Efficiency analysis of red chili farming in Pidie Jaya Aceh

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Abstract. The application of production management is very important in farming, this is reflected in the farming of red chili as one of the contributing commodities to inflation in Indonesia. chili is a commodity that has the most fluctuating price movements, where the price indicator is a reference for a farmer in planting red chili, therefore a farmer must be able to determine the time and carry out production management, one of which is the efficiency of production factors where this efficiency ultimately affects the the amount of income received by farmers. The purpose of this study is to determine what factors affect production, factors that have been economically efficient and factors that affect income in the red chili farming in Pidie Jaya Regency. This study uses Cobb Douglas efficiency analysis and income analysis. The factors that influence the production of red chili farming in Bandar Baru and Trienggadeng Districts in Pidie Jaya Regency consist of seeds, compost, NPK, urea, KCL, TSP, pesticides and labor where the magnitude of the influence of the variable reaches 94.9%. The efficiency of production factors, namely compost, and KCL are not efficient, so it needs to reduce production factors, while seeds, NPK, urea, TSP, pesticides and labor are not efficient so need the addition of production factors. The influence of the factors of the amount of production, the selling price of red chili and production costs to the income of the farming of red chili in the District of Bandar Baru and the District of Trienggadeng in the District of Pidie Jaya that is equal to 91.90%.

1. Introduction

The development of the agricultural subsector is part of national agricultural development, where agricultural development is in line with the agricultural sector policy that Indonesia wants to achieve, namely food independence. One of them is the independence of the needs of the nine basic ingredients namely red chili.

Red chili is the most influential food product economically, where the increase in the price of red chili can have a direct impact on the national economy [8]. This can be seen every year before the month of Ramadan the government through the Ministry of Agriculture and the Ministry of Trade always try to keep the stock of red chili on the market so that the price of chili does not experience a surge, this surge can affect inflation derived from food.

Red chilli commodity inflation increased in line with increased demand due to religious and national days amid stable supply. The price of red chili increased by 19.57% (mtm), higher than...
last month's inflation of 14.81% (mtm). In line with red chillies, cayenne peppers also experienced inflation this month. The cayenne pepper inflation in May 2019 was 9.64% (mtm), an increase compared to the previous month's inflation of 4.04% (mtm). The increase in the price of red chillies and cayenne peppers this month was due to the growing demand for religious and national days amidst relatively stable supply. With this development, the price of red chili reached Rp36,605 / kg, while the price of cayenne pepper was Rp31,381 / kg. Annually, red chili experienced deflation of 0.43% (yoy), not as deep as last year's deflation of 14.95% (yoy). Meanwhile, cayenne pepper experienced inflation of 6.82% (yoy), lower than the end of last year which was inflation of 12.74% (yoy) [1].

The fall in the area of harvested land and the amount of red chili production in Aceh Province over the past 5 years is due to economic value and production costs [2]. As it is known that farming is very high cost and has the greatest risk compared to other farms, therefore the fluctuation in the area of harvested land and the amount of production is one of the causes is the factor of production costs and risk of farming.

In an effort to increase production, programs that have been implemented by the government include area expansion, intensification and extensification of farming, this has given encouraging results in terms of national red chili production, therefore the need for a sustainable effort. One of them is an effort to increase good productivity through extensification and intensification through the age of plants, diverse varieties, soil fertility, land and climate suitability, cultivation techniques that have not been intensive, and pest and disease factors. Red chilli farmers’ income is still low due to low crop productivity, fluctuating prices of red chili products, monoculture farming, and efforts to diversify red chilli products have not been fully implemented [3].

The area of red chili in Pidie Jaya reaches 107 hectares which is able to produce 334.1 tons of red chili in 2016 or the level of productivity reaches 3.12 tons / Ha, while in 2017 the land area reaches 186 Ha with production reaching 218.5 tons with productivity levels reaching 1.17 tons / Ha. This illustrates that there is a decrease in red chili production in Pidie Jaya Regency, both technical and non-technical factors, including technical patterns of cultivation, causing high crop failure, while non-technical factors are absorption and very volatile selling prices that affect the income of red chili farmers.

