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Regional Case Study

Planning a Waste Processing Site with the 3r Plus Principle in Kapur Village, Sungai Raya District, Kubu Raya Regency

Yenni Andriyani[1*], Yulisa Fitrianingsih[1], Rizki Purnaini[1]
[1] Department of Environmental Engineering, Faculty of Engineering, Universitas Tanjungpura, Jalan Prof. Dr. H. Hadari Nawawi, Pontianak, Indonesia 78124
* Corresponding Author, email: yenniandriyani013@gmail.com

Abstract

Kapur Village is located in Sungai Raya District, Kubu Raya Regency. The existing condition of waste management has not been implemented properly due to the lack of waste management facilities, namely temporary waste disposal and other communal waste containers, so efforts are needed to handle the waste management system, by planning temporary waste disposal 3R plus. The aim of planning is to know, analyse existing condition of management waste, generation size, density, waste composition and planning the 3R temporary waste disposal design. The research method is sampling generation, density and composition of waste according to SNI-19-3964-1994, conducting interviews and questionnaires to obtain selected locations. The resulting waste generation is 0.35 kg/person/day. The density of domestic source waste is 142.09 kg/m3, while the largest density of non-domestic source waste is produced from restaurants at 113.32 kg/m3. The composition of domestic waste is dominated by organic waste with a percentage of 49.3%, while non-domestic waste is dominated by paper waste with a percentage of 30.60%. This 3R plus temporary waste disposal planning requires land of 1,112.3 m^2. The planned waste management is is processing organic waste into composting using the hollow brick method, while inorganic waste in the form of plastics and bottles is processed into handicraft products.

Keyword: Selotif method; waste management system; temporary waste disposal 3r plus

1. Introduction

Human daily activities and natural processes produce garbage as residue in the solid form. Nowadays, waste has become a national problem, so it is necessary to have a good management from up to down so that it can bring some benefits in economic, community health, change human behaviour, and that's all for protecting the environment (Law No. 18 of 2008). The factor that can affect the high waste production in an area is the high rate of population growth (Himmah et al., 2014), so that it can be said that the waste volume is directly proportional to the rate of population growth. The amount of waste generated can cause various problems if it is not handled properly, so an effort is needed to reduce the amount of existing waste production (Marsyah et al., 2021). The main causes of problems were identified in waste management's operational technical aspects like inadequate segregation, collection, storage, transportation, and processing (Cyntia et al., 2016). Waste management with the old paradigm system has a negative impact, namely requiring a large budget from time to time if not application the waste management system that refers to the latest regulations (Prihatin, 2020).

Temporary waste disposal 3R is a place for carrying out activities collection, sorting, reuse, and regional scale recycling. Handling waste using the 3R method is a concept of overcoming the waste problem by reduce, reuse, and recycle. Reduce is an activity to suppress and reduce the volume of waste. Reduce can be interpreted as an effort to maximize the use of goods so that they are not easily turned into waste. Reuse is the activity of reusing goods without undergoing processing. Recycling is an activity to utilize waste by recycling it. In recycling activities there is a processing process to become other

materials that are useful and can be reused. temporary waste disposal 3R is a place-based waste processing *reduce, reuse, recycle* (3R) which not only reduces the amount of waste that goes to the landfill, but can also provide other benefits (Lawa et al., 2021). The concept of waste management with the 3R principle is the basis of various efforts to reduce waste and optimize waste production processes (Nindita, 2017). temporary waste disposal 3R is expected to be a solution in making the use of increasingly critical land more effective, especially for the provision of landfill in urban areas, thus the role and function of temporary waste disposal 3R is very important in the latest waste management efforts. The new paradigm of waste management sees waste as a resource that can be utilized and has economic value, such as for energy, fertilizer, compost and also industrial raw materials (Masrida, 2017).

Kapur Village is one of the villages in Sungai Raya District, Kubu Raya Regency. Based on BPS data for Sungai Raya Subdistrict, in figures for 2020 Kapur Village has a population of 10,083 people. With a large population and high population density, the amount of waste production that will be produced is also relatively high. Existing conditions waste management in Kapur Village still applies the old paradigm system, namely collecting, transporting and disposing of it, there are also people who still pile up and burn garbage in their yards/back of the house, this is due to a lack of waste management facilities, such as a lack of waste management facilities (temporary waste disposal) and other communal waste collection containers in the Kapur village area. There is also a simultaneously significant relation between knowledge and attitudes about waste management to resident's behaviour (Pambudi and Sudaryantiningsih, 2017).

