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STUDY OF THE IMPACT OF CLIMATE CHANGE ON PRODUCTIVITY AND DISEASES OF RICE PLANT IN VILLAGES OF SIMALUNGUN DISTRICT

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Abstract

The aim of the research is to evaluate whether climate change has occurred in Simalungun Regency and study its impact on rice productivity and pest attacks. The research was carried out in March – May 2023 in Simalungun Regency, North Sumatra Province. With the results of the study of the impact of climate change on productivity and disease in rice plants in Sei Merbau village, Ujung Padang subdistrict, Simalungun district, carried out using the location survey method and taking climate data from the BMKG office, data on production, productivity and disease pests on rice plants were taken. from the agricultural service office. The climate data for 3 years that has been obtained is compared each year by looking at the results of developments in productivity and pests and diseases in rice plants in Sei Merbau village, Ujung Padang sub-district, Simalungun district. In 2018-2020, the climate in Simalungun district experienced fluctuations every year which could have an impact on the development of rice plant productivity and rice plant diseases in Simalungun district every year. There is a significant level of correlation between rainfall and rainy days on rice production and productivity in Simalungun Regency.

Keywords: ***Differences In Climate Change, Climate Elements, Rice Productivity***

1. INTRODUCTION

This rice (Oryza sativa L.) or rice as a staple food, is a very important food crop for Indonesian people. (Budi RS, 2018).Rice is the staple food for more than 95% of the Indonesian population. Apart from that, rice cultivation has also provided employment opportunities for around 20 million farming houses in rural areas, so that in terms of national food security its function is very important and strategic (Balitpa, 2009). Therefore, the availability of rice must always be guaranteed because it can cause vulnerability if there is a stock shortage. The need for rice in Indonesia continues to increase along with the increase in population, but this is inversely proportional to the rice produced by farmers. National rice production in 2010 was 66,469,394 tons, in 2011 it was 65,756,904 tons, in 2012 it was 69,056,126 tons and in 2013 it increased to 71,279,709 tons. In 2014 it decreased to 70,846,465 tonnes but in 2015 it experienced a fairly high increase to 75,397,841 tonnes (BPS, 2017). The decline in production, harvested area and rice productivity occurred due to El Niño, causing drought compared to 2010. The same event was seen in 2013 compared to 2014.

In the 2010-2014 period, the increase in productivity, harvested area and production was very heavy even though the government was determined to to increase production through the P2BN program. Production growth for the 2005-2010 period was higher than 2010-2015(Sembiring, 2017). Rice production produced by farmers has fluctuated. One of the causes of instability in national rice production is the issue of climate change due to global warming. According to Hansen et al., (2006) the short-term effect of global warming is the possibility of an increase in the El-Nino phenomenon. The impacts that occur due to the El-Nino and La-Nina phenomena are crop failure and a decrease in the Harvest Index (IP), damage to agricultural resources such as increased pest attacks (Las et al., 2008).

The decline in rice production and productivity is caused by various obstacles, including the conversion of productive rice fields to the industrial and residential sectors so that high light and uncertain climate phenomena will cause floods, droughts and disturbances by plant pests (OPT). Apart from that, land and water resources are becoming more and more degraded and abandoned, due to erosion, landslides and pollution, so that the decline in environmental quality both regionally and globally results in a reduction in strategic land for rice cultivation, plus limited potential land for agricultural development reserves. To overcome the reduction in strategic land for rice cultivation, it is necessary to develop upland rice cultivation (upland rice) by exploiting the potential of dry lands such as fields and gardens.(Saleh, et al., 2015 andSembiring, 2017).

However, climate changes such as increasing temperatures and rainfall intensity also have a positive impact on rice productivity. Increased rainfall will cause more land to be planted (Suciantini, 2015). Di Falcao et al., (2010) stated that a number of plants have a positive correlation with rainfall. Apart from rainfall, increasing temperatures also have several positive influences. The increase in temperature is caused by an increase in the concentration of CO¬2 in the air. Increasing CO¬2 concentration can increase rice yield because it is associated with the level of sterilization of rice grains at higher temperature levels (Krishnan et al., 2007). However, globally, increasing CO2 concentrations can partially reduce rice yields, this is due to low humidity and temperatures that are not optimal for rice growth (Naylor et al., 2007). Apart from being influenced by climatic factors, rice productivity can also be influenced by cultivation techniques.

Based on the background above, it is necessary to carry out research to assess the impact of climate changeSimalungun Regency is one of the districts in North Sumatra.Rice fields in Simalungun Regency have an area of 31,273 hectares. The potential of land can become capital for the development of rice farming and contribute to the economy of Simalungun Regency, especially in food crop farming. Based on data obtained from BPS Simalungun Regency in 2019, Simalungun Regency is a rice producer in North Sumatra. The largest area of rice fields in Simalungun Regency is irrigated rice fields with an area of 31,093 hectares (99.42%) of the total rice fields. Meanwhile, non-irrigated rice fields are only 180 hectares (0.57%).

Formulation of the problem

The decline in rice production and productivity is caused by various obstacles, one of which is the uncertain climate phenomenon which will cause floods, droughts and disturbances by plant pests (OPT). Apart from that, land and water resources are becoming more and more degraded and neglected, due to erosion, landslides and pollution, so that the decline in environmental quality both regionally and globally results in a reduction in strategic land for rice cultivation, plus limited potential land for agricultural development reserves. To overcome the reduction in strategic land for rice cultivation, it is necessary to study the impact of climate change on rice production so that from the research results recommendations can be made for water and land management to support rice production, namely utilizing the potential of dry lands such as fields and gardens.(Saleh, et al., 2015 andSembiring, 2017).