The use of production facilities that are not right on the red chili farming has the potential to decrease plant productivity, which in turn produces red chili that is not as expected. Indeed, the decrease in productivity of red chili can be influenced by climate factors, geographical conditions, and input input factors. Control of natural factors is indeed quite difficult to do because it is beyond the ability of farmers. But to manage the factors of production use this can be done by managing the use of production factors efficiently. Efficient use of production input is the maximum effort to optimize production input in obtaining maximum output [7] so that the production is optimal.

Based on Central Bureau of Statistics data [2] the productivity of red chili in Pidie Jaya Regency (2016 - 2017) shows that the productivity of red chili in Pidie Jaya in 2016 reached 3.12 tons / Ha, and in 2017 the land area reached 1.17 tons / Ha, it means that there is a production system in the red chili farming in Pidie Jaya Regency which is problematic namely in the production of red chili one of which is the use of production facilities.

This is reinforced by the statement of [4] which states that the majority of small farmers in developing countries behave risk aversion. Farmers' behavior to avoid risk results in inefficient allocation of input use, which in turn affects farm productivity levels. Regarding the above phenomenon where the factor of increased productivity of red chili production in Pidie Jaya Regency will provide opportunities for red chili farmers to be more active in their management, in addition to the need to increase farmers' insight on the potential decline in selling prices caused by flooding of chili production in the market, this will be a guideline for farmers regarding the timing of the cultivation of red chili plants as well as an increase in income by making efficient use of
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2. Methods
This study was conducted in Bandar Baru Subdistrict and Trienggadeng Subdistrict, Pidie Jaya Regency, the determination of the Subdistrict was carried out intentionally (Purposive Sampling) with the consideration that these two regions are one of the centers of production and marketing of red chili in Pidie Jaya Regency.

The large population of red chilli farmers from 4 selected sample villages is 720 households. The size of the sample is 10% of the total population, namely Kumba Village with 186 households taken by 19 households, Gahru with 198 households taken by 20 households, Tampui village by 185 households taken by 19 households and Deah Teumanah village by 151 households taken by 15 households. The total sample is 73 households.

The sampling method is stratified random sampling that is grouping samples into more homogeneous groups [6] the sample farmers include small farmers (<0.5 Ha), medium farmers (<0.5 - 1 Ha ) and large-scale farmers (> 1 Ha) [5].

Analysis of the stochastic frontier production function
The analytical tool used in this study is the Cobb-Douglas Production Function. The equation is transformed in a linear form into an equation:

\[
\ln Y = \ln \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + \beta_8 \ln X_8 + e
\]  
(1)

After that, the production function is converted into a double logarithmic model as follows:

Where :
- \( Y \) = Production (kg/ha/MT)
- \( X_1 \) = seed (kg/ha/MT)
- \( X_2 \) = K Fertilizer (kg/ha/MT) \( X_3 \)
- = NPK Fertilizer (kg/ha/MT)
- \( X_4 \) = Urea fertilizer kg/ha/MT
- \( X_5 \) = KCL fertilizer (kg/ha/MT)
- \( X_6 \) = TSP fertilizer (kg/ha/MT)
- \( X_7 \) = Pesticide (liter/ha/MT)
- \( X_8 \) = TK (HKP/ha/MT)

Efficiency analysis
Calculating the level of production input efficiency in lowland rice farming in West Aceh Regency, the condition of economic efficiency requires that NPM equals the price of production factors:
Analysis of farming income

\[ Z = a + b_1 Q_1 + b_2 Q_2 + b_3 Q_3 + e \]  

(2)

Where:
- \( Z \) = Farm Income (Idr / MT)
- \( a \) = constant
- \( b_1 - b_3 \) = regression coefficient
- \( Q_1 \) = production (kg / MT)
- \( Q_2 \) = Price (Sachet / MT)
- \( Q_3 \) = Production Costs (Kg / MT)
- \( e \) = error

3. Results

Analysis of the Cobb Douglas production function

The results of cobb douglas analysis are shown in Table 1.

