Institute for Advanced Science,
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MORALITY BEFORE KNOWLEDGE

Waste management plan with reduce, reuse, recycle (3r) method

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Abstract

Garbage is a problem that is quite concerning in Indonesia. Most of the waste generated comes from household waste and plastic waste. The increase in waste production is influenced by population growth, the speed of development and the socio-economic level of the community which grows every year. The increase in the amount of waste is not proportional to the expansion of the landfill area. Disposal/TPA conditions in several areas are already overloaded, one of which is in Batang Regency. The Randukuning TPA in Batang Regency is already overloaded with the amount of waste produced reaching 500 tons per day with a landfill area of 2.5 hectares. Waste management is a structured, comprehensive and sustainable activity that includes waste reduction and handling. One effort that can be done to reduce waste is to sort waste from its source and apply 3R (Reduce, Reuse, Recycle).

Keywords: final disposal; garbage; household waste; plastic waste; waste management; waste production; 3R (Reduce, Reuse, Recycle)

1. Introduction

Garbage is a problem that is quite a concern in Indonesia. The latest data from the Ministry of Environment in 2022 shows that the total amount of waste generation from 33 provinces in Indonesia as a whole is 68,410.18 tonnes/day and 24,969,716.90 tonnes/year, where the largest source of waste comes from household waste (38.64%), then commercial centers (25.05%), markets (13.11%), public facilities (7.3%), areas (6.02%), offices (5 .86%), and others (4.02%) (Ministry of Environment and Forestry, 2022 in (Maharja Rizky et al., 2022). The amount of waste is increasing every day, which causes more and more waste to accumulate and landfill land to decrease (Sarnapi, 2021). This has something to do with the fact that the waste generated is taken directly to the landfill, so around 69% of the waste ends up in the landfill (Kesuma, 2021). The government has launched various programs to address this problem, including implementing 3R-based waste management (Reduce, Reuse, Recycle) (Amelia et al., 2017).

The growth in waste production, which is increasing every year, is influenced by the increasing population, the speed of development, and the socio-economic level of the community, which is growing yearly. Over time, the increase in waste is different from the expansion of the landfill area. The disposal area/TPA condition in several areas has experienced an overload. One of them is in Batang Regency, where the condition of the Randukuning TPA is already overloaded (exceeding the provisional capacity), with waste production reaching 500 tons per day with a landfill area of 2.5 hectares.

The current waste management that is carried out only focuses on collecting, transporting, and disposing of waste without sorting and utilizing waste which still has an economic and usable value. It is undeniable that waste is part of people's lives and their environment. Information from the 2022 National Waste Management Information System states that household waste is the largest source of waste (41.79%), plastic waste (18.06%),

wood/branches (13.33%), paper/cardboard (10.93%), metal (2.87%), cloth (2.58%), glass (1.99%), rubber/leather (1.95%), and others (6.5%). Food waste is listed as the first rank and is the subject of the most contribution, with a percentage of 41%, and plastic waste is in second place, with a percentage of 18% (SIPSN, 2022).

Concerning this, local governments and communities must participate in and be responsible for implementing waste management efforts. Based on Article 4, waste management must be carried out based on responsibility, sustainability, benefits, justice, awareness, togetherness, safety, security, and economic value. This must be implemented to improve the quality of public health and the environment and manufacturing waste as a resource in Article 4. (Nindita Velma, 2017). Based on this, the state and society together can form a Waste Bank. (Utami, Rialmi and Nugraheni, 2022). The Garbage Bank is one of the facilities established for waste management to minimize waste production by applying the 3R principles (Reduce, Reuse, Recycle). Apart from being a waste bank educational tool, it can also make a difference. The community or local government can form and manage waste management and the application of a circular economy. Turning waste into raw material for the Indonesian economy is an effort to minimize the increasing waste production by maximizing the value of using a product repeatedly so that no resources are wasted. This can make a real contribution to economic growth.

Efforts to reduce waste at its source are an alternative to minimizing waste produced in landfills. The existence of a waste bank as a means of collecting dry waste that adopts bank management is formed to build public awareness of waste. (Puspitawati Yuni & Rahdriawan Mardwi, 2012) The design of waste treatment sites that apply the concept of Reduce, Reuse, Recycle, known as TPS 3R or community-based waste management, concerning this, is expected to minimize waste production, reduce the impact of waste accumulation, and generate economic value, which can later improve people's welfare. Planning a waste management site with 3R TPS is an effort that can be taken to reduce waste, including by sorting waste from the source and applying the 3R concept (Reduce, Reuse, Recycle) or reducing, reusing, and recycling waste so that the waste has economic value. (Mellyanawaty et al., 2021) Community-based waste management is a waste management system carried out in an environmentally friendly manner and is planned, organized, implemented, managed, and owned by the community. The aim is to realize the character of an independent community in maintaining environmental cleanliness and producing products of economic value from processed waste. (Zachria et al., 2019).

