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COMPOST PRODUCTION POTENTIAL FROM WASTE IN TANA TIDUNG REGENCY FINAL PROCESSING SITE (TPA)

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ABSTRACT

Tana Tidung Regency is predominantly an agricultural area, with around 61.51 percent of the total land area of the district dedicated to agricultural purposes, which amounts to 297,028.7 hectares. Despite having an FDS(Final Disposal Site) that spans roughly four hectares and is managed through a sanitary landfill system, the region still uses an open dumping system. The organic waste found in the FDS can be converted into compost, which can be utilized to fulfill the fertilizer needs of farmers in the Tana Tidung Regency. The primary aim of this study is to determine the compost production potential in Tana Tidung Regency. The research was conducted from May 2022 to January 2023, relying solely on secondary data. The secondary data utilized was waste pile data from the last five years, obtained from the Waste Sector of the Tana Tidung Regency Environmental Department. The data on waste is presented in graphical form, while the compost data projection analysis employs the provisions of Zulfinar and Sembiring (2015) in three scenarios: pessimistic, moderate, and optimistic. Based on the study's findings, the volume of waste generated in Tana Tidung Regency in 2022 will amount to 24,675,825 liters, with a total landfill of 24,676 tons. In the pessimistic scenario, no waste processing into compost will occur in 2022, while the moderate scenario estimates 17,273 tons, and the optimistic scenario estimates 19,741 tons.

Key words: Compost, Moderate, Optimistic, Organic, and Pessimistic

INTRODUCTION

Tana Tidung Regency, included in the RPJMD document for the 2021-2026 period, is a subdivision of Bulungan Regency in East Kalimantan Province. According to the Law of the Republic of Indonesia Number 34 of 2007, Tana Tidung is recognized as one of the districts within North Kalimantan Province. It covers an area of 4,828.58 km2, which accounts for approximately 65% of the total area of North Kalimantan Province. The Regency comprises five districts: Betayu, Muruk Rian, Tana Lia, Sesayap, and Sesayap Hilir, and Tideng Pale Sesayap District serves as the capital of the Regency.

Most of Tana Tidung Regency comprises agricultural land, which covers 297,028.7 hectares or approximately 61.51 percent of the district's total land area. Sesayap Hilir District has the most significant agricultural land area, which measures 93,894 hectares. Due to the large expanse of agricultural land, sufficient fertilizer inputs are necessary.

Tana Tidung Regency has an FDS that covers an area of approximately 4 hectares and is supposed to be managed through a sanitary landfill system, but in practice, it still uses an open dumping system. The sanitary landfill system is a method of managing waste by disposing and accumulating waste in sunken locations, compacting it, and then filling it with soil (1). Covering the soil in inactive waste cells can have a positive impact on the environment by reducing odors and the number of flies at the final disposal site, as well as accelerating the decay process. However, in the open dumping system, waste is simply disposed of in a landfill without any treatment (2). This method does not include any land cover, which can lead to negative impacts on the surrounding environment.

The issue of waste is currently one of the major problems in Indonesia. As the population

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continues to grow, the generation of waste, which is the by-product of human activities, is also expected to increase (3). In accordance with Law Number 18 of 2008, waste refers to the remnants of daily human activities and/or natural processes in solid form. Typically, waste consists of solid materials resulting from human and animal waste that is no longer considered useful (4). (5) defines waste as a residual product of human activities that has no further use. According to (6), waste is something that results from human and other living things' activities and is no longer needed or useful to the owner but may have value to other parties when used.

Based on its properties, waste can be categorized into two types, namely organic waste, and inorganic waste (7). Organic waste is waste that can be decomposed, while inorganic waste is waste that is not or is hard to decompose. Furthermore, (8) explain that organic waste comes from living things such as humans, plants, and animals. Generally, organic waste can still be beneficial if managed properly. On the other hand, inorganic waste is difficult to decompose and is typically not derived from living things. It originates from non-biological materials, including synthetic products and materials processed from mining technology.

Organic waste, such as yard waste, plantation and agricultural waste, and kitchen waste, can decompose easily and can be processed through composting. Composting is a process that involves the decomposition of organic waste with the help of air, humidity, microorganisms, and other factors (9). At the household scale, composting can be a solution for dealing with organic waste, and the resulting compost can be used as fertilizer. Composting can be done at both the area scale and household scale, depending on the desired scale. The area-scale composting requires a larger area of land and a minimum of ten households, while household-scale composting can be done by a single household.

