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Designing Temporary Waste Disposal Site for Integrated Waste Management in a Coal Mining Township, South Sumatra, Indonesia

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ABSTRACT

Waste management at the residential level is crucial to avoid overburdening final disposal sites. This study aims to design the waste management facility units and investment of temporary waste disposal site with a reduce, reuse, recycle concept (TPS3R) in the coal mining Township of PT. Bukit Asam. The research includes observation, literature review, calculations, and design of waste generation and volume in the township to support the TPS3R construction. Current practices involve containerization, separation, and daily collection, with waste transported to the landfill. However, waste generation driven by population growth and consumption patterns exceeds the system's capacity, requiring infrastructure improvements and increased community awareness. The TPS3R facility is designed with units for mixed waste unloading, sorting, inorganic waste handling, and composting. Valuable inorganic waste is collected for sale, while organic waste is composted using the windrow method. The estimated investment for constructing the TPS3R is IDR 792,518,057, with operational and maintenance costs at IDR 1,090,848,095. Expected revenue from organic and recyclable waste sales is IDR 1,524,620,695. Initial funding and additional operational support are provided by PT. Bukit Asam. The TPS3R design not only provides a technical waste management solution, but also enhances community awareness and participation in sustainable waste practices.

1. INTRODUCTION

Waste is a global issue requiring urgent attention, particularly in urban areas of Indonesia. Waste management problems are primarily focused on inadequate waste management practices. Unmanaged waste can produce leachate, which contaminates groundwater, and methane (CH_4) gas, a significant contributor to global warming [1]. Additionally, unmanaged waste can be a source of disease, create unpleasant odors, and degrade the aesthetics of an area [2]. Currently, the waste management paradigm in Indonesia follows a "collect-transport-dispose" approach [3]. Most waste sent to final processing sites (TPA) is neither sorted nor processed beforehand. Waste is simply dumped at the TPA, even though TPAs are meant to be the final stage after prior processing at the source, and they can only accommodate 60-70% of the waste. In response to deteriorating public health conditions, the Indonesian government has started promoting community-based waste management programs utilizing temporary waste disposal site with reduce, reuse, recycle concept (TPS3R) facilities [4]. TPS3R waste management methods aim to reduce the amount of waste transported to TPAs by sorting waste with residual value for processing or recycling into valuable products [5, 6].

Effective waste management is essential, especially in residential areas of coal mining. While coal mining has positively impacted the local economy, it has also created significant waste management challenges in the township that need immediate attention. Efficient and sustainable waste management is a major challenge for housing communities and requires an integrated approach to support the well-being of employees residing in company housing. One viable solution is the design and implementation of an integrated waste processing site. The TPS3R concept, which emphasizes reduce, reuse, and recycle, offers a comprehensive approach to waste management [7]. Implementing this system can decrease the volume of waste sent to final disposal sites (TPA), mitigate environmental impacts, and enhance public awareness and participation in waste management [8].

TPS3R technology is recommended for waste treatment in Indonesia [9]. Research involving the modeling and simulation of TPS3R development dynamics has been conducted in Aceh [10]. The study concluded that the facility should include a combination of one composter unit, two plastic counter units, and the participation of at least 131 households. In planning waste transportation systems, Putri et al. [11] emphasized the importance of integrating waste reduction activities, such as waste bank units and the TPS3R system, targeting a 20% reduction in waste in the Seberang Ulu Region of Palembang City. In Tangerang, Ulhasanah et al. [12] proposed an alternative design for processing organic waste using hollow brick boxes and plastic waste using a crushing machine at TPS3R facilities. Economic challenges often arise in the operation of TPS3R systems in Indonesia. Case studies in Cibodas and Padamukti Villages in West Java highlight the importance of detailed mass balance analysis and financial modeling based on the waste composition at each TPS3R location, which influences the type of technology and product used. This research also underscored the need for capital investment from the government or other agencies to support TPS3R operations [13].

To the best of our knowledge, research examining the management and design of a temporary waste disposal site with reduce, reuse, recycle concept (TPS3R) in Township coal mining is very limited. Therefore, this research aims to design a TPS3R system for the coal industry township owned by PT in Tanjung Enim, considering waste characteristics, cost estimates, and appropriate infrastructure implementation. With population growth projections and waste generation estimates, the results of this study provide a strong basis for planning an efficient and environmentally friendly waste management system. It emphasizes the importance of comprehensive cost estimates in TPS3R planning, including costs for building infrastructure, purchasing equipment, operational expenses, and community education programs. One of the obstacles in implementing TPS3R besides the initial investment is waste sorting. Therefore, the proposed TPS3R design includes a waste storage area, waste sorting facilities, processing units for organic and inorganic waste, and storage for recyclable or landfill-bound waste. The TPS3R technology used in this research incorporates innovative press machines, waste choppers, and compost sifters, which are more effective and efficient. Consequently, this research not only provides technical solutions for waste management in mining industry township housing but also contributes to increasing awareness and promoting sustainable waste management practices among employees and the surrounding community.

