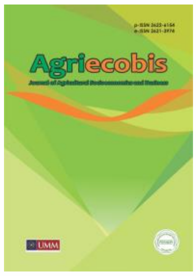
Universitas Muhammadiyah Malang, East Java, Indonesia

Agriecobis
(Journal of Agricultural Socioeconomics and Business)

p-ISSN 2662-6154, e-ISSN 2621-3974 // Vol. 7 No. 02 October 2024, pp. 108-117



Research Article

Technical and Economic Efficiency of Production Factors in Javanese Tobacco Farming: A Case Study of Belun Village, East Java

Alief Ramadhani Novita Cahyono Putri [a,1,*], Sri Widayanti [a,2], Gyska Indah Harya [a,3]

[a] Agriculture Faculty, Universitas Pembangunan Nasional "Veteran" Jawa Timur, Jl. Rungkut Madya, Gn. Anyar, Kec. Gn. Anyar, Surabaya, Jawa Timur (60294)

[1] 20024010120@student.upnjatimac.id;*; [2] Authosriwidayanti@upnjatim.ac.id; [3] gyskaharya.agribis@upnjatim.ac.id

* corresponding author

ARTICLE INFO

Article history
Received July 9, 2024
Revised August 13, 2024
Accepted October 4, 2024
Published October 31, 2024

Keywords
Economic Efficiency
Technical Efficiency
SFA

ABSTRACT

This study analyzes the technical and economic efficiency of production factors in tobacco farming in Belun Village, Temayang Subdistrict, Bojonegoro District, East Java. Using stochastic frontier software 4.1, the analysis was conducted with a sample of 87 Javanese tobacco farmers. The production inputs evaluated include land area, seeds, urea fertilizer, NPK fertilizer, NPK Phonska Plus fertilizer, labor, pesticides, and production output. The results indicate that the gamma elasticity coefficient for technical efficiency is 0.949, with all variables being statistically significant at the 1% level (t-table 2.64), except for pesticide input, which is significant at the 5% level (t-table 1.99). In the economic efficiency analysis, seedlings were identified as the inefficient input with an efficiency estimate (EE) of > 1 (52.4), while other inputs showed EE < 1. The study concludes that 94.9% of the inefficiency stems from production factors, while 5.1% is attributed to external factors. Moreover, the inputs used in Javanese tobacco farming are neither technically nor economically efficient. To achieve full technical efficiency, farmers should reduce inputs such as land area, NPK fertilizer, and NPK Phonska Plus fertilizer, while increasing the use of seeds, pesticides, urea fertilizer, and labor.

INTRODUCTION

Indonesia, endowed with abundant natural resources, relies heavily on the agricultural sector as a key contributor to national economic development. The agricultural sector in Indonesia is categorized into several subsectors, including agriculture, plantations, fisheries, livestock, and forestry. Among these, the farming subsector exhibits more consistent growth in both land area and productivity compared to other subsectors. Tobacco, a high-value crop, plays a significant role within this subsector.

As the 10th largest tobacco producer globally, Indonesia's top tobacco-producing provinces are East Java, West Nusa Tenggara, and Central Java. According to the head of East Java's Department of Industry and Trade in 2019, the tobacco industry contributed 27.35% to the provincial GDP (Mawaddah et al., 2022). However, according to data from the Central Statistics Agency (BPS), tobacco production has been steadily declining. Production reached 130,268 tons in 2020, decreased to 118,604 tons in 2021, and further dropped to 97,937 tons in 2022, attributed to tobacco's sensitivity to external factors, particularly weather (Mu'min et al., 2019). In Bojonegoro Regency, a tobacco-producing area, the decline is evident, with production falling from 13,123 tons in 2020 to 11,250 tons in 2022 (Dewi I., 2021), while land area shrank from 11,522 ha to 11,439 ha over the same period (BPS, 2023). This decrease in production negatively impacts productivity and is closely linked to the efficiency of the production factors used, which in turn affects farmers' income.

Land conversion is believed to be a key factor in this decline. Other production inputs for tobacco farming include seeds, fertilizers, labor, and pesticides (Harya et al., 2023; Indah et al., 2019). Land use changes refer to the transformation of all or part of farmland, often shifting from tobacco cultivation to other crops like corn or non-agricultural uses (Indah et al., 2018). In Bojonegoro District, two main tobacco varieties are cultivated: Virginia and Javanese tobacco. The Virginia variety is planted in four subdistricts—Ngraho, Kasiman, Kedungadem, and Sugiwaras—often under contract with cigarette company PT. HM Sampoerna (Murdiyati & Basuki, 2019). Meanwhile, the Javanese variety, grown in five subdistricts—Kedungadem, Temayang, Sugiwaras, Purwosari, and Ngasem—is cultivated independently, with no corporate partnerships (Badan Pusat Statistik Provinsi Jawa Timur, 2023).

