

Comparative Study of Rice Farmers' Income Before and After the Implementation of Modern Agricultural Techniques: A Case Study in North Kluet and East Kluet Districts, South Aceh Regency

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Abstract

This study aims to analyze the differences in rice farmers' income before and after the adoption of modern agricultural techniques in Kluet Utara and Kluet Timur Subdistricts, Aceh Selatan Regency. This research employed a quantitative approach with a comparative method. Primary data were collected through questionnaires from 99 rice farmers selected using stratified random samplings. Data analysis was conducted using the Wilcoxon Signed Rank Test because the data were not normally distributed and involved paired observations. The results show that there is a statistically significant difference in farmers' income before and after the implementation of modern agricultural techniques, with a significance value of less than 0.05. The average income increased from approximately Rp 9,580,000 to Rp 9,670,000 per planting season. However, the increase is relatively small, indicating that the economic impact is not yet optimal. These findings imply that the adoption of modern agricultural technology needs to be supported by government policies, training, and access to capital to improve farmers' welfare sustainably.

Keywords: *Farmers' Income; Modern Agricultural Technology; Rice Farming; Wilcoxon Signed Rank Test.*

Introduction

Rice is the main food commodity that plays a strategic role in supporting national food security and the rural economy. In South Aceh Regency, particularly in North Kluet

and East Kluet Districts, most of the population depends on rice farming for their income. However, the income level of rice farmers is still relatively low and not evenly distributed. The development of modern agricultural technology, such as the use of tractors, planting machines, and combine harvesters, is expected to improve production efficiency, reduce farming costs, and increase farmers' income. However, the adoption of modern technology among farmers has not been fully optimal due to limitations in capital, skills, and access to production facilities. Research on the comparison of farmers' income before and after the implementation of modern agricultural technology in South Aceh is still limited. Therefore, this study is important to provide empirical evidence on the impact of applying modern agricultural techniques on rice farmers' income. The objective of this study is to analyze the differences in rice farmers' income before and after the implementation of modern agricultural techniques in North Kluet and East Kluet Districts, South Aceh Regency.

Problem Formulation

Based on the background of the problem described above, the research problem in this study is:

How do the incomes of rice farmers in North Kluet and East Kluet Districts, South Aceh Regency differ before and after the use of modern agricultural techniques?

Research Objective

The objective of this study is to analyze the differences in rice farmers' income in North Kluet and East Kluet Districts, South Aceh Regency, before and after the use of modern agricultural techniques.

LITERATURE REVIEW

Modern Agricultural System

A modern agricultural system is a farming system that utilizes technology and agricultural machinery to improve efficiency and productivity. Modern agricultural technology helps farmers in land preparation, planting, and harvesting more quickly and efficiently compared to traditional systems. One of the modern agricultural methods is the Rice Intensification System (SRI). According to Rozen and Kasim (2018), the Rice

Intensification System is a rice cultivation method that uses young seedlings and specific management techniques to increase the number of tillers, thereby improving production yields. The use of modern agricultural technology, such as tractors, planting machines, and harvesting machines, can help farmers reduce labor usage, accelerate the production process, and increase crop yields. With increased production and cost efficiency, the use of modern agricultural technology can enhance farmers' income.

Traditional Agricultural System

A traditional agricultural system is a farming system that still relies on simple tools and human labor in agricultural production activities. This system generally does not utilize modern technology, so the production process tends to be slower and less efficient. According to Heryanto and Nugraha (2023), traditional agriculture is a farming system that is practiced from generation to generation using simple tools and minimal use of modern technology. The use of traditional tools such as hoes, ani-ani, and sickles causes land preparation and harvesting processes to take longer compared to the use of modern technology. The limited use of technology in traditional agricultural systems can lead to lower productivity and result in relatively lower farmers' income compared to modern agricultural systems

Farmers' Income

Farmers' income is the revenue earned by farmers from farming activities after deducting the production costs incurred during the production process. Farmers' income is influenced by several factors, such as production output, selling prices, production costs, and the use of technology. The use of modern agricultural technology can increase production output and work efficiency, thereby improving farmers' income. In contrast, the use of traditional agricultural systems that still rely on human labor and simple tools can lead to lower productivity, which in turn affects farmers' income. Thus, the use of modern agricultural technology is expected to have a positive impact on increasing farmers' income.

