Production and Decomposition Rate of Litter \textit{Rhizophora mucronata}

During a month, a bag was taken from each station after 7th, 14th, 21st and 28th day. This observational method based on the previous study reveals that the decomposed process occurs from 7 to 15 days (Sa'ban, 2013). However, total decomposition each leaf is different from one another. Within 60 days, it shows that no litterfall has been completely decomposed 100%, it even can take a year to be decomposed perfectly. The remaining litterfall in the bag is cleaned and dried on the oven at 80°C for 48 hours or until their weight is stable (Mahmudi et al., 2011).

3. Data Analysis

3.1 Litterfall Production Rate

The mangrove litterfall that falls into litter bag is loaded in the plastic bag, separated based on leaf, twig, flower-druce, and measured their weight. The result is calculated by gram/m2/week units. After drying at 80°C for 48 hours in the oven to reach the constant weight, it will be taken as litterfall production (Firriyani, 2016).

3.2 Littering Decomposition Rate Analysis

Identifying decomposition rate in this study is to analyze the reduction of litterfall weight in the litter bag. Its loss is calculated by comparing the original weight to residual decomposition. Decomposition rate is then measured by Formula that used by Hardianto (2012); Andrianto et al (2015):

\[ D = \frac{D_0}{D_0 - D} \]

\[ R = \frac{D_0 - D}{T} \]

\[ Wo = \text{Dried weight at initial} \]
productivity in each observation station is presented in the following Figure 3.

The production of litterfall in all observational stations indicates that leaf is the most contributed component of Rhizophora mucronata compared to other. Littering production presented in the following Table 2. The average littering production in each observational station for each littering component, can be seen as following the Figure 4.

4.2 Littering Decomposition Rate

The result of observational littering decomposition rate for 28 days in each station reveals that none of litterfall have been completely decomposed in all stations. The dried weight of mangrove litterfall that decomposed for 28 days shown in the following Figure 3. Decomposition of litterfall Rhizophora mucronata, during the study for 28 days can be seen in the following Table 3 and Figure 4. Influential factors toward productivity and decomposition rate of Rhizophora mucronata litterfall.

Based on the result of observational yield shows that influential factors toward productivity and decomposition rate of Rhizophora mucronata litterfall consist of salinity, pH, temperature, wind velocity, and Rhizophora mucronata density.

The measurement results can be seen in the following table. The density of mangrove, Rhizophora mucronata, in Tongke-tongke village shows different results. Observational station III is the

Tongke-tongke village shows different results. Observational station III is the highest density which the density value is 97 trees per 100 m2, while station I is the lowest density with 60 trees per 100 m2. Additionally, the station II and I show 82 trees per 100 m2 and 79 trees per 100 m2 respectively.
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LitterCell productivity for 28 days in each observational station shows different results. Station III is the highest production at 32.8 g/m2/28 days or 2.2 g/m2/week, followed by station I at 89.1 g/m2/28 days or 2.3 g/m2/week, while station II and IV are at 78 g/m2/28 days or 19.5 g/m2/week and 64.1 g/m2/28 days or 16 g/m2/week respectively.

The difference in production of mangrove Rhizophora mucronata litterCell due to various factors, based on observational results reveal that there are diverse densities in which station III is the highest density while station IV is the lowest density. According to Aida et al. (2014) stated that the density of mangrove vegetation effects the litterCell production, the denser the trees, the higher littering production. Another study Andrianto (2015) noticed the station that had the densest vegetation produced highest. However, different results are shown in station I and II where the density is 79 trees per 100 m2 and production is 89.1 g/m2/28 days or 2.3 g/m2/week even though it has less density but is able to produce more compared to station II, 82 trees per 100 m2 and production 78 g/m2/28 days, which is denser but produces less. These occur because there are other factors. In addition to density effect, other factors such as diverse temperature, salinity, pH, and wind velocity contribute to different results.

In this study, shows different temperature leads to diverse results in which station I is higher (31°C) than station II (30°C) but can produce more litterCell. This finding is encouraged by Riyanto (2013) stated that temperature effects the amount of litterCell production because in the lower temperature in order to reduce transpiration rate, the vegetation naturally aborts its leaves to survive. According to Panjaitan et al. (2014) the appropriate temperature for the Labe and litterCell productivity in the tropical region is approximately 26-32 °C. Based on the observation shows that the temperature in the field study is 26-32 °C which is livable for growing mangrove.

