

Soil Mesofauna Community on Ex-Landfills Land Gunung Tugel Banyumas Regency

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ABSTRACT

This study aims to identify and reveal the soil fauna community which includes individual counts, diversity and dominance as well as the quality of the soil environment in the former landfills Gunung Tugel land, Kedung Randu Village, Patikraja District, Banyumas Regency. The method used is purposive random sampling. Sampling was carried out for six months, during January-June 2021, six times with an interval of one month, at day (06.00 - 08.00) and night (18.00-20.00). Soil sampling and soil quality measurements were carried out at two research locations, location I in the northern and eastern areas of the ex-landfills Gunung Tugel area and location II in the western and southern areas of the ex-landfills Gunung Tugel area. The results of the sampling were identified using a microscope and referred to the book *An Introduction to the Study of Insects* and the book *Ecology of Soil Animals*. The results showed that 394 individuals of soil mesofauna were counted which belonged to 12 orders, 15 families and 17 species. The diversity index is classified as moderate, in the range of 0.970 - 1.097 with an average of 1.045. The dominance index is relatively low, ranging from 0.335 to 0.423 with an average of 0.367 and shows that no species dominates. The quality of the soil environment of the former Gunung Tugel landfills is classified as not yet feasible to support the life of the soil mesofauna.

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1. INTRODUCTION

Efforts to meet increasing human needs have created a threat of environmental damage. An example of environmental damage or ecological damage is the use of fertile land for landfill. Most soils in the tropics are infertile due to the scarcity of soil faunal communities, especially from soil microarthropods. The structure of the soil fauna community is an arrangement that forms a group or community of soil fauna. The soil fauna community is composed of a population of soil fauna consisting of various individual types of soil fauna. The number of individual types of soil fauna in the community will indicate the diversity of soil fauna. Diversity of soil fauna is one of the richest biodiversity on earth. Soil fauna belongs to the phylum Arthropoda. Phylum Arthropoda is the largest phylum compared to other phyla and is the dominant phylum on earth. Soil fauna lives in the soil, both on the surface of the soil and in the soil.

Soil fauna in its role in the soil ecosystem is considered as an indicator of soil fertility and quality. As an indicator of soil fertility and quality, the abundance and diversity of soil fauna found in an area can be used as a benchmark for soil quality and soil ecosystem conditions. According to Yan et al. (2011), soil fauna is a very useful indicator of soil quality because soil fauna is sensitive to changes in soil and is included in many soil functions. Soil fauna as an indicator of soil quality is very dependent on factors that exist in the soil environment, including soil biotic and abiotic factors. Soil fauna plays a role in the decomposition process by breaking down plants and the remains of dead organisms to be broken down into simple and complex organic matter. The organic matter resulting from this decomposition can support productivity and maintain soil fertility (Meitiyani and Dharma, 2018).

The former Gunung Tugel landfill is located in Kedung Randu Village, Patikraja District, Banyumas Regency. The former Gunung Tugel landfill was established in 1983 with an area of about 5 hectares. The former Gunung Tugel landfill is able to accommodate 282 m² of inorganic and organic waste per day, most of which comes from households, markets and industry. Because it has exceeded its capacity, this land was closed in 2016 (Ramadhanti, 2018). This study aims to identify and reveal: Soil mesofauna community structure in the former Gunung Tugel landfill site, knowing and revealing the relationship between environmental factors on individual count diversity of soil fauna dominance in the former Gunung Tugel landfill.

2. RESEARCH AND METHOD

This research was conducted in the former TPA Gunung Tugel, Kedung Randu Village, Patikraja District, Banyumas Regency. This land has an area of about 5 hectares. This research was conducted in two different locations: The first research location is on the former Gunung Tugel landfill located in Kedung Randu Village, Patikraja District, Banyumas Regency. This research was carried out for six months, starting from January 2021 to June 2021. Determination of the sampling point of the soil was carried out using a completely randomized method.

