

AN INTEGRATED AND SUSTAINABLE COMMUNITY-BASED WASTE MANAGEMENT MODEL IN KUPANG CITY

Karolus Ngambut^{1*}, Albertus Ata Maran¹,
Micael Johan S. Takesan¹

¹Poltekkes Kemenkes Kupang; ²NTT Provincial PPSDM Board

*E-mail : nkarolus@gmail.com

ABSTRACT

The paradigm of waste management from the "end of pipe" becomes an integrated paradigm starting from generation to final disposal of waste. The collaboration model at the community level is an option for community-based waste management. Collaborative models in dealing with waste problems at the community level are an important step in solving the problems of waste generated at the community level. To run a collaboration model in handling waste problems, aspects of leadership with a collaborative style at the community level are the key to success in handling household waste problems.

Keywords : *Integrated, Sustainable, Community-Based, Waste Management*

INTRODUCTION

The current waste management paradigm has changed, from the previous waste management applying *the end of pipe paradigm*, meaning that waste is collected and disposed of. Since the last ten years, the paradigm of waste management has shifted, waste management starts from the source of the waste itself, this concept emphasizes that waste is no longer an item that must be disposed, but waste becomes a resource that can provide benefits to the community, therefore, the paradigm has changed. into waste management starting from the source. The phrase there is "*gold in a pile of trash*" illustrates that waste is a resource that can provide benefits to society (1).

Waste management currently emphasizes integrated *solid waste management (ISWM)*. This concept has been developed in various developed countries so that it can have a good impact on efforts to handle urban waste. Integration or integrated means waste management that combines things that were previously separate into one unit, in a context that is a component in

waste management which includes aspects of policy, technical systems and context(2). The *governance* paradigm that forms the basis of urban waste management is through cross-sectoral collaboration in addressing urban waste problems (3,4).

It is widely known that the final volume of waste continues to grow, along with development progress and population growth. In addition to the increasing volume of waste, the type and characteristics of waste are also important, because the methods for managing the waste are different, for example, waste which is included in the category of Toxic and Hazardous Materials (B3), also tends to be a lot lately. On the other hand, the government has limitations in dealing with waste problems, both in terms of budget, technology and human resources. Community involvement in the context of waste management in the community is one of the agendas that needs to be continuously pushed (5).

In the context of waste management (governance concept), the involvement of related actors is very important for its success, including the components of society. Conceptually, the level of community participation in development activities consists of several levels, ranging from no participation to full participation of the community (*citizen power*). The community-based waste management model is based on the context of the community itself(6). In this case is the social, economic, educational, political context and so on. The framework for the model of community participation in waste management has become a model in other places and cannot necessarily be applied in certain contexts.

Research related to waste management can be grouped into five parts, namely research related to the challenges of waste management ((7), factors affecting urban waste management (8). Research related to the type of waste electronics(9), characteristics and estimates of waste production(10) potential and opportunities for waste management in form (11).

Research related to the integrated community-based waste management model has become a topic and theme of research by researchers in the last 10 years (1,12,13). By using the theoretical framework of community participation and public management theory, it is concluded that collaborative work between the government and the community is very important in waste management in the community (14). Factors that influence municipal waste management practices are community characteristics(14). Waste management

led by the community is one strategy in overcoming obstacles in waste management such as the unavailability of sufficient land for urban waste management or in other words decentralization of waste management (14). From these several types of research, studies on community-based integrated waste management models have not been widely carried out.

The volume of household waste continues to grow, along with the increase in population due to urbanization and the impact of development progress. In addition to the increasing volume of waste, another thing is that the types and characteristics of the waste produced are varied and require certain techniques for management, so that the waste produced does not have a negative impact on health and protects the environment from being polluted. On the other hand, the government which is given the responsibility has limitations in waste management, due to limited budget, human resources and technology. Therefore, community involvement or participation is needed in managing waste. The forms and models of community participation, of various types, are influenced by various external factors from the community itself. To understand the model framework in constructing community participation in managing waste at the community level, it is very important to do this through this study.

