Study Of Soil Physical Properties Of Oil Palm Plants (*Elaeis Guinensis* Jacq) In The Labuhanbatu University Practice Area In Rantau Selatan District

Sabribal Utandi Harahap[1*], Fitra Syawal Harahap[2], Hilwa Walida[1], Khairul Rizal[3].

[1,2,3] Agrotechnology Study Program, Faculty of Science and Technology, Labuhanbatu University, Indonesia
*Corresponding Author:
Email: sabribalutandihrp@gmail.com

Abstract.

The physical properties of the soil that need to be considered are the problem of degradation and soil structure due to management functions so that cultivated land is not eroded and organic matter is lost quickly.This research was carried out through 2 stages of activities, namely field activities and analysis activities. Stages of field activities were carried out at the Palm Oil Plantation on the Practical Land of Labuhanbatu University, Labuhanabtu, North Sumatra Province at a height of 28 meters. The method used in this research is a free grid measurement method at a semi-detailed survey level (observation frequency of 1 sample per 500 meters). Carrying out soil sampling at up to 5 sampling points with a distance of 100 meters in the field using a random method, spread over a predetermined area based on the base map. Results of land use research withSoil texture in the Labuhanbatu University Practice Field, Labuhanbatu Regency, sandy loam, The bulk density value shows low, soil porosity is still high, the soil color looks relatively dark, and the soil water content is still relatively normal.

Keywords: *Land Use, Soil Physical Properties, Palm Oil and Degradation.*

I. INTRODUCTION

Oil palm plantations are a commodity that plays an important role in the economy so that their productivity is high over a long production period and is resistant to pests and diseases [1]. The need for oil palm plants will continue to increase in line with the high demand for oil among society, both nationally and globally [2].Palm Oil (Elaeis guinensis Jacq) is a mainstay commodity that can be expected to increase the income and dignity of plantation farmers and Indonesian transmigrants[3]. Palm oil has apparently succeeded in becoming a commodity that can penetrate areas such as Kalimantan, North Sumatra and Lampung[4]. According to [5], the physical properties of soil that need to be considered are the problem of soil structure degradation due to management functions. In addition, on cultivated land that is not eroded, organic matter is lost quickly according to [6]. It was found at the Missouri Agricultural Experiment Station that as a result of cultivating land for more than 60 years in an eroded state, organic matter was lost by a third, the loss was more greater at the beginning of cultivation compared to subsequent cultivation [7].Cultivated plants such as oil palm plants have a different area of land cover when compared to densely growing forest plants[8]. Meanwhile, to protect the soil from the effects of erosion, cover crops are planted [9].

Cover crops can actually protect the soil from the threat of soil damage due to erosion and can also improve the physical, chemical and biological properties of the soil through the breakdown of organic material originating from weathering or decomposition of the vegetation itself [10]. This can also maintain the nutrient cycle in the soil so that nutrient loss due to the erosion process is not too large [11].Soil management in several plantation land uses, such as fertilization, land clearing, burning, and the use of heavy equipment will affect the soil properties in that land use.Research result[12]in[13],stated that several cases in the field show that soil characteristics can change within a narrow time span.The physical characteristics of the land are an important factor in cultivating oil palm plants. According to[14]in[15],There is a change in the physical properties of the soil due to the planting of oil palm in plantations as the age of the plant increases. Based on the statement above, it is necessary to carry out this research by examining several conditions of the physical properties of the soil for each different planting year in the oil palm plantation area inLabuhanbatu University Practice Areato provide information regarding the growth and development as well as the optimal potential of oil palm plants

II. METHODS

This research was carried out in 2 stages of activities, namely field activities and soil analysis activities. Stages of field activities were carried out at the Palm Oil Plantation on Practical Land at Labuhanbatu University, Labuhanabtu Province, North Sumatra Province at a height of 28 meters above sea level in Figure 1. Stages of laboratory activities, namely soil sample analysis, were carried out at the Applied Science Laboratory, Faculty of Science and Technology, Labuhanbatu University, North Sumatra , The research was carried out in Februari-July 2024.

