Morphological, Physical, Chemical and Mineralogical Characteristics of *Dystrustepts* Soil with Natural and Plantation Forests in South Sulawesi, Indonesia

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Abstract. In general, forest land has a low fertility potential. The conversion of natural forest into plantation forest using fast growing species with similar age and composition will accelerate the decline of it's soil fertility. Tree species are one of the factors influencing the amount of nutrient accumulation in forest stand biomass as well as it's stand age. Nutrients immobilized in vegetation tend to increase along with the stands maturity and therefore the development of plantations might reduce the soil quality. The study indicates that soil structure and consistency under natural stands are better than those of plantation forest. However, bulk density of natural forest is high and similar between those two types of forest. Chemical characteristics of soil on leda stand is better than that of the natural forest and the best of all other stands. Only the N content which is higher in the natural stand than in any other stands in the plantation forest. The nutrient content of P, Ca, and Mg are higher in leda, whereas mangium has the highest content of K. Sengon has the least content of all observed nutrients. Orthoclase, Sanidine, Muscovite and Biotite that sources of K mineral whereas Hypersthene, Augite, Hornblende, Biotite that sources of Ca and Mg mineral. Besides that, Labradorite was also found as a source of Mg. The exception of Sanidine, the concentration of these minerals is so low that it is difficult to believe that it is a supplier of nutrients. Almost all nutrients for both types of forest are sourced from organic matter

INTRODUCTION

The establishment of fast growing timber estate in the tropics may result in the depletion of the natural resources not only biotic but also abiotic such as nutrient and soil fertility of the system. This is mainly due to high nutrient consumption in short intensive rotation of the plantation, leading to high nutrient export and nutrient cycle disruption of the system. There are evidences of soil nutrient mining in timber estate resulting in the low land productivity of the plantations at the consecutive rotations.

The study aims to evaluate and compare soil characteristics between plantation forest with fast growing species and secondary forest.

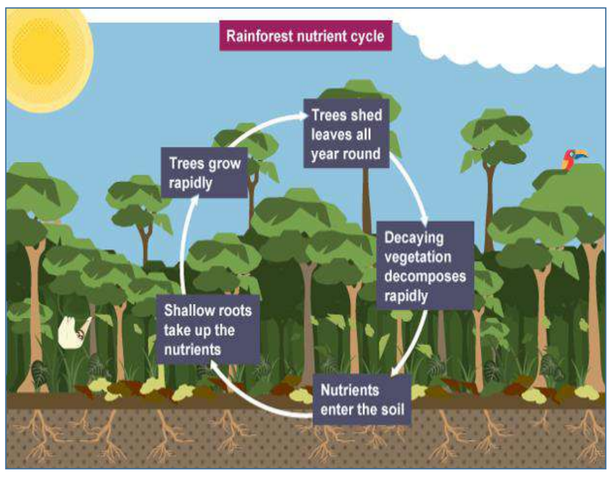


Fig. 1. Shematic Flow of Nutrients in Rainforest Ecosystem (Closed Nutrient Cycle System)