RI Law No. 18 of 2008 states that the waste problem covers many aspects, therefore its management must be carried out comprehensively and integrated with innovations that are more adequate and can be viewed from all aspects, be it social, economic, or technical aspects so that it can provide economic benefits, is healthy for the environment, and can change people's behavior, meaning that waste management needs to be done from the source (Alhada et al., 2021). Community-based waste management with the 3R concept (Reduce, Reuse, Recycle) aims to reduce waste from the source, reduce excess waste production, reduce environmental pollution, provide benefits to the community and can change people's behavior towards waste. The 3R concept (Reduce, Reuse, Recycle) is straightforward and easy to implement but difficult to implement because the success of the 3R concept (Reduce, Reuse, Recycle) is determined by the participation of the government and the community in changing their behavior which is generally influenced by the socio-cultural and socio-economic characteristics that characterize people's lives. (Triana & Sembiring, 2019).

Waste management based on 3R (Reduce, Reuse, Recycle) is expected to help the government minimize excess waste production and handle household and household-like waste in 2025. Waste management based on 3R (Reduce, Reuse, Recycle) emphasizes the concept of Reduce, Reuse, and Recycle, which starts from the source, in this case, the household. Concerning this, the central concept is to reduce the quantity and improve waste characteristics before taking it to the TPA. The 3R-based waste processing process begins with reducing waste use (if possible), sorting waste according to waste characteristics,

reusing waste that is still feasible, and recycling waste so that it can have economic value (Aripin et al., 2017).

According to Fauzi (2018), recycled waste produces IDR 16,379,472/month/48 tons of plastic waste (Fauzi, 2018) (Hariyadi et al., 2020). Thus, the process carried out in 3R-based waste processing (Reduce, Reuse, Recycle) is not only to reduce the amount of waste but can be an alternative income for the community by maximizing the value of using a product repeatedly so that no resources are wasted. In principle, a reduction from the source requires a reduction of waste products that will be sent to the TPA Community-based waste management, a system of waste settlement that is carried out in an environmentally friendly manner and is planned, arranged, operated, managed, and owned by the community.

Based on the description above, the researchers wrote this article entitled: Waste Management Planning Using the Reduce, Reuse, Recycle (3R) Method. This study aims to determine waste management with the 3R Method (Reduce, Reuse, Recycle).

2. Methods

This article contains primary data and secondary data. The primary data was obtained from the Head of the Batang Regency Environmental Service, the Ministry of Environment and Forestry, and the stakeholders who provided information. Secondary data is taken from reports, journals, articles, and publications related to waste management in Batang Regency. This study uses a quantitative descriptive research method. The research method is the steps used by the author to obtain data, either in the form of primary data or secondary data, with specific purposes and uses. In this study, the authors used quantitative methods with technical descriptive quantitative analysis to describe the data obtained from the research results using a case study approach. (Indrawan & Kaniawati Dewi, 2020) Data collection techniques used were interviews and observation. The stages involved in writing this article consisted of planning, implementing, and evaluating the community. (MacDonald, 2012). Here are the steps:

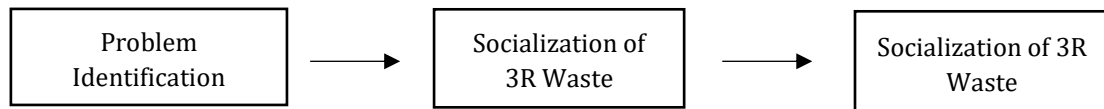| Problem Identification	→	Socialization of 3R Waste	→	Socialization of 3R Waste

Figure 1. Stages of Activity Implementation

2.1. Planning

The author coordinates with the Batang Regency Environmental Service. The author identifies existing problems through observations at public facilities and community housing environments in Batang Regency, then develops strategies to reduce the problems found.

2.2. Implementation

The author coordinated with the Batang Regency Garbage Bank Communication Forum, the co-author with the Batang Regency Environmental Service government, and the Garbage Bank Communication Forum conducted socialization on 3R (Reduce, Reuse, Recycle) waste management. The Waste Bank Communication Forum teaches how to process organic waste (compost).

2.3. Evaluation

The evaluation activity ended with questions and answers and filling out a questionnaire to determine the level of understanding of the community.

