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Mapping Thickness and Maturity Level Of Peat in The Simpang Wie Village, East-Langsa Sub-district, Langsa City

Pemetaan Ketebalan dan Tingkat Kematangan Gambut di Desa Simpang Wie Kecamatan Langsa Timur Kota Langsa

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ABSTRACT

By conducting a study on the mapping of the thickness and maturity level of peat, it can provide the usage of peatland regarding cultivated land. The result of mapping can appropriately be used to design land utilization and model of production system. This study was carried out at Simpang Wie Village, East-Langsa Sub-district, Langsa City, as known which is known as one of the Peatland areas in Langsa City. The study was conducted in December 2019. Survey method design was employed in this research while the research location was determined purposively, which means that it is directly chosen or purposively chosen because the location is a peatland. Data types applied by field observation in this study were primary and secondary data. In this study, This research requires four main following phases; (1)Preparation (2)Preliminary-Survey (3) Field-Implementation, and (4) Data Analysis/ Discussion. The research result shows that the peatland area width of 4.94 9 (Ha) was classified into two types peat thickness: Shallow/Thin Peat with thickness > 40-100 cm (1.95 Ha), and Moderate Peat with thickness of 101-195 cm (2.99 Ha). Based on the observation, the maturity Level of Peat also classified into two maturity levels, those are Hemic Maturity Level and Sapric Maturity Level. Therefore, the use of peatland area according to thickness and maturity level concluded that the thickness of 40-100 cm can appropriately be used to cultivate paddy-fields, palawijas and plantation crops (horticulture). Besides, the thickness of 101-195 cm can appropriately be used to cultivate plantation crops (horticulture), vegetable crops (olericulture), and fruit crops (fruticulture). At least, this land is suitable to be used for agricultural cultivation because it has hemic and sapric maturity level.

Keywords*: *peat, thickness, maturity level , hemic, sapric, cultivated land

ABSTRAK

Pemetaan ketebalan dan tingkat kematangan gambut perlu dilakukan untuk mengetahui pemanfaatan lahan gambut sebagai lahan budidaya. Hasil dari pemetaan dapat digunakan sebagai acuan untuk perencanaan penggunaan lahan dan sebagai masukan untuk model sistem produksi. Penelitian ini dilakukan di Desa Simpang Wie, Kecamatan Langsa Timur, Kota Langsa yang merupakan salah satu wilayah yang memiliki lahan gambut di Kota Langsa.

Jurnal Pertanian Tropik ISSN NO: 2356- 4725/p- ISSN : 2655-7576
Vol.7.No.2. 2020 (23) 174-184 DOI: 10.32734/jpt.v7i2.3964

Penelitian ini dilakukan pada bulan Desember tahun 2019. Penelitian ini menggunakan metode survei, penentuan lokasi penelitian dilakukan secara "*purposive*" yaitu penentuan lokasi yang dipilih secara langsung atau sengaja dengan alasan bahwa bahwa lokasi tersebut terdapat lahan gambut. Data yang diperoleh yaitu data primer hasil pengamatan lapangan dan data sekunder lainnya. Secara garis besar penelitian dilakukan atas 4 (empat) tahapan meliputi: (1) persiapan, (2) survei pendahuluan, (3) pelaksanaan lapangan dan (4) analisis data/pembahasan. Hasil penelitian meunjukkan bahwa dilokasi penelitian terdapat lahan gambut dengan luas 4,94 Ha dengan klasifikasi ketebalan gambut dibagi menjadi 2 yaitu gambut dangkal dengan ketealan 40-100 cm (1,95 Ha) dan gambut sedang dengan ketebalan 101-195 cm (2,99 Ha). Tingkat kematangan gambut yang terdapat dilokasi penelitian terdiri atas 2 tingkat kematangan yaitu tingkat kematangan hemik dan tingkat kematangan saprik. Pemanfaatan lahan gambut dilokasi penelitian berdasarkan ketebalan dan tingkat kematangan, untuk ketebalan 40-100 cm dapat digunakan untuk pengembangan padi sawah, palawija dan tanaman perkebunan. Lahan gambut dengan ketebalan 101-195 cm dapat digunakan untuk budidaya tanaman perkebunan, sayuran dan buah-buahan. Lahan tersebut sesuai digunakan sebagai lahan untuk budidaya pertanian karena mempunyai tingkat kematangan hemik sampai saprik.

