The Characteristics of Electrical and Physical Properties of Peat Soil in Rasau Village, West Kalimantan

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Abstract. The Electrical and physical properties can be used as indicators for measuring soil conditions. One of the methods developed in agricultural systems to obtain information on soil conditions is through measuring of electrical conductivity. Peat soil is one of the natural resources that exist in Indonesia. This study aims to determine the characteristics of peat soil in Rasau village, West Kalimantan. This research was conducted by the properties of electrical conductivity and water content using 5TE Water Contents and EC Sensor equipment, but also to know the change of physical nature of peat soil covering peat soil and peat type. The results showed that the electrical conductivity value of 1-4 samples was 0.02 -0.29 dS/m and the volume water content value (VWC) was 0.255 -0.548 m3/m3 and the physical characteristics obtained were peat colour brown to dark brown that allegedly the soil still has a very high content of organic material derived from weathering plants and there are discovery of wood chips, wood powder and leaf powder on the ground. Knowing the information is expected to identify the land needs to be developed to be considered for future peat soil utilization.

1. Introduction
The peatlands have become focus of world attention, It’s potency for agricultural land, residents, forest developments, energy resources and as a buffer of diversified life. The peatlands is increasingly perceived as an important role, especially in storing more than 30% of terrestrial carbon. It’s plays an important role in the hydrological cycle, and maintains biodiversity. The width of peat dispersal in West Kalimantan is around 1.73 million ha (8.49% of Indonesia's peatland) [1]. Peatlands in West Kalimantan province are spread across 8 districts or cities. The largest peat land is located in Pontianak and Kubu Raya regencies precisely in Rasau Jaya Village.

The Peat soil is a type of soil containing a large amount of organic matter [2]. The characteristic of organic soil does not have an absolute similarity, because peat formers also vary. In the tropics, woody trees form the origin of peat-forming, in contrast to subtropics derived from sedges and sphagnum moss. Based on the level of fertility peat soils are distinguished into eutrophic, oligotrophic and mesotrophic peat. Based on the deposition environment, the peat type consists of ombrogenius and topogenus [3]. The distribution of soil types in Indonesia is divided into several types, namely organosol, latosol, regosol, alluvial, litosol, grumusol, andosol, podsolik and Planosol Land [4]. Classification of peat land based on soil and rock is proposed by Therzaghi [5]. Based on the soil taxonomy system, peat soil is called Histosol which means tissue, whereas in the national soil classification system [6], and peat soil is called organosol because it determines soil fertility [7]. Soil
fertility is the quality of soil that provides the nutrients of plants in sufficient quantities of plant needs in the form of compounds. The compound can be used the plants through physical, chemical, and biological properties. The fertile soil contains nutrient content and sufficient water availability. Soil fertility can not be measured, but can only be estimated based on measurable physical, chemical, and biological properties of the plant [8].

The most important physical properties of the soil are texture, structure, consistency, porosity, specific weight, temperature [9], color [10], salinity and Resistivity [11]. The Soil resistivity is inversely proportional to electrical conductivity (EC). The electrical conductivity shows the total amount of salt present in water. The content of salt in water gives ions that are electrically charged to generate electrical current. The electrical conductivity is proportional to ions in water [12]. The magnitude of soil EC is closely related to soil composition such as the amount of sand, clay, organic matter and moisture content [13]. Soil EC measurement is relatively easy and faster than other soil properties. The EC value of the soil is generally very constant for the long term so it can be used as a basis for knowing the soil condition quickly. The soil EC is strongly influenced by several factors [14] as follows: soil porosity, water content level, soil acidity, cation exchange capacity (CEC) and Soil temperature. EC is also affected by total porosity, the soil pore size distribution [15]. The Peat land has an electrical conductivity value of about 0.1 - 10 dS/m

There are two methods of measuring the electrical conductivity (EC) of the soil ie, electromagnetic induction and direct contact. Electromagnetic induction is performed by delivering electromagnetic energy into the geological material using a electromagnetic wave source that passes through the earth's surface. The direct contact method involves a device that directs an electric current into the ground through an insulated metal electrode that pierces the ground surface. [16]. There is a strong relationship between conductivity, capacitance and electrical impedance with water content [17]. Conductivity rate decreases with lower water content level [18].

Given the importance of peat lands in West Kalimantan economically and ecologically, further research is needed by knowing the characteristics of peat soil by analyzing electrical properties such as electrical conductivity and water volume volume, while also knowing the change in physical properties of peat soil. By knowing information about the characteristics of peat soil it is possible to know the need of land to be developed in order to be a consideration for the utilization of peat land in the future.

2. Methods

The sampling location of this research is located in tropical peat land area in Rasau Jaya Village, Kubu Raya Regency, West Kalimantan. Geographically the location is at the coordinate point 0 ° 134'40,83 '' South Latitude and 109 ° 02'19,32 '' East Longitude up to 109 ° 58'32,16 ''East Longitude.

The sample is then tested by electric conductivity and water content with distance of each measurement is 1 cm. Soil samples obtained from the location of the sampling, then measured the electrical properties using the Decagon EM 50 tool that is connected to the computer with the help of ECH2O Utility software to communicate with the EM50 logger, schematic measurement can be seen in the following Figure 1.
Measurement of electrical conductivity (EC) and water content (VWC) values can be done by inserting 5TE device directly to the media (soil). This 5TE measuring instrument has the edge of each sharp branch because it is easier to push the sensor into the ground [19].