3. Results and Discussion

Based on the results of observations, it can be seen that the people in Batang Regency still use the end-of-pipe concept, where the community disposes of waste in the TPS that has been provided and is then taken by cleaners from the Batang Regency Environmental Service to the Randukuning TPA. The community is encouraged to collect garbage daily at 06.00 - 15.00 WIB. The garbage collection system is divided into several patterns as follows:

The first pattern is the Direct Individual Pattern, in which the community disposes of it directly to the nearest TPS from their house. It is then collected by Batang Regency Environmental Service officials using a garbage truck and transported to the Randukuning TPA. Usually this pattern is typical in residential areas. The results of observations in the field show that 53% of the community throws garbage at a frequency of 2 to 3 days a week, and 28% percent dispose of garbage daily. The second pattern is the Indirect Individual Pattern, where the community utilizes the services of officers who pick up garbage from house to house using collection and transport equipment (garbage carts/garbage rickshaws/motorcycle carts). Garbage picked up is then taken to the TPS or directly transported to the Randukuning TPA. In addition to the Indirect Individual Pattern in residential complexes, it is also carried out in non-residential complexes. The community will put their garbage on the side of the road or outside the yard; then, the haulers will go around collecting garbage from house to house. The aim of the city government to implement this is to reduce the amount of waste from outsiders who often dispose of garbage by utilizing the facilities.

The third pattern is the street sweeping pattern. The Batang Regency Environmental Service has deployed road sweepers in each sub-district. The results of road sweeping will be collected by garbage carts/garbage rickshaws/motorcycle rickshaws, which will be brought to the nearest container and later taken to the Randukuning landfill by a garbage truck. The road sweeping schedule consists of 2 (two) shifts, namely in the morning and the evening. The success of the waste management program with the 3R concept (Reduce, Reuse, Recycle) is primarily determined by community participation in the program's success. Community participation begins with knowledge and information obtained by the community regarding the program that the government will carry out. Most of the people of Batang Regency already know about the concept of 3R (Reduce, Reuse, Recycle) waste management, where 61% of residents already know the concept. This can then be encouraged by a series of activities or programs for successful waste management that apply the 3R concept (Reduce, Reuse, Recycle). However, 38% of residents do not know the 3R (Reduce, Reuse, Recycle) concept of waste management, so this needs to get attention from the government so that information about the 3R (Reduce, Reuse, Recycle) waste management concept can be received by the community evenly.

Community participation and willingness to participate in the 3R (Reduce, Reuse, Recycle) waste management program must be supported by the availability of facilities and infrastructure. However, until this survey was conducted, most respondents, namely 86%, stated they did not have waste baskets/facilities used for composting. In its efforts to reduce the amount of waste, Batang Regency should start providing facilities and facilities for reducing waste, in this case, the availability of containers for making compost on a household scale. Aside from reducing waste, the expected benefits can also be used as organic fertilizer, which the community can use directly. Implementation of waste management policies with the 3R principle (Reduce, Reuse, Recycle) is not supported by supporting facilities, making the 3R program (Reduce, Reuse, Recycle) not run well, so it is necessary to support the availability of suitable facilities and infrastructure (Safitri & Sari, 2021).

Table. 3.1 Data on the amount of waste at the Randukuning Landfill in Batang Regency in 2020

No.	Month	Garbage Volumes (meter³)
1	January	7229
2	February	6648
3	March	7133
4	April	6543
5	May	5219
6	June	5580
7	July	6621
8	August	6740
9	September	6626
10	October	7160
11	November	6957
12	December	7236
Amount		**79692**

Table. 3.2 Data on the amount of waste at the Randukuning Landfill
in Batang Regency in 2021

No.	Month	Garbage Volumes (meter³)
1	January	7135
2	February	6648
3	March	7264
4	April	6999
5	May	7450
6	June	7011
7	July	7954
8	August	7605
9	September	7139
10	October	6889
11	November	7185
12	December	7385
Amount		**86664**

Table. 3.3 Data on the amount of waste at the Randukuning Landfill
in Batang Regency in 2022

No.	Month	Garbage Volumes (meter³)
1	January	8763
2	February	7664
3	March	8516
4	April	8289
5	May	8548
6	June	8629
7	July	8490
8	August	8822
9	September	8389
10	October	8584
11	November	8483
12	December	8419
Amount		**101596**

The data on the amount of waste for the last three years show that the production of the amount has increased yearly. This happens in line with the increase in population, population density, speed in the development sector, and economic growth. With this in mind, the Batang Regency Government took the initiative to create a waste management

program with the 3R concept (Reduce, Reuse, Recycle). One approach in handling solid waste or waste disposal is through the 3R method (Reduce, Reuse, Recycle), starting from the source of the waste before being transported to the TPA (Final Disposal Site).

