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ANALYSIS OF PRODUCTION SCALE (RETURN TO SCALE) OF RICE FARMING IN SUNGGAL DISTRICT, DELI SERDANG REGENCY, NORTH SUMATRA

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Abstract

This study was conducted in Sunggal District, Deli Serdang Regency, North Sumatra, with the objective of analyzing the production scale of rice farming through the Return to Scale (RTS) approach. The research used primary data collected from 100 rice farmers selected using simple random sampling. Production factors analyzed included land area, fertilizer, and labor. The analytical method employed was a Cobb–Douglas production function estimated using multiple linear regression in logarithmic form. The RTS value was obtained by summing the elasticity coefficients of the production factors. The results showed that the sum of production elasticities was 1.241, indicating that rice farming in Sunggal District operates under increasing returns to scale. This condition implies that proportional increases in production inputs result in a more than proportional increase in output. Therefore, rice production in the study area still has the potential to be increased through the expansion and optimization of production inputs.

Keywords: rice farming, production factors, Cobb–Douglas, return to scale, increasing returns

INTRODUCTION

Indonesia is an agrarian country where the agricultural sector plays a strategic role in supporting the national economy and food security (Siti et al., 2021). One of the most important agricultural subsectors is the food crop subsector, particularly rice, given that rice is the staple food for the majority of the Indonesian population (Utama, 2015). Therefore, the sustainability and increase of rice production are primary concerns in national agricultural development (Central Statistics Agency, 2018). However, rice production in Indonesia has shown a downward trend in recent years. In 2023, national rice production was recorded as having decreased compared to the previous year (Central Statistics Agency, 2023). This condition indicates problems in the rice production system, both related to resource availability and how farmers manage production factors. In situations of limited resources, increased production cannot always be achieved through additional inputs, but rather through more efficient use of production factors (Soekartawi, 2003).

In practice, rice farmers often face limitations in production factors, such as relatively small land areas, inadequate fertilizer use, and uncertain labor availability. Land area is a key production factor that significantly determines yields. The larger the cultivated land, the greater the potential production (Maryam, 2002). Furthermore, labor plays a crucial role in all stages of rice farming, from land preparation to harvest (Usman & Juliyani, 2018). The use of appropriate fertilizer types and dosages is also a crucial factor in supporting plant growth and increasing yields (Usman & Uliyani, 2018). North Sumatra Province is one of Indonesia's rice-producing regions, with production levels varying between districts. Production data shows that Deli Serdang Regency is one of the regencies with the highest rice production in the province (Central Statistics Agency of North Sumatra Province, 2022). However, high aggregate production does not necessarily reflect the scale production factor use at the farmer level. The following table shows North Sumatra's rice production:

Table 1. Land Area and Production of Lowland Rice Crops in North Sumatra Province

No	Regency	Paddy Production (Ton)		Land Area (Ha)	
		2021	2022	2021	2022
1.	Deli Serdang	323 107,61	328 854,79	53 981,29	53 984,59
2.	Serdang Bedagai	270 270,84	289 938,03	49 091,03	50 940,35
3.	Simalungun	162 411,52	148 536,12	30 950,94	27 551,55
4.	Langkat	125 103,01	110 417,32	25 633,40	23 569,18
5.	Tapanuli Utara	122 554,37	137 822,43	21 621,69	29 920,67
6.	Nias	36 559,90	33 122,85	8 999,56	8 005,34
7.	Mandailing Natal	72 323,45	88 293,16	17 158,99	21 293,57
8.	Toba	107 239,08	107 139,29	17 687,10	17 04374
9.	Labuhan batu	59 546,40	83 640,90	12 622,84	21 455,81
10.	Asahan	55 660,79	62 786,65	9 906,85	10 185,41
11.	Dairi	30 378,06	38 714,36	5 894,95	7 868,10
12.	Karo	69 828,73	69 058,42	9 844,22	9 834,36
13	Humbang Hasundutan	49 513,29	75 426,08	11 440,24	17 922,27
14.	Pakpak Bharat	4 476,81	5 666,65	1 175,82	1 516,33
15.	Samosir	42 388,81	41 318,50	7 874,65	7 458,05
16.	Batu Bara	69 181,22	71 050,57	12 269,57	12 827,29
17.	Padang Lawas	26 328,75	27 454,82	6 961,04	7 377,46

Source : Regency Statistic North Sumatera, 2022.

