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Analysis of The Efficiency of The Use of Production Factors And Income in Sugarcane Farming (Case Study of Independent Sugarcane Farming in Kedungjajang Sub-District, Lumajang District

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I N D E X I N G

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A B S T R A C T

This study aims to analyze the efficiency of the use of production factors and income in sugarcane farming (Saccharum officinarum L.) in Kedungjajang District, Lumajang Regency. The sampling was conducted using the Simple Random Sampling technique, involving 110 sugarcane farmers from a total population of 2,191 farmers. The analysis methods used include cost, income, and efficiency analysis (technical, allocative, and economic) with Frontier software version 4.1. The research results show that the total cost of sugarcane farming reaches Rp 40,150,900/Ha/Planting Season with a revenue of Rp 79,412,830/Ha/Planting Season, resulting in a net income for farmers of Rp 39,261,900/Ha/Planting Season. Most farmers (77.28%) have achieved technical efficiency in the interval of 0.95-1.00 with an average of 0.972. Meanwhile, 60% of farmers achieved optimal allocative efficiency and 62.73% of farmers achieved economic efficiency. Factors such as age, education, and farming experience do not significantly affect technical inefficiency. Sugarcane farming at the research location has the potential to be further developed by optimizing the allocation of production inputs such as seeds, fertilizers, herbicides, and labor to maximize farmers' income.

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INTRODUCTION

The agricultural sector is a driver of Indonesia's economy, contributing 13.35% to the national economy and absorbing 28.61% of the workforce (Panggabean, 2025). As an agrarian country, this sector is capable of preserving and conserving natural resources, providing livelihoods, and creating jobs for its people. The plantation subsector plays an important role as a source of non-oil and gas foreign exchange and is directly related to environmental preservation efforts, as well as providing jobs that can reduce economic growth disparities in Indonesia.

Sugarcane is one of the strategic key commodities from the plantation subsector, in addition to being a source of sugar and a staple food in Indonesia (Andri et al. 2016), sugarcane also has connections to other sectors. The growth of the food and beverage industry is a reason why the productivity of sugarcane commodities should be increased. Although the demand for sugar continues to rise, domestic sugar production has not been

able to meet the consumption needs of the public, with an average consumption of 6.000 million tons while production was only 2.278 million tons from 2015 to 2022 (Idealistiana et al. 2024).

East Java is the national center for sugarcane production, with an average planting area and sugar production during 2021 of 205,665 hectares and 1.09 million tons per year, contributing 47.34% to Indonesia's sugar production. According to the Directorate General of Estates, crystalline sugar production in East Java in 2022 reached 1.05 million tons, much higher compared to Lampung province which could only produce 801.82 thousand tons. In Lumajang Regency, the third largest contributor in East Java, sugarcane is spread across 20 districts, with the largest areas being Padang District (2,602.8 ha), Randuagung District (2,237.42 ha), and Kedungjajang District (1,998.9 ha).

The increase in the area of cultivation in Kedungjajang District is due to the shift of commodity from food crops to sugarcane. (Suwahyuni et al. 2022) states that this change in function is caused by the higher income from sugarcane farming with lower risks, higher selling value/collateral, lower production costs, and limited water availability. Nevertheless, small-scale sugarcane farmers still face technical and non-technical challenges, particularly in access to capital and production means, especially fertilizers, which results in low income levels for the farmers.

The income received by farmers serves as an indicator of agricultural success and the main determinant of the welfare of farming households (Fattah et al. 2022). Research (Hajar et al. 2019) shows that the net income of sugarcane farmers is IDR 22,020,000 per hectare, with production costs of IDR 11,580,000 and gross income of IDR 33,600,000. The issues of low farmer income include capital and the allocation of production factors that are not yet efficient. Kumbhakar et al. state three ways to maximize agricultural profits: maximizing production with a given set of inputs (technical efficiency), combining appropriate inputs at certain input price levels (allocative efficiency of inputs), and producing the correct price combination of outputs (allocative efficiency of production).