Belun Village, located in Temayang Subdistrict, primarily grows Javanese tobacco during the dry season. According to the village's kamituwo, approximately 90% of the 750 households engage in tobacco farming, with most labor provided by family members, particularly on smallholder farms. Farmers use a variety of pesticides, including bekatul, to control pests such as caterpillars. In addition, they apply three types of fertilizers: urea, NPK, and NPK Phonska Plus. However, not all farmers receive government subsidies for these fertilizers, and rising prices due to distribution delays further burden them.

Income serves as a key indicator of economic well-being, closely tied to both production costs and profitability (Harya, Kuswanto, et al., 2023; Sudiyarto & Harya, 2020). A farming enterprise is considered successful if its income exceeds production costs. Tobacco farming has the potential to increase income, but inefficiencies in the use of production factors can reduce output and earnings (Harya et al., 2020; Harya & Wahyuningrum, 2023). In Belun Village, some farmers rely on a barter system to sell their crops, particularly smallholders. Under this system, farmers sell their tobacco to collectors before the harvest, at a fixed price per tree, regardless of yield per kilogram. This practice often results in financial losses, as farmers lack the upfront capital to sustain production. Given these challenges, further research is needed to assess the technical and economic efficiency of tobacco farming in Belun Village, Temayang Subdistrict, Bojonegoro Regency.

METHOD

This research employed a direct observation method in Belun Village, Temayang Subdistrict, Bojonegoro District, conducted from February to March 2024. Primary data were collected through interviews with tobacco farmers and the administration of questionnaires, while secondary data were obtained from the Central Statistics Agency and local village agencies. Respondents were selected using Simple Random Sampling, a technique that ensures every individual in the population has an equal chance of being chosen. The sample size was determined using the Slovin formula with a 10% margin of error (Adhiana & Riani, 2019).

n = N / (1 + (N x e2) (1)

Where:
n = number of samples
N = number of populations
e = error limits percentage from samplings
n = N / (1 + (N x e2))
= 675 / (1 + (675 x 10%2))
= 675 / (1 + (675 x 0,01))
= 675 / 7,75
= 87,09 rounded to 87 farmers

Based on the Slovin method used in this study, the total population of tobacco farmers in Belun Village, Temayang Subdistrict, Bojonegoro District, is 675. With a 10% margin of error, the sample size was calculated to be 87 farmers. The analysis employs a descriptive quantitative approach and utilizes a stochastic frontier production function model. Descriptive quantitative analysis interprets variables based on observed data (numerical values) from real perceptions. The stochastic frontier model assumes no observations result in zero output, as zero in the algorithm is considered undefined or infinite. It also assumes no technological differences between observations, the X variable operates under perfect competition, and differences in external factors such as weather are treated as error factors. The stochastic frontier equation is as follows (Adhiana & Riani, 2019).

$$LnY = \beta 0 + \beta 1LnX1 + \beta 2LnX2 + \beta 3LnX3 + \beta 4LnX4 + \beta 5LnX5 + \beta 6LnX6 + \beta 7LnX7 + ei \quad (2)$$

Where:
Y : Total tobacco production (kg)
β0 : Constant
X1 : Land area (m)2
X2 : Number of seedlings (Tree)
X3 : Amount of Urea fertilizer (Kg)
X4 : Amount of NPK Fertilizer (Kg)
X5 : Amount of NPK Phonska Plus Fertilizer (Kg)
X6 : Labor (HOK)
X7 : Pesticides (Kg)
β1-β2 : Regression coefficient which is the elasticity of production
ei : Residue

This study employs Stochastic Frontier Analysis (SFA) version 4.1 to estimate the parameters of production factors in tobacco farming using the Maximum Likelihood Estimation (MLE) method. MLE provides an assessment of the performance of tobacco farmers in Belun Village, Temayang Subdistrict, Bojonegoro District. The analysis utilizes Frontier software 4.1 to evaluate each constant parameter (β0) and production factor (βn) through partial testing. The gamma (γ) parameter measures the proportion of the total residual effect attributable to technical inefficiency. Gamma values range from 0 to 1, with values closer to 1 indicating that inefficiency (ui) is the primary source of the error term. Conversely, gamma values closer to 0 suggest that the error term is largely due to random noise (vi), such as weather or pests. The sigma-square (Σ^2) parameter reflects the variance in technical inefficiency, with values between 0 and 1. Smaller sigma-square values indicate a normally distributed error term. The technical efficiency analysis in this study follows the following equation (Adhiana & Riani, 2019).

$$TEi = Yi / Yi^* \quad (3)$$

Where:
TEi : technical efficiency
Yi : actual output
Yi* : one-side error term or random change

Technical efficiency reflects a farmer's ability to maximize output from the inputs utilized. Farmers are considered technically efficient if their efficiency index exceeds 0.7, whereas an index of 0.7 or below indicates technical inefficiency in tobacco farming (Omar & Fatah, 2021). Enhancing production outcomes can be achieved by improving farmers' skills and abilities in utilizing more efficient tobacco cultivation technologies and strengthening farm management practices.

