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CHARACTERIZATION OF SOLID ORGANIC WASTE AND LEACHATE FROM PIYUNGAN INTEGRATED WASTE MANAGEMENT SITE

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ABSTRACT

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This study characterized solid organic waste and leachate at the Piyungan Integrated Solid Waste Management (ISWM) facility to evaluate their potential use as organic fertilizer and soil conditioners. Solid waste samples were collected from three age categories (0-6 months, 7-18 months, and 2-3 years), and leachate was collected from the inlets and outlets of both the old and transition Leachate Treatment Installations (LTIs). The analyzed parameters included pH, organic C, C/N ratio, macro- and micro-nutrients, and heavy metals. The 7-18-month waste category showed the most promising quality, with neutral pH (7.17), 19.26% organic C, and 2.46% total nutrients, although its C/N ratio (46.62) and Pb concentration (99.83 ppm) exceeded standard limits. Waste aged 2-3 years exhibited greater stability (C/N 20.36; pH 7.09) but contained very low organic C (3.21%), while the 0-6-month material had an excessively high C/N ratio (301.90). Leachate samples showed slightly alkaline pH (7.68-8.34) and organic C levels of 9.98-29.93%, with Pb and Cd remaining below safety thresholds, although micronutrient concentrations were substantially below the standard range for liquid soil conditioners. Overall, solid waste aged ≥7 months demonstrates potential for use as fertilizer or soil conditioner following Pb reduction and C/N adjustment, whereas leachate exhibits limited applicability as an alternative soil conditioner. Further process optimization is required to ensure safe and compliant utilization.

Keywords: age of waste piles, final disposal site, leachate treatment, nutrient potential, waste characterization

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INTRODUCTION

Indonesia is facing an increasing urban waste problem along with population growth, changes in consumption patterns, and the intensity of community activities (Rahmawati et al., 2021). In the Special Region of Yogyakarta, the Piyungan Integrated Solid Waste Management (ISWM) Facility serves as the main waste collection center for the three areas, namely Yogyakarta, Sleman, and Bantul, with a daily waste volume of 450-500 tonnes (Dinas Lingkungan Hidup dan Kehutanan, 2024). Despite implementing the sanitary landfill method, this approach has not fully reduced the volume of waste, resulting in the Piyungan ISWM Facility exceeding its capacity and closing in May 2024. As an emergency measure, a 2.1-hectare transition area was then utilised to accommodate waste from areas that do not yet have an independent management system, including the city of Yogyakarta.

Organic waste dominates the composition of waste in Piyungan (>67%) and is theoretically potentially to be processed into value-added materials such as organic fertilizer or soil amendment. The characteristics of organic waste change throughout the biological decomposition process, indicated by shifts in pH, C/N ratio, C-organic content, and the availability of macronutrients (N, P, K). Waste age is a critical factor influencing the stability and quality of the material, where older waste generally exhibits more stable characteristics. Meanwhile, leachate (lindi) is a percolation product containing dissolved organic compounds, nutrients, and microorganisms, thereby having the potential for improving soil fertility. However, leachate quality is highly influenced by the age of the pile, waste composition, rainfall, and depth, and often contains heavy metals such as Pb and Cd, requiring additional treatment.

Several previous studies have examined the characteristics of organic waste and leachate at TPST Piyungan, including analysis based on waste age. However, these studies were generally conducted in the old zone and have not yet reviewed conditions in the transition zone, which is currently the active operational site. Leachate studies have also been carried out, but most have only highlighted limited parameters such as heavy metals or nitrogen and have not included a more comprehensive analysis of macro and micronutrients. Furthermore, no single study has simultaneously evaluated both solid organic waste and leachate as raw materials for fertilizer or soil amendment based on the quality standards set by the Ministry of Agriculture.

Based on these conditions, this research aims to characterize the physico-chemical properties of solid organic waste and leachate in the TPST Piyungan transition zone based on waste age and leachate sampling points, and to evaluate their feasibility as fertilizer or soil amendment with reference to the Decree of the Minister of Agriculture No. 261/KPTS/SR.310/M/4/2019. This study is expected to provide an initial overview of the potential for optimizing the utilization of organic waste in the transition zone as part of a more sustainable waste management effort.