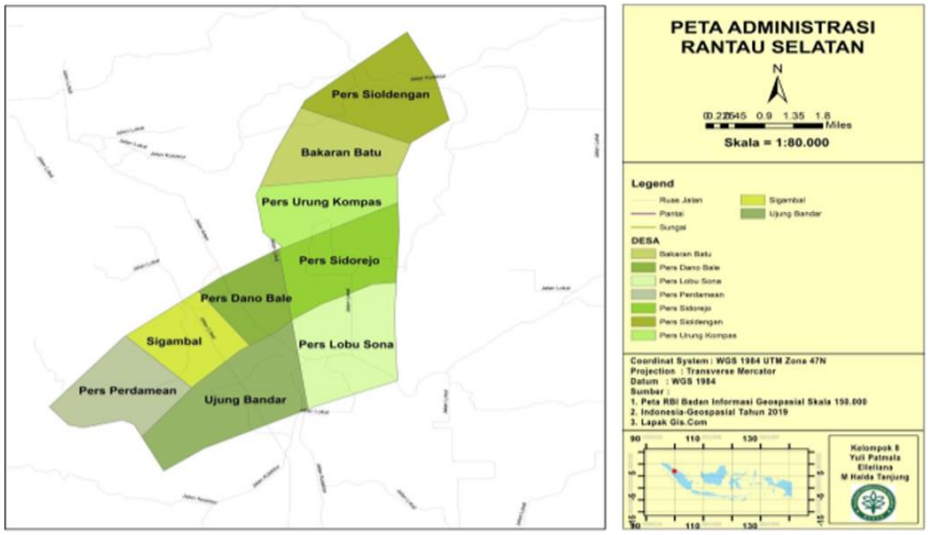

Fig 1. Map of research location and soil sampling

The tools used include digital cameras, calculators, sieves, tarpaulins, polybags, sample rings, hoes used for digging soil, machetes, rulers, ovens, erlenmeyers, measuring cups. The materials used in this research were Ultisol soil samples, polybags, water and laboratory materials that supported this research.The method used in this research is a free grid measurement method at a semi-detailed survey level (observation frequency of 1 sample per 500 meters). Take soil samples from up to 5 sampling points with a distance of 100 meters in the field using a random method, spread over a predetermined area based on the base map as shown in Figure 3 [4].Sampling was carried out using a random sampling method at predetermined points in each block, sampling was carried out from two depths, namely from a depth of 0-30 cm and from a depth of 30-60 cm, 5 samples each at the same two depths for chemical content examination. explore the properties of the soil with certain predetermined criteria,

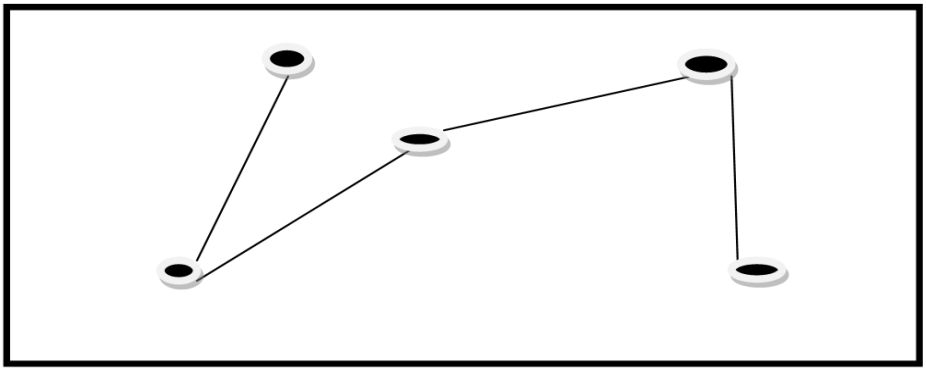

Fig 2. Taking soil sample points in the field

Observed Parameters

a. Bulk Density

Measurement of soil density (bulk density) is carried out on samples taken from the soil. Whole soil samples were taken using a ring sample. Analyzing Soil density is calculated using the equation: Soil Weight (g) / Soil Volume (cm^3)

Bulk Density: Soil Weight (g) / Soil Volume (cm^3)

b. Porosity (%) obtained by the bulk weight of the soil has been determined. Another data that must be known is the specific gravity of the particles, namely 2.65 g/cm3. Analyzing soil porosity Porosity is calculated using the equation:

$$\text{Porosity} = \frac{(1- BD)}{PD} \times 100\%$$

c. Permeability measurement using the Constant Head Test method.

$$\rho s = \frac{Ms}{Vt}$$

d. Analyzing available water Available water can be calculated by calculating the difference between pF 2.54 (field capacity) and pF 4.2 (permanent wilting point) using the pressure plate method at the Palm Oil Research Center Laboratory (PPKS).