2. MATERIALS AND METHODS

2.1 Research and study area

Tanjung Enim is experiencing rapid growth, primarily driven by the coal mining industry, notably through large companies such as PT. Bukit Asam. Township, located in the Lawang Kidul District of Tanjung Enim, South Sumatra, Indonesia is a facility specifically provided for company employees. The primary aims of this housing are to improve employee welfare, enhance retention, and strengthen the relationship between employees and the company. The Township is designed to accommodate various levels of employee positions, including homes for Directors, Vice Presidents, Assistant Vice Presidents, and Assistant Managers. Geographically, the Township is situated at coordinates 3°46'16.45"S and 103°47'1.37"E, indicating a strategic location that provides easy access for employees working in this sector (Figure 1).

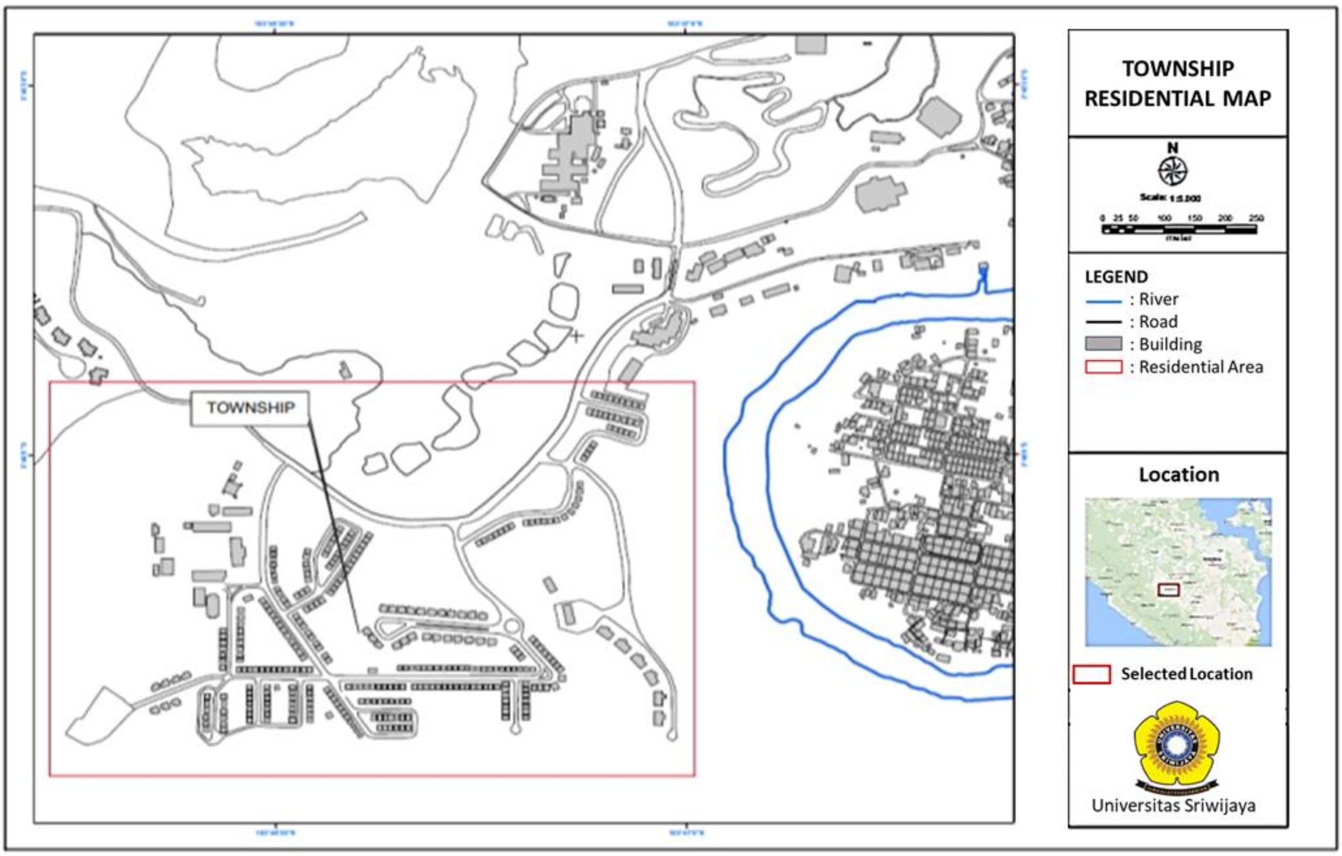

Figure 1. Study location

2.2 Materials

This study measures the waste generated in the PT. Bukit Asam Township area, encompassing both household and non-household waste associated with households. Waste generation is quantified according to the Indonesian National Standard (SNI) 19-3964-1994, using units of liters per person per day (L/person/day) for volume and kilograms per person per day (kg/person/day) for weight. This research focuses on the physical characteristics of waste, specifically composition and density. Waste composition is categorized into organic and inorganic materials. Organic waste includes residues from organic materials that originate from human activities or natural processes and decompose naturally over time, such as food waste, leaves, paper, and wood. Inorganic waste, which is not easily decomposed and often originates from minerals, includes materials like glass, rubber, metal, and plastic and can be recycled. Additionally, items commonly found in residential and non-residential areas, such as batteries, masks, and electronic devices, are considered residues. Waste composition is measured as a percentage by weight, and waste density is measured in kilograms per cubic meter (kg/m³).

2.3 Method

This research employs both primary and secondary data collection methods, including observation, literature review, calculations, and design. Observations were conducted over eight days, focusing on measuring the amount and volume of waste generated in the Township, specifically from the Director's house, Vice President's house, Assistant Vice President's house, and Assistant Manager's house. This data collection process adheres to the Indonesian Standard with number 19-3964-1994 standard for sampling and measuring the generation and composition of urban waste. Secondary data were sourced from various references, including population data, waste generation data from PT. Bukit Asam, and supplementary information from journals and websites. The data serves as the basis for calculating the size and type of equipment, the number and wages of workers, energy and electricity needs, land area, and other costs that must be calculated to determine the investment costs.

For population projections, three general methods were utilized: the arithmetic method, the geometric method, and the exponential method [14, 15]. For projecting the population over a 10-year period, the geometric method [14] was chosen. The subsequent step involved calculating the projected solid waste generation by multiplying the average waste generation per capita by the previously estimated population projection.

The analysis of cost estimates for TPS3R represents a crucial phase in sustainable waste planning and management. This estimation encompasses diverse aspects, including infrastructure development costs for constructing waste processing facilities, procuring sorting and recycling equipment, and operational expenses like transportation, equipment upkeep, and employee salaries [16, 17]. In the waste processing process, waste sorting may have shortcomings due to the lack of adequate technology. The sorting is still done manually by workers. Additionally, it is essential to estimate costs for educational programs and community outreach aimed at promoting waste segregation and environmentally sound waste management practices. A thorough cost estimation analysis enables the formulation of an accurate and practical budget for TPS3R implementation, thereby facilitating the attainment of sustainable waste management objectives [18].

