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Technical Efficiency of Hybrid Corn Farming in Bontonompo District, Gowa Regency, South Sulawesi

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Abstract

This study aims to analyze the factors that influence the production and technical efficiency of hybrid corn farming in Manjapai Village, Bontonompo District, Gowa Regency. The sampling method was carried out by simple random sampling with a sample size of 65 people. The data analysis used is multiple regression with the Cobb Douglas Stochastic Frontier Production Function. The results showed that the factors that significantly influenced the production of hybrid corn farming were land area, urea fertilizer, NPK (phonska) fertilizer, and pesticides. Land area, phonska fertilizer, and pesticides had a negative correlation with the production of hybrid corn farming, so that the addition of these inputs would reduce production efficiency. Urea fertilizer was positively correlated, so the addition of urea fertilizer would increase the production of hybrid corn farming. The average technical efficiency level of hybrid corn farming was 0.83 so that there was still an opportunity to increase technical efficiency by 0.17. The technical efficiency level of corn farming had a maximum value of 0.97 and a minimum of 0.42. Most hybrid corn farmers (43%) have achieved a technical efficiency level of between 0.91-0.99, so that most hybrid corn farming businesses are very efficient.

Keywords: technical efficiency, hybrid corn, production, farming.

INTRODUCTION

Hybrid corn farming plays a very important role in the context of agriculture in Indonesia, especially in increasing food security and farmers' income. Corn, as one of the main sources of carbohydrates after rice, has great potential to meet the increasing food

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needs of the community along with population growth. According to Dewi (2023), domestic corn demand has increased by around 3.77% annually, which shows the importance of developing hybrid corn farming to meet this demand.

One of the advantages of hybrid corn is its higher productivity compared to local varieties. Firdaus & Fauziyah (2020) explain that the use of hybrid corn can increase the economic efficiency of farming, which in turn can increase farmers' income. Research on Madura Island shows that farmers who use hybrid corn can produce more at a more efficient cost, thereby increasing their profits (Hasan & Fauziyah, 2020). This shows that the adoption of hybrid corn can be an effective strategy to improve farmer welfare.

Farming efficiency is a crucial aspect in increasing agricultural productivity, including in hybrid corn cultivation. In the context of agriculture, efficiency can be defined as the ability to maximize output from available inputs, or conversely, minimize inputs to achieve a certain level of production. According to Suek et al. (2021), high efficiency in the use of resources can significantly increase productivity. This is very important considering the challenges faced by the agricultural sector, such as limited land and resources.

One form of efficiency that needs to be considered is technical efficiency, which is related to the use of production inputs. Research by Sahara et al. (2019) shows that many corn farmers in Kendal Regency still use diverse production inputs, which causes their technical efficiency to be low. By increasing technical efficiency, farmers can produce more corn with the same amount of input, which in turn can increase their income. This is in line with the findings of (Andung, 2023), who emphasized the importance of analyzing technical efficiency in corn farming to identify areas that need improvement.

Technical efficiency in hybrid corn farming can be measured through the use of optimal production inputs. According to research conducted by Dewi et al. (2018), technical efficiency is greatly influenced by the use of production factors such as seeds, fertilizers, and labor. This study shows that farmers who use the right combination of inputs can significantly increase their yields. This is in line with the findings of Firdaus & Fauziyah (2020), who also emphasize the importance of using efficient inputs to increase hybrid corn productivity.

Technical efficiency analysis must also consider the allocative aspect, namely how farmers allocate their resources. Hasan & Fauziyah (2020) showed that proper resource allocation can increase allocative efficiency in hybrid corn farming. In the context of Bontonompo District, it is important to analyze how farmers allocate land, fertilizer, and

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labor to achieve optimal results. Research by Situmorang et al. (2020) also supports the importance of allocative analysis in increasing technical efficiency.

To achieve better technical efficiency, it is important to conduct periodic evaluations of the applied farming practices. Research by Alfayanti et al. (2020) shows that cost-to-revenue ratio analysis can provide a clear picture of farming efficiency. By conducting this evaluation, farmers can identify areas that need improvement and implement the necessary changes.

Gowa Regency is one of the corn production centers in South Sulawesi Province. This study aims to analyze the factors that influence the production and technical efficiency of hybrid corn farming in Manjapai Village, Bontonompo District, Gowa Regency.

RESEARCH METHODS

This research was conducted in Manjapai Village, Bontonompo District, Gowa Regency. This research was conducted from October to December 2023. The sample of this study amounted to 65 respondents, taken using the purposive sampling method of hybrid corn farmers. The data source is primary data, taken through direct interviews using a questionnaire.

