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The Effect of Production Input Use on Corn Productivity on Sloping Land in Ulapato B Village

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Abstract

Corn is a strategic food crop that plays an important role as a source of food, feed, and industrial raw material. However, corn productivity on sloping land remains constrained by the risks of erosion, nutrient loss, and variation in production input use among farmers. This study aimed to analyze the effect of production input use on corn productivity on sloping land in Ulapato B Village. A quantitative approach using a survey method was applied to 61 corn farmers. The data were analyzed using multiple linear regression with a Cobb-Douglas production function approach. The independent variables consisted of seed, urea fertilizer, Phonska fertilizer, pesticide, HKSP/labor input, and a land-slope dummy variable, while the dependent variable was corn productivity. The results showed that the regression model had a significant simultaneous effect, with an F-statistic of 13.225 and a significance value of p < 0.001. The R Square value of 0.595 indicated that the independent variables explained 59.5% of the variation in corn productivity, while the remaining 40.5% was explained by factors outside the model. Partially, seed had a positive and significant effect on corn productivity, whereas pesticide had a negative and significant effect. Meanwhile, urea fertilizer, Phonska fertilizer, HKSP/labor input, and the land-slope dummy variable had no significant effect. These findings indicate that corn productivity on sloping land is more strongly determined by appropriate seed use and pesticide management than by fertilizer use, labor input, or differences in land-slope categories.

Keywords: corn, production inputs, productivity, sloping land, Cobb-Douglas.

INTRODUCTION

Corn (Zea mays L.) is a strategic food crop that plays an important role in Indonesia's food system and agricultural economy. This commodity is used as food,

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animal feed, and industrial raw material. Statistics Indonesia reported that the average national corn productivity based on the 2024 Crop-Cutting Survey reached 59.40 quintals per hectare, or approximately 5.94 tons per hectare, with productivity varying across regions and land types (Badan Pusat Statistik, 2025a). These data indicate that increasing corn productivity remains an important issue, particularly in areas with biophysical land constraints.

Gorontalo Province is one of the corn development areas in Indonesia. Corn is a leading regional commodity supported by a dryland potential of 383,769 ha (Ferdinantara & Hidayat, 2023). However, corn productivity in Gorontalo remains suboptimal, at approximately 4.7 tons per hectare, which is lower than the national average of 5.8 tons per hectare (Mado & Firmansyah, 2022). This condition indicates that increasing corn productivity remains a major challenge, especially in areas with biophysical constraints such as sloping land.

At the farm level, corn productivity is influenced by production input use and agroecological conditions. Production inputs such as seed, fertilizer, pesticide, and labor support crop growth and yield formation. However, increasing input use does not necessarily increase productivity when it is not supported by appropriate dosage, application timing, input quality, and suitability to land conditions. In production economics, the relationship between inputs and output is commonly analyzed using the Cobb-Douglas production function because it can explain the production elasticity of each input and can be transformed into logarithmic form for regression estimation (Debertin, 2012).

Productivity problems become more complex on sloping land. Sloping land has a higher risk of erosion, surface runoff, topsoil loss, and declining soil fertility. FAO explains that soil erosion can reduce soil health and productivity because fertile topsoil is removed, thereby reducing agricultural productivity (FAO, 2023). Therefore, on sloping land, soil management, cropping patterns, and production input use are important factors in maintaining corn productivity.

Studies on sloping land indicate that soil conservation techniques play an important role in reducing erosion and maintaining corn productivity. Neswati et al. (2023) reported that corn cultivation on sloping land in Gorontalo with slopes of approximately 15-30% requires conservation techniques because erosion may still exceed the tolerance limit. The study also showed that corn production on sloping land can exceed 6 tons per hectare under appropriate management. This finding indicates that sloping land is not necessarily associated with low productivity, but its productivity is strongly influenced by land management practices and production input use.

Ulapato B Village is one of the areas where corn farming is conducted on sloping land, including sloping and steep land categories. These conditions may create cultivation

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constraints such as erosion, surface runoff, nutrient loss, and differences in the effectiveness of production inputs. At the same time, farmers use production inputs such as seed, urea fertilizer, Phonska fertilizer, pesticide, and labor in varying amounts. Differences in input use are therefore suspected to cause differences in corn productivity among farmers.

The main problem addressed in this study is the uncertainty regarding which production inputs have the greatest influence on corn productivity on sloping land in Ulapato B Village. Although farmers cultivate corn on both sloping and steep land, input use among farmers is not uniform. Therefore, differences in seed, urea fertilizer, Phonska fertilizer, pesticide, labor, and land slope conditions need to be empirically analyzed to identify the factors that significantly affect corn productivity.