MATERIALS AND METHODS

Research location and design

The study was conducted in February 2025 at the Piyungan Integrated Solid Waste Management (ISWM) site, Bantul, Yogyakarta (Figure 1). The site lies in a basin-shaped landscape at approximately 80 meters above sea level, dominated by latosol soil that is naturally acidic and low in fertility. The region has a semi-arid tropical climate (Schmidt-Ferguson type E) with an average of 6.6 dry months per year.

This research employed a non-experimental survey design with a descriptive quantitative approach. Primary data were obtained through field observations, interviews with facility operators, literature review, and laboratory analyses, while secondary data were collected from previous studies and institutional reports. Solid waste samples were taken from the transition zone of Piyungan ISWM based on waste age categories of 0 to 6 months, 7 to 18 months, and 2 to 3 years using purposive sampling. Leachate samples were collected from four points consisting of the inlet and outlet of both the old and the transitional Leachate Treatment Installations (LTI). Leachate sampling followed the composite vertical method in accordance with SNI 6989.59:2008.

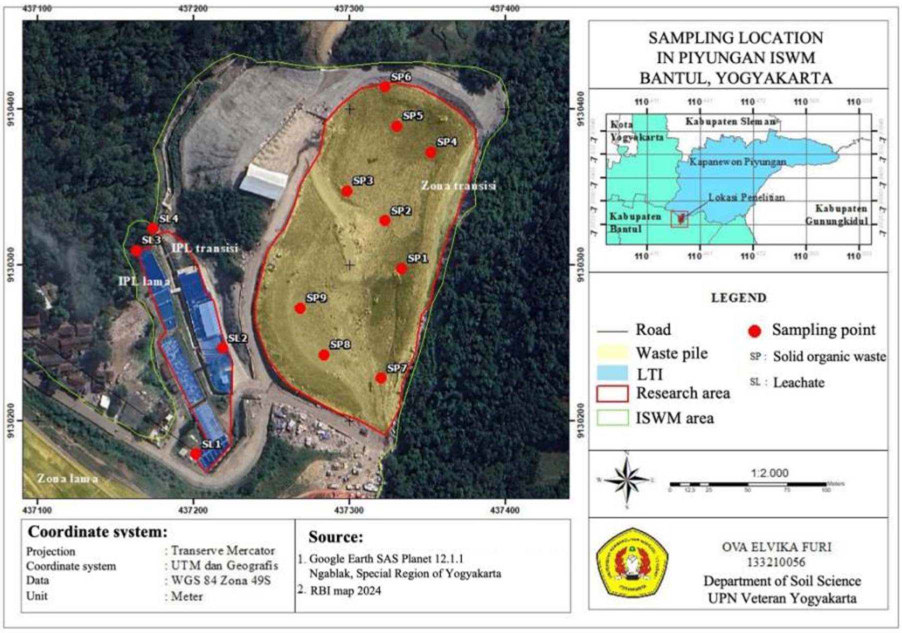

Figure 1. Map of the research area sampling points

Sampling procedures

Solid waste sampling

Solid waste sampling was based on the operational record of waste placement and discussions with ISWM operators. Each age category was represented by three replicates. Each replicate consisted of five sub-points (four corners and one central point) which were combined into a single composite sample. Samples were taken at a depth of approximately 20 to 70 cm using hand tools, and only decomposed, dark- colored material was selected. Each composite sample of about one kilogram was placed in a labeled polyethylene bag to ensure proper identification.

Leachate sampling

Leachate sampling aimed to capture vertical variations in dissolved constituents. At each sampling point, leachate was collected from the surface, middle, and bottom layers and then homogenized into a composite sample. The homogenized leachate was transferred into clean one-liter plastic bottles and labeled immediately. The four sampling points represented both the influent and effluent of the old and transitional LTIs to compare leachate characteristics before and after treatment and to observe differences between leachate from old, stabilized waste masses and younger, active waste deposits.

