Analysis economic efficiency use of production factors corn farming on marginal land in South Sulawesi

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Abstract. The UPSUS program to increase corn production in marginal land is strived to implement the recommended technology package so that it can add value to increasing corn productivity. The purpose of this study is to determine the factors of production that affect corn farming on marginal land. This research was conducted on less than optimal land in the village of North Tolo, Kelara District, Jeneponto Regency, South Sulawesi. Using survey and interview methods using a structured questionnaire, the selection of respondents was done by accidental sampling, the number of respondents determined using the Slovin formula as many as 92 respondents. The analysis used is the Cobb Douglas analysis. The results of the analysis indicate that the variable land area significantly influences corn production at a 95% to 99% confidence level or a significance value of 0.05. While the factors of seed production, labor, manure, and pesticides do not have a significant effect seen from the significance value greater than the level of significance tested (0.05). Economically the use of corn production inputs in marginal land is considered less efficient and the effect of production inputs on output is not elastic, this shows a lower increase in output when compared to an increase in input. use input is already in an unfavorable condition (decreasing return to scale) and marginal input productivity starts to decline.

1. Introduction

South Sulawesi is one of the main corn-producing provinces in Indonesia after East Java, Central Java and Lampung. The harvested area and maize production in South Sulawesi in 2018 reached 420,984 ha and 2,341,659 tons with a productivity of 5.56 t / ha [1]. Its productivity is still low compared to the productivity of research results which reach 7-8.5 t / ha [2],[3]. Corn production growth in 2018 has decreased by 2.13% compared to 2017 [1]. The decline in production was caused by a decrease in harvested area and productivity simultaneously [4],[5]. Some technical problems that cause low corn productivity include climate disturbances which are often in the form of rain stagnation in the period of plant growth, lack of input used by farmers, use of less-quality seeds, and most farmers use varieties of hybrid yields in the previous year[6],[7],[8]. Expansion of the area can be directed at potential land, such as irrigated fields, rain-fed rice fields, and dry land that has not been utilized for agriculture. Corn producing regions in the province of South Sulawesi include Bone, Jeneponto, and Gowa Regencies.

The three districts are dry land corn development areas. Whereas to increase the cropping index by utilizing paddy fields that are not planted with rice is in the northern part of South Sulawesi, namely the districts of Sidrap, Wajo, and North Luwu. In addition, efforts to develop corn require increased production efficiency, strengthening farmer institutions, improving production quality, increasing added value, increasing capital systems, developing infrastructure, and regulating trading systems. Therefore,
the implementation of the UPSUS program to increase maize production on sub-optimal land is strived to implement a corn production technology package, ranging from the addition of land area, intensive assistance in the form of seeds, fertilizers and agricultural machinery and irrigation improvements that affect the increase in maize production on land sub-optimal with the aim of introducing a corn technology package in sub-optimal land that can add value to productivity and production of farming, based on this it is necessary to study the factors of production that affect corn farming system, especially in sub-optimal land.

2. Materials and Methods

2.1. Place and time
This research was carried out on sub-optimal land namely North Tolo, Kelara Regency, Jeneponto Regency, South Sulawesi. The choice of location is based on the consideration that the location is a sub-optimal region that has the potential for corn development.

2.2. Sample Determination
Respondents were determined using the accidental sampling method, the number of samples was 92 respondents, determined using the Slovin formula with a confidence interval of 90% with assuming that population conditions in homogeneous conditions.

2.3. Data collection
Assessment uses survey and the materials interview methods to use structured questionnaires. The data used are primary data that is research data obtained directly from the original source without going through intermediaries in this study. The resource persons are farmers in corn development areas, and secondary data are research data obtained indirectly, namely data obtained from related institutions.

2.4. Data Analysis

2.4.1. Analysis of factors of production
The model used for representation of the relationship between input with output in process production using the Cobb Douglas function with function applications Frontier To estimate the factors that affect output (Y), the Cobb-Douglas models a relevant model. Mathematical model of frontier functions:

\[ \ln Y = b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + e_i \]

Where :
\( \ln Y \) = Ln production
\( \ln X_1 \) = Ln land area
\( \ln X_2 \) = Ln seed
\( \ln X_3 \) = Ln labor
\( \ln X_4 \) = Ln manure
\( \ln X_5 \) = Ln pesticide
\( b_1, b_2 \) = Regression coefficient
\( e \) = Error (error term)

F test is done to find out are all independent variables used jointly significant effect on dependent variable.

