Regulatory evaluation of waste management institutions in Yogyakarta, Sleman, and Bantul Metropolitan Areas

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Abstract. Waste management of single-use plastic bags is a common problem in metropolitan areas, including Yogyakarta, Sleman, and Bantul. It urges the needs to evaluate the existing regulation that decide the most suitable institution to overcome this issue. This research used mixed method. Regulations related to Law No. 18/2008 on Waste Management were inventoried and analysed for determining institutional related keywords. The results of content analysis are related to the volume of waste at Integrated Waste Treatment Area (IWTA) and community participation’s level. Yogyakarta does not instruct specific institutions which are in charge in sorting, collecting, and transporting waste to Temporary Trash Disposal Sites. In contrast, Sleman specifies the institutions, yet it does not include the obligation of the community level. Meanwhile, Bantul clearly regulates institutions at the community level, authority, and budget. Based on the data obtained from Piyungan IWTA, Yogyakarta is the largest contributor of waste (51.02%), followed by Sleman (29.10%) and Bantul (12.79%). However, Bantul has the highest community participation in plastic waste management (93.9%), followed by Yogyakarta (89.7%) and Sleman (88.0%). It is evident that region with the absence of waste management institution tend to generate greater amount of waste, and lower level of community participation.

1. Introduction

The waste problem is faced by most of urban areas. Indonesia was estimated to produce 67 million tons of waste in 2019, in which 15% of its content is plastic waste [1]. In addition, Arief [2] has predicted that there is a potential amount of 6,397 m$^2$ of waste domestic landfill (at regency level) and 4,961 m$^3$ of waste rural landfill, every day. The present study aims at evaluating the prevailing policies related to waste management institutions in metropolitan areas of Yogyakarta, Sleman and Bantul (Kartamantul). Research areas were selected based on the consideration that Yogyakarta is one of pilot project areas for paid plastic bag since 2016 [3]. In fact, the issues related to the damage of plastic waste pollution have started to reverberate since 2017 thus motivate the present study.

Research on waste management has been carried out and reported, some of them were conducted in Indonesia [4, 5, 6, 7, and 8]. These studies were based on an approach of participatory waste management. Nevertheless, comprehensive study which includes the distribution between the local government’s authority and the community involvement is rarely discussed. This research entails an examination of institutional aspect represented by the community participation in waste management, which is linked to the amount of waste at Piyungan Integrated Waste Disposal Area (Tempat Pembuangan Sampah Terpadu/TPST) in Bantul. It is the final landfill of waste from Kartamantul area [9, see figure 1].
The present study attempts to expose the significance of a government policy in determining the institutional model at the execution level, particularly at community level. The viability and suitability of an institution that is supported by stakeholders will likely to accommodate successful waste management, particularly at household level. Controlling domestic waste potentially brings positive effect on reducing the amount of waste at TPST Piyungan.

2. Research Method

2.1. Research time and location

The present study, a survey type research, was initiated in 2017. It is a parallel research: a qualitative study for examining laws and regulations, and a quantitative study for investigating the level of community participation. Evaluation of legislation (Peraturan Perundang-undangan/PUU) covered the study on laws (higher level act) and regulations (lower level statutes) related to the research topic, examine the correlation between them, and their current status [10]. The research used qualitative descriptive fashion, documentary method for data collection, and content analysis for data evaluation [11]. Content analysis is known as quantitative method [12-14], but it can be used for qualitative research [11, 15] or mixed [16]. The topic of this research is the problem related to single-use plastic bags as one type of waste in Kartamantul. Research areas were selected based on the consideration that Yogyakarta is one of pilot project areas for paid plastic bag in 2016 [3] by Ministry of Environment and Forestry. The evaluation of PUU will be followed up by further examination referring to the content analysis method. The keywords are the "institutional" waste management, including organizations/institutions and authorities [10], and financing/budget [17]. Deep structure approach [18] was used in this research to analyse those keywords.

Figure 1. Kartamantul metropolitan area.