Mesofauna samples were taken using the Tullgren funnel method, this method was carried out by taking soil samples using a soil drill or digging the soil. Soil sampling was carried out at each sampling point. This sampling begins with making a plot measuring 25x25 cm with a depth of about 15-25 cm. Soil samples that have been obtained are then extracted using a Barlesse funnel which has been modified into a tool called a tullgren funnel. Soil sample extraction is carried out for about three to seven days (Syah, 2016). During the extraction process, the soil sample was irradiated using a lamp so that the soil mesofauna in the soil descended into a glass beaker filled with 70% alcohol. Beaker glass was used to capture soil mesofauna that descended from the funnel. The use of 70% alcohol was used to preserve the obtained soil mesofauna samples.

Measurement of environmental factors was carried out at each research location. Measurements carried out include abiotic environmental factors, including: Air temperature, soil temperature, soil pH, soil texture. Environmental factor measure with digital tools.

The process of identifying the collected soil mesofauna and macrofauna samples was carried out by referring to the book *An Introduction to the Study of Insect Borrh* et al. (1992) and other references related to soil fauna identification. The process of quantification of samples of soil mesofauna and macrofauna that have been identified to calculate the number of individual counts at each level of same family taxon.

2.1. Data Analysis measure with descriptive each parameter

a. Individual Count

Mesofauna that have been identified to determine their classification are then counted or quantified. The same mesofauna and macrofauna families were then added together to determine the number of individuals in each mesofauna and macrofauna family obtained during the research process.

b. Diversity

Mesofauna diversity index values were determined using Shannon-Wiener Diversity Index.

c. Dominance

According to Odum (1993), the dominance index of a particular species can be calculated using the Simpson's Dominance Index.

3. RESULT AND DUSCUSSION

3.1 Soil Mesofauna Community Structure

3.1.1. Individual Count and Soil Fauna Type

The number of individuals in the soil mesofauna that was successfully obtained and identified during the study from January-June 2021 in the ex-landfill of Mount Tugel was 394 individuals. The 394 individuals obtained belong to 17 species, 15 families and 12 orders. The most soil mesofauna species found in the ex TPA Gunung Tugel land were the Isotomideae family, i.e., *Isotomurus* sp. which amounted to 118 individuals. The

soil mesofauna species with the fewest number of individuals numbered, one individual was the flea (*Pulex* sp.). While other species have individual numbers that vary with a range between 2 - 65 individuals.

The variety of species caught was seen based on the sampling season, in the rainy season, during January - March 2021, as many as 14 species during the day and 10 species at night. In the dry season, from April to June 2021, there are 12 species during the day and 7 species at night. Based on the sampling time in January, soil mesofauna was obtained as many as 14 species, in February 9 species, in March as many as 12 species. A total of 13 species were found in April, 6 species in May and 5 species in June. Based on the location, 22 species were caught at location one and 19 species were caught at location two.

The number of individuals obtained in this study was less when compared to research conducted by Amelinda et al., (2017) in the active and passive zones of the Jatibarang landfills which managed to obtain 29 species including 18 families and 8 orders. However, the number of individuals obtained in this study is more than the research conducted by Anggriawan et al., (2020) on different types of land use in Bogor which obtained 13 species.

The highest number of soils mesofauna individuals in this study were members of the Collembola family with two species, i.e., *Entomobrya sicia* as many as 40 species (10%) and *Isotomurus* sp. as many as 118 species (30%). While the lowest individual counts were the families Scolopendrellidae, Acerentomidae, Ascidae, and Cimicidae with 2-5 species (1%). Based on the sampling season, the rainy season in January-March and the dry season to be precise in April-June, the number of soils mesofauna caught in the rainy season was 241 species. In the dry season the number of mesofauna was 153 species. The highest species is *Isotomurus* sp. which is the order Collembola, found as many as 65 individuals. The number of species in the rainy season is more than in the dry season, this is in line with Lestari (2021) which revealed that the abundance of soil mesofauna will decrease drastically during the dry season, so that the higher the air temperature, the lower the population level of soil mesofauna.

