Identification of microclimate conditions in cocoa plantations (Theobroma cacoa L.) At Gedong Tataan sub-district, Pesawaran

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Abstract. Pesawaran Regency is one of the largest cocoa-producing areas in Lampung Province. Pesawaran Regency has a cocoa area of 27,411 ha with total production in 2021 reaching 30 thousand tons, with an average production per hectare of approximately 1 ton of dry cocoa beans. This is considered to be quite low considering the potential for cocoa production, which is up to 2 tons per hectare of dry beans. There are many aspects that lead to low cocoa production in Pesawaran Regency [1]. In connection with the efforts to rejuvenate the cocoa plant in Pesawaran Regency with the use of land, vegetation and the area of the area, it is hoped that there will be an appropriate use of cocoa cropping patterns. Thus the analysis of land suitability and climate is of course very important for efforts to make efficient use of land for cocoa commodities. Suitable land and climatic conditions will produce good cropping patterns and optimal results. This study uses a survey method by taking several sample points of community gardens that will be replanted in the cocoa revitalization program. Sampling points were taken based on the condition of the land and the condition of land cover or vegetation in the pesawaran cocoa area. Each village is classified into 3 areas. Based on the results and discussions that have been obtained, it can be concluded that the experimental plots of the Sungailangka and Wiyono Village cocoa farms each produced a micro-climate that varied with each element meeting the appropriate cocoa growing requirements.

1. Introduction

Pesawaran Regency is one of the largest cocoa-producing areas in Lampung Province. Pesawaran Regency has a cocoa area of 27,411 ha with total production in 2021 reaching 30 thousand tons, with an average production per hectare of approximately 1 ton of dry cocoa beans. This is considered to be quite low considering the potential for cocoa production, which is up to 2 tons per hectare of dry beans. There are many aspects that lead to low cocoa production in Pesawaran Regency [1].

Based on these data, Pesawaran Regency has very good prospects with the re-development of cocoa in the area. However, with the aging of the plants and the number of pests and diseases that attack the cocoa plants, some farmers are reluctant to maintain their gardens and switch to other agricultural commodities or even look for other jobs so that they can continue to survive. There are also many things besides the above factors that cause the degradation of cocoa commodities in Pesawaran Regency, including the problem of land suitability and climate which is no longer suitable.

The growth, development and productivity of a plant are influenced by internal factors, namely the genetic condition of a plant and external factors that are influenced by the environment [2]. One of the environmental influences is climate. Climate does not only affect plants but is also influenced by plants [3]. Climatic elements such as air temperature, solar radiation, and humidity support and play an important role in crop production, and the physical, chemical, and biological properties of soil are directly related to crop productivity, in this case cocoa. Therefore, land suitability also plays an

important role in the rejuvenation of cocoa plants in Pesawaran Regency in order to get the expected results.

In connection with the efforts to rejuvenate cocoa plants in Pesawaran Regency with the use of land, vegetation and the area of the area, it is hoped that there will be an appropriate use of cocoa commodity cropping patterns. Thus the analysis of land suitability and climate is of course very important for efforts to make efficient use of land for cocoa commodities. Suitable land and climatic conditions will produce good cropping patterns and optimal results.

2. Methods

This research was conducted in the Gedong Tataan sub-district, Pesawaran district in July-October 2022. The tools and materials used in this research are stationery, camera, raffia, meter, map, thermometer, hygrometer, Lux meter, soil meter and alti meter. This study uses a survey method by taking several sample points of community gardens. Sampling points were taken based on the condition of the land and the condition of land cover or vegetation in the pesawaran cocoa area. Each village is classified into 3 areas, namely as follows:

1. Rare River (garden 1)
2. Rare River (Garden 2)
3. Rare River (Garden 3)
4. Wiyono (Garden 1)
5. Wiyono (Garden 2)
6. Wiyono (Garden 3)

The data taken is primary data from the results of sample points both in terms of climate including temperature, humidity, light intensity. The results of observations of microclimate elements (temperature, humidity and light intensity) were analyzed using analysis of variance (F test) with a level of 5%. If the results are significantly then it will be continued using the Least Significant Difference (LSD) test with a level of 5%.

