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SOCIALIZATION AND PLANNING OF TPS 3R DESIGN CONCEPT SUSTAINABLE IN SALEMO ISLAND COASTAL SETTLEMENTS

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Abstract

The rapid development and population growth in coastal areas have caused the carrying capacity of the environment to decline. This problem is caused by several factors, one of which has become a common problem in coastal settlement areas, especially in coastal settlements of small islands, is the problem of waste. The waste problem that occurs is due to several factors, such as limited access and land to be used as a landfill, poor waste management, inadequate waste facilities and infrastructure and lack of public awareness to maintain the cleanliness of the environment. Public awareness to maintain the cleanliness of their environment needs to be educated by the application of 3R waste management (reduce, reuse and recycle) from the source while maintaining nature and the environment in a settlement. The availability of appropriate waste facilities can also help waste management in small island coastal settlements. The existence of the 3R TPS will be very helpful in waste management in the settlement, both organic and inorganic waste. The location to be studied is the coastal settlement of Salemo Island. The existing state of the waste system in the coastal settlements of Salemo Island does not have a TPS or access to the nearest landfill, so people throw their garbage directly into the sea or are left to accumulate on the shores of their beaches. This situation is very concerning because there is no solution from the local government to overcome this problem. With this research, it is hoped that it can provide solutions and inputs in planning the right waste processing using the reference to the 3R TPS design concept produced in the coastal settlements of Salemo Island.

Keywords: Coastal Settlement; TPS 3R Design; Waste Management.

1. Introduction

Coastal settlements are settlements that have their own characteristics both in terms of physical and non-physical. One of the coastal settlements that has its own characteristics is the coastal settlements of small islands, where the land area is surrounded by the ocean and the dominant people make a living as fishermen. The rapid development and population growth in coastal areas have caused the carrying capacity of the environment to decline. This problem is caused by several factors, one of which has become a common problem in coastal settlement areas, especially in coastal settlements of small islands, is the problem of waste.

The waste problem that occurs is due to several factors, such as limited access and land to be used as a landfill, poor waste management, inadequate waste facilities and infrastructure and lack of public awareness to maintain the cleanliness of the environment. This causes the garbage to become a common sight in their environment. Based on the Regulation of the Minister of Public Works No. 3 of 2013 concerning the implementation of infrastructure and waste facilities in handling household waste and similar household waste, it is emphasized that waste reduction starting from the source is the responsibility of all parties, both the government and the community. However, if the sorting and reduction of waste since the source is still inadequate, various movements need to be improved through the role of community leaders, non-governmental organizations (KSM) or the government [1].

Public awareness to maintain the cleanliness of their environment needs to be educated by the application of 3R waste management (reduce, reuse and recycle) from the source. The availability of appropriate waste facilities can also help waste management in small island coastal settlements. The existence of the 3R TPS will be very helpful in waste management in the settlement, both organic and inorganic waste. One of the coastal settlements of small islands that experienced this was in the coastal settlements of Salemo Island, Pangkep Regency. There has never been any socialization of proper waste management and the lack of available waste facilities has caused the accumulation of garbage along

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almost along the coastline of the island. The procurement of 3R TPS can reduce the generation of waste produced on this island, especially household waste which is the largest waste production because of its dense settlements. However, before designing and building the procurement of 3R TPS, it is also necessary to pay attention to nature and the environment in which it will be built. Therefore, socialization activities and planning the concept of a sustainable 3R TPS design in the coastal settlements of Salemo Island are very important to be carried out to minimize waste generation while maintaining nature and the environment in the Salemo Island settlements.

2. Literature Review

Salemo Island settlement is a small island coastal settlement that requires proper waste processing to reduce the quantity of waste generation on the island. The way to manage waste on a small island has been explained in the Procedures for Implementing a Waste Management System in the Small Island Area (2016) in Table 1 below: [2]

Table 1. How to Manage Waste on a Small Island

How to manage waste on a small island : **WASTE REDUCTION ON A SMALL ISLAND**			
Type	**Reduce**	**Recycle**	**Reuse**
Household Waste (Organic and Inorganic)	Using refillable packaging products to reduce waste.	Processing waste into reusable items, for example, used tires into trash can containers.	Utilizing water bottles for dish soap containers or biscuit cans into snack containers.