3. Results and Discussion
Data obtained from the measurement results using Decagon EM-50 is the distribution of electrical conductivity (EC) and volume water content (VWC) values. Based on these measurements, the graphs of the measured parameters are electrical conductivity and moisture content to depth to delineate the lower layers of the surface. In the research area delineation was done into four samples or layers.

3.1. The Electrical Conductivity versus Depth on the First Sample
The measurement results show the highest electrical conductivity value for first sample is 0.12 dS/m and the lowest is 0.03 dS/m. The highest volume water content measurements show 0.514 m³/m³ and the lowest volume water content is 0.311 m³/m³ as shown in Fig. 2. In the picture can be seen the electrical conductivity increase because of the value water content increases, in addition to the porosity of the soil in this depth the greater the more easily electricity is delivered. But from a depth of 13 cm the value of electrical conductivity decreases, because at the bottom of this organic sediment on the peat soil is mixed with other inorganic elements ie clay (peat clay), other than that the water content contained in the soil is quite low.
3.2. The Electrical Conductivity versus Depth on the Second Sample
The results of conductivity and water content measurements for the second sample showed the highest electrical conductivity value of 0.09 dS/m and the lowest was 0.02 dS/m. The measurement of moisture content for the second sample has the highest water content value of 0.535 m$^3$/m$^3$ and the value of volume water content (VWC) is as high as 0.255 m$^3$/m$^3$ as in the graph of Figure 3. In this second sample, electrical conductivity (EC) increases with increasing depth. At a depth of 1-15 cm the value of electrical conductivity (EC) decreases, this is because the soil texture conditions in the soil sample are clay soil, the permeability of the clay texture will be low because the texture of this clay soil has macro pores so that the movement of water and certain substances can not move quickly or obstructed. The movement of water that is inhibited causes the value of water content in the soil sample is also decreased. However, at a depth of 16-50 cm increased the value of electrical conductivity (EC), due to increased value of water content and salinity.

3.3. The Electrical Conductivity versus Depth on The Third Sample
In the third sample, the highest conductivity value is 0.09 dS/m and the lowest is 0.03 dS / m. While the measurement of moisture content obtained highest is 0.541 m$^3$/m$^3$ and the lowest is 0.334 m$^3$/m$^3$.
as shown in Figure 4. The electrical conductivity value to depth in this third sample decreases with increasing depth, in sample three is not conductive, where the soil in this sample is clay. Decreasing the value of electrical conductivity will cause the decrease of salinity value, this is because peat land in Rasau Jaya area is adjacent to the ditch. With a ditch or drainage adjacent to the land it is capable of washing salt or organic and inorganic acids and other compounds that are toxic to plants and enter (supply) fresh water to provide oxygen.

Figure 4. (a) Graph of Electrical Conductivity on The Third Sample, (b) Graph Volume Water Content on The Third Sample

3.4. The Electrical Conductivity versus Depth of Fourth Sample
The fourth sample measurement results have the highest electrical conductivity value of 0.29 dS/m, and the lowest is 0.02 dS / m. The measurements for the samples of the four highest VWC values are $0.548 \, m^3 / m^3$ and the lowest is $0.267 \, m^3 / m^3$ as shown in Fig. 5. In this fourth sample, the electrical conductivity data processing to the depth increases with increasing depth. The EC soil in this sample of four increases in height due to the increasing EC minerals, in addition to the higher electrical conductivity values due to the increased moisture content as well. The EC value is increasing because the peat soil in the fourth sample is composed of shales and pieces of woody stems that have not been completely decomposed, so the soil has a large pore space.

Figure 5. (a) Graph of Electrical Conductivity on The Fourth Sample, (b) Graph Volume water Content on The Fourth Sample
The electrical conductivity (EC) value on the first and third Samples are lower than the second and fourth samples. This is due to the organic deposits in peat soil mixed with other inorganic elements ie clay. Physical characteristic of peat soil is the color of each soil sample. The color of each sample is dark brown to black caused by oxidation, forest burnt, decomposition and contamination of organic matter.

4. Conclusion

Based on the results of data processing, On the first sample, highest electrical conductivity value is 0.12dS /m and the lowest 0.03 dS/m. On the second sample, the highest electrical conductivity value is 0.09 dS/m and the lowest 0.02 dS/m. On the the third sample, the highest conductivity value is 0.09 dS/m and the lowest 0.03 dS/m. On the fourth sample has the highest electrical conductivity value of 0.29 dS/m and the lowest conductivity value of 0.02 dS/m. The value of electrical conductivity (EC) in the first and third samples are lower than the second and fourth samples. This is due to the presence of organic deposits on peat soil.

The first sample, the highest volume water content value is equal to 0,514 m$^3$/m$^3$ and the lowest is 0.311m$^3$/m$^3$. For the second sample has the highest water content value that is 0,535 m$^3$/m$^3$ and the lowest water content value is 0,255m$^3$/m$^3$. In sample three it has the highest water content value of 0.541 m$^3$/m$^3$ and the lowest water content value is 0.334 m$^3$/m$^3$. The fourth sample has highest water content value of 0.548 m$^3$/m$^3$ and the lowest water content value of 0.267 m$^3$/m$^3$.

For further research can be done a Munsell Color test used to determine the soil color. The test of magnetic grain test and composition by performing the SEM-EDS test using TM-3000 Tabletop Microscope.

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