In the present study, institutional entity examines those at the community level, which are evaluated through the community participation in managing their own domestic waste. Participation is a voluntary engagement in an activity by contributing one’s possession to advantage him/her [19].
Community participation is assessed using a structured questionnaire as the instrument. It consists of semi-closed questions, dividing into three sections: personal data, understanding on waste management, and participation in waste management. The level of community participation will reveal the prospective enthusiasm to promote appropriate waste management.

2.2. Data collection
The concern about waste management has been regulated in several laws and regulation as well as policies at the central, provincial, municipal, and metropolitan areas, which are limited by the periods of validity of each regulatory/policy instrument. The research stages are as follows:

- The collection of primary data, namely the institutions at the community level that was obtained through a questionnaire in regard people’s attitudes towards single-use plastic bags management;
- The collection of secondary data was done through literature study of laws and regulations on domestic/household waste management, particularly plastic bags;
- Content analysis of the prevailing waste management-related laws/regulations and policies;
- Gap analysis between the waste management-related laws/regulations and policies and the current situations; and
- Comparison of the gap analysis on the results of single-use plastic bags management in the metropolitan area of Kartaman tul with the amount of waste transported to TPST Piyungan.

2.3. Data processing
Assessment on the level of community participation was done by scoring the questions in the questionnaire [20]. The score is classified into several categories as follows [21]:

- Low participation = \((\text{Min.V}) – (\text{Min.V} + I)\)
- Moderate participation = \((\text{Min.V} + I + 1) – (\text{Min.V} + 2I)\)
- High participation = \((\text{Min.V} + 2I + 1) – (\text{Max.V})\)

\[ I = \frac{(\text{Maximum V} - \text{Minimum V})}{3} \]

Min.V : Minimal value
Max.V : Maximal value
I : Interval

Furthermore, Slovin's formula was used to calculate the number of respondents involved in this study. It is expressed as follows:

\[ n = \frac{N}{1 + Ne^2} \]

n : Total sample
N : Total population
e : Limit of error tolerance (level)

3. Results and Discussion
3.1. Regulatory analysis
The ultimate goal of this research was designed to support in policy making process in a way to reduce single-use plastic bags. Nevertheless, it was found that along with the development of review on
legislation and policies, none of them specifically regulate the management of single-use plastic bags. Therefore, single-use plastic bags are classified in the category of household waste, excluding feces and specific wastes [22]. It is stipulated in article 11, paragraph (1), letter a that waste management system to reduce landfilling is by limiting the use of single-use plastic bags [22]. Based on this regulation, the laws and regulations related with household waste are evaluated.

The results of the inventory recorded indicates that there are as many as 19 of laws and regulations as well as policies related to the household waste in Kartamantul. Table 1 details the results to be filtered for conducting subsequent stage of content analysis.

| Legislation | No. | Detail | Topic |
|-------------|-----|--------|-------|
| Law         | 1   | Law No.18/2008 on Waste Management [23] | -     |
| Government regulation | 2   | Government Regulation No. 81/2012 on Management of Household Waster and Similar Waste [22] | -     |
| Ministerial regulation | 3   | Regulation of the Minister of Environment No. 13/2012 on the Implementation of 3R through Waste Bank [24] | -     |
|              | 4   | Regulation of the Minister of Environment No. 16/2011 on Regulatory Guidelines for Regional Regulation Draft on Management of Household Waste and Similar Waste [25] | -     |
|              | 5   | Regulation of the Minister of the Home Affairs No. 33/2010 on the Guidelines for Waste Management [26] | -     |
| Provincial regulation | 6   | Provincial Regulation of Special Region of Yogyakarta (DIY) No. 3/2013 on Management of Household Waste and Similar Waste [27] | -     |
|              | 7   | Provincial Regulation of Special Region of Yogyakarta (DIY) No. 3/2016 on The Second Amendment of Provincial Regulation of Special Region of Yogyakarta (DIY) No. 11/2011 on Public Service Retribution [28] | -     |
| Governor regulation | 8   | Regulation of the Governor of Special Region of Yogyakarta (DIY) No. 21/2014 on the Guidelines for Waste Management, Waste Management Business Permit, and Environmental Compensation [29] | -     |
|              | 9   | Regulation of the Governor of Special Region of Yogyakarta (DIY) No. 99/2014 on Implementation of Waste Management Facilities and Services at Regional Final Waste Processing Site in the Center for Municipal Sanitation and Drinking Water Infrastructure Management [30] | -     |
| Governor’s decree | 10  | Decree of the Governor of Special Region of Yogyakarta (DIY) No. 18/2000 on the Management of Solid Waste Disposal Site (Tempat Pembuangan Akhir/TPA) Piyungan, Bantul Regency | -     |
| Local regulation | 11  | Local Regulation of Yogyakarta City No. 10/2012 on Waste Management [31] | -     |
|              | 12  | Local Regulation of Sleman Regency No. 4/2015 on Waste Management | -     |
Table 1. Law, regulations, and policy related to household waste.