WASTE HANDLING ON A SMALL ISLAND				
Types of Garbage	**Resignations**	**Collection**	**Removal/ Processing**	**Final Processing**
1.Household Waste (Organic and Organic) 2.Marine debris 3.Wet garbage carried away by the current	Individual : Prepare at least two simple containers for biodegradable and non-biodegradable waste (barrels/cans/plastic bags). Communal: Prepare at least two simple containers for biodegradable and non-biodegradable waste (barrels/cans/plastic bags)	Communal: Prepare a clean, well-maintained and separate wheeled cart with a size of 0.5-1 m^3 for decomposable and non-biodegradable garbage. Preparing special garbage containers for drying wet litter. Provide ships that can comb through the garbage around the island, for example catamaran ships.	Individual : 1.Organic waste is processed by household-scale composting. 2.Garbage is processed using the waste module. Communal: 1.Organic waste is treated with Open Windrow Composting and SIKIPAS module. 2.Using certain technologies to manage organic waste, for example by using the sikipas module. 3.Inorganic waste is managed with a waste bank or sold to a waste collector. 4.Waste residues are burned with thermal technology and disposed of in heap fields. 5.The government provides socialization and training on how to process waste, for example composting, garbage bins, etc.	

Source : Procedures for Implementing a Waste Management System in a Small Island Area (2016)

Temporary Shelter (TPS) is a place before waste is transported to a recycling, processing, and/or integrated waste processing site (Law of the Republic of Indonesia No. 18 of 2008) [3]. Waste processing sites with the 3R principle (reduce, reuse, recycle) hereinafter referred to as TPS 3R are places for collection, sorting, reuse, and regional scale recycling activities (Government Regulation of the Republic of Indonesia No. 81 of 2012) [4]. TPS 3R as a temporary shelter which is also a waste processing site that applies the 3R principle which emphasizes more on how to reduce, reuse and process from the source so as to minimize the amount of waste generation on an area scale. The implementation of TPS 3R is a pattern of community empowerment approach that involves the active role of the government and its community. Through a community empowerment approach, including for low-income communities and/or those living in dense and slum settlements. The main concept of waste processing at TPS 3R is to reduce the quantity and/or improve the characteristics of waste, which will be further processed at the Final Processing Site (TPA) of waste carried out to serve a minimum of 200 houses or heads of families (Technical Guidelines for the Implementation of Labor-Intensive Activities of the Directorate General of Cipta Karya, 2020) [5].

Based on the National Standardization Agency (2002), operational waste management techniques consisting of waste disposal activities to the final disposal of waste must be integrated by sorting from the source which can be explained through the following Figure 1: [6]

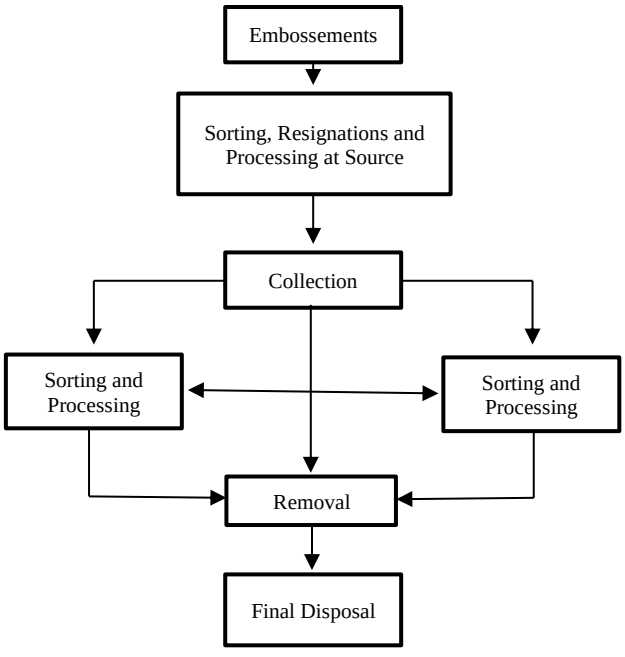

Figure 1. Diagram of Waste Management Operational Techniques
Source : National Standardization Agency (2002)

The following is an explanation of the operational engineering activities of waste management:

a. Waste generation is the amount of waste that arises from the community in units of volume or weight

per capita per day, or expand buildings, or extend roads.

b. Waste storage is the activity of temporarily collecting waste in a container in a garbage source.
c. Waste collection is a handling process that not only collects waste from communal (shared) containers but also transports it to a certain terminal place, either by direct or indirect transportation.
d. Transfer and sorting of waste. Waste transfer can be done by manual, mechanical, or a combination of manual and mechanical, that is, the filling of containers is carried out manually by the collection officer, while the transportation is carried out mechanically (load haul). As for sorting at the transfer location, it can be done manually by cleaners and or interested people, before being transferred to a garbage transportation device.
e. Waste transportation is the activity of bringing waste from the transfer site or directly from the source of waste to the landfill.

