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The Effect of Changes in Rainfall on Corn Crop Productivity in Kuimasi Village, Fatuleu District, Kupang Regency

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Abstract. This study aims to determine the effect of changes in rainfall on corn productivity in Kuimasi Village, Kupang Regency. This study uses quantitative methods. The analysis used in this study is simple regression analysis and Pearson Product Moment Correlation Analysis. The data sources used are primary data and secondary data, then the data is collected through documentation and questionnaires. The results of this study show that the variable (X) changes in rainfall have a positive effect on the variable (Y) of corn productivity, which can be seen through the results of a simple linear regression with a Correlation or Relationship (R) value of 0.743. From this output, a coefficient of determination (R square) of 0.552 is obtained, from the variations that occur in corn productivity in Kuimasi Village, Fatuleu District, Kupang Regency. In other words, changes in rainfall contribute 55.2% to changes in corn productivity. While the remaining 44.8% is influenced by other factors outside this research model, such as seed quality, fertilization, soil processing, pest and disease control, and other agroclimatic factors. In this study, rainfall has changed over the past five years, affecting and causing unstable corn productivity.

Keywords: Rainfall Change, Corn Productivity, Regression, Correlation.

1. Introduction

East Nusa Tenggara (NTT) is a province in Indonesia with a tropical climate [1]. The climate of East Nusa Tenggara is a dry tropical climate with a relatively long dry season, lasting approximately eight months per year, and uneven rainfall ranging from 800 to 1,500 mm per year, much lower than other regions in Indonesia [2]. This dry region of East Nusa Tenggara is influenced by the east monsoon, which blows from Australia to Asia from April to October [3]. This monsoon causes reduced rainfall and a shorter rainy season in NTT Province [4]. NTT Province is a province located in southeastern Indonesia, bordering the Flores Sea to the north, the Indian Ocean to the south, Timor Leste to the east, and West Nusa Tenggara Province to the west. East Nusa Tenggara is an archipelago province consisting of 1,192 islands, most of which are uninhabited [5]. The five largest islands in NTT are known as 'Flobamorata', consisting of Flores, Sumba, Timor, Alor, and Lembata [6]. One of the most superior sectors in this province is: the maritime sector, the agricultural sector, and plantations. Of the three superior sectors above, the most dominant in the East Nusa Tenggara region is the agricultural sector [7]. The majority of the people of East Nusa Tenggara work as farmers due to the topography and natural resources [8]. The topography of NTT is hilly. This condition causes some people to cultivate crops in hilly areas [9]. NTT also has extensive agricultural potential, such as rice, corn, soybeans, peanuts, cassava, and coffee [10].

Timor Island is one of the islands in East Nusa Tenggara, where the majority of the population is farmers. The agricultural system on Timor Island is largely traditional and highly dependent on climate conditions. Timor's agricultural land, which is less fertile than Java or Sumatra, is also volcanic, making it highly vulnerable to agricultural activities [11]. The island has two seasons: dry and rainy. However, on Timor Island, the dry season

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is longer than the rainy season. Generally, during the dry season, agricultural productivity decreases due to water shortages. Meanwhile, during the rainy season, agricultural productivity increases [12].

The dry climate makes agriculture less promising on Timor Island. Only a few crops adapted to Timor's natural habitat are relied upon, such as corn and beans. These two crops remain the staple foods of the Timorese people. Timor's dry climate encourages local communities to pursue agricultural practices suited to the local conditions, which experience low rainfall and limited water availability. Kupang Regency is one of the regencies in East Nusa Tenggara that is less prominent in the agricultural sector. The agricultural sector dominates economic activity in Kupang Regency, particularly in Kuimasi Village, Fatuleu District, where dry land conditions and limited water supply force the community to work as farmers. One of the crops frequently planted by farmers in Kuimasi Village, Fatuleu District, is corn. Corn production in Kuimasi Village still falls short of expectations. One of the climatic factors affecting corn production is rainfall [13].