Economic efficiency, on the other hand, refers to the comparison between actual and maximum potential profits. It can be evaluated using two criteria: profit maximization and cost minimization. Profit maximization occurs when a farmer's profits have reached their optimal level, while cost minimization serves as a strategy to further increase profitability. Economic efficiency is realized when the ratio of each marginal product value (NPM) equals the cost of production inputs. This can be calculated using the following formula (Soekartawi, 2019)

$$NPM\ Xi = b \cdot Y/X \cdot Py \quad (4)$$

Where:
NPMxi = Marginal product value of production factor (Rupiah)
B = Production elasticity / regression coefficient of production factor (unit)
Y = Average production of tobacco (Kg)
Py = Selling price of tobacco leaf production (Rupiah)
X = Average use of inputs/factors of production (m or Kg or Hok)
Px = Input/factor of production price (IDR)

Based on the calculations presented above, the following conclusions can be drawn (Bloom & Reenen, 2019).

1. If NPMxi = 1, the utilization of production inputs is optimal.
2. If NPMxi > 1, the utilization of production inputs is not optimal, indicating that the quantity of production inputs should be increased.
3. If NPMxi < 1, the utilization of production inputs is not optimal, necessitating a reduction in the quantity of production inputs

RESULTS AND DISCUSSION

Descriptive Statistic

This study focuses on farmers engaged in Javanese tobacco farming in Belun Village. The profiles of these farmers provide essential context for understanding their conditions in the research area. The characteristics of the Javanese tobacco farmers are as follows.

Farmers Age

Age significantly influences a farmer's physical capabilities in performing agricultural activities. As farmers age, their physical abilities may decline, which is a critical consideration since farming requires substantial physical effort, from land preparation to post-harvest activities. Conversely, farmers of productive age tend to maintain better physical fitness, which can enhance their farming productivity. The age distribution of the tobacco farmers is presented in the table below:

Table 1. samples of tobacco farmers' age

Vulnerable Age of Farmers (Years old)	Number (farmers)	Percentage (%)
31 – 60	78	89.65
>60	9	10.35
Total	87	100

Source: Primary Data Analysis, 2024

Based on the table, the age distribution of farmers engaged in tobacco farming in Belun Village indicates that a significant majority, 89.65%, fall within the productivity-vulnerable age group, while the remaining 10.35% are classified as being in the non-productivity-vulnerable age group. This demographic composition may facilitate the expansion of production in the Javanese tobacco farming business, as age influences productivity levels and overall performance, both physically and non-physically. Prasetya (2019) argues that human age affects achievement levels, particularly in agriculture, which demands considerable physical strength for fieldwork. Similarly, Nasir, et (2023) assert that optimal productivity occurs between the ages of 15 and 55, as individuals within this age range typically possess the physical capacity necessary for effective business operations.

Education Level of Farmers

Education plays a crucial role in shaping the knowledge and skills that influence farmers' mindsets. According to Nasir, et (2023), education level significantly impacts individuals' ability to adopt and experiment with new ideas. Furthermore, education enhances farmers' capacity to understand and implement innovations. This finding aligns with the research conducted by Pramesti (2023), which highlights that higher education levels contribute positively to farmers' willingness to absorb and apply new techniques. The education levels of the sample farmers, as measured by their formal education, are presented in the table below.

Table 2. Samples of Tobacco Farmers' Education Level

Farmers Education Level	Number (farmers)	Percentage (%)
Uneducated	4	4,6
SD (Elementary School)	19	21,84
SMP (Middle School)	17	19,54
SMA (High School)	47	54,02
Total	87	100

Source: Results of Primary Data Processing, 2024

The table indicates that the majority of farmers have attained a formal education level that meets the governor's standard, specifically completing high school (SMA). However, a few farmers have not met these educational criteria or have never attended school. The low education level among farmers contributes to inefficiencies in tobacco farming. According to Febriyanto (2021), inefficiencies arise from both internal and external factors, with the farmers' education level being a key internal factor. Education significantly influences decision-making processes and the selection of appropriate production inputs for farming businesses.