| Legislation No. | Detail | Topic |
|-----------------|--------|-------|
| 13              | Local Regulation of Sleman Regency No. 13/2011 on Garbage Service and Cleanliness Levy [33] | - V - |
| 14              | Local Regulation of Bantul Regency No. 15/2011 on Waste Management [34] | V - - |
| 15              | Local Regulation of Sleman Regency No. 14/2007 on Waste Management [35] | V - - |
| 16              | Regulation of Yogyakarta Mayor No. 114/2016 on the Guidelines for the Provision and Use of Waste Collection Service/Cleanliness Levy Incentives [36] | - V - |
| 17              | Regulation of Sleman Regent No. 81/2016 on the Establishment, Organizational Structure, Tasks, Functions and Procedures for Waste Management Technical Implementation Unit [37] | - - V |
| 18              | Regulation of Sleman Regent No. 20/2010 on the Guidelines of Waste Management Implementation [38] | V - - |
| 19              | Joint Decree between Provincial Government of Special Region of Yogyakarta (DIY), Local Government of Bantul Regency, Local Government of Sleman Regency, and Local Government of Yogyakarta City No. 11/PERJ/GUB/X/2016, 47/PK/Bl/2016, 45/PK.KDH/A/2016, and 53/PERJ.YK/2016 on Regional Solid Waste Management System in Bantul Regency, Sleman Regency, and Yogyakarta City (valid until October 20, 2019) [39] | V V V |

Remark: *UPT* = Technical Implementation Unit.

The legal products specified in table 1 are mapped to figure out the correlation among all those law and regulations. In accordance with Law No. 18/2008 as the main legal umbrella for waste management in Indonesia, a collection of laws and regulations is depicted in figure 2. The regulations and policy in the gray shaded boxes are analysed since they are implemented at the regional/technical level in waste management.
Figure 2. The hierarchy of legislation of waste management in Kartamantul.

Waste management is primarily carried out by the Joint Secretariat of Kartamantul as established based on the joint decree and prevailing regulations in each regency/city. Furthermore, the results of the content analysis regarding waste management-related legislation in Kartamantul metropolitan area are summarized and presented in table 2 with an emphasis on community participation. Of the three keywords of institution, authority and budget, the components of examination are sorted out. The results are a group of clearly identified people, attached interests/goals, collective rules/agreements, structure/position and role of each person [40].

Yogyakarta City has no specific regulation regarding with the form of waste management institution, yet the distribution of authority/responsibility is obvious as indicated by involvement of the local government of handling the waste from Temporary Trash Disposal Sites (Tempat Pembuangan Sementara/TPS) to Solid Waste Disposal Site (TPA). This system requires the institutions at the community level to ensure the sorting, collecting and transporting of waste to Temporary Trash Disposal Sites (TPS). Furthermore, the Local Government of Yogyakarta City has provided incentives for the implementation of waste management, implying that the community of self-reliance waste management can utilize this scheme started from the sorting process.
### Table 2. Analysis of institution, authority, and budget in Kartamantul waste management.