The novelty of this study lies in integrating physical production input variables with sloping-land characteristics in one model of farm-level corn productivity analysis. Unlike previous studies that focused more on soil conservation aspects or general farm analysis, this study treats seed, urea fertilizer, Phonska fertilizer, pesticide, labor, and a land-slope dummy variable as explanatory factors of corn productivity on sloping land. Based on this background, the study aims to analyze the effect of production input use on corn productivity on sloping land in Ulapato B Village.

LITERATURE REVIEW

Corn

Corn is a strategic food commodity and is one of the main contributors to the national food subsector after rice (Rohi et al., 2018). Corn productivity in Indonesia remains relatively low and varies across regions. The national average corn productivity has been reported at approximately 5.474 tons/ha (FR et al., 2022), while in some areas productivity is much lower. In Madura, for example, local corn productivity reaches only 0.9-1.0 tons/ha and hybrid corn productivity ranges from 1.4 to 4.2 tons/ha, although the land potential may reach 5-6 tons/ha (Hasan & Fauziyah, 2020). In Lampung Province, corn productivity was reported at 5.074 tons/ha (Fitriani et al., 2016), whereas in the Lawo Watershed, Soppeng Regency, it was only 3.57 tons/ha, lower than the national productivity level (Harjianto et al., 2016).

In several regions of Indonesia, corn is also used as a staple food and an alternative functional food source (Hidayat et al., 2022). In Grobogan Regency, Central Java, for instance, the community consumes sego jagung, a traditional food made from coarsely ground corn that is steamed to resemble the texture of rice. This reflects a long-standing local food culture (Santhyami & Yunita, 2024). Grobogan itself contributes 21.8% of total corn production in Central Java (Santhyami & Yunita, 2024).

Corn Productivity in Indonesia

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Production Factors

Production factors are resources used in farming activities to generate output. In agriculture, the main production factors include land, labor, capital or production facilities, and management. Soekartawi (2002) explains that farming is an activity of organizing production factors to obtain output and income, while Mubyarto (1989) states that land, labor, capital, and management are essential elements in agricultural economics. In corn farming, these production factors include seed, fertilizer, pesticide, labor, and land conditions. Debertin (2012) explains that the relationship between inputs and output can be analyzed using a production function, including the Cobb-Douglas model, to determine the effect of each input on production. Thus, appropriate use of production factors is important for improving corn productivity, particularly on sloping land with biophysical limitations.

Cobb-Douglas Production Function

A production function represents the technical relationship between inputs used in a production process and the output produced. In agricultural production economics, the production function is used to analyze how strongly production factors influence the resulting output. One widely used form of production function in agricultural research is the Cobb-Douglas production function. This model is commonly applied because of its simple form, its ability to be transformed into natural logarithms, and its capacity to interpret coefficients as production elasticities. Debertin (2012) explains that the production function in agricultural economics is used to describe the relationship between input and output in the production process. Through the Cobb-Douglas production

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function, researchers can analyze the effect of each production input on output or productivity.

Effect of Sloping Land on Corn Productivity

Land slope is a geographic factor that can influence corn productivity. A study in Boalemo Regency showed that corn production was relatively stable at slopes of 20-30%, declined in each season at slopes of 30-40%, and decreased sharply to only 2-3 tons at slopes of 50-60% (Mamangkay et al., 2023). The fertility status of farmers' sloping land generally shows very low nitrogen and carbon levels, although phosphate and potassium levels may be high (Mamangkay et al., 2023). Land slope affects the physical, chemical, and biological properties of soil by accelerating soil detachment and transport, which ultimately reduces soil productivity (Mamangkay et al., 2023).

METHODOLOGY

Location and Time

This study was conducted in Ulapato B Village in 2025. The location was selected purposively because the village has corn farming activities on sloping land, including sloping and steep land categories. This condition is consistent with the focus of the study, namely the analysis of corn productivity on sloping land based on production input use.

Data Type

This study used a quantitative approach with a survey method. The main data were primary data obtained from corn farmers through interviews and farm-record collection. The data collected included corn production, land area, seed use, urea fertilizer, Phonska fertilizer, pesticide use, HKSP/labor input, and land slope conditions. Secondary data were obtained from literature, statistical publications, and previous studies relevant to corn productivity, production input use, and sloping-land management.

Population and Sample

The population in this study consisted of all corn farmers in Ulapato B Village who cultivated corn on sloping land, totaling 156 farmers. The sample size was determined using the Slovin formula with a 10% margin of error, resulting in 61 respondents. The sampling technique used was proportionate stratified random sampling, in which samples were selected randomly and proportionally based on land slope categories, namely sloping land and steep land. This technique was used to ensure that each sloping-land category was represented in the study sample.