Laboratory analysis

Laboratory analyses were conducted on pH, organic carbon, total nitrogen, phosphorus (P_2O_5), potassium (K_2O), and the C/N ratio. The pH was measured using a pH meter in a 1:5 material-to-water suspension. Organic carbon was analyzed using the Walkley and Black method, total nitrogen was determined using the Kjeldahl method, and phosphorus and potassium were extracted using a mixed acid solution of HNO_3 and $HClO_4$ and measured with spectrophotometry and flame photometry. All analytical procedures followed the standards specified in the Decree of the Minister of Agriculture No. 261/KPTS/SR.310/M/4/2019 regarding the minimum technical requirements for organic fertilizers and soil conditioners.

Secondary data sources

Secondary data included micro-nutrient concentrations (Fe, Zn, Cu) and heavy metals (Pb, Cd). For solid waste, micro-nutrients and heavy metals were sourced from previous studies. Iron and cadmium data were taken from Izzah (2022), while lead, zinc, and copper data were taken from Savira (2022). Secondary leachate data were obtained from the 2024 laboratory report of the Environmental and Forestry Agency of Yogyakarta. These parameters were used to complement the primary laboratory results and provide a complete evaluation of compliance with fertilizer and soil conditioner standards.

Data analysis

All data were analyzed descriptively to characterize the physicochemical properties of solid organic waste and leachate and to evaluate their suitability as raw materials for organic fertilizer and soil conditioner production. Statistical tests were not applied because the research objective focused on assessing conformity with technical standards rather than examining treatment differences. This descriptive approach allowed for a comprehensive interpretation of parameter compliance and the potential for safe utilization within sustainable agricultural systems.

RESULTS AND DISCUSSION

Waste treatment system at Piyungan Integrated Solid Waste Management (ISWM)

The increasing volume of municipal waste has significantly reduced the landfill capacity at the Piyungan Integrated Solid Waste Management site (ISWM). Once the old disposal zone reached full capacity, a 2.1-hectare transition zone was opened as an emergency facility to temporarily accommodate incoming waste, particularly solid organic materials. This zone is divided into two operational blocks, with Block 1 used from March to October 2022 and Block 2 beginning operation in mid-2023. Although the sanitary landfill method is formally applied, field observations indicate that the system is implemented under emergency constraints and does not fully meet standard sanitary landfill requirements.

In principle, sanitary landfill operations in the transition zone involve placing waste into a geomembrane-lined basin designed to minimize leachate infiltration into soil and groundwater. A network of drainage pipes is provided to channel leachate and landfill gas, while daily operations include waste unloading, spreading, compaction, and periodic soil cover. When a block is no longer active, the surface is covered with geotextile followed by an additional soil layer for temporary closure. The schematic of this system is presented in Figure 2.

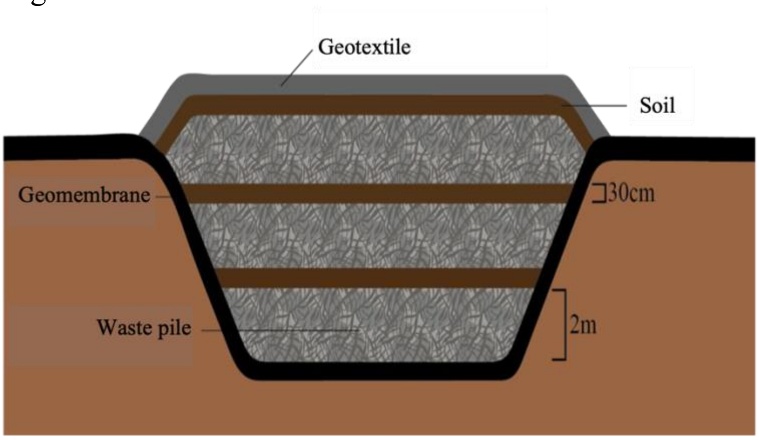

Figure 2. Illustration of the sanitary landfill processing method

Leachate treatment installation at Piyungan ISWM

Piyungan ISWM operates two Leachate Treatment Installations (LTIs): the old LTI, which treats leachate from the 12-ha passive landfill zone, and the transition LTI, which receives leachate from the 2.1-ha transition area. The distance between the leachate inlets and the waste piles differs considerably, with the old LTI located approximately 210 meters from the landfill, while the transition LTI is situated much closer at about 50 meters. Together, both facilities have a combined treatment capacity of around 300 m³ per day. The final effluent is conveyed through a one-kilometer drainage channel before being discharged into the Opak River, and its quality is routinely monitored by the Environmental and Forestry Service of the Special Region of Yogyakarta to ensure compliance with applicable environmental regulations (Amalia, 2024).

