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Soil Classification on Megawati Soekarno Putri Botanical Garden Inratatotok, Southeast Minahasa Regency

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Abstract: *The objective of this study are to identify soil characteristics and to determine the classification of the soil of the Megawati Soekarno Putri botanical garden in Ratatotok, Southeast Minahasa Regency, North Sulawesi Province. This research was conducted based on the land unit approach that the determination was made on the overlay of landform units, land use and slopes that were delineated from the Earth's map, GeoEye image (2011), and SRTM 30 m (2012) imagery. There are 17 units of land in the study area. Identification and inventory of land potential of each unit of land were obtained by observing soil morphology land characteristics on 14 soil profiles.*
The soil classification was implemented according to Soil Taxonomy (Soil Survey Staff, 2010). Physical and chemical characteristics of the soil were carried out through laboratory tests including texture analysis, C-organic, N-total, P-available, cation exchange capacity (NH4OAc, pH 7), exchangeable bases (Ca, Mg, K and Na), pH (H2O) and pH (KCl) (1:1). This research was carried out in the field on reclaimed land of gold mine which has been designated as botanical garden of Megawati Soekarno Putri Ratatotok and in laboratory of Department of Soil Science,Faculty of Agriculture of Brawijaya University Malang. The research shows: (1) Botanical garden of Megawati Soekarno Putri has various soil colors , ie dark chocolate to dark brown, dark brown, brown to dark brown, and yellowish brown to dark yellowish brown; (2) soil pH (H2O) is included in slightly acid to neutral criteria, P is very low to medium, low K +, very low Na +, Mg2 + is low to moderate, Ca2 + is very high and cation exchange capacity (CEC); (3) Megawati Soekarno Putri Botanical Garden Ratatotok has 17 units of land map (SPT) consisting of nine SPT of karst land group, seven SPT Volcanic group and one SPT in the form of body / water body; (4). The classification of land in Megawati Soekarno Putri Botanical Garden Ratatotok is dominated by the order Inceptisol, followed by Alfisol, Mollisol, and Entisol. Subgroup categories include Typic Hapludalfs (SPT 4.5.8. and 16), followed by Typic Dystrudepts (SPT 9 and 14), Typic Eutrudepts (SPT 3 and 11), Typic Hapludolls (SPT 7 and 12), Lithic Udorthents (SPT 6 and 13), Lithic Dystrudepts (SPT 15), Lithic Eutrudepts (SPT 1 and 2) and Typic Udorthents (SPT 10).

Keywords*: Land Classification, Potential Land, Botanical Garden, Gold Mine.*

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I. Introduction

Ratatotok is known as one of the gold mining areas in North Sulawesi Province. Mining activities in this region was begun in the 1850s (Hartono, 2004). The gold mining system was originally done by hydroulic method followed by digging holes both vertically and horizontally, forming a narrow and long underground passage. The exploitation of gold mining by blasting techniques was begun around 1898 by the Dutch, while the peasants' mining was originally undertaken at Hais in 1914 (Garwin, 1994).ctivity / mining business in Ratatotok was conducted by PT. Newmont Minahasa Raya (PT NMR). This gold mining company was established in 1984. Gold mining activities began with drilling at Hais in 1987. In 1989 drilling was carried out on Mount Surat, Mesel with the discovery of gold deposits beneath the rocks closing desit followed by exploration until 1994 (Ta'indanSutrisno , 2003). Gold seed mining began in 1995 and ended in 2001 (PT NMR 2002. PT NMR2007).During the gold mine, PT. NMR used an open pit system. These activities include the stripping of soil and stockpiling of rock cover, drilling and blasting rock and waste rock. Environmental impacts caused by mining activities include: loss of forest vegetation, changes in landform / topography, changes in physical, chemical and biological properties of the soil (Suprapto, 2008; Hidayat et al., 2015; Nadalia, 2009; Murjanto, 2011). In such conditions, the soil becomes poor nutrients, soil compaction, soil ability to hold low water and decrease soil microorganisms, so that the growth of the plant becomes slow. In order to recover the decrease in the carrying capacity of the environment, the discourse that leads to the prevention of land resource degradation becomes the center of attention after the mine closure (Burhanuddin et al, 2010; Burhanuddin, 2012).he reclamation of ex-mining land is an important activity before the mining business ends (Annisa, 2010). This effort can be done by several methods both mechanically, biologically-vegetation and chemical-physical (Setyawan et al., 2008). In the early stages, land needs to be prepared, among others, by returning a relatively fertile topsoil (Jasper, 2002; Ward, 2000), reprocessing and condensing certain sections useful for stabilizing the land surface (Osborne, 1996; Koch et al., 1996) . In the geotechnical stage is also often made drainage channels to regulate the disposal of excess surface water after the rain. Planting activities are generally done immediately to improve land cover that is useful for erosion control and ultimately restore organic material and soil fertility (Bradshaw, 1997).he characteristics of mined land are different from the soil that develops naturally. This distinction is characterized by the poor physical, chemical, and biological properties of the soil caused by soil damage from mining and post-mining reclamation. In principle, reclamation and post-mining through revegetation actions on critical and damaged lands are conducted primarily to restore land function to safe and productive conditions, thus becoming a useful and efficient area (Soewandita dkk, 2010; Suprapto, 2008; PT Newmont Minahasa Raya, 1994).