Based on Table 1, one of the rice farming areas in North Sumatra is Deli Serdang Regency. Rice production in Deli Serdang Regency ranks first, with a total production of 328,854.79 tons in 2022, followed by other regencies. Deli Serdang Regency has 22 sub-districts, consisting of 380 villages and 14 urban villages, with its capital in Lubuk Pakam. One of these sub-districts is Sunggal District. Sunggal District consists of 17 villages, with production figures declining annually, as shown in Table 2 below.

Table 2. Harvested Area and Production Amount of Paddy Fields in Sunggal District in 2020-2024

No	Year	Harvested Area (Ha)	Production (ton)
1.	2020	2.986	16.415
2.	2021	2.732	16.023
3.	2022	2.986	14.905
4.	2023	2.690	14.746
5.	2024	2.497	14.321
Total		**10.731**	**76.904**

Source: Agricultural Extension Center, 2024.

Sunggal District is one of the rice production centers in Deli Serdang Regency. Data shows that in recent years, Sunggal District has experienced a gradual decline in harvested area and rice production. This decline is suspected to be related to land conversion, suboptimal irrigation networks, and limited and unstable agricultural labor (Sunggal District Agricultural Extension Center, 2024). Although farmers in this area continue to intensify their cropping practices, with up to three crops per year, production declines persist, indicating problems with the scale production factors. This situation suggests that the decline in rice production in Sunggal District is not solely due to reduced land area but is also likely related to the scale of production farmers' management of available production factors, impacting the elasticity value. Analysis of production scale, particularly through the concept of Returns to Scale (RTS), provides insight into how output responds to proportional changes in all production inputs. RTS analysis helps determine whether production activities operate under increasing, constant, or decreasing returns, thus informing appropriate production strategies and policies (Soekartawi, 2003). Previous studies mainly focus on productivity and efficiency, while studies analyzing production scale behavior of rice farming at the sub-district level remain limited. Based on this description, this research is important to analyze the production scale and use of production factors in lowland rice farming in Sunggal District, Deli Serdang Regency. This research aims to analyze

the scale of rice farming production in Sunggal District using the Return to Scale approach based on the Cobb–Douglas production function.

LITERATURE REVIEW

Production Factors in Rice Farming

Production factors are all inputs used in the production process to produce a specific output. In farming activities, production factors are the primary elements determining production levels and farm scale productions. In the agricultural sector, commonly used production factors include land, labor, capital, and other inputs such as fertilizers and pesticides (Soekartawi, 2003; Amini, 2016).

Land

Land is a strategic production factor in rice farming because it serves as the primary medium through which the production process takes place. Land includes soil, water, and the elements contained therein that support rice plant growth (Soekartawi, 2003). The area of land cultivated by farmers directly influences production capacity. The larger the area of land cultivated, the greater the potential output, and therefore, land area is often used as an important indicator in the analysis of farm production and income (Amini, 2016; Maryam, 2002). Physically and economically, land conditions are location-specific and have varying levels of productivity across regions. Differences in land area and quality between farmers can lead to variations in scale produstions levels, as farmers with relatively similar land conditions can produce different outputs depending on their management skills (Maryam, 2002).

Fertilizer

Fertilizer is a crucial input in rice farming, providing essential nutrients for plants. Fertilizers can be either natural or synthetic, applied to the soil or plants to replace nutrients absorbed during the production process (Soil Research Institute, 2015). Appropriate fertilizer use, in terms of type, dosage, and application time, significantly impacts plant growth and yield. Fertilizer application that does not comply with recommendations can lead to inefficient input use and reduce crop productivity (Amini, 2016).