During daytime 265 species of soil mesofauna were captured and 129 species soil mesofauna caught during nighttime. The most species caught were *Isotomurus* sp. which is the order Collembola and the family Isotomidae, during the day as many as 77 species and at night as many as 41 species. Based on the research location, there were 239 species at location one and 155 species at location two. The location one has more species due to the fact that location one is an active area or zone so that species are abundant. Similarly, research by Amelinda et al in 2017 at the Jatibarang TPA Semarang stated that 2240 individuals were found in the active zone and 480 individuals in the passive zone. This type of Order Collembola, besides being abundant, this order is always found every month, both in the rainy and dry seasons. The order Collembola consists of two families, Isotomidae and Entomobryidae with a total of 158 individuals. As well as Fahmi's research (2016) entitled community structure of soil fauna based on different types of vegetation in the Indonesian Safari Park II Prigen East Java stated that the Collembola species is a very dominant fauna species in terms of number, biomass or types of species in the soil and makes up about 95% of the total number of soils microarthropods. The existence of Collembola is related to the presence of litter in an area because most of the Collembola eat the remains of decaying vegetation.

Muli (2015) stated that land differences did not affect the population and presence of Collembola. This shows the tolerance and adaptation of Collembola to environmental factors that make it an indicator of soil conditions and has a major role in the ecosystem. Collembola is an animal that is abundant in the soil preying on bacteria, fungi, soil mineral particles, organic matter, protozoa and nematodes. The presence of soil animals is also influenced by soil environmental factors, one of which is soil pH. Lestari (2021) stated that land with an acidic soil pH, it is estimated that the most prominent soil animal population is the Collembola group. This is in line with the pH value in the ex-landfills Gunung Tugel area which shows a number less than 7 or is acidic.

1. Diversity

The soil mesofauna diversity index in the ex-landfills Gunung Tugel area based on the sampling season as a whole ranged from 0.970 to 1.097 with an average of 1.045. In the rainy season the diversity index ranges from 0.970 to 1.097 with an average of 1.048 during the day and night. Meanwhile, during the dry season, the day and night time ranged from 0.972 to 1.094 with an average of 1.043. The highest diversity index is in the rainy season, precisely at night with an index of 1.097, and the lowest diversity index is in the rainy season during the day, which is 0.970.

The soil mesofauna diversity index in the ex-landfills Gunung Tugel land based on the time of sampling in January-June 2021 overall shows a range between 0.429-0.684 with an average of 0.623. The diversity index during the day ranged from 0.577 to 0.684 with an average of 0.643. At night, the index ranges from 0.429 – 0.655 with an average of 0.602. The highest diversity index during the day was in June, which was 0.684, while the lowest was in January, which was 0.577. At night, the highest diversity index was in May at 0.655 and the lowest was in June at 0.429.

The soil mesofauna diversity index based on the sampling location as a whole ranged from 1.589 to 1.778 with an average of 1.70. At location one during the day the diversity index is 1.719 and at night is 1.778 with an average of 1.749. Location two during the day the soil mesofauna diversity index is 1.589 and at night is 1.725 with an average of 1.657. The highest index is at location one night at 1.778, and the lowest is at location two at 1.589.

Based on the analysis of the calculation of the diversity index (H') on the ex-landfills Gunung Tugel area seen from the season, time and location of sampling with day and night intervals, the results obtained where the index includes the criteria for a moderate level of diversity, because it has an average above 1 and less than 3 and the unstable condition of the former Gunung Tugel landfill so that species diversity is not stable. This is in accordance with Awaludin (2019) which states that the value of the species diversity index (H') is used to see the value of the stability level of species diversity in a community. The higher H' value indicates a more stable community species diversity value. Fahmi (2016) states that a community is said to have high species diversity if the community is composed of many species and the number of individuals per species is evenly distributed.

According to Odum (1996) states that if the value of $H' < 1$ is said to have a low diversity value, if the value of H' is between 1-3 it is said to have a moderate diversity value and if the value of $H' > 3$ is said to have a high diversity value. When compared with the research conducted by Amelinda et al in 2017 in the active and passive zones of the Jatibarang landfills Semarang, the results of the diversity index in the Jatibarang TPA were the same as in the former Gunung Tugel TPA which showed a moderate category. The level of diversity in the medium category is probably the result of changes in land conditions and soil texture, so that the presence of soil fauna is not so diverse. Based on the results and discussion of the mesofauna diversity index of the soil during the study, it was in the medium category. This means that the presence of soil mesofauna in the former Gunung Tugel landfill in Kedungrandu Village, Patikraja District, Banyumas Regency consists of a few species with an uneven number of individuals.