Kata Kunci: gambut, ketebalan, tingkat kematangan, hemik, saprik, lahan budidaya

INTRODUCTION

Indonesia has a very large area of land, both land used for agriculture and non-agriculture. In the current era of globalization, Indonesia needs more land to be used or utilized either to increase food productivity or to create jobs. This causes mineral lands in Indonesia to decrease, so that land that was previously considered marginal has now been widely used. Peatlands are currently widely used marginal lands. Peatland is land that has a layer of soil rich in organic matter with a thickness of 50 cm or more, which is composed of plant residues that have not completely decomposed (Agus and Subiksa, 2008).

The potential of peatlands can be utilized for community welfare. Indonesia has been recognized as the fourth country after Canada, Russia and the United States of America to have the largest peatlands. The area of peatlands in Indonesia is around 14.94 million ha. located on the islands of Sumatra, Kalimantan, Papua and a small part of Sulawesi (Wahyunto, et al., 2014).

Farmers have long used peatlands to produce food and plantation commodities (Rina and Noorginayuwati, 2007; Masganti and Yuliani, 2009; Masganti, 2013). The conversion of agricultural land functions threatens food availability in the future. This is a consideration for the importance of peatlands for agricultural development, even if peatlands become a future food warehouse for Indonesia (Haryono, 2013; Masganti, 2013).

Simpang Wie Village, East Langsa District, Langsa City is one of the areas that has peatlands. The people of Simpang Wie Village are currently not using this peatland, as a result the land is filled with shrubs. This peatland is not used by the community because it experiences frequent fires. In one year there were two fires, namely in April and early September. Fires that occur due to the use and management of peatlands that are not in accordance with conservation principles.

The unwise use and management of peatlands will result in a long series of impacts, starting with land destruction, fires during the dry season, decreasing peat area, decreasing land productivity and decreasing the welfare of communities around the forest. The next threat that will

Jurnal Pertanian Tropik ISSN NO: 2356- 4725/p- ISSN : 2655-7576
Vol.7.No.2. 2020 (23) 174-184 DOI: 10.32734/jpt.v7i2.3964

occur is exploitation activities that will encroach on deep peat areas that have been designated as conservation areas.

Attention to the management of peatlands so that their characteristics do not change and result in decreased land productivity, so that the land becomes unproductive. The consideration that must be considered in the use of peatlands is the thickness of the peat. 50-100 cm thick is classified as shallow / thin peatland. It is known that the thicker the peat, the lower the potential for food crop cultivation (Wahyunto, et al., 2014).

Therefore, studying the diversity of peat soils such as the thickness of the peat and the level of maturity is a very determining factor in the management and utilization of peatlands.

MATERIALS AND METHODS

Simpang Wie Village, East Langsa District, Langsa City became the research location. Located at 7 meters above sea level. This research was conducted in December 2019. The map of the research location is presented in Figure 1. The materials used in the study were the East Langsa District administrative map and the Research Location Map.

The tools used are a peat drill, Rollmeter, GPS (*Global Positioning System*), stationery, printer, digital camera, machete, hoe, cutter and a set of laptops withinstalled *Microsoft Officesoftware* 2010 and *ArcGIS* 10.3.

Figure 1. Map of Research Locations

Preliminary Survey

The preliminary survey is the determination of the research location used as the sampling location, direct interviews with residents, farmers and local government agencies.

The study used a survey method. The location was determined *purposively*, in the location was determined directly or deliberately provided that the location contained damaged peatlands. Field observation data includes: the depth and level of maturity of the peat. In addition, there are secondary data in the form of land history, type of overflow in the dry and rainy season, information on land fire incidents obtained from interviews with surrounding communities, data from local government agencies, maps of research locations and other supporting data. The research was carried out in 4 stages, consisting of: (1) preparation, (2) preliminary survey, (3) field implementation and (4) data analysis/ discussion.

Preparation

This stage is carried out by arranging the legality of the research location permit. After that, the collection of supporting data as a first step in the research is equipped with a map of the location of the field, GPS (*Global Positioning System*), stationery, meters, communication and transportation tools.