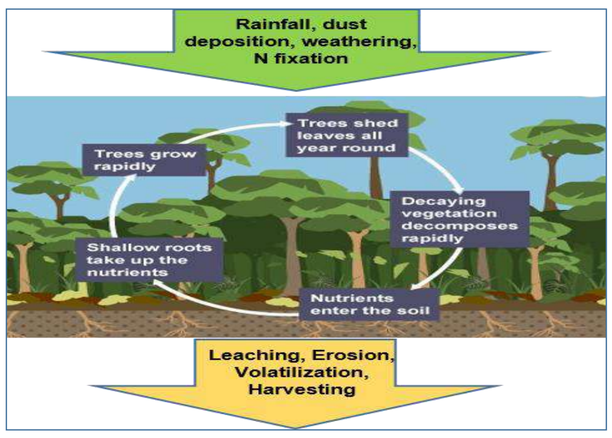
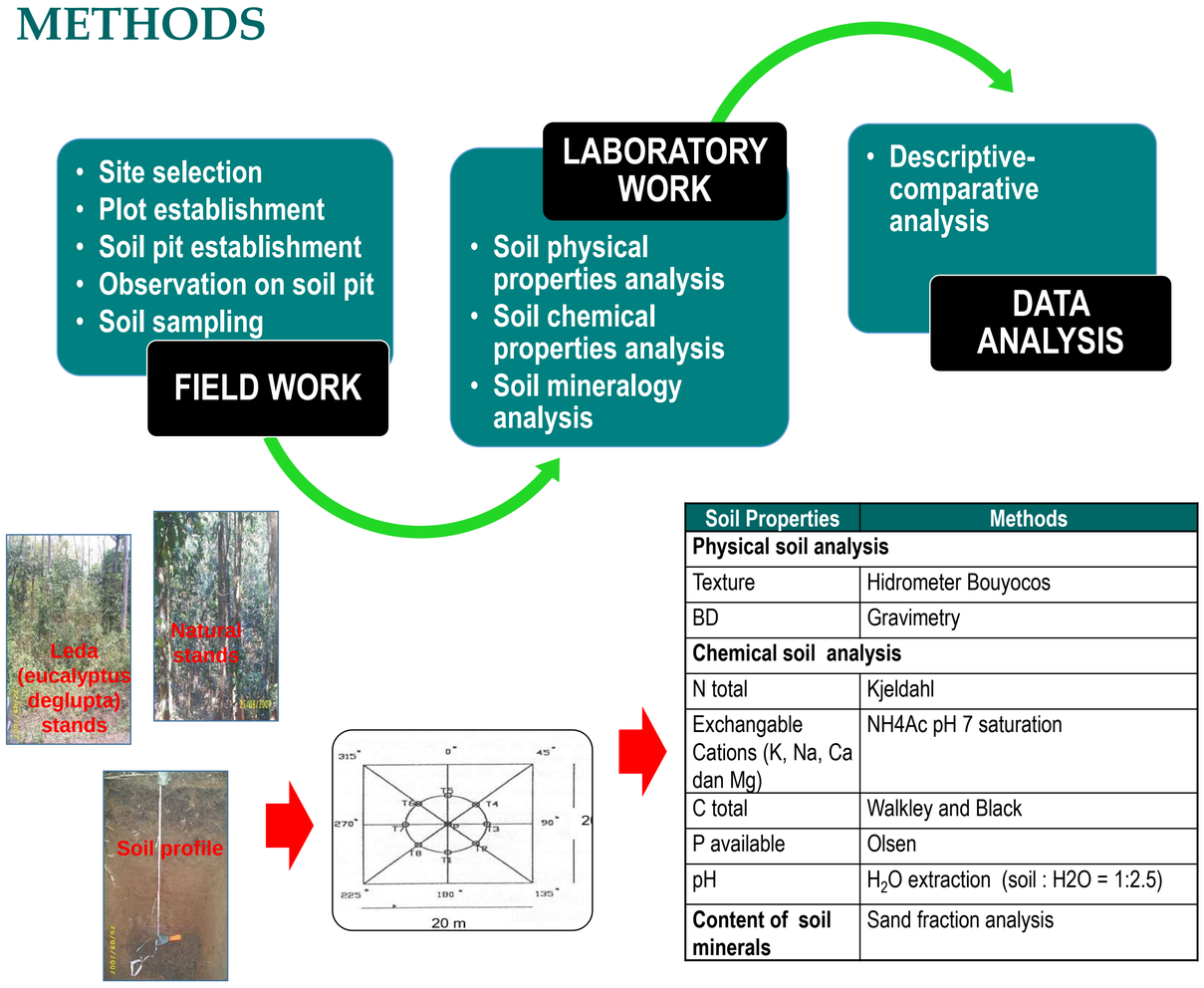


Fig. 2. Shematic Flow of Nutrients in Plantation Forests (Open Nutrient Cycle System)