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Data Analysis

The data were analyzed using multiple linear regression with a Cobb-Douglas production function approach. The Cobb-Douglas model was selected because it is suitable for analyzing the relationship between production inputs and output or productivity. This model also allows input coefficients to be interpreted as production elasticities when the variables are expressed in natural logarithmic form. Data processing was carried out using statistical software. The general Cobb-Douglas model used in this study was transformed into natural logarithmic form as follows:

$$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 D + e$$

where:
Y = Corn productivity (kg/ha)
X1 = Seed use (kg/ha)
X2 = Urea fertilizer (kg/ha)
X3 = Phonska fertilizer (kg/ha)
X4 = Pesticide use (L/ha)
X5 = Labor input (HKSP/ha)
X6 Dummy = Land slope dummy variable (0 = sloping land; 1 = steep land)
beta0 = Intercept or constant
beta1-beta6 = Estimated regression coefficients
e = Error term

The coefficient of determination (R2) was used to determine the ability of the independent variables to explain variation in the dependent variable in the regression model. The R2 value indicates the proportion of variation in the dependent variable that can be explained by the independent variables. The larger the R2 value, the better the model explains the relationship among variables. According to Harlan (2018), the coefficient of determination can be calculated by comparing the regression sum of squares with the total sum of squares.

Hypothesis

Hypothesis in this study was conducted using the F-test and t-test. The F-test was used to determine the simultaneous effect of the independent variables on the dependent variable, while the t-test was used to determine the partial effect of each independent variable. The decision criterion was based on the significance value at the 5% level. If the significance value was less than 0.05, the independent variable was considered to have a significant effect on the dependent variable, either simultaneously or partially. Conversely, if the significance value was greater than 0.05, the independent variable was considered not to have a significant effect. Data processing was conducted using SPSS,

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and interpretation was based on the regression coefficient, F-statistic, t-statistic, and significance value (Gujarati & Porter, 2009; Ghozali, 2018).

RESULTS

The research data were obtained from 61 corn farmers in Ulapato B Village. The respondents were farmers who cultivated corn on sloping land, including sloping and steep land categories. Corn productivity was calculated based on corn production per hectare. Production input use was converted into per-hectare units to reduce bias caused by differences in land area among farmers. Data cleaning was conducted by checking measurement units, identifying extreme values, and applying natural logarithmic transformation to productivity and physical input variables.

Corn productivity values were within a reasonable range for corn farming conditions, namely several tons per hectare. This range is consistent with information from Statistics Indonesia, which reported national corn productivity at approximately 5.94 tons per hectare based on the 2024 Crop-Cutting Survey (Badan Pusat Statistik, 2025a). This indicates that the productivity data used in the analysis became more appropriate after unit correction and variable transformation.

Classical Assumption Tests

Classical assumption tests were conducted to assess the suitability of the regression model used in this study. These tests aimed to ensure that the regression model met the basic assumptions required for estimating the effect of independent variables on the dependent variable. The classical assumption tests in this study included normality, heteroscedasticity, multicollinearity, and autocorrelation tests.

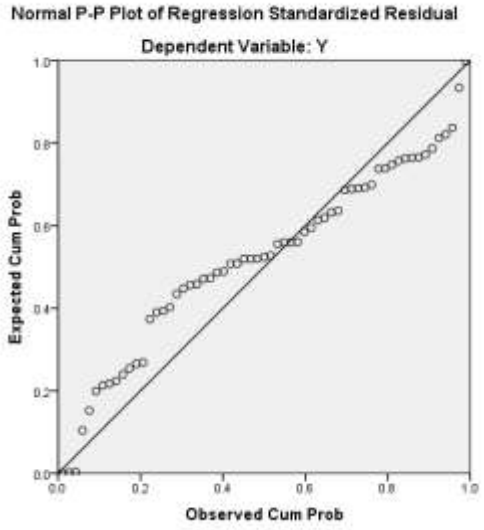
Normality Test

The normality test was conducted to determine whether the residuals in the regression model were normally distributed. A good regression model has normally distributed residuals. In this study, the normality test was performed using the Normal Probability Plot or Normal P-P Plot of Regression Standardized Residual. If the points in the plot are distributed along the diagonal line, the residuals of the regression model can be considered normally distributed.

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Figure 1. Normal Probability Plot



Source: Primary data processed, 2026.

Based on Figure 1, the normality test results show that the residual points in the Normal Probability Plot are distributed around and follow the diagonal line. Although a slight deviation is observed in several points, the residual distribution generally indicates an approximately normal pattern. Therefore, the regression model used in this study satisfies the normality assumption.