The TPS3R design must incorporate previously analyzed cost estimates to optimize resource efficiency. For instance, in infrastructure design for 3R waste management, it's essential to consider the cost-effectiveness of constructing and operating waste processing facilities, alongside selecting environmentally friendly and efficient equipment aligned with the prepared cost estimates. Establishing a waste processing system using TPS3R is deemed technically sufficient if it meets the criteria outlined in the TPS3R Technical Guidelines, including servicing a minimum of 400 households on a 200m^2 land area. This design entails various zones: mixed waste storage, waste sorting, organic and inorganic waste processing, as well as areas for processing or storing recycled inorganic waste and residues. Thus, integrating cost estimation analysis with TPS3R design ensures effective realization of sustainable waste management plans through efficient budget utilization.

3. RESULTS AND DISCUSSION

3.1 The existing condition of solid waste management in township

Based on interviews with public service work unit officers, household waste management at the source level in township involves containerization, separation, and collection activities. Containerization serves as the initial waste handling stage, utilizing 4 L drums for waste collection. Daily, 120 to 130 bags of trash are collected from 47 sampled houses between 5-7a.m., followed by transport to the landfill by truck.

3.1.1 Waste generation and composition

Waste generation refers to the quantity of waste produced within a specified timeframe, measured in weight (kg) or volume (L). The generation of waste is influenced by factors such as population growth, living standards in the area, consumption habits, and commercial activities. Presently, the residents of Township generate a significant amount of solid waste that surpasses the capacity of the existing waste management system. This discrepancy highlights the need for improved waste management strategies in township, including infrastructure upgrades and increased public awareness about sustainable waste management practices.

The estimation of waste generation in Township involves projecting the waste generation rate relative to the population. Previous research indicates that each waste source produces varying amounts of waste, influenced by activities at each source and the number of samples collected. Calculations demonstrate that waste generation escalates with population growth in township, correlating with expected trends in population growth and waste production levels. Details on total domestic and non-domestic waste generation in Township are documented in Table 1.

The waste generated by residents is related to their job positions at PT. Bukit Asam. Samples were taken from 41 households who produced 630.34kg of waste in one week. The average waste produced by different groups as summarized in Table 1. Based on analysis, Assistant manager cluster produced highest volume waste than other clusters. This is influenced by the number of occupations which is higher than the others. More employees in those positions live in the Township. Differences in waste weight and volume among employees with various income levels arise from the type of waste generated in their households, influenced by their monthly earnings. Variations in waste weight and volume in the samples are also caused by waste compaction, with organic waste being heavier but less voluminous and inorganic waste being lighter but more voluminous.

