Characteristics Of Soil Chemical Properties In Several Types Of Oil Palm (*Elaeis Guineensis* Jacq.) Land And Shrubs In Negeri Lama Seberang Village (Case Study Of Lower Bilah Watershed)

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Abstract.

The Bilah Sub-Watershed area includes areas that have somewhat critical or semi-critical land so that land use is the result of human efforts in managing the available resources to meet their various needs. This often results in land use not being in accordance with its capabilities. This research aims to examine the chemical properties of several vegetation in Negeri Lama Seberang Village, Bilah Hilir District, Labuhanbatu Regency. The research was carried out from December to March 2024 using a survey method. Soil samples were taken at 3 points for each vegetation and different slopes at depths of 1-10 cm and 10-20 cm using a simple random method. The soil parameters measured were soil acidity (electrometry), soil organic carbon content (Walkley and Black), and soil texture (bouyoucos hydrometer). Soil analysis was carried out at the Laboratory of the Faculty of Agriculture, University of North Sumatra. The results of this research show that on a slope of 0-8% the average soil pH value is 4.61% and organic C is 1.04%, while on a slope of 8-15% the average soil pH value is 4.46% and C -organic 0.91%. On a slope of 0-8% the average value of the clay fraction is 20.27%, the dust fraction is 15.02% and the sand fraction is 64.41%, while on a slope of 8-15% the average value of the clay fraction is 27.48%, the dust fraction 19.87%, and sand fraction 52.63%.

Keywords: *Downstream DAS, Land Use, Land Type, Oil Palm and Soil Chemical Properties.*

I. INTRODUCTION

A river basin (DAS) is generally defined as an expanse of territory/area bounded by topographic barriers (ridges) that receive and collect rainwater.[2].sediment and nutrients and drain them through tributaries and out the main river into the sea or lake[3]. DAS is a unit of natural resource management (SDA) which generally aims to achieve the goal of increasing agricultural and forestry production optimally and sustainably (sustainably) with efforts to reduce damage to a minimum so that the distribution of river water originating from the DAS can be even throughout the year.[4].Watersheds are based on function, namely first, the upstream watershed is based on a conservation function which is managed to maintain the environmental condition of the watershed so that it is not degraded, which can be indicated, among other things, by the condition of the vegetation cover of the watershed land, water quality, ability to store water (discharge), and rainfall.[5]. The two middle watersheds are based on the function of utilizing river water which is managed to provide benefits for social and economic interests, which can be indicated, among other things, by water quantity, water quality, ability to channel water, and groundwater level, as well as related to irrigation infrastructure such as management of rivers, reservoirs and lakes[6]. The three downstream watersheds are based on the function of utilizing river water which is managed to provide benefits for social and economic interests[7].

Land is a land area whose characteristics include all the characteristics of the biosphere, atmosphere, soil, geology, relief, hydrology, plant and animal populations as well as the results of past and present human activities which are stable and cyclical (PP No. 150 of 2000)[8].Meanwhile, according to[9],Land is defined as part of the natural landscape which includes the physical environment including climate, topography/relief, hydrology including the state of natural vegetation, all of which have the potential to influence land use.[10].Land use is the result of human efforts in managing available resources to meet various needs. Semi-critical land is land whose production and protection functions have been reduced. The land has experienced erosion but agricultural businesses can still be carried out with low yields[11]. Land classified as semi-critical has the following characteristics: a) the land has experienced moderate erosion, but its productivity is low because its fertility level is low; b) medium solum thickness (60-90 cm) and the dominant vegetation is usually reeds, grass, shrubs and sparse forest[12].

II. METHODS

PeThis research was carried out in the Bilah Sub-watershed area, Negeri Lama Seberangan Village, Bilah Hilir District, Labuhanabatu Regency and soil analysis was carried out at the Laboratory of the Faculty of Agriculture, Medan. This research was conducted from December 2023 to March 2024. This research was carried out using a survey method. Soil sampling was carried out simply randomly. Soil samples were taken at 3 points for each vegetation and different slopes at depths of 0-10 cm and 10-20 cm, respectively. The soil parameters measured were soil texture (Bouyoucos Hydrometer), soil pH (Electrometry), and organic carbon (Walkley and Black).

III. RESULTS AND DISCUSSION

General conditions of the Research Area

Labuhanbatu Regency has many rivers, both large/main rivers and small rivers. It is recorded that there are 2 (two) large rivers, namely the Barumun River and the Bilah River with a width of between 16 m - 250 m, with small rivers as tributaries/branches. The estuary of the two main rivers is the Malacca Strait, with a discharge of between 97-195 m/sec. With such hydrological conditions, the Labuhanbatu region has periodically inundated areas of ± 151,208 ha or 59.03% and continuously inundated areas or swamps of ± 5,210 ha or 2.03%. The watershed areas (DAS) of the major/main rivers in Labuhanbatu Regency are: 1. The Barumun River Watershed (DAS) covers the sub-districts of Panai Hulu, Panai Tengah and Panai Hilir. 2. The Bilah River Basin (DAS) includes the Districts of West Bilah, North Rantau, South Rantau, Pangkatan, Bilah Hilir. Negeri Lama Seberang Village is one of the villages in Bilah Hilir District which is the location for taking soil samples to analyze the chemical properties of the soil. Soil samples were taken randomly using a simple random survey method. Samples were taken from each vegetation, namely immature oil palm plantations, mature oil palm plantations and shrubs in the area at a depth of 0-10 cm and 10-20 cm.