| Object | Yogyakarta | Regency/City | Bantul |
|--------|------------|--------------|--------|
| 1. Institution | The absence of waste management institution. | • Waste management institutions consist of self-reliance institutions, producers, Waste Management Services Providers (Penyedia Jasa Pengelolaan Sampah/PJPS), and the Local Government; | Waste management institutions at the Neighborhood/Citizen Association are in charge for transporting waste to Temporary Trash Disposal Sites (Tempat Pembuangan Sementara/TPS); and the task is continued by the Local Government. |
| 2. Authority | • Waste separation according to the type, amount and/or nature of the waste; | • Waste separation is required for every person, consisting of organic, inorganic, and specific waste; | • Waste separation between organic and inorganic wastes; |
| | • Collection based on the type of waste is ensured; | • Waste collection must be done separately based on the type, namely: hazardous and toxic waste (B3), degradable, reuse, recycle, and others; | • Waste collection must be separated until the level of TPA; |
| | • The type of waste transported to TPS by producers; to Solid Waste Disposal Site (Tempat Pembuangan Akhir/TPA) by the Local Government; is ensured; | • Organic and inorganic wastes are separately transported; | • Wastes are separately transported based on their types, and the tasks are divided to the person in charge depending on the source of the waste; |
| | • Processing by changing the characteristics, composition, and amount of waste; | • Waste processing consists of compaction, composting, and recycle; | • Waste processing by changing the characteristics, composition, and amount of waste; |
| | • Final processing returns the waste to environmental media that safe for human and environment. | • Final processing through controlled landfill, sanitary landfills, or technology-based. | • Final processing returns the wastes to environmental media that safe for human and environment. |
| 3. Budget | The Local Government provides incentives and allocates budget for waste management; | The Local Government provides incentives to waste management institutions/units. | The Local Government provides incentives and allocates budget for waste management. |
| | • Community and business actors finance self-reliance waste management. | | |

Based on table 2, Sleman Regency has regulated specific form of institutions in waste management. They include the community, the private sector, and the local government. Nevertheless, the
distribution of authority between these institutions is indecisive, particularly to what extent the self-reliance/private institutions are responsible in handling the collected waste, and at which stage the authority is taken over by the Local Government.

In Bantul Regency, the institution for waste management is regulated merely at the community level with a plain limit of authority. Likewise, the budget for waste management has been entirely provided by the Local Government of Bantul Regency.

Subsequently, the results of regulatory analysis are compared with the amount of waste at TPST Piyungan. In 2017, there were 422,732; 1,193,512; 995,244 inhabitants in Yogyakarta City, Sleman Regency, and Bantul Regency, respectively [41]. The data obtained from the Center for Municipal Sanitation and Drinking Water Infrastructure Management/Balai PISAMP (2017) is confirmed by local government publication [9]. It is evident that Yogyakarta City is the largest contributor of waste in TPST Piyungan. Based on the data released by TPST Piyungan in 2017, this TPST received approximately 16,570,712 kg of solid waste in April 2017. The sources of waste are listed in table 3 below.

| No | Source           | Total (kg) | Percentage (%) |
|----|------------------|------------|----------------|
| 1  | Yogyakarta City  | 8,118,370  | 48.99          |
| 2  | Sleman Regency   | 4,590,340  | 27.70          |
| 3  | Bantul Regency   | 2,072,940  | 12.51          |
| 4  | Non-recorded, Yogyakarta City | 336,302 | 2.03 |
| 5  | Non-recorded, Sleman Regency | 232,340 | 1.40 |
| 6  | Non-recorded, Bantul Regency | 46,650 | 0.28 |
| 7  | Incidental       | 1,173,770  | 7.08           |
|    | Total            | 16,570,712 | 100            |

Table 3 indicates that Yogyakarta City is the largest waste contributor, which is equal to 48.99% of the total waste at TPST Piyungan. Likewise, this city remains the largest contributor when non-recorded waste is added to total waste, with the garbage production approximately 51.02%, followed by Sleman Regency (29.10%) and Bantul Regency (12.79%). Despite this city has the least population compared to the other two districts, yet the generated total waste is above the average of others. Considering total population, the average waste production per individual in April 2017 are: ± 20 kg/person in Yogyakarta City, 3.84 kg/person in Sleman Regency, and 2.08 kg/person in Bantul Regency. The high number of waste produced as in the case of Yogyakarta maybe explained by the high number of commuters pass by the surroundings Yogyakarta.