3. Results and Discussion

3.1 Situation of area

Based on the newly obtained results, informing that the plots used in data collection are in community gardens in Gedong Tataan District which are divided into 3 Plots in Sungai Langka Village and 3 Plots in Wiyono Village. For sampling, both soil and climate are still in the data collection process stage. These two villages are located almost close together but differ in the location of the altitude. Rare river village is located at an average altitude of 700 meters above sea level, while Wiyono village is at an average altitude of 500 meters above sea level. In general, altitude also affects the microclimate of the area, both in terms of temperature, humidity and the intensity of incoming light.Most of the cocoa in the two villages was a mixture of several clones, but the largest was clone MCC 02, while the others consisted of clones MCC 01, Sulawesi 1, Sulawesi 2 and BB. The main problems in cacao cultivation in the area are old plants, pest attacks, especially cocoa pod borer and lack of garden sanitation, resulting in plants not growing and developing optimally.

3.2 Climate condition

Climate is a major component in influencing the growth and development of a plant. In this case, the cocoa plantations in Sungai Rare and Wiyono villages, which mostly consist of mixed plants such as bananas, jengkol, petai and others, will produce a microclimate for the organisms or plants below, in the form of air temperature, humidity and also solar radiation that will generated. Land use conditions will also affect the resulting microclimate and in particular have a large impact on the surrounding organisms [4].

The temperature parameter (table 1) shows the different conditions of each experimental field. Based on the analysis of variance that has been made, there are significant differences in temperature conditions in the 2 villages, both the Rare River and Wiyono. Wiyono 2 land produces the highest air temperature when compared to other lands, which is 29.77 0C while rare river land 1 area with the

lowest average temperature is 26.37 0C. this is based on the location of different land uses so that it allows temperature conditions to vary even in the same village.

Table 1. Everage of temperature at sungai langka and wiyono village

Place	Themperature (^{0}C)	Notation
Sungai langka 1	26,37	a
Sungai langka 2	28,57	d
Sungai langka 3	26,92	b
Wiyono 1	27,90	c
Wiyono 2	29,77	e
Wiyono 3	28,93	f
LSD (5%)	0,26	

Note: Numbers accompanied by the same letter in the same column show that they are not significantly different, based on the 5% LSD test.

The influence of air temperature is very important for the survival of a plant. In this case, the cocoa area which has a variety of plant species requires different conditions of air temperature. Temperature plays an important role in the physiological processes of each plant. Temperature is able to affect the biochemical processes of each organism, especially the enzymatic processes of a plant [5]. Thus, the character of the appropriate or ideal temperature is needed by every plant in order to produce optimal growth and yields. Furthermore, the air humidity parameter (table 2) through analysis of variance also produces mixed results. Based on the observations obtained, the village of Wiyono produces low air humidity when compared to the rare river village in general. The lowest air humidity conditions are in Wiyono 1 land with an average air humidity value of 33.73% while the highest air humidity value is located in Rare River Gardens 1 with an average value of 69.9%.

Table 2. Everage of temperature at sungai langka and wiyono village

Place	Humidity (%)	Notation
Sungai langka 1	69,50	d
Sungai langka 2	69,07	d
Sungai langka 3	67,63	c
Wiyono 1	33,73	a
Wiyono 2	45,67	b
Wiyono 3	45,23	b
LSD (5%)	0,96	

Note: Numbers accompanied by the same letter in the same column show that they are not significantly different, based on the 5% LSD test.

Air humidity is one of the important factors in influencing the development and growth of a plant. Basically, most plants require low and moderate air humidity for their survival. High humidity conditions will cause disease attacks on cultivated plants so that if the humidity is too high, it will be very detrimental [6]. This is certainly very detrimental because if the attack of pests or diseases is high, it will affect the growth of plants and the results that will be obtained. However, high humidity conditions can also have a positive impact on good pathogens to help plants grow and develop [7].