Based on the description of the problem, as an effort to overcome the waste problem that is currently happening, it is necessary to have good waste management efforts in Kapur Village, namely in the form of planning a Waste Processing Site using the principle of *reduce, reuse, recycle* (temporary waste disposal 3R) plus reference to the temporary waste disposal 3R technical guidelines issued by the Public Works and Housing Office of the Republic of Indonesia. With the 3R temporary waste disposal planning, it is possible to reduce waste starting from the source in accordance with current conditions, namely inadequate waste sorting and reduction from the source (households) as well as involving the active role of the government and community through a community empowerment approach, including communities with low income and/or who live in crowded and slum settlements. An integrated waste management system based on 3R is a system approach that should be used as a solution in solving problems regarding waste (Sitanggang et al., 2017). The purpose of this plan is to plan a temporary waste disposal 3R design that is suitable and can be implemented in Kapur Village based on the waste generation and waste generated compositions in Kapur Village.

The temporary waste disposal 3R plus intended in this plan is to process organic waste into compost which will then be used for fertilizer for vegetables and plants in temporary waste disposal 3R, and recycling inorganic waste such as plastic, plastic packaging and bottles into new items that have a sale value. and a higher use value with help from the surrounding community, especially women and the PKK team in the lime village in its processing, so that it can open job vacancies and can also increase the income of the surrounding community, especially for housewives, and there are gardens that are used for grow vegetables which will also be marketed and become buffer areas/*buffer zone* at temporary waste disposal 3R Kapur Village.

2. Methods

Kapur Village is one of the villages in Sungai Raya District, Kubu Raya Regency, which, based on BPS data, figures for 2020 have an area of 21,500 km2.[2] and has two hamlets namely Parit Mayor and Parit Bugis hamlets.

2.1 Data Collection

Sampling of waste generation was carried out for 8 consecutive days with the sampling method referring to SNI-19-3964-1994 concerning Procedures for Collection and Measurement of Sample Generation and Composition of Municipal Solid Waste. Sampling of this waste was carried out to

determine the amount of waste generation, density and composition of the waste generated in the Kapur Village area. Sampling of waste was carried out at domestic and non-domestic sources.

A. Domestic Sector

The formula used to determine the number of samples using the formula from equation (1):

$$n = \frac{N}{1 + Ne^2} \quad \text{.....(1)}$$

n representens the sample size, N is population size, population size in this study is 10083 people and Ne^2 is error or inaccuracy due to tolerable sampling errors, the value of Ne^2 was 0,05.

n $= \frac{10083}{1 + (10083\ x\ 0{,}05^2)} = \frac{10083}{26{,}21}$ = 384,70 people = 385 people

Based on the calculation above, the number of samples obtained is 385 people. The process of calculating the amount of waste generation is converted from the number of people to the number of houses with the assumption that 1 household has an average of 4 people, so that the required number of samples is 96 houses in the study area, but in this plan, 100 households were taken as a sample.

B. Non Domestic Sector

The calculation of the number of non-domestic sector samples was carried out by referring to the SNI 19-3964-1994 formula concerning Methods for Taking and Measuring Sample Generation and Composition of Municipal Solid Waste in equation (2)

$S = Cd\ x\ \sqrt{Ts}$ .....(2)

S represents the number of examples (souls), C_d is non-residential building coefficient, the value of C_d was 1 and T_s is number of non-residential buildings.

The calculation results obtained are as follows:

- **School**
  $\boldsymbol{S = Cd\ x\ \sqrt{Ts}}$
  S = 1 x $\sqrt{\mathbf{3}}$
  S = 2
- **Office**
  $\boldsymbol{S = Cd\ x\ \sqrt{Ts}}$
  S = 1 x $\sqrt{\mathbf{1}}$
  S = 1
- **Medical facility**
  $\boldsymbol{S = Cd\ x\ \sqrt{Ts}}$
  S = 1 x $\sqrt{\mathbf{2}}$
  S = 2
- **Mosque**
  $\boldsymbol{S = Cd\ x\ \sqrt{Ts}}$
  S = 1 x $\sqrt{\mathbf{17}}$
  S = 4
- **Klontong shop**
  $S = Cd\ x\ \sqrt{Ts}$
  S = 1 x $\sqrt{100}$
  S = 10
- **Restaurant/canteen**
  $S = Cd\ x\ \sqrt{Ts}$
  S = 1 x $\sqrt{1}$
  S = 1

Table 1. Number of samples

No	Source	Number of Samples
1	Domestic (home)	100 KK
2	Non Domestic	
	School	2 unit
	Office	1 unit
	Medical facility	2 unit
	Klontong shop	10 unit
	Mosque	4 unit
	Restaurant/Canteen	1 unit

2.2 Data Processing

The data that has been obtained from the results of sampling, interviews with the help of questionnaires and direct observation of the field are then analyzed. Data on waste generation, density and composition are used to plan and determine the type of waste processing activities to be planned at temporary waste disposal 3R plus Kapur Village which includes waste sorting and storage, waste collection systems and waste processing. Population data is used to project the amount of waste generation that will be generated over the next 10 years, from 2023 years to 2032 years.