$$F = \frac{(1-\rho s)}{\rho p} \times 100\%$$

e. Soil Texture

Weight of soil sample The air-dried soil was then analyzed for soil texture using the Hydrometer method. Soil texture can be calculated by:

$$\% \text{ Clay + Dust} = \frac{\text{Hydrometer I reading}}{\text{Soil Sample Weight}} \times 100\%$$

$$\% \text{ See} = \frac{\text{Hydrometer II reading}}{\text{Soil Sample Weight}} \times 100\%$$

% Dust = % (Clay+ Dust) - % Clay

% Sand = 100% - % (Clay+Dust)

To determine the name of the soil texture, the results are (% sand, dust and clay) entered into the USDA texture triangle. As follows :

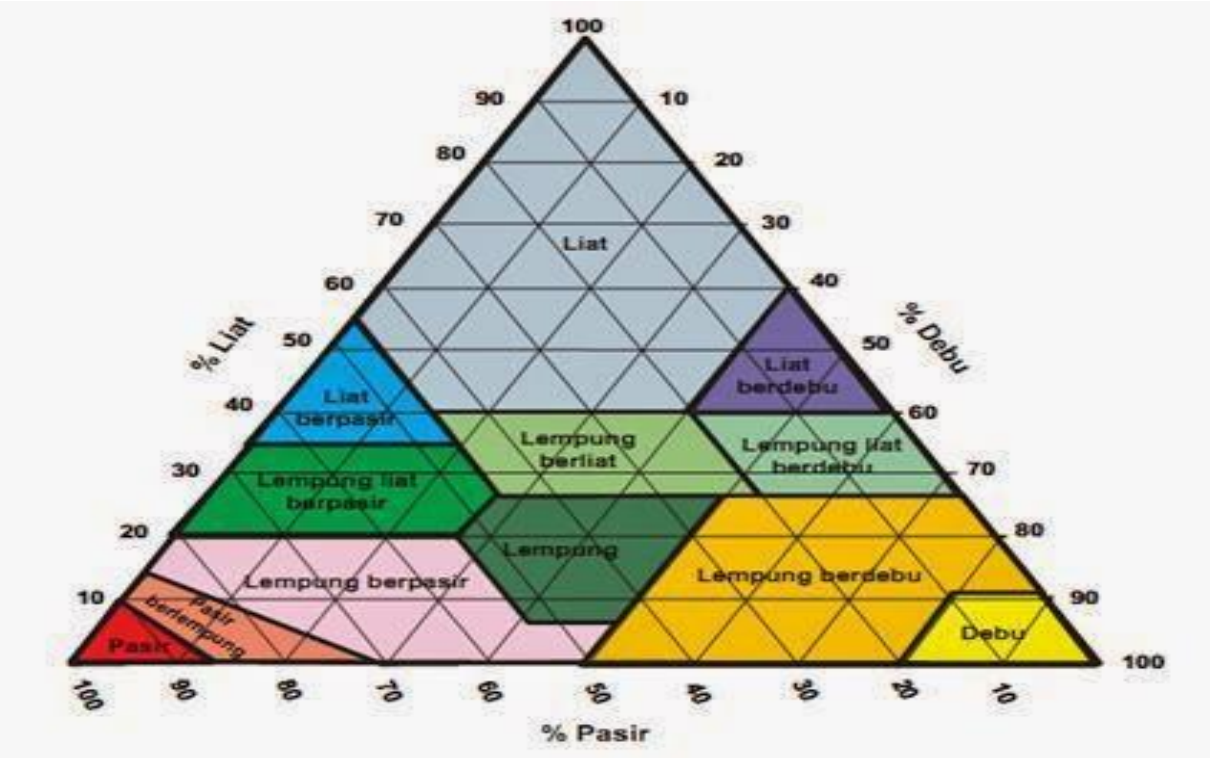

Fig 3.USDA texture triangle

III. RESULTS AND DISCUSSION

Identify the physical characteristics of planting oil palm plantations(Elaeis guinensis Jacq)in the Practical Land of Labuhanbatu University, Labuhanabatu Regency, namely bulk density, porosity, water content, permanent wilting point, soil texture are presented in Table 2.