Salinity monitoring in observational field shows ranging from 26 % to 28 % which station III and IV have less salinity than station I and II. Less salinity in station III and IV is caused by water intrusion from Baringeng River. In station III, having 27 % salinity, produces more litterCell than station I and II. Although station I and II have similar salinity 28 %, they produce different amount of litterCell. This is because station I has higher temperature than station II has. Bengen
(2004), stated that one of mangrove ecosystem identities consisted of normal salinity (2-22 %) and salty salinity (38 %), so all stations have high salinity. Regarding to salinity, leaves play an important role in mangrove adaptation against high level of salinity by storing the salt in their particular cells (Fitriyani, 2016). Another finding by Zamroni and Rohyani (2008) shown that leaves had high contribution to the litter fall decomposition due to adaptation pattern to reduce the water loss in highly salty environment. Wind velocity monitoring in each station reveal that wind velocity rate is low where station I and III have higher wind velocity than station II and IV have. This is because the station I and III directly face the open ocean, but its category level is still low between 0.9 m/s and 0.7 m/s. While station II and IV located in onshore which receive less wind. Therefore, the production of litter fall in station II and IV is lower than station I and III, supported by Zamroni and Rohyani finding (2008) stated that there was a positive correlation between production of litter fall and wind velocity.
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the [aster wind velocity, the more production. Observational result shows that the largest production of mangrove litter[all is leaves coming from Rhizophora mucronata. According to Yulma (2012) said that it caused by [all season of mangrove in dry season with high temperature. Moreover, leaves contribute more on production of litter[all than any other organs because compared to twig and branch, biologically they are formed quickly and aborted easily by wind. Additionally, Gunarto (2004) stated that mangrove ecosystem was a main food chain that played significant role in food web as producer in marine ecosystem. This ecosystem provided adequate food and shelter for various marine species such as fish, crab, shell, and shrimp. Meanwhile, Kawaroe & Mujizat (2001) said that mangrove contributed significantly to the juvenile fishes. As a result, if mangrove underwent degradation either quality or quantity, it would drive negative impact on marine creatures especially fish as a main source of food.

5.2 Decomposition rate of Rhizophora mucronata litter[all

Mangrove leaves that fall in the ground need long time to be decomposed depending on several factors. Based on the observational result reveals that the decomposed process in station IV is the slowest among other stations. It can be seen from the mass of dried leaves before was 10 g, but after decomposing, the mass fell into 2.4 g. The composition rate in station I 76%, station II 44%, station III 56% and station IV 39% show that during study, 28 days, none of litter[all has been completely decomposed.

The highest decomposition rate in all stations occurs in the second week, 15 days, which encouraged by Sa’ban (2013) stated that mostly mangrove litter[all had decomposed from 7 to 15 days. This was due to organic material and soluble organic material loss or the presence of microorganism. In addition to Yulma (2012) said that the highest fungal cellulitis enzyme more likely happened in the beginning of decomposition, but after 14 days decomposition rate declined. Similarly, Uldrody (2018) found that the average decomposition rate in the first 14 days ranging from 0.562-0.601 g/day while Lestarina (2011), obtaining an average decomposition rate in the first 14 days was 0.415-0.420 g/day. According to Yulma (2012) it was caused by decreasing organic
materials and nitrogen contents in the rest of the leaves. The different amount of decomposition in each station is dependent on several factors. The results of measurements in the study sites reveals that the average water temperature is 28-29 °C. It shows that the decomposition rate in every station is quite high while all stations reached 1.3 g/week or 13% per week. Section I that has water temperature at 25°C is the highest decomposition rate reaching 76% in 28 days, followed by section III in the second place at 56% in 28 days.

Mahan (1978) stated that the humid and high temperatures region throughout the year led to the decomposition of mangrove litter rapidly, so that the process of forming topsoil was followed by the mineralization process. The optimum temperature for bacteria was at 27 - 36 °C which was the best condition for decomposing mangrove litter as it is essential for maintaining the decomposed process of Rhizophora mucronata litter. The decomposition rate was well known as the litter loss rate due to the removal of litter components by physical conditions such as tidal currents (Personal, 1998). In the waters, the decomposition process assisted by the physical mechanism such as the movement of tidal currents and inundation by sea in which the tidal stream in the study area occurs in the morning then at night new receding. The decomposition of litter can also be caused by the erosion of the wave movement. Wet and humid environment led to decomposition process faster (Mahan, 1978). In the field, the largest exposed to the tidal currents is station I and III. Thus, it also affects the high decomposition rate. Furthermore, station II still influenced by tidal water puddles, and also receded. However, although station IV is not influenced by the tidal, it is always submerged by river water. This is because station IV is located in Baringeng River.

6. Conclusion

6.1 The observational result in Tongke-tongke, mangrove ecosystem, East Sinjai obtained the average productivity of Rhizophora mucronata litter at 2.89 g/m²/day or 10.55 tons/ha/year with the largest contributor from the leaf litter then followed by the organ twigs and also the flowers while the fruits are not found. The highest production of mangrove litter in station III, with an average at 3.18 g/m²/day, and the lowest production found in station IV point, with an average of 2.29 g/m²/day.