Compost is a type of organic fertilizer that has been in use for a long time. Its definition encompasses organic materials that have undergone a process of decomposition due to interactions between microorganisms or decomposing bacteria that work in the organic materials. The organic materials included in the definition of compost are grass, straw, remaining twigs and branches, animal manure, fallen flowers, livestock urine, and other organic materials. All of these organic materials will undergo decomposition caused by microorganisms that thrive in moist and wet environments. This process also results in liquid organic fertilizer (10). In summary, compost is beneficial in providing nutrients to plants, increasing cation exchange capacity (CEC), raising soil pH in acidic soils, and enhancing the availability of microelements (11).

RESEARCH METHODS

The study was conducted over a period of nine months, starting from May 2022 until January 2023, using secondary data. The secondary data was obtained from the Garbage Sector of the Tana Tidung Regency Environmental Department, and it comprised waste pile data from the past five years.

Visits were made to relevant agencies to obtain secondary data, which was presented in the graphical form regarding the amount of waste. For the projection analysis of compost data provisions were used, which included three scenarios: pessimistic, moderate, and optimistic. The pessimistic scenario was based on the existing conditions or business as usual (BAU) with technical variables for landfill planning, such as cell height, landform factors, waste compaction, and decomposition variables in the simulation. The moderate and optimistic scenarios involved managing waste at the source by the community through various variables, including TPS 3R, garbage banks, and waste management through composting, burning, recycling, stockpiling, dumping into vacant land, and dumping into waterways. Technical variables for landfill planning, such as cell height, land formation factors, waste compaction, decomposition, and scavenger

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variables, were also used in waste management at the FDS based on several predetermined parameters. The research was conducted over nine months, from May 2022 to January 2023, and relied on secondary data obtained from the Waste Sector of the Tana Tidung Regency Environmental Department on waste piles in the last five years.

RESULT AND DISCUSSION

Based on the obtained data, it indicates a yearly increase in the amount of waste deposited in landfills, spanning from 2018 to 2022. the graphical representation is presented in Figure 1, Figure 2, and Figure 3.