Hypothesis:

\[ H_0: b_1 = b_2 = \ldots = b_5 = 0 \]
\[ H_1: \text{there is at least one } b_i \neq 0 \]

Form of Hypothesis:

\( H_0: b_i = 0 \) means the observed factor no effect on production.
\( H_1: \text{at least one } b_i \neq 0 \) means that the influence of the observed factors significantly affects production
If F-count > F-table, then \( H_0 \) is rejected meaning together independent variables significant effect on the dependent variable.
If F-count ≤ F-table, then \( H_0 \) cannot rejected means the shared variable independent no significant effect on the dependent variable.
T test was carried out to find out whether each free variable is significant to the dependent variable.

Hypothesis:
H0 : bi = 0
H1 : bi ≠ 0

Form of Hypothesis:
Ho: bi = 0 means the factors are observed no significant effect on production.
H1: at least one bi ≠ 0 means that the observed factors have an significant effect on production.

If t arithmetic > t table, then H0 is rejected means individual variables independent significant effect on dependent variable.
If t arithmetic ≤ t table, then H0 is accepted Independent individual variables have no significant effect on dependent variable.

2.4.2. Analysis Economic Efficiency
To find out whether useproduction factors reach optimal conditions done by looking at the comparison between physical product marginal factor of production with the price of the factors of production, so that it can written as follows:

\[
\frac{(NPMXi (VMP))}{PXi} = k, \text{ then } k = 1
\]

Note:
Y = Average Y;
Py = average price Y;
Xi = X average;
Pxi = average price X to i
NPMXi = value of marginal product

That if k = 1, then the factor production must be fully used, so it does not need to be added or subtracted.
Furthermore.
If k> 1, then the factors of production have not been used efficiently, so needs to be added. Finally
If k <1, the factor of production is not used efficient so it needs to be reduced.
The analysis method using the Cobb Douglas production function model is processed with the help of SPSS software.
3. Results and Discussion

3.1. Characteristics of Respondents

![Figure 1. Characteristics Of Respondent Farmers](image)

3.2. Characteristics of Production Technology

Technology characteristics of maize production in Sub optimal land in Jeneponto Regency in the use of seeds and fertilizing.

![Figure 2. The Average Use Of Production Inputs On Corn](image)
Not all respondents use complete type fertilizer. Almost all farmers use urea fertilizer. There is an assumption that if high corn production is desired, the plant must be given urea fertilizer. This shows that respondents have not fully used complete production technology according to recommendations. Actually, to get high yields, input support is needed, especially fertilizer that is suitable to the needs of the plant and is not excessive [9]. At the research location, almost all farmers used hybrid varieties. Especially for the use of hybrid corn seeds, to get high yields, farmers must provide balanced fertilization both in the type of fertilizer and the amount. If the type and amount of fertilizer given is insufficient, corn production will decrease [10], [11], [12].

3.3. Relationship between Factors of Production with Corn Production Results

Estimation to determine the effect of independent variables on the dependent variable is done using multiple linear regression models by adopting the Cobb-Douglas production function, as follows:

Table 1. Analysis of Various Factors Affecting Corn Production.

| Model     | Sum of Squares | Df | Mean Square | F       | Sig. |
|-----------|----------------|----|-------------|---------|------|
| Regression| 16.598         | 5  | 3.320       | 27.185  | .000 |
| Residual  | 4.152          | 34 | .122        |         |      |
| Total     | 20.750         | 39 |             |         |      |

Notes: a. Predictors: (Constant), Ln_Pesticides, Ln_Seed, Ln_TK, Ln_Pukan, Ln_LL
b. Dependent Variable: Ln_Prod

Table 1. Shows that Fcount = 27.185 with sig = 0.000 <0.01 proves rejecting the null hypothesis (H0) at \( \alpha = 1\% \), which means that the independent variables are land area (X1), seed (X2), labor (X3), manure (X4) and herbicide (X5) simultaneously (together) affect maize production in North Tolo District, Kelara District, Jeneponto Regency, South Sulawesi. The estimation results of the influence of the independent variables on the dependent variable in the form of multiple linear regression models are presented in Table 2.