2.1. Operational Basis of TPS 3R

The implementation of TPS 3R according to the Technical Guidelines for TPS 3R by the Ministry of Public Works and Public Housing (2017) must be carried out in synergy and sustainability through: [7]

a. The process of involving the community and local governments.
b. The process of empowering/strengthening the community and local government.
c. The process of coaching and assisting local governments for the sustainability of TPS 3R.

Some of the main things related to the implementation of TPS 3R according to the Technical Guidelines for the Implementation of Labor-Intensive Activities of the Directorate General of Cipta Karya (2020) are as follows: [8]

a. Handling waste-prone areas in accordance with the City Sanitation Strategy (SSK) as defined by the Central Bureau of Statistics (BPS);
b. Able to serve a minimum of 200 households or 1000 - 1600 people which is equivalent to 3-6 m3 per day;
c. Land required for TPS 3R with an area of at least 200 m2;
d. The incoming waste has been sorted since from the source. This is to optimize the performance of the 3R TPS. For this reason, efforts are needed to empower waste sorting by residents;
e. Disaggregated garbage collection is carried out using manual carts or motor carts. Disaggregated waste collection can be done by making bulkheads on garbage collection carts or by making a schedule mechanism for transporting waste according to its type, for example organic waste every day, inorganic waste every 2-3 days;
f. The process of waste processing with a sorting process (physics), processing organic (biological) waste, collecting and distributing waste that can still be recycled or reused, as well as transporting waste to landfills for residual waste that has been processed physically (compaction or enumeration) or residual waste that is no longer processed.
g. For Hazardous and Toxic Materials (B3) waste, it is collected and managed based on applicable regulations.

2.2. Criteria for Waste Treatment Plant (TPS) 3R

According to the Regulation of the Minister of Public Works No. 3 of 2013 the requirements of TPS 3R are as follows: [9]

a. The area of the 3R TPS is greater than 200 m2;
b. The type of use of waste processing residue/residue reservoirs at TPS 3R is not a permanent container;
c. Placement of the location of the 3R TPS as close as possible to the service area within a radius of not more than 1 km;
d. TPS 3R is equipped with a sorting room, composting organic waste, warehouse, buffer zone, and does not interfere with aesthetics and traffic;
e. Active community involvement in reducing and sorting waste;
f. The location of the 3R TPS varies. For a new residential area (service coverage of 2000 houses) a 3R TPS with an area of 1000 m2 is needed. As for the coverage of RW-scale services (200 houses), a 3R TPS with an area of 200-500 m2 is needed;
g. TPS 3R with an area of 1000 m2 can accommodate waste with or without the process of sorting waste from the source;
h. TPS 3R with an area of <500 m2 can only accommodate waste in a 50% disaggregated state and 50% mixed waste; and
i. TPS 3R with an area of <200 m2 should only be able to accommodate 20% mixed waste while 80% of disaggregated waste.

The criteria for TPS 3R according to the Technical Guidelines for the Implementation of Labor-Intensive Activities of the Directorate General of Cipta Karya (2020) have a minimum capacity of 200 families with a minimum area of 200 m^2 consisting of: [10]

a. Archways/inscriptions containing the logos of the Regency/City Government and the Ministry of Public Works and Public Housing;
b. Roofed buildings (hangars);
c. Office;
d. Disaggregated waste containers for source;
e. Mixed waste sorting unit;
f. Organic waste processing unit;
g. Inorganic/recycling waste processing/storage units;
h. Residual waste treatment/storage unit;
i. Warehouses/containers for storing solid/liquid/bio gas compost/recycled waste/residual waste; and
j. Garbage collection carts/motors.

2.3. Sustainable Design

Sustainable design is a design that during the process, starting from taking resources in nature to reprocessing using methods that are not harmful to the environment or human health, so that human and natural life on earth can continue to survive (Febriany et al, 2013) [11]. Sustainable design is one of the descriptions of the larger concept of sustainable development, focusing on the philosophical concept of designing physical objects, built environments, and services to meet the principles of sustainable economic, social and ecological. Sustainable design is an effort to reduce the negative impact that occurs on the environment, the health and comfort of occupants or building users, thereby improving building performance (Iwan Priyoga, 2010) [12]. The concept of sustainable development can be defined simply, namely development that meets current needs without compromising the ability of future generations to meet their needs in the future (Prayoga, 2013) [13].