Research purposes

The aim of the research is to evaluate whether climate change has occurred in Simalungun Regency and study its impact on rice productivity and pest attacks

Research Hypothesis

The research hypotheses are (1) it is suspected that there is a difference in climate change in Simalungun and the impact on rice productivity is studied, (2) it is suspected that there is an influence of climate elements on rice productivity and, (3) it is suspected that there is an influence of pest attacks on rice productivity.

2. RESEARCH METHODS

Place and time

The research was carried out in March – May 2023 in Simalungun Regency, North Sumatra Province. At height± 20 m above sea level with flat topography. The materials used in this research are climate data consisting of rainfall and temperature for 2001 - 2021 obtained from BMKG Simalungun, data on land area, rice production and productivity for 2001-2021 obtained from the Simalungun Regency Agriculture and Plantation Service.Pest and disease data from the agricultural departmentThis research uses a survey method. Determination of the research location and names of respondents was carried out randomly (Random Sampling). Analysis of climate change that occurred in Simalungun Regency was carried out by dividing climate data for 10 years into 2 decades and comparing the start of the dry season and the start of the rainy season in the first decade with the second decade. To determine the relationship and influence between climate variables and rice productivity, correlation and linear regression tests were used, then continued with descriptive analysis. The correlation test is used to determine the close relationship between climate elements and rice productivity. A regression test is carried out if climate (temperature or rainfall) and rice productivity have a significant relationship. Linear regression analysis is used to determine the effect of climate variables (temperature and rainfall) on rice productivity using the formula: $Y = a + bX$, where Y: Rice Productivity (t ha-1,), a: Constant Value and B: Regression Coefficient.

3. RESULTS AND DISCUSSION

General Description of Climate Conditions in Ujung Padang District, Simalungun Regency, North Sumatra in 2018-2020

Based on climate data obtained from BMKG Simalungun Regency, 2016-2020, it is known that the climate elements recorded at the research location, namely Ujung Padang District, are only rainfall (CH) and rainy days (HH). CH and HH data obtained and presented in Table 1. CH and HH fluctuations since 20162020in Ujung Padang sub-district, Simalungun Regency are presented in Figures 1 and 2. Information on other climate elements such as air temperature, air humidity (RH), solar radiationand also wind speed, the data was not obtained because the only tools available in the Ujung Padang District, Simalungun Regency, are rain catchers. Due to the limited equipment used in the Ujung Padang District, Simalungun Regency, I can only present data on CH and HH.

Table 4.1Data on Rainfall (mm/month) and Rainy Days (days) in Ujung Padang District, Simalungun Regency in 2018-2020.

RAINFALL & RAINY DAYS SIMALUNGUN DISTRICT IN 2018-2020						
	2018		2019		2020	
Month	CH	HH	CH	HH	CH	HH
	mm/month	day	mm/month	day	mm/month	day
January	289	19	222	15	50	6
February	208	9	258	16	72	7
March	83	10	380	20	195	10
April	53	14	345	18	212	13
May	241	20	364	20	280	14
June	223	12	172	13	116	11
July	115	9	191	6	212	17
August	106	9	199	10	123	9
September	428	22	73	14	224	13
October	537	23	395	17	190	13
November	357	19	171	17	454	21
December	312	17	180	15	285	18
Average	246	15.25	245.83333	15.08333	201,083	12.666667
Amount	2952	183	2950	181	2413	152

In Table 1, it can be presented that the average rainfall (CH) in Simalungun Regency in 2018-2020 is classified as above the optimal requirement for rice plant growth, namely in the range of 201-246 mm/month, with an average of 12-246 mm of rainy days. 15 days every month. The optimal rainfall needed by rice plants is 200 mm/month. And the average rainfall in Simalungun Regency is above 200 mm/month, so it can be concluded that the rainfall in Simalungun Regency is relatively high, the CH in Simalungun Regency during 2018-2020 has been able to meet the optimal needs of rice plants which range from 201-2020. 246 mm/month.According to Paski et al. (2017), stated that the optimal rainfall that supports the growth and development of rice plants is around 200 mm per month or more, with distribution over 4 months and the desired annual rainfall is around 1500-2000 mm.

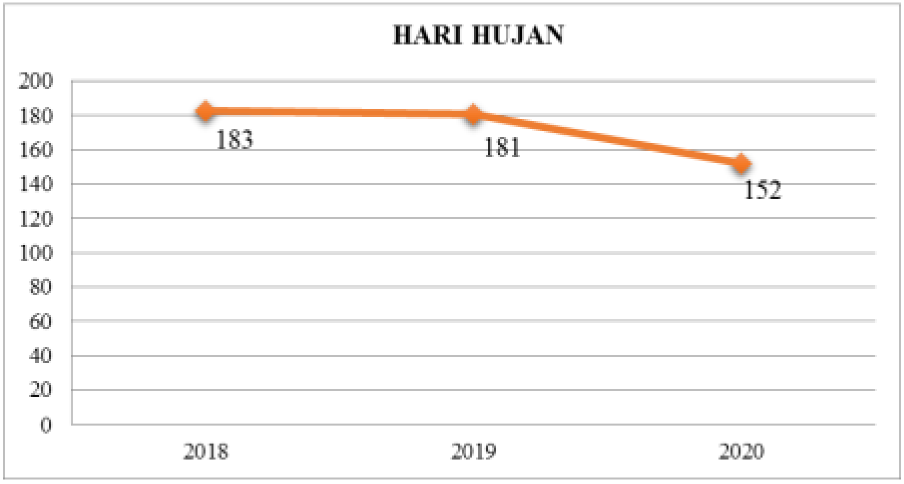

Figure 1 Graph of Rainy Days (mm/year) Simalungun Regency in 2018-2020.

In Figure 1, it can be seen that rainy days in Simalungun district for 3 years have fluctuated each year with the highest number of rainy days being in 2018 (183 days/year) and the lowest in 2020 (152 days/year). However, it cannot be concluded that low rainy days can guarantee low rainfall, just as high rainy days do not necessarily mean high rainfall because we cannot determine how many mm of rain falls per day.

