Temporal Variation of Soil...

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Temporal Variation of Soil Surface Temperature in Dalugha (Cyrtosperma Merkusii (Hassk.) Schott) Swamp Habitat

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Abstract-This article describes about the changes of the temporal variation of the soil surface temperatur daily in swamp habitat Dalugha in Sangihe regency. This study is a part of Dalugha habitat research, associated with the development of this plant as a food alternative. The study was conducted transects made the cut edge of the habitat area, ranging from mixed soil farms inward Dalugha clumps . Temporal changes in the temperature of the soil surface and its immediate surroundings of dalugha obtained through the mathematical modeling of the data result measurements at nine positions along the transect is logarithmic. The results showed that temporal changes in land surface temperature by measuring the position of the three examples have the same pattern, sinusoidal. The difference in the three examples shown by the differenting in the position of the average, lowest, highest, and the time of the incident the highest and lowest values

Keywords- *Terms-giant swamp taro; temporal variation; soil surface temperature; mathematics model*.

I. INTRODUCTION

Dalugha is the local name for the crop in Sangihe regency for the giant swamp taro (*Cyrtosperma merkusii* (Hassk.) Schott). Other scientific name / synonym *C. lasoides*, *C. edule* and *C. chamissonis* [1]. According to [1] the plant is not to be in Sulawesi, but it actually was ever reported in Sangihe by van Dinter (1899) and a Vorderman (1899) [2] and the fact it is on Sangihe although until now there has been no effort to develop the plant and habitat conservation by government. This special crop in the district Tamako is able to live on land that is also influenced by tides, river flow and water flow in the subsurface soil causing soil waterlogged all day long. In addition, Dalugha can live in conditions of daily sludge water salinity in the range of 0586 - 1.91 ppt and water slurry pH from 6.9 to 9.8. Dalugha is a very important food crop for people in Sangihe and its surrounding which is living on the typical wetland habitation.

Wetlands are known as useful ecosystem providing water, raw materials (raw material) and food, services such as water purification and prevent flooding, and intangible values such as religious and cultural values. Threats to these ecosystems have increased, more than half of the world's wetlands have been lost [3]. Research of the land surface temperature as part of the plant habitat conditions. Dalugha is an interesting issue in the scope of the study wetlands, especially tidal freshwater swamp [4,5]. Still a little of research reports on a range of land surface temperature on habitat Dalugha.

Researching land surface temperature under the Dalugha canopy bordering the swamp habitat, it is important to know the daily land surface temperature ranges where Dalugha can grow properly. This data will be the basis for the development of crop cultivation and conservation of their habitat. Surface temperature variations due to thermal diffusion process between habitat Dalugha with the surrounding environment is important to describe the observed effects of environmental change on growth dalugha.

Variations in the amount of land surface temperature is an indicator of the thermal diffusion between the environment and ecosystems can also be used to predict the effects of global warming [6] to the sustainability of Dalugha crops. Environmental factors are variable microclimate temperature sensitive to environmental change and ecosystems [7,8,9]. This paper aims to provide information on the temporal variation of land surface temperature in Dalugha swamp habitat in the form of graphs functions and mathematical models.

II. METHODS

The study was conducted on Dalugha swamp habitat that exist in the district of Tamako's in Sangihe Island, part of Sulawesi Island (Figure 1).

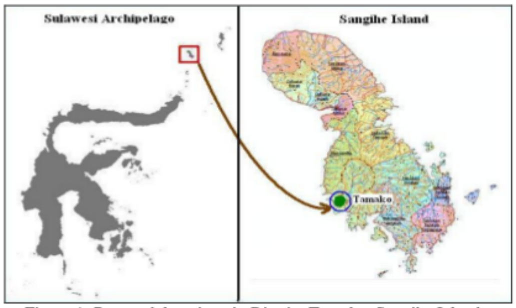

Figure 1. Research locations in District Tamako, Sangihe Island

The research was done by creating cutting edge transect area dalugha, of the mixed farms bordering the Dalugha swamp into the grove. Transects were made starting from the initial observation (4 m outside) to coordinate 030 27 '09.6'' North latitude and 1250 30' 27.8" East longitude (Figure 2).

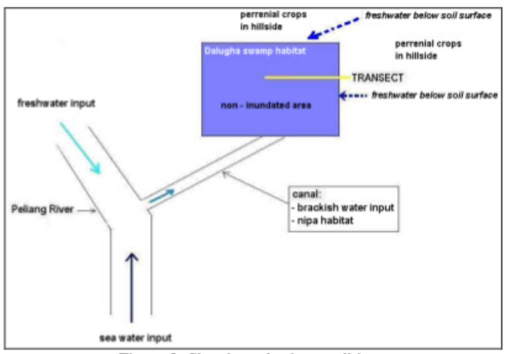

Figure 2. Sketch study site conditions

Environmental conditions at this location are saturated water throughout the day, not inundated by sea water, but suspected salinity intrusion during high tides. Dalugha area obtain supplies of fresh water from ground water and small springs that came out around the border dalugha with dry land. Wetlands adjacent to a wooded garden with a mixture of canopy density 55-78%. High dalugha hardly varies between 2:41 to 3:26 m, with a higher tendency to shade the area affected. Dalugha canopy cover varies between 87% - 95%.