Tobacco Farming Business Experiences

Experience in farming refers to the length of time a farmer has been engaged in agricultural activities. A farmer's experience significantly influences decision-making processes and the ability to manage risks in the farming business. The table below presents the experience of tobacco farmers in Belun Village in managing their tobacco farming businesses.

Table 3. Samples of Tobacco Farming Business Experience

Farmer's Experience on Farming Business (Year)	Frequency (People)	Percentage (%)
16 – 20	5	5,75
21 – 25	6	6,9
26 – 30	27	31,03
31 – 35	19	21,84
36 – 40	17	19,54
41 – 45	8	9,2
46 – 50	5	5,75
Total	87	100

Source: Results of Primary Data Processing, 2024

The table indicates that the majority of tobacco farmers in Belun Village have between 26 and 30 years of farming experience, accounting for 31.03% of the sample. Farming experience plays a crucial role in the success of a farming business, as it informs decision-making throughout the production process. Hertanto (2019) highlights that a farmer's experience serves as a foundation for expanding the business and improving production outcomes. Similarly, Pramesti (2023) emphasizes that the length of farming experience significantly influences the success of a farming enterprise, particularly in decisions related to production, processing, and marketing.

Tobacco Farmer's Land Area

Land area is a key input in farming that significantly influences productivity, as it determines the quantity of other production inputs required in the cultivation process. The table below presents the distribution of land area used by Javanese tobacco farmers in Belun Village.

Table 4. Sample of Tobacco Farmer's Land Area

Land Area (meter^2)	Numbers (Farmers)	Percentage (%)
1001 - 2000	51	58,62
2001 - 3000	27	31,03
3001 - 4000	5	5,75
4001 - 5000	4	4,6
Total	87	100

Source: Results of Primary Data Research, 2024

The table indicates that most tobacco farmers in Belun Village have a land area between 1,001 and 2,000 square meters, with 51 farmers in this category. These farmers can be classified as small-scale farmers, as half of them cultivate less than 0.5 hectares (5,000 square meters). This limited land area requires them to carefully adjust production inputs, such as seedlings, fertilizers, labor, and pesticides, to achieve maximum efficiency in the production process. The efficiency of farming operations is often tied to land size, with larger areas typically enabling more efficient use of inputs. According to research by Parichatnon et al (2019), farmers must adjust labor allocation based on the size of the land being managed. Inefficiencies in farming can arise from both internal and external factors, with land area being a key internal factor. Febriyanto (2021) also emphasized that land control is a major internal factor contributing to inefficiency in farming operations.

Efficiency Analysis Using the Production Function

Javanese tobacco production in Belun Village is influenced by several key production factors, including land area, seedlings, fertilizers (urea, NPK, and NPK Phonska Plus), labor, and pesticides. On average, farmers cultivate tobacco on plots of approximately 2,076 square meters. Seedlings play a crucial role in the production process, with farmers typically using high-quality Javanese tobacco varieties. The average number of seedlings used per planting season is 2,875 branches, with the quantity dependent on the size of the farmer's land.

Fertilizers are another essential input in the tobacco production process. On average, farmers apply 48 kg of urea per planting season. Additionally, they use 12 kg of NPK fertilizer and approximately 22 kg of NPK Phonska Plus for each 2,076 square meters during the same period.

Labor and pesticides are also significant factors in the production process. Most farmers rely on family labor, with an average of 31 laborers involved per planting season. Although tobacco plants naturally produce substances that help deter pests, farmers in Belun Village use an average of 6 kg of pesticides as an additional precaution. They also spread rice bran on the leaves as a pest control measure, utilizing bran produced from previous rice harvests.

Based on the estimated production function using stochastic frontier software (version 4.1), the analysis of tobacco farming in Belun Village resulted in the elasticity coefficients shown in Table 5.

Table 5. Production input elasticity coefficient

No	Variables	Elasticity Coefficient	T count
1	Constant	5.720	4.606*
2	LnX1 (land area)	-0.013	-9.254*
3	LnX2 (Seedlings)	0.745	3.931*
4	LnX3 (Urea fertilizer)	0.007	3.046*
5	LnX4 (NPK fertilizer)	-0.614	-3.768*
6	LnX5 (NPK Phonska Pluss fertilizer)	-0.008	-3.474*
7	LnX6 (Labor)	0.386	3.950*
8	LnX7 (Pesticide)	0.004	2.399**
9	*Gamma*	0.949	17.575*
10	N	87	

Source: Primary Data Processing, 2024
Description: * : significant at 1% α
** : significant at 5% α