Figure 2 Graph of Rainfall (mm/year) Simalungun Regency in 2018-2020.

In Figure 2, it can be seen that rainfall in Simalungun Regency for 3 years has fluctuated every year, with the highest rainfall being in 2018 (2952 mm/year) and the lowest being in 2020 (2413 mm/year). In 2018-2020, the annual rainfall meets the needs of rice plants, rice plants in an optimal year require rainfall of 1600-2000 mm.

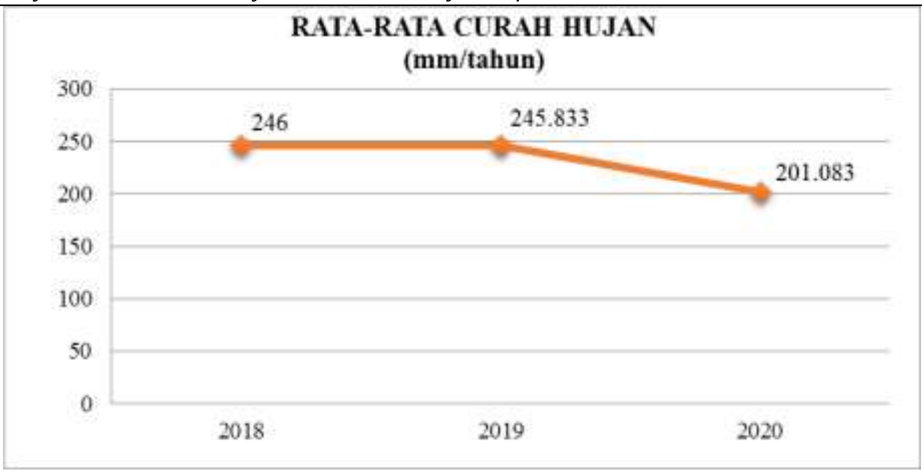

Figure 3 Graph of Average Rainfall (mm) of Simalungun Regency in 2018-2020.

In Figure 3, it can be seen that the average rainfall in Simalungun Regency for 3 years has fluctuated every year. The highest average rainfall was in 2018 (246 mm/year) and the lowest was in 2020 (201,083 mm/year). year). As we know, the lowest average rainfall in 2020 was because rainy days in 2020 were also relatively low and the highest average rainfall was in 2018 because rainfall in 2018 was relatively higher compared to previous years. another year. Annual rainfall in Simalungun Regency can be classified as high.

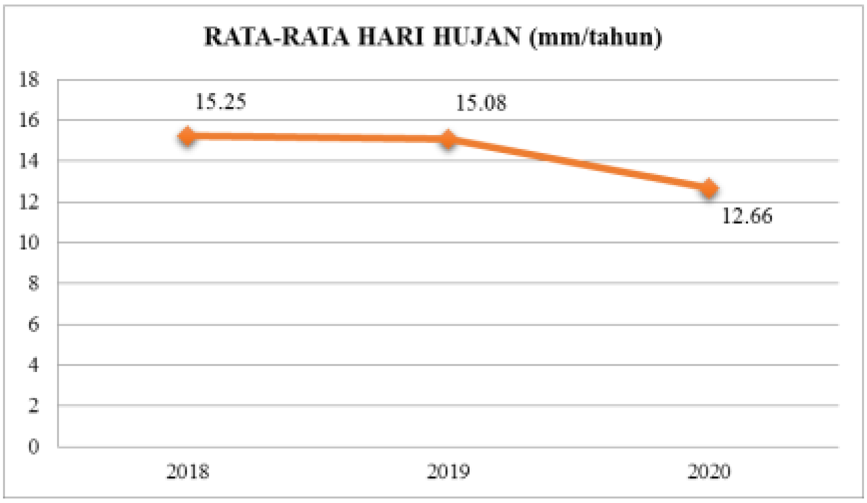

Figure 4 Graph of Average Rainy Days (days/month) of Simalungun Regency in 2018-2022.

Data relating to rice production and productivity, obtained from the Food Crops and Horticulture Department of North Sumatra Province for 2018-2020 at one research location in Simalungun Regency, Ujung Padang District, Sei Merbau Village, includes the total area of planted rice fields, area Harvest, production, productivity and diseases that attack rice plants at the research location are presented in tables 2, 3 and 4. The cropping index in Simalungun Regency is generally carried out twice planting seasons and two harvest seasons a year, but it is likely that some farmers in Simalungun Regency carry out three planting seasons and three harvest seasons in one year. Data are presented in Table 2.

Table 4.2Data on Planted Area (ha/year) and Rice Harvested Area (ha/year) in Simalungun Regency in 2018-2020.

Data on Planted Area (ha/yr) & Harvested Area (ha/yr) Simalungun Regency in 2018-2020		
Year	Planting Area (ha/yr)	Harvested Area (ha/yr)
2018	85,783	77,887
2019	61,873	62,599
2020	46,293	51.303
Average	64,650	63,930
Amount	193,949	191,789

In Table 2, it can be seen that the planted area and harvested area in Simalungun Regency for 3 years experienced fluctuations every year. The fluctuations in land area and harvested area can be seen clearly in figures 5 and 6.