The correlation between the results of regulatory analysis and the amount of waste reveals that Sleman Regency and Bantul Regency have implemented self-reliance waste management through the community participation. Further, they already successfully reduce the amount of waste heaping in TPST Piyungan. On the contrary, Yogyakarta City has not been able to reduce its wastes. The city still faces the community behavior problems related to appropriate waste management [42]. Briefly, the community pioneering in which people have high awareness and capacity to handle their own waste independently is able to reduce the amount of waste at TPA to 30% [43]. Similarly, [44] claims that community-based household waste management is found to be effective in reducing waste volume by 70%. The waste management in Sleman and Bantul affirms the constructive role of community participation through the community empowerment in promoting environmentally friendly generation.
3.2. Community participation in waste management

The level of community participation is linked to what extent people are concerned about their potential or contribution in waste management. It reflects the outlook of a community towards the significance of appropriate waste management. At this level the role of the community is in the form of co-option, cooperation, consultation, collaboration, co-learning, and collective action [45]. Table 4 below shows the level of community participation in waste management as the locus of this study:

| No | Regency/City | Participation level | Total respondents | Percentage (%) |
|----|-------------|---------------------|-------------------|----------------|
| 1. | Bantul      | Low                 | 1                 | 0.7            |
|  |             | Moderate            | 8                 | 5.4            |
|  |             | High                | 138               | 93.9           |
|  |             | Total               | 147               | 100.0          |
|  |             | Low                 | 1                 | 0.5            |
| 2. | Sleman      | Moderate            | 23                | 11.5           |
|  |             | High                | 176               | 88.0           |
|  |             | Total               | 200               | 100.0          |
|  |             | Low                 | 1                 | 1.1            |
| 3. | Yogyakarta  | Moderate            | 8                 | 9.2            |
|  |             | High                | 78                | 89.7           |
|  |             | Total               | 87                | 100.0          |

Table 4 indicates that the level of community participation in managing single-use plastic bags waste in Kartamantul metropolitan area is relatively high (88%), particularly Bantul (93.9%) that has higher participation level compared to Sleman and Yogyakarta City. It implies that the community has an aspiration about appropriate waste management as indicated by their initiative in managing their own waste effectively. The active participation of the community in household waste management significantly determines its success [46]. So far, the inefficiency of waste management is mostly due to the lack of public awareness about the importance of environmental preservation, low participation in waste management, or low awareness about the surrounding environment [47].

The provision of education by the government through direct socialization and indirect dissemination through electronic media is useful in shifting the paradigm, particularly community attitudes and behaviors toward waste management. In addition, Mantarisa [48] suggests that mass media and electronics media have been very influential in transforming the current society.

3.3. Community empowerment in waste management

In fact, the current waste management primarily adopts a standard system without reckoning the characteristics and culture of the local community. Consequently, it is not carried out optimally. Based on this consideration, there is a discourse that a waste management mechanism should be based on the needs of a respective community and circumstance, to prevent any compulsion in the implementation. In Bantul, the waste bank, recent initiatives, has been running appropriately. The level of community participation is high as indicated by the number of self-reliance extension agents who actively provided assistance and knowledge transfer about waste management. The waste bank has encouraged the capacity building of the community by seeking to form the independence and self-reliance society [49-50]. This society has espoused waste management principle covering the idea of reducing, reusing, recycling, and replanting (4R, see figure 3).
Figure 3. The principle of reduce, reuse, recycle and replanting (4R).

In Jogokerten, Sleman Regency, the community have established self-reliance waste management that applies the 4R Principle of Reduce, Reuse, Recycle, and Replanting. This self-reliance institution is formed systematically nowadays, hence it should be maintained and further developed to the surrounding areas. The integration of waste bank and the 4R principle will likely to reinforce and improve the efficiency of waste management at the source level [49]. Moreover, Utami et al. [43] states that community-based waste management provides several benefits, i.e., reducing the amount of waste by 57% and cost efficiency by 23-37%, as compared to conventional method. Similarly, Arief [2] reaffirms that the integrated waste management policy involving community empowerment is more effective in solving the waste management-related problems.

