the average value of the overall economic efficiency, which is 0.70, it can be seen that corn farming in South Lampung Regency is not yet economically efficient. The cause of the economic inefficiency is that corn farming requires a large amount of labor, seeds, and fertilizers, while the price of seeds and labor is quite high. The fertilizer subsidy policy was able to reduce the production costs of corn farming (Lestari et al., 2020), but resulted in the application of fertilizers outside of the recommended dosage.. In addition, the unstable price of corn causes the income of corn farmers to be uncertain.

Tabel 7. Distribution of corn farming allocative efficiency based on cultivated area

Scatter of Allocative Efficiency	Number of farmers							
	Narrow Field ≤ 0.50 ha		Medium Field 0.51-1.00 ha		Large Field > 1.00 ha		Total	
	Amount Of farmer (people)	Percentage (%)	Amount Of farmer (people)	Percentage (%)	Amount Of farmer (people)	Percentage (%)	Amount Of farmer (people)	Percentage (%)
0.21 - 0.30	16	76.19	19	67.86	17	77.27	52	73.24
0.31 - 0.40	5	23.81	6	21.43	3	13.64	14	19.72
0.41 - 0.50	0	0	0	0	2	9.09	2	2.82
0.51 - 0.60	0	0	3	10.71	0	0.00	3	4.23
Total	21	100	28	100	22	100	71	100

Average	0.28	0.30	0.27	0.28
Minimum	0.23	0.23	0.22	0.22
Maximum	0.39	0.59	0.43	0.59

Based on Table 7, the level of allocative efficiency of corn farming is quite low, with an average of 0.28. If farmers want to get maximum allocative efficiency, they must save costs by (1- (0.28/0.59)x100), which is 53 percent. Based on the area of land, the average allocative efficiency on narrow land is the same as the average allocative efficiency of all respondent farmers. The average allocative efficiency on medium land was 7.1 percent higher than the average allocative efficiency for all respondent farmers. The average allocative efficiency on a large area of land is 3.6 percent lower than the average allocative efficiency of all respondent farmers. Farming on large land has the smallest average allocative efficiency, because the wider the area that cultivated, the more inputs are used, while farmers have not been able to allocate inputs by paying attention to the prices of the inputs themselves, not based on needs or recommendations. All respondent farmers have an allocative efficiency value of 0.70, which indicates that corn farming in South Lampung Regency is not allocatively efficient. Farmers use inputs while still paying attention to the prices of the inputs themselves. This can be caused by the low purchasing power of farmers, because farmers have to wait long enough to start farming in the first planting season (MT-I). The waiting period for planting is long enough that the income that farmers have from harvests in the previous II (MT-II) planting season has been used by farmers to meet their daily needs. So that when starting planting in the next growing season, farmers lack farming capital. As a result, there is excessive use of inputs that have low prices, namely Urea and SP-36 fertilizer, where the use of Urea fertilizer is 544.48 kg per hectare of land and the use of SP-36 fertilizer is 243.53 kg per hectare. Meanwhile, the recommendation for the use of Urea fertilizer by field extension officers in South Lampung Regency is 250 kg per hectare of land and for SP-36 fertilizer as much as 100 kg per hectare. The excessive use of Urea and SP-36 fertilizer is the effect of the subsidized price of Urea Fertilizer and SP-36 fertilizer which is cheaper than other fertilizers, so farmers use Urea fertilizer and SP-36 fertilizer in higher quantities. In addition to excessive use of fertilizers. The use of NPK fertilizer is less than the recommended amount, which is 206.31 kg per hectare, while the recommended use of NPK fertilizer is 250 kg per hectare. The existence of subsidy policies can have both negative and positive effects on farming activities. According to Lestari et al., (2022), the elimination of fertilizer subsidies is still able to provide benefits to corn farming, but the selling price of corn remains stable. The increase in allocative efficiency caused by farmers focusing on input prices is by using inputs as recommended, so that there is no excessive or insufficient use of inputs. This situation will increase the efficiency of the use of farming capital.