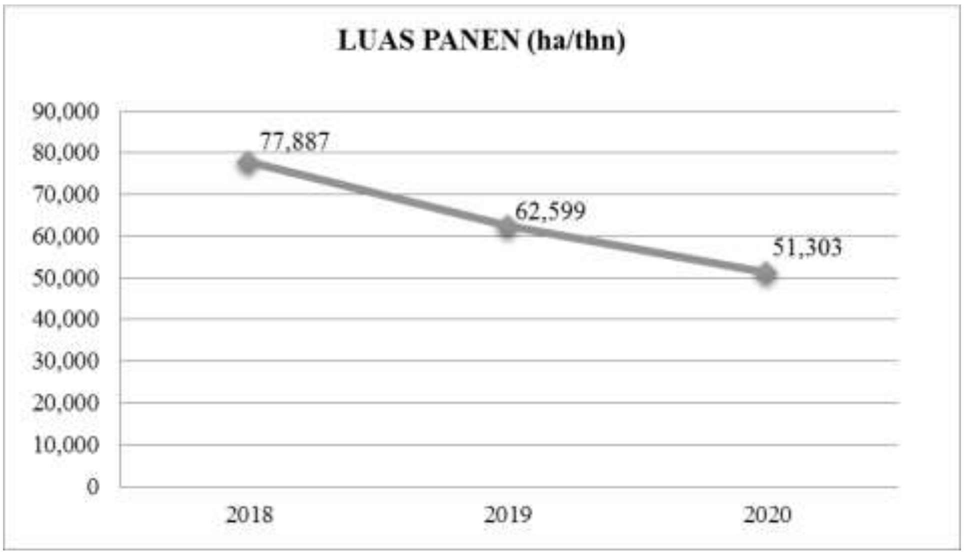

Figure 5 Graph of Harvested Area (ha/year) in Simalungun Regency in 2018 -2020.

In Figure 5, it is clear that the harvest area in Simalungun Regency for 3 years has fluctuated every year with the highest harvest area occurring in 2018 (77,887 ha/year), then the lowest harvest area was in 2020 (51,303 ha/year) . As we can see, in 2018 there was the highest fluctuation in harvest area. This could be influenced by the planted area of sawa rice land planted in Simalungun Regency. In 2020, there was the lowest fluctuation in harvest area. This could be influenced by the low planting area in the area around Simalungun Regency..

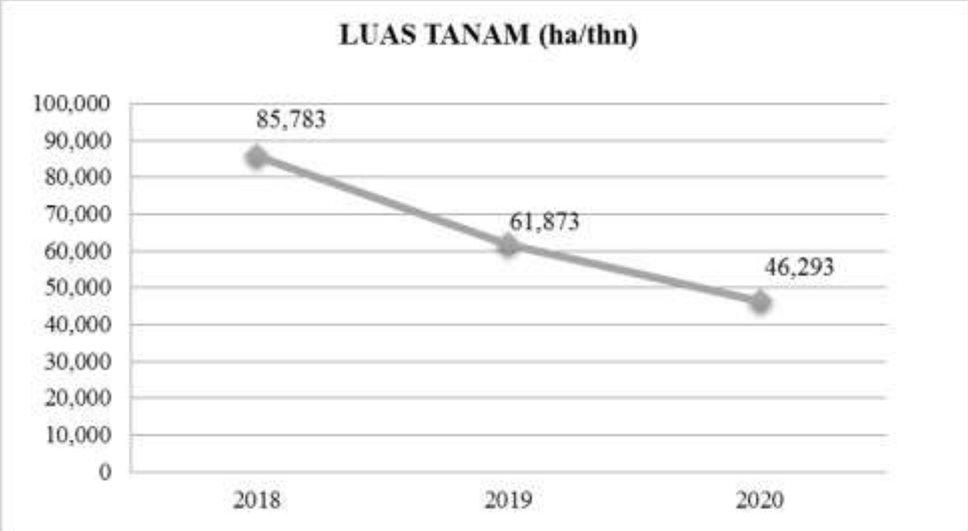

Figure 6 Graph of Planted Area (ha/year) in Simalungun Regency in 2018-2020.

In Figure 6, it is clear that the highest planted area was in Simalungun district in 2018 (85,783 ha/year), then experienced fluctuations since 2019-2020, and the lowest planted area was in 2020 (46,293 ha/year). The high planting area can influence the high production yield of rice crops in Simalungun Regency and the low planting area can affect the rice production yields in Simalungun Regency due to the high and low planting area that occurs in Simalungun Regency.can affect the yield of rice crop areas in Simalungun Regency and if the harvest area decreases, the production and productivity of rice crops in Simalungun Regency may also decrease.

Table 4.3Production Data (tons) and Productivity Data (tons/ha) in Simalungun Regency in 2018-2020.

Production Data (tons/ha) & Productivity (tons/ha) of Rice Plants in Simalungun Regency 2018-2020		
Year	Production (tons/ha)	Productivity (tons/ha)
2018	472,440	60.66
2019	335,075	53.53
2020	300,200	58.52
Average	369,238	57.57
Amount	1,107,715	172.71

In table 3, it is known that production (tons) and productivity (tons/ha).The highest rice production during the 3 year period (2018-2020), was in 2018 (472,440 tons/ha) and in 2020 (300,200) rice production in Simalungun Regency experienced a decline. That the high and low rice production in Simalungun Regency is closely related to the planted area and harvested area in Simalungun Regency, where the higher the planted area, the higher the harvested area and this has an impact on the high rice production obtained. This is also related to the irrigation system in rice fields in Simalungun Regency, the rice fields have a higher technical irrigation water system compared to non-irrigation, and there are other things that can influence the high and low levels of production and productivity, namely attacks from pests and diseases on rice plants and maintenance of rice plants. Farmers can also have a big influence on reducing production yields and rice productivity.