The constraints in the implementation of sugarcane farming in Kedungjajang District include limited capital, land area, technology, lack of mastery of cultivation techniques, low yield, and inefficient allocation of production factors. Farmers are unaware of the impacts of increasing or decreasing the use of production factors due to the absence of research on this matter. Therefore, research is needed on "Analysis of the Efficiency of Production Factor Usage and Income in Sugarcane Farming (Saccharum officinarum L)" in Kedungjajang District, Lumajang Regency, as input and consideration to improve the income of sugarcane farmers.

LITERATURE REVIEW

Production Factor of the Sugar Farming

With a 1.3% yearly population growth rate, Indonesia is the fourth most populous nation in the world. The consumption of sugar is rising at a pace of 4.3% per year in tandem with this rise. There is a significant discrepancy between sugar supply and consumption as a result of the enormous demand. In 2017–2018, Indonesia became as the world’s biggest importer of sugar. Farmers who grow sugarcane play a significant part in the production of sugar. They are dealing with issues including dwindling arable land and decreased sugarcane output. By generating money from farming, creating jobs, and bolstering rural economies,

sugar and sugarcane production play significant roles in the rural economy. The problem is figuring out the best ways to boost national sugar output in order to increase food security and farmers' income (Sulaiman *et al*, 2019).

Because of its widespread use in people's daily life and its industrial use for gastronomic and financial sustenance, sugarcane is considered an essential crop globally. Around the world, sugarcane is a significant industrial crop in tropical and subtropical areas. The Fair Labor Association estimates that sugarcane is grown on over 28.3 million hectares across more than 90 countries, with a global yield of roughly 1.69 billion tons. According to reports, South Africa's sugar business places a strong emphasis on socioeconomic development in rural areas by allocating resources, generating employment opportunities, supplying a source of income, and establishing networks for transportation and communication (Zulu *et al*, 2019).

Numerous and unclearly affecting elements of the external, related, and internal business environment are causing major changes in the economic activity growth of sugar production companies. The ongoing exploration and mobilization of underutilized resource potential, as well as the system of business relations, are linked to the growth of sugar factory economic activity. The management tools of organizational development must therefore be updated, first and foremost, in light of environmental factors, which are the cause of the conditions that hinder the growth of economic activity in sugar production processing organizations. Finding the important elements whose structure and interactions influence the outcome—profit per ton of sugar—is the first step in evaluating the potential for combining the interests of those involved in business operations in sugar production (Pirogova *et al*, 2021).

RESEARCH METHOD

This research was conducted in the Kedungjajang District, Lumajang Regency, which was selected using purposive sampling method as one of the centers for sugarcane cultivation (ranked third in planting area in Lumajang Regency), with the majority of the population working as sugarcane farmers. The study took place from August to October 2024. The research population includes farmers who are part of farmer groups as well as those who are not, from 12 villages in Kedungjajang District, totaling 2,191 sugarcane farmers. The sample determination used a Simple Random Sampling technique of 5% from the population, which consists of 110 farmers with the criteria: farmers who are both active and inactive in farmer groups and do not engage in partnerships with the nearest sugar factory, aged 30-75 years, have been farming for at least 5 years, planting the BL (Bululawang) sugarcane variety, and have land no more than 2 hectares. The largest number of samples came from Tempursari Village (19 respondents) and the smallest from Sawaran Kulon Village (1 respondent).

Data collection was carried out through two types of data: primary data obtained directly from the field through interviews to gather information on sugarcane farming costs, sugarcane prices, and farmers' behavior in facing sugarcane price risks; and secondary data from existing sources such as journals, BPS, and books related to the research topic. The data collection methods included direct interviews guided by questionnaires, observations with documented field conditions, and documentation as evidence of the research including data in the sub-district related to the research.