Table 1. The Result of Cobb Douglas Analysis Lined into Double Logarithms on Seed Factors, Compost Fertilizers, NPK Fertilizers, Urea Fertilizers, KCL Fertilizers, TSP Fertilizers, Pesticides and Labor in the Study Area, 2019.

| Variabel         | Coefficient Regresi | T(DF =69) | Prob | T tabel |
|------------------|---------------------|-----------|------|---------|
| Constant (Y)     | 0.078               | 0.095     | 0.925| 0.05    |
| Seed (X1)        | 0.089               | 4.542     | 0.000| 1.669   |
| Compost F (X2)   | -0.002              | -3.036    | 0.004|         |
| NPK F (X3)       | 0.036               | 2.916     | 0.006|         |
| Urea F(X4)       | 0.004               | 3.486     | 0.005|         |
| KCL F(X5)        | -0.016              | -4.494    | 0.001|         |
| TSP F(X6)        | 0.014               | 3.185     | 0.004|         |
| Pesticide (X7)   | 0.014               | 2.812     | 0.007|         |
| Labor (X8)       | 0.757               | 5.168     | 0.000|         |

\[ R^2 = 0.827 \]

F count = 72.016, Tabel = 2.07

Furthermore, the results of the equation are linearized into the double logarithmic function asfollows:

\[ \ln Y = \ln 0.078 + \ln 0.089X_1 - \ln 0.002 X_2 + \ln 0.036X_3 + \ln 0.004 X_4 - \ln 0.016X_5 + \ln 0.014X_6 + \ln 0.014X_7 + \ln 0.757X_8 \]

The calculation results above show that each additional seed (X1) of 1 kg will cause an increase in production of 0.089 kg / farmer if the factors (X2, X3, X4, X5, X6, X7, and X8) are considered constant, then the hypothesis accept Ha and said Ho. For the seed variable (X1), it is obtained that \( t \) count = 4.542, while \( t \) table \( (\alpha = 0.05) = 1.669 \). Then \( t \) count > \( t \) table which means the null hypothesis is rejected and the alternative hypothesis is accepted at the level of 95%.

Each addition of compost (X2) of 1 kg will cause a decrease in production of 0.002 kg/ ha if the production factors (X1, X3, X4, X5, X6, X7, and X8) are considered constant, then the hypothesis accept Ha and reject Ho. For compost variable (X2) obtained \( t \) look = - 3.036, while \( t \) table \( (\alpha = 0.05) = 1.669 \). Then \( t \) count > \( t \) table which means the null hypothesis is accepted and the alternative
hypothesis is rejected at the level of 95%. Each addition of NPK fertilizer (X3) of 1 kg will cause an increase in production of 0.036 kg / ha if the production factors (X1, X2, X4, X5, X6, X7, and X8) are considered constant, then the hypothesis accept Ha and reject Ho. For NPK fertilizer variable (X3) obtained t count = 2,916, while t table (α = 0.05) = 1.669. Then t count > t table which means the null hypothesis is rejected and the alternative hypothesis is accepted at the level of 95%.

Every addition of urea (X4) by 1 kg will cause an increase in production by 0.004 kg / ha if the production factors (X1, X2, X3, X5, X6, X7, and X8) are considered constant, then the hypothesis accept Ha and reject Ho. For the variable Urea fertilizer (X4) obtained t count =3.486, while t table (α = 0.05) = 1.669. Then t count > t table which means the null hypothesis is rejected and the alternative hypothesis is accepted at the level of 95%.

Every addition of 1 kg KCL (X5) fertilizer will cause a decrease in production of 0.016 kg / ha if the production factors (X1, X2, X3, X4, X6, X7, and X8) are considered constant, then the hypothesis accept Ha and reject Ho. For the KCL fertilizer variable (X5) obtained t count = 4.494, while t table (α = 0.05) = 1.669. Then t count > t table which means the null hypothesis is rejected and the alternative hypothesis is accepted at the level of 95%.

Each addition of TSP fertilizer (X6) of 1 kg will cause an increase in production of 0.14 kg / ha if the production factors (X1, X2, X3, X4, X5, X7, and X8) are considered constant, then the hypothesis accept Ha and reject Ho. For TSP fertilizer variable (X6) obtained t count = 3.185, while t table (α = 0.05) = 1.669. Then t count > t table which means the null hypothesis is rejected and the alternative hypothesis is accepted at the level of 95%.