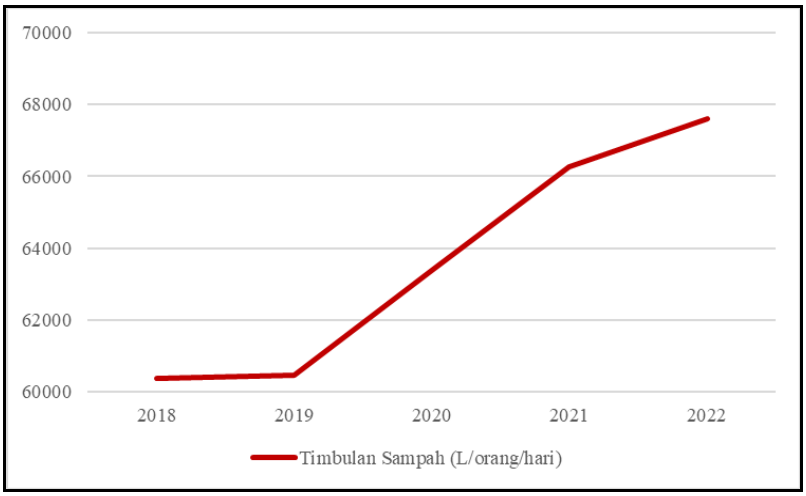

Figure 1. The daily volume of individual community waste in Tana Tidung Regency

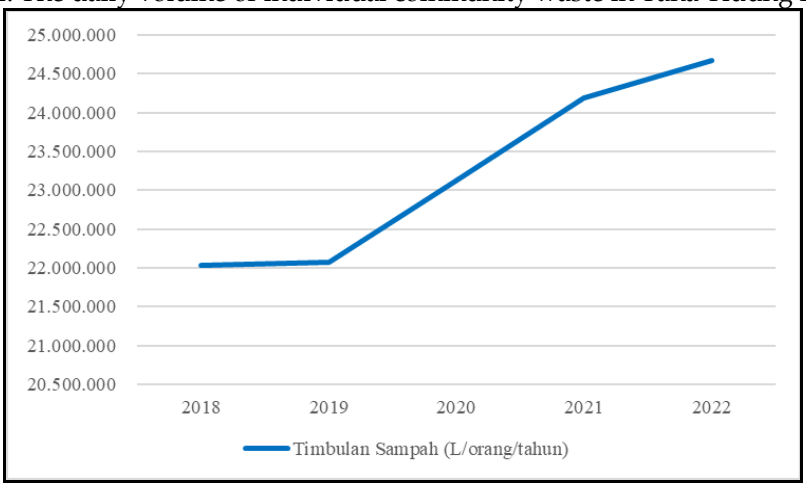

Figure 2. Annual volume of individual community waste in Tana Tidung Regency

In 2018, the average volume of waste generated by individual communities in Tana Tidung Regency was 60,363 liters per day. However, by 2022, this volume had increased by approximately 7,000 liters per day, reaching 67,605 liters per day (Figure 1). This escalation in daily waste volume has had a significant impact on the annual waste volume per individual. The data obtained indicated that the volume of waste per individual had increased by around 2,650,000 liters since 2018. Specifically, the annual waste volume per person was 22,032,313 liters in 2018, while it rose to 24,675,825 liters in 2022 (Figure 2). The term "waste volume" describes the amount of space that trash fills. This increase in waste volume will result in a total of 24,676 tonnes of waste being deposited in landfills in 2022 (Figure 3). The quantity of landfill waste is directly linked

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to the weight of the waste produced. In Tana Tidung Regency, the volume and amount of waste piles have a direct correlation, whereby a higher waste volume leads to a greater quantity of landfill waste.

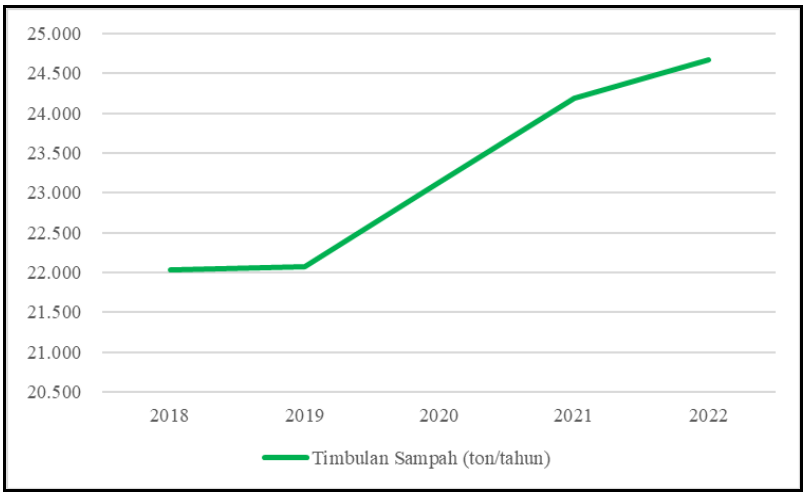

Figure 3. Annual community waste piles in Tana Tidung Regency

Activities and facilities done by humans are a source of waste, where the source of the waste itself is where the waste comes from. The quantity of waste generated can be determined by analyzing the existing waste sources. By understanding the amount of waste that is accumulated, it becomes possible to ascertain the amount of waste that requires management. (12) argue that the use of land can be linked to waste sources, with different types of waste generated by specific activities and locations. This relationship allows us to identify the specific sources of waste and their types.

Residential waste, for example, originates from family residences and apartments and is generated from various household activities, such as wrapping food leftovers in plastic, paper, or leaves, disposing of leaves from parks or gardens, and discarding household appliances. Commercial waste, on the other hand, is generated by various establishments, such as shops, offices, hotels, markets, workshops, and healthcare facilities, and consists of dry waste, food waste, dust, and hazardous waste. The city generates waste from both residential and commercial activities, including waste from household and commercial activities. Industrial waste, on the other hand, is produced by industrial activities such as chemicals, refining, and construction and comprises waste generated during the production process and waste from industrial buildings. Waste generated in open spaces, such as parks, playgrounds, recreational areas, streets, alleys, and vacant land, includes dry waste such as paper, plastic, and special waste. Waste produced in processing locations, such as clean water treatment, wastewater, and industrial processing, consists of waste generated during the processing of waste or in the form of sediment. Agricultural waste, which is generated from agricultural land, gardens, and fields, comprises various materials such as wood branches, rice straws, unused vegetable scraps, rice stalks, and corn.