Analysis of Costs, Revenues, and Agricultural Business Income

Income analysis is used to determine whether a farming business is profitable or not. If the farming business is profitable, it can be continued, but if it is not profitable, management improvements are needed to make the cultivation more beneficial. This research is related to income because the unstable price of sugarcane can affect the income of farmers. The steps to obtain income results from sugarcane farmers are as follows: The determination of total costs in this study is obtained from the sum of total variable costs and total fixed costs, where these variable and fixed costs differ for each farmer, depending on their management methods and the extent of land owned by the farmer. The larger the area of land owned, the higher the total costs that must be incurred for the sugarcane farming, and vice versa.

The revenue from this research is focused on sugarcane commodities, which are cultivated using a stricken cultivation system and sold through direct cutting methods. Therefore, the farmers' revenue is calculated directly based on the farmers' selling price at that time, as the farmers surveyed are PTM (Independent Sugarcane Farmers) who sell their produce to middlemen, making their selling system direct cutting in the field. Most sugarcane farmers in this area do not cooperate with sugar mills, which increases the risk of price fluctuations. The income from sugarcane farming is calculated from the difference between the revenue of sugarcane farmers and the total costs incurred for farming until the harvest. The formula that can be used in this research is: (Sugiyono 2013)

$$\pi = TR - TC$$

$$\pi = (Py.Y) - (TFC + TVC)$$

Where:

Py = selling price of sugarcane (Rp/kg)
TR = total revenue (Rp)
TFC = total fixed costs (Rp)
π = sugarcane farming income (Rp/kg)
Y = quantity of product (kg)
TC = total costs (Rp)
TVC = total variable costs (Rp)

Efficiency analysis using Frontier software version 4.1.

The levels of technical efficiency, allocative efficiency, and economic efficiency of using production factors in sugarcane farming are formulated as follows: The levels of technical efficiency, allocative efficiency, and economic efficiency of using production factors in sugarcane farming are formulated as follows:

1. Technical Efficiency

$$ET = \frac{MPP}{APP} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where :

ET = Technical Efficiency
MPP = Marginal Physical Product
APP = Average Physical Product

Criteria:

If the ET value < 1, then the production factor is considered technically inefficient. If the

ET value > 1, then the production factor is considered not yet technically efficient. If the ET value = 1, then the production factor is considered technically efficient.

2. Allocative Efficiency

$$EA = \frac{NPM_{xi}}{BKM_{xi}} = \frac{B_{xi}\, Y/X_i \;\; P_Y}{P_{xi}} \quad \text{atau} \quad \frac{MPP \;.\; P_Y}{P_{xi}} = 1 \ldots\ldots 4$$

Description:

NPMxi = Marginal Product Value because using xi
BKMxi = Marginal Sacrifice Cost because using xi
Pxi = Price of production factor used.

Criteria:

$\frac{MPP \;.\; P_Y}{P_{xi}}$ < 1 1 means the use of production factors is inefficient, so the use of inputs needs to be reduced.

$\frac{MPP \;.\; P_Y}{P_{xi}}$ = 1 means the use of efficient production factors

$\frac{MPP \;.\; P_Y}{P_{xi}}$ > 1 means that the use of production factors is not efficient, so the use of inputs needs to be increased.

3. Economic Efficiency

$$EE = ET \times EH \ldots\ldots (5)$$

Description:
EE = Economic Efficiency
ET = Technical Efficiency
EH = Price Efficiency

Criteria:

EE > 1, meaning that maximum economic efficiency has not been achieved, thus the use of production factors needs to be increased to achieve efficiency.
EE < 1, meaning that the farming operation being conducted is not efficient, therefore a reduction in the use of production factors must be carried out.
EE = 1, meaning that efficient conditions have been achieved and are able to produce maximum profit.