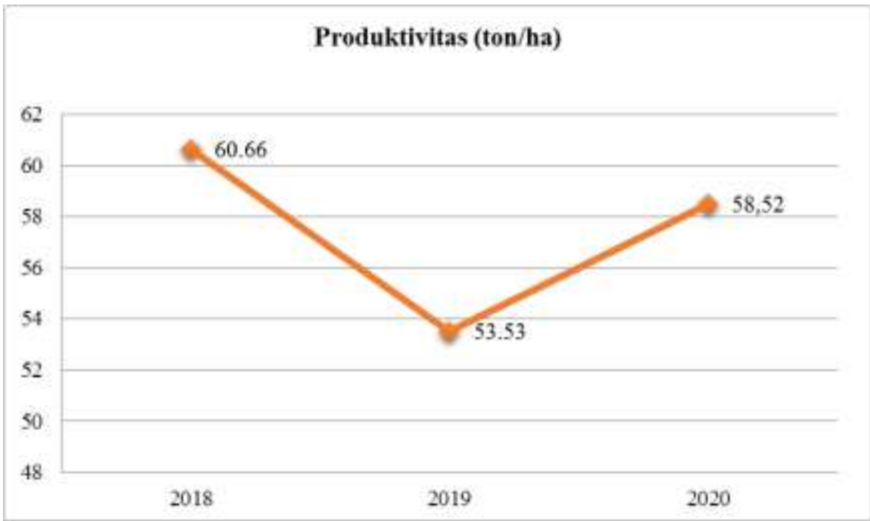

Figure 7 Productivity Graph in Simalungun Regency in 2018 -2020.

In Figure 7, it can be seen that rice productivity in Simalungun Regency during the 3 years of observation experienced fluctuations every year, with the highest productivity obtained in 2018 (60.66 tonnes/ha) and the lowest in 2019 (53.53 tonnes/ha). As we know in 2018, the highest productivity was due to several factors such as sufficient rainfall, increased rainy days, increased planting area, increased harvest area, fairly good maintenance and production results which also experienced an increase in yield. The productivity value of rice plants will also increase to the highest value compared to previous years because all factors support increasing productivity, but in 2019 the productivity of rice plants in Simalungun Regency experienced a decline due to rainfall, rainy days, planting area, harvest area and production. decrease.

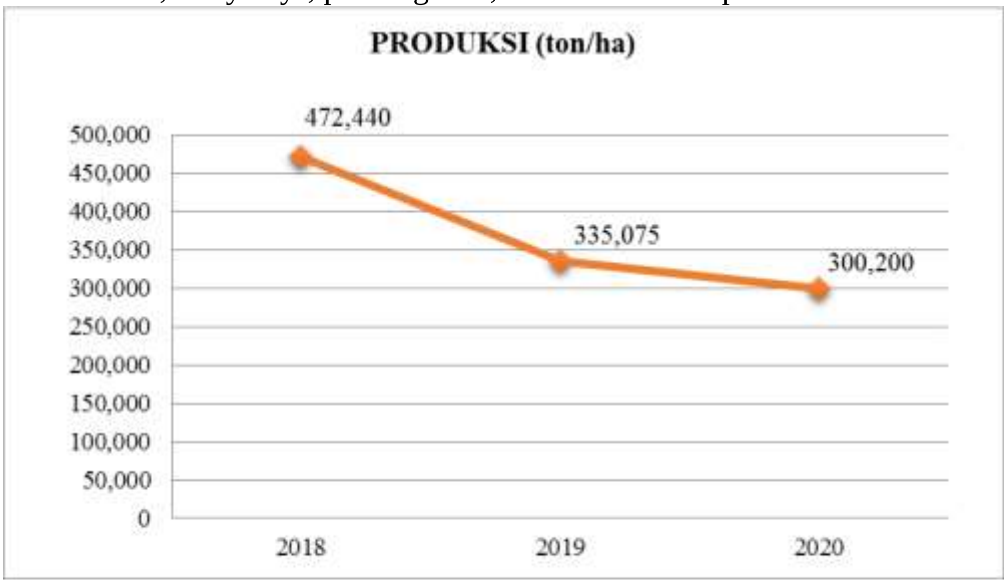

Figure 8 Production Graph (tons) in Simalungun Regency in 2018 -2020.

Table 4 Observation data on BLAST disease attacks on rice plants in Simalungun Regency 2018-2020.

Year	January				February				March				April				May				June			
	R	S	B	P	R	S	B	P	R	S	B	P	R	S	B	P	R	S	B	P	R	S	B	P
2018	2	0	0	0	1	0	0	0	10	0.5	0	0	4	0	0	0	1.9	0	0	0	8.5	0	0	0
2019	11	0	0	0	4	0	0	0	1	0	0	0	17	0.5	0	0	23.8	1	0	0	14.5	0	0	0
2020	7	0	0	0	6	0	0	0	16	0	0	0	4	0	0	0	6	0	0	0	8	0	0	0
Average	7	0	0	0	3	0	0	0	9	0.2	0	0	8.3	0.2	0	0	10.6	0	0	0	10.3	0	0	0
Amount	20	0	0	0	10	0	0	0	26	0.5	0	0	25	0.5	0	0	31.7	1	0	0	31	0	0	0

Year	July				August				September				October				November				December			
	R	S	B	P	R	S	B	P	R	S	B	P	R	S	B	P	R	S	B	P	R	S	B	P
2018	14	0	0	0	5	0	0	0	4.5	0	0	0	3.5	4	0	0	8	0	0	0	17	0	0	0
2019	17	0	0	0	15	0	0	0	11	0	0	0	11	0	0	0	8	0	0	0	17	0	0	0
2020	12	0	0	0	20	1	0	0	1	0	0	0	11	0	0	0	4	0	0	0	10	0	0	0
Average	14	0	0	0	13	0	0	0	5.5	0	0	0	8.5	1	0	0	6	0	0	0	15	0	0	0
Amount	42	0	0	0	40	1	0	0	17	0	0	0	26	4	0	0	19	0	0	0	44	0	0	0

In Table 4 above, it can be explained that the cumulative attacks of blast disease in Simaungun Regency, had different levels of attacks from 2016-2020. The disease attack classes used in this study are R (mild), S (moderate), B (severe) and P (severe). Blast disease is one of the factors causing a decrease in rice production because if left unchecked, this disease will cause death of rice plants.