2.4. Basic Principles of Sustainable Design

According to Oktavi (2015), the basic principles of sustainable design include the following aspects: [14]

a. Low-impact material, utilizing non-toxic materials and produced in an environmentally friendly manner;
b. Energy efficiency, using or making products that require little energy;
c. Quality and durability, products that are well-displaced (have a long service life) mean reduced maintenance or replacement;
d. Reuse and recycle, the product design must consider continuous utilization until after the end of the service life (after-life);
e. Renewable ability, materials come from nearby regions, are produced from renewable resources, and (whenever possible) can be processed into compost;
f. Healthy, the product is not harmful to users / residents and the surrounding environment, it can even support health aspects at large.

3. Research Methodology

In this planning there are several important steps that are carried out with the following explanations:

Primary Data

Primary data were obtained from observations and interviews. Sampling is performed using the Slovin Formula. The formula is as follows:

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

Where n is the sample size to be searched for, N is the population size and e is the margin of error which is the expected or set error amount. From the data obtained, the number of populations at the study site was 433KK, in this study, researchers took an error tolerance of 15% (0.15), so that:

$$n = \frac{433}{1 + 433(0.15)^2}$$

$$n = \frac{433}{10.74}$$

$$n = 40.31$$

Thus, the number of samples that will be needed in this study is around 41 families.

Secondary Data

Secondary data were obtained through literature studies and documents from the village office on Salemo Island.

4. Results and Discussion

4.1. Characteristics of the Coastal Settlements of Salemo Island

Salemo Island has an area of 10 km2. The sea trip by small boat from the nearest pier is approximately 25 minutes. There are 8 neighborhoods inhabited by 433 households or around 1,449 people (Early 2020 citizen data) [15].

4.2. Settlement Location

The research location is on one of the islands in Mattiro Bombang Village, namely Salemo Island, Liukang Tupabbiring District, Pangkep Regency. This village is a village with a coastal geographical location with sandy soil conditions, which is located in the Northwest of Pangkajene City. The following is a map of the location of Salemo Island which can be seen in Figure 2:

Figure 2. Location Map of Salemo Island in Google Earth image

4.3. Shape and Pattern of Salemo Island Settlement

From the following map, we can note that the island of Salemo has a pattern of coastal settlements that are concentrated because they surround the water area and are perpendicular to the parallel, where this pattern forms the main access parallel to the coastline and forms an environmental road access that is perpendicular to the coast. The layout of the building is parallel to the coastline and the main access can be seen in Figure 3 and Figure 4 below:

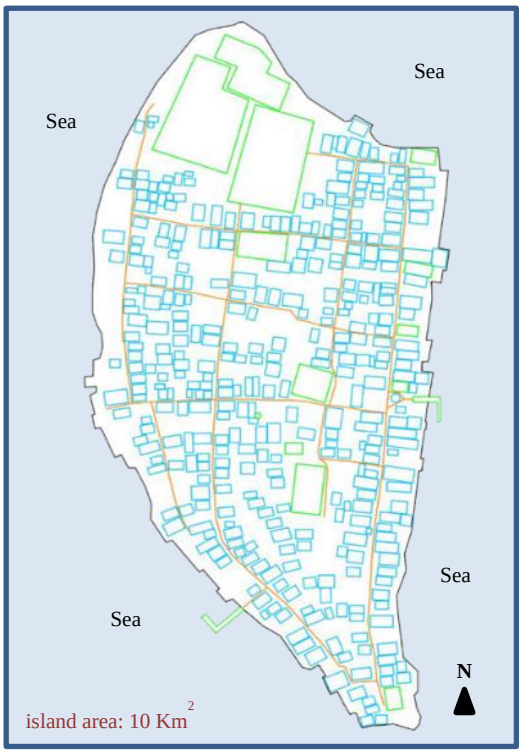

Figure 3. Map of Salemo Island

Information:

: Main road / Road network
: Public facilities & infrastructure
: Residential settlements
: Island boundary line

Figure 4. Orientation of Salemo Island Settlement Buildings

4.4. Planning a Sustainable TPS 3R Design Concept

The existing state of the waste system in the coastal settlements of Salemo Island does not have a TPS or access to the nearest landfill, so people throw their garbage directly into the sea or are left to accumulate on the shores of their beaches. This situation is very concerning because there is no solution from the local government to overcome this problem. Based on the Technical Requirements of TPS and TPS 3R by the Ministry of Public Works and Public Housing (2017) which states that the procurement of TPS such as TPS 3R has at least 400 households [16], while the Salemo Island settlement has 433 households or 1,449 people. So, it should have a 3R TPS with a minimum area of 200 m2. The planning of a sustainable TPS 3R design concept that can be applied based on the 3R TPS criteria according to the Technical Guidelines for the Implementation of Labor-Intensive Activities of the Directorate General of Cipta Karya (2020) is as follows: [17]

4.4.1. Location of TPS 3R Placement

The location chosen is based on vacant land in the coastal settlements of Salemo Island that can meet the minimum area standard of TPS 3R, which is 200 m^2.