The aim of the research is to construct a community based waste management concept framework model. For this reason, it is necessary to identify cross-sectors related to waste management at the community level, driving factors for waste management at the community level, obstacles in waste management at the community level, knowledge and attitudes of the community in waste management. , Identify waste management facilities and infrastructure at the community level, identify the flow of waste management at the community level.

RESEARCH METHOD

This type of research is descriptive, the sample is taken proportionally and randomly from two villages, namely TDM and Liliba villages. The number of samples from households in the Liliba village is 120 and in the TDM village as many as 110 households. Data collection through interviews and observations, and Focus Group Discussions (FGD) with cross-sectors related to waste management. The description of the respondents in this study is as shown in table 1 below.

Table 1: Description of research respondents

No.	Village	Respondents	Information
1	Liliba	House representative	120 households
2	TDM	House representative	110 households
3	Cross sector	DLHK Kupang City	2 persons
4		Subdistrict	6 districts
5		Ward	2 sub-districts
6		RT/RW	2 RT/RW
7		Society	4 people
8		Businessman	1 person
9		Media	1 person
10		Academy of Sciences	1 person
11		NGO	1 person
12		Professional Organization	1 person

Quantitative data collection was carried out by staff who were given an explanation on how to collect data. An overview of the data collected is shown in table 2 below. The collected data is processed descriptively.

Table 2: Data collection in the field

Method of collecting data	Description	Destination
Household survey (quantitative data)	The survey was conducted on 230 households randomly	<ul style="list-style-type: none"> Community perceptions and attitudes about waste management and their expectations. Waste management practices at the household level Number and the type of waste that is generated

Focus group discussion with cross sectors	Discussion with 15 representatives of relevant cross-sectors waste management in the city of Kupang	<ul style="list-style-type: none"> • Waste handling flow • Related policies • Resources related to wastemanagement • Barriers to waste management • Factors driving wastemanagement
Observation	Observation of 198 polling stations in the city of Kupang	<ul style="list-style-type: none"> • Number and location and type of TPS • Landfill location
Document review	Review of available documents and reports on waste management, review of media news about waste, and various policies on waste management	<ul style="list-style-type: none"> • Garbage stats • Policy aspects regarding waste management • Another explanation related to waste management

RESULTS AND DISCUSSION

Characteristics

The characteristics of the respondents such as gender, household size, education and availability of a trash can as well as the behavior of waste disposal at the household level are shown in table 3 below.

Table 3: Characteristics of Research Respondents

Characteristics	n(%)
Gender	
Man	96 (41.7)
Woman	134 (58.3)
household size	
1. Small family (1-3 people)	36 (15.7)
2. medium family (4-6 people)	128 (55.7)
3. big family (> 6 people)	66 (28.7)

Respondent's education	
1. Until Elementary School	59 (25.7)
2. Junior High School	52 (22.6)
3. High School	75 (32.6)
4. College	44 (19.1)
Availability of household trash	
1. Trash cans are available	186 (80.9)
2. Not available Trash can	44 (19.1)
Garbage segregation	
1. separate trash	39 (17.0)
2. Garbage is not separate	191 (83.0)

Result

The results of the research on 230 households show that household waste occupies the largest proportion (37.39%), followed by traditional market and regional waste. At least the garbage comes from the office. This can be seen in Figure 1 below.