Regression equation capital = 5.720 - 0.013LnX1 + 0.745LnX2 + 0.007LnX3 - 0.614LnX4 - 0.008LnX5 + 0.386LnX6 + 0.004LnX7

The table above presents the results of the estimated function using Stochastic Frontier Software 4.1, with a t-table value of 2.64 at the 1% significance level and 1.99 at the 5% significance level. All variables in the analysis have elasticity coefficients less than 1, indicating significance at either the 1% or 5% levels. The key elasticity coefficients are as follows:

1. Gamma Coefficient: The elasticity of the gamma coefficient is 0.949, significant at the 1% level, indicating that 94.9% of the inefficiency in production is due to input variations, while the remaining 5.1% is attributed to uncontrollable external factors such as weather, climate, pests, and diseases.
2. Land Area: The elasticity coefficient for land area is -0.013, significant at the 1% level. This implies that a 1% increase in land area results in a 1.3% decrease in Javanese tobacco production. The negative relationship suggests that as land size increases, efficiency decreases, consistent with Unique (2019) finding of land area efficiency at 0.311, suggesting the need for reduced land use.
3. Seedlings: The elasticity coefficient for seedlings is 0.745, significant at the 1% level. A 1% increase in seedlings leads to a 74.5% increase in tobacco production, indicating that increasing seedling input significantly boosts production.
4. Urea Fertilizer: The elasticity coefficient for urea fertilizer is 0.007, significant at the 1% level. This shows that a 1% increase in urea fertilizer use leads to a 0.7% increase in tobacco production, reflecting the fertilizer's role in promoting plant growth. Balandina (2019) supports this, indicating that fertilizer quantities directly impact production outcomes.
5. NPK Fertilizer: The elasticity coefficient for NPK fertilizer is -0.614, significant at the 1% level. A 1% increase in NPK fertilizer results in a 61.4% decrease in production. This suggests overuse of NPK fertilizer reduces efficiency, aligning with Unique (2019) finding of -0.051 elasticity, which calls for reduced NPK usage to optimize production.
6. NPK Phonska Plus Fertilizer: The elasticity coefficient for NPK Phonska Plus fertilizer is -0.008, significant at the 1% level. A 1% increase in its use leads to a 0.8% decrease in production, implying inefficiency due to overuse. This is corroborated by Unique (2019) research, which also recommends reducing NPK Phonska Plus fertilizer for better efficiency.
7. Labor: The elasticity coefficient for labor is 0.386, significant at the 1% level. A 1% increase in labor leads to a 38.6% increase in production, highlighting the critical role of manpower in enhancing tobacco yields.
8. Pesticides: The elasticity coefficient for pesticides is 0.004, significant at the 5% level. A 1% increase in pesticide use results in a 0.4% increase in production. This suggests that pesticide application has a positive, albeit modest, impact on tobacco yields.

Technical Efficiency Analysis

Technical efficiency refers to the ability of Javanese tobacco farmers to maximize productivity using the available production inputs during the production process. The analysis of production inputs utilized by farmers in Belun Village, conducted using Frontier Software version 4.1, is presented in the following table:

Table 6. Technical Efficiency

Technical Efficiency Level	Number of Respondents (farmers)	Percentage (%)
< 0.70	28	32.18
> 0.70	59	67.82
Total	87	100

Source: Primary Data Analysis of Research, 2024

Table 6 indicates that most tobacco farmers in Belun Village demonstrate technical efficiency, with an efficiency level greater than 0.70. Analysis using Frontier Stochastic Software version 4.1 reveals that the lowest level of technical efficiency is 0.13, while the highest is 0.92, with an average technical efficiency of 0.675. This average, being less than 0.70, indicates that tobacco farming in Belun Village has not yet achieved full technical efficiency. The standard deviation is 0.184, lower than the mean of 0.675, suggesting limited variability in the data. A lower standard deviation compared to the mean implies that the data points are relatively close to the mean, indicating less dispersion. This finding is consistent with research, which shows that variables with standard deviations smaller than the mean are more accurate, while larger standard deviations indicate more variability and less accuracy.

The production inputs used by Javanese tobacco farmers—land area, seedlings, urea fertilizer, NPK fertilizer, NPK Phonska Plus fertilizer, labor, and pesticides—are technically inefficient. This aligns with Dewi (2021), who argues that a farming business is technically inefficient if its efficiency score is far from 1 and closer to 0. Soekarwati (2016) also supports this view, stating that the use of production inputs is technically efficient only when it results in maximum productivity.

Most Javanese tobacco farmers in Belun Village operate on small plots of land, but they use excessive production inputs, leading to suboptimal profits. With an average technical efficiency of 67.5%, farmers have the potential to increase production by 32.5%. This improvement can be achieved by enhancing farmers' ability to adopt technological advancements and improve farm management practices (Indah et al., 2018; Mutiarasari, 2019).