The role analysis presented in table 5 and figure 4, underlines the necessity in the integrated community-based waste management related to "stakeholders and their roles". A suitable role can synchronize the level and position of stakeholders regarding their roles. Today, management is emphasized on the function of related agencies, especially the Regional Technical Implementation Unit (Unit Pelaksana Teknis Daerah/UPTD) of Waste Management. In line with the improvement in community empowerment, the synchronization and collaboration among stakeholders is required to prevent any overlap role. Suharti [51] highlights two primary aspects that must be identified at the level of stakeholders, namely the aspects of influence and the aspects of interest.

Table 5. The role analysis in waste management.

| No | Stakeholder                                      | Role                                           | Status |
|----|-------------------------------------------------|------------------------------------------------|--------|
| 1  | Community                                       | Collecting and sorting waste at the earliest stage | ++     |
| 2  | UPTD of waste management                       | Collecting and processing waste at the advanced stage | ++     |
| 3  | Self-reliance extension agents                 | Transferring knowledge about the integrated waste management | +      |
| 4  | Waste bank                                      | Implementing alternative system, instead of conventional ones. | ++     |
| 5  | Official personnel at Neighborhood/Citizen Association | Providing facility for waste management together with other stakeholders. | +      |

Remark:
++ : Direct influence on waste management
+ : Indirect influence on waste management
In the integrated waste management with community empowerment, the community becomes the main "actor". It has a dual role of being a producer that generates waste and at the same time, being a "waste processor" at the site level. If this dual functions work properly, hence an attempt to reduce the amount of waste transported to TPA landfill will be on the ground. The community is suggested to separate their own wastes based on waste type and to process them as soon as possible in accordance with the 4R principle. Further, the role of the self-reliance extension agent is to facilitate knowledge dissemination related to waste processing through direct training/assistance.

The waste bank facilitates alternative waste processing in order to increase the added value of the residual products generated by the community. The UPTD of waste management carries out the waste collection and process the waste at advanced stage. It can be done neither at the site nor by the local community. Meanwhile the official Neighborhood/Citizen Associations (RT/RW) facilitate the communal activities and encourages community to actively participate in waste management at the local level. From table 2, it is understandable that the transportation of waste to the TPS is the responsibility of the waste producer, and owing to this fact, RT/RW is expected to play a role in this stage. Transportation of collective waste will be more effective than single household’s transportation system.

The roles of each stakeholder in community empowerment can be done by optimizing the function of Joint Secretariat of Kartamantul—bearing obligations to coordinate all stakeholders of the collaborating regencies and city. Supervision is conducted from the process of levy collection, waste collection from sources to TPS, waste transportation from TPSs in Yogyakarta City, Sleman, and Bantul to TPST Piyungan, to the daily operation of TPST Piyungan [42].

4. Conclusion and Recommendation
4.1. Conclusion
This study indicates that the absence of non-regulated institutions leads to uncontrolled amount of waste and non-optimized community participation in the waste management. Yogyakarta City is evident where the city being as the largest waste contributor (51.02%) in TPST Piyungan, even if the level of community participation in waste management is somewhat high, 89.7%, comparable to those obtained by Sleman Regency and Bantul Regency.

This research also found that the most suitable institution to overcome single-use plastic bags issue is institution combining community empowerment, authority, and budgeting. Waste management model that involves the participation of community through community empowerment is found to be effective in reducing the amount of household waste. Community acting as the main actor can play the important role in community empowerment so as proper waste management is in place.
4.2. Recommendation

The role of the Kartamantul Joint Secretariat is crucial to maintain the integration of all stakeholders in Yogyakarta City, Bantul Regency, and Sleman Regency. The existence of this secretariat can be used as a forum for exchange of knowledge in strengthening each region's institutions referring to waste management. The working period of the secretariat needs to be renewed based on its expired validity period (in October 20, 2019) and its important role in managing metropolitan waste.

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