The data analysis used is multiple regression with the Cobb Douglas Stochastic Frontier Production Function. The efficiency analysis tool for hybrid corn farming uses Frontier 4.1 software. To analyze the factors that influence the production of hybrid corn farming, the following formula is used:

$$lnY = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + \beta_6 lnX_6 + \beta_7 lnX_7 + \beta_8 lnX_8 + (v_i - u_i)$$

Where:

Y = Hybrid corn farming production (kg)
X_1 = Land area (ha)
X_2 = Corn Seed (kg)
X_3 = Urea fertilizer (kg)
X_4 = Phonska fertilizer (kg)
X_5 = Pesticides (liters)
X_6 = Labor (HOK)
X_7 = Farmer's age (years)
X_8 = Length of formal education (years)
B_1, β_2, β_3, β_4, β_5, β_6 = estimated parameters

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(vi-ui) = error term (effect of technical inefficiency in the model)
Expected parameter signs and magnitudes: β1, β2, β3, β4, β5, β6 > 0
The analysis of technical efficiency mathematically can be written as follows:

ET = Yi/Y^i

Where:

ET	= technical efficiency level
Yi	= the ith output
Y^i	= potential production/ith frontier
(0 ≤ ET ≤ 1)	
ET closer to 1	= more efficient
ET getting closer to 0	= more inefficient

RESULTS AND DISCUSSION

Factors Affecting Hybrid Corn Farming Production

The technical efficiency of hybrid corn farming in Bontonompo District, Gowa Regency, South Sulawesi, is an important topic to study considering the role of corn as one of the main food commodities in Indonesia. Factors that influence the production of hybrid corn farming include land area, seeds, urea fertilizer, NPK fertilizer, pesticides, labor, age, and formal education of farmers. The results of the Cobb Douglas Stochastic Frontier production function estimation can be seen in Table 1 below.

Table 1. Factors Affecting Hybrid Corn Farming Production in Manjapai Village, Bontonompo District, Gowa Regency

Variable	Parameter	Coefficient	Error Standards	t Ratio
Constant	A	-0.6256	0.0981	-63.768***
Land area	β1	-0.8728	0.1912	-45.630***
Seed	β2	0.3220	0.1970	1.636 ns
Urea Fertilizer	β3	0.1107	0.6950	15.924***
NPK Fertilizer	β4	-0.1094	0.7580	-14.425***
Pesticides	β5	-0.3817	0.2191	-17.418***
Workforce	β6	-0.1660	0.1070	-1.550 ns
Farmer's Age	D1	2.2490	4.2730	0.526 ns

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Education	D2	1.4730	3.0620	0.481 ns
Sigma-squared		1.0950	1.3430	0.815 ns
Gamma		0.9900	1.3990	70.779***
Information: ***significant at α = 1%			ns: non-significant	

Source: Primary Data Analysis, 2024.

Based on Table 1, it can be seen that the value of the coefficient (0.99) Gamma is significant at the confidence level of 99 percent (α=1%), this means that the level of variation in hybrid corn farming production is 99 percent due to differences in technical efficiency, while the remaining 1 percent is influenced by external factors that cannot be controlled by corn farmers. These external factors can be in the form of pest and disease attacks, climate, rainfall, and so on. The results of partial testing (t-test) showed that land area, urea fertilizer, NPK fertilizer, and pesticides had a significant effect on the production of hybrid corn farming.

Land area has a significant effect on hybrid corn farming production at a confidence level of 99 percent, with a negative frontier production elasticity value (-0.8728). This means that if the land area increases by one percent (1%), then the production of hybrid maize farming will decrease to 0.8728 percent, assuming that the other inputs are fixed. This phenomenon indicates that land use has a level of soil fertility saturation, so it is necessary to increase land productivity in a more natural way (organic agriculture). So far, farmers have always used chemical fertilizers and pesticides that tend to be excessive and continuous.

Urea fertilizer had a significant effect on the production of hybrid corn farming at a confidence level of 99 percent, with a positive frontier production elasticity value (0.1107). This means that if urea fertilizer is added by one percent (1%), then the production of hybrid maize farming will increase to 0.1107 percent, assuming that the other inputs are fixed (ceteris paribus). Urea fertilizer is a very important nutrient in increasing the growth and development of corn plants, so that corn farming production is getting higher.

NPK fertilizer had a significant effect on the production of hybrid corn farming at a confidence level of 99 percent, with a negative frontier production elasticity value (-0.1094). This means that if NPK fertilizer is added by one percent (1%), then the production of hybrid corn farming will decrease to 0.1094 percent, assuming that the other inputs are constant. This incident indicates that the use of NPK fertilizer has exceeded the dose or is excessive, so the addition of NPK fertilizer reduces technical efficiency.

