Analysis of Biomass Content of Bottom Plants and Biomass Litter on Agroforestry Land with Slash and Buring System

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A R T I C L E   I N F O

A B S T R A C T

In this land use, humans act as ecosystem regulators, namely by getting rid of components that he considers useless or by developing features that are expected to support their land use (Mather, 1986; Gandasasmita, 2018), which is a residue and others that can increase soil fertility levels such as soil organic matter, biomass, and necromass. This study aims to measure the biomass content of lower plants and litter biomass on agroforestry land with a slash and burn system. Before and after the combustion process, the ten soil samples showed more C-organic content before the combustion treatment, with a total C-organic of 8.16% - 7.8% = 0.36% C-organic released. The organic matter available before burning is more when compared to after burning, which is 14.05% - 13.43% = 0.62% of the organic matter released. Biomass litter contained wet weight 2500g – 3910g dry weight = -1410 grams of carbon emitted.

Introduction

Almost all land in Indonesia has initially been a Virgin Forest that humans gradually converted into other forms of land use such as settlements and yards, agriculture, gardens and plantations, production forests or industrial crops, and others to reduce the fertility rate on existing land.

Instead of forest land, agricultural land is realized to cause many problems such as decreased soil fertility, erosion, extinction of flora and fauna, floods, droughts, and even changes in the global environment. This problem increases in weight over time in line with the increasing forest area converted into other business land. In this land use, humans act as ecosystem regulators, namely by getting rid of components that he considers useless or by developing features that are expected to support their land use (Gandasasmita, 2001) which is a residue and others that can increase soil fertility levels such as soil organic matter, biomass, and necromass (FWI, 2009; Lal, 2004).

The existence of soil organic matter is needed related to the ability to provide crop production, as stated by several experts (Anas, 2016): the power of soil to produce biomass is directly related to the content of organic matter (Soepardi, 1983). (Ariani et al., 2014; Seybold et al., 2005) stated that without organic matter, all biochemical activities, including the breakdown of fertilizer nutrients, would be stopped, and (Anas, 2016) stated that organic matter is the life of the soil.

Agroforestry is one of the land management systems that may be offered to overcome problems arising from the existence of land use mentioned above and, at the same time, also to overcome the problem of nutrients in a land (Franzluebbers, 2010). Concerning farming that uses land clearing patterns with slash and burns methods, agriculture has become a highlight of the fragility of the lending power of acidic mineral soils in Indonesia. Former plantation land is moving into unproductive territory, and even land-use pressures that no longer follow a long cycle cause former plantation land to move into critical land (Hairiah et al., 2011).

In the land clearing system by slash and burn, farmers usually pass on the habit of burning wood and branches of land clearing by burning the remaining crops. If burning is done only once, the time of land clearing will not damage the soil much, but burning done repeatedly every season will quickly reduce soil organic matter, which eventually reduces soil productivity. Burning the remains of plants every year will speed up the process of washing and impoverishing the soil. Plummeting levels of soil organic matter will worsen the physical and chemical properties of the ground (Hartati et al., 2017; KLHK, 2015). The structure of the land becomes unstable. When there is rain, the blow of rain grains will quickly destroy the soil aggregate, and fine soil particles will fill the pore space. The filling of pore space by soil particles leads to a decrease in soil infiltration capacity and increases surface flow, and accelerates the rate of soil erosion (Lal, 2004). The loss of the top layer of soil due to erosion causes land productivity to decrease, and because there will be horizon B, whose organic matter content is low, the ground will degrade. According

to (Bronick & Lal, 2005), the transfer trade (Slash and Burn) is the wrong land management system because it exploits its natural resources.

Materials and Methods

Time and Place

The research was conducted in the agroforestry area of Teluk Dore Village, Malumkarta District, Sorong Regency, and at Laboratotium Tanah Institut Petanian Bogor (IPB). This study was conducted for three months, from June - to November 2021.

Tools and Materials

The tools and materials used in this study were samples of soil biomass, litter (necromass), and undergrowth biomass on agroforestry land. Research Tools The equipment used in this research are Knife or Grass Scissors, a Permanent marker, a Hoe, Cement sacks and paper bags weighing 10 kg, an Electric Oven, Pegs to mark plot boundaries, a Digital camera to document activities in the field, Writing utensils and observation forms, Sieve with a hole size of 2 mm, Meter tape.

Research Methods

Field Observation

Field observations are conducted to obtain information about agroforestry land cultivated by the surrounding community. In addition, it also aims to find out whether or not this research is carried out on agroforestry land.