Field Implementation

From the predetermined location map, soil measurements and observations are then carried out. Observations in the field

Jurnal Pertanian Tropik ISSN NO: 2356- 4725/p- ISSN : 2655-7576
Vol.7.No.2. 2020 (23) 174-184 DOI: 10.32734/jpt.v7i2.3964

were carried out including physical observations in the form of the depth and level of maturity of the peat. Soil sampling is done by drilling with a grid system.

Determination of Drilling Points

To map the depth of peat in a peat expanse or dome, drilling points are carried out in ansystem *orderly grid* across the peat domes, for example in the North-South, East-West, Northeast-Southwest or Northwest-Southeast directions so that various thicknesses are represented. .

According to Agus et al (2011), the distance of the drilling point is determined

Peat Thickness Measurement

To measure the thickness of the peat, a peat drill is required. A peat drill is used to extract peat soil, starting from the top layer to the bottom layer of the peat. Peat that is submerged in water can be sampled using a peat drill.

Determination of Peat Maturity Level Peat

Maturity level can be divided into 3 parts, namely sapric, hemic and fibric peat. The following is how to observe the field using the method *Von Post Humification* (Andriese, 1998). Take a handful of peat samples from the desired depth and squeeze them by hand.

1. Sapric (ripe) peat is peat which has continued to decompose from its original material and its original material is unknown, dark brown to black, when squeezed the fiber content is left in the palms <one third of the original amount.
2. Hemic peat (half-ripe) is half-ripe peat, part of the original material is still identifiable, colored, and when squeezed the fiber content left in the palms is> two-thirds of the original amount
3. Fibric (raw) peat is peat that has not been rotted, the original material is still recognizable, brown, when squeezed the fiber content left in the palm of the hand is> two-thirds of the original amount.

Determination of land characteristic values for soil samples was carried out using a peat drill until it reached the mineral soil.

by drilling at a distance of 50 m using a system *grid*. This is done at several locations showing that every 50 m distance, the difference in peat thickness ranges from 10-50 cm.

Each coordinate point is measured using a GPS (*Global Positioning System*). Based on pairs of coordinate data and peat thickness, a contour map of the peat thickness will be obtained.

Data Analysis

Primary data obtained from the field were then analyzed using Microsoft Excel 2010 andsoftware *ArcGIS* 10.3and presented in the form of tables, graphs and maps as well as secondary data.

RESULT AND DISCUSSION

Characteristics of Peat Thickness

One of the most important characteristics of peat soil is the thickness of the peat layer. Peat thickness measurements were carried out at 20 observation points at the research location in Simpang Wie Village. According to Suryadikarta and Sutriadi (2007) by using the peat thickness classification that is commonly used in agriculture, the thickness of the peat in the research location is divided into 2 classes, namely shallow peat and medium peat. The thickness of the peat at each sampling point is presented in Table 1.

Table 1. Peat thickness in Simpang Wie Village

Point	Peat Thickness (cm)	Class Peat Thickness

T1	40	Shallow	T11	185	Medium
T2	86	Shallow	T12	100	Shallow
T3	135	Medium	T13	75	Shallow
T4	160	Medium	T14	115	Medium
T5	120	Medium	T15	153	Medium
T6	92	Shallow	T16	195	Medium
T7	46	Shallow	T17	165	Medium
T8	60	Shallow	T18	120	Medium
T9	124	Medium	T19	183	Medium
T10	168	Medium	T20	135	Medium

Table 1, shows that the thickness of the peat in The research locations ranged from 40 to 195 cm thick peat. The thickness of the peat is classified into 2 classes, namely shallow peat (40 to 100 cm) and medium peat (101 to 195 cm). The peat thickness in the study location was dominated by the medium peat thickness class, amounting to 13 points (65%). The lowest thickness class was found in the shallow peat thickness class with a total of 7 points (35%). Peat thickness classes at the study sites are presented in Figure 2 and Table 2.

Percentage of peat thickness classes in the study sites consisted of shallow peat with an area of 1.95 Ha (39.47%) and deep peat with an area of 2.99 Ha (60, 53 %). Peat thickness of 40-100 cm (shallow), predominantly found in areas near community settlements and on cultivated land, the land cover is dominated by shrubs. Peat thickness 101 - 195 cm (moderate), predominantly found in areas far from residential areas, the land cover is dominated by shrubs and rubber.