Government policy of South Minahasa Regency of North Sulawesi Province by setting reclamation area of former gold mine PT. NMR Ratatotok as a botanical garden is expected to overcome the threat of land degradation and biodiversity. For that matter has been confirmed in the Regional Regulation No. 3 of 2013 on Spatial Plans of Southeast Minahasa Regency Year 2013-2033 and Regional Regulation Number 3 Year 2015 on Botanical Garden "Megawati Soekarno Putri" in Ratatotok, South Minahasa Regency.he botanical landscaping approach on the former gold mine land is very strategic to be developed in the management of ex-mining land into productive land. Through this policy it is expected to have an impact on an ecosystem such as restoring land functions as climate regulator, water regulator, biomass production (Sudiana , 2009; Karamoy et al., 2014), as well as decreased erosion and surface flow, CO2 absorber (Setyawan et al., 2008; Hermawan 2011: Patiung et al., 2011). In addition it will serve as a learning platform for the community about the importance of botanical gardens based on the functions of conservation, education, tourism and environmental services (Anonymous, 2014; Lubis and Rosyidah, 2012).

II. Research Methods

2.1. Research sites

The research was conducted in the field and in laboratory. Field research was conducted on reclaimed gold mine land of PT NMR which has been designated as the botanical garden of Megawati Soekarno Putri (KR-MSP). This area is located on Mount Surat, Mesel, Ratatotok of Southeast Minahasa Regency of North Sulawesi Province which has area of 443.40 ha. Geographically it is located between 0 ° 48'00 "-01º 03'00" North Latitude and 124 ° 38'00 "-124º55'00" East Longitude. Soil samples were taken from the field then analyzed the physical and chemical properties of the soil in the laboratory of the Soil Department of the Faculty of Agriculture at Brawijaya University Malang.

2.2. Materials and Methods

This research used materials consisting of: base map, satellite image and DEM SRTM. The source of the base map is the Earth Map (RBI) scale of 1: 50.000. To match the 1: 10.000 scale mapping, a newly modified base map was developed with the 2011 GeoEye Image and DEM SRTM resolution of 30 m in 2012. The tools used in this study include ground survey equipment such as Munsell Soil Color Chart, compass , land description card, meter, Keys to Soil Taxonomy (Soil Survey Staff, 2010), field notes, global positioning system (GPS), abney-hand level, altimeter, and sample ring. In addition there was equipment for making minipit and soil profile observations, as well as laboratory equipment for analysis of soil physical and chemical properties.Observation of soil morphology and soil sampling was based on land map unit (Rayes, 2007). The units of land maps are composed of map units obtained from the overlay of three elements, namely geology, slope and land use (Pioh et al 2014).Determination of soil observation follows the path / transect. In each of the soil sampling locations, it is also noted that their coordinates with the help of global positioning system (GPS) and high places from the sea level are determined with the help of altimeter. To determine the slope is used abney hand level.Soil sampling is done by creating a soil profile. In the observed soil profile: the boundary between layers / thicknesses, color, structure, consistency, soil pores, and effective depth, basalt, and drainage. The morphologically enriched films, reliefs, elevations, outcrops, hazards, flood hazards, including other supporting data such as data climate covering the last 10 years rainfall, temperature and humidity. Location of observation and sampling of soil can be seen in Table 1.