Meanwhile, (13) stated that several factors have an impact on the quantity of waste produced, such as the number of inhabitants in an area. If an area has a high population density, it can result in a larger amount of waste produced. In addition, areas with high social and economic standards can generate a greater amount of waste per person, particularly inorganic waste like leftover plastic bags from shopping. Technological advancements also play a role in the type and quantity

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of waste produced. With increasingly advanced technology, a wider range of waste can be produced.

There are various methods available for managing waste. Organic waste, such as yard waste, plantation and agricultural waste, and kitchen waste, which easily decomposes, can be composted (14). Composting is a process that involves decomposing organic waste with the help of microorganisms, air, humidity, and other factors. Composting at the household level can be a solution for dealing with organic waste, and the resulting compost can be used as fertilizer. Composting can be done at both area and household scales, with the area scale requiring a larger land area and a minimum of ten households. On the other hand, household-scale composting can be done by one person. Composting can be carried out using various methods, such as drums, baskets, or planting (Figure 4).

Figure 4. Composting method

There is an estimation that composting waste falls into the moderate category at 0.7% and reaches 0.8% in the optimistic category. However, in the pessimistic category, no composting activities were found. Based on this, if 24,676 tons of waste are collected in 2022, it is projected that 17,273 tons of compost can be produced in the moderate scenario, while in the optimistic scenario, 19,741 tons of compost can be produced (Figure 5).

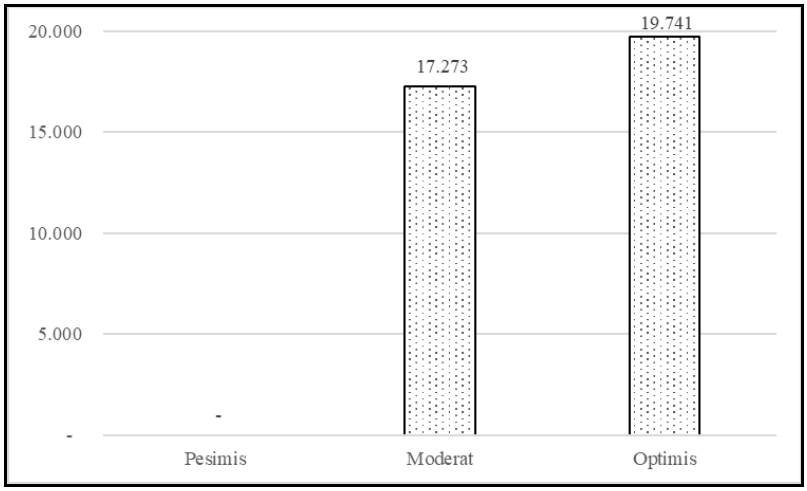

Figure 5. Projection of waste processing into compost (tons/year) in Tana Tidung Regency

An ample amount of compost can be used by farmers to fulfill the nutrient requirements of their plants. Nutrients are classified into three categories, primary macronutrients, which include Nitrogen, Phosphorus, and Potassium, secondary macronutrients, which consist of Sulphur, Calcium, and Magnesium; and micronutrients, such as Copper, Zinc, Chlorine, Manganese, and Molybdenum. Additionally, compost can enhance the soil structure, which refers to the land being

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tightly bound to each other. Compost functions as an adhesive for soil particles equalizing the soil's adhesive level and drawing active microorganisms to the soil making it looser. This type of fertilizer also increases the cation exchange capacity (CEC) which is a chemical property closely related to soil fertility. Soil that has high CEC can provide nutrients more efficiently than soil with low CEC (15).

CONCLUSION

Based on this research, it can infer that the amount and quantity of waste piles have been steadily rising over the past five years. In the year 2022, the total volume of waste in Tana Tidung Regency was 24,675,825 liters, with a corresponding waste pile of 24,676 tons. The composting of waste in the year 2022, according to the pessimistic scenario, yielded zero tons, while the medium scenario resulted in 17,273 tons, and the optimal scenario produced 19,741 tons.

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