Economic Efficiency Analysis

This analysis evaluates the economic efficiency of Javanese tobacco farming businesses in Belun Village. Prior to conducting the economic analysis, it is essential to determine the production elasticities for each input utilized in the production process. The production elasticities obtained using Frontier Stochastic Software version 4.1 yield the following regression equation:

Regression equation model: 5,720 – 0,013LnX1 + 0,745LnX2 + 0,007LnX3 – 0,614LnX4 – 0,008LnX5 + 0,386LnX6 + 0,004LnX7

The parameters B1, b2,…b7 represent the production elasticities for each input employed in the Javanese tobacco production process. These production elasticities facilitate the calculation of the Marginal Physical Product (MPP) and the Normal Profit Margin (NPM), which are essential for assessing economic efficiency. The results of the economic efficiency analysis for Javanese tobacco in Belun Village are presented in the table below:

Table 7. Economic Efficiency

No	Variables	MPP Value $(\boldsymbol{b}.\frac{y}{Xi})$	NPM Value (MPP. Py)	Production Input Price (Px_i)	Economical Efficiency $(\frac{NPMxi}{Pxi})$
1	Land area	-0,01	-40	-20	-2
2	Seedlings	0,393	1.572	30	52,4
3	Urea fertilizer	0,222	888	2.250	0,394
4	NPK fertilizer	-68,69	-274.760	2.300	-119,46
5	NPK Phonska Pluss fertilizer	-0,559	-2.236	11.000	-0,203
6	Labor	19,124	76.496	80.000	0,956
7	Pesticides	0,972	3.888	5.000	0,778

Source: Primary data processing, 2024

Economic efficiency is achieved when the efficiency (EE) value equals 1; it is considered inefficient when the EE value is less than 1 and not yet efficient if the EE value exceeds 1. This aligns with Soekartawi's (2019) assertion that if the Net Profit Margin (NPM) exceeds the price of input (Pxi), or if the ratio of NPM to Pxi exceeds 1, then the utilization of each production input is not economically efficient, necessitating an increase in input quantity. Conversely, an EE value less than 1 indicates inefficient use of production inputs, suggesting that to attain economic efficiency, a reduction in input quantities is required. In Javanese tobacco farming, land area as a production input exhibits an efficiency value of approximately -2, indicating significant economic inefficiency. As depicted in the accompanying table, 51 farmers in Belun Village cultivate land areas ranging from 1,001 to 2,000 square meters, constituting 58.62% of the sample, which is relatively small. Balandina, (2019) and Nasrullah et al., (2020) assert that land area correlates positively with farming efficiency, as broader land areas facilitate more efficient use of production inputs, leading to higher output.

Seedling inputs show an efficiency value of 52.4, indicating that their economic utilization remains inefficient. On average, Javanese tobacco farmers in Belun Village use 2,875 seedlings per planting season. Cultivation techniques, including seed spacing, significantly impact productivity; however, some farmers do not adhere to recommended practices. The farmers utilize high-quality, non-subsidized Javanese variety seeds, priced at approximately Rp. 30 per seedling, resulting in an average expenditure of Rp. 86,241 per planting season. Balandina (2019) emphasizes the critical role of seeds in determining production outcomes.

Urea fertilizer exhibits an economic efficiency value of 0.394, indicating economic inefficiency. On average, farmers use 47.66 kg of urea fertilizer at a cost of Rp. 107,250 per planting season. To achieve full economic efficiency, farmers must reduce their urea fertilizer usage.

The efficiency values for NPK and NPK Phonska plus fertilizers are -119.46 and -0.203, respectively. Farmers in Belun Village typically require approximately 13.56 kg of NPK fertilizer, costing Rp. 31,209 per planting season, and 21.72 kg of NPK Phonska plus fertilizer, costing Rp. 238,966. Both fertilizers are economically inefficient, and farmers need to reduce their usage to achieve optimal economic efficiency. Poppy (2020) and Septiadi, (2023) highlight that excessive use of these inputs negatively affects production outcomes.

Manpower inputs exhibit an efficiency value of 0.956, indicating economic inefficiency in the Javanese tobacco production process in Belun Village. To attain economic efficiency, farmers must reduce their reliance on manpower. Soekartawi (2019) notes that achieving economic efficiency in manpower inputs is challenging due to farmers' limited knowledge and utilization of resources. Additionally, external factors hinder farmers from maximizing their agricultural productivity. The average expenditure per tobacco farmer is approximately Rp. 2,449,655 each planting season.