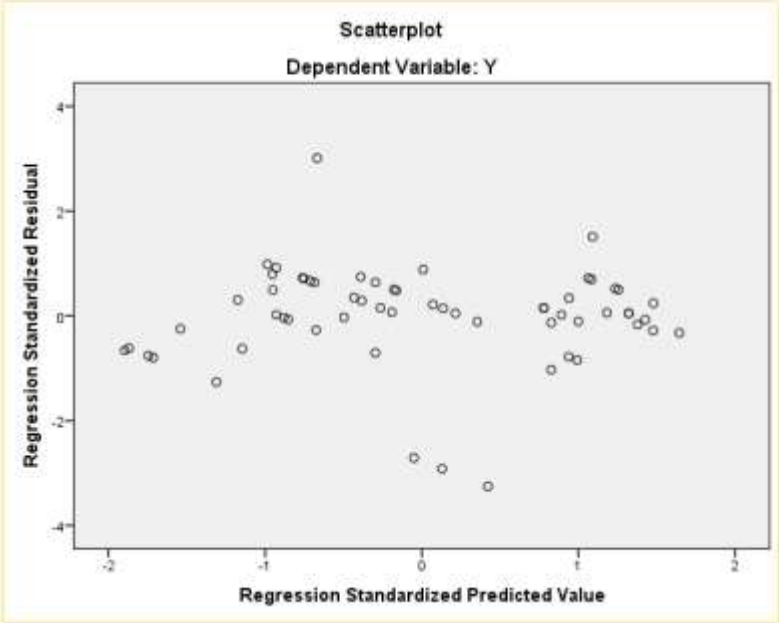
Heteroscedasticity Test

The heteroscedasticity test was used to examine whether the regression model exhibited unequal residual variance across observations. A good regression model should not show symptoms of heteroscedasticity, or should be homoscedastic. The presence or absence of heteroscedasticity was detected using a scatterplot between the Regression Standardized Predicted Value and the Regression Standardized Residual. If the points form a specific pattern, such as narrowing, widening, or waving, heteroscedasticity is indicated. Conversely, if the points are randomly distributed above and below zero, heteroscedasticity is not indicated.

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Figure 2. Heteroscedasticity Test Results (Scatterplot)



Source: Primary data processed, 2026.

Based on Figure 2, the heteroscedasticity test results show that the residual points are randomly distributed and do not form a specific pattern. The points are distributed above and below zero; therefore, the regression model does not show symptoms of heteroscedasticity. Thus, the regression model satisfies the homoscedasticity assumption.

Multicollinearity Test

The multicollinearity test was conducted to determine whether strong relationships existed among the independent variables in the regression model. A good regression model should not exhibit multicollinearity. Multicollinearity was examined using Tolerance and Variance Inflation Factor (VIF) values. If the Tolerance value is greater than 0.10 and the VIF value is less than 10, the regression model is considered free from multicollinearity.

Table 1. Multicollinearity Test Results

Variable	Tolerance	VIF	Description
X1 / Seed	0.315	3.175	No multicollinearity
X2 / Urea fertilizer	0.282	3.551	No multicollinearity
X3 / Phonska fertilizer	0.293	3.412	No multicollinearity
X4 / Pesticide	0.474	2.110	No multicollinearity

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X5 / HKSP	0.814	1.229	No multicollinearity
X6 / Land slope	0.954	1.049	No multicollinearity

Source: Primary data processed, 2026.

Based on Table 1, all independent variables have Tolerance values greater than 0.10 and VIF values less than 10. The VIF values were 3.175 for seed, 3.551 for urea fertilizer, 3.412 for Phonska fertilizer, 2.110 for pesticide, 1.229 for HKSP, and 1.049 for land slope. Therefore, the regression model in this study does not exhibit multicollinearity.

Autocorrelation Test

The autocorrelation test was conducted to determine whether there was a relationship or correlation between residuals from one observation and residuals from another observation. In this study, autocorrelation was tested using the Durbin-Watson value in the Model Summary table. A regression model is considered acceptable when the Durbin-Watson value is around 2, because this indicates the absence of serious autocorrelation.

Table 2. Autocorrelation Test Results

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.771	0.595	0.550	0.13376	2.245

Source: Primary data processed, 2026.

Based on Table 2, the Durbin-Watson value was 2.245. This value is close to 2, indicating that the regression model does not exhibit serious autocorrelation. Thus, the autocorrelation assumption in the regression model is satisfied. Because the data in this study are farmer survey data or cross-sectional data, autocorrelation is not a major issue as it is in time-series data. Nevertheless, the Durbin-Watson value shows that the model is within an acceptable range.