Labor

Labor is a production factor that plays a role in all stages of rice farming, from land preparation and planting to maintenance and harvesting. The success of the production process is greatly influenced by the availability, skills, and experience of the labor employed (Amini, 2016). In rice farming, labor is divided into family labor and non-family labor. Family labor does not receive direct wages, while non-family labor is paid according to the prevailing wage agreement (Hermanto in Zaman et al., 2021).

Synthesis of Production Factors

Based on the above description, it can be concluded that land area, fertilizer use, and labor are the main production factors influencing the scale produstions of rice farming. Variations in the use and management of these production factors among farmers lead to differences in their ability to produce maximum output from available inputs (Soekartawi, 2003; Amini, 2016).

The Concept of Production Efficiency

Production efficiency is a concept that describes a producer's ability to optimize the use of inputs to produce a specific output. According to Sukirno (2020), efficiency is achieved when a producer is able to produce maximum output with a given input or produce a specific output with a minimum input. In general, production efficiency can be analyzed using input and output approaches. The input approach emphasizes minimizing input use, while the output approach emphasizes maximizing output without increasing the amount of input (Soekartawi, 2003).

Technical Efficiency

Technical efficiency is a producer's ability to produce maximum output from a given amount of inputs at the available technological level. Shinta (2011) states that technical efficiency measures the ratio between actual production and potential production.

Allocative Efficiency

Allocative efficiency relates to a producer's ability to use a combination of inputs that minimizes production costs or maximizes profits at a given input and output price level. Allocative efficiency is achieved when the value of the marginal product of an input equals the price of that input (Nicholson in Maulina, 2023).

Economic Efficiency

Economic efficiency is a condition where technical efficiency and allocative efficiency are achieved simultaneously. According to Maulina (2023), economic efficiency indicates a producer's ability to produce output with minimum costs and maximum profits.

Scale Produstions

Return to Scale (RTS) refers to the change in output resulting from proportional changes in all production inputs. RTS can be increasing (IRS), constant (CRS), or decreasing (DRS). RTS analysis is commonly derived from the sum of input elasticities in a Cobb–Douglas production function (Soekartawi, 2003).

Rice as a Farming Commodity

Rice is a primary food crop that plays a vital role in meeting the community's food needs. Rice, a processed rice product, is the primary source of carbohydrates for the majority of the Indonesian population (Pratiwi, 2016).

METHOD

Location, Object, and Scope

This research was conducted in Sunggal District, Deli Serdang Regency, North Sumatra Province. The research location was selected through purposive sampling, considering that Sunggal District is one of the centers of lowland rice production in Deli Serdang Regency and has experienced a decline in production in recent years. This situation is relevant for to analyze the production scale (Return to Scale) of lowland rice farming based on the Cobb–Douglas production function. The subjects of this research were lowland rice farmers operating in Sunggal District. The scope of the study was limited to analyzing the elasticity and scale productions of the use of primary production factors land area, labor, and fertilizer on lowland rice production.

Data Types and Sources

The type of data used in this study is quantitative, that is, data expressed in numerical form and amenable to statistical analysis. Quantitative data are used to measure the relationship between the use of production factors and the level of lowland rice production and to calculate elasticity and scale productions of farming. The data sources in this study consist of primary and secondary data. Primary data were obtained through direct interviews with lowland rice farmers using a structured questionnaire containing information on production and the use of production factors. Secondary data were obtained from the Central Statistics Agency (BPS), the Agricultural Extension Center, and various scientific literature such as journals, books, and research reports relevant to the research topic.

Population and Sample

Sunggal District has a population of 251,348. The population in this study was all 1,041 rice farmers in Sunggal District. The sample size was determined using the Slovin formula with an error tolerance of 10 percent, as follows:

$$n = \frac{N}{1 + Ne^2}$$

Description:

n = sample size

N = population size

e = 10%

So we get:

$$n = \frac{1.670 + 200}{1+1.870\ (0{,}10)^2}$$

$$= 91 \text{ Farmers}$$

Based on these calculations, a sample size of 91 respondents was obtained. To increase data representativeness and anticipate the possibility of incomplete data, the sample size was rounded to 100 respondents.