Measurements positions at each transect are determined by the logarithmic distance from the edge. Logarithmic spacing is related to the construction of a mathematical model of the microclimate variables that change due to radiation and thermal diffusion between the environment and the ecosystem. Changes in the spatial variable microclimate around the edges ecosystem exponential form [9,10,11]. The position measurements along the transect are: 4 m and 2 m beyond the edge, on the edge (which is used as a reference zero position, 1 m, 2 m, 4 m, 8 m, 16 m, and 32 m from the edge to the center of clump dalugha. '

Measurement variable land surface temperature using a thermometer instrument ground. Measurement variable surface temperature performed at a depth of 30 cm. Measurements from one position to the next position along the transect done to move, resulting in data modeling and quantitative determination of the parameters of land surface temperature data by synchronizing the time [9]. Data synchronization is a correction of land surface temperature changes that occur due to the time difference between the position measurements along the transects (ranging from 1 to 1.5 minutes). Measurement starts at 07.00 on August 18, 2012 until at 07.00 on August 19, 2012. The time interval of each measurement position is one hour. Microclimate variable number of data obtained during the measurement time is 24 data.

Temperature changes follow a sinusoidal pattern so as to generate mathematical equations and Fourier series curve approach [18, 19]. Modeling temporal functions of the soil surface temperature using Fourier function modeling. Model selection was based on the pattern of daily temperature changes follow a sinusoidal-shaped solar radiation changes. The general form of Fourier functions are:

$$F(t) = F_0 + \sum_{m=1}^{N/2} a_m \cos\omega_m t + b_m \sin\omega_m t \qquad \text{........(1)}$$

where am and bm are the Fourier series coefficients, ωm = 2πm / N, m is minced or chopped tribal harmonic series, and N is the number of data used to construct Fourier functions. For a period of one day, with one hour time interval measurement, the value of N for each measurement position is 24.

Comparative analysis of temporal changes in air temperature between transects conducted for three positions: 4 m beyond the edge, on the edge or 0 m, and the distance of 32 m from the edge to the center of clump Dalugha.
Modeling temporal functions of land surface temperature using software created by Medellu [9]

III. RESULTS AND DISCUSSION

Data of soil surface temperature was presented as in Table 1 below.

TABLE 1. DATA OF SOIL SURFACE TEMPERATURE (^{0}C) FOR THE MEAN, LOWEST, AND HIGHEST

Parameter	Position		
	1	3	9
Mean	25.60	25.59	25.17
Lowest value	24.7	24.9	24.1
Incident time of Lowest value	21.00, 02.00	21.00-01.00, 04.00	07.00, 01.00
Highest value	28.0	28.0	26.9
Incident time of Highest value	13.00	13.00	13.00

Daily changes in the temporal pattern of land surface temperature at position 1 (4 m outside the swamp), 3 (edge / boundary or 0 m), and 9 (32 m in a swamp) is presented in Figure3.

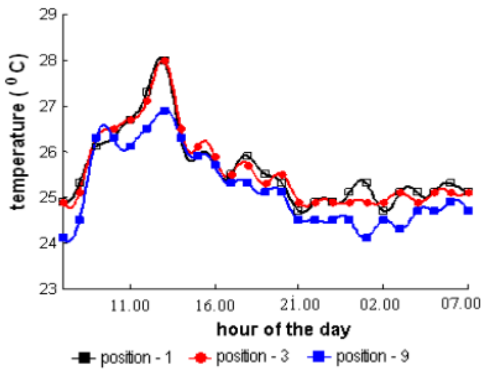

FIGURE 3. CHANGE PATTERN OF SOIL SURFACE TEMPERATURE AT POSITION-1, 3, AND 9

Figure 3 is constructed from mathematical models following the model equation of Fourier series:

1. Position 1:

$$T_1(t) = 25.600 - 0.095.cos(\pi t)/12 + 0.895 sin(\pi t)/12 - 0.438.cos(\pi t)/6 – 0.066.sin(\pi t)/6 - 0.120.cos(\pi t)/4 – 0.266.sin(\pi t)/4 + 0.252.cos(\pi t)/3 – 0.049.sin(\pi t)/3 - 0.177.cos(5\pi t)/12 + 0.021.sin(5\pi t)/12 – 0.063.cos(\pi t)/2 – 0.105.sin(\pi t)/2 + 0.106.cos(7\pi t)/12 – 0.090.sin(7\pi t)/12 \quad ………… (2)$$