2. Dominance

Soil mesofauna dominance index in the ex-landfills Gunung Tugel based on the rainy season (January-March 2021) and dry season (April-June 2021) as a whole ranged from 0.335 – 0.423 with an average of 0.383. In the rainy season during the day the dominance index at location one is 0.375 and location two is 0.423 with an average of 0.399, while in the rainy season at night, location one is 0.337 and location two is 0.335 with an average of 0.336. In the dry season during the day at location one the dominance index is 0.357 and location two is 0.368 with an average of 0.363. The dominance index of 0.337 was obtained in the dry season at night at location one, and location two of 0.405 with an average of 0.371. The highest dominance index by season was found in the rainy season, which was 0.423 and the lowest was in the rainy season at 0.335. The data from the analysis of the dominance index by season is presented in Figure 13 (A).

The range of 0.356 – 0.474 is the dominance index based on time which obtained an overall average of 0.392. During the day the dominance index ranges from 0.292 to 0.450 with an average of 0.398. At night, the dominance index ranges from 0.145 to 0.474 with an average of 0.386. The highest dominance index is at night, precisely in March and the lowest is at night in February. The dominance index is seen from the sampling location. Overall, the dominance index ranged from 0.171 to 0.246 with an average of 0.208. At location one during the day the dominance index is 0.191 and at night 0.171 with an average of 0.181. At location two dominance index during the day is 0.246 and at night is 0.223 with an average of 0.184. The highest index is at location two of 0.246 and the lowest is at location one of 0.171.

The dominance index according to Odum (1993) criteria are: if $0 < D < 0.5$ means that no species dominates, and $0.5 < D < 1$ means that there is a dominating species. Soil mesofauna dominance index on the ex-landfills Gunung Tugel as a whole ranged from 0.145 to 0.474 indicating that there was no dominant species because $D < 5$. Likewise, when viewed based on season, time and location of sampling, the level of dominance was low or it could be said that there was no species that dominate because no index value exceeds a scale of 0.5. This is because the ex-TPA Gunung Tugel land is still left unattended and there is no intensive activity on the land.

In refers to previous research conducted by Awaludin et al in 2019 on land conversion in the area around Situ Cisanti, it showed low dominance results in mixed forest areas of 0.13 and pine forest areas of 0.24. The tea garden area is 0.72 and the field area is 0.75. This is due to the dominance of the Isotomidae family. The increase in the value of the dominance index can be caused by intensive activities such as high disturbances and environmental stresses against species that inhabit a particular habitat or site, so that only a few other species can dominate the area. In the fields, intensive disturbances in the form of pest control, artificial soil loosening, and other agricultural activities cause this dominance effect. Odum (1996) states that habitats with relatively or unchanging environmental conditions have a high number of species with a small number of individuals in each species. In addition, stable land conditions mean more species diversity or variety, but on the other hand unstable land conditions make fewer organisms. Based on the discussion of the dominance index of soil mesofauna species

on the ex-landfills Gunung Tugel land in Kedungrandu Village, Patikraja District, Banyumas Regency, shows that there is no dominant species.

3.1.2.1 Environmental factors

The results of measurements of environmental factors carried out on the ex-TPA Gunung Tugel area include air temperature, soil temperature, acidity or soil pH, humidity, and soil texture. land. This is because the air temperature is quite high and the soil temperature is higher than the optimum soil temperature for the life of soil fauna. The soil environment in the ex TPA Gunung Tugel land has acidic properties so it is not suitable as a habitat for soil fauna that tend to choose to live in an environment with a pH close to neutral. At-Tawaha et al. (2021) Nasirudin and Susanti (2018) Husamah et al. (2017) Amelinda et al. (2017).

4. CONCLUSION

Based on the results and discussion, it can be concluded that the structure of the soil fauna community on the ex-TPA Gunung Tugel land does not yet have a good value. The quality of the soil environment in the ex-TPA Gunung Tugel area which includes air temperature, soil temperature, acidity or soil pH, soil moisture, and soil texture does not yet have an optimum environmental quality that is suitable for supporting soil mesofauna life.

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