The economic efficiency of pesticide inputs is 0.778, signifying that their usage has not reached the economic efficiency threshold. On average, farmers use 6.24 kg of pesticides per planting season at a cost of Rp. 31,207. To achieve full economic efficiency, farmers should decrease pesticide application.

CONCLUSION

This study on the Javanese tobacco farming business in Belun Village, Temayang Subdistrict, Bojonegoro District, East Java, yields the following conclusions: Approximately 67.82% of farmers demonstrate technical efficiency, while the remaining 32.18% possess the potential to enhance production by improving their skills in technology adoption and farm management. The Gamma coefficient indicates a value of 0.949, suggesting that 94.9% of inefficiencies arise from internal production factors, with the remaining 5.1% attributable to external factors, such as weather conditions. Among the inputs, only pesticide usage is statistically significant at the 5% level, while land area, fertilizers, seedlings, and manpower are significant at the 1% level.

Regarding economic efficiency, the seedling inputs utilized by Javanese tobacco farmers in Belun Village are economically inefficient, as their efficiency value exceeds 1. Conversely, other production inputs, including land area, urea fertilizer, NPK fertilizer, NPK Phonska plus fertilizer, manpower, and pesticides, exhibit inefficiency with values less than 1.

Based on the findings from this study, it is recommended that Javanese tobacco farmers in Belun Village enhance their capacity to utilize production inputs proportionately. This includes optimizing the use of land area, seeds, fertilizers, labor, and pesticides, as 94.9% of inefficiencies stem from production factors. To achieve full technical efficiency, farmers should reduce inputs such as land area, NPK fertilizer, and NPK Phonska plus fertilizer, while simultaneously increasing inputs such as seeds, pesticides, urea fertilizer, and labor.

REFERENCES

Adhiana, & Riani. (2019). Analisis efisiensi ekonomi usahatani : Pendekatan Stochastic Production Frontier. *Sefa Bumi Persada*, 1–137.

Badan Pusat Statistik Provinsi Jawa Timur. (2023). *Jumlah Produksi Tanaman Perkebunan Menurut Kabupaten/Kota dan Jenis Tanaman di Provinsi Jawa Timur (ha), 2021 dan 2022*.

Balandina, N. (2019). Analisis Efesiensi Teknis Penggunaan Faktor Produksi Pertanian Pada Usahatani Tembakau (Studi Kasus di Desa Polagan Kecamatan Galis Kabupaten Pamekasan). *Angewandte Chemie International Edition, 6(11), 951–952.*, *3*(1), 10–27. https://medium.com/@arifwicaksanaa/pengertian-use-case-a7e576e1b6bf

Bloom, N., & Reenen, J. Van. (2019). Efisiensi Pertanian. *NBER Working Papers*, 89. http://www.nber.org/papers/w16019

Dewi I., D. . A. (2021). Analisis Efisiensi Penggunaan Faktor Produksi Usahatani Tembakau di Subak Sengguan, Desa Sukawati,Kecamatan Sukawati. *Jurnal Agribisnis Dan Agrowisata*, *10*(2), 482–492.

Febriyanto, A. T. dan A. P. (2021). Efisiensi Teknis Usahatani Bawang Merah. Efficient: Indonesian. *Journal of Development Economics.*, *4 (1) : 10*.

Harya, G. I., Hanani, N., Asmara, R., & Muhaimin, D. A. W. (2023). Dynamic capabilities for leading industries: proof of export commitment of chocolate products. *Bulgarian Journal of Agricultural Science*, *29*(4), 579–589.

Harya, G. I., Indah, P. N., Sudiyarto, Widayanti, S., & Pratiwi, L. F. L. (2019). Competitiveness and development perspective of processed cocoa industries in East Java. *AIP Conference Proceedings*, *2019*(2018). https://doi.org/10.1063/1.5061855

Harya, G. I., Kuswanto, K., Asmara, R., Tarik, J. T., Maulidah, S., & Budiwitjaksono, G. S. (2023). Taking a Deeper Look at the Priority of Agricultural Industry Efficiency Through the Use Data Envelopment Approach. *Agroalimentaria*, *29*, 167–177. https://orcid.org/0000-0003-

Harya, G. I., Sudiyarto, Budiwitjaksono, G. S., & Patiung, M. (2020). *Competitiveness and Processing of Processed Cocoa Industry in Improving the Welfare of People's Cocoa Farmers in East Java*. *2019*, 302–310. https://doi.org/10.11594/nstp.2019.0443

Harya, G. I., & Wahyuningrum, W. (2023). Analisis Kelayakan Usahatani Kunyit Petani Desa Petiken yang Tergabung Dalam Kelompok Tani BPP Driyorejo Kabupaten Gresik. *Jurnal Ilmiah Manajemen Agribisnis*, *11*(2), 112–120. https://doi.org/10.33005/jimaemagri.v11i2.17

Hertanto. (2019). *Ilmu Usahatani*. Penebar Swadaya.