Regression Analysis Results

The analysis of corn productivity on sloping land in this study was conducted using the Cobb-Douglas production function approach. This model was used to describe the relationship between production input use and corn productivity generated by farmers. Through this approach, the extent to which changes in production input use are associated with changes in corn productivity under sloping-land conditions can be identified.

The dependent variable in this study was corn productivity, while the independent variables included seed, urea fertilizer, Phonska fertilizer, pesticide, HKSP/labor input,

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and a land-slope dummy variable. The land-slope variable was included as a dummy variable to distinguish between sloping and steep land conditions. All physical production input variables were analyzed in natural logarithmic form, whereas the land-slope dummy variable was not transformed. This analysis was used as the basis for explaining the relationship between production inputs and corn productivity on sloping land in Ulapato B Village.

Table 3. Multiple Linear Regression Results

Variable	Coefficient B
Constant	6.916
Seed (X1)	0.949
Urea fertilizer (X2)	-0.119
Phonska fertilizer (X3)	0.048
Pesticide (X4)	-0.163
HKSP (X5)	0.001
Land slope dummy (X6)	-0.044

Based on Table 3, the regression equation obtained in this study is as follows:

$$\ln Y = 6.916 + 0.949\ln X1 - 0.119\ln X2 + 0.048\ln X3 - 0.163\ln X4 + 0.001\ln X5 - 0.044D + e$$

The constant value of 6.916 indicates the baseline value of corn productivity when seed, urea fertilizer, Phonska fertilizer, pesticide, HKSP, and land slope are held constant. This constant represents the initial productivity level before being influenced by the production input variables included in the model.

The seed variable had a coefficient of 0.949 with a significance value of 0.000. The positive coefficient indicates that an increase in seed use tends to increase corn productivity. Because the significance value is less than 0.05, seed use has a positive and significant effect on corn productivity on sloping land.

The urea fertilizer variable had a coefficient of -0.119 with a significance value of 0.103. The negative coefficient indicates a negative direction of association; however, because the significance value is greater than 0.05, the effect of urea fertilizer on corn productivity is not statistically significant. Thus, urea fertilizer use was not proven to have a significant effect on corn productivity in this study.

The Phonska fertilizer variable had a coefficient of 0.048 with a significance value of 0.599. The significance value is greater than 0.05; therefore, Phonska fertilizer does not have a significant effect on corn productivity. Although the coefficient is positive, the effect is not statistically strong enough to explain changes in productivity.

The pesticide variable had a coefficient of -0.163 with a significance value of 0.013. Because the significance value is less than 0.05, pesticide use has a negative and significant effect on corn productivity. This indicates that increased pesticide use is

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associated with lower corn productivity. Such a condition may reflect that high pesticide use is a response by farmers to more severe pest, disease, or weed pressure in the field.

The HKSP or labor input variable had a coefficient of 0.001 with a significance value of 0.994. The significance value is greater than 0.05, indicating that HKSP does not have a significant effect on corn productivity. This means that additional labor was not statistically proven to increase corn productivity.

The land slope variable had a coefficient of -0.044 with a significance value of 0.340. The significance value is greater than 0.05; therefore, land slope does not have a significant effect on corn productivity. The negative coefficient indicates that steeper land tends to have lower productivity, but this effect is not statistically significant.

The coefficient of determination was used to identify how well the independent variables explain variation in the dependent variable. In this study, the coefficient of determination was assessed using the Adjusted R Square value because the model included more than one independent variable.

Table 4. Determination Coefficient Test Results

Model	R	R Square	Adjusted R Square
1	0.771	0.595	0.550

Based on Table 4, the R Square value was 0.595. This indicates that seed, urea fertilizer, Phonska fertilizer, pesticide, HKSP, and the land-slope dummy variable explain 59.5% of the variation in corn productivity. The remaining 40.5% is explained by factors outside the research model, such as corn variety, soil fertility, rainfall, cultivation techniques, cropping pattern, pest and disease intensity, and sloping-land management.

F-Test (Simultaneous Test)

The F-test was used to determine the simultaneous effect of the independent variables on the dependent variable. In this study, the F-test was used to examine whether seed, urea fertilizer, Phonska fertilizer, pesticide, HKSP, and the land-slope dummy variable simultaneously affected corn productivity on sloping land. The testing criteria were based on the F-statistic, F-table value, and significance value. If the F-statistic is greater than the F-table value or the significance value is less than 0.05, the independent variables simultaneously have a significant effect on the dependent variable.

