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Soil Chemical Properties and Microbial Biomass Respond during Land Use Change

Soil Chemical Properties and Microbial Biomass Respond during Land Use Change

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Abstract. In Ponorogo, East Java, Indonesia, pine-based agroforestry was mostly converted to sengon-based agroforestry before partly converted to monoculture. Land-use changes during the process affect soil properties. There is few information about the effects of land-use changes from pine-based agroforestry systems to sengon-based agroforestry systems and monocultures on soil chemical properties and microbial biomass. The aims of this study were to analyze the response of soil chemical properties and microbial biomass to land use changes in latosol Indonesian. Samples from three land-use changes, i. e. pine-based agroforestry, sengon-based agroforestry and monoculture were analyzed. Soil samples were taken at 2 depths, i. e. 0-30 cm and 30-60 cm. As the results, it was found that the land-use change affected the chemical properties and microbial biomass of the soil. Land-used change from pine-based agroforestry to sengon-based agroforestry have no significant effect on pH, organic carbon, available P, and microbial biomass in 0-30 cm depth. Meanwhile, in 30-60 cmdepth, microbial biomass in sengon-based agroforetry was higher than that in pine-based agroforestry. The pine-based agroforestry which was converted into monoculture, reduced the soil organic carbon and available P concentration, contrast with the soil microbial biomass which was increased in 0-30 cm depth. The highest soil microbial biomass was found in sengon-based agroforestry in 30-60 cm depth. The conclusion of this study implicated that land use in monoculture decreased soil fertility. Therefore, conversion of pine-based agroforestry to monoculture is full of risks.

Key words: Soil chemical, microbial, land-use

1. Introduction

Pine agroforestry systems have been developed in East Java, especially areas that have an altitude above 800 m above sea level. Pine plants can contribute organic carbon to the soil through leaves and roots. The amount of organic carbon donated to the soil depends on the age of the pine, the older the pine, the greater the organic carbon given to the soil [1,2]. Pine plants can affect the chemical and biological properties of the soil [3]. Pine plants besides being able to be planted in monoculture, they can also be planted in agroforestry. The problem with pine-based agroforestry was that it takes too long to harvest pine trees, which wass more than 10 years. An alternative to pine plants was sengon, with the advantage of relatively shorter harvest times compared to pine.

Sengon is a legume that grows very fast. This was related to the ability of sengon which can be in symbiosis with rhizobium. Rhizobium in symbiosis with rhizobium plays a role in remembering N from the air [4]. Rhizobium bacteria can donate nitrogen to sengon plants. The very fast growth of sengon was beneficial in donating organic carbon to the soil. Sengon plant leaves that fall to the ground and rotting roots are a source of organic carbon in the soil [5].

Pine-based agroforestry land in addition to being converted into segon-based agroforestry land, there was also conversion to monoculture land. Monoculture lands have different management management from agroforestry systems. In monoculture land, the input of organic matter depends on the amount of organic fertilizer applied to the soil. The quality of organic fertilizer depends on the source of organic matter and its quality. The quality of organic fertilizers can be determined based on the C/N ratio [6]. The quality of organic fertilizer can determine the addition of organic carbon into the soil.

Changes in organic carbon from pine-based agroforestry systems to sengon agroforestry and monocultures have the potential to affect soil chemical properties and microbial biomass. Microbial biomass in agroforestry systems was influenced by the type of annual plant. Microbial biomass in Acaci-based agroforestry >Populus-based agroforestry > Eucalyptus-based agroforestry in alkaline soils of India [7]. The availability of scientific articles that discuss changes in organic carbon due to land conversion was very limited. This study aims to examine changes in soil chemical properties and microbial biomass due to changes in land use. This information was useful for assessing the impact of land use change

2. Materials and Methods

2.1. Sampling

The research was conducted in Mrayan Village, Ngrayun District, Ponorogo Regency, East Java, Indonesia. Samples in the form of soil will be taken randomly from the rhizosphere of porang plants in agroforestry systems (pine and sengon) and monoculture. Each sampling site was repeated randomly for 3 replications. For each replication, 5 sub samples were taken randomly, so that the number of sub samples taken was 3 x 3 x 5 = 45 sub samples. Soil samples were taken at a depth of 0-30 cm and 30-60 cm. Sub samples for each planting and the same replication were composited. The composite results were taken 2 kg of soil and divided into 2 parts, each 1 kg. One part was put in a paper bag and stored at room temperature prior to soil chemical analysis. Another part was put into a paper bag and stored in the refrigerator for analysis of soil microbial biomass. Soil analysis and microbial biomass were carried out at the Agrotechnology Laboratory, university of Darussalam Gontor.

