



The Effect of Weather on Corn Production Levels (*Zea mays L.*) in Dua Koto District, Pasaman Regency

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Abstract

Purpose of Study: Corn is a strategic food commodity that plays an important role as a raw material for food and animal feed in Indonesia. Its production is very vulnerable to weather changes such as rainfall, air temperature, humidity, and duration of sunlight. This study aims to examine the effect of weather conditions on the level of corn production (*Zea mays L.*) in Dua Koto District, Pasaman Regency.

Methodology: This study was conducted from June to August 2025. The research was carried out in Dua Koto District, Pasaman Regency. The research method used is a quantitative method with a survey approach. The data analysis was used Multiple linear regression is a statistical analysis.

Main Findings: Based on the results of multiple linear regression analysis, the following can be concluded: Rainfall (X1) has a positive and significant effect on corn production, with a regression coefficient of 1.875. Air temperature (X2) has a negative and significant effect on corn production, with a regression coefficient of -3.214. Air humidity (X) has no significant effect on corn production, with a regression coefficient of 0.432.44.

Novelty/Originality of This Study: The duration of sunlight (X4) has a positive and significant effect on corn production.

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INTRODUCTION

Background of the study:

Corn is one of the strategic agricultural commodities that plays an important role in the food sector and livestock feed industry in Indonesia. In Pasaman Regency, particularly in Dua Koto District, corn (*Zea mays L.*) is one of the leading commodities and serves as a primary source of income for many farmers. Climate change and extreme weather conditions have become major challenges in the agricultural sector across various regions, including Dua Koto District, Pasaman Regency. Recent studies have shown that increasing temperatures, reduced rainfall, and irregular precipitation patterns may decrease agricultural productivity and threaten food security, particularly in developing countries that depend heavily on climate-sensitive agricultural systems (Abebaw et al., 2025).

Recent studies have shown that climate variability affects crop productivity through changes in rainfall patterns, temperature fluctuations, and solar radiation, thereby increasing production uncertainty in the agricultural sector (Alotaibi, 2023; Ruminta et al., 2024). Phenomena such as El Niño and La Niña, which influence extreme weather patterns, have been proven to significantly affect corn production not only in Indonesia in general but also in West Sumatra, including Dua Koto District (Sari & Rahmawati, 2023). Climate change has been reported to alter temperature patterns, precipitation regimes, and the frequency of extreme weather events, all of which may significantly affect maize growth and productivity. Consequently, understanding the relationship

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between climatic variables and crop production is essential for developing effective adaptation strategies in the agricultural sector (Li & Tian, 2024).

Unpredictable weather conditions have also made it difficult for farmers in Dua Koto District to determine the appropriate planting time. Shifts in planting seasons due to changes in rainfall patterns and temperature often lead to crop failure or suboptimal yields, particularly when farmers have limited access to accurate weather information and adaptive agricultural technologies. Studies conducted in several regions of Indonesia indicate that improving farmers' capacity to adapt to climate change, such as through the selection of weather-resistant corn varieties and the implementation of efficient irrigation techniques, can help enhance the resilience of corn production (Nurhadi, 2024). This finding is supported by Tchouandem Nzali et al. (2024), who reported that farmers' adaptation capacity and climate-responsive agricultural practices play an important role in maintaining maize productivity under changing climatic conditions.

Extreme weather changes also have implications for corn prices in both local and national markets. When corn production declines due to adverse weather conditions, corn prices tend to increase significantly. This situation affects the livestock feed industry, which relies on corn as a primary raw material. Consequently, rising corn prices lead to higher feed production costs and ultimately result in increased prices of animal products such as meat and eggs (Kementerian Pertanian, 2023). Previous studies have also indicated that fluctuations in agricultural production caused by climate variability may affect food supply chains and market stability, thereby influencing commodity prices and food security (Affoh et al., 2022; Alotaibi, 2023).

Based on the background described above, this study examines the influence of weather conditions on corn production levels in Dua Koto District, Pasaman Regency. Specifically, the study analyzes the effects of rainfall, air temperature, and humidity on corn production. Understanding the relationship between weather variables and agricultural output is important for supporting appropriate farming strategies and improving corn productivity in the study area. Therefore, the objective of this study is to determine the extent to which weather conditions affect corn production levels in Dua Koto District, Pasaman Regency.