Kupang Regency has rainfall that varies every year. Based on data obtained from the Kupang Regency Central Statistics Agency located on Jalan Sombai KM 01 Bonen-Baumata Kupang NTT. Based on Kupang Regency rainfall data for 2020-2024, the highest rainfall was in 2022, at 2387 mm and the lowest rainfall was in 2020, at 1225 mm. Meanwhile, the amount of rainfall data for 5 years, the month with the highest rainfall is in February, at 2207 mm and the lowest rainfall is in August, at 1 mm. With rainfall fluctuating every year above, this will affect the productivity of corn plants. Hubertus et al. [14] stated that the rainfall required for optimal corn growth is 1,200–1,500 mm/year, with 4–6 wet months (more than 100 mm per month) and 4–6 dry months (less than 60 mm per month) [15]. Corn plants require moderate to high humidity (50%–80%) to maintain optimal plant metabolic balance. To address the issue of crop production related to this shift in the onset of the season, a study of changes in rainfall on corn productivity is necessary.

Kuimasi Village, Fatuleu District, Kupang Regency, is an area with dryland farming and the land is highly dependent on rainfall. Dryland in Kuimasi Village is used by farmers to grow corn. Changes in rainfall in recent years have a direct impact on corn productivity, even risking crop failure in recent years in Kuimasi Village. The results of an initial interview with the Head of the Kuimasi Village Agricultural Extension Center, data on harvest yields in 2020 reached 780 tons while in 2023 it only reached 300 tons, from the data above it can be seen that there are differences in harvest yields each year. Based on the problems above, the researcher wants to study further by limiting the problem only to changes in rainfall on corn production on dry land with the aim of determining the effect of changes in rainfall on corn productivity in Kuimasi Village, Kupang Regency.

2. Method

This research method uses a quantitative approach to analyze the effect of rainfall on corn productivity in Kuimasi Village, Fatuleu District, Kupang Regency. The research was conducted from July 21 to August 1, 2025. Kuimasi Village was chosen as the research location because it is one of the corn cultivation centers in Fatuleu District, and the research location map is presented in the Research Location Chart/Map which shows the position of Kuimasi Village in the context of the Kupang Regency area. The type of research used is quantitative research with the aim of knowing the phenomenon and causal relationship between the independent variable and the dependent variable, namely the effect of rainfall (X) on corn productivity (Y). The population in this study were all heads of corn farming families in Kuimasi Village, totaling 101 people. Determination of the number of samples using the Slovin formula with an error rate of 10% (e = 0.1), so that n = 50 was obtained. Thus, the number of samples in this study was 50 heads of families. Sampling was carried out using a purposive sampling technique, namely the selection of respondents based on certain characteristics, namely corn farmers who have actively planted corn for at least the last 5 years.

The data sources used consisted of primary and secondary data. Primary data were obtained through questionnaires distributed to corn farmers to gather information related to corn productivity, cultivation practices, and relevant field conditions. Secondary data, in the form of rainfall data, were obtained from the Class II Climatology Station of the Meteorology, Climatology, and Geophysics Agency (BMKG), NTT. Supporting data on corn productivity were obtained from the Kuimasi Village Agricultural Extension Center (BPP) and administrative documents available from relevant agencies and the community. The variables in this study consist of rainfall as the independent variable (X) and corn productivity as the dependent variable (Y). The research instrument is a closed questionnaire containing a list of structured questions related to corn productivity, where respondents are only asked to tick (√) on the provided answer alternatives without writing the answer in their own words. The measurement of answers uses a Likert scale with five categories [16]. Data analysis was carried out using simple linear regression analysis to determine the effect of the independent variable (rainfall) on the dependent variable (corn productivity). The form of a simple regression equation, where y is corn productivity, X is rainfall, a is a constant, b is the regression coefficient (slope), and e is the standard error. Before conducting the regression analysis, instrument testing was first conducted which included validity and reliability tests [17].