2.2. Soil chemical analysis.

Soil chemical analysis will be carried out on ground samples with a size of < 2 mm. Organic C analysis was carried out by the Black and Walkey method [8]. Available P analysis was using the Olsen method [9]. Soil pH was determined with water solvent (1:5).

2.3. Microbial biomass analysis.

Microbial biomass analysis was carried out using the fumigation method [10]. Microbial biomass was determined by calculating the difference in organic carbon content between after fumigation and before fumigation, then the result was converted into microbial biomass by multiplying by 0.35.

2.4. Statistical analysis

Data analysis will be carried out using one-way analysis of variance (ANOVA) using the SPSS program. LSD (Student's t lest significant difference) analysis was used to compare between treatments.

3. Results and Discussions

3.1. Soil chemical properties

At a depth of 0-30 cm, it was found that sengon-based agroforestry had no different organic pH and organic carbon compared to pine-based agroforestry and monocultures. The average soil pH was 6.28-6.81, while the average soil organic C is 1.29-1.49%. AvailableP in agroforestry systems were higher than in monocultures (Table 1). In pine-based agroforestry and sengon can contribute organic carbon into the soil through leaf fall in the top layer of soil. Leaves that have touched the ground will decompose to produce organic P and organic acids. Organic acids were able to release P which is bound by the soil so that the available P content increases. This situation supports the research of Wang et al. [6] which states that agroforestry lands have higher available P levels compared to monocultures.

Table 1. Soil chemical properties

	Pine-based agroforestry	Sengon-based agroforestry	Monoculture
Depth: 0-30 cm			
pH	6,28±0,56 a	6,81±0,34 a	6,35±0,04 a
Organic Carbon (%)	1,41±0,33 a	1,49±0,09 a	1,29±0,09 a
Available P (ppm)	24,43±1,23 b	28,11±4,61 b	13,64±1,72 a
Depth: 30-60 cm			
pH	5,19±0,83 a	6,31±0,39 b	5,31±0,47 a
Organic Carbon (%)	0,54±0,19 b	0,56±0,07 b	0,49±0,20 a
Available P (ppm)	24,35±0,62 b	23,89±0,38 b	13,50±0,87 a

Data followed by the same letter in the same colum were not significantly different based on the 5% LSD test

At a depth of 30-60 cm, it was found that soil pH in sengon-based agroforestry was higher (21.57%) than pine-based agroforestry (5.19). Sengon was a legume plant that contains many nutrients including calcium which can increase soil pH. Organic matter that has a C/N of 27 can increase soil pH higher than organic matter that has a C/N of 15 [6]. The monoculture system had a lower pH (15.85%) than sengon-based agroforestry system (6.31). In monoculture land, the addition of organic matter was relatively small compared to agroforestry systems. Decomposition of organic matter will increase soil pH. Organic matter can increase pH in Typic Paleudalf soil [11].

There was not significant difference between organic carbon levels in agroforestry systems. The average organic carbon in agroforestry systems is 0.54-0.56%. This was related to the contribution of plant roots to soil organic carbon. Roots that have rotted will provide organic carbon input into the soil. In addition, with active plant roots, soil microbes will develop better. Dead microbes were a source of organic carbon in the soil. The monoculture system had lower organic C (9.26% and 12.50%) than the pine-based agroforestry (0.54%) and sengon-based agroforestry (0.56%). In monoculture porang plants, plant roots will focus at a depth of 0-30 cm, a few reach a depth of 30-60 cm. Coffee agroforestry systems have a much higher SOC than monocrop coffee [12]. Likewise, Hergoualc'h et al. [13] found that coffee agroforestry systems with leguminous tree species had higher soil organic carbon than monoculture coffee.