Table 2. Results of Analysis of the Effects of the Use of Corn Production Factors

| Model     | Koefisien Regresi | T    | Sig. |
|-----------|-------------------|------|------|
| 1         | (Constant)        | 6.735| .000 |
|           | Ln_LL             | .450 | 6.898| .000 |
|           | Ln_Seed           | -.048| -.507| .615 |
|           | Ln_TK             | .001 | .013 | .990 |
|           | Ln_Pukan          | .075 | 1.413| .167 |
|           | Ln_Pesticides     | .275 | 1.707| .097 |
|           | R-Square          | .800 |      |      |
|           | Adjusted R Square | .770 |      |      |
|           | F-hitung          | 27.185|      | 0.000|
|           | F-tabel           |      |      |      |
|           | \( \alpha 1\% = 3.61 \) |      |      |      |
|           | \( \alpha 5\% = 2.49 \) |      |      |      |
|           | t tabel           |      |      |      |
|           | \( \alpha 1\% = 2.7333 \) |      |      |      |
|           | \( \alpha 5\% = 2.0345 \) |      |      |      |

Notes: Ln Prod = Corn Production (kg); 6,736 = Constants, Ln LL = Land area (ha), Ln Seed = Number of Seeds used (kg), Ln TK = Number of Workers (HOK), Ln Pukan = Number of Manure (kg), Ln Pesticides = Amount of pesticides (kg)

In Table 2. The linear regression model can be made for this study as follows:

\[ \text{Ln Prod} = 6.736 + 0.450 \text{Ln LL} - 0.048 \text{Ln Seed} + 0.001 \text{Ln TK} + 0.075 \text{Ln Pukan} + 0.275 \text{Ln Pesticides} \]
Based on the table above obtained; F arithmetic = 27.185 Significant = 0.000 and F table value = 2.49. Because significant Fcount> Ftable or sig <α (5%) then reject HO (accept H1) means, the ability of the model in explaining the variation of Y is 80.0% significant at α = 5%, thus the model is worth seeing from the Test of Goodness of Fit, Test partially (t-test), to determine the effect of each independent variable (variable land area, number of seeds, external labor, amount of fertilizer cage, and the amount of pesticides) to the level of corn production or to the dependent variable.

The hypothesis is as follows:

HO: bi = 0 means that there is no significant independent variable (land area, number of seeds, external labor, amount of manure, and amount of pesticides) on the dependent variable (corn production),

H1: bi # 0 means, there is a significant influence of independent variables (land area, number of seeds, external labor, the amount of manure, and the amount of pesticides) on the dependent variable (corn production)

In Table 2, it can be stated that the coefficient of determination (R2) is 0.80. This shows that the independent variables (X) that affect production (Y) by 80%, while the remaining 20% are influenced by other factors outside the model.

Land Area (X1). Land area variable significantly influences maize production. This is due to the greater land area, the greater the production produced by respondent farmers. Where tcount 6.898> ttable 2.7333 at 99% confidence level. Thus the land area variable (X1) has a significant effect on corn production so that H0 is rejected and H1 is accepted. While the regression coefficient of land area of 0.450 means that each additional land area of 1% will increase corn production by 4.50% with the assumption that other factors are considered constant.

Seeds (X2). Based on the results of the analysis showed that the regression coefficient of seed variables did not significantly affect maize production in the North Tolo Village, where tcount 0.507 <ttable 2.7333 at 99% confidence level. Thus the seed variable (X2) has no significant effect on corn production so H0 is accepted and H1 is rejected. Seed regression coefficient of 0.048 means that each seed increase of 1% will increase corn production by 0.48%.

Fertilizer (X3) The results of the analysis show that the labor variable (X3) has no significant effect on corn production. This can be seen from the results of the t-test which showed that the t-value of 0.013 < ttable 2.0345 at the α level of 5% so that the labor variable had no significant effect on corn production so that H0 was accepted and H1 was rejected. The labor regression coefficient value of 0.001 means that the addition of fertilizer by 1% will increase corn production by 0.01% with the assumption that other factors are considered constant.