Table 1. Observation and Soil Sampling Sites

No	Code	Elevation (m dpl)	Slope (%)	Geographic Coordinates	
				North Longitude	Longitude
1.	SPT-1	275	3 %	0^{o} 53' 7.27"	124^{o} 40' 07.3"
2.	SPT-2	275	3 %	0^{o} 53' 7.27"	124^{o} 40' 07.3"
3.	SPT-3	231	15 %	0^{o} 53' 09.6"	124^{o} 39' 51.6"
4.	SPT-4	191	18 %	0^{0} 53' 10"	124^{0} 40' 15.8"
5.	SPT-5	119	10 %	0^{0} 52' 53.9"	124^{0} 40' 28.1"
6.	SPT-6	220	20 %	0^{o} 52' 58.5"	124^{o} 39' 58.3"
7.	SPT-7	148	25 %	0^{o} 53' 03.8"	124^{o} 40' 17.7"
8.	SPT-8	119	10 %	0^{0} 52' 53.9"	124^{0} 40' 28.1"
9.	SPT-9	144	20 %	0^{o} 52' 40.10"	124^{o} 40'2.5"
10.	SPT-10	378	25 %	0^{o} 53' 38.83"	124^{o} 39' 35.83"
11.	SPT-11	231	15 %	0^{o} 53' 09.6"	124^{o} 39' 51.6"
12.	SPT-12	148	25 %	0^{o} 53' 03.8"	124^{o} 40' 17.7"
13.	SPT-13	308	20 %	0^{o} 53' 8.82"	124^{o} 39' 53.94"
14.	SPT-14	420	35 %	0^{o} 53' 31.8"	124^{o} 39' 19.0"
15.	SPT-15	293	40 %	0^{o} 53'7.37"	124^{o} 40' 12.03"
16.	SPT-16	316	40 %	0^{o} 53' 30.9"	124^{o} 39' 50.1"

Soil sampling is done on each horizon of approximately 1 - 2 kg of soil. For the purposes of analyzing the physical and chemical properties of the soil is carried out in the top 2 (two) layers. Parameter of soil physical properties analyzed was soil texture with hydrometer method (Bouyoucos, 1951). Soil chemical analysis consists of pH, C-organic by Walkley-Black method (Evrendilec et al, 2004); N-total by Kjeldahl method (Bremmer, 1960), P-is available by Olsen method, bases can be exchanged (K, Na, Ca and Mg) and CEC by NH4OAc method pH 7.0 (Phillips & Marion, 2007) and Saturation alkaline. Field condition data, physical and chemical properties of soil before being mined is done through literature study of environmental impact assessment documents and closure plan of PT. NMR.