The thickness of the peat affects land productivity, therefore the thickness of the peat needs to be considered in peatland management that aims for agricultural development. The subsidence rate is also influenced by the thickness of the peat, where the subsidence rate of deep peat will be greater than shallow peat (Barchia, 2012).

According to Suwondo et al. (2010) differences in peat thickness can affect the level of peat fertility. Peat thickness has a close correlation with carbon content and plant biomass addition, peat thickness is directly proportional to carbon content. The thicker the peat, the higher the carbon content.

Based on PP. 57 (2016) regarding the protection and management of peat ecosystems, the thickness requirement of peat as cultivation land is <3 m with the condition of the mineral layer under the peat not quartz sand or pyrite clay and the level of maturity is not fibric. In the research location, peatland can be used as cultivation land because the thickness of the peat ranges from 40 cm - 195 cm and the layer below the peat is not quartz sand.

Table 2. Percentage of Peat Thickness Class based on Area

No	Thickness Level Peat	Thickness (cm)	Number of Points	Area (Ha)	%
1	Shallow	40 – 100	7	1, 95	39, 47
2	Medium	101 - 195	13	2, 99	60, 53
	Total	0, 86	17, 44	4, 94	100

Jurnal Pertanian Tropik ISSN NO: 2356- 4725/p- ISSN : 2655-7576
Vol.7.No.2. 2020 (23) 174-184 DOI: 10.32734/jpt.v7i2.3964

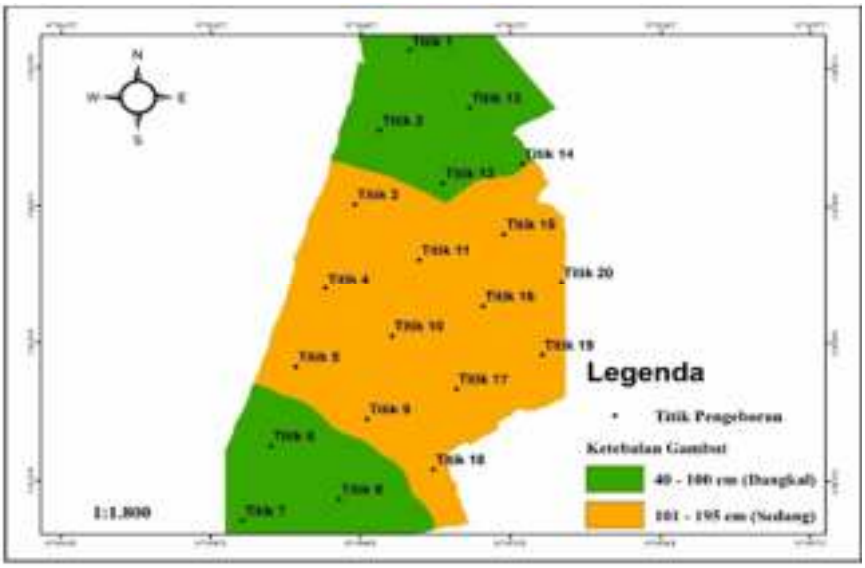


Figure 2. Peat Thickness Class in the location Research

Peat Maturity

Based on the level of maturity of the peat in the research location, it can be divided into 2 classes, hemic peat and sapric peat. Hemic peat soil is peat soil with a moderate decomposition level and has a *bulk density* 0.13 - 0.29 g/cm^{3,} with moderate fine fiber (25 - 27%), while the sapric maturity level is peat that has a high decomposition rate. *Bulk density* ≥ 0.2 g/ cm^3 and high fine fiber (> 75%). The observation of the maturity level of peat at each sampling point is shown in Table 3.

Table 3. The level of maturity of peat in Simpang Wie

Point	Maturity Level	
	Symbol	Equivalent With
T1	H5	Hemic
T2	H5	Hemic
T3	H6	Hemic
T4	H6	Hemic
T5	H7	Hemic
T6	H7	Hemic
T7	H7	Hemic
T8	H7	Hemic
T9	H7	Hemic
T10	H7	Hemic
T11	H6	Hemic
T12	H5	Hemic
T13	H5	Hemic
T14	H5	Hemic
T15	H7	Hemic
T16	H8	Sapric
T17	H8	Sapric
T18	H8	Sapric
T19	H8	Sapric
T20	H8	Sapric

From Table 3 can be seen that the level of maturity hemic peat dominates in the study site. Hemic peat maturity was found at 15 observation points (75%), with the distribution points at the T1-T15 sampling point. The sapric peat maturity level is obtained at point T16-T20. Details of the extent and percentage of peat maturity levels are presented in Table 4.