Chemical Properties

Soil pH analysis was carried out on 12 soil samples from each vegetation after the soil was air dried. The results of the soil pH analysis can be seen in Table 1. The lowest pH value is 4.30 and the highest is 4.90 with a criteria range of very sour to acidic. This is because regional areas are areas or land that have experienced land degradation which causes the land to experience a decrease in soil chemical properties. One of the causes of land degradation is erosion. This is in accordance with [13] which states that critical land from an erosion perspective is defined as agricultural land with conditions where the rate of soil loss due to rainwater exceeds the rate of soil formation itself. The erosion that occurs will transport soil to the top layer of soil, namely fertile soil that is rich in nutrients, so the greater the erosion that occurs, the more soil fertility will decrease. Considerable losses of nutrients and soil organic matter generally occur in forest areas that have just been cleared for other uses, such as plantations, settlements and transmigration, as well as from agricultural land cultivated by farmers. The level of soil acidity (pH) is also influenced by the amount of organic material contained in the soil. Each soil depth has a different amount of organic material, thus affecting the soil pH at each depth. This is supported by research [14], which states that coffee plantations with a depth of ≤ 30 cm are 6.49 higher than primary forest and agroforestry land. Meanwhile, at a depth of 30-60 cm, namely 6.91, the pH value is higher in primary forests. The high pH of the soil in primary forests and coffee plantations indicates the contribution of litter which falls to the ground and decomposes and forms a layer of organic material.

Table 1. Soil pH Analysis Results

Vegetation	Slope (%)	Depth (cm)	Soil pH	Criteria
TBM I Palm Oil	0-8	0-10	4.50	Sour
		0-20	4.60	Very Sour
TBM II Palm Oil	0-8	0-10	4.30	Very Sour
		0-20	4.30	Very Sour
TM I Palm Oil	0-8	0-10	4.50	Sour
		0-20	4.40	Very Sour
Palm Oil TM II	0-8	0-10	4.80	Sour
		0-20	4.75	Sour
Undergrowth I	0-8	0-10	4.60	Sour

		0-20	4.60	Sour
Undergrowth II	0-8	0-10	4.80	Sour
		0-20	4.75	Sour

From the organic C content of the soil, the organic matter content of the soil can be determined. Soil organic C levels on semi-critical land can be seen in Table 2 that the organic C content in the soil is included in the criteria of very low to medium. The lowest C-organic value is found in cocoa vegetation, in cocoa sample 2 at a depth of 10-20 cm with a C-organic value of 0.40% belonging to the very low criteria and the highest C-organic value is found in Shrub 1 vegetation at a depth of 10-20 cm has a C-organic value of 2.07% with medium criteriaThe conversion of forest land to agricultural land is one of the causes of decreasing organic C levels, soil degradation due to rainwater erosion and low amounts of organic matter in the soil. This is in accordance with [15], which shows that the conversion of forest land to agricultural land and cocoa significantly reduces soil organic C content. The decrease in soil organic C levels occurred because land clearing was carried out using a slash and burn system. Loss of vegetation and litter which previously tightly covered the surface of the soil resulted in the soil becoming exposed, making it very vulnerable to climatic factors, especially light, temperature and rain. Apart from that, the management of agricultural land throughout the year is also the cause of decreasing soil organic carbon content.

The low level of organic matter in the soil is caused by soil degradation due to rainwater erosion. This is in accordance with [16], which states that soil degradation is the reduction or loss of part or all of the top layer of soil, decreased levels of C-organic and soil nutrient elements, as well as changes in several parameters of soil physical properties, such as soil structure, aeration pores. or pore drainage quickly becomes worse. The further consequences of land degradation are that crop yields experience a drastic decline, the physical and chemical quality of the soil decreases, and ultimately one day the land becomes unproductive or critical for plantations, settlements and transmigration, as well as agricultural land cultivated by farmers.Based on Table 2, it is known that the C-organic content in cocoa vegetation plantations is very low, ranging from 0.40% - 1.52% and the lowest C-organic content is found in cocoa vegetation compared to other vegetation. This is supported by [16], which shows that the C-organic status of forest land is very high (>5.00%) then the status decreases to moderate (2.01-3.00%) after being converted to cocoa land aged ≤3 years. and stated that the soil organic carbon content due to the conversion of forest land to cocoa land was unable to return to its original state even after 12 years. This happens because the decomposition of organic material takes place quickly. Changes in temperature and humidity create conditions conducive to the proliferation of soil microorganisms. The rapid development of microorganisms causes the need for organic materials as an energy source to increase. The intensive activity of microorganisms stimulates the decomposition process of organic material so that it quickly decreases in the soil.