METHODS



Soil Properties	Methods
Physical soil analysis	
Texture	Hidrometer Bouyocos
BD	Gravimetry
Chemical soil analysis	
N total	Kjeldahl
Exchangable Cations (K, Na, Ca dan Mg)	NH4Ac pH 7 saturation
C total	Walkley and Black
P available	Olsen
pH	H_2O extraction (soil : H2O = 1:2.5)
Content of soil minerals	Sand fraction analysis

Fig. 3. Procedure of Research

RESULTS AND DISCUSSION

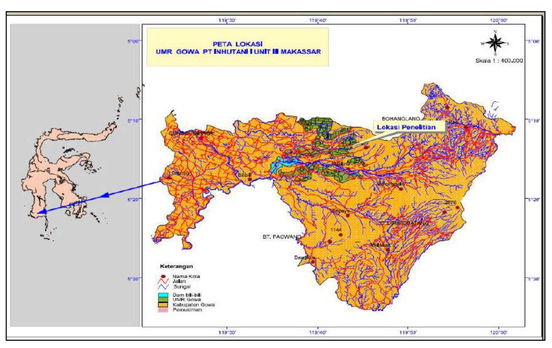


Fig.3. Study Area, Gowa, South Sulawesi

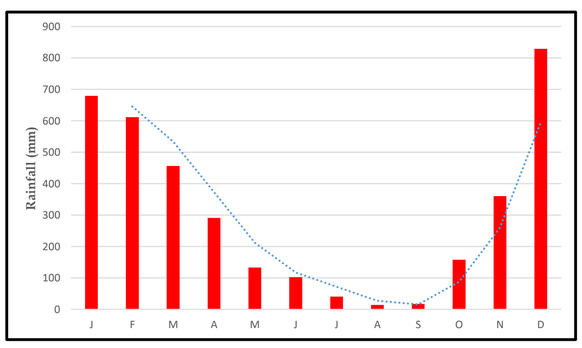


Fig. 4. Monthly Rainfall Distribution, Gowa, South Sulawesi

Morphological and physical properties of *Dystrustepts* of plantations and secondary forest

Soil Properties	Plantation Forest			Secondary Forest
	Mangium	Sengon	Leda	
Morphological Properties				
Soil depth (cm)	51	64	41	34
Efective soil depth (cm)	19	23	21	34
Structure	sab - ab	sab	cr - sab	g - sab
Consistency	f - fi	f – f	vf - fi	f - f
Phisical Properties				
BD	1.55	1.40	1.50	1.60
Texture	SiCL – SiL	SiC	SiC - SiCL	C

- There were slight differences in soil depth and soil effective depth among systems studied;
- The texture of soil under A. mangium plantations is coarser than the others;
- The difference in soil texture did not affect soil classification (*Lithic Dystrustepts*);
- The texture (clay content < 30 %) of soil under A. mangium plantation may support optimal condition for plant growth

Chemical and mineralogical properties of *Dystrustepts* of plantations and secondary forest