Table 5 Observation Data on Bacterial Leaf Blight (BLB) Disease Attacks on Rice Plants in Simalungun Regency 2018-2020

Year	January				February				March				April				May				June			
	R	S	B	P	R	S	B	P	R	S	B	P	R	S	B	P	R	S	B	P	R	S	B	P
2018	7	0	0	0	5	0	0	0	8	1	0	0	5,6	0	0	0	7.8	0.5	0	0	9	0	0	0
2019	11	0	0	0	5	0	0	0	2	0	0	0	14.5	0	0	0	10.5	2	0	0	9	3	0	0

2020	23	0	0	0	3	0	0	0	17	0	0	0	6	0	0	0	5	0	0	0	5.2	0	0	0
Average	14	0	0	0	4	0	0	0	9	0	0	0	8.7	0	0	0	7.77	0.8	0	0	7.73	1	0	0
Amount	41	0	0	0	13	0	0	0	27	1	0	0	26.1	0	0	0	23.3	2.5	0	0	23.2	3	0	0

Year	July				August				September				October				November				December			
	R	S	B	P	R	S	B	P	R	S	B	P	R	S	B	P	R	S	B	P	R	S	B	P
2018	8.5	0	0	0	5.5	5	0	0	8	1	0	0	9.6	1	0	0	6,7	0	0	0	19	0	0	0
2019	9	2	0	0	20	0	0	0	13.5	0	0	0	22	0	0	0	6.5	2	2	0	11	0	0	0
2020	12	0.5	0	0	18	0.5	0.5	0	15	0	0	0	6.5	0	0	0	3.5	0	0	0	4	0	0	0
Average	9.83	0.8	0	0	14	1.8	0.2	0	12.2	0.3	0	0	12.7	0.3	0	0	5,6	0.7	0.7	0	11.3	0	0	0
Amount	29.5	2.5	0	0	43	5.5	0.5	0	36.5	1	0	0	38.1	1	0	0	17	2	2	0	34	0	0	0

In Table 5 above, it can be explained that the cumulative attacks of keresek disease in Simaungun Regency, had different levels of attacks from 2018-2020. The disease attack classes used in this study are R (mild), S (moderate), B (severe) and P (severe). Symptoms of a keresek disease attack are damage to the leaves which starts from the edge a few cm from the tip, in the form of lines, blisters and then spreads with wavy edges. Within a few days the leaves turn yellow and in severe wounds the leaves are greyish white. One factor that causes a decrease in rice production is because if this disease is left untreated, photosynthesis cannot be maximized as a result, it will interfere with plant growth and will result in death of the rice plant.

Table 6 Data on Production, Productivity and Planted Area, Harvested Area in Simalungun Regency from 2018-2020.

Year	Rainfall	Rainy day	Planting Area	Harvest Area	Production	Productivity
2018	2952 mm	183mm	85,783 ha	77,887 tons	472,440 tons	60.66 tonnes
2019	2950mm	181mm	63,873 ha	62,599 tons	335,075 tons	53.53 tons
2020	2413 mm	152mm	46, 293 ha	51,303 tons	300,200 tons	58.52 tons

Table 7 Correlation Analysis of Rainfall, Rainy Days Planted Area, Harvested Area, Production and Productivity of Rice Plants in Simalungun Regency, 2018-2020

	CH	HH	Planting Area	Harvest Area	Production	Productivity
CH	1					
HH	0.99852	1				
Planting area	0.80116	0.83254	1			

Harvest Area	0.82144	0.85126	0.9993978	1		
Production	0.65901	0.69897	0.978088	0.970275	1	
Productivity	-0.2217	-0.1683	0.4059157	0.373958	0.58729	1

In the table above, it is explained that rainy days and rainfall have a significant effect on the development of rice production in Simalungun Regency with correlation values that are classified as very high, but rainfall and rainy days have no effect on the development of rice plant productivity, but rice plant productivity is correlated with development. planting area, harvest area and crop production. This can be explained by the increase in planting area, harvest area, rainfall and stable rainy days, production and productivity will also increase. It can be seen in table 6, in 2018 where rainfall, rainy days planted area, harvest area, production and productivity has also increased. Water is the main component that is needed in every phase of the rice plant cycle, from germination to grain filling. And also sunlight is the main factor after water. Rice plants are classified as plants that need light as an energy source in the photosynthesis process.

Table 8 Correlation Analysis of Rainfall, Rainy Days Planted Area, Harvested Area, Production, Productivity and Rice Plant Diseases in Simalungun Regency, 2018-2020

	Rainfall	Rainy day	Planting Area	Harvest Area	Production	Productivity	BLB disease		Blast disease	
							®	(S)	®	(S)
Rainfall	1									
Rainy day	0.998517878	1								
Planting area	0.83446813	0.86322241	1							
Harvest area	0.821442087	0.85126257	0.999730154	1						
Production	0.659010161	0.69896809	0.964391103	0.9702747	1					
Productivity	-0.22172964	-0.1683311	0.352313092	0.3739583	0.58728996	1				
BLB ® disease	-0.14769557	-0.2013045	-0.66825994	-0.685361	-0.8412182	-0.931665559	1			
(S)	0.998258	0.99356742	0.800502333	0.7863641	0.61348648	-0.278874486	-0.08908563	1		
Blast disease ®	0.15521555	0.10122041	-0.41485532	-0.43588	-0.64073	-0.99770637	0.95412176	0.213229832	1	
(S)	0.612542198	0.65465367	0.946722645	0.9539483	0.99818677	0.634943689	-0.87223882	0.564839546	-0.685782202	1

It can be concluded from the table above that rainfall and rainy days have a real influence on the development of BLB disease, but it is still at a moderate level of attack. Rainfall and rainy days influence the development of blast disease, so it can be concluded that if the conditions are humid, the disease in rice plants will increase.

