Leaf litter production of mahogany along street and campus forest of Universitas Negeri Semarang, Indonesia

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Abstract. The leaf litter of trees along the existing streets on campus UNNES if not managed properly will be scattered and become garbage. Leaf litter Production in UNNES campus is not known for certain. Mapping of leaf litter Production of dominant tree species on campus are not owned by UNNES. This cause leaf waste management is not optimal yet. There is still a lot of leaf litter that is discharged (not processed) because it exceeds the capacity of the fertilizer production equipment in the compost house. Aims of this study were to examine leaf litter production of dominant trees in Universitas Negeri Semarang and evaluate relationship between leaf litter and average rainfall. Purposive sampling method placed pouches of nylon gauze measuring 1 x 1 mm² as litter trap container with size 1 x 1 m² (10 points mounted along street and campus forest). Litter trap mounted at a height of 50 cm above ground level. Leaf litter will be taken once a week for three months to observe the litter production. The litter were then dried by oven at 70 ° C for 48 hours to obtain constant dry weight. Based on the results of the research, it was known that Mahogany tree in UNNES campus area has the potential to produce litter of about 10 ton / ha / 3 months in campus forest area and 2.5 ton / ha / 3 months along campus street. There is a significant relationship between litter production of Mahogany leaves and precipitation during August - October 2017.

1. Introduction

The UNNES conservation-based campus is implemented through seven pillars. Biodiversity is one of the pillar. The pillar is implemented by protecting, preserving, utilizing, and developing wisely and sustainably on environment, flora, and fauna in UNNES and surrounding areas.

The numerous and varied trees on the UNNES campus also cause problems when leaf litter (litter) is not managed properly. The leaf litter of trees along the street on the campus UNNES if not properly treated will be scattered and become garbage disrupting the beauty of the campus environment. Campus will be impressed slum and scary. In addition, if large rains come, then the garbage can cover the flow of water along the gutter.

Composting of leaf litter is one form of leaf waste management which has been done by UNNES. This activity can increase the value of leaf waste into more useful products. But it is unfortunate potential leaf litter production produced (litter) on campus UNNES not known for sure. Production mapping of tree species on campus are not owned by UNNES. This cause leaf waste management is not optimal yet. There is still a lot of leaf litter that is discharged (not processed) because it exceeds the capacity of compost fertilizer production. In addition, the failure in composting also occurs because so far there has been no sorting of leaf waste according to the existing tree species on the
campus of UNNES. Therefore, mapping of leaf litter production inside campus of Universitas Negeri Semarang is very important to consider leaf waste management.

Litter production is a part of vegetative and reproductive strains caused by age (due to aging), stress, mechanical factors (e.g., wind), or a combination of several factors and death and damage from whole plants by climate such as rain and wind [1]. The most commonly used meaning of litter production is the dead matter weights fall in the unit of surface area and at a certain period of time [2]. The tree produces a lot of litter and has an important role in maintaining the level of soil fertility. Mostly, litter consists of plant material that has been dead and found on the soil surface [3].

Ecologically, the litter layer is a major component of terrestrial ecosystems become the source of soil organic matter and as a place of soil biological processes such as decomposition and the commencement of nutrient cycles. Evaluation about litter production is very important in understanding the nutrient cycle, growth forests, and interactions with environmental factors in forest ecosystems [4]. Litter can contribute a significant role in nutrient cycling and primary productivity in any cropland agro forest ecosystem [5].

2. Methods

2.1. Location and time of study
The study was conducted on the campus of Universitas Negeri Semarang (UNNES) which was divided into two groups of observation areas consisting of street and campus forest area. The result of preliminary observation was used to place the litter trap purposively in the three areas according to the dominant plant species. Harvesting of leaf litter was done for three months (August - October 2017).

2.2 Data collection procedures
Each location dominated by Mahogany tree will be placed 5 pieces of litter trap (total 10 litter traps). Litter traps were placed under the canopy of trees. Litter trap is the sac of nylon mesh (size 1 x 1 mm²) as container of litter with size 1 x 1 m². Litter traps are installed using paralon at a height of 50 cm above ground level to avoid contamination with soil and other animals [6].

Leaf litter will be taken once a week for three months to study the resulting litter production. The litter is accommodated in a plastic bag (zipper plastic) and labeled. Then the leaf litter was taken to the laboratory to be cleaned and put into the dryer oven for 48 hours at 70°C. The dry litter is weighed by a scales instrument with a precision of 0.01 gr [7].

Environmental factor data in the form of daily rainfall taken by weekly average value during August - October 2017. Data obtained from weather station owned by Meteorology, Climatology and Geophysics Agency (BMKG) for Gunungpati region.