Table 1. Waste generation and volume in the township

Day	Directors			Vice President			Assistant Vice President			Asisstant Manager		
	Number of Occupants	**Weight**	**Volume**	**Number of Occupants**	**Weight**	**Volume**	**Number of Occupants**	**Weight**	**Volume**	**Number of Occupants**	**Weight**	**Volume**
1	3	0.64	12.80	17	9.00	95.60	50	17.55	182.80	105	45.55	613.20
2	3	0.48	10.80	17	7.89	78	50	16.87	216.80	105	54.60	534.80
3	3	1.44	30.80	17	9.80	92.80	50	17.07	200	105	49.73	551.60
4	3	1.96	25.60	17	9.35	89.20	50	17.91	222.40	105	52.14	547.60
5	3	1.89	31.20	17	6.82	88.40	50	17.56	206	105	49.01	515.60
6	3	2.04	26.80	17	9.27	94	50	19.03	191.60	105	47.06	573.20
7	3	1.89	25.20	17	8.61	78	50	18.24	216.80	105	53.59	540.80
8	3	2.28	31.20	17	9.80	92.40	50	19.07	201.20	105	52.20	551.60
Average Yield (/day) and Average Volume (/day)		1.58	24.30		8.82	88.55		17.91	204.70		50.49	553.55
Average Yield (/person/day) and Average Volume (person/day)		0.53	8.10		0.52	5.21		0.36	4.09		0.48	5.27