METHOD

Research Location and Time:

This study was conducted from June to August 2025. The research was carried out in Dua Koto District, Pasaman Regency. The study location was selected purposively because Dua Koto District, Pasaman Regency, is one of the areas with a high level of corn production in West Sumatra (BPS Kabupaten Pasaman, 2024).

Research Method and Data Sources:

This study employed a survey method with a quantitative descriptive approach to obtain a systematic, factual, and accurate description of the effect of weather conditions on corn production levels in Dua Koto District, Pasaman Regency. The survey method was selected because it enables researchers to collect data directly from respondents, including corn farmers and other related parties who possess relevant information regarding weather conditions and harvest outcomes. The quantitative descriptive approach was used to describe existing phenomena numerically, allowing statistical analysis to examine the relationship between weather variables and corn production variables. The use of survey methods and quantitative approaches is widely applied in agricultural research because they allow researchers to systematically measure relationships among variables and generate empirical evidence for decision-making processes (Creswell & Creswell, 2018; Hair et al., 2019).

The data used in this study consisted of primary and secondary data. Primary data were obtained directly from respondents through observation and interviews, while secondary data were collected from relevant institutions and published documents. The use of both primary and secondary data is important to provide comprehensive information and improve the validity of research findings (Sugiyono, 2020). Combining primary and secondary data sources can improve data reliability and provide a more comprehensive understanding of agricultural production systems, particularly when assessing environmental and climatic influences on crop productivity

(FAO, 2023). Both primary and secondary data were collected in the form of monthly time series data from January to April 2025. Data collection techniques employed in this study included observation, interviews, and documentation obtained from corn farmers in Dua Koto District, Pasaman Regency. In addition, some data were obtained from related institutions, including the Food Agency, the Department of Agriculture, and the Central Bureau of Statistics (Loanga et al., 2023).

Data Analysis Technique:

1. Multiple Linear Regression

Multiple linear regression is a statistical analysis method used to examine the relationship patterns among two or more variables that are mathematically formulated (Hair et al., 2019; Montgomery et al., 2021). The model can be expressed in the following linear equation:

$$Y_t = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + e$$

Where:

- Y_t : Corn production
- β₀ : Constant term
- X₁ : Effect of rainfall on production levels
- X₂ : Effect of air temperature on production levels
- X₃ : Effect of air humidity on production levels
- X₄ : Effect of duration of sunlight exposure on production levels
- E : Error term

Table 1. Rainfall, Air Temperature, Air Humidity, and Sunshine Duration in Dua Koto District, January–April 2025 Period

Month	Rainfall (mm)	Air Temperature (°C)	Air Humidity (%)	Sunshine Duration (hours/day)
January	325	25.6	88	3.5
February	290	26.0	86	4.0
March	260	26.3	84	4.5
April	210	26.8	81	5.2

Source: BMKG Data, January–April 2025

The climatic trends observed in Dua Koto District during the study period are consistent with previous research findings. The decrease in rainfall accompanied by increasing air temperature indicates a seasonal transition that may influence crop growth and productivity. Ruminta et al. (2024) reported that increasing temperature trends and decreasing rainfall trends were associated with changes in maize production. Similarly, Alotaibi (2023) found that variations in climatic factors, particularly rainfall and temperature, significantly affect agricultural productivity and crop yields. Therefore, the climatic conditions observed in Dua Koto District during the study period are in line with previous studies regarding the influence of weather variability on agricultural production.

2. F-Test (Simultaneous Test)

The F-test is a statistical test used in regression analysis, particularly multiple linear regression, to determine whether the regression model as a whole is statistically significant in explaining variations in the dependent variable. Fundamentally, the F-test indicates whether all independent variables included in the model simultaneously affect the dependent variable. If the significance value (Sig.) is less than the alpha level of 0.05, the independent variables significantly affect the dependent variable. Conversely, if the significance value (Sig.) is greater than the alpha level of 0.05, the independent variables do not significantly affect the dependent variable.

The F-test, also known as the simultaneous test, is used to determine whether all independent variables jointly have a significant effect on the dependent variable in the regression model. In this study entitled "*The Effect of Weather on Corn Production Levels in Dua Koto District, Pasaman Regency*," the independent variables include rainfall, air temperature, air humidity, and sunshine duration, while the dependent variable is corn production levels. The F-test was conducted to

examine whether these four weather indicators simultaneously affect corn production in the study area. According to Montgomery et al. (2021), the F-test is one of the most widely used procedures in regression analysis because it evaluates whether the independent variables collectively contribute to explaining variations in the dependent variable.