Previous Research

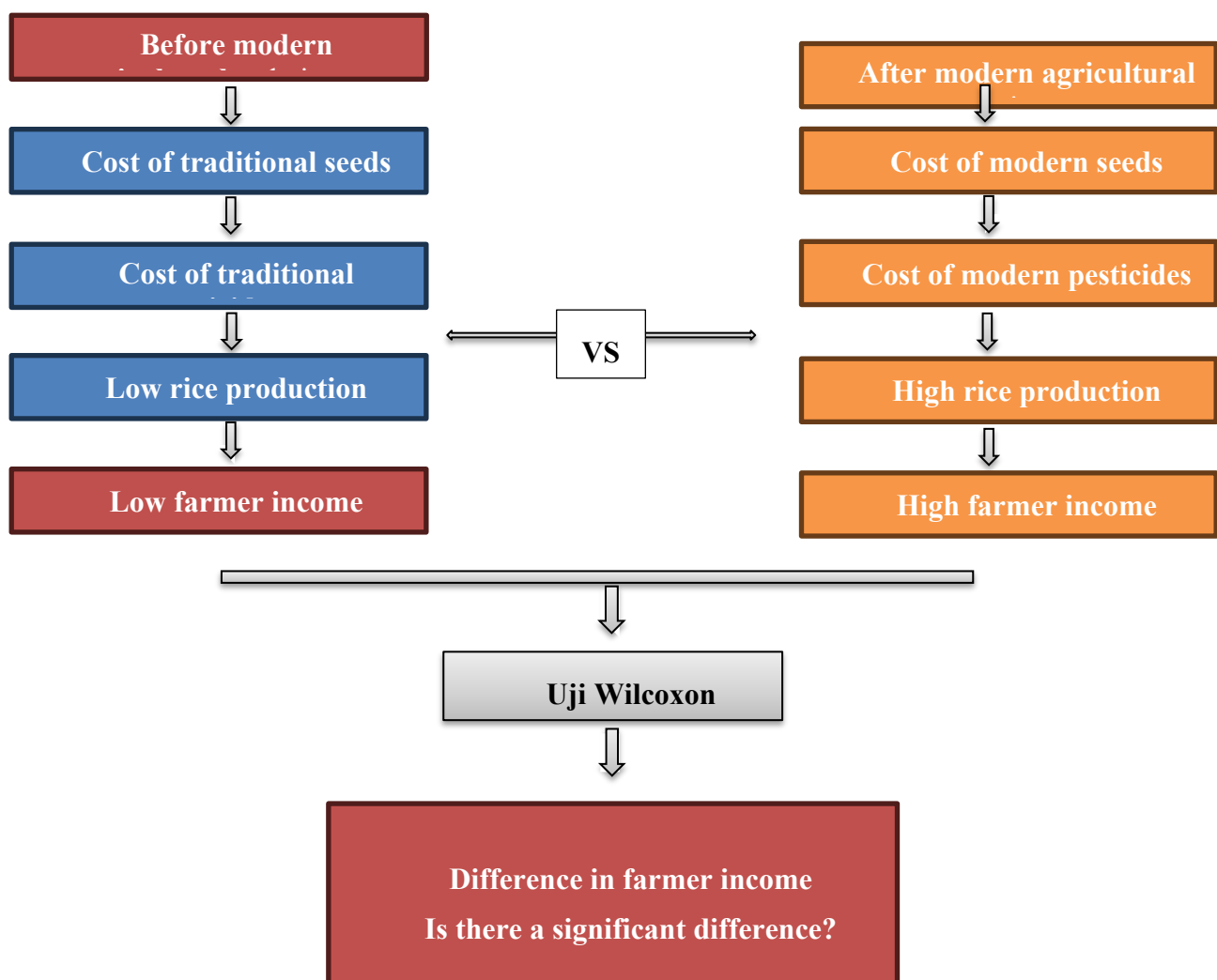
A study conducted by Sianipar (2023) shows that there is a difference in rice farmers' income between the rainy season and the dry season, where farmers' income in the dry