At both LTIs, leachate undergoes a multi-stage treatment process beginning with preliminary screening using a bar screen, followed by flow measurement and a coagulation–flocculation process where alum or PAC is added to promote particle aggregation. The leachate then flows into an equalization basin and subsequently into a primary sedimentation tank to allow suspended solids to settle. Biological degradation takes place in an Anaerobic Baffled Reactor (ABR), after which the effluent proceeds to an aeration unit for further oxidation. Final polishing includes maturation and disinfection using chlorine to eliminate pathogenic microorganisms, followed by secondary sedimentation to remove any remaining flocs.

Differences in waste age between the two zones affect the characteristics of the incoming leachate. The transition LTI typically receives fresher waste inputs that result in higher organic content, whereas the old LTI processes leachate derived from more stabilized waste layers. These variations influence key parameters such as pH, C-organic concentration, and nutrient levels, which are further examined in the subsequent section on leachate characteristics.

Waste tonnage and composition at TPST Piyungan

Piyungan ISWM served Sleman Regency, Yogyakarta City, and Bantul Regency with a waste input of approximately 450-500 tons per day prior to the operational restrictions. Waste tonnage from 2019 to 2024 showed substantial fluctuations, with a steady increase until 2022 followed by a sharp decline in 2023-2024 due to service limitations and the eventual permanent closure in May 2024 (Table 1). The closure a waste-handling emergency, particularly in Yogyakarta City, and as a temporary measure, the transition zone continued to operate under a special permit.

Table 1. Data on waste entering Piyungan ISWM

Years	Waste (Ton)	Average waste/day (Ton)	Average daily per district (Ton)		
			Yogyakarta	Sleman	Bantul
2019	198.994,92	545,41	274,42	183,58	87,42
2020	207.086,05	573,08	262,58	216,08	94,42
2021	255.147,23	699,82	256,49	271,43	171,90
2022	270.152,94	740,68	265,99	289,14	185,56
2023	181.753,57	499,61	180,69	196,78	122,15
2024	31.418,82	346,12	146,59	96,79	102,74

Note: Processed from Dinas Lingkungan Hidup dan Kehutanan, 2024

Based on a study in 2024, the waste entering Piyungan ISWM is predominantly organic, especially food and garden waste, accounting for more than 60 percent of the total composition (Adidarma et al., 2014), and there are no official recent data regarding waste composition. This acknowledged temporal gap between the composition data (2014) and the waste tonnage dataset (2019–2024) represents a methodological limitation in this study. However, these older composition figures are often cited in current regional waste-management reports and are used here to provide the most representative available baseline for waste characteristics. This constraint should be acknowledged when interpreting the waste characteristics and their implications for management strategies.

Characteristics and potential of solid organic waste

Based on the authors' laboratory measurements (primary data), Table 2 presents a comparison of compost characteristics from waste piles aged 0-6 months, 7-18 months, and 2-3 years. The comparison with the quality standards (Minister of Agriculture Decree No. 261/KPTS/SR.310/M/4/2019) is performed to assess the intrinsic potential and maturity level of the existing raw waste piles as a baseline for future resource recovery efforts, although raw waste typically requires further processing to reach the final fertilizer quality. The parameters observed include pH, organic carbon content, macronutrients (N, P_2O_5, and K_2O), C/N ratio, micronutrients (Fe and Zn), as well as heavy metals (Pb and Cd).