III. Results And Discussions

3.1. Soil Morphology

Effective depth of soil in the area of Megawati Soekarno Putri Botanical Garden included in the class shallow to moderate (<100 cm). Based on document of environmental impact statement of PT. NMR (1994), the soil in this area has a depth of 135-155 cm of land. In certain locations there are surface rock outcrops, except for secondary forest (SPT 4) and mixed gardens (SPT 5/8). In addition, the materials (rocks) deposited on the reclaimed land of gold mines are clear and revegetation plants grow and develop among the rocks. The mother plants may turn into young soils in a relatively short period of time under enabling environmental conditions (Rajamudin, 2009). This level is characterized by a pile of organic matter on the ground surface.The characteristic of the soil layer of the main garden of Megawati Soekarno Putri is mainly the color of the soil varies, ie dark chocolate to dark brown, dark brown, brown to dark brown, and yellowish brown to dark yellowish brown. The longer the age of reclamation, the darker the soil color, because the level of development of the soil has entered the advanced stage of the age of 8-17 years. This soil color change is one indicator of the increase of organic matter content (Hardjowigeno, 1992).The structure of the soil is generally dominated by a rounded clump structure (subangular blocky) with a weak to strong developmental level. The consistency of the soil is dominated by friable until very loose, followed by rather firm to firm. The existence of plant roots and litter decomposed into soil organic matter affects the soil pores so as to extend root penetration in its spreading.On secondary forest land and agricultural land (mixed plantation) shows different things in terms of depth and soil consistency. The soil profile on secondary forest land and mixed plantation has a soil horizon that is in 155 cm (secondary forest) and 150 cm (mixed garden). The soil layer on the secondary forest and mixed garden is thicker than the thickness of the soil layer on this botanical garden. Soil consistency in mixed cultivated land is firm, whereas in secondary forest land has a loose consistency.

3.2. Physical Characteristics and Soil Chemistry

The physical and chemical characteristics of the soil in the area of the botanical garden of Megawati Soekarno Putri Ratatotok can be seen in Table 2. In Table 2 shows the soil in the botanical area is dominated by the dust fraction, followed by sand fraction and clay fraction. The highest dust fraction is found in secondary forest (SPT 5 and SPT 10) that is 60% and the lowest is in SPT 6 which is 27%. The highest sand fraction is in SPT 6