3. Coefficient of Determination (R^2)

According to Sugiyono (2020), the coefficient of determination (R^2) test aims to measure the extent to which the regression model can explain variations in the dependent variable. The coefficient of determination describes the magnitude of the influence of each independent variable on the dependent variable, allowing researchers to identify which independent variable has the most dominant effect on the dependent variable. If the R^2 value approaches 1, it indicates that the regression model performs well, meaning that the independent variables collectively can explain the dependent variable. Conversely, if the R^2 value approaches 0, it indicates that the independent variables collectively cannot explain the dependent variable. Hair et al. (2019) stated that the coefficient of determination is useful for evaluating the explanatory power of a regression model and determining how well the independent variables predict changes in the dependent variable.

RESULTS AND DISCUSSION

The results of the multiple linear regression analysis were generated using SPSS (or similar statistical software) and are presented in the following table:

Table 2. Regression Coefficients

Variables	Coefficient (β)	Std. Error	t-value	Sig. (p)	Description
Constant	225.643	45.321	4.978	0.000	Significant
Rainfall (X_1)	1.875	0.668	2.808	0.006	Significant
Air Temperature (X_2)	-3.214	1.479	-2.172	0.034	Significant
Air Humidity (X_3)	0.432	0.389	1.109	0.273	Not Significant
Sunshine Duration (X_4)	2.125	0.659	3.225	0.002	Significant

Source: Primary Data

Based on the results of the multiple linear regression analysis, it was found that the regression model used was able to explain the relationship between weather factors and corn production levels. Of the four independent variables examined, three variables—namely rainfall, air temperature, and sunshine duration—showed a significant effect on corn production levels. This was indicated by the significance values (Sig. < 0.05) for each of these variables. Although air humidity showed a positive relationship, it did not have a statistically significant effect (Putra et al., 2021).

This study provides an understanding that ideal weather conditions as a whole greatly influence the success of corn harvests. Therefore, climate-based corn farming management, such as utilizing weather forecasts, adjusting planting schedules, and selecting appropriate planting seasons, becomes an important strategy that should be considered by farmers and policymakers. Adaptation to climate change should also continue to be strengthened in order to maintain the sustainability of corn production in Dua Koto District.

a. Constant

The constant value of 225.643 indicates that when all independent variables, namely rainfall (X_1), air temperature (X_2), air humidity (X_3), and sunshine duration (X_4), are assumed to be zero or have no effect, corn production is estimated to remain at 225.643 kg/ha. Although, in practical conditions, it is unlikely that all weather variables would actually be zero, this constant remains statistically important because it represents the baseline level of corn production that may be influenced by other factors not included in this model, such as soil fertility, corn varieties, cultivation techniques, and human interventions such as fertilization and irrigation. Therefore, the constant serves as the basic predicted value when weather-related influences are considered neutral.

b. Rainfall (X_1)

Rainfall is one of the most important factors affecting the growth process of corn plants, as corn requires a relatively stable water supply, particularly during the vegetative and cob formation stages. The regression results showed that rainfall had a coefficient value of +1.875, with a significance level of 0.006, which met the statistical requirement ($p < 0.05$). This indicates that every 1 mm increase in rainfall is predicted to increase corn production by 1.875 kg/ha, assuming all other variables remain constant. This positive and significant effect can be explained by the role of rainfall in maintaining adequate soil water availability, enhancing photosynthetic activity, and supporting nutrient absorption from the soil. However, excessive rainfall may also create problems if it exceeds the soil's absorption capacity, although in this study, increased rainfall still had a positive effect on corn production. The findings of this study are consistent with previous research that identified rainfall as an important determinant of corn production. Putra et al. (2021) reported that rainfall significantly influenced corn productivity in Pasaman Regency because adequate water availability supports plant growth and grain formation. Similarly, Ruminta et al. (2024) found that changes in rainfall patterns were associated with variations in maize production. These findings indicate that rainfall remains one of the key climatic factors affecting corn production, particularly during the vegetative and reproductive growth stages.