The results of the analysis showed that the variable manure (X4) had no significant effect on corn production. This is evident from the results of the t-test which showed that the t-value of 1.413 < ttable 2.0345 at the α level of 5% so that H0 was accepted and H1 was rejected. Regression coefficient value of manure of 0.075 means that each addition of labor by 1% will increase corn production by 0.75%.

The analysis showed that the pesticide variable (X5) had no significant effect on corn production. This can be seen from the results of the t-test which showed that the t-value of 1.707 < ttable 2.0345 at the α level of 5% so that H0 was accepted and H1 was rejected. Regression coefficient value of manure of 0.275 means that each addition of labor by 1% will increase corn production by 0.275%.

T test (t-test) is done and look for the probability value in the HO hypothesising region as an indicator of its significance. Partial test results (t-test) of the model by means of SPSS 19 can be seen in Table 3.
Table 3. Partial test results (t-test) SPSS models

| Variabel | B   | T Calculate | significance | Standart | Conclusion   |
|----------|-----|-------------|--------------|----------|--------------|
| LnLL     | 0.450 | 6.898       | 0.000        | 0.01     | H0 rejected  |
| LnBenih  | -0.048 | -0.507      | 0.615        | 0.01     | H0 received  |
| LnTK     | 0.001 | 0.013       | 0.990        | 0.05     | H0 received  |
| LnPukan  | 0.075 | 1.413       | 0.167        | 0.05     | H0 received  |
| LnPesticides | 0.275 | 1.707       | 0.097        | 0.05     | H0 received  |

Based on the table above, it can be seen that only the land area variable (Ln LL) is significantly different from the production variable. This can be seen from the significance of 0.000 <0.05, which means rejecting the hypothesis H0. This explains that in a partial analysis there is a significant effect of land area on maize production.

3.4. Analisis Return To Scale (RTS)
The RTS value from the analysis results is obtained that RTS value for corn production, namely:
RTS = coefficient (Ln LL + Ln Seed + Ln TK + Ln Pukan + Ln Pesticides)
= 0.450 - 0.048 + 0.001 + 0.075 + 0.275 = 0.753

If RTS <1 (Decreasing return to scale), meaning that the proportion of the addition of production factors (inputs) will exceed the increase in production (output), this means the assumption applies that in a reduced legal state or the law of return decreases for each input i, so information obtained can be used so that each addition of production inputs can produce additional production that is greater (elastic), it can be interpreted that every time there is additional input to corn farming it is expected to produce greater production. This shows an increase in output output overLow when compared to the increase in these inputs. means use the input is already in an unfavorable condition (return decreases) for scale) and marginal input productivity has begun to decline.

3.5. Economic Efficiency of the Use of Factors Production
Technical efficiency analysis can be seen from the regression coefficients of each variable, this is because the coefficient of each variable is the production elasticity of the independent variable. a production will reach a favorable level when the elasticity value is between 0 and 1 or 0 <Ep, ie when the production process is in a rational area

Based on the sum of the regression coefficients the factors of production are obtained elasticity. The coefficients of each of these variables are the Production Elasticity of the independent variables (land area, number of seeds, labor, amount of manure, and amount of pesticides). A production will reach a beneficial level if the elasticity value is between 0 and 1 or 0 <Ep, this explain that the production process is in the rational region

Based on the results of the response analysis it can be seen that:
1) the elasticity Land use value is between 0 and 1 or 0 <Ep that is 0.450, this can be interpreted that land use is at a disadvantage and the increase in production is relatively lower despite the added area of land
2) the elasticity value is between 0 and 1 or 0 <Ep that is 0.048 the use of seeds, this can be interpreted that the use of seeds is at a disadvantage and the increase in production is relatively lower if done on the number of seeds
3) the elasticity is between 0 and 1 or 0 <Ep, which is 0.001 the use of labor, this can be interpreted that the use of labor is at a disadvantage and the increase in production is relatively lower despite an increase in the number of workers
4) the elasticity value is between 0 and 1 or 0 <Ep that is 0.075 the use of manure, this can be interpreted that the use of manure in an unfavorable position and increased production is relatively lower despite an increase in the amount of manure.
5) the elasticity value is between 0 and 1 or 0 < Ep that is 0.275 the use of pesticide, this can be interpreted that the use of pesticides in production is unprofitable and increases relatively lower despite an increase in the amount of pesticide use.