	Age / Reclamation Technique	Depth (cm)	pH 1 : 1		C-Org	N-Tot	C/N	P-Olsen	K	Na	Ca	Mg	KTK	Amount Basa	Kej Basa	Sand	Debu	Liat	Texture
			H_2O	KCl 1 N	............%............			mg. kg^{-1}	..........................me/100 g..........................							............%............			
1	SPT-1	0-14	7.1	6.5	0.94	0.08	12	3.72	0.16	0.26	35.38	0.79	42.20	36.58	87	28	47	25	Loam
		14-35	7.2	6.5	0.57	0.05	11	3.78	0.11	0.27	38.35	0.80	42.89	39.53	92	28	46	26	Loam
2	SPT-2	0-14	7.1	6.5	0.94	0.08	12	3.72	0.16	0.26	35.38	0.79	42.20	36.58	87	28	47	25	Loam
		14-35	7.2	6.5	0.57	0.05	11	3.78	0.11	0.27	38.35	0.80	42.89	39.53	92	28	46	26	Loam
3	SPT-3	0-13	7.0	6.5	2.35	0.21	11	5.96	0.46	0.25	33.04	0.79	43.36	34.54	80	23	50	27	Clayey loam
		13-39	7.0	6.5	0.75	0.10	7	5.18	0.18	0.20	32.85	1.56	40.85	34.80	85	29	42	29	Clayey loam
4	SPT-4	0-14/16	6.1	5.3	1.96	0.20	10	2.22	1.34	2.02	16.76	2.19	39.77	22.22	56	18	56	26	Dusty loam
		14/16-32/35	6. 0	5.2	1.33	0.14	9	2.26	0.11	0.33	16.40	0.64	47.35	17.48	37	12	56	32	Dusty clay loam
5	SPT-5	0-13	6.6	5.7	2.82	0.26	11	3.09	0.78	1.47	22.33	2.77	54.38	27.35	50	15	60	25	Dusty loam
		13-28	6.3	5.3	1.77	0.16	11	3.13	0.44	0.38	20.96	4.95	53.86	26.73	50	14	45	41	Dusty clay
6	SPT-6	0-13	6.9	6.5	1.54	0.17	9	3.81	0.27	0.30	37.85	1.61	50.24	40.03	80	16	56	28	Dusty clay loam
		13-18	7.1	6.8	0.65	0.05	12	10.99	0.13	0.25	28.16	1.55	33.67	30.09	89	61	27	12	Sandy loam
7	SPT-7	0-12	6.9	6.2	0.56	0.42	8	1.53	0.83	0.45	32.56	0.97	64.63	34.81	54	27	45	28	Clayey loam
		12-42	6.8	6.2	3.10	0.19	8	4.64	0.29	0.32	28.65	2.45	57.99	31.71	54	22	37	41	Clay
8	SPT-8	0-13	6.6	5.7	2.82	0.26	11	3.09	0.78	1.47	22.33	2.77	54.38	27.35	50	15	60	25	Dusty loam
		13-28	6.3	5.3	1.77	0.16	11	3.13	0.44	0.38	20.96	4.95	53.86	26.73	50	14	45	41	Dusty clay
9	SPT-9	0-7	7.0	6.0	3.23	0.34	10	5.23	0.60	0.32	14.35	3.00	38.89	18.27	47	19	56	25	Dusty loam
		7-23	6.5	5.6	1.22	0.17	7	1.49	0.12	0.24	11.60	0.78	31.85	12.74	40	30	33	37	Clayey loam
10	SPT-10	0-20	7.1	6.5	0.74	0.10	8	8.78	0.17	0.28	24.90	0.62	40.39	25.97	64	40	48	12	Loam
		20-40	7.1	6.5	1.22	0.90	13	4.48	0.15	0.31	28.71	2.05	46.92	31.22	67	32	42	26	Loam
11	SPT-11	0-13	7.0	6.5	2.35	0.21	11	5.96	0.46	0.25	33.04	0.79	43.36	34.54	80	23	50	27	Clayey loam
		13-39	7.0	6.5	0.75	0.10	7	5.18	0.18	0.20	32.85	1.56	40.85	34.80	85	29	42	29	Clayey loam
12	SPT-12	0-12	6.9	6.2	0.56	0.42	8	1.53	0.83	0.45	32.56	0.97	64.63	34.81	54	27	45	28	Clayey loam
		12-42	6.8	6.2	3.10	0.19	8	4.64	0.29	0.32	28.65	2.45	57.99	31.71	54	22	37	41	Clay
13	SPT-13	0-15	6.9	6.5	1.19	0.11	11	8.74	0.20	0.28	27.21	0.61	31.23	28.30	91	41	44	15	Loam
		15-50	7.1	6.6	0.56	0.04	15	5.16	0.06	0.25	25.40	0.78	33.91	26.49	78	46	35	19	Loam
14	SPT-14	0-6/7	6.0	5.2	1.01	0.25	4	36.53	0.48	0.24	8.49	3.09	30.22	12.30	41	42	52	6	Dusty loam
		6/7-17/24	5.9	5.0	1.19	0.15	8	1.45	0.28	0.21	8.25	1.53	25.49	10.27	40	45	46	9	Loam
15	SPT-15	0-9	6.5	5.7	1.76	0.24	7	18.65	0.14	0.27	10.51	0.82	23.81	11.74	49	30	57	12	Dusty loam
		9-19	6.3	5.5	1.01	0.16	6	2.91	0.36	0.26	8.76	0.92	24.52	10.30	42	31	49	13	Loam
16	\SPT-16	0-11	7.0	6.6	3.85	0.38	10	7.44	0.47	0.34	18.07	0.63	33.06	19.51	59	29	60	11	Dusty loam
		11-33	7.1	6.4	2.33	0.27	9	7.39	0.30	0.30	11.55	0.52	28.30	12.67	45	29	59	12	Dusty loam
17	SPT-17	Water body																	