Therefore, for waste management both in the scope of the city or activity units, an integrated waste management plan is needed. The planning process in waste management in an area requires data on waste generation, waste composition, waste sources, and waste management as a basis for determining the concept of waste management and the level of need for waste infrastructure facilities that can support waste management, such as the processing technology used. (Raharjo et al., 2015).

The amount of waste generation that needs to be appropriately managed through an integrated urban waste management system can cause various environmental pollution problems, ultimately impacting environmental damage and public health.

In addition to preventing environmental pollution, waste management can also be a blessing for humans, where good waste management through the 3R concept (Reduce, Reuse, Recycle) can provide income and benefits for the community (Sukarmawati, et al., 2022) (Wahyudin. et al., 2020). The following are the stages of waste processing (Wiyung, 2010):

3.1. Waste Management

Processing in general is a transformation process either physically, chemically or biologically. Each definition of the transformation process is: First Physical Transformation where at this stage the waste changes physically through several methods or methods, namely separating the waste components, reducing the volume of waste by compacting or compacting, reducing the size of the waste by the enumeration process. The second is Chemical Transformation, which changes the form of waste chemically by using a combustion or incineration process. Third, Biological Transformation where the change in the form of waste by utilizing the activity of microorganisms to decompose waste into a stable material, namely compost.

3.2. Waste Management Scale

Based on the management responsibility data processing method, the processing scale can be divided into several scales, namely: First there is the individual scale; namely processing carried out by producers of waste directly at the source (household/office). An example of processing on an individual scale is waste sorting or composting on an individual scale.

Figure 2. Individual Scale Processing

Second, is the regional scale, namely processing carried out to serve an environment/area (housing, offices, markets, etc.). At the scale of the location area used for processing can be done at TPST (Integrated Waste Management Site). The process carried out at TPST (Integrated Waste Management Site) generally takes the form of sorting waste, sorting waste, enumeration of organic waste, chopping organic waste, composting, filtering compost, packing compost, and counting plastic for recycling.

Figure 3. Regional Scale Processing Process

3.3. Manager's Responsibilities

In implementing waste management, waste processing is crucial to turn waste into something more valuable, reduce environmental pollution and minimize the amount of waste production that must be landfilled in TPA (Final Disposal Sites). The manager of a waste processing process is very dependent on the processing carried out. Therefore, the processing must be done correctly.

Reducing the amount of waste that must be managed can be done with source-scale processing; this can help reduce waste that must be managed. The existence of the 3R concept (Reduce, Reuse, Recycle) and community-based waste management can change people's behavior and views of waste. *Waste* is a resource that must be managed properly from the source of the waste because waste can generate high economic value if appropriately managed.

3.4. Managers at the Waste Source Scale and Area Scale

Community-based waste management is a waste settlement system that is carried out in an environmentally friendly manner and is planned, organized, operated, managed and owned by the community. The aim is to realize the character of an independent community in maintaining environmental cleanliness and producing products of economic value from the processed waste. The responsibilities carried out from this management including its processing depend on waste management in the community. As an example can be seen in Figure 4. below.
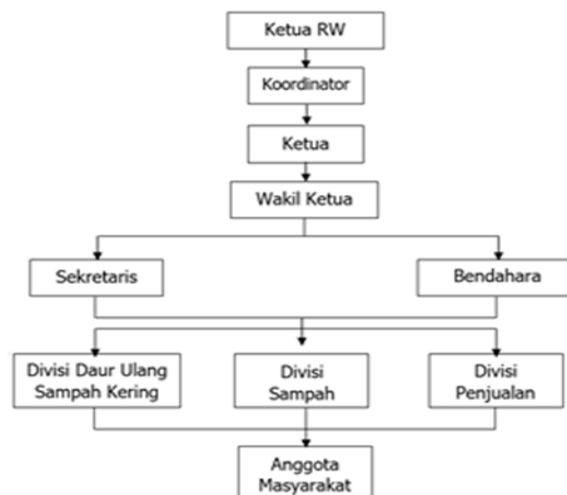

Figure 4. Source Scale Waste Management Scheme

Where the Head of the RW is responsible for all implementation of household waste processing activities, provides direction and activity input to the management, both through the chairperson and through regular meetings held by the management, can motivate the management to remain consistent in household waste management, reminding the

management if activities occur that are not following what has been agreed within the framework of achieving common goals.