Based on the Indonesian National Standard 19-3694-1994 concerning the method of taking and measuring samples of urban waste generation and composition, the measurement of waste generation is calculated using the following equation (3) :

$$\text{Waste genration} = \frac{trash\ weight\ (kg/day)}{number\ of\ people} \quad \ldots\ldots(3)$$

Meanwhile, for calculating the density of waste based on SNI 19-3694-1994, the following equation (4) is used:

$$\text{Trash density} = \frac{trash\ weight\ (kg)}{waste\ volume\ (m^3)} \quad \ldots\ldots(4)$$

The calculation of the percentage of waste composition uses the following equation (4):

$$\%\text{waste weight per component} = \frac{componen\ weight}{total\ waste\ weight}\ x\ 100\% \quad \ldots\ldots(5)$$

To calculate the projected waste generation, a formula based on RI minister of Public Works Regulation No. 03/PRT/2013 following equation (6)

Waste generation projection = Total population x Waste generation .....(6)

2.3 Selotif Method Analysis

The participatory site selection (Selotif) method aims to obtain information and an assessment of the existing condition of the environment and a plan for handling environmental problems that are appropriate for each prospective location. This method consists of several variables namely society participation, land, village committee, waste services and processing, and regional government commitment (related agencies) (Direktur Jenderal Cipta Karya, 2021). The evaluation of prospective locations using the selective method was carried out by direct field observation and interviews with the help of questionnaires.

3. Result and Discussion

This planning requires data regarding waste generation, density and composition of waste which will be used to plan a waste management system, design a 3R plus based Waste Treatment Site and plan the budget required in accordance with applicable regulations.

3.1 Analysis of Waste Generation and Composition of Waste

Waste generation is the amount of waste generated from an activity within a certain period of time, or in other words the amount of waste generated in units of weight (kilograms) or volume (litters) (Tchobanoglous, 1993). The amount of waste generation generated in the Kapur Village area can be calculated by projecting the rate of waste generation on the population in Kapur Village.

Table 2. Waste Generation in Kapur Village

Garbage Source	Unit	Waste Generation	
		Weight (kg/org/day)	Volume (m^3/org/day)
Domestic	person/day	0.23	0.0016
School	person/day	0.01	0.0002
Medical Facility	person/day	0.2	0.002
Office	person/day	0.1	0.001

Garbage Source	Unit	Waste Generation	
		Weight (kg/org/day)	Volume (m^3/org/day)
Mosque	person/day	0.02	0.0002
Klontong Shop	person/day	0.35	0.007
Restaurant/canteen	person/day	0.03	0.0002
Total non-domestic waste generation		0.12	0.0018
Total average generation of domestic and non-domestic waste		0.35	0.0034

From the results of the research that has been done, it is found that each source of waste produces a different amount of waste generation. This difference can be influenced by the variety of activities carried out at the source and the number of samples of people from the waste source. From the results of the calculations that have been carried out, the waste generation in Kapur Village will increase along with the increase in the population in Kapur Village. In 2032 it is estimated that the volume of waste generation in Kapur Village will reach 37.94 m3^3/person/day.

Table 3. Projection of Waste Generation in Kapur Village

Year	Total Population (Person)	Waste Generation		Waste generation projection	
		Kg/person/day	m^3/person/day	Kg/day	m^3/day
2020	10,086	0.35	0.0034	3,530	34.29
2021	10,222	0.35	0.0034	3,578	34.75
2022	10,220	0.35	0.0034	3,577	34.75
2023	10,314	0.35	0.0034	3,610	35.07
2024	10,408	0.35	0.0034	3,643	35.39
2025	10,502	0.35	0.0034	3,676	35.71
2026	10,596	0.35	0.0034	3,709	36.03
2027	10,690	0.35	0.0034	3,742	36.35
2028	10,783	0.35	0.0034	3,774	36.66
2029	10,877	0.35	0.0034	3,807	36.98
2030	10,971	0.35	0.0034	3,840	37.30
2031	11,065	0.35	0.0034	3,873	37.62
2032	11,159	0.35	0.0034	3,906	37.94