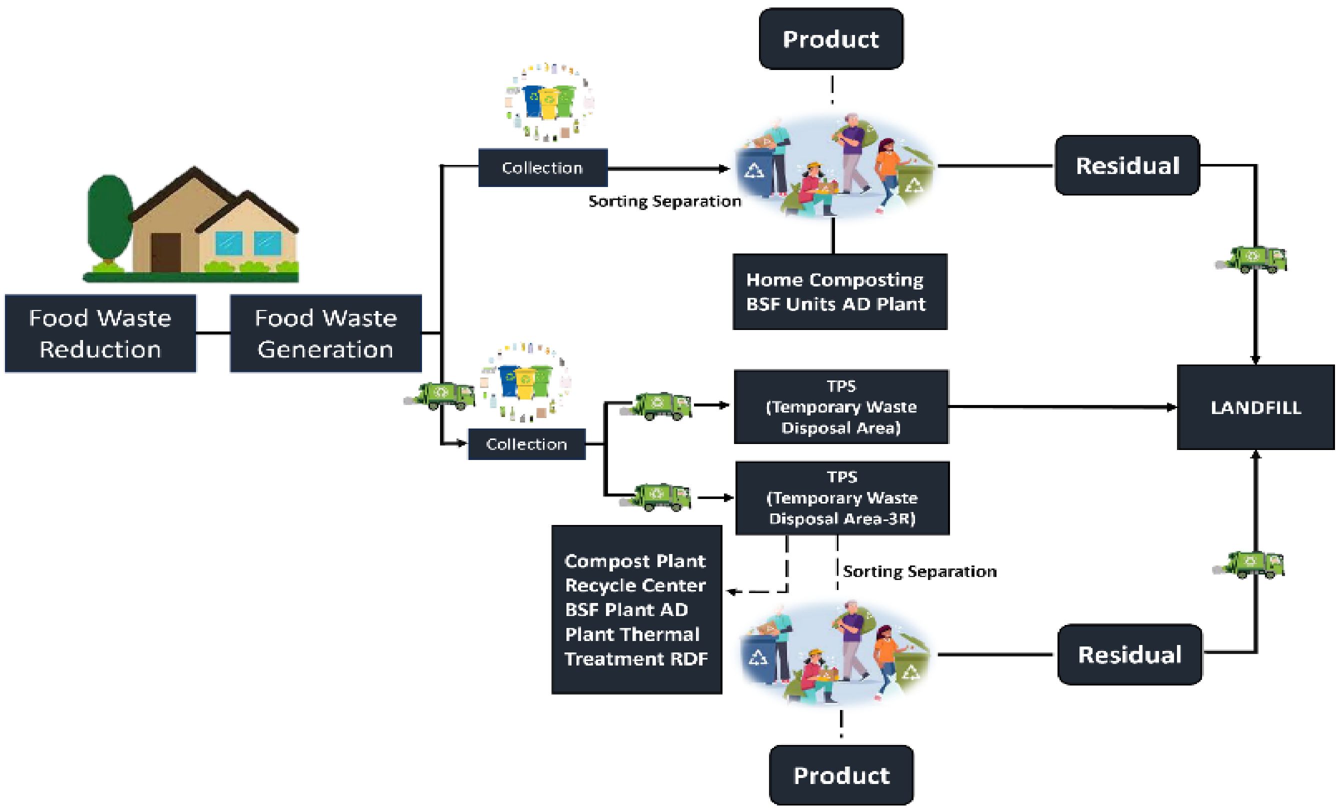

Figure 2. Design of waste processing flow at TPS3R township

3.2 Design of a temporary waste disposal site (TPS3R)

The processing area in TPS3R comprises a reception or pre-processing section, an inorganic waste handling area involving waste washing and compaction, a storage facility, and other infrastructure supporting TPS3R operations. The planned waste management concept involves sorting inorganic waste for resale and converting organic waste into compost to optimize utilization and minimize residual waste. TPS units include mixed waste dumping units, waste sorting units, inorganic/recycled waste processing/storage units, and organic waste processing units (including composting with organic waste choppers) (Figure 2).

The planned operational period for TPS3R in Township is 10 years, aiming for a service level of 100%. Generally, waste from Township Housing is transported to TPS3R and deposited in the waste reception area. Upon arrival, waste is segregated into organic and inorganic categories. Organic waste is directed to the organic waste reception section, while sorted inorganic waste, categorized into five types, is also deposited in respective reception sections. Some organic waste undergoes composting [19, 20], while recovered inorganic waste undergoes washing or compacting and is subsequently sold to third parties [21]. Residual waste is temporarily stored in a residue storage warehouse before final disposal at the landfill. The operational hours for TPS3R are from 8a.m. to

3p.m., with a break from 12p.m. to 1p.m.

3.3 Mixed waste dumping unit

3.3.1 Waste loading rate

The loading rate is the amount of waste processed in the TPS3R hangar per hour. In this plan, the operational time for TPS3R is scheduled for 7 hours each day. To calculate the loading rate, data from the daily waste volume in the last planning year of 2023 is used, where the daily waste volume reached 50,240.26 L/day. Based on calculations, the waste loading rate is 8,373.38L/h or 8.37m³/h.

3.3.2 Reception/pre-processing area

The reception area is situated at the front of the TPS3R building, adjacent to the entrance. Here, waste collection vehicles will unload waste transported from the Township Complex. Therefore, this area must adequately accommodate waste generated from all Township areas, allowing waste transport vehicles to enter and unload efficiently. Prior to sorting in the next area, workers will segregate oversized items and materials that could disrupt subsequent management and processing units. Items with sales value will be stored in warehouses for recycling by waste collectors, whereas those without sales value or reprocessing potential will be treated as residual waste and disposed of in the landfill.

3.3.3 Waste sorting types

The subsequent step involves waste sorting conducted by contracted sorting officers at TPS3R. Sorting at TPS3R continues even after the waste has been sorted in the dump truck, ensuring accurate categorization of waste types: organic waste, plastic, paper and cardboard, glass, metal, and residue [22]. The main sorting process occurs once daily with five personnel manually sorting waste. Adjacent to the sorting table area are designated bins for each category of inorganic waste, facilitating storage and grouping for subsequent management and recycling. The choice of bins aids in easy transport to the next processing site. Meanwhile, residual waste is collected using carts and stored in a residue storage warehouse before landfill disposal. Organic waste sorted at the reception site undergoes composting in a dedicated facility. Each bin has a capacity of 660 L. Based on a recovered waste loading rate of 4,280.3L/h for paper, 5,708.33L/h for plastic, 458.33L/h for glass, and 666.67L/h for metal, the required number of bins for inorganic waste totals 61 units. The calculation of the total sorting area needed is outlined in Table 2.

Table 2. Waste sorting land requirements

Planning	Needs
Loading Rate Waste	8373.38 L/hours 8.37 m^3/hours
Area Dimensions Pre-Processing (m)	6×7×5
Pre-Processing Plan Area (m^2)	42
Dimensions of Sorting Table (m)	5×7×5
Sorting Plan Area	35
Total Land Requirement (m^2)	77

3.4 An organic waste handling unit

In this area, inorganic waste such as plastic, glass, and metal is processed through washing. Following washing, the waste is segregated into different storage areas based on its type for eventual sale to collectors. Inorganic waste, excluding paper, undergoes washing after the sorting process to prepare it for recycling. Subsequently, the washed inorganic waste is dried in a manual drying area. The combined area comprising the washing tub and waste drying space measures 10m². Plastic waste undergoes compression using a press machine to conserve space in the inorganic waste storage warehouses and facilitate transportation to recycling stalls for sale. Each type of waste is segregated by category within a single room, with sufficient storage capacity for all waste managed over a typical work week (5 days). The total area necessary for storing inorganic waste amounts to 19.25m². Specifics regarding the total area required for handling inorganic waste are outlined in Table 3.