Hemic peat is peat that has a moderate level of weathering (half-baked), some of the material has been weathered and partly in the form of fibers. Sapric peat is peat that has an advanced or mature level of maturity. Najiyati et al, (2005) explained that the level of maturity of peat varies because it is formed from different materials, environmental conditions and time. Ripe peat is finer than unripe peat and contains lots of fiber. The peat

Jurnal Pertanian Tropik ISSN NO: 2356- 4725/p- ISSN : 2655-7576
Vol.7.No.2. 2020 (23) 174-184 DOI: 10.32734/jpt.v7i2.3964

maturity level is presented in Figure 3.

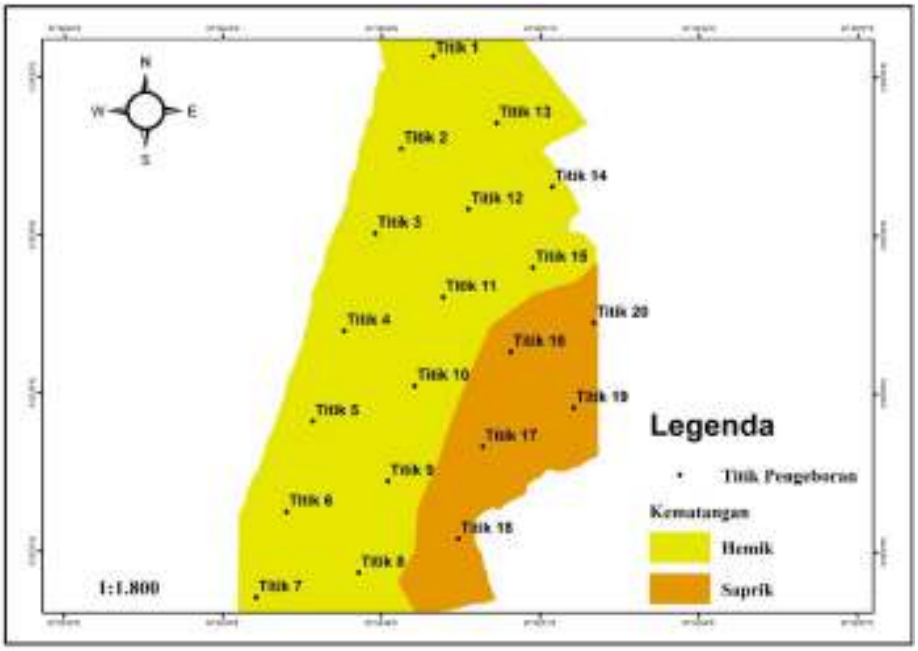
From the research results, peat which has a high fertility level is the sapric maturity level. A high level of maturity will determine the level of land productivity, because the availability of nutrients in peatlands is relatively mature compared to raw peat conditions (Dariah, et al., 2014).

Peat maturity also correlates with carbon storage capacity, the higher the level of peat maturity, the higher the carbon content of the peat volume per unit. Sapric maturity level of carbon content per volume 66 ± 20 kgm^{-3}. The hemic maturity level of the volume unit carbon content of 50 ± 14 $kgm^{-3}$and the fibric maturity level of the volume unit carbon content of 39 ± 11 kgm^{-3}. The exception is that in total it does not mean that the further the peat is matured in a location, the carbon storage in that place will increase. As a result of the decomposition process, the peat experiences a reduction in volume or compression (*subsidence*), so that although the volume of the peat content per volume increases, the total volume of peat decreases, the total carbon storage also decreases (Dariah et al., 2011).

The maturity of the peat also affects the occurrence of peatland fires. Saharjo and Syaufina (2015) stated that peatland fires are influenced by the maturity level of the peat. The level of maturity of peat which often experiences fire is at fibric maturity due to the large amount of litter that is flammable. In the research location, fires often occur at the hemic maturity level, because there is still flammable litter and the land cover at the research location is shrubs, as well as a source of fire due to burning for land clearing around the research location.