After the instrument was declared valid and reliable, a classical assumption test was performed to ensure the feasibility of the regression model. The normality test was used to assess whether the residuals were normally distributed. The heteroscedasticity test was performed to determine whether there was inequality in residual variance between observations in the regression model. The linearity test was used to ensure that the relationship between rainfall and corn productivity was linear [18]. Hypothesis testing was conducted using a t-test (partial test) to determine the significant effect of rainfall (X) on corn productivity (Y). To clarify the relationship between rainfall and corn productivity, Pearson Product Moment correlation analysis was also used. The correlation coefficient (r) value is in the range of -1 to 1 and describes the strength and direction of the relationship between variables. The interpretation of the strength of the relationship follows the Guilford classification, namely: $0<0.2$ very small relationship (almost none), $0.2\geq0.4$ small relationship, $0.4<0.7$ moderate relationship, $\geq0.7<0.9$ strong relationship, and $0.9<1$ very strong relationship.

3. Result and Discussion

3.1 Rainfall Data

Rainfall data collection at the NTT Class II Climatology Station of the Meteorology, Climatology, and Geophysics Agency was carried out on July 21, 2025. Based on the data collected, rainfall data in Kuimasi Village can be seen in Table 1.

Table 1. Rainfall Data Table

Month / Year	2020	2021	2022	2023	2024
January	231	216	603	286	205.5
February	124.4	473	498.5	233.5	454.5
March	123	179	231.3	233.5	454.5
April	39.5	559	100.5	176	57
May	16	0	4	1	23
June	6.5	3	–	31	9
July	0	0	0	25	1

August	0	0	1	0	0
September	0	1	55	0	141
October	16.6	68	94	0	28
November	88.5	173.7	241.5	66	183
December	286.9	324	410	182.5	161.5
Total	**932.4**	**1996.7**	**2238.8**	**1586**	**1442**

Based on rainfall data for Kuimasi Village from 2020 to 2024 in Table 1, the highest rainfall occurred in 2022 with a total of 2,238.8, and the lowest rainfall occurred in 2020 with a total of 932.4. This fluctuating rainfall annually impacts corn productivity. The rainfall pattern in Kuimasi Village is characterized by an unstable monsoon pattern, meaning rain only falls for a few months a year and often at irregular times. Sometimes the rainy season arrives late, or rainfall is very low compared to the previous year. This condition makes it difficult for farmers to determine planting times, and corn plants often experience water shortages during the growing season, resulting in decreased productivity.

3.2 Annual Corn Crop Productivity Data

Based on the data taken, the productivity data for corn plants in Kuimasi Village can be seen in Table 2.

Table 2. Annual Corn Productivity Table

Year	Land area	Production (Ton/Ha)	Productivity (Ton/Ha)
2020	130	780	6
2021	95	665	7
2022	95	665	7
2023	50	300	6
2024	50	300	6

Based on Table 2, it can be seen that in the last five years, corn crop productivity in Kuimasi Village was lowest in 2020, 2023, and 2024, while the highest was in 2022 and 2023.

3.3 Respondent Characteristics

Respondent characteristics can be seen in Table 3

Table 3. Respondent Characteristics Based on Gender

No	Respondent Characteristics	Category	Number (of Souls)	Percentage (%)
1	Gender	Male	18	36
		Famele	32	64
	Total		50	100
2	Age	25–35 years	8	16
		36–45 years	16	32
		46–55 years	16	32
		56–67 years	10	20
	Total		50	100
3	Long Time Corn Farmer	> 5 years	50	100
	Total		50	100

Based on Table 3, the respondents in this study numbered 50 people with relatively homogeneous characteristics as experienced corn farmers. In terms of gender, the majority of respondents were female, namely 32 people (64%), while 18 were male (36%). In terms of age, respondents were dominated by the middle-productive age group, namely 36–45 years old and 46–55 years old, each with 16 people (32%), followed by 56–67 years old with 10 people (20%) and 25–35 years old with 8 people (16%). In terms of length of time as corn farmers, all respondents (100%) have been engaged in corn farming for more than 5 years. This indicates that respondents have considerable experience in corn cultivation, so that the data provided can be considered to represent the real conditions in the field regarding corn productivity and its relationship to rainfall in Kuimasi Village.

3.4 Validity and Reliability Test Results

The results of the validity and reliability tests can be seen in Table 4.