Characterization of waste is very important for choosing the right waste management system which consists of collection, selection, waste treatment facilities, energy transformation and reuse of reusable waste, design, implementation of optimal waste disposal routes and methods (Ugwu et al., 2020). From the results of sampling the composition of waste in Kapur Village, it was found that the composition of waste from domestic sources was dominated by organic waste with a percentage of 49.3%. This organic waste consists of food scraps, leftover vegetables and fruit. The large percentage of organic waste composition is due to the fact that organic waste has a large waste weight compared to other waste compositions and more organic waste is produced by each person every day. Every day the community produces organic waste in the form of large food scraps and is a daily necessity, and there is also no processing of organic waste (Hapsari and Herumurti, 2017). The least composition of waste generates from domestic sources is household B3 waste with a percentage of 0.9%. While composition of waste from non-domestic sources is dominated by inorganic waste in the form of paper waste with a percentage

of 30.60%. The high composition of paper waste is because all sources of non-domestic waste produce paper waste every day, especially office sources that use paper as the main component in office activities. The least composition of waste from non domestic sources is B3 waste with a percentage of 3.5% which is only generated from health facilities.

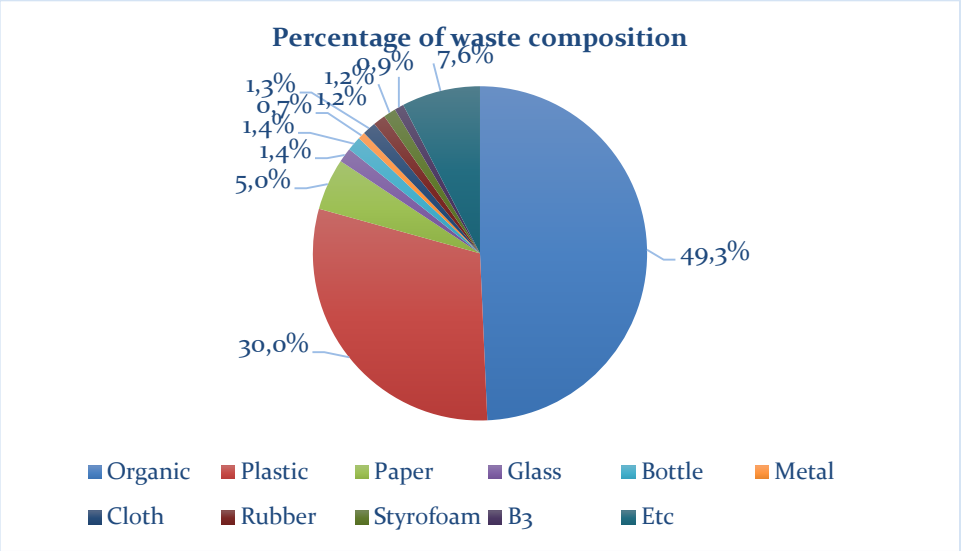

Figure 1. Percentage diagram of the composition of domestic waste in 2023

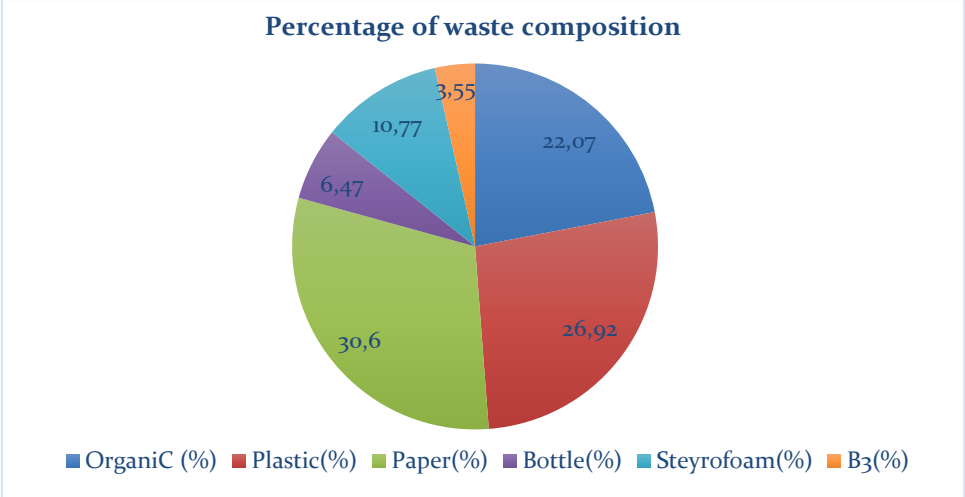

Figure 2. Percentage diagram of the composition of non domestic waste in 2023

3.2 Selected Location of Selotif Method

The candidate location with the highest assessment results will be determined as the selected candidate location for temporary waste disposal 3R development. In this plan, there are 2 alternative candidate locations for temporary waste disposal 3R with location 1 being on Desa Kapur street and location 2 being on Kota Raya Street. From the results of the research that has been carried out, the results of the assessment for the selected temporary waste disposal 3R location candidates are alternative 1 location which are on Desa Kapur street with a total value of NV 336, 20.