Table 3. Calculation of total inorganic waste handling area

Planning	Needs
Washing and Drying Area Dimensions (m)	4×4×5
Washing and Drying Area Plan (m^2)	16
Dimensions of Waste Press Area (m)	4×3×5
Plan Area of Waste Press Area (m^2)	12
Storage Shed Dimensions (m)	6×7×5
Storage Shed Plan Area (m^2)	42
Office Dimensions (m)	6×4×5
Office Area (m^2)	24
Total Land Requirement (m^2)	94

3.5 Equipment and needs storage warehouse

The warehouse serves to store equipment essential for supporting TPS3R operations, occupying a built area of 18 m². By calculating the technical requirements for the TPS3R main hangar as detailed in the preceding point, the total land area necessary for the TPS3R main hangar is determined. A summary of the land area requirements is provided in Table 4.

Table 4. TPS3R main hangar area requirements

Planning	Needs
Waste Pre-Processing & Sorting Room (m^2)	77
Inorganic Waste and Office (m^2)	94
Warehouse (m^2)	18
Building Plan Dimensions (m)	33×7×5
Total Area of TPS3R Main Hangar (m^2)	231

3.6 Composting unit

The compost house facility is utilized for conducting composting activities at TPS3R. It comprises a waste shredding area, composting area, compost sieving and packaging area, and a compost storage warehouse. The initial stage involves quantifying the organic waste directed to the composting house. The shredding process aims to reduce waste size, facilitating quicker and more efficient composting [23]. Mechanical shredding of organic waste is executed using an organic waste chopping machine. Besides the chopping machine, the area must also accommodate the hourly volume of organic waste generated by TPS3R. In planning, it is assumed that the waste processed in the shredding area aligns with the amount destined for composting. The composting method adopted at TPS3R Township is the windrow method [24, 25]. This technique involves the addition of EM4 inoculum, with a composting duration of 28 days.

To accommodate 60 compost mounds every 30 days, the mounds are arranged in 6 rows, with each row containing 10 mounds. The spacing between mounds is 1m long and 0.5m wide, with a distance of 0.5m between the mounds and the wall, resulting in a required composting area of 720m^2. After 30 days, the finished compost undergoes mechanical sieving using a compost sieving machine to ensure uniform size. Any larger compost particles are returned to the composting area for further processing. Following sieving, the compost is packaged into 10kg bags and stored in the compost storage warehouse until sale. The warehouse is designed to store compost produced over one working week. The total area needed for constructing the TPS3R Housing Township composting house is detailed in Table 5, while the specifications of the main equipment used in TPS3R are summarized in Table 6. The selection and size of equipments based on the waste capacity to process based on the Indonesian Standard with number of 19-3964-1994, such as pressing, shredding, and composting. The layout and design of TPS3R in this study are depicted in Figures 3-4.

Table 5. Total area of composting house

Planning	Needs
Waste Shredding Area (m^2)	16
Composting Area (m^2)	720
Sieving and Packaging Area (m^2)	40
Compost Storage Shed (m^2)	16
Total Land Requirement (m^2)	702
Building Plan Dimensions (m)	40×18×5
Total Composting House Area (m^2)	792

Table 6. Main equipment specifications in TPS3R planning

Garbage Press Machine		Organic Waste Shredding Machine		Compost Sifter	
Model and Type	MPH 6T Electric Hydraulic Press	Material	Thick angle frame	Model and Tipe	AM-AK500
Frame	UNP 120	Knife	Steel	Frame material	5 angle iron
Capacity	+/-12 ball/hours	Capacity	200-300kg/h	Capacity	400kg/h
Drivers	3PK 3 phase / motor diesel 30 PK	Drivers	5.5 hp petrol or 7 pk diesel motor	Drivers	8 HP Diesel / HP Electric Motor
Dimention	150×90×250cm	Dimention	120×55×120cm	Dimention	450×100×150cm
Compressive Strength	2000-6000kg	Knife Quantity	6 sets (3 pcs per set)+1 fan	Total Weight	534g
Ball Size	50×50×70cm	Tube Diameter	40cm	Sieving Material	Perforated plate SS