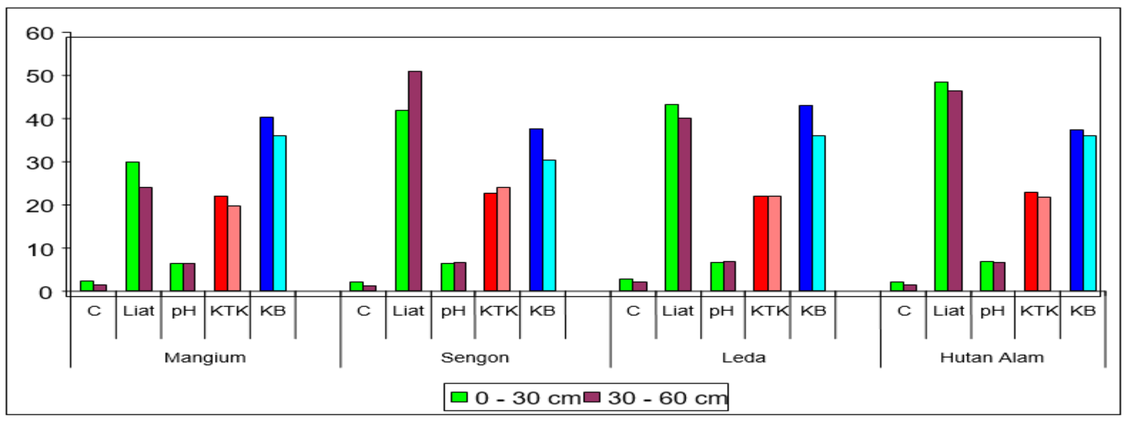


Fig. 5. Chemical properties of *Dystrusteps* of Plantations and Secaondary Forest, Gowa, South Sulawesi

Chemical characteristics of soil on leda stand is better than that of the natural forest and the best of all other stands. Only the N content which is higher in the natural stand than in any other stands in the plantation forest. The nutrient content of P, Ca, and Mg are higher in leda, whereas mangium has the highest content of K. Sengon has the least content of all observed nutrients

No	Fraction	Mangium		Sengon		Leda		Secondary Forest	
		M/PR/2	M/PR/3	S/PR/1	S/PR/2	E/PR/2	E/PR/3	HA/PR/1	HA/PR/2
1	Opaq	16	26	27	17	3	7	2	8
2	Quartz	-	sp	-	sp	sp	-	-	-
3	Iron Concretion	-	-	-	-	-	sp	-	
4	Limonite	-	sp	-	-	-	-	-	sp
5	SiO2 Organic	sp	sp	sp	-	sp	-	-	-
6	Hidrargilite	2	sp	sp	-	sp	-	-	-
7	Lapukan mineral	11	11	43	58	64	68	28	38
8	Volcanic glass	sp	sp	2	-	-	-	sp	sp
9	Labradorite	sp	sp	sp	-	-	-	sp	sp
10	Ortoclase	-	sp			1	-	-	sp
11	Sanidine	68	62	24	23	26	20	67	53
12	Muscovite	sp	1	-		-	-	-	-
13	Biotite	1	1	2	2	4	3	1	sp
14	Green Hornblende	-	-	-	-	sp	-	sp	-
15	Brown Hornblende	-	-	-	-	sp	-		
16	Augite	1	sp	1	-	sp	-	2	1
17	Hypersthene	-	-	sp	-	-	-	-	-
18	Garnet	sp	sp	-	-	2	2	-	sp
19	Epidote	sp	-	-	-		-	sp	sp
20	Andalusite	-	sp	-	-	-	-	-	-
21	Enstatite	1	-	sp	-	sp	-	sp	sp

There were 21 kind of minerals in the soil studied, varying in abandon ranging from < 1% to 68%;
Of those mineral found in the studied area, Sanidine represent the highest abandunce ranging from 20 % in leda plantations to 68 % in mangium plantations;
Base on the similarity of the presence of Sanidine and the presence of potassium in the studied area, it is most likely that the soil mineral contribute significant amount of potassium in the system

CONCLUDING REMARKS

- The study indicates that soil structure and consistency under natural stands are better than those of plantation forest. However, bulk density of natural forest is high and similar between those two types of forest;
- Chemical characteristics of soil on leda stand is better than that of the natural forest and the best of all other stands. Only the N content which is higher in the natural stand than in any other stands in the plantation forest. The nutrient content of P, Ca, and Mg are higher in leda, whereas mangium has the highest content of K. Sengon has the least content of all observed nutrients;
- Orthoclase, Sanidine, Muscovite and Biotite that sources of K mineral whereas Hypersthene, Augite, Hornblende, Biotite that sources of Ca and Mg mineral. Besides that, Labradorite was also found as a source of Mg. The exception of Sanidine, the concentration of these minerals is so low that it is difficult to believe that it is a supplier of nutrients.;
- Almost all nutrients for both types of forest are sourced from organic matter