The waste pile aged 0–6 months still exhibits unstable characteristics. This is reflected by the acidic pH (6.13), a very high organic carbon content (36.48 percent), and an extreme C/N ratio (301.90). These values indicate that the organic material is still fresh and has not undergone complete decomposition. The effective C/N ratio for the composting process typically ranges between 30 and 40. Microorganisms break down C compounds for energy and utilize N for protein synthesis. Within the 30–40 range, microbes obtain sufficient C for energy and N for protein synthesis. Conversely, if the C/N value is excessively high, microbes lack N for protein synthesis, leading to slow decomposition (Isroi, 2008). The macronutrient content remains low. However, during fermentation, microbial activity produces enzymes that accelerate the degradation of lignin, cellulose, and hemicellulose in vegetable and fruit waste, thus softening the organic structure and making it easily degradable. Furthermore, fermentative microorganisms such as Rhizobium and Azotobacter also play a role in nitrogen fixation, which is the process of capturing nitrogen from the air and converting it into a form available to plants. In addition to increasing nitrogen content, fermentation contributes to the release of phosphorus and potassium from the organic materials used (Silaban & Elfayetti, 2025). At this stage, the waste is still in the active decomposition phase and is not yet suitable as organic fertilizer. Its C/N ratio and nutrient levels do not meet the standards, and the Pb content exceeds the permitted threshold. Although it can still be classified as a soil improver, its quality remains low and requires further processing, such as extended maturation and nutrient enrichment.

Table 2. Characteristics of solid organic waste

Age variation of waste	pH	Organic Carbon (%)	Macro-nutrients ($N+P_2O_5+K_2O$) (%)	C/N	Micronutrients		Heavy metals	
					Fe (ppm)[1]	Zn (ppm)[2]	Pb (ppm)[2]	Cd (ppm)[2]
0–6 month	6.13	36.48	0.92	301.90	1033	223.69	89.19	1.30
7–18 month	7.18	19.26	2.46	46.62	1387	257.35	99.83	1.10
2–3 year	7.08	3.21	1.54	20.36	1387–1681	201.53 – 257.35	65.94–99.83	0.90–1.10
Quality standard[3]	4–9	15	2	-	≤15,000	≤500	≤50	≤2

Notes:
[1] Savira (2022)
[2] Izzah (2022)
[3] Decree of the Minister of Agriculture No. 261/KPTS/SR.310/M/4/2019 on Technical Requirements Minimum Organic Fertilizers, Biofertilizers, and Soil Improvers.

The waste pile aged 7–18 months already shows characteristics close to stability. The pH increases to a neutral level (7.17), C-organic decreases to 19.26 percent, and macronutrients increase, particularly nitrogen and phosphorus, which already meet minimum requirements. The C/N ratio drops significantly to 46.62, although it is still above the acceptable limit, indicating that decomposition is not fully complete. Potassium levels tend to decrease due to leaching. Moreover, the mobile nature of the K element means it is easily lost through the washing process (Hidayanto, 2019). Overall, this waste has better potential than the younger pile. With additional treatment to further lower the C/N ratio, it can be used as a fertilizer or soil conditioner. However, the Pb content still exceeds the threshold, necessitating heavy metal stabilization before field application.

The waste pile aged 2–3 years shows characteristics that indicate a more mature decomposition phase. The average pH approaches neutral (7.09), and the C/N ratio (20.36) already meets the fertilizer and soil conditioner standards. However, decomposition is not fully uniform, as indicated by areas with acidic pH and the presence of resistant materials such as lignin. The low organic carbon content (3.21 percent) and declining macronutrient levels show that easily decomposed organic matter has been exhausted. Nutrient loss may also occur due to leaching during rainfall. Although Fe, Zn, and Cd levels remain within safe limits, Pb levels still exceed the standard, likely originating from electronic waste or batteries. This high concentration of Pb is supported by the fact that lead (Pb) is a heavy metal that naturally occurs in the earth's crust, but its presence in the environment can be 300 times higher from human activities, particularly from the motor vehicle battery industry. Additionally, Pb is also used in gasoline for vehicles, paints, and pesticides (Rahmi and Sajidah, 2018). This waste is more suitable as a soil conditioner for non-food crops, with additional treatment needed to reduce Pb contamination and improve nutrient availability.