Pine-based agroforestry land had higher available P (44.91%) compared to porang land in monoculture (13.50 ppm). The highest available P levels were in the Pine-based agroforestry area and the lowest was in the monoculture system (Table 1). The pine plant has the characteristics of leaves that contain a lot of lignin so that pine leaves were difficult to decompose. In organic matter that was difficult to decompose, the decomposition product is in the form of low nutrients but produces organic acids that were able to release P which was absorbed by the soil so that it becomes available P in the soil. The increase in total soil organic carbon due to the addition of organic matter can increase the available P in Xerofluvent [14]. This fact was different from Emiru and Gebrekidan [15] which stated that the decrease in soil organic carbon was not followed by a decrease in available P in soil in Senbat Watershed, Western Ethiopia.

3.2. Microbial biomass

At a depth of 0-30 cm, microbial biomass in sengon-based agroforestry was higher than pine-based agroforestry (Figure 1). This is related to the source of energy and nutrients needed by soil microbes. Pine leaves have different characteristics from sengon leaves. Sengon leaves contain better nutrients than pine leaves so that the development of microbes is higher. Microbial biomass in agroforestry systems depends on the type of annual crop. Ficus hookerii-based agroforestry (801 mg kg) was higher than Terminalia myriocarpa-based agroforestry (790 mg kg) [16].

Monoculture system had higher microbial biomass than sengon-based agroforestry and pine-based agroforestry (Figure 1). This result is different from the results of research by Lepcha et al. [17], that Cardamom-based agroforestry has higher microbial biomass than rice plants in monoculture. This occurs due to differences in the input of organic matter into the soil. Microbial biomass is related to the concentration of nutrients in the soil. Microbial biomass is more determined by the concentration of N than P [18]

At a depth of 30-60 cm, sengon-based agroforestry systems were not different from pine-based agroforestry. This means that the root system of the two types of plants has not effect on soil microbial biomass. Monoculture systems have lower microbial biomass than sengon-based agroforestry. Porang plants grown in monoculture have shallow roots so that the contribution of organic matter from the roots was low at a depth of 30-60 cm.

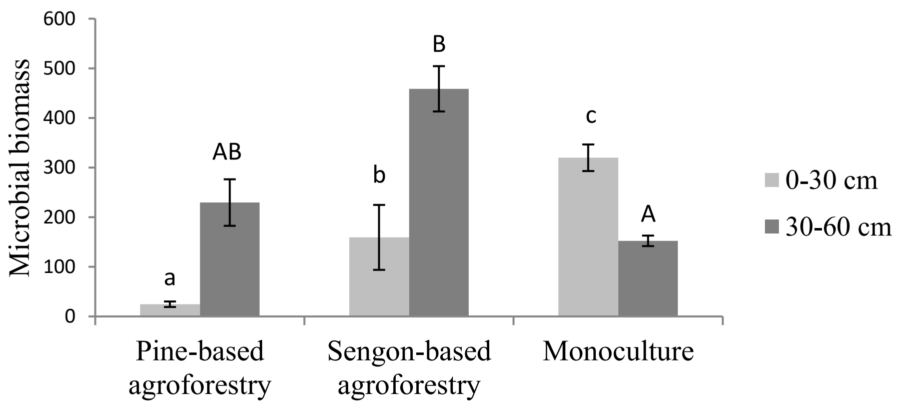

Figure 1. Microbial biomass

3.3. Correlation soil chemical properties and microbial biomass

At a depth of 0-30 cm, microbial biomass was negatively correlated with available soil P (Table 2). Microbial biomass increases with decreasing soil available P. This result was in line with the research by Fujita et al. [18] which revealed that microbial biomass was negatively correlated with soil available P. However, these results differ from those of Lepcha et al [17], in that microbial biomass was positively correlated with soil P available in the Eastern Himalayas. Furthermore, Tan et al. [19] stated that microbial biomass was positively correlated with available P in Boreal Aspen Forest soil.