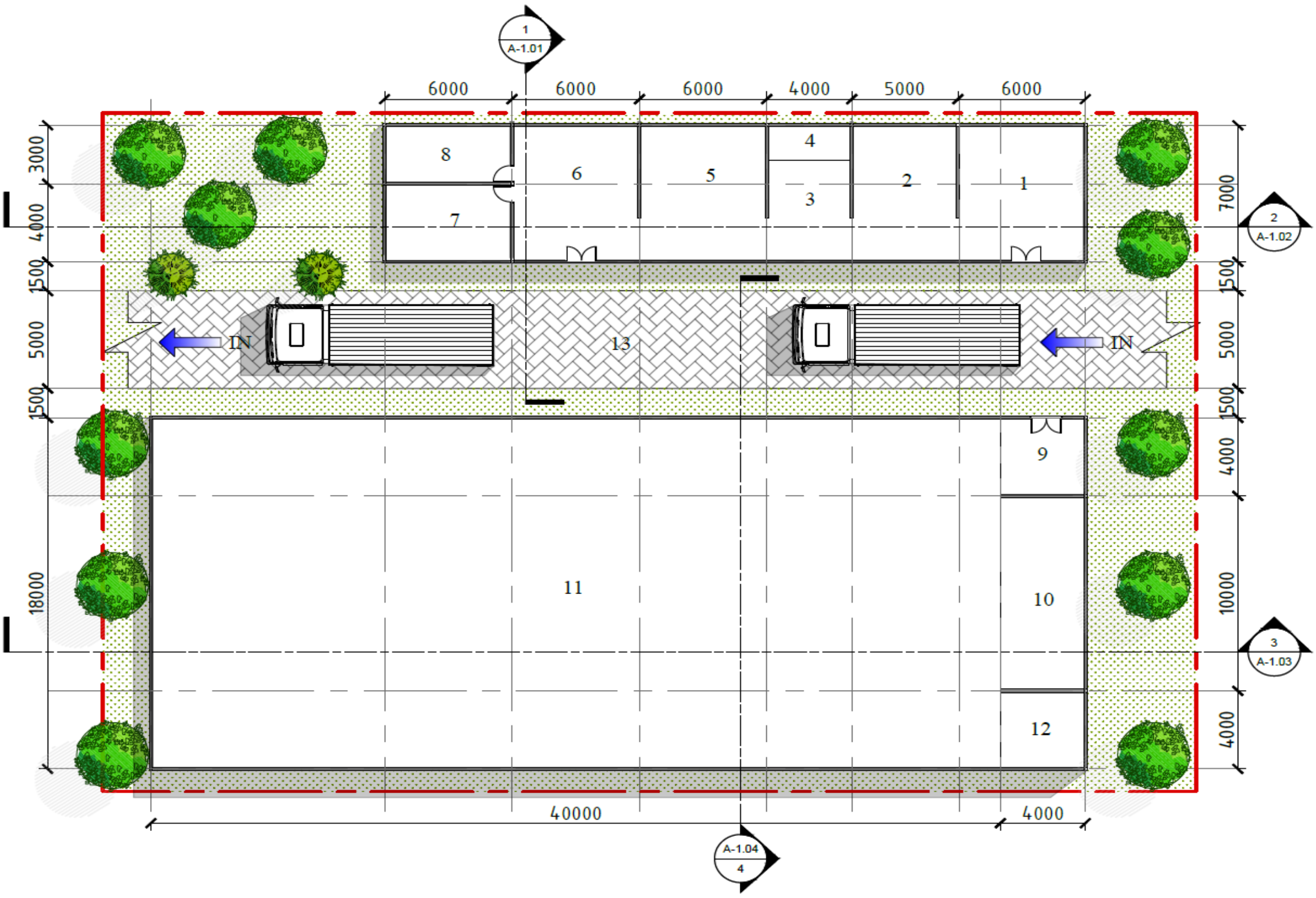

Figure 3. The layout of TPS3R at Township PT. Bukit Asam

(1) Waste reception room; (2) Sorting room; (3) Washing room; (4) Waste press room; (5) Storage warehouse; (6) Residue warehouse; (7) Office; (8) Equipment warehouse; (9) Organic waste reception room; (10) Sieving and packaging room; (11) Composting room; (12) Storage warehouse; (13) Road

Figure 4. 3D modeling building design of TPS3R at Township PT. Bukit Asam

3.7 Cost estimation and future recommendation

Following the design of the TPS3R building, calculations were conducted to draft the expenditure and income budget to estimate the required costs. The initial investment cost for constructing TPS3R amounts to IDR 792,518,057, allocated for the purchase of machinery and other equipment needs. This initial investment was funded by PT. Bukit Asam, the owner and manager of the Township. Projected operational costs in 2023 are around IDR 1,090,848,095 (Table 7), including equipment, salaries, equipment maintenance, and purchase of consumables which are also added to depreciation costs. Sales of valuable waste consist of sales of compost, plastic, paper, metal and glass. Costs are meticulously planned based on investment, operational, and maintenance expenses [26]. The operational maintenance costs include various components, such as workers' wages, safety equipment like boots, helmets, reflector vests, gloves, and masks. Additionally, the operational costs cover the use of EM4 for composting, the operation and maintenance of dump trucks, maintenance of garbage carts, buildings, and waste processing machinery. Income and expenditure estimates for the next ten years are illustrated in Figure 5, demonstrating consistent annual increases in both income and expenditure.