As the age of the waste pile increases, significant changes occur in the stability and nutrient content of the organic material. Waste aged 0-6 months remains unstable and requires further treatment. Waste aged 7-18 months shows better maturity and can be used with additional refinement, while waste aged 2-3 years has reached the maturation phase but shows reduced nutrient content due to leaching and lower microbial activity. Overall, older waste material offers better stability, although improvements are still needed to meet fertilizer quality standards, particularly related to Pb reduction and nutrient enrichment.

Characteristics and potential of leachate

Table 3 presents the characteristics of leachate from the old and transitional Leachate Treatment Installation (LTI) at both the inlet and outlet points. The parameters evaluated include pH, C-organic, macro-nutrients, micro-nutrients, and heavy metals, and are compared with the quality requirements stated in the Ministry of Agriculture Decree No. 261/KPTS/SR.310/M/4/2019.

Table 3. Leachate characteristics in the Leachate Treatment Installation (LTI)

LTI	pH	Organic Carbon (%)	Macro-nutrients ($N+P_2O_5+K_2O$) (%)	Micronutrients		Heavy metals		
				Fe (ppm)[1]	Zn (ppm)[1]	Cu (ppm)[2]	Pb (ppm)[2]	Cd (ppm)[2]
Inlet old LTI	8.27	19.95	0.09	1.56	0.11	<0.0042	<0.08	<0.0081
Outlet old LTI	8.34	9.98	0.10	0.71	0.08	<0.0042	<0.08	<0.0081
Inlet transition LTI	7.68	29.93	0.15	2.26	0.19	<0.0042	<0.08	<0.0081
Outlet transition LTI	8.04	19.95	0.12	1.62	0.16	<0.0042	<0.08	<0.0081
Quality standard[2]	4–9	10	2–6	90–900	25–500	25–500	≤5	≤1

Notes:
[1]DLHK DIY Waste Processing Center test results report 2024
[2]Decree of the Minister of Agriculture No. 261/KPTS/SR.310/M/4/2019 on Technical Requirements for Minimum Organic Fertilizers, Biofertilizers, and Soil Improvers.

LTI inlet

The leachate entering the old LTI originates from a passive landfill zone that no longer receives new waste, which explains its more stable biological condition. Organic materials broken down by certain types of microorganisms initially produce simple organic acids, creating an acidic environment. In the subsequent process, other types of microorganisms consume these organic acids, causing the pH level to rise again

(Sulfianti, 2021). Therefore, the alkaline pH (8.27) and relatively lower C- organic content (19.95 percent) in the old LTI indicate that the decomposition process has entered the stable phase. These values indicate that the leachate meets the minimum requirement for liquid soil conditioners. However, the macro-nutrient content is very low at only 0.09 percent, falling far below the standard for liquid organic fertilizers. The concentrations of Fe and Zn are also much lower than the minimum required values, while Cu is undetected. Heavy metals such as Pb and Cd remain far below the maximum limits, showing that the leachate is safe in terms of toxicity.

In contrast, the inlet of the transitional LTI receives leachate from an active landfill zone, which still disposes of fresh household and food waste. This condition results in a lower pH of 7.68 and a higher C-organic content of 29.93 percent, reflecting active decomposition. This profile (lower pH and high organic concentration) aligns with characteristics of leachate still in the early fermentation phase, where the activity of acid-producing bacteria, such as those generating lactic and acetic acids, dominates, causing the leachate pH level to drop (Sulfianti, 2021). Similar to the old LTI, the macro-nutrient and micro-nutrient levels remain below the standards for organic fertilizer. Heavy metals also remain very low, indicating that the leachate is still safe for use. Overall, leachate from both inlets is more suitable as a liquid soil conditioner rather than a liquid organic fertilizer.

LTI outlet

After undergoing physical and biological treatment processes such as coagulation, sedimentation, anaerobic baffled reactors, aeration, and chlorination, the characteristics of leachate change significantly. At the outlet of the old LTI, the pH increases to 8.34, while the C-organic content decreases to 9.98 percent, which still meets the minimum requirement for soil conditioners. Macro-nutrients show a slight increase but remain below fertilizer standards. The concentrations of Fe and Zn decrease further, and Cu remains undetected. Heavy metals, including Pb and Cd, remain far below maximum limits.