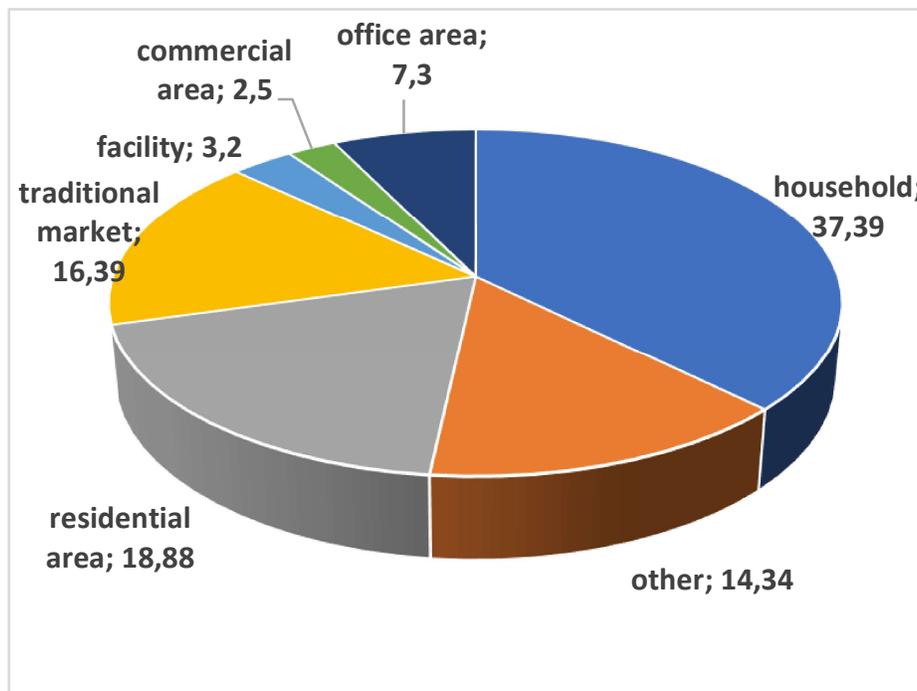


Figure 1: Volume of waste generated in Kupang City

The picture above illustrates the volume of the most waste from households which is the same as the results of the study. These results are in accordance with data which shows that the highest volume comes from household waste(15).

Waste Management System Elements

Elements of the waste management system are categorized into the first two parts related to the stages of waste management from waste generating sources, namely generation and separation, temporary storage, transportation and final disposal of waste. The second element is a waste management strategy which includes the 4 R concepts: *Reduce*, *Reuse*, *Recycle* and *Recovery*.

Elements of The Stages of Waste Management

Garbage generation is the stage where the material becomes worthless to the owner and because it is useless and does not need it anymore, and throws it away. What may be worthless to one person may not necessarily be worthless to another. for example used goods, such as cans, bottles, and others.

The generation of waste at the household level is reflected in the type of waste produced and the way the waste is disposed of. Regarding the type of waste produced, the results showed that the type of waste produced by the community was mostly plastic (28%) followed by food scraps (15.6%), wood and twigs (13.1%). The least is leather or rubber waste (3.8%). There is no segregation of waste generated at the household level, all waste that belongs to the category of *organic waste* and *an organic waste* is mixed in one particular container that has been prepared. There are various types of trash storage containers at the household level, some use plastic, some use used sacks and some are stored in cartons. An overview of the type of waste produced is shown in this image:

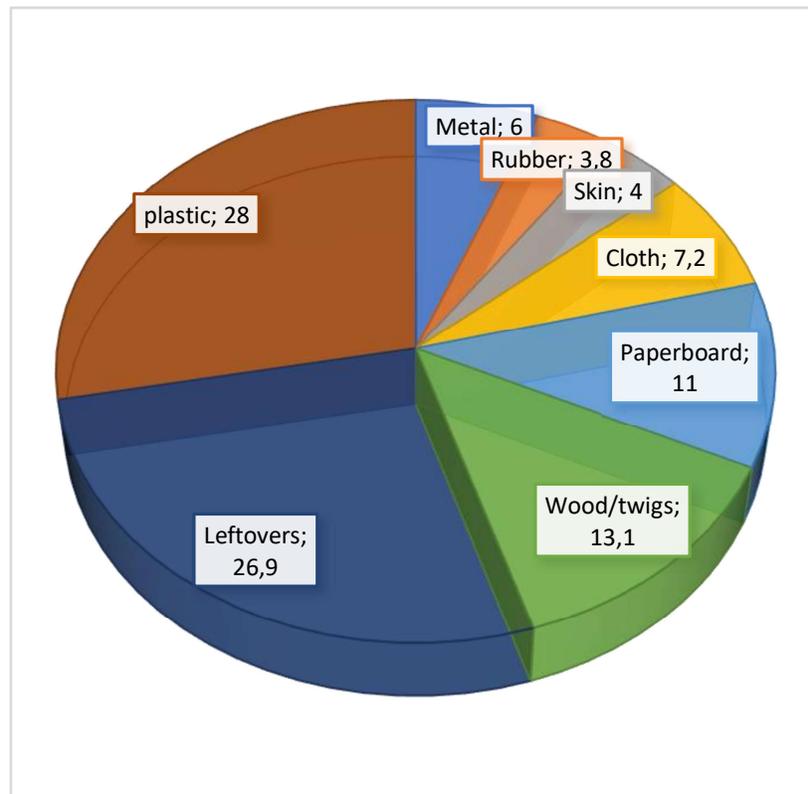


Figure 2: Type of waste generated in Kupang City

Table 4 : Characteristics of the generated waste

Characteristics	Garbage type
Organic waste/household waste	Food waste, twigs (leaves, grass,), wood, leftovers in the kitchen.
Paper	Waste paper, cardboard, newspapers, magazines, bags, boxes, wrapping paper, phone books, shredded paper, drinking glass paper. Actually paper is organic but unless it is contaminated by food residue, paper is not classified as organic.
Plastic	Bottles, packaging, containers, bags, chairs, plastic bags,
Glass cup	bottles , non-hazardous aerosol bottles , other used goods.
Other iron/metal	Textiles, leather, rubber, multi-laminate, electronic waste, equipment, ash, other inert materials

The types and categories of each of the above-mentioned wastes areas shown in the following table. The description of each type of waste group is as shown in table 4 below.

Community waste disposal practices

The waste generated by the community is stored in their respective households in various storage containers. The majority of the waste produced by the community is disposed of or burned around the house 66%, another 15.6% is dumped into the trash that has been provided (5.6%) and as much as 5.6% of the community throws garbage in canals or ditches and 4.5% dumped elsewhere. This can be seen in Figure 3 below. The time for the community to store waste at the TPS is between 18.00 and 06.00 in the morning.

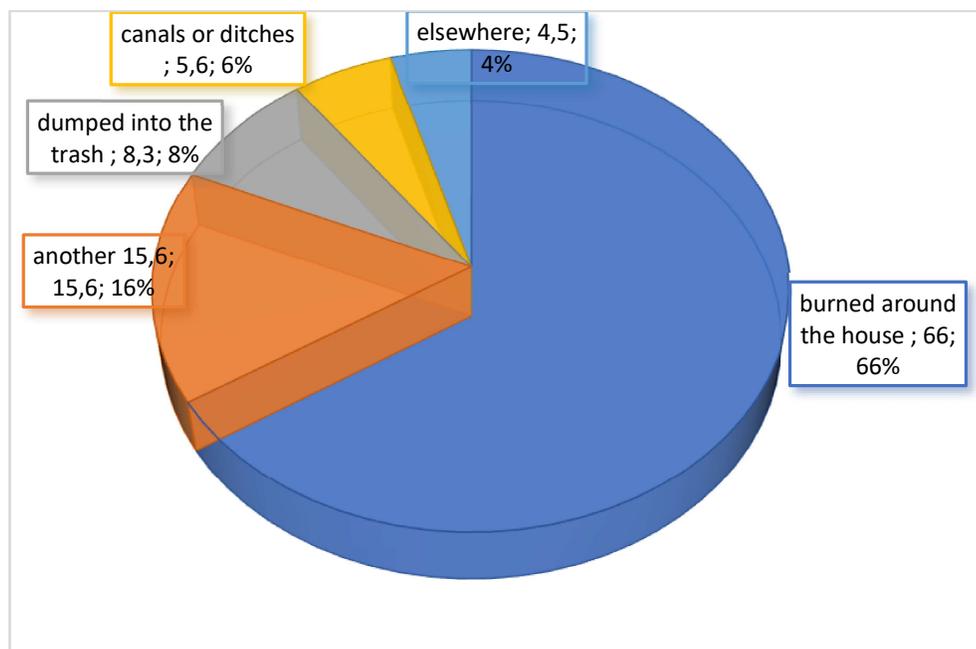


Figure 3: Community practice of disposing of garbage

Number and type of TPS

The number and type of TPS as a temporary storage place for waste in the entire city of Kupang is 198 units. Which consists of two types, namely Omrol and concrete tubs. The types of unofficial TPS are not recorded in the results of this study. The description of the number of TPS in each kelurahan in Kupang City is as follows.