Table 4. Recapitulation of score calculations for alternative 1 and alternative 2 locations

Variable		Indicator	Alternative Location 1				Alternative Location 2			
			Score (N)	**Amount**	**Weight**	**Total Score (TN)**	**Score (N)**	**Amount**	**Weight**	**Total Score (TN)**
A	Society Participation	1 Forms of Community Participation	2	2	30	60	2	2	30	60
		2 Readiness to pay dues	3				3			
		3 Community readiness to accept the program	3				3			
B	Land	1 Land ownership status	1	5.75	25	143.75	1	5.5	25	137.5
		2 Land area	4				4			
		3 Physical condition of the land	4				4			
		4 Road accessibility	4				3			
		5 Accessibility of supporting facilities	3				3			
		6 History of floods in 10 years	3				3			
		7 Use existing land	4				4			
C	Village Committee	1 Operational land maintenance funding support	6	3	15	45	6	3	15	45
		2 Labor support	5				5			
		3 Institutional support	4				4			
		4 temporary waste disposal 3R business support	2				2			
		5 Other support	1				1			
D	Waste Service and Processing	1 Location service area	2	3.5	15	52.5	2	3.25	15	48.75
		2 Characteristics	2				2			

		of the service area								
		3 Potential number of service	2				2			
		4 Garbage service conditions	2				2			
		5 Land distance from the settlement	3				3			
		6 Distance of land/location from temporary waste disposal	3				2			
E	Regional Government Commitment (Related Agencies)	1 Transport of residues	6	2.33	15	34.95	6	2.33	15	34.95
		2 Labor support	3				3			
		3 Institutional support	3				3			
		4 temporary waste disposal 3R business support	1				1			
		5 Other support	1				1			
Total Variable Value (NV)						**336.20**				**326.20**

3.2.1 Planning of Waste Processing Process at Temporary Waste Disposal 3R Plus Kapur Village

After calculating the amount of waste generation, density and composition of waste then determine the waste management process and the land requirement for temporary waste disposal 3R plus in Kapur Village. Waste management besides being carried out at the TPA should also be supported by waste management from the source. Waste management from the source first begins with knowing the waste generation and the composition of the waste at the source (Wardiha et al., 2013). Waste management based on source has major challenges, namely the limited coverage of waste service areas and the lack of community participation in sorting waste (Purnomo, 2021).

3.2.2 Storage and Sorting

Storage are activities of temporarily accommodating waste in an individual or communal container at the source of the waste by considering the types of waste (PermenPU No. 13 of 2013). Containers planned for individual containers are made segregated based on type in order to facilitate the process of sorting waste from its source and processing waste. One of the general requirements in waste management is the aspect of community participation. One of the forms of community participation in managing waste is by sorting waste from the source (Zahara et al., 2015), Therefore, the waste that enters temporary waste disposal 3R is planned to be segregated from the source. The planned segregated waste containers are divided into 2 types of containers, namely organic waste (food waste, vegetables and fruits) and inorganic waste.

Determination of the number of containers refers to SNI 3242:2008 concerning Waste Management in Settlements.

- Waste generation = waste generation rate (l/people/day) x projected population
  = 3.4 l/ people/day x 11,159
  = 37,941 l/ people/day
- Container $= \frac{waste\ generation}{number\ of\ families}$
  $= \frac{37{,}941}{2790}$ = 13.6 L

From the calculation results, it is found that each source of waste in Kapur Village can produce 13.6 litters of waste per day, so that 2 segregated waste bins are needed with a capacity of 7 L each. One of the most frequently used individual container capacities is a capacity of 15 L (Saugi et al., 2016). The use of the same container capacity for organic and inorganic waste is due to better aesthetic value (Santi et al., 2017).

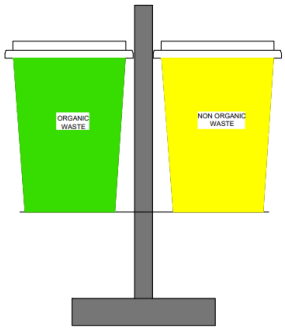

Figure 3. Garbage container

3.2.3 Gerbage Collection and Transportation

Waste collection that will be planned is garbage collection carried out at each house with a garbage transportation system that is carried out every 2 days with 4 rotations. This waste collection tool is used to collect waste from waste sources to temporary waste disposal 3R plus Kapur Village. The choice of a waste transporter in the form of a motorized cart is due to the fact that it is easier and more flexible to transport garbage into small alleys. Based on the calculation results, it takes 5 motorbike garbage carts to transport 37.94 m of garbage³/day.