Table 5. F-Test Results (Simultaneous Test)

F-Statistic	Sig.
13.225	0.000

Source: Primary data processed, 2026.

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on Table 5, the F-statistic was 13.225 with a significance value of 0.000. Because the significance value is less than 0.05, seed, urea fertilizer, Phonska fertilizer, pesticide, HKSP, and the land-slope dummy variable simultaneously have a significant effect on corn productivity on sloping land in Ulapato B Village.

t-Test (Partial Test)

The t-test or partial test was used to determine the effect of each independent variable on the dependent variable. In this study, the t-test was used to determine the effects of seed (X1), urea fertilizer (X2), Phonska fertilizer (X3), pesticide (X4), HKSP/labor input (X5), and the land-slope dummy variable (X6) on corn productivity on sloping land. The test was conducted by comparing the t-statistic with the t-table value and by examining the significance value at the 5% level. If the significance value is less than 0.05, the independent variable is considered to have a significant effect on corn productivity.

Table 6. t-Test Results (Partial Test)

Independent Variable	t-statistic	t-table	Sig.	Description
Seed (X1)	4.575	2.005	0.000	Significant effect
Urea fertilizer (X2)	-1.659	2.005	0.103	No significant effect
Phonska fertilizer (X3)	0.529	2.005	0.599	No significant effect
Pesticide (X4)	-2.557	2.005	0.013	Significant effect
HKSP (X5)	0.007	2.005	0.994	No significant effect
Land slope dummy (X6)	-0.962	2.005	0.340	No significant effect

Source: Primary data processed, 2026.

Based on Table 6, the t-test results show that seed (X1) had a t-statistic of 4.575, which is greater than the t-table value of 2.005, with a significance value of 0.000. This significance value is lower than 0.05, indicating that H0 is rejected and H1 is accepted. Thus, seed use has a significant effect on corn productivity on sloping land. This result supports the hypothesis that seed use has a positive effect on corn productivity and confirms that seed is an important factor in increasing corn productivity on sloping land.

Agronomically, seed is an initial factor that determines plant population, growth uniformity, and yield potential. The use of high-quality seed in an appropriate amount can

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help establish an optimal plant population and increase productivity. This finding is supported by Dalimunthe and Safitri (2023), who showed that seedling or seed variables significantly affected corn production, with a significance value of 0.038 < 0.05. Seed is an important component in agricultural production systems because seed quality determines plant viability and the potential yield obtained by farmers.

Empirically, the significant effect of seed on corn productivity indicates that seed is a key factor in the success of corn farming on sloping land. In the field, adequate and high-quality seed use can form a more optimal plant population, improve growth uniformity, and increase the likelihood of good ear formation. On sloping land, seed is particularly important because sloping and steep land conditions may increase the risk of seed loss, uneven growth, and reduced plant population due to surface runoff or erosion. Therefore, farmers who use seed in appropriate quantity and quality tend to obtain higher corn productivity than those whose seed use is less optimal.

Based on Table 6, the t-test results show that urea fertilizer (X2) had a t-statistic of -1.659, which is lower than the t-table value of 2.005, with a significance value of 0.103. Because this significance value is greater than 0.05, H0 is accepted and H1 is rejected. This means that urea fertilizer use does not have a significant effect on corn productivity on sloping land. Therefore, the hypothesis that urea fertilizer affects corn productivity is not supported. In this study, urea fertilizer use was not statistically proven to have a significant effect on corn productivity.

When related to field conditions, the non-significant effect of urea fertilizer on corn productivity may be caused by urea use that was not proportional to land area and crop requirements. Respondent data showed considerable variation in urea use among farmers. On 0.50 ha of land, some farmers used 150 kg of urea, equivalent to approximately 300 kg/ha, whereas on 0.60-0.70 ha of land, urea use reached 300-350 kg, equivalent to approximately 500 kg/ha. Conversely, on larger land areas, such as 1.50 ha, some farmers used only 136 kg of urea, equivalent to approximately 90.67 kg/ha. This indicates that urea use at the farmer level was not uniform and was not fully based on crop requirements per unit of land area.

Inappropriate dosage, timing, and application methods may explain why urea fertilizer did not have a significant effect on corn productivity. High urea application does not necessarily increase productivity when it is not applied properly and gradually according to crop growth stages. Saragih et al. (2013) explained that the timing of urea application does not always affect all corn growth components, but split application can reduce nitrogen loss through leaching and volatilization. Therefore, the effectiveness of urea is determined not only by the amount applied, but also by dosage accuracy, timing, and application method.