Table 5. Number and Types of TPS

subdistrict	village street	Street and type of TPS	
		Omrol (unit)	Concrete tub (unit)
Alak	31	13	18
Kelapa Lima	21	6	15
Kota raja	34	15	19
Kota Lama	51	21	30
Maulafa	26	10	19
Oebobo	32	10	22
Total	198	75	123

Freight

The transportation of waste from the Temporary Storage (TPS) to the Final Disposal Site (TPA) is carried out by the Kupang City Environment and Hygiene Service. Waste collection time is carried out in the morning between 06.00 am to 10.00 am. On average, waste is transported from TPS to TPA three to four times a week.

Final disposal

The location of the final waste disposal in Kupang City is in the Alak District of Kupang City. The distance from the TPA location to the nearest community settlement is 1 KM to the northwest of Kupang City. At the TPA location there are 46 households as scavengers, each household ranging from two to three people, so that the number of scavengers living in the TPA location is 96 people. Apart from scavengers who are settled, the surrounding community also looks for leftovers for their livestock. The scavengers collect plastic, cardboard cans. The type of landfill currently located at the landfill site is open dumping. When the research was conducted, the landfill site was on fire. Several facilities, such as office buildings, were also burned.

Elements of waste management strategy

Waste management carried out at the household level includes efforts to *reduce, reuse, recycle* and *recover* (4R). The 4R practice in the research sample is illustrated in the following table or graph.

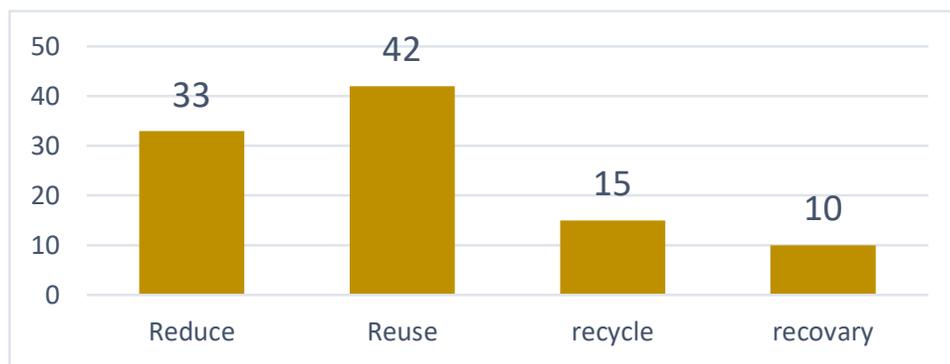


Figure 4: The practice of community-based waste management at the research site.

Table 6: Cross-Sectoral Involvement In Waste Management

Sector	Role
Department of Environment and Forestry	<ul style="list-style-type: none"> • Drafting regulations on waste management • Transporting waste from TPS to TPA • Conduct education and outreach to the community
Subdistrict	<ul style="list-style-type: none"> • Coordinate with the village head within the scope of his work area • Participate in cleaning up waste management
Ward	<ul style="list-style-type: none"> • Make regulations and circulars to RT and the community to dispose of waste properly • Coordinate with RT and RW in the work area
RT/RW	<ul style="list-style-type: none"> • Coordinate the community for waste management
Public	<ul style="list-style-type: none"> • Garbage generator • Paying waste management fees • Dispose of trash in a designated place
Entrepreneur/business world (banking, BUMD)	<ul style="list-style-type: none"> • Provide assistance (facilities and budget) for waste management • Carry out garbage cleaning
Media	<ul style="list-style-type: none"> • Educate the public through the media

Cross-sector Engagement

The results of the study by conducting FGDs showed that various related cross-sectors related to waste management included: first, the government sector, (DLHK, Dinas, Kupang City Government agencies, Subdistricts, Villages at the RT/RW level). The second is elements of the community and community groups such as youth groups, PKK youth groups, community organizations, religious organizations). The third is the element of entrepreneurs or the business world such as banking, BUMD). Fourth is mass media, electronic media. Fifth are academics and students. The various types of cross-sectors involved in waste management in Kupang City have their respective roles, which are illustrated in the following table:

Garbage Disposal Behavior

The survey results show that each household produces 80-85% organic waste *and* 10-15% *inorganic waste*, such as plastic, rubber, iron, cloth, glass. This result is in accordance with the results of research that has been done previously, that the proportion of household waste is dominated by organic waste (15). Types of inorganic waste consist of types of waste with the category of B3 waste amounting to 0.3%. The types of B3 waste include drug residues and chemicals, used light bulbs, used batteries, used oil. This amount is in accordance with the findings of previous researchers (16), That households also produce B3 organic waste.

Only 5-10% of the community manages waste by collecting, transporting and disposing of waste to the nearest TPS. Meanwhile, 90-95% of the people throw garbage around their yards including water ditches and burn it. The description of the flow of the community waste disposal process is illustrated as follows:

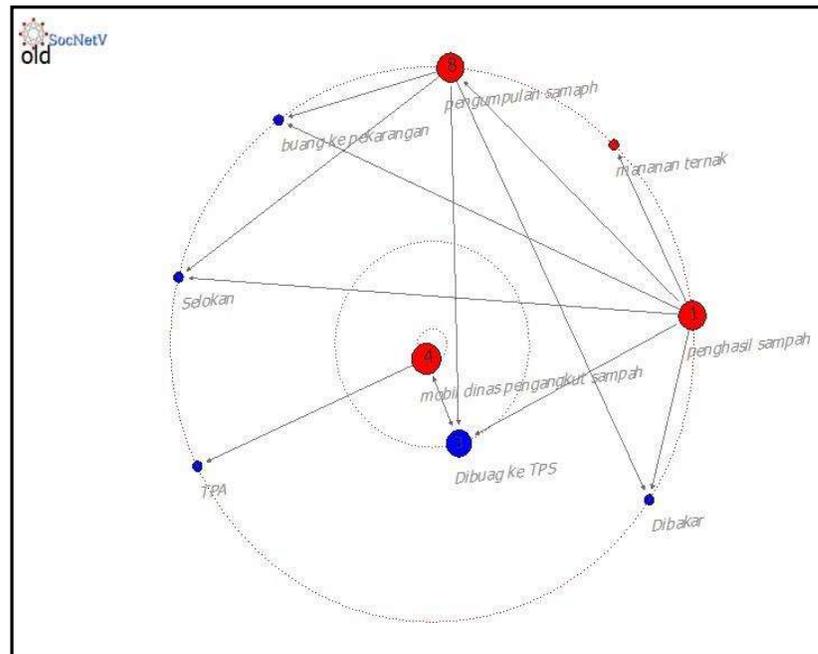


Figure 5: siklus of community waste management

The flow of the waste management scheme as mentioned above uses the old paradigm of waste management, namely collect-transport- dispose (17). This paradigm raises problems, namely uncontrolled waste and fast waste disposal. Since 2008 Indonesia has implemented a new paradigm in waste management, namely reducing *atsource* and recycling waste or known as the 3R concept, namely *reduce, reuse, recycle*(18).

The flow of waste management in the research location is illustrated by the social relations between the components which consist of various components. As shown in the following figure 6. Figure 6 shows the relationship between components in waste management. From the picture it can be seen that the community is the center of the community service, and the head of the RT is a component that has very many relationships with various components.