Allocative happens if farmers are able to make an effort if the marginal product value (NPM) from production inputs the same as the input price (Px).

| Description   | B     | Y     | Py   | &     | PR   | NPM              | Px     | K     |
|---------------|-------|-------|------|-------|------|------------------|--------|-------|
| Land area     | 0.450 | 4138.68 | 2300 | 0.93  | 3848.97 | 8852625.825     | 350000 | 25.29 |
| Seed          | -0.048| 4138.68 | 2300 | 17    | 70357.48 | 161822192.5     | 38788  | 4171.93|
| Labor         | 0.001 | 4138.68 | 2300 | 2     | 8277.35  | 19037905        | 104937.5| 181.42|
| Fertilizer    | 0.075 | 4138.68 | 2300 | 167   | 691158.73 | 1589665068      | 167000 | 9518.95|
| Pesticide     | 0.275 | 4138.68 | 2300 | 3     | 12416.03 | 28556857.5      | 192187.5| 148.59|

Variable land area with a value of k = 25.29> 1 and t test statistics show t arithmetic = 6.898> t table = 2.733 at α1% two-way test, indicating reject H0, meaning that the use of land for corn farming in terms of price inefficient or still less, so it needs to be expanded, in order to maximize the production of corn which will later increase the income of corn farmers. Besides, expansion land can be done by utilizing land that was not planted with corn before for example moor land, or rice fields originally only planted rice all year round, can be interspersed with planting corn one or two growing seasons.

Seed Variables with a value of k = 4171 > 1 and the t test statistics show t arithmetic = 0.507 < t table = 2733 at the α level of 1 % two-way tests, indicating that accepting H0, rejecting H1, means the use of seeds in corn farming in terms of economic efficiency is inefficient or less than optimal conditions so the use of inputs needs to be added.

Labor Variables with a value of k = 181.42> 1 and the t test statistics show t arithmetic = 0.13 < t table = 2.0345 at the α level of 5% two-way tests, indicating that accepting H0, rejecting H1, means the use of labor in corn farming shows its use is inefficient or less than optimal conditions so that the use of labor input needs to be added.

Fertilizer variable with a value of k = 9518.95> 1 and t test statistics show t arithmetic = 1.413 < t table = 2.0345 at the α level of two-way test 5%, determine accepting H0, reject H1, means the use of manure on corn farming shows its use is inefficient or less than optimal conditions and does not comply with fertilization instructions so the use of fertilizer inputs needs to be added.

Pesticide variables with a value of k = 148.59> 1 and t test statistics show t arithmetic = 1.707 < t table = 2.0345 at α 5% two-way test, means accepting H0, rejecting H1, this means that the use of pesticides in corn farming shows its use is inefficient or less than optimal conditions so the use of fertilizer inputs needs to be added because of the consideration of the number of pests and diseases in corn plants. Addition to the use of solid pesticides will reduce the risk of damage to corn plants caused by pests and diseases so corn production can increase. NPMxi / Pxi value for the factor of production soil, seeds, labor, manure, and pesticides are greater than intended use factors of production are inefficient and their use is not optimal so to increase economic efficiency, factors of production need to be added.

### 4. Conclusion

The results of the study showed that the variable land area significantly affected the production of maize at a 95% to 99% confidence level. Economically the use of corn production inputs in marginal land is considered less efficient and the effect of production inputs on output is not elastic, this shows a lower increase in output when compared to an increase in input. Use input is already in an unfavorable condition (decreasing return to scale) and marginal input productivity starts to decline.
5. Acknowledgements
The author thanks the agricultural research and development institute that funded this research activity, and sincere appreciation to farmers and extension workers, especially extension workers in North Tolo, Kelara Regency, Jeneponto Regency, South Sulawesi in helping to provide the information needed, as well as colleagues. researchers who contributed expertise and time to the process of reviewing and reviewing this paper to guarantee quality and impact substantially.

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