- Garbage generation : 37.94 m³/day
- Transport period : every 2 days
- The number of serviced expenses : 37.94 m³/day x 2
  : 75.88 m³/day
- rolling : 4 times
- Collector capacity : 3 m³
- Compaction factor : 1.2
- Calculation of the number of collectors : $\frac{the\ amount\ of\ waste\ generation\ served}{KK\ x\ Fp\ x\ Rolling}$
  $= \frac{75{,}88\ m3/day}{3\ m3\ x\ 1{,}2\ x\ 2}$ = 5 motorbike carts

Based on the calculation results, as many as 5 pieces of waste motorbike carts are needed to transport as much as 37.94 m of garbage³/day. This motorized cart is designed to have a partition to separate organic and inorganic waste.

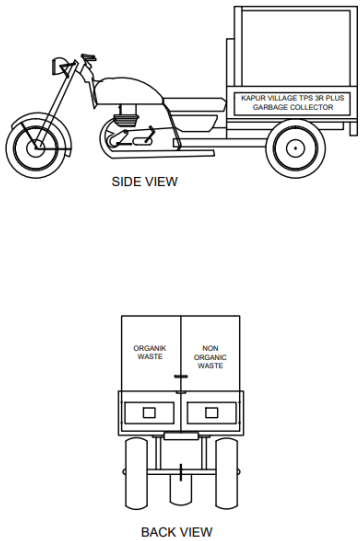

Figure 4. Garbage transport motor design

3.3 Waste Management Planning at Temporary Waste Disposal 3R Kapur Village

The temporary waste disposal 3R plus waste management plan in Kapur Village is planned for 10 years period. Organic waste processing at temporary waste disposal 3R plus Kapur Village with a composting process. Composting is a method of organic waste management that aims to reduce and change the composition of waste into a more useful product (Worotitjan et al., 2022). The composting method used is aerobic hollow brick. This composting method with hollow bricks was chosen because easy to do in technically, operating with no special skills, short time, and not spend large costs for the operational (Afifah et al., 2021). Inorganic waste processing at temporary waste disposal 3R plus Kapur Village is carried out by processing plastic waste and bottles into handicrafts that will be displayed in the production room recycle for further sale. If the facilities in a waste processing site are better and more complete, the better and the maximum management will be provided in dealing with waste problems at the waste treatment site (Shofi et al., 2023).

3.3.1 Receiving/dropping area

Garbage transported from waste sources will enter the receiving area / Loading rate is the amount / capacity of waste that will be processed at temporary waste disposal 3R every hour. The following is the calculation of the waste receiving area:

- Garbage generation = 37.94 m^3/day
- Operational time = 7 hours/day
- Loading rate $= \frac{waste\ volume\ (m3/day}{processing\ time\ (hours/day)}$
  $= \frac{37.94\ (m3/day)}{7\ (hour/day)}$ = 5.42 m^3/hour
- Garbage pile height = 1 m
- Receiving area $= \frac{waste\ generation}{garbage\ pile\ height}$
  $= \frac{37.94\ m3/day}{1\ m/day}$ = 37.94 m^2 ≈ 40 m^2

3.3.2 Room for Organic Waste Management

The organic waste management room consists of a container, enumeration and composting room.

1. Organic waste storage room

The storage room is used to store organic waste from the receiving room before the waste is processed.

- Organic vs = Percentage of organic waste x loading rate
  = 71.37% X 5.42 m^3/hour = 3.87 m^3/hour
- incoming trash volume = Vol. Garbage comes in per hour x working time
  = 3.87 m^3/hour x 7 hour/day = 27.09 m^3/hour
- Processed waste volume = 80% x vols. organic trash
  = 80% x 27.09 m^3/hour = 21.7 m^3/hour
- Stack height = 1.5 m
- Compostable waste capacity = $\frac{incoming\ waste\ volume}{garbage\ pile\ height}$
  = $\frac{27.09\ m3/day}{1{,}5\ m}$ = 18.06 m^3/hour
- Weight of incoming organic waste = % organic waste x waste weight
  = 71.37% x 3.906 Kg/day
  = 2.788 kg/day
- Weight of processed organic waste = 80% x the weight of organic waste
  = 80% x 2.788 kg/day
  = 2.230.4 kg/day

The calculation of the dimensions of the organic waste storage space is as follows:

- Stack height = 1.5 m
- Organic waste volume = 27.09 m^3/day
- Storage area = $\frac{organic\ volume}{stack\ height}$
  = $\frac{27.09\ m3/day}{1.5\ m}$ = 18.06 m^2≈ 20 m^2

2. Enumeration Room

   Organic waste that is in the storage room will be taken to the enumeration room to be chopped using a machine so that the waste becomes finer and can speed up the composting process.

