Examining of solid waste generation and community awareness between city center and suburban area in Medan City, Indonesia

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Abstract. Municipal solid waste (MSW) management is still an issue in many cities in Indonesia including Medan. Understanding the waste generation, its characteristic and communities involvement could provide effective solid waste management. This research compares waste generation from people who live in the city center and suburban area. The research also examines the willingness and participation of community about environmental aspect, especially solid waste management. The method of waste generation used Indonesian Nasional Standard 19-3964-1994. The city center generates 0.295 kg/person/day of solid waste and 0.180 kg/person/day for suburbs. The result showed that there are the common amount of waste compositions between the city center and suburban area. The majority waste composition was an organic fraction. Questionnaires were distributed to examine the community awareness. The descriptive statistic used to analyze the data. The result showed that people living in the city center are slightly higher in community awareness than in the suburb. This paper highlights that area of living could give some effect to solid waste generation, waste composition and rate of awareness.

1. Introduction

Increasing generation of municipal solid waste (MSW) is a logical consequence of increasing city population. However, to treat the municipal solid waste is still an issue. This condition will lead to bad impact to human and environment. In the other hand, treating properly municipal solid waste will improve the quality of life. MSW management is an effort to eliminate waste from its sources and disposed to environmental securely.

Present day, solid waste in Medan are collected in mixed scale, put all solid waste in one plastic bag and municipality disposed it into landfill directly without any treatment. This action will reduce the capacity and the age of landfill. Municipalities should upgrade these condition into integrated sustainable solid waste management (ISSWM).

The concept of the integrated solid waste management system has gained acceptance. Integrated solid waste management has been defined as the selection and application of suitable techniques, technologies, and management approach to achieve specific objectives and goals. MSW management is not just a technological system facilitating the handling and disposal of MSW. MSW management deals with many other factors such as socioeconomic conditions, operating environment and actions of the municipal government [1].

In developed countries, citizens are supposed to drop their waste at specific locations by the municipalities on a particular day of the week at a given moment and waste categories. Public participation, awareness, and corporation are the main keys to success in solid waste management. In ISSWM, public participation is a necessary part to make the people aware of active participation in the

system. Without public participation, it may be difficult to make city cleaner and may also become less effective in using of cost resource.

Research conducted in several cities in Java and Sumatera. It showed that city with high population density, a high total of population, and high of economic growth characteristics have high waste generation. Meanwhile, the city with low population density and economic growth, its waste generation is also low [2]. Environment problems associated with the generation of waste are part of societal changes where households play an important role. These societal changes influence the characteristics of given households, including family size, income, education, occupation and residential location [3].

The main objective of this paper is to examine the waste generation, characteristic and community involvement in Medan city to reduce solid waste generation. This research compares waste generation from people who live in the city center and suburban area. The research also examines the level of awareness of the community about environmental aspect, especially solid waste management.

2. Methods

Sample collection and measurement of solid waste generation and composition were referred to the Indonesian National Standard SNI 19-3964-1994, Method of Collecting and Measurement of Samples and Composition of Urban Wastes. Based on this method, waste generation and composition were measured in eight days period[4]. Solid waste generation was calculated through load count analysis method, which calculates the total of waste collection every day. Waste samples are weighted and sorted based on pre-defined components. Each element is also weighted afterward.

Two sub-district of Medan City is selected as areas of study. Medan Polonia represents as the city center and Medan Helvetia as a suburban area. Based on SNI 19-3964-1994, Number of the sample in Medan Polonia is 29 households and 72 households in Medan Helvetia. To measure the level of public awareness, questioners distribute into the area of study. Each selected households are also as respondent. The analysis was based on the descriptive statistic.

3. Results and discussions

This study found that the city center generates waste 0.295 kg/person/day. Then, suburban generates 0.180 kg/person/day of solid waste. The study showed that there is a different amount of solid waste generation between two areas. Medan Helvetia represents as suburban area and Polonia as the city center. The amount of solid waste generates in the city center is higher than suburban, nearly 64%. This difference could be due to income, education, food consumption, and residential location.

Results further in the waste composition in two area described that dominantly household waste comes from food waste, where approximately 80% domestic type waste is organic. The other types of waste are plastic, paper, glass, metal, LWTR and other material. The results of the solid waste composition are shown in table 1.

Table 1. Solid waste composition.

Composition	The city center (%)	Suburban (%)
Paper	4.14	1.75
Plastic	5.43	4.91
Organic	79.16	86.29
LWTR	1.56	1.61
Glass	3.70	1.60
Metal	0.67	1.12
Aluminum	1.04	0.53
Inert material	0.19	0.06
Other	4.12	2.13

In this research, respondents were also asked to answer several questions related public awareness in solid waste management. Respondents were asked about:

1. Level of acceptance in paying retribution fee monthly
2. Willingness to separate waste at their home
3. Their habit, to bring own plastic bag while shopping
4. Willingness to get involved in solid waste management community in their area
5. Their habit dumping the waste in proper manner, not littering it