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On sloping land, the effectiveness of urea fertilizer can also be affected by the risk of nutrient loss through surface runoff and erosion. Li et al. (2026) showed that nitrogen loss through runoff is an important issue in corn cultivation systems on sloping land. Therefore, increasing urea quantity alone is not sufficient to increase corn productivity without proper fertilizer management and soil conservation. In addition, Zou et al. (2024) explained that corn yield response to nitrogen fertilizer is strongly influenced by soil fertility; therefore, fertilizer dosage should be adjusted to soil conditions.

Thus, the results of this study do not indicate that urea fertilizer is unimportant for corn, but rather that urea use in the study area was not yet efficient or proportional. On sloping land, urea application should be adjusted to recommended dosage, applied gradually, and combined with compound fertilizers, organic matter, and soil conservation techniques. Therefore, the non-significant effect of urea fertilizer in this study reflects suboptimal fertilizer management at the farmer level.

Based on Table 6, the t-test results show that Phonska fertilizer (X3) had a t-statistic of 0.529, which is lower than the t-table value of 2.005, with a significance value of 0.599. This significance value is greater than 0.05, indicating that H0 is accepted and H1 is rejected. Thus, Phonska fertilizer does not have a significant effect on corn productivity on sloping land. The hypothesis that Phonska fertilizer has a positive effect on corn productivity is therefore not supported. Although the coefficient of Phonska fertilizer is positive, its effect is not statistically strong enough to increase corn productivity.

Based on Table 6, the t-test results show that pesticide (X4) had a t-statistic of -2.557. In absolute terms, this value is greater than the t-table value of 2.005, with a significance value of 0.013. Because the significance value is less than 0.05, H0 is rejected and H1 is accepted. This means that pesticide use has a significant effect on corn productivity on sloping land. However, the negative coefficient indicates that increased pesticide use is associated with lower corn productivity. This condition may occur because high pesticide use reflects greater pest, disease, or weed pressure in farmers' fields.

When related to field conditions, this result can be explained by variation in pesticide use among farmers. Based on respondent data, pesticide use in variable X4 ranged from 6 to 21 units. On 0.50 ha of land, some farmers used 6-9 units of pesticide, while on 0.70 ha of land pesticide use reached 8 units. On larger land, such as 2.50 ha, pesticide use reached 21 units. These conditions show that pesticide use in the field varied considerably and was not necessarily proportional to land area. For some farmers with relatively small land areas, pesticide intensity per hectare may have been higher.

The negative coefficient for pesticide does not necessarily mean that pesticide directly caused productivity to decline. In farming conditions, high pesticide use is often

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a farmer's response to severe pest, disease, or weed pressure. Thus, pesticide use may serve as an indicator of heavier crop pest pressure. Farmers facing higher infestation tend to use more pesticides, but productivity may remain low because crops have already been damaged before or during control measures.

On sloping land, this condition becomes more important because corn plants are more vulnerable to environmental stress. Sloping land generally has a higher risk of erosion, nutrient loss, and soil moisture imbalance. These conditions can cause non-uniform plant growth and increase plant susceptibility to pests or diseases. As a result, farmers tend to increase pesticide use to control field problems. However, if pesticide use is not appropriate in dosage, timing, target, and application method, additional pesticide use may not increase corn productivity.

This finding is consistent with Pohan et al. (2025), who found that pesticide use had a negative and significant effect on corn production in Kertagena Tengah Village, Pamekasan Regency, with a coefficient of -0.435. Their study explained that excessive pesticide use can reduce production because it exceeds the recommended dosage and negatively affects the soil ecosystem. This supports the finding of the present study that increased pesticide use is not always followed by increased corn productivity, especially when pesticide use is inefficient.

In addition, Kenyi et al. (2024) showed that fall armyworm infestation in corn can cause yield losses, but increasing insecticide dosage does not always produce a significant difference in yield. Their study found no significant yield difference between insecticide doses of 75 ml and 150 ml, indicating that pest control should emphasize appropriate and efficient dosage rather than simply increasing pesticide quantities.

Thus, the negative and significant effect of pesticide use in this study indicates that pesticide use in the study area did not fully reflect efficient control, but rather represented high pest, disease, or weed pressure in farmers' fields. Therefore, pesticide use in corn cultivation on sloping land should be directed toward integrated pest management, namely the wise, targeted use of pesticides combined with cultural, mechanical, biological control, and pest population monitoring. FAO emphasizes that integrated pest management combines various control techniques to keep plants healthy, minimize pesticide use, and reduce risks to human health and the environment.

Based on Table 6, the t-test results show that HKSP (X5) had a t-statistic of 0.007, which is lower than the t-table value of 2.005, with a significance value of 0.994. Because the significance value is greater than 0.05, H0 is accepted and H1 is rejected. This means that HKSP or labor input does not have a significant effect on corn productivity on sloping land. This result indicates that the hypothesis stating that labor affects corn productivity is not supported. Additional labor was not statistically proven to increase corn productivity in this study.