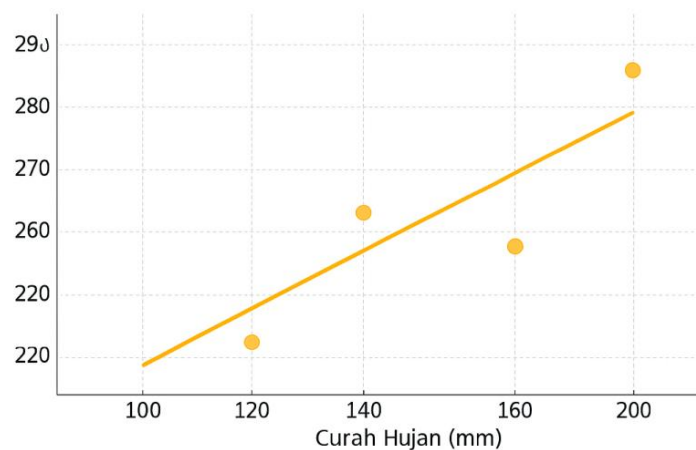


Figure 1. The Effect of Rainfall on Corn Production

The first graph illustrates the relationship between rainfall and corn production. The graph indicates a positive correlation, where higher rainfall levels (mm) tend to be associated with increased corn production. This finding suggests that rainfall plays an important role in supporting corn growth, particularly during the vegetative stage. However, rainfall exceeding the optimal threshold may also lead to waterlogging, which can negatively affect crop yields. Therefore, it is important for farmers to consider seasonal rainfall patterns when determining appropriate planting schedules.

The findings of this study are consistent with previous research indicating that rainfall is one of the most influential climatic factors affecting maize productivity. Saketa (2025) reported that increases in annual rainfall had a positive and significant effect on maize yield because water availability directly supports crop growth, nutrient uptake, and grain formation. Therefore, the positive effect of rainfall observed in this study further confirms the importance of adequate rainfall for corn production.

c. Air Temperature (X_2)

The regression coefficient for air temperature was -3.214 , with a significance value indicating that the effect of temperature on corn production was negative and statistically significant. This means that every 1°C increase in air temperature is predicted to reduce corn production by 3.214 kg/ha, assuming other factors remain constant. Excessively high temperatures may cause stress in corn plants, particularly during the flowering and grain-filling stages, which are considered the most vulnerable periods to water deficits and excessive heat. High temperatures increase evapotranspiration rates, thereby accelerating water loss from leaves and soil, reducing

photosynthetic efficiency, and inhibiting chlorophyll formation. As a result, crop yield potential declines. These findings support agronomic theories stating that corn plants grow optimally at temperatures ranging from 21°C to 30°C and tend to experience reduced production when temperatures exceed this threshold.

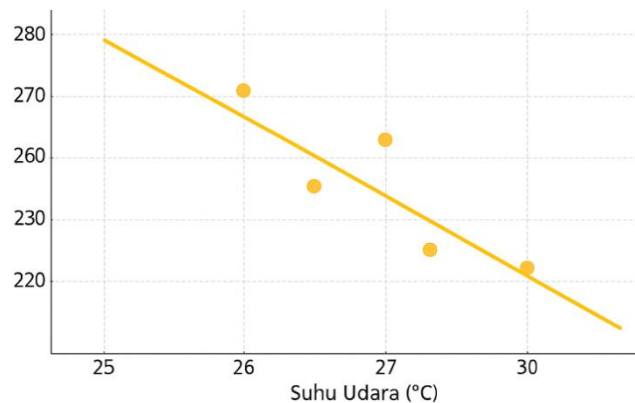


Figure 2. The Effect of Air Temperature on Corn Production

The second graph illustrates the relationship between air temperature and corn production. The regression pattern shows a negative trend, indicating that increases in air temperature tend to be followed by decreases in corn production. This finding can be explained by the fact that excessively high temperatures may cause heat stress in corn plants, particularly during generative stages such as flowering and grain filling. Extreme temperatures above 30°C often reduce corn productivity and quality because they accelerate soil evaporation and shorten the plant growth cycle.

The findings of this study are consistent with previous research regarding the influence of climatic factors on corn production. Putra et al. (2021) reported that climate variables significantly affected corn production in Pasaman Regency. Similarly, Ruminta et al. (2024) found that increasing temperature trends were associated with changes in maize production, indicating that temperature is an important climatic factor affecting crop productivity. High temperatures can increase evapotranspiration rates, reduce soil moisture availability, and cause physiological stress in plants, ultimately decreasing crop yields. In addition, Dewi (2024) emphasized that weather variability, particularly changes in rainfall patterns and temperature conditions, plays an important role in determining maize production. Therefore, the negative and significant effect of air temperature found in this study strengthens previous findings that excessive temperature increases may reduce corn productivity.