Table 2. Correlation soil chemical properties and microbial biomass

	pH	**Microbial biomass**	**Organic Carbon**	**Available P**
Depth 0-30 cm				
pH	1	-.052	.837**	.466
Microbial biomass	-.052	1	-.306	-.776*
Organic Carbon	.837**	-.306	1	.465
Available P	.466	-.776*	.465	1
Depth 30-60 cm				
pH	1	.613	.001	.333
Microbial biomass	.613	1	.287	.644
Organic Carbon	.001	.287	1	.780*
Available P	.333	.644	.780*	1

Soil pH was positively correlated with soil organic carbon (Table 2). Soil pH increases with increasing soil organic carbon. This was in line with Kaiser et al. [20] that soil pH was positively correlated with soil organic carbon. Soil pH was positively correlated with soil organic carbon in European agricultural soils [21].

Meanwhile, at a depth of 30-60 cm, soil organic carbon was positively correlated with available P (Table 2). Increased organic carbon levels will cause available P to increase as well. Organic carbon was positively correlated with soil available P in Ultisol soils in Owerri, Southeastern [22].

4. Conclusions

Land use change affected the chemical properties and microbial biomass of the soil. Changes from agroforestry to monoculture decreased available P, in depth 0-30 cm and decreased available P and organic Cin depth 30-60 cm. Changes from pine-based agroforestry to monoculture caused microbial biomass increase in depth 0-30 cm. Pine-based agroforestry converted to sengon-based agroforestry can be increased pH in depth 30-60 cm and microbial biomass in depth 0-30 cm. Results of this study implicated that monoculture agricultural land use was worse than sengon-based agroforestry.

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References

[1] Cheng X, Han H, Kang F, Song Y& Liu K 2013 *Journal of Plant Interactions* **9** 521–528.
[2] Helmisaari HS, Makkonen K, Valtonen E, Kellomaki S, Malkonen F 2002 *Forest Ecology and Management* **165** 317–326.
[3] Mosculo A, Sidari M, Mercurio R 2007 *Forest Ecology and Management* **242** 412-418.
[4] Wedhastri S, Prahastiwi Y, Widada J, Widianto D and Kabirun S 2013 *Journal of Biotechnology* **18** 64-69.
[5] Agus C, Putra PB, Faridah E, Wulandari D& Napitupulu RRP 2016 *Procedia Engineering*, 159329–337.
[6] Wang L, Li Y, Prashe SO, Yan B, Ou Y, Cui H & Cui Y 2019 *Bioresource Technology* **289** 121745.
[7] Kaur B, Gupta SR & Singh G 2000 *Applied Soil Ecology* **15** 283–294.
[8] Walkey A and Black IA 1934 *Soil Sci.* 3739-28.
[9] Olsen SR, Cole CV, Watanabe FS and Dean LA 1954 Estimation of available phosphorus in soils by extraction with sodium bicarbonate. US Dept Agric Circ, pp. 939.
[10] Vance ED, Brookes PC andJenkinson DS 1987 *Soil Biology and Biochemistry* **19** 703 – 707.
[11] Pietri AJC & Brookes PC 2008 *Soil Biology and Biochemistry* **40** 1856–1861.
[12] Tumwebaze SB, Byakagaba P 2016 *Agriculture, Ecosystems and Environment* **216** 188–193
[13] Hergoualc'h K, Blanchart E, Skiba U, Hénault C, Harmand JM 2012 *Agric. Ecosyst. Environ.* **148** 102–110.
[14] Melero S, Porras JCR, Herencia JF & Madejon E 2006 *Soil and Tillage Research* **90** 162–170.
[15] Emiru N and Gebrekidan H 2013 *ARPN Journal of Agricultural and Biological Science* **8** 206-212.
[16] Singh M, Das SK and Avasthe RK *Indian J. of Agroforestry* **20** 25-29.
[17] Lepcha NT, Devi NB 2020 *Ecol Process* **9** 10-14.
[18] Fujita K, Miyabara Y& Kunito T 2019 *European Journal of Soil Biology* **91** 1–8.
[19] Tan X, Chang S& Kabbzem R 2008 *BiolFertil Soil* **44** 471-479.
[20] Kaiser EA, Mueller T, Joergensen RG, Insam H& Heinemeyer*Soil Biology and Biochemistry* **24** 675–683.
[21] Xu H & Zhang C 2020 *Science of The Total Environment* **14** 1-11.
[22] Okon MA, Osuji GE, Uzoho BU, Ahukaemere CM 2014 *International Journal of Research in Agriculture and Forestry* **1** 18-22.

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