The sampling technique used was simple random sampling, so that every rice farmer had an equal chance of becoming a respondent.

Data Analysis Method

Technical Efficiency

Technical efficiency can be determined by calculating the production elasticity value. Elasticity in analysis is a concept that measures the rate of change in output due to the use of inputs. This elasticity can be determined through the regression coefficient. The production elasticity can be described as follows:

$$ET = EP = \beta_i$$

The use of production factors is declared efficient if the production elasticity is between 0 and 1 or 1 > EP > 0 (Mandei, 2011)

RESULTS AND DISCUSSION

The elasticity and scale productions of the use of production factors for rice farming in Sunggal District can be met if the elasticity value (**β**) is between 0 and 1. The closer to 1, the more technically efficient the rice farming is. Conversely, the closer to 0, the less technically efficient the rice farming is (Kaban et al., 2012). The production elasticity value in the Cobb Douglas production function is shown in the following table:

Table 3. Elasticity of Lowland Rice Production

Variable	Elasticity of Production
Constant	8.370
Land Area	1.030
Fertilizer	0.031
Labor Forces	0.018

Source: Primary Data Processed, 2024.

Land use is still in stage I, indicating overutilization of >1 (Ep = 1.030), indicating that the land area is inefficient and located at stage 1 of the production curve. An efficiency value greater than 1 indicates that the use of the production factor, land area, is inefficient and Land use is still in stage I, indicating overutilization and irrational input use. This situation could be addressed by farmers in Sunggal District, as larger land areas increase production. For the fertilizer variable, the elasticity value is <1 (Ep = 0.031), indicating that fertilizer is approaching technical efficiency and is located at stage 2 of the production curve. There are three types of fertilizers in this production factor: urea, phonska, and ZA. The average fertilizer use at the study site was 558.52 kg/ha. To achieve efficiency, farmers in Sungga District need to add urea, phonska, and ZA fertilizers. For the labor variable, the elasticity value is <1 (Ep = 0.018), indicating that labor is approaching elasticity and scale productions and is located at stage 2 of the production curve. For the labor variable, farmers must increase the number of workers to achieve elasticity and scale productions. If too many workers are added, rice production will not be proportional to the labor used. This is because the labor force in Sunggal District is clustered, with varying labor groups having varying numbers, causing the labor force to approach the efficient value.

Return to Scale (RTS)

The purpose of return to scale (RTS) analysis is to measure the production response to all factors of production, thus determining whether production output can be increased, maintained constant, or decreased. The RTS value can be determined by summing the elasticity coefficients of each factor of production. The logarithmic form of the Cobb-Douglas function regression analysis can be used to measure production elasticity (Soekartawi, 2002).

Table 4. RTS Production of Lowland Rice

Variable	Elasticity of Production
Land Area	1.030
Fertilizer	0.031
Labor Force	0.018
RTS	1,241

Source: Processed Primary Data, 2024

In the RTS analysis, it can be said that rice production is in a condition of increasing returns to scale because the sum of the coefficient values of production factors (land area, fertilizer, and labor) is 1.241 more than 1 ($\beta > 1$). This means that the addition of production factors will result in additional production output that is proportionally greater, for example, if the production factor is added by 10%, production will increase by 20% (Soekartawi, 2003). If there is a proportional increase in input of land area, fertilizer, and labor by 1%, it will cause an increase in rice production by 1.241%. At the research location, the amount of production can still be increased by adding inputs in the production process.

CONCLUSION

Rice farming in Sunggal District operates under increasing returns to scale (RTS = 1.241), indicating that proportional increases in land, fertilizer, and labor inputs can lead to more than proportional increases in output.

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