which is 61%, and the lowest is in SPT 4 mixture garden which is 12%. The highest clay fraction is in SPT 15. which is 42% and the lowest is in SPT 16 and SPT 14 which is 6%.The mean percentage of the fraction of dust and sand, tend to be higher in the topsoil compared to the layer just below it. The presence of clay leaching from the top layer to the lower layer causes the clay fraction to tend to increase in harmony with the depth of the soilSoil pH (H2O) in the botanical area is included in slightly acid to neutral criteria. Soil reactions (soil pH) not only show the soil acidity, but also related to other soil chemical properties, such as the availability of phosphorus (P) and others (Hanudin, 2000 in Arifin, 2011). The availability of P on the botanical garden ranges from 1.45 to 36.53 mg.kg-1 (very low to moderate). Its main material is dominated by limestone which contains many bases, especially Ca2 +. In this condition, P is bound by the Ca2 + element so it is less available to the plant.Based on soil analysis results indicate that the N-total content is in the range very low to very high. The reclaimed land of the former gold mine has been designated as a botanical garden, tending to have a higher average C-organic and N-total content on topsoil compared to lower ground. This may be due to the high organic material and has not been decomposed perfectly so that it is difficult to be transferred to the layers below (Taharu et al., 2006).Land in the area of the botanical garden of Megawati Soekarno Putri Ratatotok generally have KTK about 23.82 - 64.63 me.100 g-1 which is moderate to very high. The saturation of the base on the reclamation field ranges from 40 to 92% (medium - very high). These results indicate that the soil in the area of the prospective botanical garden has varying fertility rates because it has main material and different levels of development.

3.3. Land Map Unit

In general it can be stated that the area of the botanical garden of Megawati Soekarno Putri Ratatotok has 17 units of land map (SPT) consisting of nine SPT karst soil group, seven SPT volcanic group, and one SPT in the form of water body that is small lake (excavation pit) sediment pond. In this area there are four forms of land, namely karst plains, karst hills, volcanic hills and water bodies, and has a slope (%) from slightly flat to hilly (steep), and made from main materials dominated by limestone and wet tuf volkan andesite (Table 3).

Table 3. Landform in Botanical Garden Ratatotok Area Southeast Minahasa

No. SPT	Symbol	Landform	Area form (% Lereng)	Main material	Wide	
					Ha	%
Soil on KARST Group						
1	Kc2n1	Karst plain	Somewhat flat (1-3)	Limestone	12.30	2.77
2	Kc2.u1	Karst plain	Wavy (3-8)	Limestone	3.43	0.77
3	Kc2.r2	The karst plain is inscribed	Wavy (8-15)	Limestone	38.72	8.75
4	Kc3.c1	Karst hills	Hilly small (15-25)	Limestone	52.84	11.92
5	Kc3.c2	The karst hills are inscribed	Hilly small (15-25)	Limestone	4.64	1.05
6	Kc3.h1	Karst hills	Hilly (25-40)	Limestone	1.21	0.27
7	Kc3.h2	The karst hills are inscribed	Hilly (25-40)	Limestone	9.08	2.05
8	Kc3.h2	The karst hills are inscribed	Hilly (25-40)	Limestone	26.32	5.94
9	Kc3.h3	The karst plain is very inscribed	Hilly (25-40)	Limestone	13.92	3.14
Soil on VOLKANGroup						
10	Vab31.n1	Plains volkan	Somewhat flat (1-3)	Tuf volkan,wet andesit	5.04	1.14
11	Vab31.r1	Plains volkan	Wavy (8-15)	Tuf volkan, wet andesit	19.36	4.73
12	Vab32.c1	Volcanic hills	Hilly small (15-25)	Tuf volkan,wet andesit	29.34	6.62
13	Vab32.c2	The volcanic hills are inscribed	Hilly small (15-25)	Tuf volkan, wet andesit	28.34	6.39
14	Vab32.h2	The volcanic hills are inscribed	Hilly (25-40)	Tuf volkan,wet andesit	90.96	20.51
15	Vab32.h2	The volcanic hills are inscribed	Hilly (25-40)	Tuf volkan, wet andesit	18.66	4.21
16	Vab32.h3	The volcan hills are very inscribed	Hilly (25-40)	Tuf volkan, wet andesit	83.29	18.78
Other Groups						
17	X3	Water body			5.95	1.34
Amount					**443.40**	**100.00**