4.4.2. Archways/Inscriptions

The archway design planning uses brick material with a height and is placed in front of the 3R TPS. To facilitate the discovery of this 3R TPS, the color given to the archway design uses a light color by containing the logo of the Regency/City Government and the Ministry of Public Works and Public Housing.

4.4.3. Buildings (Hangars)

Building design planning (hangar) uses steel structure material as well as the roof. The use of steel structures is based on its stronger resistance than other materials such as wood and also corrosion resistance, where we all know that the coastal settlements of Salemo Island are surrounded by seawater which can cause corrosion faster and can dampen heat. The opening should be made large so that it does not feel hot and the smell from garbage is not trapped in the hangar room. The orientation of the TPS 3R building (hangar) faces north-south, this is based on the orientation of residential buildings on the coast of Salemo Island facing west-east, where the wind direction also blows from the west-east so that with the 3R TPS building facing north-south, it can avoid unpleasant odors coming from garbage at the TPS.

4.4.4. Office

The office design planning is placed away from the hangar building, this is so that the officers in the building are more comfortable because they do not smell unpleasant odors. The iftar was made on the west-east side but not made large. As for anticipating the limited land on Salemo Island, the office space was made on the second floor of the hangar building

4.4.5. Disaggregated Garbage Containers for Source

The planning of the design of the disaggregated waste container from the source was carried out with a pattern of indirect communal housing due to the dense settlements on Salemo Island. This shelter is divided into organic and inorganic waste, made of fiber glass container material in each RT which will then be transported and taken to the TPS 3R hangar building. The colors used in communal containers are dark colors for organic waste and light colors for inorganic waste with a special emblem.

4.4.6. Waste Sorting/Processing/Storage Unit

The design planning of the waste sorting/processing/ storage unit is designed in one building that is given a partition to facilitate the transfer of waste from sorting to waste processing.

4.4.7. Warehouse/Solid Compost Storage Container/ Liquid/Bio Gas/Recycled Waste/Residual Waste

The design planning of the warehouse/solid/liquid compost storage container/bio gas/recycled waste/residual waste is made extensive by placing it near the transportation area.

4.5. TPS 3R Design Concept

The following is the design concept of the 3R TPS plan depicted in Figure 5 below:

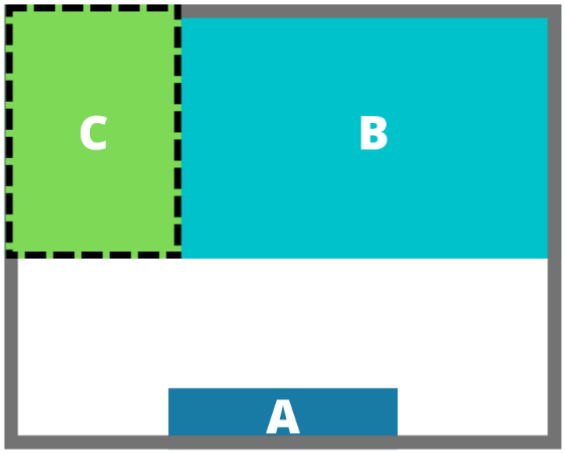

Figure 5. TPS 3R Plan Concept

The explanation of the plan is that part A is the gate of TPS 3R, then part B is a building (hangar) in which there are partitions of the sorting, processing, and garbage collection units and part C is an office space on the second floor of the building (hangar).

5. Conclusions and Recommendations

5.1. Conclusions

The location chosen is based on vacant land in the coastal settlements of Salemo Island that can meet the minimum standard area of TPS 3R, which is 200 m^2. The planning of the TPS 3R design concept consists of an archway located in the front area, then a hangar building which is divided into two floors to overcome the problem of limited land, consisting of one hangar building in which there are partitions of the sorting, processing and garbage collection units, and the second floor which is an office area.

5.2. Recommendations

Educating the community on 3R waste processing (reduce, reuse, and recycle) and carrying out mutual aid activities to clean the beach. The procurement of facilities and infrastructure as well as the implementation of the 3R TPS must be supported by the local government and the social community to reduce marine pollution by household waste generated by the people of Salemo Island.

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