Each addition of pesticides (X7) of 1000 ml will cause an increase in production of 0.014 kg / ha if the production factors (X1, X2, X3, X4, X5, X6, and X8) are considered constant, then the hypothesis accept Ha and reject Ho. For the pesticide variable (X7) obtained t count = 2.812, while t table (α = 0.05) = 1.669. Then t count > t table which means the null hypothesis is rejected and the alternative hypothesis is accepted at the level of 95%.

Each addition of labor (X8) of 1 HKP will cause an increase in production by 0.757 kg / ha if the production factors (X1, X2, X3, X4, X5, X6, and X7) are considered constant, then the hypothesis accept Ha and reject Ho. For the variable labor (X8) obtained t count = 5.168, while t table (α = 0.05) = 1.669. Then t count > t table which means the null hypothesis is rejected and the alternative hypothesis is accepted at the level of 95%.

The results of the simultaneous testing carried out by the F test were obtained Fcount of 38.386 and Ftable (0.01) at a 95 percent confidence level of 2.07 with other words Fcount Ftable, this means that the seeds (X1), compost (X2), NPK fertilizer (X3), Urea fertilizer (X4), KCL fertilizer (X5), TSP fertilizer (X6), Pesticide (X7) and Labor (X8) have very significant effect on the production of red chili. Next to see the magnitude of the relationship between the efficiency of the use of production factors (Y) with seeds (X1), compost (X2), NPK fertilizer (X3), Urea fertilizer (X4), KCL fertilizer (X5), TSP fertilizer (X6), Pesticides (X7) and Labor (X8) used the coefficient of determination (R2). The results showed that R2 = 0.827, this means that 82.70 percent of the variable Y could be explained by variables X1, X2, X3, X4, X5, X6, X7, and X8, while the other 17.30 percent was explained by other factors outside research.

Efficiency Analysis of Production factors

Analysis of price efficiency on production factors can be seen in Table 2 as follows:
Table 2. Results of Efficiency Analysis of Seed Production Factors, Compost Fertilizers, NPK Fertilizers, Urea Fertilizers, KCL Fertilizers, TSP Fertilizers, Pesticides and Labor in the Study Area, 2019

| Production Factors | Regression Coefficient (a) | Average Production (Y) (Kg/Farmer) | Production Price, P_y (Rp/Kg) | Average Production Factor (X) (Sat/Farmer) | Production Factor Prices, P_x (Rp/Kg) | Rasio Efisiensi Ket |
|--------------------|-----------------------------|------------------------------------|-------------------------------|----------------------------------------|-------------------------------------|---------------------|
| Seed               | 0.089                       | 741,4                              | 28.933                        | 1.59                                   | 130,000                             | 9,193               | > 1                 |
| Compost            | -0.002                      | 741,4                              | 28.933                        | 1,026,03                               | 250                                 | -0,175              | < 1                 |
| NPK                | 0.036                       | 741,4                              | 28.933                        | 311,77                                 | 2,300                               | 1,065               | > 1                 |
| Urea               | 0.004                       | 741,4                              | 28.933                        | 34,74                                  | 1,800                               | 1,407               | > 1                 |
| KCL                | -0.016                      | 741,4                              | 28.933                        | 57,58                                  | 7,000                               | -0,835              | < 1                 |
| TSP                | 0.137                       | 741,4                              | 28.933                        | 52,42                                  | 5,500                               | 10,213              | > 1                 |
| Pesticide          | 0.014                       | 741,4                              | 28.933                        | 1,222                                  | 150                                 | 1,622               | > 1                 |
| TK                 | 0.757                       | 741,4                              | 28.933                        | 78,21                                  | 100,000                             | 2,076               | > 1                 |

Based on Table 2, the value of the ratio of marginal products to the prices of production inputs can be explained as follows:

a. Seed NPM has not been efficient (9,193) and therefore needs to be added in order to achieve efficiency.
b. NPM Fertilizer Compost is inefficient (0,175), therefore it is necessary to reduce its use.
c. NPM Fertilizer NPK is not efficient yet (1,065), therefore it is necessary to add more in order to achieve efficiency.
d. Urea fertilizer UPM is not efficient yet (1,407), therefore it is necessary to add more in order to achieve efficiency.
e. NCL of KCL fertilizer (X5) is inefficient (0,835), Therefore it is necessary to reduce its use.
f. NPM fertilizer TSP (X6) is not efficient yet (10,213), therefore it is necessary to add more in order to achieve efficiency.
g. Pesticide NPM (X7) is not efficient yet (1,622), therefore it is necessary to add more in order to achieve efficiency.
h. The labor NPM is not yet efficient (2,076), therefore it is necessary to add more in order to achieve efficiency.