Table 9 Simple Linear Regression Data on Rainfall and Rice Plant Productivity in Simalungun Regency in 2018-2020

SUMMARY OUTPUTS								
Regression Statistics								
Multiple R	0.22172964							
R Square	0.04916403							
Adjusted R Square	-0.9016719							
Standard Error	5.04539103							
Observations	3							
ANOVA								
	Df	*SS*	*M.S*	*F*	*Significance F*			
Regression	1	1.316229366	1.31623	0.051706	0.857659516			
Residual	1	25.45597063	25,456					
Total	2	26.7722						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	64.8088219	31.96741432	2.02734	0.291724	-341.3756892	470.993333	-341.3757	470.993333
X	-0.0026117	0.011485659	-0.2274	0.85766	-0.148550862	0.14332742	-0.148551	0.143327418

X = rainfall in Simalungun district.
Y = productivity of rice planting in Simalungun district

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Based on the results of processed regression data in table 9 using the computerized program Microsoft Excel version 2010, the regression equation can be presented as follows: Y = 64.808 + 0.002 (X)

The regression equation Y = 64.808 + 0.002 (X) illustrates that the rainfall variable (X) in the simple regression model can be stated that if the rainfall variable changes by 1 (one), then the change in the dependent variable productivity (Y) is equal to the coefficient value of the value the rainfall variable. These results can be explained as follows:

1. The constant (a) of 64.808 means that if the rainy day (X) does not change or is equal to zero (0), then the value of (Y) is 64.808.
2. If the value (b) which is the regression coefficient of rainy days (X) is 0.002, which means it has a positive influence on the variable (Y), it means that if the rainfall variable (X) increases by 1 unit, then productivity (Y) will increase by 0.808 units assuming other variables remain constant.

Table 10 Simultaneous Hypothesis Testing (F Test)

ANOVA

	Df	*SS*	*M.S*	*F*	*Significance F*
Regression	1	1.316229366	1.31623	0.051706	0.857659516
Residual	1	25.45597063	25,456		
Total	2	26.7722			

a. Variable: Productivity.
b. Variable: Rainy Day. Microsoft Excel output source version 2010, 2023 (processed)

It can be seen that the significance level of p-value = 0.29 > 0.05, so it can be concluded that Ho is rejected and Ha is accepted, which means that simultaneous rainfall (X) has no significant effect on productivity (Y).

Table 11 Partial Hypothesis Test (t Test)

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	64.8088219	31.96741432	2.02734	0.291724	-341.3756892	470.993333	-341.3757	470.993333
X	-0.0026117	0.011485659	-0.2274	0.85766	-0.148550862	0.14332742	-0.148551	0.143327418

a. Variable: productivity
Source: outputMicrosoft excel version 2010, 2023 (processed)

It can be seen that rainy days (X) have a significance level of p-value significance p-value = 0.85 > 0.05, so it can be concluded that H0 is accepted and Ha is rejected, which means that Rainfall (X) partially has no significant effect on Work Productivity (Y).

Table 12 Coefficient of Determination Test (R2)

SUMMARY OUTPUTS								
Regression Statistics								
Multiple R	0.22172964							
R Square	0.04916403							
Adjusted R Square	-0.9016719							
Standard Error	5.04539103							

Observations	3							

a. Predictors: Rainfall
b. Dependent Variable: Productivity
Source: outputMicrosoft excel version 2010, 2023 (processed)

The results of the processed data in the table above show that the correlation coefficient (R) and determination coefficient (R square) values. From the table above, it is known that the R value of 0.221 shows a strong relationship because it is between zero and one. R Square explains how much the dependent variable is explained by the independent variable. From the calculation results, an RSquare value is obtained0.049From the calculation results, the R Square value is obtained0.049. This means that the Rainy Day variable (X) has a contribution of -90.16% to the dependent variable, namely Work Productivity (Y). Meanwhile, the remaining 5.67% is influenced by other variables not examined in this research. In table 9, based on a simple linear regression analysis between rainfall and productivity in Simalungun district, the results of the T test analysis of the variable

The results of the F analysis were 5.1706, the significant F was 0.8576 and the alpha value was 0.05. If the significance value is less than the alpha value, then there is a real influence between variable X (rainfall) on variable Y (productivity). Based on a simple linear regression analysis between productivity and rainfall in Simalungun Regency, an equation is obtained, namely productivity = 64,808 + -0.00261 rainfall. The results of the negative linear regression test show that the value of the rainfall variable is -0.00261, meaning that every increase in rainfall by 1 mm/year will reduce rice productivity by -0.00261 tonnes. The multiple correlation value (R) between rainfall and productivity is 0.2217, which is in the low category, this can be explained that rainfall has a big impact on productivity. From the regression equation, it can be seen that the coefficient of determination (R2) is -90.16%, which means that rainfall explains that lowland rice productivity is influenced by rainfall and rainy days by -90.16% and 91.16% is influenced by other factors such as fertilizer. , varieties, pests etc.

This can be explained by the fact that as the harvest area increases with stable rainfall, production and productivity also increase, as can be seen in table 6, in 2020, where rainfall and rainy days are low but productivity is high, this is influenced by fertilizer, maintenance and irrigation. So productivity is higher than in 2019. Water is the main component that is needed in every phase of the rice plant cycle, from germination to grain filling. And also sunlight is the main factor after water. Rice plants are classified as plants that need light as an energy source in the photosynthesis process.

Table 13 Simple Linear Regression Data on Rainy Days and Rice Plant Productivity in Simalungun Regency in 2018-2020.