- Weight of processed organic waste = 2,230.4 kg/day = 319 kg/hour
- Chopper capacity = 500 kg/hour
- The need for a counter machine = $\frac{composted\ organic\ waste\ weight}{machine\ capacity}$
  = $\frac{319kg/jam}{500\ kg/jam}$= 0.6 unit ≈ 1 unit
- The area of the chopper = 0.75 m^2≈ 1 m^2
- Work space = 4 m^2
- Total land requirement = L. chopper + Space to move
  = 1 m^2 + 4 m^2 = 5 m^2

3. Composting Room

   The composting method used at temporary waste disposal 3R plus in Kapur Village is the hollow brick method. This composting method is by circulating air in the waste pile through porous pipes, holes in the walls.

   a). Design criteria:
   - Dimensions: Box width: 3.5 m
   - Box height: 1.5 m
   - Box length: 7.5 m

   b). Composting Total Volume
   - Composting time: 30 days
   - Total composting volume = composting time x volume of organic waste per day
   - Total volume of composting = 30 days x 22.29 m^3/day = 669 m^3/day

c). Determination of the Volume of Each Box

- Volume boks = P x L x T
- Volume boks = 7.5 m x 3.5 m x 1.5 m = 39.38 m^3

d). Determination of the Number of Brick Boxes

- Volume of compost generation = L x L (box height – base pipe height)
  = 7,5 x 3,5 (1,5-0,2) = 34,125 m^3
- Number of boxes needed = $\frac{total\ volume\ of\ composting}{compost\ heap\ volume}$
  = 669 m^3/day/34.125 m^3
  = 19 unit

e). Determination of Area of Space Requirements

- Length per box unit = End space A + box length + end space B + masonry length
  = 0,5 + 7,3 + 0,5 + (2 x 0,2) = 8,4 m
- Width per box unit = box width + right space + left space + (masonry width x width)
  = 3,5 + 0,4 + 0,4 + (2 x 0,1) = 4,5 m
- Room for one box unit = Length x Width = 8,4 x 4,5 = 37,8 m^2
- Total space requirement = Number of boxes x space for one box unit
  = 19 x 37.8 = 718.2 m^2 ≈ 720 m^2

3.3.3 Inorganic Waste Processing Room

This inorganic waste processing room consists of rooms for sorting, washing, compacting and making handicrafts.

1. Inorganic canoe sorting room

   Inorganic waste that has been received at the receiving area will then be taken to the inorganic waste sorting room, then sorted according to the composition of the waste: plastic, paper, bottles, metal, glass, rubber, cloth, styrofoam, B3 and others. So, the dimensional calculation for the inorganic waste sorting room is as follows:

   - Stack height = 1.5 m
   - Total volume of inorganic waste = 48.88 m^3/day
   - The size of the sorting area = $\frac{volume\ of\ organic\ waste}{stack\ height}$
     = $\frac{48.88}{1.5}$ = 32.59 m^2 ≈ 45 m^2

2. Storage room for plastic waste and bottles

   The planned plastic waste storage room at temporary waste disposal 3R is used to store or temporarily accommodate loads of sorted plastic waste before being processed at a later stage.

   - Composition of plastic waste and bottles = 64.79%
   - Waste volume = 24.56 m^3/day
   - Stack height = 1.5 m

   Then the dimensional calculation for the plastic waste storage space is as follows:

   - Storage area = $\frac{waste\ volume}{stack\ height}$
     = $\frac{24.56\ m3/day}{1.5\ m}$ = 16,37 m^2 ≈ 18 m^2

3. Warehouse

   The following is the calculation of the warehouse area needed to store salable inorganic waste, it is planned to store it for 7 days.

   - The volume of inorganic waste worth selling for 1 week = 13.99 m3/day x 7 days
     = 97.93 m3/hari
   - Stack plan height = 1.5 m

- Storage area $= \frac{waste\ volume}{stack\ height}$

$= \frac{97.93\ m3/day}{1.5\ m}$ = 65.23 m² ≈ 67.5 m²

3.3.4 Supporting facilities at temporary waste disposal 3R Plus in Kapur Village

Supporting facilities to be built include offices, container areas, garages, guard posts, kitchens, toilets, septic tanks and gardens. For the design dimensions of each building can be seen in table 5 below.