2.3. Data Analysis
a. The differences in litter production for three months was assessed using one-way ANOVA, followed by Tukey's HSD test if there were significant differences.
b. To assess whether leaf litter production in the campus forest is higher than along the street, a one-tailed t-test was performed at a 95% confidence level.
c. Correlation analysis was conducted to assess the relation between rainfall and weekly litter production during 3 months sampling.

3. Results and discussion

3.1. Leaf Litter Production
Mahogany (*Swietenia macrophylla* King), a tropical timber tree species with high-quality wood, has been cultivated in Indonesia. *S. macrophylla* is another famous member of the Meliaceae family besides *Azadirachta indica*. Mahogany has great potential applications, such as the protection of slopes, water catchment, avenue, furniture and cabinet making, and compost fertilizer [8].

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Central Java and West Java have contributed as much as 60% of the total number of mahogany trees in Indonesia, and have produced abundant leaf litter that has not been maximally used [9]. Mahogany selected by UNNES as a greening plant in the campus environment. The selection of this type is because Mahogany is one of the plant resource acquisition plant species that is able to grow faster than other types of hard plants. Mahogany is also able to adapt to changes in environmental factors well, for example by aborting the leaves and peel of peeling bark as a form of adaptation when the lack of water.

The phenomenon of adaptation is very interesting to investigate further, one of which is the shedding of leaves of Mahogany that produce litter. Based on observations for three months (August - October 2017), it was known that there is a decrease in total litter of Mahogany leaves per month (figure 1.) for tree litter in campus forest and along campus street.

The result of ANOVA analysis showed that there was significant difference (p <0.01) on the amount of litter production for the third month during observation. Based on further tests using HSD Tukey, it was found only between September and October that had no significant difference (p> 0.05) for litter production in both campus forests and along street.

If summed up during three months of observation, the UNNES campus has the potential to produce litter of about 10 tons / ha / 3months in campus forest area and 2.5 ton / ha / 3 months along campus main street. This number only comes from the Mahogany plant that is dominating (80%) tree compared to other plant species in the campus area.

The weekly leaf litter production of Mahogany observed for 12 weeks showed a marked difference between the two observation areas (campus forest and campus street). Based on t test (one party), it is known that Mahogany in campus forest has higher litter production (t = 2.67, p = 0.009) compared to shade plant along the street (figure 2).

The difference in the number of litter in the two different areas and the three different months is possible due to differences in Mahogany density and seasonal variations. In accordance to [10] which stated that the density, seasonal variation and age of stands are also reported to play a significant role in the litter production.

Mahogany in the campus forest is planted with spacing about 1 - 2 meters between plants and concentrated on a particular area. This caused a high density level. While the spacing of Mahogany tree along campus street is 3 - 8 meters between trees with long cropping pattern on the right and left along the main street campus. The cropping pattern makes the density low.
According to [11] that litter both production, annual variations and the composition may be affected by age-related stages succession, species composition, community structure and form of canopy. Next thing happened the nature of human disorders can also contribute in increasing litter production and annual variations. The older the plant the production of the litter is declining, and vice versa [1].

3.2. Relationship Between Rainfall and Leaf Litter Production

Another factor that may be related to litter production is seasonal variation. In this research was taken data of weekly rainfall (August-October 2017) from BMKG weather observation station for Gunungpati, Semarang. Observations were made at the end of the dry season (August) and the beginning of the rainy season (September and October) of 2017.

Figure 3 shows a decrease in litter production per week for three months of observation. If associated with weekly precipitation, it is known that at the end of the dry season litter production is more fluctuating and far more than at the beginning of the rainy season. This is also in accordance with the data of water content in the litter that has increased along with the increase of rainfall.

![Figure 3](image_url)

**Figure 3.** The pattern of Weekly litter production (grams / m² / week), weekly rainfall (3a), and water content in leaf litter (3b).

Based on the pattern of weekly litter production and rainfall data, the correlation analysis is performed between the two. Retrieved a correlation value of -0.59 is included in the moderate category. The significance test showed a significant value (p <0.05) which means there is a significant relationship between rainfall and weekly litter production. In figure 4 it can be seen that litter production will be more at a time of slight rainfall, and vice versa.
Precipitation is the climatic factor which interferes directly in the production of litter which has inverse relationship between the precipitation and the production of litter [12]. Similar result showed that precipitation was a better predictor of quantity of typhoon-associated litterfall than wind velocity. Both types of forests in southeastern China beyond the reach of typhoons have litterfall peaks in the dry season [13].

4. Conclusion
Mahogany trees in the UNNES campus have the potential to produce leaf litter as much as 12.5 tons / ha / 3months. Production of leaf litter Mahogany in campus forests and along the street of UNNES campus is fluctuating at the end of the dry season and decreased in the rainy season. There is a significant relationship between litter production of Mahogany leaves with rainfall.

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