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The use of fertilizers, especially urea and NPK fertilizers, is a key factor in increasing corn productivity. Urea fertilizer provides the nitrogen necessary for plant growth, while NPK fertilizer provides other essential nutrients. Research by Kabeakan et al. & Junaidi (2024) showed that the right use of NPK fertilizer can significantly increase corn production. In addition, research by Sahara et al. (2019) emphasizes the importance of appropriate fertilizer doses to achieve optimal results. Improper application of fertilizer can result in waste and even a decrease in yield.

Pesticides had a significant effect on the production of hybrid maize farming at a confidence level of 99 percent, with a negative frontier production elasticity value (-0.3817). This means that if pesticides are added by one percent (1%), then hybrid corn farming production will decrease to 0.3817 percent, assuming that the other inputs are constant. This fact indicates that the use of pesticides has been excessive, so the addition of pesticides reduces technical efficiency.

The use of pesticides also plays an important role in protecting corn plants from pests and diseases. According to research by Sutrantiyas et al. (Hasan & Fauziyah, 2020), the proper use of pesticides can increase crop yields by reducing damage caused by pests. However, the use of pesticides must be done with caution to avoid negative impacts on the environment and human health. Research by Pakanyamong & Abubakar et al. (2019) shows that the judicious use of pesticides can improve the efficiency of corn production.

Technical Efficiency of Hybrid Corn Farming

The level of technical efficiency of corn farming is an important indicator that shows how well farmers use production inputs to produce output. Technical efficiency can be measured by a variety of methods, one of which is the Stochastic Frontier Analysis (SFA) approach, which allows researchers to identify factors that affect efficiency and measure how close actual production is to the maximum achievable potential (Hidayat & Sadi'ah, 2021).

The level of technical efficiency is usually expressed in the form of numbers between 0 and 1, where a value of 1 indicates maximum efficiency, and a value of 0 indicates total inefficiency. According to Wilujeng (2021), technical efficiency can be calculated using a formula that considers various production inputs. Research by Hidayat & Sadi'ah (2021) also shows that technical efficiency can be affected by various factors, including the experience of farmers and the quality of inputs used.

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Table 2. Distribution of Farmers according to the Technical Efficiency of Hybrid Corn Farming

Efficiency Level	Number of Farmers (people)	Percentage (%)
0.42 - 0.69	11	17
0.70 - 0.80	5	8
0.81 - 0.90	21	32
0.91 - 0.99	28	43
Total	65	100

Source: Primary Data Analysis, 2024.

The technical efficiency of hybrid corn farming in Manjapai Village, Bontonompo District, Gowa Regency has an average value of 0.83 with a minimum technical efficiency value of 0.42 and a maximum of 0.97. This shows that with an average value of 0.83, hybrid corn farmers still have the opportunity to increase technical efficiency by 0.17. The highest percentage (43%) of corn farmers had a technical efficiency level between 0.91-0.99, while the lowest percentage (8%) of corn farmers had a technical efficiency level between 0.70-0.80. This indicates that most of the hybrid corn farming in Manjapai Village has achieved a high level of technical efficiency.

Analysis of the technical efficiency of corn farming has been carried out in various regions, with varying results. Research by Dewi et al. (2018) in Pati Regency showed that the technical efficiency achieved by hybrid corn farmers can still be improved, with the efficiency value obtained below 1. This shows the potential to increase productivity through better input management.

On Madura Island, research by Firdaus & Fauziyah (2020) also shows that the technical efficiency of hybrid corn farming still needs to be improved, with many farmers not making optimal use of inputs. This study emphasizes the importance of training and counseling for farmers to improve their understanding of efficient agricultural practices.

CONCLUSION

Hybrid corn farming in Manjapai Village, Bontonompo District, Gowa Regency is simultaneously and significantly influenced by land area, seeds, urea fertilizers, NPK fertilizers, pesticides, labor, farmer age, and the length of formal education. The results of the partial analysis showed that the factors that had a significant influence on the production of hybrid corn farming were land area, urea fertilizer, NPK fertilizer, and

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pesticides. Land area, NPK fertilizers, and pesticides have a negative correlation with the production of hybrid corn farming, so the addition of these inputs will reduce production efficiency. Urea fertilizer is positively correlated, so the addition of urea fertilizer will increase the production of hybrid corn farming.

The average level of technical efficiency of hybrid corn farming in Manjapai Village is 0.83 so there is still an opportunity to increase technical efficiency by 0.17. The level of technical efficiency of corn farming has a maximum value of 0.97 and a minimum value of 0.42. Hybrid corn farmers mostly (43%) have achieved a technical efficiency level between 0.91-0.99. Thus, hybrid corn farming in Manjapai Village has mostly achieved a high level of technical efficiency.

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