RESULT AND DISCUSSION

Analysis of Sugarcane Farming Costs

The costs in sugarcane farming are the expenses that must be incurred during one sugarcane planting season, which consists of two types of costs, namely fixed costs and variable costs. Fixed costs are expenses incurred in one sugarcane planting season that are not affected by the amount of production produced. Fixed costs in sugarcane farming

include annual taxes or land rent and equipment depreciation costs. Meanwhile, variable costs are expenses that change according to the conditions on the field; the larger the land, the more variable inputs are needed. Variable costs incurred in sugarcane farming include the cost of purchasing sugarcane seedlings, the cost of purchasing fertilizers, labor costs, and harvesting and transport costs. The calculation of average farming costs can be seen in the table below.

Table 1. Total Cost of Sugarcane Farming for the Planting Season 2023-2024

No.	Description of Values	(Rp/Ha)
1.	Total Fixed Costs	20.086.000
2.	Total Variable Cost	20.037.800
Total Cost		40.150.900

Source: Processed primary data (2024)

Based on table 1, it is known that the amount of fixed costs is Rp 20,086,000 /Ha/Planting Season with a total variable cost of Rp 20,037,800/Ha/Planting Season, resulting in a total cost of Rp 40,150,900/Ha/Planting Season. This total fixed cost is incurred by independent sugarcane farmers in Kedungjajang District in one planting period, namely the planting season of 2023-2024, with an area of 1 Ha. One planting season ranges from 8 to 12 months, so in a year, sugarcane can only be planted once. Detailed calculations can be seen in Appendix 2 to Appendix 4. The total costs may vary from one planting season to another, because in farming there are unexpected conditions, which sometimes cause the costs incurred in farming to increase or decrease depending on the conditions in the field. For example, a condition that leads to a decrease in farming costs occurred during the 2023-2024 planting season, where many sample farmers claimed that they did not incur costs for irrigation, as there was rain during that planting season, therefore irrigation was solely from rainwater; this is one phenomenon that can reduce costs. The increase in sugarcane farming costs can actually be reduced by farmers through good cost management; however, the majority of sampled farmers do not calculate the amount of costs they incur, and they usually only realize the high expenses when harvest time arrives and their income turns out to be reduced. There are indeed some farmers who record their expenditures in farming, but they are few. Typically, those who keep track of their farming costs use them as a benchmark for future farming endeavors. Additionally, managing farming finances also requires knowledge and skills, which is why the level of education can influence farmers in conducting this management.

Analysis of Sugarcane Farming Income

Analysis of farm income is the multiplication of the production obtained with the selling price. The income received by sugarcane farmers in Kedungjajang District, Lumajang Regency can be seen in the table below.

Table 2. Income of independent sugarcane farmers in Kedungjajang District, Lumajang Regency, 2024

NO	Description	Amount
1.	Production (Kui/Ha)	883,15
2.	Price (Rp/Kui)	151.090
	Income (Rp)	79.412.830

Source: Processed primary data (2024)

The sugarcane farming income analyzed here is different from the income in other types of farming, because the income received is equal to the purchase price from the farmers. Based on calculations as shown in table 15 above, the average income from sugarcane farming is Rp 79,412,830 per hectare per planting season, or about 88.3 tons per hectare per planting season. This income is obtained based on a predetermined lump sum price set by the harvester with the farmers under a lump-sum system. This is in line with the opinion of (Syafa'at and Rohmatulloh 2018) which states that the cutting system involves purchasing by cutting in the field, where the crops being purchased are still in the field and ready to be harvested under an estimation system, for example, 1 hectare bought for a certain amount of money expected to yield a certain tonnage. In general, the earnings of each farmer in that district vary, depending on the size of land owned by the farmer, the quality of sugarcane, the sugar factory targeted by the harvester, and the average sugar prices applicable at that time. Farmers in this village are aware of the prices (earnings) from other farmers which they then use to negotiate with the harvester, even though the price information (earnings) from other farmers may not be valid or accurate. Hence, the farmers' ability to access information is crucial so that they do not feel disadvantaged by the prices formed through that negotiation process.