Table 4. Validity and Reliability Test Results

Variables	items	Rcount	Rtable	Cronbach's α	Information
Change in Rainfall (X)	X1	0.394	0.361	0.819	Valid and Reliable
	X2	0.495	0.361		Valid and Reliable
	X3	0.412	0.361		Valid and Reliable
	X4	0.604	0.361		Valid and Reliable
	X5	0.637	0.361		Valid and Reliable
Corn Crop Productivity (Y)	Y1	0.621	0.361		Valid and Reliable
	Y2	0.489	0.361		Valid and Reliable
	Y3	0.373	0.361		Valid and Reliable
	Y4	0.637	0.361		Valid and Reliable
	Y5	0.477	0.361		Valid and Reliable

Based on the validity and reliability test results in Table 4, all statement items for the variables of rainfall change and corn productivity were declared valid because their calculated r values were greater than r tables. Furthermore, a Cronbach's Alpha value of 0.819 indicated that the research instrument was reliable with a high level of internal consistency, making the questionnaire suitable for further data analysis.

3.5 Results of the Correlation Test Between Changes in Rainfall and Corn Crop Productivity

The calculation results are presented in Table 5.

Table 5. Correlation Test Results

Measure		Rainfall	Corn Productivity
Rainfall	Pearson Correlation	1	0.390
	Sig. (2-tailed)		0.005
	N	50	50
Corn Productivity	Pearson Correlation	0.390	1
	Sig. (2-tailed)	0.005	
	N	50	50

Based on the Pearson correlation test results in Table 5, the correlation coefficient was 0.390 with a significance level of 0.005. This value indicates a positive and significant relationship between rainfall and corn productivity. The strength of the relationship is in the low to moderate category, but remains statistically significant because the sig value is <0.05. Thus, increased rainfall tends to be followed by increased corn productivity in Kuimasi Village, although the relationship is not very strong.

3.6 Simple Linear Regression Test Results

The calculation results are presented in Table 6.

Table 6. Results of the Classical Assumption Test

No	Test Type	Reported Indicators	Value	Sig.	p
1	Normality (K–S)	N = 50	T = 0.088	0.200	p > 0.05
2	Heteroscedasticity	AbsRES	t = 0.000	1.000	p > 0.05
3	Linearity	Linearity	F = 0.141	0.710	p > 0.05
4	Deviation from Linear	Deviation from Linearity	F = 2,100	0.065	p > 0.05

Based on Table 6, it can be concluded that the regression model meets all the classical assumptions tested. The Kolmogorov–Smirnov normality test shows a significance value of 0.200 ($p > 0.05$), so the residuals are normally distributed. The heteroscedasticity test (AbsRES) produces a significance value of 1.000 ($p > 0.05$), which means there is no heteroscedasticity symptom. The linearity test also shows a linear relationship between rainfall and corn productivity with a significance value of 0.710 ($p > 0.05$), while the deviation from linearity is not significant with a significance value of 0.065 ($p > 0.05$). Thus, the simple linear regression model used is feasible and meets the requirements for use in further analysis.

3.7 Simple Linear Regression Results

The results of linear regression can be seen in Table 7.

Table 7. Results of Simple Linear Regression Analysis: Effect of Rainfall on Corn Productivity

Component	Indicator	Value	Information
Model Feasibility	R	0.743	Strength of the model relationship
	R Square (R^2)	0.552	55.2% of the variation in productivity is explained by rainfall
	Adjusted R Square	0.543	Adjusted R^2
	Std. Error of the Estimate	3,165	Standard error of the estimate
ANOVA test	F count	8,621	The regression model is significant ($p < 0.05$)
	Sig. (p-value)	0.005	
Regression Coefficient	Constant (a)	21,058	Sig. = 0.000
	Rainfall (b)	0.656	Sig. = 0.005; Beta = 0.390; t = 3.936
Model Equation	Y = a + bX	Y = 21.058 + 0.656X	Y = Corn Productivity, X = Rainfall