3.4. Soil Classification

The land in the botanical garden of Megawati Soekarno Putri can be grouped in four orders, four sub-orders, four great groups, and eight subgroups. Four main land orders, dominated by the Inceptisol order of 197.35 ha, followed by Alfisol 167.09 han, Mollisol 38.42 ha. Entisol 34.59 ha. At the subdivision level of Udepts, Orthents, Udalfs and Udolls and at a great group level consists of Eutrudepts, Udorthents, Hapludalfs, and Hapludolls.There are eight taxa soil at the location of the botanical garden of Megawati Soekarno Putri Ratatotok, namely Lithic Eutrudepts, Typic Eutrudepts, Typic Dystrudepts, Lithic Dystrudepts, Lithic Udorthents, Typic Udorthents, Typic Hapludalfs, and Typic Hapludolls (Table 4). The distribution of soil classification at sub-group level is presented in the following land-use map (Figure 1).

Table 4. Land found in Megawati Soekarno Putri Ratatotok Regional Area of Southeast Minahasa Regency

No. SPT	Symbol	Landform	Area form (% Lereng)	Main material	No. SPT	Wide	
						Ha	Ha
Soil on KARST Group							
1	Kc2n1	Lithic Eutrudepts	Karst plain	Somewhat flat (1-3)	Limestone	12.30	2.77
2	Kc2.u1	Lithic Eutrudepts	Karst plain	Wavy (3-8)	Limestone	3.43	0.77
3	Kc2.r2	Typic Eutrudepts	The karst plain is inscribed	Wavy (8-15)	Limestone	38.72	8.75
4	Kc3.c1	Typic Hapludalfs	Karst hills	Hilly small (15-25)	Limestone	52.84	11.92
5	Kc3.c2	Typic Hapludalfs	The karst hills are inscribed	Hilly small (15-25)	Limestone	4.64	1.05
6	Kc3.h1	Lithic Udorthens	Karst hills	Hilly (25-40)	Limestone	1.21	0.27
7	Kc3.h2	Typic Hapludolls	The karst hills are inscribed	Hilly (25-40)	Limestone	9.08	2.05
8	Kc3.h2	Typic Hapludalfs	The karst hills are inscribed	Hilly (25-40)	Limestone	26.32	5.94
9	Kc3.h3	Typic Dystrudepts	The karst plain is very	Hilly (25-40)	Limestone	13.92	3.14

			inscribed				
Soil on VOLKAN Group							
10	Vab31.n1	Typic Udorthens	Plains volkan	Somewhat flat (1-3)	Tuf volkan,wet andesit	5.04	1.14
11	Vab31.r1	Typic Eutrudepts	Plains volkan	Wavy (8-15)	Tuf volkan, wet andesit	19.36	4.73
12	Vab32.c1	Typic Hapludolls	Volcanic hills	Hilly small (15-25)	Tuf volkan,wet andesit	29.34	6.62
13	Vab32.c2	Lithic Udorthens	The volcanic hills are inscribed	Hilly small (15-25)	Tuf volkan, wet andesit	28.34	6.39
14	Vab32.h2	Typic Dystrudepts	The volcanic hills are inscribed	Hilly (25-40)	Tuf volkan,wet andesit	90.96	20.51
15	Vab32.h2	Lithic Dystrudepts	The volcanic hills are inscribed	Hilly (25-40)	Tuf volkan, wet andesit	18.66	4.21
16	Vab32.h3	Typic Hapludalfs	The volcan hills are very inscribed	Hilly (25-40)	Tuf volkan, wet andesit	83.29	18.78
Other Groups							
999	X3		Tubuh air			5.95	1.34
Amount						**443.40**	**100.00**