Farm income is the difference between the revenue received by farmers and the total costs incurred during one planting season. Sugarcane farmers can be said to profit if the revenue exceeds the total costs incurred, but they are considered to incur losses if the total costs exceed the revenue. The income obtained by farmers in Kec. Kedungjajang is presented in the following table.

Table 3: Farmers' Income of Respondent for the 2023-2024 Planting Season

No.	Description	Nilai (Rp/Ha)
1.	Income	79.412.830
2.	Total Cost	40.150.900
3.	Income	39.261.900

Source: Processed primary data (2024)

The results of the income analysis conducted in Kedungjajang District show that sugarcane farmers in this area during the 2023-2024 planting season earn an income of Rp 39,261,900/Ha/Planting Season. This means that sugarcane farming can be considered feasible to develop because farmers are making a profit. (Normansyah et al. 2014) state that farm income is the difference between revenue and total costs incurred. The larger the income earned, the more it can be said that the farming business can continue to develop well because, in principle, the general goal of farming is to seek maximum profit.

Analysis of the Technical Efficiency Level of Independent Sugarcane Farmers

Technical efficiency refers to the farmers' ability to combine the use of inputs in sugarcane farming to achieve maximum output. Farmers are considered technically efficient if they can produce sugarcane at their production frontier level, which is not always attainable due to various factors such as weather, pests, diseases, and environmental factors affecting sugarcane yields. Based on the analysis using stochastic frontier production function modeling, the efficiency levels achieved by farmers vary among each individual farmer. The efficiency levels can be seen in Table 4. The analysis of technical efficiency in the use of production factors for sugarcane in Kedungjajang

District, Lumajang Regency is divided into three interval levels: < 0.95; 0.95 – 1.00; and > 1.00. Below is Table 23, which shows the frequency distribution of the technical efficiency levels achieved by respondents at the research location:

Table 4. Frequency Distribution of Technical Efficiency Achieved by Respondents

Efficiency Level	Technical Efficiency	
	Number of Farmers (Person)	Percentage (%)
< 0,95	25	22,72
0,95 – 1,00	85	77,28
> 1,00	0	0,0
Total	110	
Average	0.972	
Minimum score	0,915	
Maximum score	0,999	

Source: Processed primary data (2024)

Based on Table 23, it shows that the majority of farmers, namely 77.28%, are within the efficiency level interval of 0.95 – 1.00. Meanwhile, in the efficiency level interval of < 0.95, there are 25 farmers or 22.72%. According to the table above, it is known that the highest technical efficiency level in sugarcane farming is 0.999. This means that the respondents can achieve at least 99.9% of the potential production obtained based on the combination of inputs used in sugarcane farming activities. The estimation results of this efficiency level indicate that there is still a 0.1% opportunity for respondents to increase their production. The lowest efficiency level is 0.915, which means that the farmers achieve a technical efficiency level of 91.5% from the combination of production factors used and still have the opportunity to increase their sugarcane production by 8.5%. The average technical efficiency level of the respondents is 0.972 or 97.2%. Based on this, it explains that there is still 2.8% for the average respondent farmer to improve their production. This proves that the hypothesis in this study, which indicates that the use of production factors is not yet efficient, is not supported. Because out of 110 respondents, almost all of them, only a small portion of farmers are still at a low level of technical efficiency or still experiencing technical inefficiency in their farming operations. According to (Fahriyah et al. 2018), technical efficiency can be said to be a condition that farmers must achieve so that the farming they conduct gets optimal results by using production inputs according to the amounts/doses needed by the sugarcane. Technical efficiency as a requirement that must be achieved by farmers is the initial stage that farmers must undertake so that the overall efficiency of sugarcane farming can be achieved. Farmers who already have technical efficiency close to one can improve their efficiency by managing the use of input amounts according to needs; in other words, farmers must pay attention to the use of inputs according to the recommendations of the officers.