Table 1. Parameters of soil physical properties inoil palm plantations on practical land at Labuhanbatu University

Sample	Bulk Denisty (gr/cm3)	Porosity (%)	Water content (%)	Permanent Wilting Point (Days)	Soil Texture	Results	Criteria
I	1.21	40	36.25	24	Sand Dust Look	48 22 30	Clay Clay
II	0.98	65	23.59,	24	Sand Dust Look	64 18 18	Sandy Loam
III	1.16	56.3	40.36	24	Sand Dust Look	47 25 28	Sandy Clay Loam
IV	1.33	49.6	32.54	24	Sand Dust Look	50 26 24	Sandy Clay Loam
V	1.32	50.2	28.01	24	Sand Dust Look	63 22 15	Sandy Loam

Research Results on Oil Palm Plants able to reduce the highest soil bulk density, namely reaching 1.33g/cm3,then followed and the lowest at the second first location was 0.75g/cm3. This is in accordance with research conducted by[16],which states that Bulk density at a location can reduce the density of mineral soil contents because it increases the surface area of the soil, thereby increasing the pore space in the soil.According to[17], at the location of oil palm plantations, it reduces the bulk density of the soil as a resultorganic materials that haveits porous nature increases the pore space in the soilwhich causes a significant effect on reducing bulk density and increasing soil pore volume.From the analysis results it was found that oil palm plants in the fourth location had an impact on soil porosity. An increase in porosity is in line with a decrease in soil bulk density, so that the amount of soil mass in a volume of soil can determine the amount of pore space in the soil. [18], states that porosity is the ratio between the density of the soil mass and the density of soil particles, therefore it can be said that a soil volume consists of soil mass and soil pore space.

Thus, soil with low mass density means the soil has a lot of pore space, and vice versa. So the existence of pore space in the soil greatly determines the size of the mass density of a soil [19].The highest porosity occurred at the second location at 64% followed by the first location at 45%HThis is in accordance with research [21], that the influence caused by the location of oil palm plants is not all the same, but varies based on each type of soil.Based on the results of the analysis, it can be seen that the highest available water is at the location of the oil palm plantation. One of the factors that influences the availability of water in the soil is soil texture. Soil texture greatly influences the soil's ability to retain water [22]. Galang ultisol soil has a sandy loam texture, where the soil has a dominant sand content so that the soil's ability to hold water is low.This situation causes the availability of ultisol soil. Apart from that, the availability of water in the soil is also influenced by the distribution of pore sizes in the soil. Coarse-textured soil is rich in macropores which have free drainage so the ability to store moisture is low. Fine-textured soils have more micropores that are able to hold water against free drainage [23].

IV. CONCLUSION

Based on the physical properties of the soil from the research results and the discussion description, it can be concluded that the soil texture in the Labuhanbatu University Practice Field in Rantau Selatan District, Labuhanbatu Regency is sandy clay loam, The bulk density value shows low, soil porosity is still high, the soil color looks relatively dark, and the soil water content is still relatively normal.

REFERENCES

[1] Farrasati, R., Pradiko, I., Rahutomo, S., Sutarta, ES, Santoso, H., & Hidayat, F. (2019). C-Organic Soil in Oil Palm Plantations in North Sumatra: Status and Relationship with Several Soil Chemical Properties**.** ***Journal of Soil and Climate***, 43(2), 157-165.

[2] Rauf, A. (2018). Evaluation of the Characteristics of Soil Chemical Properties of Oil Palm Plantation in Adolina Plantation Ptpn Iv Serdang Bedagai on Several Generations of Planting: Evaluation of the Characteristics of Soil Chemical Properties of Oil Palm in the Adolina Plantation Ptpn Iv Serdang Bedagai on Several Generations of Planting. ***Online Journal of Agrotechnology***, 6(3), 453-459.

[3] Simarmata, JE, Rauf, A., & Hidayat, B. (2017). Study of Soil Physical Characteristics in Oil Palm (Elaies guinensis Jacq.) PTPN IV Adolina Plantations in Several Planting Generations. ***Indonesian Journal of Agricultural Sciences***, 22(3), 191-197.

[4] John, A.H. (2020). Soil Macrofauna as Bioindicators on Oil Palm Plantation Lands (Doctoral Dissertation, University of North Sumatra).

[5] Nuraini,N.(2017).Evaluation of the Characteristics of Soil Chemical Properties in the Adolina Plantation Land of PTPN IV Serdang Bedagai in Several Planting Generations (Doctoral Dissertation,University of North Sumatra).

[6] Harahap, FS, Arman, I., Wicaksono, M., Mico, WT, Rauf, A., & Walida, H. (2019). Providing Organic Materials to Sloping Oil Palm Land on Soil Chemical Analysis. Agrica Extensiona, 13(2), 47-54.