In an organization, the Coordinator can coordinate with related parties both from the organization itself and from outside the organization, such as the Kelurahan, District, and Government as well as other related parties, plans for household waste management activities with the 3R concept (Reduce, Reuse, Recycle) can be prepared by the chairperson, discussions are held in regular meetings to discuss progress on the implementation of household waste management, can be led by the chairperson, monitoring, and evaluation of programs that have been prepared are carried out by the chairperson.

In carrying out his duties to manage the organization, the deputy chairman can assist the chairman; if there is a routine meeting, the vice chairman can represent the chairman if he cannot attend. The secretary can record documentation and results of routine meetings, and the secretary records the results of organizational agreements and inventory items owned; in addition to incoming and outgoing letters, it is also the secretary's responsibility to record them. The treasurer records the amount of waste collected and sold; the treasurer can report transparently and manage the organization's finances.

Coordination of the collection of waste that can still be recycled is carried out by the Dry Waste Recycling Division, which can be used for making shoe covers from plastic packaging for washing soap or cooking oil to make bags. Coordination in manufacturing the Takakura composter is carried out by the Wet Waste Division, in addition to coordinating household waste composting and providing training to residents on how to use the Takakura composter.

Collection of waste sorting and recycling suitable for sale is coordinated by the Sales Division, selling waste sorting and recycling results, recording sales proceeds from waste that has been sorted, and recycling marketing. Community members carry out the segregation of wet and dry waste.

3.5. The 3R Concept is:
Steps taken to reduce production and use of waste, which can be done by reducing the use of disposable items (such as tissue, cotton, and pads), using bags for shopping (not plastic), and others, are called Reduce. Furthermore, steps to emphasize the Reuse of waste with the same or different functions can be taken, for example, using cans as pencil cases and tubs as flower pots called Reuse.

This step emphasizes the Reuse of waste after processing, which can be done by making new paper from used paper/newspaper, making decorations from milk cans, compost, and others. You can also buy items that have a recycling logo, which can be referred to as Recycle.

Waste reduction is carried out by scavengers, waste dealers, the recycling industry, and waste bank activities to process dry waste types, while TPST processes wet waste types. In contrast, the rest of the waste generated is handled by disposal to the TPA or not handled properly, including burning, dumped into water bodies, buried in the ground, and so on. Waste generation data conducted by 208 Regencies/Cities throughout Indonesia in 2022 amounted to 21,718,674.88 tons/year, waste reduction was 3,648,716.26 tons/year (16.8%), waste handling was 10,473,963.75 tons/year (48.23%), managed waste was 14,122,680.01 tons/year (65.03 %), unmanaged waste 7,595,994.87 tons/year (34.97%).

4. Conclusions

Before implementing waste management with the 3R concept (Reduce, Reuse, Recycle), the Batang Regency Government used the End of Pipe concept (Collect, Transport, and Dispose) in waste management. Implementation of Waste Management using the 3R Concept (Reduce, Reuse, Recycle) has proven to be capable of reducing the percentage of the amount of waste generated. Some segregated waste can be reused and has a high economic value. The implementation of Waste Management using the 3R (Reduce, Reuse, Recycle) method has yet to be entirely evenly carried out by residents of Batang Regency, only in a few

locations in Batang District. However, the percentage that occurs shows a reduced volume of existing waste.

The central government has attempted waste management in Indonesia to local governments. The form of management that is widely socialized is TPS 3R. TPS 3R is a place for collecting and managing waste using the 3R concept (Reduce, Reuse, Recycle). Activities to reduce the use of an item or the production of waste and not carry out excessive consumption patterns can be called Reduce. The activity of reusing material or materials that are still suitable for use is called Reuse. Meanwhile, activities to reprocess by utilizing used goods so that they can be used further can be called recycling.

Implementation of Waste Management using the 3R method would be better to be maximized. At least this can help the government in reducing the amount of excessive waste production. The government will not be able to carry out its roles and duties, so there needs to be awareness from the public to participate in efforts to overcome and reduce waste by doing things that can preserve nature and maintain the beauty and comfort of the environment.

3R Waste Management can provide innovation in waste problems in Batang Regency. Through 3R (Reduce, Reuse, Recycle), waste management can provide potential economic value to a product resulting from waste management using the 3R concept. 3R waste management (Reduce, Reuse, Recycle).

Ethical Review Board Statement
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Informed Consent Statement
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Data Availability Statement
We encourage all authors of articles published in this journal to share their research data. This section provides details regarding where data supporting reported results can be found, including links to publicly archived datasets analyzed or generated during the study. A statement is still required when no new data are created or unavailable due to privacy or ethical restrictions.

Conflicts of Interest
The authors declare no conflict of interest.

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