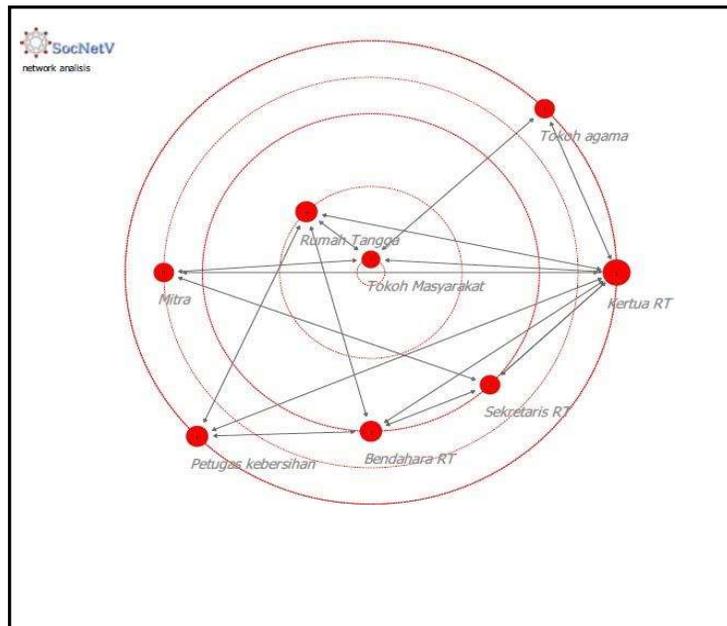


Figure 6: Relations between components in the management of RTs in Kupang City

Regulations related to waste management

Several regulations related to waste management start at the global, national and local levels of Kupang City. This figure shows that waste management is a global, national and local issue. The types of regulations are as shown in the following table.

Table 7: Types of regulations in waste management

Levels	Type of regulation	Information
International	Basel Convention	B3 waste cross-border movement control and disposal Indonesia ratified 20/09/1993
	Stokhlom Convention	Global agreement to protect human health and the environment from organic pollutants (POPs)
	Rotterdam Convention	Pre-approval procedures for certain hazardous chemicals and pesticides in international trade Indonesia ratifies 24/09/2013

	Minamata Convention	To protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds
National	Law No. 18 of 2008 concerning municipal solid waste management	Indonesia ratifies 10/10/2013
	PP number 81 of 2012	Urban waste management consists of reducing waste, handling waste, reducing waste including limiting waste generation, recycling, or recycling waste. In carrying out their activities, all actors utilize production materials that produce minimal waste, can be reused, and can be recycled and/or easily decomposed by natural processes. The goal is to improve the quality of the environment and public health and utilize waste as a resource and focus on 3R strategies. Waste management is a shared responsibility of all parties, both individuals, society, the business world and the government.
	PUPR Ministerial Decree No. 3 of 2013 concerning the provision of advice and infrastructure for handling domestic waste and similar types of domestic waste	Management of domestic waste and waste that is equivalent to domestic waste: everyone is obliged to reduce and manage the volume of their waste including repetition, recycling and reuse of waste. Waste reduction can be done by using materials that can be reused, or collecting waste packaging that has been used. TPS is a place to collect waste before it is taken to a recycling facility, an integrated waste management and/or processing facility. TPS must meet certain technical criteria, such as the availability of waste sorting facilities as well as the temporary nature of the collection site

Presidential Decree number 97 of 2017 concerning the policy of the Indonesian national strategy for managing domestic waste

Becoming a roadmap for a clean waste Indonesia in 2021. The national policy and strategy (jakstranas) includes improving management and reducing domestic waste and the equivalent of domestic waste. The Jakstranas target is to reduce 30% of waste production at its source and 70% of waste processing in 2025. Jakstranas is aligned with the RPJM and RPJMN as well as being a guide in formulating regional policies and strategies at the provincial and district levels.

CONCLUSION

Household waste is an unresolved problem, and household waste production tends to increase along with the improvement of human civilization as a result of scientific and technological advances that use natural resources. To overcome the household waste problem, cross-sector involvement is needed. The approach of involving the community as a producer of waste in managing waste is very important and shows good progress in overcoming waste problems. Communities are involved or participate in planning and decision-making to address waste problems.

The collaborative model in overcoming the waste problem at the community level is an important step in solving the waste problem generated at the community level. To run a collaborative model in handling waste problems, the leadership aspect with a collaborative style at the community level is the key to successful handling of household waste problems.

RECOMMENDATION

The study on the household waste management model that has been carried out shows that implementing the collaboration model in handling household waste can be applied in various settings.