Table 5. Details of land requirments in the construction of temporary waste disposal 3R Plus in Kapur Village

No	Land requirements	Length (m)	Width (m)	Planning Land Area (m²)
1.	Reception Area/*loading rate*	10	4	40
2.	Organic Waste Processing			
	a. Organic waste container room	4	5	20
	b. Enumeration room	2	2,5	5
	c. Composting room	36	20	720
	d. Compost sifting and storage room	3	2	6
	e. Tub of leachate	2	4.4	8.8
3.	Inorganic Waste Treatment			
	a. Sorting room	7.5	6	45
	b. Storage room for plastic waste and bottles	6	3	18
	c. Plastic and bottle waste sorting room	6	3	18
	d. Room for washing and drying plastic waste and bottles	6	3	18
	e. Craft processing room	6	4	24
	f. Room *boutique* handycrafts	5	4	20
	g. Warehouse	9	7.5	67.5
4.	Supporting facilities			
	a. Office	4	4	16
	b. Container Area	3	2	6
	c. Garage	10	3	30
	d. Guard post	3	2	6
	e. Kitchen	3	2	6
	f. Toilet	3	2	12
	g. Septic tank	2	1	2
	h. Garden	6	4	24
Total Land Area				1,112.3 m²

The total land area required for temporary waste disposal 3R plus in Kapur Village to accommodate waste for the next 10 years is 1,112.3 m². From the results of the site selection, alternative 1 was selected with a land area of 1,587 m², so that it is still possible for further development areas if the planned volume of temporary waste disposal 3R plus services increases. Because a waste treatment site will give off an unpleasant odor and also create a dirty and unsightly or dirty impression (Jemali et al., 2022), plants are needed that can function as odor reduction and support environmental aesthetic aspects. Examples of vegetation that can be planted around temporary waste disposal 3R are samanea trembesi trees and bintaro carbea which can absorb pollutants, *delicious mimusops* and *Pterocarpus indicus* which can function as a noise damper (Jemali et al., 2022).

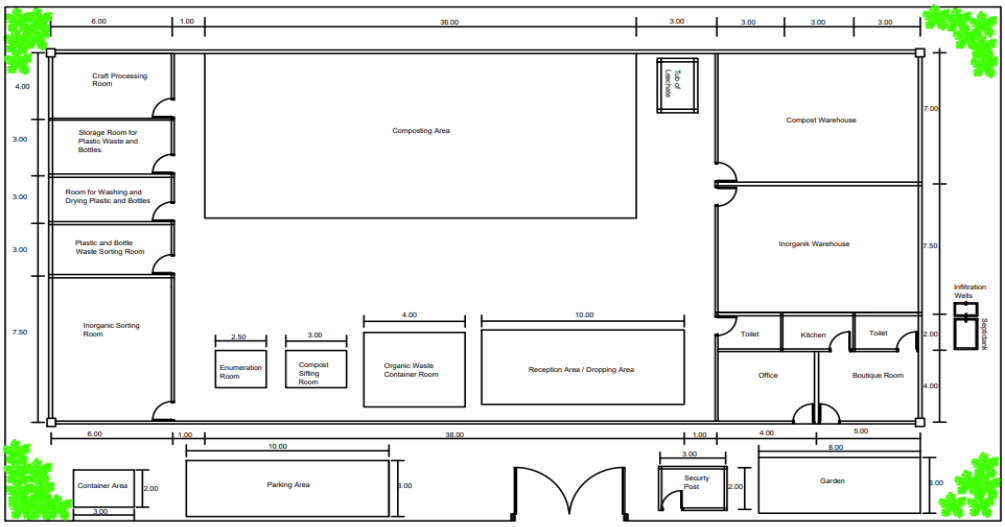

Figure 6. Layout of temporary waste disposal 3R plus in kapur village

4. Conclusions

Total waste generation generated in Kapur village from domestic and non-domestic waste sources is 0.35 kg/person/day and 0.0034 m^3/person/day or 3.4 L/person/day. The projection of waste generation in 2032 is 37.94 m^3/day. The most abundant composition of waste generated from domestic sources in Kapur Village is organic waste with a percentage of 49.3%, while the composition of waste from non-domestic sources is dominated by paper waste with a percentage of 0.60%. The temporary waste disposal 3R design planning planned for Kapur Village consists of a reception area/*dropping area* with an area of 40 m^2, a sorting room with an area of 45 m^2, organic waste container space with an area of 20 m^2, a composting area with an area of 720 m^2, room for screening and packaging compost with an area of 6 m^2, storage room for plastic waste and bottles with an area of 18 m^2, a plastic and bottle waste sorting room with an area of 18 m^2, a room for washing and drying plastic waste and bottles with an area of 18 m^2, a handicraft processing room with an area of 24 m^2, room *boutique* with an area of 20 m^2, warehouse with an area of 67.5 m^2, and other supporting facilities. Processing of organic waste is processed into compost using the hollow brick method, inorganic waste in the form of plastic and bottles will be processed into handicraft products. The required land requirement is 1,112.3 m^2. The location chosen as the temporary waste disposal 3R plus construction site is alternative 1 location which is on the Kapur Village main road.

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