Income for the operational TPS3R is derived from the sales of compost and valuable inorganic waste such as paper, plastic, metal, and glass. In the management planning of TPS3R, there is a fixed annual income expected from PT. Bukit Asam, budgeted around IDR 50,000,000 annually as part of the company's budget plan. Financing and income aspects are crucial resources that sustain effective waste management operations. The waste management system is expected to be self-sustaining. Therefore, establishing TPS3R can provide benefits to the management, which can be used to enhance the income of locally recruited workers [27].

Table 7. Summary of cost estimation for TPS3R construction

Cost Component	Value
Income	
Sales Proceeds of Sellable Waste	IDR 1,524,620,695
Funds from PT. Bukit Asam	IDR 50,000,000
Total Income	Sales Results+RKAP PTBA IDR 1,524,620,695+IDR 50,000,000 IDR 1,574,620,695
Expenses	
Operation & Maintenance Costs	IDR 1,090,848,095
Reinvestment	-
Unexpected Expenses	5%×(OP Cost+Reinvestment) 5%×(IDR 1,047,648,095+IDR 0) IDR 54,542,405
Total Income	OP Expenses+Reinvestment+Unexpected Expenses IDR 1,047,648,095+IDR 0+IDR 52,382,405 IDR 1,145,390,500
Profit	Total Income-Total Expenditure IDR 1,574,620,695-IDR 1,100,030,500 IDR 429,230,195

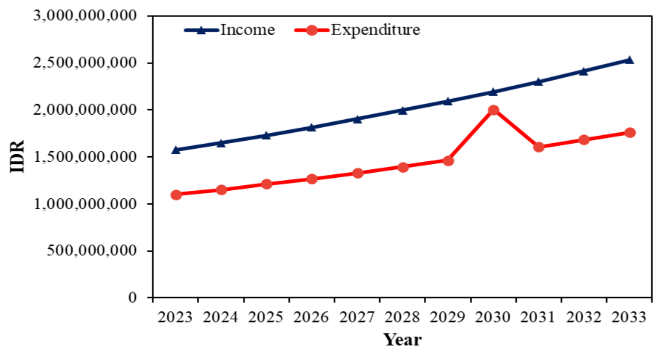

Figure 5. Economic profile of TPS3R

Future research should explore the scalability of the proposed TPS3R (Reduce, Reuse, Recycle, Recovery) design by investigating its adaptability to different township sizes and waste generation rates. Studies could focus on optimizing the design for various environmental conditions and resource availability, ensuring it remains effective across diverse settings. Additionally, research could look into incorporating renewable energy sources into the TPS3R facilities to enhance sustainability. Also, TPS3R can generate some energy or other valuable product such as plastic pyrolysis oil, refused derived fuel, and organic pellets. Assessing the long-term cost-effectiveness and environmental impact of scaling up the TPS3R model would provide valuable insights for broader implementation. This study has provided an in-depth assessment of the long-term effectiveness and sustainability of these methods. Additionally, it includes a financial analysis of investment costs, operations, and potential income, which strengthens the practical implementation of the recommendations, an aspect that was not addressed in the previous study [11]. This research also offers a more comprehensive projection, including return on investment and initial financial support from PT. Bukit Asam, demonstrating a stronger readiness for practical implementation compared to the study by Ulhasanah et al. [12].

4. CONCLUSION

A waste processing program designed with the reduce, reuse, recycle (TPS3R) concept has been developed as a solution to the waste issue in the Township owned by PT. Bukit Asam. According to the analysis results, waste management in Township of PT. Bukit Asam entails trash containment, separation, and collection, all of which is delivered to the landfill on a daily basis. Population expansion and consumption habits have outpaced the capacity of the present waste management system, needing improved infrastructure and public awareness. TPS3R is specifically designed to manage waste in PT. Bukit Asam Township. It comprises several units: a mixed waste dumping unit including areas for waste loading, reception, and waste type sorting; an inorganic waste handling unit; and a composting unit. Valuable inorganic waste such as plastic, paper, cardboard, glass, and metal is collected for sale. Organic waste undergoes composting using the windrow method.

Based on calculations, constructing TPS3R requires an investment of IDR 792,518,057 for machinery and equipment, with operational and maintenance costs amounting to IDR 1,090,848,095. Estimated income from TPS3R, derived from the sale of processed organic and valuable waste, is IDR 1,524,620,695. PT. Bukit Asam, as the Township owner, provided initial financing and additional operational funding to manage TPS3R. An effective TPS3R design not only provides technical solutions to waste management but also enhances community awareness and engagement in sustainable waste management practices.

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NOMENCLATURE

TPS3R	Temporary waste disposal site with a reduce, reuse, recycle concept
TPA	Final processing site
IDR	Indonesian Rupiah (currency)