season is higher than in the rainy season. Another study conducted by Rusydi and Rusli (2022) shows that production has a positive and significant effect on farmers' income. This indicates that the higher the production output, the higher the farmers' income. Based on these previous studies, it can be concluded that the use of technology and increased production play an important role in improving farmers' income.

Conceptual Framework

The conceptual framework in this study explains that the use of modern agricultural systems can improve efficiency and productivity compared to traditional agricultural systems. This increase in productivity will have an impact on increasing farmers' income. This study compares farmers' income before and after the use of modern agricultural systems to determine whether there is a difference in farmers' income after adopting modern agricultural technology

Figure 1. Conceptual framework diagram



Research Hypothesis

Research Hypotheses in this study are:

H₀: There is no significant difference in farmers' income before and after the implementation of modern agricultural techniques in Kluet Utara District and Kluet Timur District, South Aceh Regency.

Research Methods

Time and Place of Research

This research was conducted in Kluet Utara District and Kluet Timur District, South Aceh Regency. The selection of the location was carried out purposively, considering that both areas are centers of rice production

Type and Research Approach

This study uses a quantitative approach with a comparative method, namely comparing rice farmers' income before and after the use of modern agricultural techniques. The quantitative approach is used because the data analyzed are in the form of numerical data and are analyzed using statistical methods.

Population and Sample

The population in this study consists of all rice farmers in Kluet Utara District and Kluet Timur District, South Aceh Regency, totaling 5,325 farmers. The sample size was determined using the Slovin formula with a 10% margin of error, as follows:

$$n = \frac{N}{1 + N(e)^2}$$

Description:

n = sample size

N = population size

e = margin of error (10%)

$$n = \frac{5325}{1 + 5325(0,1)^2}$$

$$n = \frac{5325}{1 + 53,25}$$

$$n = \frac{5325}{54,25}$$

$$n = 98,15 \approx 99 \text{ responden}$$

Thus, the total sample in this study is 99 farmers

To ensure that every farmer has an equal opportunity to become a respondent, the sampling technique was further carried out using the Stratified Random Sampling method. This method involves randomly selecting samples by dividing the population into several strata (groups) based on sub-district areas, after which samples are taken proportionally from each stratum. The distribution of the sample size for each sub-district was carried out proportionally using the following formula:

$$n_i = \frac{N_i}{N} \times n$$

Explanation:

- n_i = jumlah sampel pada strata ke-i
- N_i = jumlah populasi pada strata ke-i
- N = total populasi

Based on these calculations, the sample size obtained is as follows

- North Kluet Subdistrict

$$n_1 = \frac{3.417}{5.325} \times 99 = 63,5 \approx 64 \text{ responden}$$

- East Kluet Subdistrict

$$n_2 = \frac{1.908}{5.325} \times 99 = 35,5 \approx 35 \text{ responden}$$

Thus, the total sample in this study is:

- North Kluet: 63 respondents
- East Kluet: 36 respondents
- Total: 99 respondents

The types of data used in this study are primary data and secondary data.

Primary data were obtained directly from respondents through interviews and questionnaires regarding:

- Rice production
- Rice selling price
- Production costs
- Farmers' income before and after using modern agricultural techniques

Secondary data were obtained from the Central Bureau of Statistics, sub-district offices, as well as literature relevant to this study.

Operational Definition of Variables

The variable in this study is the income of rice farmers before and after using modern agricultural techniques. Farmers' income is the difference between total revenue and total production costs during one planting season.