According to (Anggrainingrum et al. 2022), differences in levels of technical efficiency are influenced by farmers' skills in sugarcane farming. Farmers' skills can be affected by age, years of farming experience, education, and information related to sugarcane farming. Older farmers may impact their mindset and physical abilities, causing them to tend to have less physical capacity compared to younger or more productive farmers. The mindset of older farmers tends to be less receptive to new practices related to sugarcane farming, leading them to still use old methods that are less

effective for sugarcane cultivation.

Table 5. Results of Estimation of Factors Influencing Technical Inefficiency

Variabel	Coefficient	Sd.Error	t count
Intercept	-0.0061	0.9755	-0.0062
Age	0.0026	0.6077	0.0044
Education	0.0619	0.4613	0.1343
Farming Duration	-0.0501	0.3372	-0.1488
Sigma-squared	0.0443	0.0077	5.7317***
Gamma	0.0008	0.1998	0.0038
t-Table	α 1 % = 2.625 α 5 %=1.983 α 10%= 1.660		

Note: ***=Significant at α 1%, **=Significant at α 5%, * =Significant at α 10%. Source: Primary data processed, 2024.

From the table above, it can be explained that the estimates of age, education, and the duration of sugarcane farming do not significantly affect the level of technical inefficiency in sugarcane farming in Kedungjajang sub-district. It can be explained that for the variable age, which has a positive coefficient, it means that the older the farmer is, the more likely he is to be inefficient in running his farming business. Meanwhile, the education variable, which also has a positive coefficient, means that the higher the farmer's education, the less likely he is to be inefficient. On the other hand, the variable of the duration of farming, which has a negative coefficient, means that the longer the farming period, the less likely the farmer is to be inefficient in running his farming business.

Analysis of Allocative Efficiency in Sugarcane Farming

Allocative efficiency is useful for measuring the ability of sugarcane farming to select a combination of input usage that can minimize costs with the same technology, thereby maximizing farmers' profits. Allocative efficiency is the ratio between total production costs and the actual cost factors of production using optimal factors under technically efficient conditions. Based on the analysis results using the frontier cost function model, the level of efficiency achieved by farmers varies among different farmers. The level of efficiency achieved by farmers can be seen in Table 6.

Table 6. Frequency Distribution of Allocative Efficiency in Sugarcane Farming

Efficiency Level	Technical Efficiency	
	Number of Farmers (Person)	Percentage (%)
1	66	60
>1	44	40
Total	110	100
Average	1,40	
Minimum	1	
Maximum	3,08	

Source: Processed primary data (2024)

Farmers are said to achieve allocative efficiency when the level of allocative efficiency is equal to one. Based on table 25, farmers who have a level of allocative efficiency of 1 amount to 66 farmers or 60% of the respondent farmers, while the remaining 40% include farmers who have not yet achieved allocative efficiency. The level of allocative efficiency of respondent farmers can be seen in Appendix 17. Farmers who have not achieved allocative efficiency indicate that they have not allocated production factor costs properly, thus they have not reached optimal profits. Farmers who have not yet achieved allocative efficiency can improve their allocative efficiency by allocating the use of certain inputs, so that using a certain amount of inputs can minimize production costs, allowing farmers to be allocatively efficient.

Farmers who have achieved allocative efficiency have an average input usage of 0.58 hectares of land with a harvest yield of 482.66 kui, using 4 kui of seeds, 8.3 kui of fertilizer, 0.6 liters of herbicide, 8 harvest costs, and 68 labor days (HOK). The average input usage based on allocative efficiency can be seen in Table 20. Farmers who are not yet efficient can achieve efficiency when they can intensify the use of existing land by managing the input usage such as fertilizer and pesticides. The input usage of farmers who have achieved allocative efficiency can serve as a reference for those who have not yet achieved allocative efficiency. Furthermore, input usage should pay attention to the dosages used according to recommendations, so that the input used meets the plant's needs.