SUMMARY OUTPUTS								
Regression Statistics								
Multiple R	0.168331055							
R Square	0.028335344							
Adjusted R Square	-0.943329312							
Standard Error	5.100352978							
Observations	3							
ANOVA								
	Df	*SS*	*M.S*	*F*	*Significance F*			
Regression	1	0.758599502	0.758599502	0.02916165	0.892324475			
Residual	1	26.0136005	26.0136005					
Total	2	26.7722						

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	63.67571429	35.87553279	1.774906443	0.32663716	-392.1661503	519.5175789	-392.1661503	519.5175789
X	-0.035498339	0.207874869	-0.170767824	0.89232448	-2.676798977	2.6058023	-2.676798977	2.6058023

Based on the results of processed regression data in Table 10 using the computerized program Microsoft Excel version 2010, the regression equation can be presented as follows:

Y = 63.675 + 0.035 (X)

The regression equation Y = 63.675 + 0.035 (X) illustrates that the rainy day variable (X) in the simple regression model can be stated that if the rainy day variable changes by 1 (one), then the change in the dependent variable productivity (Y) is equal to the coefficient value of the the rainy day variable. These results can be explained as follows:

3. The constant (a) of 63.675 means that if the rainy day (X) does not change or is equal to zero (0), then the value of (Y) is 63.675.
4. If the value (b) which is the regression coefficient for rainy days (X) is 0.035, which means it has a positive influence on the variable (Y), it means that if the rainfall variable (X) increases by 1 unit, then productivity (Y) will increase by 0.035 units assuming other variables remain constant.

Table 14 Simultaneous Hypothesis Testing (F Test)

ANOVA					
	Df	*SS*	*M.S*	*F*	*Significance F*
Regression	1	0.758599502	0.758599502	0.02916165	0.892324475
Residual	1	26.0136005	26.0136005		
Total	2	26.7722			

a. Variable: Productivity.
b. Variable: Rainy Day. Microsoft Excel output source version 2010, 2023 (processed)

It can be seen that the significance level of p-value = 0.32 > 0.05, so it can be concluded that Ho is rejected and Ha is accepted, which means that Rainy Days (X) simultaneously have no significant effect on Productivity (Y).

Table 15 Partial Hypothesis Test (t Test)

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	63.67571429	35.87553279	1.774906443	0.32663716	-392.1661503	519.5175789	-392.1661503	519.5175789
X	-0.035498339	0.207874869	-0.170767824	0.89232448	-2.676798977	2.6058023	-2.676798977	2.6058023

a. Variable: productivity

Source: outputMicrosoft excel version 2010, 2023 (processed)

It can be seen that rainy days (X) have a significance level of p-value significance p-value = 0.89 > 0.05, so it can be concluded that H0 is accepted and Ha is rejected, which means that Rainfall (X) partially has no significant effect on Work Productivity (Y).

Table 16 Coefficient of Determination Test (R2)

SUMMARY OUTPUTS								
Regression Statistics								
Multiple R	0.168331055							
R Square	0.028335344							
Adjusted R Square	-0.943329312							
Standard Error	5.100352978							

Observations	3							

c. Predictors: Rainy day
d. Dependent Variable: Productivity
Source: outputMicrosoft excel version 2010, 2023 (processed)

The results of the processed data in Table 7 show that the values of the correlation coefficient (R) and coefficient of determination (R square). From the table above, it is known that the R value of 0.168 shows a strong relationship because it is between zero and one. R Square explains how much the dependent variable is explained by the independent variable. From the calculation results, an RSquare value is obtained0.028From the calculation results, the R Square value is obtained0.028. This means that the Rainy Day variable (X) has a contribution of 94.33% to the dependent variable, namely Work Productivity (Y). Meanwhile, the remaining 5.67% is influenced by other variables not examined in this research.

In the table above, based on a simple linear regression analysis between rainy days and productivity in Simalungun district, the results of the T test analysis of the variable The results of the F analysis were 0.0291, the significant F was 0.8923 and the alpha value was 0.05. If the significance value is less than the alpha value, then there is a real influence between variable X (rainy days) on variable Y (productivity). Based on a simple linear regression analysis between productivity and rainy days in Simalungun Regency, an equation is obtained, namely productivity = 63.6757 + 0.0354 rainy days. The positive linear regression test results show that the variable value for rainy days is 0.0354, meaning that every increase in rainy days by 1 mm/year will increase rice productivity by 0.0354 tons.

The multiple correlation value (R) between rainy days and productivity is 0.1683, which is included in the very strong category, this can be explained that rainfall has a big impact on productivity. From the regression equation, the coefficient of determination (R2) value is -94.33%, which means that rainfall explains that lowland rice productivity is influenced by rainy days by -94.33% and 95.33% is influenced by other factors such as fertilizer, variety, and pests etc. This can be explained by the fact that as the harvest area increases with stable rainfall, production and productivity also increase, as can be seen in table 6, in 2020, where rainfall and rainy days are low but productivity is high, this is influenced by fertilizer, maintenance and irrigation. So productivity is higher than in 2019. Water is the main component that is needed in every phase of the rice plant cycle, from germination to grain filling. And also sunlight is the main factor after water. Rice plants are classified as plants that need light as an energy source in the photosynthesis process.

4. CONCLUSION

Based on the discussion and description that has been explained in the previous chapters, it can be concluded that

1. The study of the impact of climate change on productivity and disease in rice plants in Sei Merbau village, Ujung Padang subdistrict, Simalungun district was carried out using the location survey method and taking climate data from the BMKG office, data on production, productivity and pests and diseases on rice plants were taken from the office. Department of Agriculture.

2. The climate data for 3 years that has been obtained is compared each year by looking at the results of developments in productivity and pests and diseases in rice plants in Sei Merbau village, Ujung Padang sub-district, Simalungun district.
3. In 2018-2020, the climate in Simalungun district experienced fluctuations every year which could have an impact on the development of rice plant productivity and rice plant diseases in Simalungun district every year.
4. There is a significant level of correlation between rainfall and rainy days on rice production and productivity in Simalungun Regency.

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