CONCLUSION

Land area, number of seeds, quantity of K elements, and labor force are inputs that significantly influence corn production in South Lampung Regency. Corn farming in South Lampung Regency is technically efficient; the average level of technical efficiency is 82%. Factors that can reduce the level of technical efficiency at the research location are the age of the farmer and the number of family members. However, corn farming is not efficient either economically or allocatively. The average level of economic efficiency is 22%, while the average level of allocative efficiency is 28%. The low level of economic and allocative efficiency is due to the high price of corn cultivation inputs, so farmers have not allocated inputs according to the recommended dosage.

Farmers are expected to use fertilizers in accordance with the recommendations or recommended doses, namely 250 kg of urea per hectare, SP-36 fertilizer of 100 kg per hectare and 250 kg of NPK fertilizer per hectare. The use of fertilizers according to the recommended dose can reduce farming costs and can increasing the efficiency of corn farming production in South Lampung Regency. Income certainty will encourage farmers to use inputs appropriately and efficiently. The use of inputs appropriately and efficiently will reduce the use of excessive inputs to be allocated to other inputs that are less used, with the aim of achieving allocative and economic efficiency.

REFERENCES

Abdulai, S., Nkegbe, P. K., & Donkoh, S. a. (2015). Technical efficiency of maize production in Northern Ghana. *African Journal of Agricultural Reseearch*, *8*(43), 5251–5259. https://doi.org/10.5897/AJAR2013.7753

Anggraini, N., Harianto, & Anggraeni, L. (2016). Efisiensi Teknis, Alokatif dan Ekonomi pada Usahatani Ubikayu di Kabupaten Lampung Tengah, Provinsi Lampung. *Agribisnis Indonesia*, *4*(1), 43–56. https://doi.org/https://doi.org/10.29244/jai.2016.4.1.43-56

Bati, M., Tilahun, M., & Parabathina, R. K. (2017). Economic efficiency in maize production in Ilu Ababor zone , Ethiopia. *Research Journal of Agriculture and Forestry Sciences*, *5*(12), 1–8.

Chiona, S., Kalinda, T., & Tembo, G. (2014). Stochastic Frontier Analysis of the Technical Efficiency of Smallholder Maize Farmers in Central Province, Zambia. *Journal of Agricultural Science*, *6*(10), 108–118. https://doi.org/10.5539/jas.v6n10p108

Fadwiwati, A. Y., Hartoyo, S., Kuncoro, S. U., & Rusastra, I. wayan. (2014). Analisis Efisiensi Teknis, Efisiensi Alokatif, dan Efisiensi Ekonomi Usahatani Jagung Berdasarkan Varietas di Provinsi Grorontalo. *Jurnal Agro Ekonomi*, *32*(1), 1–12. https://doi.org/http://dx.doi.org/10.21082/jae.v32n1.2014.1-12

Fadwiwati, A. Y., & Tahir, A. G. (2013). Analisis Faktor-Faktor yang Mempengaruhi Produksi dan Pendapatan Usahatani Jagung di Provinsi Gorontalo. *Jurnal Pengkajian Dan Pengembangan Teknologi Pertanian*, *16*(2), 92–101. https://doi.org/http://dx.doi.org/10.21082/jpptp.v16n2.2013.p%25p

Firdaus, M. wahyu, & Fauziyah, E. (2020). Efisiensi Ekonomi Usahatani Jagung Hibrida. *Agrisience*, *1*(1), 74–87. https://doi.org/https://doi.org/10.21107/agriscience.v1i1.7624

Ismail, M., Fariyanti, A., & Rifin, A. (2017). Efisiensi Teknis Usahatani Kedelai Pada Lahan Tadah Hujan Dan Lahan Kering Di Kabupaten Pidie Jaya, Aceh. *Forum Agribisnis*, *7*(1), 21–34. https://doi.org/10.29244/fagb.7.1.21-34

Kementerian Pertanian. (2017). *Outlook Tanaman Pangan dan Hortikultura* (I). Pusat Data dan Sistem Informasi Pertanian.