[7] Alan, AD, Harahap, FS, Rizal, K., & Septyani, IAP (2023). Characteristics of the Chemical Properties of Oil Palm Soil Produce and Insertion in the Land Cover of the Barumun River Sub-Watershed, Tanjung Village, Medan. ***Journal of Agros Agriculture***, 25(3), 2892-2898.

[8] Lukas, A., Ngudiwaluyo, S., Mulyono, H., Rosyadi, I., Noor, IM, & La Teng, PN (2018). Financial Analysis of Utilizing Empty Palm Oil Bunches Waste to Make Biocarp for Planting Media. ***Journal of the Plantation Products Industry***, 13(1), 37-42.

[9] Sihombing, EPS (2017). Evaluation of the Physical Properties of Typic Hapludults Soil in Four Generations of Palm Oil Planting PT. Indonesian Socfin in Aek Loba Gardens, Asahan Regency. ***Journal of Tropical Agriculture***, 4(2), 106-113.

[10] Hidayat, MS, Hasibuan, A., Harahap, B., & Nasution, SP (2022). Utilization of Empty Palm Oil Bunches as Fertilizer Material at Pt Karya Hevea Indonesia. ***Factory Journal of Industry, Management and Industrial Systems Engineering***, 1(2), 52-58.

[11] Baihaki, A., Zuraida, Z., & Ilyas, I. (2019). Comparison of Chemical Properties of Forest Soil and Oil Palm Plantations (Elaies guineensis Jacq) in Beutong District, Nagan Raya Regency. ***Agricultural Student Scientific Journal***, 4(2), 434-445.

[12] Kesumaningwati, R. (2015). Use of banana weevil mole (Musa paradisiaca) as a decomposer for composting empty oil palm fruit bunches. Ziraa'ah Agricultural Scientific Magazine, 40(1), 40-45.

[13] Nurdin, IA, Syauqi, A., & Laili, S. (2020). Measurement of the C/N Ratio in a Mixture of Oil Palm Leaves (Elaeis guineensis Jacq.) and Cow Feces (Bos taurus L.) in Biogas Fermentation. ***Journal of NATURAL SCIENCE (Known Nature)***, 3(1).

[14] Darlita, RDR, Joy, B., & Sudirja, R. (2017). Analysis of several soil chemical properties on increasing Palm Oil production on sandy soil in Selangkun Palm Oil Plantations. Agriculture, 28(1).

[15] Harahap, FS, Oesman, R., Fadhillah, W., & Nasution, AP (2021). Determination of Ultisol Bulk Density in the Open Practice Field of Labuhanbatu University. AGROVITAL: ***Journal of Agricultural Sciences***, 6(2), 56-59.

[16] Surya, E., Hanum, H., Hanum, C., Rauf, A., Hidayat, B., & Harahap, FS (2019). Effects of composting on growth and uptake of plant nutrients and soil chemical properties after composting with various comparisons of POME. ***International Journal of Environment, Agriculture and Biotechnology***, 5(6).

[17] Fadhillah, W., & Harahap, F.S. (2020). The effect of giving solids (empty oil palm fruit bunches) and rice husk charcoal on tomato plant production. ***Journal of Soils and Land Resources***, 7(2), 299-304.

[18] Murtilaksono, K., Darmosarkoro, W., Sutarta, ES, Siregar, HH, & Hidayat, Y. (2019). Efforts to increase palm oil production through the application of soil and water conservation techniques***. Journal of Tropical Soils***, 14(2), 135-142.

[19] Agustira, MA, Lubis, I., Listia, E., Akoeb, EN, Harahap, IY, & Lubis, MES (2018). Financial and economic analysis of intercrops (corn and soybeans) in immature oil palm plantation areas. ***J.Pen Palm Oil***,26(3),141-152.

[20] Rosa, R.N., & Zaman, S. (2017). Management of oil palm (Elais guineensis Jacq.) nurseries in the Bangun Bandar plantation, North Sumatra. Agrohorti Bulletin, 5(3), 325-333.

[21] Agustiana, S., Wandri, R.,& Asmono, D.(2019,March).Performance of oil palm plants in the dry season in South Sumatra; the effect of water deficit on plant phenology.In National Seminar on Suboptimal Land(pp.67-73).

[22] Harahap, F.S., Purba, J., & Rauf, A. (2021). The relationship between rainfall and groundwater availability patterns on oil palm ***(Elaeis guineensis Jacq)*** production in the highlands. Agriculture, 32(1), 37-42.