Based on the results of simple linear regression analysis, the R value = 0.743 was obtained, which indicates that there is a strong relationship between rainfall and corn productivity. The R Square (R^2) value of 0.552 indicates that 55.2% of the variation in corn productivity can be explained by changes in rainfall, while the remaining 44.8% is influenced by other factors outside the model. The results of the ANOVA test show that the regression model is significant with a value of F = 8.621 and p = 0.005 ($p < 0.05$), so the model is suitable for predicting the effect of rainfall on corn productivity. The regression coefficient shows that rainfall has a positive effect with a value of b = 0.656 and a significance of 0.005, which means that rainfall has a significant effect on increasing corn productivity [19]. The regression equation obtained is:

$\hat{Y} = 21.058 + 0.656X$, which indicates that every 1 unit increase in rainfall is followed by an increase in corn productivity of 0.656 units [20]. This result indicates that rainfall is an important factor in determining corn productivity in Kuimasi Village. The positive relationship indicates that the higher the rainfall (within the optimal limit), the higher the resulting corn productivity. The low significance value confirms that this effect is not coincidental, but occurs consistently based on field data. The constant value of 21.058 means that when rainfall is at zero (or has no effect), basic corn productivity is estimated to be in the range of 21 units (e.g., quintals/ha according to the research unit). Meanwhile, the coefficient value of 0.656 indicates that the increase in rainfall makes a significant contribution to increasing crop yields.

3.8 Discussion

Based on the results of a simple linear regression analysis, changes in rainfall significantly impact corn productivity in Kuimasi Village. This can be seen from the significance value of 0.016 (<0.05) and the Pearson correlation value of 0.743, indicating a strong positive relationship between rainfall and corn productivity. The correlation value of 0.743 falls within the strong correlation category (0.70 - 0.89), indicating that when rainfall increases, corn productivity also tends to increase with a fairly close relationship. This impact occurs because rainfall is the primary source of water for the rain-fed agricultural system, which still dominates agricultural activities in Kuimasi Village [14]. Corn plants require adequate water throughout the growth period, from germination to grain filling. Adequate and even rainfall allows the soil to retain the moisture needed for optimal plant growth. However, low or erratic rainfall can cause corn plants to experience drought, particularly during the flowering and grain filling phases, resulting in incomplete grain development and reduced yields [21].

Furthermore, the rainfall pattern in Kuimasi Village is monsoonal, with the rainy season occurring only between December and March, while the dry season occurs from May to October [22]. This rainfall pattern results in a highly dependent on the timing of rainfall. If the rainy season arrives late, farmers also delay planting, shortening the crop's growth period before the dry season arrives [23]. This directly impacts corn productivity. Fluctuations in rainfall from year to year also affect planting patterns and crop yields. In years with high rainfall, corn productivity increases because water is readily available throughout the growing season. However, in years with low rainfall, groundwater levels rapidly deplete, causing plants to experience water stress. This disrupts photosynthesis, leaves dry out quickly, and corn cob formation is impaired [24]. Thus, it can be concluded that changes in rainfall significantly impact corn productivity in Kuimasi Village [25]. Water availability from rainfall is the primary limiting factor in rain-fed farming systems. Therefore, to maintain stable corn yields, adjusting planting times to reflect rainfall patterns is necessary, as well as implementing groundwater conservation measures such as constructing infiltration wells or using mulch to maintain soil moisture during the dry season [26].

4. Conclusion

Based on the research results, it can be concluded that changes in rainfall have a positive and significant effect on corn productivity in Kuimasi Village, Fatuleu District, Kupang Regency. The effect of changes in rainfall on corn productivity can be seen through the results of a simple linear regression with a Correlation or Relationship (R) value of 0.743. From this output, a coefficient of determination (R square) of 0.552 is obtained, which means that the influence of the independent variable (changes in rainfall) is 55.2% on changes in corn productivity. While the remaining 44.8% is influenced by other factors outside this research model, such as seed quality, fertilization, soil cultivation, pest and disease control, and other agroclimatic factors. Corn productivity will be optimal when rainfall is at a level appropriate to planting needs, while excessive or insufficient rainfall can lead to decreased yields. In this study, rainfall has changed over the past five years, affecting and causing unstable corn productivity. Based on the description above, the recommendation proposed in this study is to create rainwater reservoirs by constructing small ponds, reservoirs, or rainwater catchment wells so that the water can be reused if rainfall is uncertain.

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6. Declaration

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