Income is calculated using the following formula:

$$\pi = TR - TC$$

Description:

π = Farmers' income

TR = Total revenue

TC = Total production costs

Total revenue is calculated using the following formula:

$$TR = P \times Q$$

Description:

P = Rice selling price

Q = Quantity of rice production

Total cost is the sum of all fixed costs and variable costs incurred by farmers during the production process.

Data Analysis Method

Wilcoxon Signed-Rank Test

Skor-skor	
Z	-5.054 ^b
Asym. Sig. (2.tailed)	<.001

The results of the analysis using the Wilcoxon Signed-Rank Test show that out of a total of 99 respondents, 85 farmers experienced an increase in income after the adoption of modern agricultural techniques (positive ranks), while 14 farmers experienced a decrease in income (negative ranks), and no respondents had unchanged income (ties = 0). Statistically, the test yielded a Z value of -5.054 with an Asymp. Sig. (2-tailed) of 0.000. This significance value is lower than the 0.05 significance level ($0.000 < 0.05$), therefore H_0 is rejected and H_1 is accepted. This indicates that there is a significant difference in rice farmers' income before and after the adoption of modern agricultural techniques in Kluet Utara and Kluet Timur Subdistricts, Aceh Selatan Regency.

The increase in income indicates that the use of modern agricultural technologies, such as tractors and combine harvesters, is able to improve production efficiency, reduce labor costs, and minimize post-harvest losses. However, a small proportion of farmers still experienced a decline in income, which may be attributed to limited access to technology, operational costs, and the ability to operate modern equipment.

Results and Discussion

The results of the descriptive analysis show an increase in the average income of rice farmers after the implementation of modern agricultural techniques. The average farmers' income before the application of modern technology was approximately Rp 9,580,000 per planting season, while after the implementation of modern technology it increased to approximately Rp 9,670,000 per planting season. Thus, there is an average increase in income of about Rp 90,000 per planting season.

The increase in farmers' income is caused by improved production efficiency, reduced labor costs, and decreased post-harvest losses. The use of modern equipment such as tractors and combine harvesters can speed up the production process and increase productivity. However, the increase in income is not felt evenly, as it is influenced by land size, the ability to operate technology, and the amount of production costs.

The results of this study are in line with production economic theory, which states that improvements in the efficiency of production factor use will increase income. These findings also support previous studies which indicate that the adoption of modern agricultural technology has a positive effect on farmers' income.

The findings of this study indicate that the adoption of modern agricultural technology is an effective strategy for increasing rice farmers' income. This increase is mainly caused by production cost efficiency, faster work processes, and reduced post-harvest losses through the use of modern agricultural tools and machinery such as tractors and combine harvesters.

However, there are still a small number of farmers who have not experienced a significant increase in income. This condition is influenced by limited access to technology, low skills in operating equipment, age factors, and farmers' education levels, which affect their ability to adapt to technological innovations.

Limitations of the Study

This study has several limitations, including that it has not measured the long-term impacts of the use of modern agricultural technology, such as equipment maintenance costs, dependence on spare parts, and the effect of rice price fluctuations. In addition, this study only focuses on two districts, so the results cannot yet be generalized to the entire South Aceh Regency.

Policy Implications

The results of this study imply that local governments need to increase support for agricultural modernization through the provision of equitable agricultural machinery and equipment, subsidies for agricultural machinery rental costs, and improved training and extension services for farmers. Strengthening farmer group institutions and agricultural machinery service units is also necessary to ensure that the use of technology can be carried out efficiently and sustainably.

Conclusion

This study concludes that there is a significant difference in rice farmers' income before and after the implementation of modern agricultural techniques in Kluet Utara District and Kluet Timur District, South Aceh Regency. The application of modern agricultural technology has been proven to improve production efficiency and farmers' income, although the benefits have not been equally experienced by all farmers. Local governments are expected to increase support for farmers by providing agricultural machinery and equipment, offering training on technology use, and improving access to capital. Future research is recommended to include other socio-economic variables such as education level, farming experience, and market access in order to obtain more comprehensive results.

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