Table 4. Extent and Percentage of Peat Maturity Level

No	Maturity Level of Peat	Area (Ha)	Percentage(%)
1	Hemic	3, 79	60, 63
2	Sapric	1, 16	29, 37
	Total	4, 95	100



Jurnal Pertanian Tropik ISSN NO: 2356- 4725/p- ISSN : 2655-7576
Vol.7.No.2. 2020 (23) 174-184 DOI: 10.32734/jpt.v7i2.3964

Figure 3. Peat Maturity Level in Locations Research

Peatland Utilization Model in Simpang Wie Village

utilization is one of the efforts to expand agricultural cultivation land due to demands for food supply for the population. Peatlands that are marginalized have become targets for agricultural cultivation. Utilization of peat land needs to pay attention to the physical characteristics of peat soil, namely the thickness of the peat. Utilization of peat land in Simpang Wie Village based on thickness is presented in Table 5.

Table 5. Utilization of peatlands in Simpang Wie Village based on thickness

No	Peat Thickness Level	Thickness (cm)	Material under the Peat Layer	Allocation
1	Shallow	40 – 100	Clay	Rice Paddies, palawija and plantations
2	Medium	101 - 195	Clay	Plantation, vegetables and fruits

Thickness of peat that can be used as cultivation area <3 m. The peatlands at the research location have a thickness of 40-100 cm so they can be used for lowland rice development. Peatlands with a thickness of 101-195 cm can be used for the cultivation of vegetables and fruits. The land is suitable for use as agricultural land because it has a hemic to sapric maturity level (Suryadikarta and Sutriadi, 2007). The results of this study indicate that the peatlands in Simpang Wie Village are designated for agricultural cultivation areas.

The results also showed that the peat layer subratum was found in the research location. This makes the land usable as agricultural land. This is in accordance with the opinion of Limin, et al. (2000) who stated that peatlands with a thickness of ≤ 50 cm with a layer of peat substratum in the form of clay are suitable for rice/secondary crops. Peat thickness of 50 - 100 cm with a layer of peat substratum in the form of clay suitable for rice / secondary crops and plantations. Meanwhile, peat thickness of 100-200 cm with a layer of clay substrate is used for plantation commodities.

Before cultivating on peat land, reclamation is first necessary. The Directorate of Land Management, Ministry of Agriculture (2008) states that this reclamation is an effort to use peat land for agricultural business through improving facilities and infrastructure in the area, the aim is to increase land productivity.

Peat land that is reclaimed before being used as a cultivation area must begin with a land drainage arrangement. Drainage aims to remove excess water from rainwater efficiently and control groundwater levels. Improper drainage has serious impacts on the peatland ecosystem. The impact can be in the form of subsidence and peatland fires. Peatland fires usually occur due to poor drainage conditions resulting in subsidence. Because peat hasproperties *irreversible drying*, it means that once it experiences excessive drought, the peat will become damaged so that the peat cannot re-tie water. As a result, the nature of peat changes like charcoal, which burns easily in the dry season (Widyati, 2011).

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

1. There is peat land with an area of 4.94 Ha in Simpang Wie Village with a thickness classification of peat divided into 2, namely shallow peat with a thickness of 40-100 cm (1.95 Ha) and medium peat with a thickness of 101-195 cm (2.99 Ha).
2. The peat maturity level in Simpang Wie Village consists of 2 maturity levels, namely the hemic maturity level and the sapric maturity level.
3. Utilization of peat land in Simpang Wie Village based on the thickness and level of maturity of the peat at the research location, is grouped into 2, namely peat with a thickness of 40-100 cm which can be used for the development of lowland rice, secondary crops and plantation crops,

   while peatlands with a thickness of 101-195 cm can be used for the cultivation of plantation crops, vegetables and fruits. The land is suitable for use as agricultural land because it has a hemic to sapric maturity level.

Recommendations

1. It is necessary to carry out further research in Simpang Wie Village by looking at other parameters such as: soil chemical properties, soil physical properties and soil biological properties to provide information on the biophysical peatlands in the research location.
2. It is necessary to conduct trials of rice and secondary crops cultivation in Simpang Wie Village to see the effect of peat soil properties on plant growth and production.

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