Table 2. Soil C-organic Analysis Results

Vegetation	Slope (%)	Depth (cm)	C_Organic	Criteria
TBM I Palm Oil	0-8	0-10	0.95	Very low
		0-20	1.05	Low
TBM II Palm Oil	0-8	0-10	0.90	Very low
		0-20	0.54	Very low
TM I Palm Oil	0-8	0-10	1.36	Low
		0-20	1.46	Low
Palm Oil TM II	0-8	0-10	1.52	Low
		0-20	1.11	Low
Undergrowth I	0-8	0-10	0.88	Low
		0-20	0.98	Low
	0-8	0-10	0.87	Low
Undergrowth II		0-20	0.98	Low

Soil texture on semi-critical land was analyzed after the soil was air-dried. The results of the soil texture analysis can be seen in Table 3 that the Ultisol soil texture in rubber vegetation with depths of 0-10 cm and 10-20 cm is dominated by sandy clay loam. In cocoa vegetation, the soil texture with a depth of 0-10 cm and 10-20 cm is clayey sand. In oil palm vegetation with a depth of 0-10 cm, sandy clay and sandy clay are dominated. Meanwhile, at a depth of 10-20 cm, the soil texture is dominated by sandy clay loam and clayey clay. In shrub vegetation, the soil texture at depths of 0-10 and 10-20 cm is dominated by clayey sand.

In mixed vegetation with depths of 0-10 cm and 10-20 cm, sandy clay and clay dominate.BeBased on the results of the soil texture analysis in Table 3, it can be seen that on a slope of 0-8% the average clay fraction is 20.27%, the dust fraction is 15.02% and the sand fraction is 64.41% and on a slope of 8-15% the average clay fraction of 27.48%,dust 19.87% and sand fraction 52.63%. From the results of this analysis, it is known that the amount of sand fraction is much higher than the clay and dust fractions in some vegetation on the semi-critical land of the Bilah Sub-watershed. This can indicate that the vegetation does not change the condition of the soil texture on this land.

Table 3. Soil Texture

Vegetation	Slope (%)	Depth (cm)	Fraction			Texture
			Sand	Dust	Look	
TBM I Palm Oil	0-8	0-10	21.00	28.00	51.00	Sandy clay loam
		0-20	28.00	28.00	44.00	Clayey clay
TBM II Palm Oil	0-8	0-10	17.50	24.40	58.10	Sandy loam
		0-20	28.20	28.20	43.70	Sandy clay loam
TM I Palm Oil	0-8	0-10	28.00	28.00	44.00	Clayey clay
		0-20	35.20	21.10	43.60	Sandy clay loam
Palm Oil TM II	0-8	0-10	28.00	28.00	44.00	Clayey clay
		0-20	34.70	10.40	54.80	Sandy clay loam
Undergrowth I	0-8	0-10	28.00	28.00	44.00	Clayey clay
		0-20	35.70	9.40	53.80	Sandy clay loam
	0-8	0-10	7.00	10.00	82.00	Clayy sand
Undergrowth II		0-20	8.00	11.00	81.00	Clayy sand

Based on Table 3 of the 12 soil samples analyzed, it has an average sand fraction of 59.36%, dust fraction of 17.27% and clay fraction of 23.36% and on average it is included in the sandy clay soil texture according to USDA. The high sand fraction is caused by the Bilah Sub-watershed area being a degraded land area which can cause a deterioration in the physical properties of the soil, including due to the impact of raindrops or erosion. Soil containing high levels of sand is also a planting medium that is not good for growth. plant. This is in accordance with [17], which states that sandy soil does not have the ability to absorb water and nutrients so that sandy soil is not fertile and dries out easily. Sand soil also contains little clay, has low cation exchange capacity and is poor in organic matter or humus. Sand is a mineral left over from weathering which has high resistance to weathering so it is difficult to weather.

IV. CONCLUSION

On a slope of 0-8% the average soil pH value is 4.61% and organic C is 1.04%, while on a slope of 8-15% the average soil pH value is 4.46% and organic C is 0.91 %, On a slope of 0-8% the average value of the clay fraction is 20.27%, the dust fraction is 15.02% and the sand fraction is 64.41% while on a slope of 8-15% the average value of the clay fraction is 27.48%, the dust fraction was 19.87%, and the sand fraction was 52.63%, the results of the correlation analysis stated that the slope had a significant effect on the clay fraction, sand fraction and soil pH. Based on the results of soil analysis on several vegetation in the semi-critical land of the Bilah Sub-watershed, it was stated that vegetation does not affect C-organic conditions, soil pH and soil texture.

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