Sample Plot Creation

The creation of a sample plot is in the form of a measuring scheme that was previously determined in advance based on the land condition in the field. The sample plot size for measuring soil organic matter and biomass litter on agroforestry land is 5 m × 40 m. Plots are made rectangular, while soil sampling and biomass litter are made subplots measuring 1 m × 1 m as much as five subplots, i.e., four in the direction of the wind or each corner and one in the middle.

Inventory

After determining and creating the Sample Plot, an inventory is carried out to get data and information to fulfil the stand according to the state in the field according to the stratum of plants (seedlings, stakes, poles, and trees) on the sample plot.
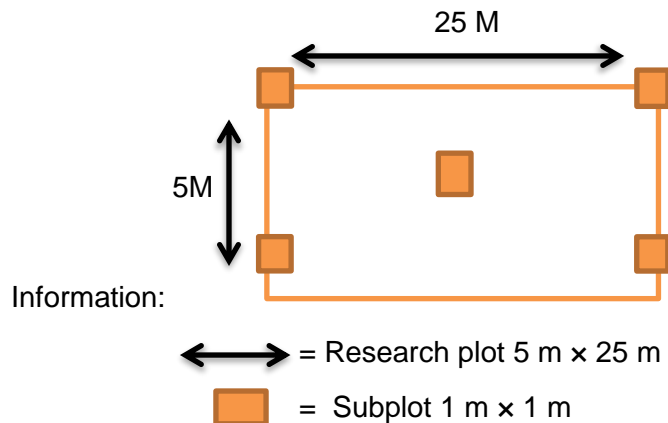
25 M

5M

Information:

= Research plot 5 m × 25 m

= Subplot 1 m × 1 m

Figure 1. Research Plot Design

Bottom plant and litter sampling

The lower plants and litter above ground level in subtypes of 1 m × 1 m were taken with a sample weight of 500 g and weighed to find out the wet weight (BB). After that, the bottom plant and the litter are put in a paper media in the oven at 800 for 48 hours to determine the dry weight. Data on each component of the plant below and litter per plot is calculated by the formula (Hairiah et al., 2011):

W Total (g) = $=\frac{sub-sample\ DW\ (g)}{Sub-sample\ WW\ (g)} \times WW\ Total\ (g)$

Where:

WW = Wet weight; DW = Dry weight

Soil Sampling

Soil sampling is carried out at three levels of depth, namely 0-10 cm, 10-20 cm, and 20-30 cm. Soil samples analyzed in the laboratory sample disturbed soil (composite) are taken from 5 points of each subplot. Examples of soil taken in this way are used to analyze C-Organic and organic matter content. All three samples of soil are put into plastic buckets and mixed evenly. Take, for example, the mixed soil is about 1 kg. When it arrives at the laboratory, the wind dredges the ground. After dry mashing and sifting with a sieve measuring 2 mm, take the soil that escapes the sieve and is ready to be analyzed in the laboratory.

a). C-Organic can be calculated by (Walkley and Black Method):

$$\% \text{ C-org} = \frac{(me\ K2Cr2O7 - me\ FeSO4) \times 0,003 \times F}{ADW} \times 100\%$$

Description: f = 1,33 > C oxidized 77% = 100/77 = 1,30; me = N × V; N = Normality; V = Volume; ADW = absolute dry weight 105 degrees Celsius; 0,003 = oxidized Cr valuation = 3 × 0,001 (mg to grams); %B – Organic = % C organic × 1,724

Results And Discussion

In this study, Results of C-Carbon Analysis and Calculation of Organic Matter, based on the results of the analysis that has been done with the Walkley and Black approach, C-organic is produced as follows:

Table 1. Calculation results of % C-organic using Walkley and Black Formula

Sample Weight	Field number	Walkley & Black C-Org (%)
250 g	A1	1.51
250 g	A2	1.67
250 g	A3	1.83
250 g	A4	1.60
250 g	A5	1.55
Total		**8.16%**
250 g	B1	1.51
250 g	B2	1.75
250 g	B3	1.51
250 g	B4	1.51
250 g	B5	1.52
Total		**7.8%**