2. Position 3:

$$T_3(t) = 25.592 - 0.137.cos(\pi t)/12 + 0.964.sin(\pi t)/12 - 0.441.cos(\pi t)/6 – 0.056.sin(\pi t)/6 - 0.098.cos(\pi t)/4 – 0.275.sin(\pi t)/4 + 0.116.cos(\pi t)/3 + 0.002.sin(\pi t)/3 - 0.095.cos(5\pi t)/12 – 0.022.sin(5\pi t)/12 - 0.013.cos(\pi t)/2 - 0.132.sin(\pi t)/2 + 0.157.cos(7\pi t)/12 – 0.106.sin(7\pi t)/12 \quad ……………. (3)$$

3. Position 9:

$$Tl(t) = 25.172 - 0.199.cos(\pi t)/12 + 0.982.sin(\pi t)/12 - 0.322.cos(\pi t)/6 – 0.070.sin(\pi t)/6 - 0.121.cos(\pi t)/4 – 0.237.sin(\pi t)/4 + 0.031.cos(\pi t)/3 – 0.111.sin(\pi t)/3 - 0.116.cos(5\pi t)/12 – 0.169.sin(5\pi t)/12 + 0.052.cos(\pi t)/2 - 0.154.sin(\pi t)/2 + 0.162.cos(7\pi t)/12 - 0.143.sin(7\pi t)/12 \quad …………………………………. (4)$$

The validity of the model function to the data field is indicated by the amount of total donations diversity provided by the seven first Fourier harmonic. Donations diversity function T1 (t), T2 (t) and T3 (t) are respectively 95 643%, 96.42% and 97.686%. Total donations diversity reach 100 percent if all harmonic series is included as a tribal construct temporal function.

The results of modeling the temporal function of air temperature show a pattern of daily changes in air temperature in the form of periodic functions as shown in Equation 2-4. The general form of the daily temporal functions such as land surface temperature equation 1. Graph function (Figure 3) shows the change of land surface temperature for 24 hours.

Temporal changes daily showed a pattern similar to the cycle of three samples are comparable position (positions 1, 3, and 9), which rose in the morning, reaching a peak at about the middle of the day, down in the afternoon, then show relatively small fluctuations in night. The pattern of temporal changes in the land surface temperature is consistent with the results of previous research by Medellu [9].

The pattern of temporal change is also consistent with the pattern of changes in air temperature [9,10,12,13,14], because both the air temperature and soil surface temperature is controlled by a main factor of solar radiation. However, changes in land surface temperature indicated by the values of some parameters are quantitatively more complex than the air temperature [9]. As with the land surface temperature changes in the mangrove ecosystem [15,16,17] more complex land surface temperature changes in swamp habitat Dalugha than air temperature because in addition to solar radiation, is also influenced by the input of sea water tidal activity, freshwater streams, and input of freshwater from underground water flow, and the difference in canopy cover and canopy trees Dalugha. Research shows that the mangrove forest ecosystem and environmental conditions different to the revenues and thermal emission components of the ecosystem caused by temperature differences on the surface of mangrove ecosystems [11]

Surface temperature differences between the three positions than can be seen on a quantitative parameter values are presented in Table 1. The data obtained shows the parameter values between positions 1 and 3 are similar, whereas between positions 1 and 3 at position 9 show the values of the difference is greater. This is because the location of the position 1 and 3 closer than the 9th position is crucial to achieve the equilibrium conditions of temperature due to thermal diffusion processes in the soil.

Comparison chart changes in land surface temperature between the positions indicate that significantly different during the day. At night, the temperature fluctuation is smaller. The difference in air temperature during the day and evening positions are affected by differences between ecosystem condition (structure and canopy density) and environmental conditions in the vicinity. Ecosystems and environmental conditions different to the revenues and thermal emission components of the ecosystem caused by differences in surface temperature. This is consistent with the results of research on mangroves [11].

IV. CONCLUSION

The conclusion of this study shows that the temporal variation of land surface temperature in the Dalugha habitat showed the same pattern, sinusoidal. The difference temperature between the land surface visible location from the value of the average, lowest, highest and lowest value of time and the highest incidence. These values result from significant fluctuations during the day and night because of differences in habitat conditions and the environmental surrounding. Environmental changes in Dalugha surrounding habitat will cause the changes in the surface temperature range and growth of Dalugha. Parameter values of land surface temperature can be used as references in the further research and evaluation of the impact of environmental change on plants dalugha.

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