Analysis of farming income

Here are some factors that influence the income of red chili farming in Pidie Jaya Regency or in further details, the relationship between the variable amount of red chili production (Q1), selling price of red chili (Q2), and production cost (Q3), fertilizer to farmland income of red chili (Z) in Pidie Jaya Regency, the multiple linear regression method is used as follows:

Table 3. Analysis results of factors affecting revenue of red chili farming in Bandar Baru subdistrict and Trienggadeng subdistrict, Pidie Jaya Regency, 2019

| Variabel            | Coefisien Regresi | T(DF =69) | Prob | Tabel |
|---------------------|-------------------|-----------|------|-------|
| Constant (Y) Production (Q1) | -7439507,434      | 10,486    | 0,000| 0,05 = 1.669 |
| Selling Price (Q2)  | 1437424,855       | 6,882     | 0,001|       |
| Production Cost (Q3)| 110092,363        | 4,308     | 0,007|       |
The test results simultaneously obtained price $F_{count} = 85.255$ while $F_{table}$ at $F (\alpha = 0.05) = 2.07$. Thus $F_{count} > F_{table}$, then the decision method is the null hypothesis is rejected and the alternative hypothesis is accepted at the level of 95% which means that the amount of red chili production ($Q_1$), the selling price of red chili ($Q_2$), and the cost of producing red chili ($Q_3$), towards the income of red chilli farming ($Z$) in Bandar Baru Subdistrict and Trienggadeng Subdistrict, Pidie Jaya Regency.

The closeness of the relationship that occurs between the independent variable with the dependent variable can be known by using the coefficient of determination ($R^2$). The calculation results obtained $R^2 = 0.919$ means that 91.90% of the variation that occurs in farm chili income is influenced by the amount of production of red chili ($Q_1$), the selling price of red chili ($Q_2$), and the cost of production of red chili ($Q_3$), while the rest is 8.10% is explained by other variables outside the research model.

The multiple linear regression equation:

$$Y = -7439507.434 + 1437424.855 Q_1 + 110092.363 Q_2 - 0.177 Q_3$$

Based on the analysis results can be seen the regression equation as follows:

a) For every additional production of red chili by 100 kg, the income of the red chili farming will increase by 1,437,424,855 Idr per MT. If seen partially, then $t_{count} = 6.882 > t_{table} = 1.669$.

b) Every additional increase in the selling price of red chili ($Q_2$) by 1,000 Idr per kg, the income of the red chilli farming will increase by 110,092,363 Idr per MT. If seen partially then $t_{count} = 4.308 > t_{table} = 1.669$.

c) Each additional cost of production ($Q_3$) of 1 Idr, -, the income of red chilli farming will decrease by 0.177 Idr per MT. If seen partially, then $t_{count} = 3.541 > t_{table} = 1.669$.

4. Conclusions
Factors that influence the level of production in Pidie Regency's red chili farming consist of seeds, compost fertilizer, NPK fertilizer, urea fertilizer, KCL fertilizer, TSP fertilizer, pesticides and labor where the magnitude of the influence of the variable reaches 82.70%.

Based on Cobb Douglas analysis, it is obtained the coefficient value of the compost production factor and KCL fertilizer which has a negative effect on the production of red chili, while the use of the factors of seed production, urea, TSP, pesticides and labor has a positive effect on the production of red chili in Pidie Jaya Regency, seen from the level of efficiency, compost and KCL are inefficient so the need for measures to reduce the use of production factors, while for seeds, NPK, urea, TSP, pesticides and labor, the efficiency level is not efficient, so it is recommended to add production factors. The influence of factors of production amount, selling price of red chili and production costs the income of farming of red chili in Bandar Baru and Trienggadeng Districts of Pidie Jaya Regency that is equal to 91.90%
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