Description: A1 – A5: No room before burning, B1 – B5: Airy, no after burning

Table 2. Calculation results % Organic matter

Sample weight (g)	Field number	Walkley & Black C-Organic (%)	Organic matter (%)
250	A1	1.51	2.60
250	A2	1.67	2.88
250	A3	1.83	3.15
250	A4	1.60	2.75
250	A5	1.55	2.67
Total		**8.16%**	**14.05%**
250	B1	1.51	2.60
250	B2	1.75	3.02
250	B3	1.51	2.60
250	B4	1.51	2.60
250	B5	1.52	2.61
Total		**7.8%**	**13.43%**

Table 3. Calculation of Waste Biomass

Example Sample (g)	Field number	Wet weight ...(g)...	Dry weight ...(g)...
500	A1	**500 g**	**785 g**
500	A2	**500 g**	775 g
500	A3	**500 g**	790 g
500	A4	**500 g**	775 g
500	A5	**500 g**	785 g
Total		**2500 g**	**3910 g**

Table 3, based on the results of the C-organic percent calculation, the amount of carbon can be determined regardless of the combustion process, namely 8.16% – 7.8% = 0.36. This means that soil that has not been burned has more organic carbon potential when compared to the slash and burn process. Table 3 shows the calculation results of the percent of organic matter. The calculation of the percent of organic matter can determine that the amount of organic matter in the soil is more significant, namely 14.05% - 13.43% = 0.62%. Organic matter in incendiary waste, namely ash, did not significantly impact plant growth rates.

Table 4 shows the results of calculating the wet weight of the litter biomass and its dry weight. In the calculation of biomass litter that has been produced, the process of carbon release by biomass and litter makes a difference in wet weight and dry weight, namely wet weight 2500 g - 3910 dry weight = -1410 grams, meaning the soil experiences a carbon reduction from litter biomass by 1410 grams. Biomass and litter are two critical indicators in the decomposition process assisted by the micro-organization for the plant growth process.

Farmers mainly use slash and burn techniques because it is considered cheaper, faster, and more practical than the no-burn method. In addition, the community still assesses that the remaining burning ash can increase soil fertility. Instead of forest land, agricultural land is realized to cause many problems such as decreased soil fertility, erosion, extinction of flora and fauna, floods, droughts, and even changes in the global environment.

The existence of soil organic matter is needed related to the ability to provide crop production, as stated by some experts (Anas, 2016): the power of the soil to produce biomass is directly related to the level of organic matter (Soepardi, 1983). (Kusumarini et al., 2020) stated that without organic matter, all biochemical activities, including fertilizer nutrients, would be stopped, and (Anas, 2016) stated that organic matter is the life of the soil. This is proven when looking at the results obtained from the comparison of soil that has not been burned and after being burned and the amount of waste biomass lost in the combustion process. The amount of carbon released is relatively large, and organic matter is degraded due to combustion.

Land clearing with a slash-and-burn system on dry land and biomass burning will affect some environmental parameters. Temporary changes include the addition of a considerable amount of plant nutrients, an increase in pH and saturation of bases, uneven distribution of soil nutrient content due to re-combustion, re-burning of previously burned branches and stems, dehydration of soil colloids due to high temperatures by combustion, decreased activity of soil microorganisms due to sterilization by burning thereby lowering the population of soil microorganism (Nofrianto et al., 2018).

Organic matter derived from plant residues contains various nutrients that plants can reuse if they have undergone decomposition and mineralization. The rest of this plant has a nutrient content that differs in quality depending on the level of ease of decay and mineralization. Plants can reuse nutrients in the rest of the new plant material if they have undergone decomposition and mineralization. If the land is burned, there will be degradation of organic matter derived from plant residues because it is burned out. The burning of organic matter affects the growth rate of plants (Widyasari et al., 2010).

The provision of organic matter into the soil has a good impact on the soil where plants grow. Plants will give a positive response if the place where the plant grows provides suitable conditions for its growth and development. Organic matter added to the soil provides plant-growing regulatory substances that benefit plant growth, such as vitamins, amino acids, auxins, and gibberellins formed through the decomposition of organic matter (Franzluebbers, 2010).

Organic matter added to the soil is high in carbon. Regulating the amount of carbon in the soil increases crop productivity and the sustainability of plant life because it can increase soil fertility and efficient nutrient use.

Conclusion

Ten soil samples taken before and after the combustion process showed more outstanding C-organic content contained in the soil before the combustion treatment with a total C-organic of 8.16% - 7.8% = 0.36% C-organic released Organic matter available before burning is more when compared to after burning, namely 14.05% - 13.43% = 0.62% of released organic matter. Biomass litter contained wet weight 2500g – 3910g dry weight = -1410 grams of carbon released.

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