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When related to field conditions, the non-significant effect of labor may occur because labor in corn farming on sloping land is mostly used for routine and physical activities, such as land preparation, planting, fertilizing, weeding, spraying, harvesting, and transporting produce. On sloping land, these activities require more labor because the terrain is more difficult than flat land. Thus, increased HKSP reflects the higher labor requirement caused by land conditions rather than improved cultivation efficiency or higher productivity.

Furthermore, additional labor does not necessarily increase yield when it is not accompanied by timely work, labor skills, appropriate input use, and proper cultivation techniques. On sloping land, labor is needed to support farming activities, but corn productivity is more strongly determined by the quality of crop management, such as the use of high-quality seed, balanced fertilization, appropriate pest control, and soil conservation.

This finding is consistent with Pohan et al. (2025), who showed that labor did not have a significant effect on corn production. A similar finding was reported by Palia et al. (2018) for hybrid corn farming in North Gorontalo, where labor was not always the main factor determining corn production compared with other inputs such as seed and fertilizer. Thus, the present study confirms that increased labor does not necessarily increase productivity when labor is not used efficiently and is not supported by appropriate cultivation techniques.

Based on Table 6, the t-test results show that the land-slope dummy variable (X6) had a t-statistic of -0.962, which is lower than the t-table value of 2.005, with a significance value of 0.340. This significance value is greater than 0.05, indicating that H0 is accepted and H1 is rejected. Thus, land slope does not have a significant effect on corn productivity on sloping land. This finding indicates that the hypothesis stating that land slope affects corn productivity is not supported. Therefore, the difference between sloping and steep land categories was not proven to have a significant effect on corn productivity.

When related to field conditions, this result can be understood because the land cultivated by farmers in the study area was generally within the sloping-land category. In other words, both sloping and steep land have similar biophysical limitations, such as surface runoff risk, erosion, nutrient loss, and difficulties in crop management. Therefore, differences in land slope category were not strong enough to explain significant differences in corn productivity.

The negative coefficient indicates that corn productivity on steep land tends to be lower than on sloping land. However, because the effect is not significant, this difference cannot be used as a basis for concluding that steep land always produces lower productivity. Under field conditions, corn productivity on sloping land is not determined only by slope level, but also by seed use, fertilization, pest control, labor input, soil fertility,

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rainfall, and farmers' ability to manage the land. This finding is consistent with Neswati et al. (2023), who explained that sloping land is prone to erosion, but appropriate soil conservation techniques can reduce erosion without lowering corn growth and productivity. Mamangkay et al. (2024) also showed that the effect of slope on corn yield is more closely related to soil fertility conditions, particularly nutrients and soil carbon, rather than slope level alone. Thus, the non-significant effect of the land-slope dummy variable in this study indicates that differences between sloping and steep land were not the main determinants of corn productivity. Productivity is more influenced by production input management, soil conditions, and the application of sloping-land conservation techniques.

CLOSING

Conclusion

Based on the results of the study, production input use affects corn productivity on sloping land in Ulapato B Village. Simultaneously, seed, urea fertilizer, Phonska fertilizer, pesticide, HKSP/labor input, and land slope explain changes in corn productivity. Partially, however, the factors that significantly affect corn productivity are seed and pesticide. Seed has a positive effect, indicating that appropriate seed use can increase corn productivity. Conversely, pesticide has a negative effect, indicating that high pesticide use is likely associated with greater pest, disease, or weed pressure in farmers' fields. Meanwhile, urea fertilizer, Phonska fertilizer, HKSP/labor input, and land slope do not have significant effects on corn productivity. Thus, corn productivity on sloping land in Ulapato B Village is more strongly determined by appropriate seed use and pesticide management than by fertilizer use, labor input, or differences in land slope categories.

Recommendations

Farmers are advised to use high-quality seed in quantities appropriate to land requirements because seed was proven to have a significant effect on corn productivity. Pesticide use should be directed toward integrated pest management principles to avoid excessive use and improve targeting. In addition, urea and Phonska fertilization should be applied in a balanced manner according to recommended dosage, application timing, and land conditions, particularly on sloping land that is prone to nutrient loss.

Agricultural extension workers and village governments should provide assistance to farmers regarding balanced fertilization, wise pesticide use, and soil conservation practices on sloping and steep land. Future research should include additional variables such as soil fertility, variety, rainfall, conservation techniques, and pest and disease intensity to produce a more comprehensive analysis.

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