Allocative efficiency is a sufficiency requirement that sugarcane farmers must meet in order for their farming operations to be overall efficient. The goal of allocative efficiency is to achieve maximum profit on the condition that the marginal product value is equal to the marginal cost incurred. The amount of production input used can be seen from the marginal cost used to obtain certain inputs. This sufficiency requirement must be achieved by farmers so that their farming operations yield results with maximum profit. According to (Wilujeng and Fauziyah 2021), allocative efficiency is influenced by the prices of each input used, and the amount of production costs is affected by the quantity and price of inputs. High input prices and excessive input use will increase the production cost of sugarcane, thus the allocation of input use is still not efficient. Sugarcane farmers generally use excessive production inputs. The fact in the field is that farmers use fertilizers excessively, resulting in high production costs. Therefore, farmers are advised to reduce the use of chemical fertilizers and replace them with inexpensive organic fertilizers.

The input usage that needs to be managed includes the quantity of seeds, herbicides, and logging transport costs. This input should be managed well in its usage so that the costs allocated for these inputs can be redirected to the use of other inputs such as fertilizers, land area, and labor. The use of fertilizers by farmers is still excessive because it does not comply with the recommendations. Furthermore, the farmers' dependence on subsidized fertilizers also has an influence. According to (Sholihah et al. 2014), optimal land use in a certain area will yield more optimal results. The average farmer has 0.58 ha of land, allowing farmers to optimize sugarcane production by intensifying land use to achieve better yields. Intensification of land use can be supported by the use of superior seeds and changes in cropping patterns, thus achieving more optimal results. Meanwhile, the use of seeds should be improved or replacing plants that have reached maximum production with new seeds as recommended, so that the amount used can be more precise.

The use of herbicides can also be optimized by assessing whether herbicides are needed on the land or if it can be managed with ordinary human labor. The amount of labor and transportation costs used in the sugarcane production process employs workers who have at least basic knowledge of good sugarcane cultivation, so that the work done can be completed quickly.

The use of production input quantities is not only based on the results of the analysis conducted but must also consider the recommendations for the use of certain inputs from agricultural services or extension workers. This is done to ensure that the sugarcane's nutritional needs are met and that input usage by farmers is more efficient, resulting in higher-quality sugarcane. Sugarcane farmers must be more meticulous in using and purchasing production inputs. According to Hantoro et al. (2014), sugarcane farmers require assistance from the government and extension workers to be more careful in using the production inputs. The assistance provided can serve as a consideration for farmers in using inputs, and farmers can know the prevailing prices of inputs in the market, thus allowing them to save costs on certain input usage.

Analysis of Economic Efficiency in Sugarcane Farming

The analysis of the level of economic efficiency is used to determine the overall efficiency level or the combined efficiency of technical and allocative efficiency in sugarcane farming conducted by farmers. Economic efficiency can be achieved when farmers are able to use inputs at minimal cost and obtain maximum results. The level of economic efficiency is attained if farmers can meet the requirements for necessity and sufficiency, meaning that farmers must achieve technical efficiency and allocative efficiency, so they can achieve economic efficiency or overall efficiency in sugarcane farming. The level of economic efficiency can be seen in Table 7.

Table 7. Frequency Distribution of Economic Efficiency in Sugarcane Farming

Economic Efficiency Level	Number of Farmers (person)	Percentage (%)
<1	0	0
1	69	62,73
>1	41	37,27
Total	110	100
Average	1,36	
Minimum	0,92	
Maximum	2,95	

Source: Processed primary data (2024)

Farmers with an economic efficiency level of less than 1 are 0 farmers or 0%, while those achieving economic efficiency with an efficiency value of 1 are 69 farmers, around 62.73%. Farmers with an economic efficiency level greater than 1 account for 37.27% or 41 farmers out of the total respondent farmers. Farmers who have not achieved economic efficiency are those who have not reached technical and allocative efficiency, thus, economically or overall, they have not attained efficiency. Farmers with an efficiency greater than one are said to be operating inefficiently, therefore they need to either increase or decrease certain input costs. Farmers who have already achieved economic efficiency can be said to have allocated the use of production inputs at minimal costs,

resulting in more optimal outputs.