The results are also supported by Kim et al. (2023), who reported that increasing temperatures can accelerate crop growth, shorten the growing season, and ultimately reduce maize productivity. Excessive heat may disrupt physiological processes, increase evapotranspiration, and reduce grain yield. Therefore, the negative effect of air temperature found in this study is consistent with previous findings regarding the adverse impact of high temperatures on maize production.

d. Air Humidity (X_3)

Air humidity in this study showed a positive coefficient, indicating that, theoretically, an increase in humidity may contribute to higher corn production. However, statistically, the significance value of humidity was greater than 0.05, indicating that the effect of humidity on corn production was not significant in this model. This result may be explained by two main possibilities. First, variations in humidity levels at the research site during the planting period may not have been sufficiently extreme and may have remained relatively stable, thus failing to create substantial differences in production outcomes. Second, the effect of humidity may be indirect and more closely associated with the influence of temperature and rainfall. High humidity can reduce water loss through transpiration; however, it may also increase the risk of plant diseases such as fungal infections. Therefore, further studies are needed to examine the interaction between humidity and other variables, such as temperature and light intensity.

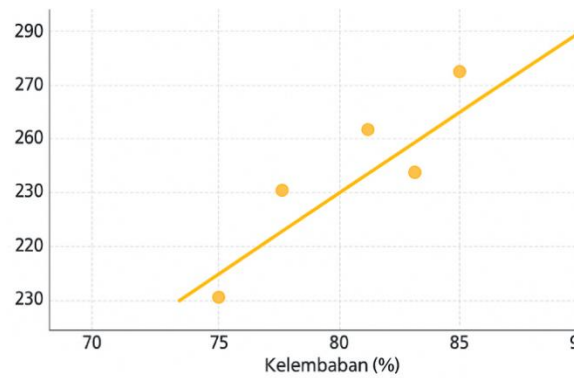


Figure 3. The Effect of Air Humidity on Corn Production

The third graph illustrates the relationship between air humidity and corn production, which appears to be relatively weak. Although a slight positive trend can be observed, the relationship is not statistically significant. This finding is consistent with the previous statistical test results, which indicated that humidity is not a dominant factor affecting corn productivity. Nevertheless, humidity still plays an important physiological role because it influences plant transpiration processes and the development of pathogenic microorganisms. Therefore, humidity should still be considered, even though its effect is not as strong as other weather variables.

The results of this study are partly consistent with previous research regarding the influence of relative humidity on maize production. Tchouandem Nzali et al. (2024) reported that relative humidity was associated with maize yield; however, its effect varied depending on local climatic conditions and interactions with other weather variables. Similarly, Affoh et al. (2022) found that relative humidity could have both positive and negative effects on maize yield at different growth stages, indicating that its influence is often less direct than that of rainfall and temperature. Furthermore, Kumar (2025) reported that humidity had a weaker effect on maize productivity than rainfall and temperature, and its impact was not statistically significant during the observation period. Therefore, the non-significant effect of air humidity observed in this study suggests that humidity alone may not be a dominant factor affecting corn production in Dua Koto District, but rather interacts with other climatic variables in influencing crop productivity. The findings of this study are also supported by recent studies indicating that relative humidity does not always have a direct effect on maize productivity. The influence of humidity often depends on its interaction with rainfall, temperature, and solar radiation, making its contribution less significant when compared with other climatic variables (Ayanlade et al., 2024).

e. Sunshine Duration (X_4)

The sunshine duration variable showed a positive and significant regression coefficient, indicating that the longer the duration of daily sunlight exposure, the higher the corn production achieved. This finding is consistent with plant physiological principles, as sunlight is a major component in the photosynthesis process, which produces energy and organic compounds required for plant growth. In the context of corn cultivation, sufficient sunshine duration helps plants develop wider leaves and larger cobs due to increased photosynthate production. Corn production tends to be optimal in areas receiving at least 6–8 hours of sunlight per day, while disruptions in sunlight exposure, such as prolonged cloudy conditions, may reduce crop yields. The findings of this study support the importance of adequate sunlight exposure as an essential requirement for productive corn cultivation.