REFERENCE

1. Wilson DC, Velis CA, Rodic L. Integrated sustainable waste management in developing countries. *Proc Inst Civ Eng Waste Resour Manag.* 2013;166(2):52–68.
2. Tai J, Zhang W, Che Y, Feng D. Municipal solid waste source-separated collection in China: A comparative analysis. *Waste Manag [Internet].* 2011;31(8):1673–82. Available from: <http://dx.doi.org/10.1016/j.wasman.2011.03.014>
3. Imperial MT. Using collaboration as a governance strategy: Lessons from six watershed management programs. *Adm Soc.* 2005;37(3):281–320.
4. Quick KS, Feldman MS. Boundaries as junctures: Collaborative boundary work for building efficient resilience. *J Public Adm Res Theory.* 2014;24(3):673–95.
5. Walling E, Walston A, Warren E, Warshay B, Wilhelm E. Municipal Solid Waste Management in Developing Countries: Nigeria, a case study. *Gr 9, NTRES 314, Stephen Wolf.* 2004;group 9(April):1–70.
6. Arnstein SR. A Ladder Of Citizen Participation. *J Am Plan Assoc.* 1969;35(4):216–24.
7. Guerrero LA, Maas G, Hogland W. Solid waste management challenges for cities in developing countries. *Waste Manag [Internet].* 2013;33(1):220–32. Available from: <http://dx.doi.org/10.1016/j.wasman.2012.09.008>
8. Pasang H, Moore GA, Sitorus G. Neighbourhood-based waste management: A solution for solid waste problems in Jakarta, Indonesia. *Waste Manag.* 2007;27(12):1924–38.
9. Kiddee P, Naidu R, Wong MH. Electronic waste management approaches: An overview. *Waste Manag [Internet].* 2013;33(5):1237–50. Available from: <http://dx.doi.org/10.1016/j.wasman.2013.01.006>
10. Kofoworola OF, Gheewala SH. Estimation of construction waste generation and management in Thailand. *Waste Manag [Internet].* 2009;29(2):731–8. Available from: <http://dx.doi.org/10.1016/j.wasman.2008.07.004>
11. Laurent A, Bakas I, Clavreul J, Bernstad A, Niero M, Gentil E, et al. Review of LCA studies of solid waste management systems - Part I: Lessons learned and perspectives. *Waste Manag [Internet].*

- 2014;34(3):573–88. Available from:
<http://dx.doi.org/10.1016/j.wasman.2013.10.045>
12. Morrissey AJ, Browne J. Waste management models and their application to sustainable waste management. *Waste Manag.* 2004;24(3):297–308.
 13. Vidanaarachchi CK, Yuen STS, Pilapitiya S. Municipal solid waste management in the Southern Province of Sri Lanka: Problems, issues and challenges. *Waste Manag.* 2006;26(8):920–30.
 14. R. Ambastha, Aich S. Decentralized Community-Led Solid Waste Management. In: *Sustainable Waste Management: Policies and Case Studies*. 2020. p. 77–89.
 15. Hayong Edi. Sampah terbanyak di Kota Kupang dihasilkan dari rumah tangga [Internet]. *Pos Kupang* . 2022 [cited 2022 Oct 14]. Available from: <https://kupang.tribunnews.com/2022/08/29/sampah-terbanyak-di-kota-kupang-dihasilkan-dari-rumah-tangga>
 16. Ngambut K. Pengelolaan Limbah Medis Puskesmas Di Kabupaten Kupang Provinsi Nusa Tenggara Timur, Indonesia. *J Info Kesehat* [Internet]. 2017;15(2):417–27. Available from: <http://jurnal.poltekeskupang.ac.id/index.php/infokes/article/view/157>
 17. Tapobali S. Kepala DLHK sebut volume sampah di Kota Kupang 86 ton per hari [Internet]. *Victory News*. 2022 [cited 2022 Jul 13]. Available from: <https://www.victorynews.id/kupang/pr-3313193031/kepala-dlhk-sebut-volume-sampah-di-kota-kupang-86-ton-per-hari>
 18. KemenLHK. Kementerian Lingkungan Hidup dan Kehutanan ajak Ibu rumah tangga kelola sampah dari sumbernya [Internet]. *KemenLHK*. 2021 [cited 2022 Jul 14]. Available from: http://ppid.menlhk.go.id/siaran_pers/browse/1382