According to (Wilujeng and Fauziyah 2021), the level of economic efficiency describes the overall efficiency condition of a combination of technical and allocative efficiency. Farmers who are close to achieving economic efficiency demonstrate their ability to use production factors, both in quantity and cost, efficiently, resulting in profits that are greater than the costs incurred over the sugarcane farming period. Economic efficiency will be achieved when farmers can allocate the costs of production factors accurately, such as the costs of seeds, fertilizers, herbicides, and labor.

These factors are the ones used directly and involve the actual costs incurred by farmers in a single planting season. The use of actual costs incurred directly can be adjusted according to the amount of input used, allowing for the minimization of production costs. Minimum production costs will impact the profits earned, as profits will increase if farmers can minimize the costs incurred. According to (Fadwiwati et al. 2014), farmers who have not yet achieved efficiency can save costs by reducing expenses or decreasing certain input amounts. Economic efficiency aims to minimize costs and maximize output, thus economic efficiency can be viewed as a combination of technical and allocative efficiency.

CONCLUSION

The conclusion of this research are :

1. Sugarcane farming in Kedungjajang District, Lumajang Regency requires a total cost of Rp 40,150,900/Ha/Planting Season, which consists of fixed costs of Rp 20,086,000/Ha/Planting Season and variable costs of Rp 20,037,800/Ha/Planting Season.
2. Sugarcane farming at the research site generates revenue of Rp 79,412,830/Ha/Planting Season with an average productivity of 88.3 Ton/Ha/Planting Season, resulting in a net income of Rp 39,261,900/Ha/Planting Season, indicating that sugarcane farming is feasible to develop.
3. The average technical efficiency level of sugarcane farming reaches 0.972 or 97.2%, with 77.28% of farmers falling within the efficiency interval of 0.95-1.00, indicating that the use of production factors is technically almost optimal with a potential production increase of approximately 2.8%.
4. As many as 60% of farmers have achieved optimal allocative efficiency (value = 1), indicating the farmers' ability to allocate production factor costs well in order to maximize profits.
5. The majority of farmers (62.73%) have achieved economic efficiency (value = 1), which illustrates the success of farmers in combining technical and allocative efficiency to obtain maximum profits at minimal costs.
6. Socio-economic factors such as age, education, and length of farming experience do not have a significant effect on the level of technical inefficiency of sugarcane farming in the research area.

The suggestions are :

1. Sugarcane farmers who have not yet achieved technical efficiency are advised to optimize the use of production inputs in accordance with the technical recommendations from agricultural extension workers, especially in the use of fertilizers, seeds, and herbicides.

2. Farmers need to perform better cost management by recording all farming expenses as a basis for decision-making for the next planting period, so that they can minimize production costs.
3. Farmers who have not achieved allocative efficiency are recommended to adopt input usage patterns from farmers who are already efficient, with an average land use of 0.58 ha, seeds of 4 kui, fertilizers of 8.3 kui, herbicides of 0.6 liters, harvesting costs of 8 trips, and labor of 68 HOK.
4. The government, through the agricultural department and extension workers, needs to provide intensive support to sugarcane farmers to enhance their knowledge and skills in cultivation, particularly regarding the efficient use of inputs and access to market information.
5. Sugarcane farmers are advised to reduce their dependence on subsidized chemical fertilizers and start switching to cheaper organic fertilizers to reduce production costs.
6. Land optimization through agricultural intensification and replanting with superior seeds needs to be carried out periodically to improve the productivity and yield of sugarcane.
7. Farmers are advised to form strong groups or associations of farming groups to improve their bargaining position against middlemen or buyers, so they can obtain more advantageous selling prices.

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