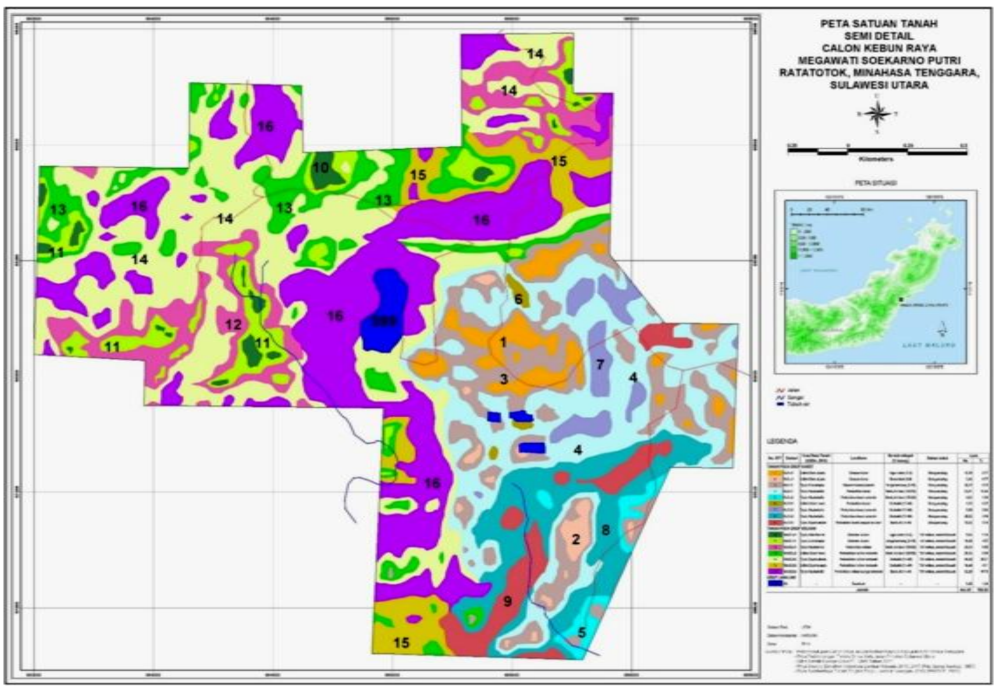

Figure 1. Map of Semi Detail Unit Land of Megawati Soekarno Putri Botanical Gardens in Ratatotok Southeast Minahasa Regency

IV. Conclusion

1. Megawati Soekarno PutriBotanical Garden has various soil colors, ie dark chocolate to dark brown, dark brown, brown to dark brown, and yellowish brown to dark yellowish brown.
2. pH soil (H2O) in the botanical garden area including the criteria slightly acid to neutral, P available ranged from 1.45 to 36.53 mg.kg-1 (very low to moderate), the content of K + is 0.23 - 0.85 me.100 g-1 (low), Na + content of 0.26 - 0.91 me.100 g-1 (very low), and for Mg2 + is low-moderate ie 0.87 - 1.73 me.100 g-1. and Ca2 + content of 20.59 - 23.99 me.100 g-1 (very high) and cation exchange capacity (KTK) of about 23.82 - 64.63 me.100 g-1 which are moderate to very high.
3. Ratatotok botanical garden area has 17 units of land map (SPT) consisting of nine SPT karst soil group and seven SPT Volcanic group and one SPT in the form of body / body of water.

4. Classification of land in Ratatotok botanical garden area dominated by Inceptisol with an area of 197.35 ha, followed by Alfisol 167.09 han, Mollisol 38.42 ha. Entisol 34.59 ha. Subgroup categories include Typic Hapludalfs (SPT 4.5.8. and 16) with an area of 167.09 ha, followed by Typic Dystrudepts (SPT 9 and 14) with an area of 104.88 ha, Typic Eutrudepts (SPT 3 and 11) with an area of 56.08 ha, Typic Hapludolls (SPT 7 and 12), with an area of 38.42 ha, Lithic Udorthents (SPT 6 and 13) with an area of 29.55 ha, Lithic Dystrudepts (SPT 15) with an area of 18.66 ha, Lithic Eutrudepts (SPT 1 and 2) 15.73 ha and Typic Udorthents (SPT 10) of 5.04 ha.

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