The result of their answers can be shown from figure 1 to figure 5. In figure 1 describes that respondents were asked about the fees of the waste retribution charged to the community monthly. 74-84% of respondents in two areas claimed to accept the retribution fees and said 'it does not matter.' However, when asked to separate the waste at home (figure 2), the respondents in the two study areas were divided, the respondents who live in the suburbs seem reluctant, while the residents in the city center had a willingness to do it.
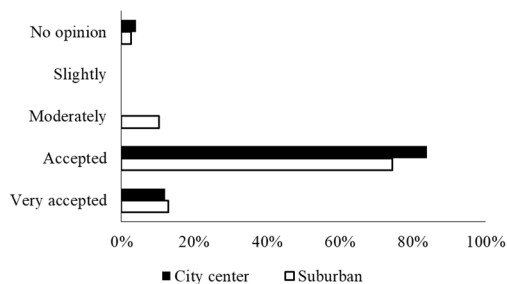

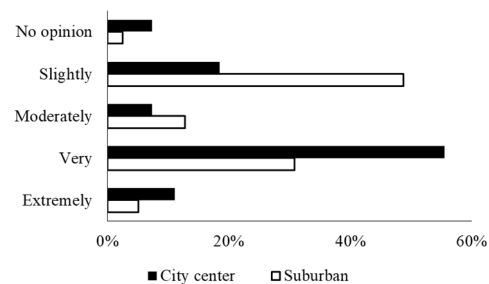**Figure 1.** Responses of respondent 'acceptance of paying retribution fee.'

Figure 2. Responses of respondent 'willingness to separate their waste at home.'

Respondents were asked their responses about the habit of carrying their plastic bag while shopping (Figure 3), both areas of the study showed the same responses that more than 50% did not carry it. Asking about their participation in waste management activities (Figure 4), the majority of respondents answered pleased and very pleased. 52% of respondents in city center answered pleased and 19% very pleased. While in the suburbs only 46% who answered pleased, 10% very pleased and the rest hesitate and without opinion.
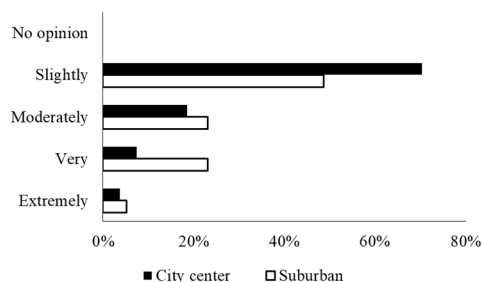

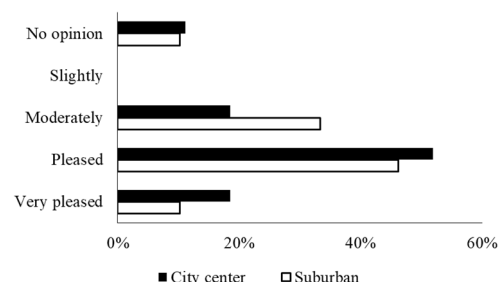**Figure 3.** Responses of respondent 'to bring their plastic bag while shopping.'

Figure 4. Responses of respondent 'willingness to get involved in solid waste management community.'

People who live in the city center and suburban, both have a willingness to maintain cleanliness. There is not any different answer in this case. It can be seen in figure 5. In the city center, 74% answered agree, and 19% answered very agree. In the suburbs, 67% answered agree, and 26% answered very agree.
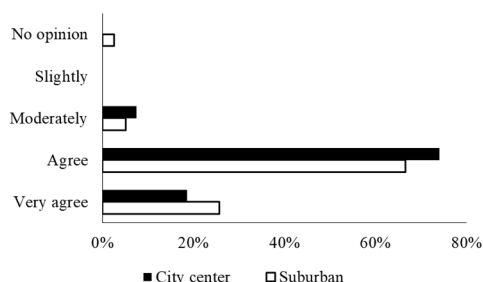
Figure 5. Responses of respondent 'willingness to put the solid waste into the proper manner, not littering it.

All responses data were analyzed using weighting analysis. The score was divided into 5 level: poor < = 20%, fair < = 40%, good <= 60%, very good <= 80% and excellent <= 100%. The results of weighting analysis how those people living in the city center were slightly higher in community awareness than those in the suburbs. The total score for city center was 70% (very good) while in the suburbs was 69% (very good). The T-test was conducted to assess the difference of response from people living in city center and suburbs. The results of the analysis showed that level of awareness of residents was not different between two areas ($\alpha = 0.05$, P-value = 0.258). The Indonesian government has implemented 3R policy through Waste Law 2008. One of the factors influencing the success of the policy is public participation. Emphasis towards greater public awareness would enhance the outcome. This study shows that in general there is no location influence on the level of public awareness. It should be noted; the final score is the result of a combination of several problem points. That is, to solve the problem, specific treatment is required for each area.

4. Conclusions

The majority composition of waste is a biodegradable waste of 79.16% to 86.3%. Thus, the municipality should treat this waste as soon as possible. It also indicates a real prospect of organic waste recycling through composting. The municipality could distribute some compost center points around the city to treat organic waste. This effort could reduce up to 80% waste to landfill. The composition of solid waste also could give information the trends of waste that may be reused/recycling. The fraction of economic/reusable/recyclable items, e.g., paper, plastic, metal, aluminum, glasses.

Statistically, the rate of public awareness in the city center and a suburban are same in 'good level.' The environmental concern is a potential variable in influencing the successful integrated solid waste management. Thus, the municipality should allocate its budget to non-technical purposes, educate the people and approach the people based on their characteristic and improve the awareness by educational promotion programs. The municipality needs to build partnerships in term of community-based management. Through this study, the stakeholders could formulate better policies, plans, and strategies in solid waste management.

References

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