At the outlet of the transitional LTI, the pH increases to 8.04 and the C- organic content decreases to 19.95 percent. Macro-nutrients decrease to 0.12 percent, reflecting biological processes such as denitrification. The concentrations of Fe and Zn also decrease, while Cu remains undetected. Pb and Cd concentrations remain within safe limits. The decrease in metal concentrations is likely due to precipitation triggered by the coagulation process in the initial treatment stages. Coagulation is a rapid mixing process that works by neutralizing particle charges, promoting particle aggregation, and forming flocs that can be easily removed from the treated water, including reducing levels of iron and manganese (Saputra, 2024).

Regulatory-wise, both outlets do not qualify as organic soil conditioners, as the treatment process involves the use of synthetic disinfectants such as chlorine, which is prohibited according to the Ministry of Agriculture regulations. Nevertheless, from a chemical perspective, the treated leachate still has potential as an alternative liquid soil conditioner, particularly for semi-organic or low-input farming systems.

Efforts to optimize quality and utilization

The findings from this study directly address the research goal of assessing the resource potential of Piyungan ISWM's residual waste streams to support sustainable waste management practices. Compost derived from waste aged 7-18 months and 2-3 years shows potential for use as solid organic fertilizer and soil improver, offering a viable pathway for circular economy implementation beyond basic disposal. In contrast, compost from waste aged 0-6 months is not recommended because it remains in the early decomposition stage and has unstable characteristics. Leachate from both the old and transitional treatment units also has potential as a liquid soil improver based on its chemical composition. However, its utilization is more suitable for non-food crops unless nutrient enrichment is conducted to meet the organic fertilizer standards. This dual potential (solid and liquid) implies that proper separation and further refinement can significantly reduce the volume requiring final disposal while generating valuable agricultural inputs, thereby contributing to the long-term sustainability of regional waste management.

Improvement of nutrient content can be carried out by adding specific organic materials according to the required elements. Nitrogen can be increased using chicken manure, cow urine, or lamtoro leaves (Langi, 2017; Hairul *et al*., 2016; Ningsih *et al*., 2013). Phosphorus can be improved with cow bone meal or rice straw, while potassium can be added through wood ash, banana stalks, or corn husks (Hairul *et al*., 2016). C-organic levels may be enhanced using organic matter amendments. These amendments help improve the C/N ratio, pH, and nutrient availability.

This study still has several limitations that may be addressed in future research. Additional analyses such as moisture content, *E. coli*, *Salmonella sp.*, organic nitrogen, the presence of co-materials, and evaluation of other heavy metals including As, Hg, Cr, and Ni are needed to ensure compliance with the Ministry of Agriculture Standard No. 261/KPTS/SR.310/M/4/2019. Field trials are also necessary to obtain more representative results regarding the effects of compost and leachate application on soil and plants, to support sustainable agricultural practices. For management purposes, TPST Piyungan is advised to conduct routine monitoring of heavy metals in both leachate and solid waste to prevent pollutant accumulation. Early separation of organic and inorganic waste is also important to facilitate processing and improve the safety and value of organic residues.

CONCLUSION

The characteristics of solid organic waste at TPST Piyungan varied with waste age. Waste aged 0–6 months remained unstable, whereas waste aged 7–18 months exhibited more favorable properties, including near-neutral pH and higher nutrient availability. Waste aged 2–3 years reached the maturation stage but showed reduced nutrient concentrations, likely due to leaching. Overall, waste aged 7–18 months and 2–3 years demonstrated potential for use as an organic fertilizer or soil conditioner, although low organic carbon content and elevated Pb concentrations remain limiting factors.

Leachate from both the old and transitional Leachate Treatment Installations (LTI) met the minimum requirements for liquid soil conditioners but did not satisfy the standards for liquid organic fertilizer because of insufficient micronutrient concentrations. These findings suggest that both solid waste and leachate have potential for agricultural utilization following further treatment, particularly through nutrient enrichment and heavy-metal stabilization. Future studies should validate their agronomic performance and environmental safety under field conditions.

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