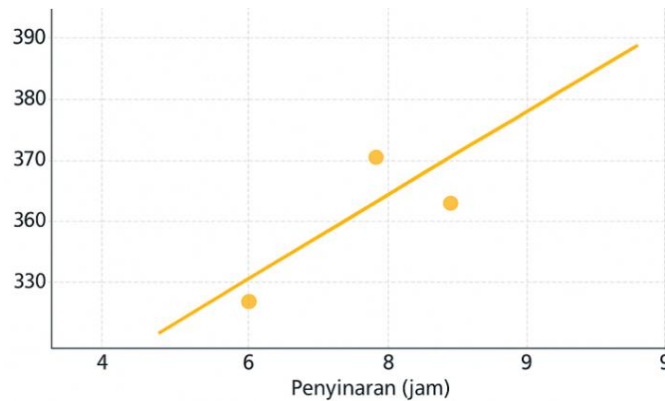


Figure 4. The Effect of Sunshine Duration on Corn Production

The fourth graph illustrates the relationship between sunshine duration and corn production. The graph shows that the longer the duration of sunlight exposure (hours per day), the higher the corn production achieved. This finding is reasonable because sunlight serves as the primary energy source for photosynthesis, which plays a crucial role in biomass accumulation and grain formation. A reduction in sunlight intensity or duration, particularly during the rainy season with prolonged cloudy conditions, may decrease the plant's ability to synthesize nutrients, ultimately leading to reduced crop yields.

The findings of this study are consistent with previous research emphasizing the importance of solar radiation and sunshine duration for maize productivity. Ruminta et al. (2024) reported that climatic factors, including solar exposure, contribute to variations in maize production because sunlight is the primary energy source for photosynthesis and biomass accumulation. In addition, Tchouandem Nzali et al. (2024) found that weather variables associated with solar energy availability significantly influenced maize yield under different climatic conditions. The positive and significant coefficient obtained in this study indicates that longer sunshine duration supports photosynthetic activity, improves plant growth, and increases grain production. Therefore, adequate sunshine duration remains an important climatic factor in achieving optimal corn productivity.

The importance of sunshine duration in this study is supported by Wu et al. (2024), who found that solar radiation, temperature, and precipitation were among the main climatic variables influencing maize grain yield. Adequate solar radiation increases photosynthetic activity and biomass accumulation, thereby contributing to higher crop productivity. This finding supports the positive and significant effect of sunshine duration observed in the present study.

f. Simultaneous Significance Test (F-Test)

Table 3. F-Test Results

Source	df	F-value	F-table ($\alpha = 0.05$)	Sig. (p)
Regression	5	8.932	2.31	0.000
Residual	71	-	-	-
Total	76	-	-	-

Source: Primary Data

Since the calculated F-value is greater than the F-table value and the p-value is less than 0.05, it can be concluded that all independent variables simultaneously have a significant effect on corn production. The F-test results presented in Table 15 indicate that the calculated F-value of 8.932 is greater than the F-table value of 2.31 at a significance level of 5% ($\alpha = 0.05$). In addition, the significance value (p-value) of 0.000 is considerably lower than 0.05. These findings indicate that the regression model used has a statistically significant simultaneous effect on the dependent variable, namely corn production.

g. Coefficient of Determination (R and Adjusted R²)**Table 4.** R and R² Values

Statistics	Value
R	0.825
R ²	0.681
Adjusted R ²	0.648

Source: Primary Data

The Adjusted R² value of 0.648 strengthens the interpretation that approximately 64.8% of the variation in shelled corn production can be accurately explained by the regression model incorporating five weather variables. Adjusted R² is used to adjust the R² value according to the number of variables in the model and the sample size, thereby providing a more realistic estimate of the model's predictive ability. The Adjusted R² value, which is relatively close to the R² value (0.681), indicates that the model does not suffer from overfitting and that each variable in the model contributes meaningfully to the variation in production.

CONCLUSION

Based on the results of the multiple linear regression analysis, the following conclusions can be drawn:

1. Rainfall (X₁) has a positive and significant effect on corn production, with a regression coefficient of 1.875.
2. Air temperature (X₂) has a negative and significant effect on corn production, with a regression coefficient of -3.214.
3. Air humidity (X₃) does not have a significant effect on corn production, with a regression coefficient of 0.432.
4. Sunshine duration (X₄) has a positive and significant effect on corn production, with a regression coefficient of 2.125.

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