Furthermore, in addition to temperature and air humidity, the observed climatic parameters are light (table 3). Light is the source of life for all organisms living on earth. No exception with plants or plants that really need sunlight as a source of energy for plant growth and development. Plants need sunlight for the process of photosynthesis as a food reserve for each plant. Sunlight is the main component in producing both biomass and crop yields [8].

Table 3. Everage of light intensity at sungai langka and wiyono village

Place	Light intensity (Lux)	Notation
Sungai langka 1	744,67	e
Sungai langka 2	652,00	d
Sungai langka 3	809,00	f
Wiyono 1	391,00	a
Wiyono 2	368,67	b
Wiyono 3	537,00	c
LSD (5%)	12,25	

Note: Numbers accompanied by the same letter in the same column show that they are not significantly different, based on the 5% LSD test.

3.3 Relationsip between microclimate elements

Based on the 3 microclimate elements that have been observed based on the location and use of the land, it is also found that the relationship between the microclimate elements is plotted based on 2 cocoa center villages, namely Sungai Rare Village (Table 4) and Wiyono (Table 5). Each region produces a fairly diverse relationship between climate elements based on the correlation test that has been carried out.

Table 2. The relationship between elements of the microclimate in Sungai Langka Village

	Themperature	*Humidity*	*Light*
Themperature	1		
Humidity	0,057366772	1	
Light	-0,78855259	-0,659191298	1

Table 3. The relationship between elements of the microclimate in Wiyono Village

	Themperature	*Humidity*	*Light*
Themperature	1		
Humidity	0,909049066	1	
Light	-0,060628851	0,360807939	1

Based on the results of the correlation test for the climate elements of the rare Sungai Village cocoa land, several positive and negative relationships were found. The temperature and humidity variables have a positive relationship with a moderate level of strength, namely with a value of 0.057, temperature and light produce a fairly strong negative relationship with a value of 0.78 while the relationship between light and humidity is also negative with a value of 0.65. Meanwhile, the relationship between climate elements in the Wiyono village cocoa field based on the correlation test resulted in various relationships. Temperature and humidity produce a strong positive relationship with a value of 0.90, the temperature and light parameters produce a negative relationship with a value of 0.06 while the relationship between light and humidity is positive with a value of 0.36.

Based on the data that has been obtained, it shows that each element of the microclimate includes air temperature, humidity and light intensity that influence each other. This has been described in Tables 6 and 7 which explain the relationship between air temperature, humidity and light intensity. When viewed from the correlation analysis, it is known that the elements of air temperature and humidity have a strong relationship to influence each other between elements. Based on the exposure of the data obtained, it shows that the higher the air temperature, the higher the humidity will be, as well as the lower the air temperature, the lower the humidity will be. A similar opinion was conveyed by [9]. revealed that the higher the air temperature it will be accompanied by an increase in

air humidity in an area. In response to this, the differences occurred due to the different locations and coverage of the observed areas. This is in contrast to the opinion [10] which reveals that the higher the light intensity, the higher the air temperature in an area.

In general, the microclimate conditions in the cocoa plantation areas in Sungai Rare and Wiyono villages have met the requirements for growing cocoa plants there. The temperature is not too high and low, the humidity is moderate and the light intensity is not too high. So that both the Sungai Rare Village and Wiyono Cocoa areas have the potential to produce superior cocoa. Then coupled with sufficient rainfall between 1700-2000 mm / year so that in terms of climate it is appropriate. The important climatic factors are rainfall, number of rainy days, and temperature. Rainfall especially its distribution throughout the year is related to the formation of young shoots, plant growth period, and cocoa production. In addition, the temperature and intensity of rainfall can control the number of cocoa flowers produced. The optimum temperature between those studied for cocoa growth was a combination of a night temperature of 24°C and a day temperature of 30°C [11].

4. Conclusions

Based on the results and discussions that have been obtained, it can be concluded that the experimental plots of the Sungailangka and Wiyono Village cocoa farms each produced a micro-climate that varied with each element meeting the appropriate cocoa growing requirements.

5. References

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