Indah, P. N., Harya, G. I., Fatma, L., Pratiwi, L., & Widayanti, S. (2018). *Analisis Faktor-Faktor yang Mempengaruhi Olahan Kakao Industri di Jawa Timur Indonesia*. 652–656.

Indah, P. N., Harya, G. I., Pratiwi, L. F. L., & Widayanti, S. (2019). *Analysis of Factors Influencing Processed Cocoa Industry in East Java Indonesia*. *1*(Icst), 652–656. https://doi.org/10.2991/icst-18.2018.133

Mawaddah, J. U., Mubarokah, M., & Laily, D. W. (2022). Efisiensi Penggunaan Faktor Produksi Pada Usahatani Tembakau Di Desa Katemas Kecamatan Kudu Kabupaten Jombang. *Jurnal Ilmiah Mahasiswa Agroinfo Galuh*, *9*(3), 1393. https://doi.org/10.25157/jimag.v9i3.8486

Mu'min, M. S., Anggara, Y. P., & Maulana, R. B. (2019). Identifikasi Pengembangan Industri Tembakau di Jawa Timur: Pendekatan Model Dinamis dan Penerapan The Triple Layered Business Model Canvas. *Seminar Nasional Program Studi Agribisnis*, 575–591.

Murdiyati, A. S., & Basuki, T. (2019). Agribisnis tembakau virginia. *Monograf Balittas: Tembakau Virginia. Balai Penelitian Tanaman Tembakau Dan Serat. ISBN*, 978–979.

Mutiarasari, N. R., A. F. dan N. T. (2019). Analisis efisiensi teknis komoditas bawang merah di Kabupaten Majalengka, Jawa Barat. *J. Agristan*, *1 (1) : 31*.

Nasir, et, A. (2023). *Analisis Kelayakan Kopi Arabika Kecamatan Kayu Aro Kabupaten Kerinci* (Vol. 9).

Nasrullah, M., Saddozai, K. N., & Khan, N. P. (2020). Stochastic Frontier Production Analysis of Tobacco Growers in District Mardan, Pakistan. *Pakistan J. Agric. Res*, *28*(4). https://www.researchgate.net/publication/336589241

Omar, Z., & Fatah, F. A. (2021). Determinants of technical efficiency among coconut smallholder production in Johor, Malaysia: A cobb douglas stochastic frontier production approach. *IOP Conference Series: Earth and Environmental Science*, *757*(1). https://doi.org/10.1088/1755-1315/757/1/012013

Parichatnon, S., Maichum, K., & Peng, K. C. (2019). Measuring Technical Efficiency of Thai Rubber Production Using the Three-stage Data Envelopment Analysis. *Agricultural Economics (Czech Republic)*, *64*(5), 227–240. https://doi.org/10.17221/19/2016-AGRICECON

Poppy, S. (2020). *Analisis Efisiensi Penggunaan Faktor - Faktor Produksi Pada Usahatani Kopi di Kecamatan Sumowono, Semarang*.

Pramesti, W. D. (2023). *Analisis Efisiensi Teknis, Alokatif Dan Ekonomi Usahatani Kelapa Sawit Pola Swadaya Di Kecamatan Pamenang Selatan Kabupaten Merangin*.

Prasetya, N. R. dan S. P. (2019). Hubungan Tingkat Pendidikan dan umur Petani Dengan Penurunan Jumlah Rumah Tangga Usaha Pertanian Sub Sector 67 Tanaman Pangan di Desa Meteseh Kecamatan Boja Kabupaten Kenda. *J. Edu Geography*.

Septiadi, D. (2023). *Analisis Efisiensi Ekonomi Usahatani Tembakau Rakyat di Kabupaten Lombok Timur*. *8*(1), 65–71.

Soekartawi. (2019). *Agribisnis: Teori dab Aplikasinya*. Jakarta, PT Raja Grafindo Persada.

Sudiyarto, & Harya, G. I. (2020). Attitude of Consumer Confidence in Multiattributes Coffee People East Java. *Ajmse.Leena-Luna.Co.Jp*, *9*(January), 22–30. http://www.ajmse.leena-luna.co.jp/AJMSEPDFs/Vol.9(1)/AJMSE2020(9.1-04).pdf

Unique, A. (2019). *The analysis of Tobacco Farm Production Efficiency in Sumberejo Village, Mranggen District, Demak Regency*. *0*, 1–23.