Lestari, S. P., Lestari, D. A. H., & Abidin, Z. (2020). Analisis Daya Saing Usahatani Jagung di Kabupaten Lampung Selatan. *Journal of Food System and Agribusiness*, *4*(2), 66–75. https://doi.org/https://jurnal.polinela.ac.id/JFA/article/view/1606

Lestari, S. P., Lestari, D. A. H., & Abidin, Z. (2022). Dampak Kebijakan Input terhadap Daya Saing Usahatani Jagung di Kabupaten Lampung Selatan. *Journal of Agriculture and Animal Science*, *2*(Nomor 1), 33–44. https://doi.org/https://doi.org/10.47637/agrimals.v2i1.512

Musaba, E., & Bwacha, I. (2014). Technical Efficiency of Small Scale Maize Production in Masaiti District , Zambia : A Stochastic Frontier Approach. *Journal of Economics and Sustainable Development*, *5*(4), 104–111.

Nursan, M. (2015). *Efisiensi dan Daya Saing Usahatani Jagung pada Lahan Kering dan Sawah di Kabupaten Sumbawa*. Institut Pertanian Bogor.

Nursan, M. (2016). Analisis Kelayakan Usaha Dan Faktor-Faktor Yang Mempengaruhi Produksi Usahatani Jagung Pada Lahan Kering Dan Sawah Di Kabupaten Sumbawa. *Jurnal Bisnis Tani*, *2*(2), 182–188.

Paeru, R. H., & Dewi, T. Q. (2017). *Panduan Praktis Budidaya Jagung* (F. A. Nurrohmah (ed.); Pertama). Penebar Swadaya.

Prasetyo, D. D., & Fauziyah, E. (2020). Efisiensi Ekonomi Usahatani Jagung Lokal Di Pulau Madura. *Jurnal Agriscience*, *1*(1), 26–38. https://doi.org/https://doi.org/10.21107/agriscience.v1i1.7505

Rohi, J. G. (2019). *Analisis Efisiensi dan Pendapatan Usahatani Jagung di Kecamatan Kupang Timur Kabupaten Kupang Nusa Tenggara Timur*. Institut Pertanian Bogor.

Rohi, J. G., Winandi, R., & Fariyanti, A. (2018). Analisis Faktor Yang Mempengaruhi Produksi Usahatani Jagung Serta Efisiensi Teknis Di Kabupaten Kupang. *Forum Agribisnis*, *8*(2), 181–198. https://doi.org/10.29244/fagb.8.2.181-198

Sahara, D., Kurniaty, E., Basuki, S., & Hermawan, A. (2019). Sebaran Efisiensi Teknis Berdasarkan Sumber Inefisiensi pada Usahatani Jagung Di Kabupaten Kendal, Jawa Tengah. *Jurnal Pangan*, *28*(2), 121–134. https://doi.org/10.33964/jp.v28i2.433

Sihlongonyane, M. B., Masuku, M. B., & Belete, A. (2014). Economic Efficiency of Maize Production in Swaziland: The Case of Hhohho, Manzini and Shiselweni Regions. *Research in Applied Economics*, *6*(3), 179. https://doi.org/10.5296/rae.v6i3.6045

Sisay, D., Jema, H., Degye, G., & Abdi Khalil, E. (2015). Technical, allocative, and economic efficiency among smallholder maize farmers in Southwestern Ethiopia: Parametric approach. *Journal of Development and Agricultural Economics*, *7*(8), 282–291. https://doi.org/10.5897/jdae2015.0652

Situmorang, H., Winandi, R., & Nuryartono, N. (2020). Tingkat Efisiensi Ekonomi Usaha Tani Jagung di Kabupaten Dairi Provinsi Sumatera Utara. *Journal of Agribusiness and Community Empowerment*, *3*(2), 83–91. https://core.ac.uk/download/pdf/335134875.pdf

Suprapti, Isdiana, Dwidjono Hadi Darwanto, J. H. M. dan L. R. W. (2014). Efisiensi Produksi Petani Jagung Madura Dalam Mempertahankan Keberadaan Jagung Lokal. *Agriekonomika*, *3*(1), 96–107.

Yoko, B., Syaukat, Y., & Fariyanti, A. (2017). Analisis Efisiensi Usahatani Padi di Kabupaten Lampung Tengah. *Jurnal Agribisnis Indonesia*, *2*(2), 127. https://doi.org/10.29244/jai.2014.2.2.127-140