Overview of a Community-Based Waste Management System and Its Effect on Waste Discharge and Concerns

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Abstract

Community-based waste management system (CWMS) is one of the options to deal with waste management problems in developing countries. This paper aims to evaluate the effect of CWMS on people's behavior towards solid waste, and to investigate the practice of CWMS in Semarang city. The data obtained by questionnaire and interview to four different area (Bukit Kencana Jaya (BKJ) where the CWMS is implemented, upper class area, middle class area and rural class area) in Semarang city, Indonesia. The results show that there are significant effects of CWMS on people's behavior and awareness in BKJ compared to those of other areas. The percentage of people who are willing to participate in the system has a significant relation with the knowledge level of information about 3R. Relating to the expenses that can be afford by the respondents, a half of the respondents cannot afford to pay additional fees for solid waste management.

Keywords: Community-based waste management system, Municipal solid waste, Waste separation, Willingness to participate

1. INTRODUCTION

1.1 Background

The increasing municipal solid waste (MSW) amount along with the increasing of population in developing countries has become a potential threat to environment and society. Indonesia as one of developing countries also faces the same problem. The waste generated per day had reached around 67 thousand tons in 2008[1)] and an increase of the amount is predicted.

Traditional MSW management in Indonesia is open dumping. The open dumping has caused many negative environmental impacts, such as groundwater and river water contamination by leachate, a human health threat from vector of disease, and methane gas generation that contributes to global warming[2)]. The open dumping system is no longer feasible to handle the increasing solid waste in future.

In response to the situation, Indonesian Government Act No. 18 year 2008 regarding waste management[3)] was issued in 2008. The article 44 paragraph 2 obliges the local government to close the open dumping sites for a maximum 5 years after the enactment of the act. In the act it is defined that waste has economic values and it could be utilized as energy, fertilizer and industrial raw materials. And 3R (*reduce-reuse-recycling*) concept was introduced in the Act. This concept emphasizes citizen/community participation in waste segregation based on waste type, quantity, and/or waste characteristic.

One of the community participation in the MSW is a Community-based Waste Management System (CWMS). It is expected that CWMS can reduce the amount of waste disposed at landfill sites especially in developing countries. CWMS has been introduced in several communities in Indonesia through various methods. However, the numbers of communities are limited; therefore expansion of the practice is required.

1.2 Aim of research

There are few investigations about detailed CWMS practices and the effect of the system on the people's behavior. In this paper, firstly the situations of typical waste management system in Semarang city and the practice of CWMS in Bukit Kencana Jaya (BKJ) were investigated. Secondly, differences of resident's behavior and awareness for waste management between BKJ and other areas were investigated. Finally, the effect of CWMS on the current waste management was discussed.

2. METHOD

Questionnaire was used to obtain residents awareness's and behaviors to waste management system in BKJ. As control, upper class area (Area 1), middle class area (Area 2), and rural class area (Area 3) in Semarang city were chosen for study area (Figure 1). The investigation was carried out through interviews and questionnaire to households from July to August in 2009. The outline of questions is shown in Table 1. In the questionnaire personal attributes of respondents, knowledge about 3R, concerns about waste management, disposal method of household waste were asked. The questionnaire

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was distributed to 50 household for each area, and 30, 26, 27, and 37 of answers were obtained from BKJ, Area 1, Area 2, and Area 3 respectively.

The secondary data, such as Semarang city waste generation volume and information about waste management situation was obtained from the Cleansing Agency of Semarang municipality, and other supporting data was obtained from literature review and the Internet.

Table 1. Outline of questionnaire.

- Frequency of household waste discharge.
- Where do you usually discharge the waste?
- Do you practice waste burning?
- What waste management issue are you aware of?
- Did you ever get information about 3R?
- Are you satisfy with the current waste Management?
- What is the best waste management in the future?
- Expenses can be afforded.

3. RESULTS

3.1 Solid waste management in Semarang

Semarang is the capital city of the Central Java Province, and has a tropical climate with a mean annual temperature of 27°C and humidity averaging 80%. The municipality covers an area of 373 km^2, consisting of 16 *Kecamatan* (Sub-districts) and 177 *Kelurahan* (Villages). Total population of Semarang in 2009 is 1.7 million people[4].

The cleansing Department (*Dinas Kebersihan*) is charged with municipal waste management. Total waste generated from all sources was around 4,934 m^3 per day in 2009. Total waste consists of 80% of household waste, and followings are markets and industrial waste at 13% and 4%, respectively[5].

Figure 2 shows MSW flow in Semarang. Households put their waste in containers in front of their houses. Collectors hired by neighborhood associations collect the waste and carry to the temporary disposal site (TPS) using hand carts. The workers hired by Cleansing Department carry the waste from TPS to Jatibarang landfill by trucks. At the landfill workers manually unload the waste and the recyclables materials are recovered by scavengers and the organic waste are fed to cattle

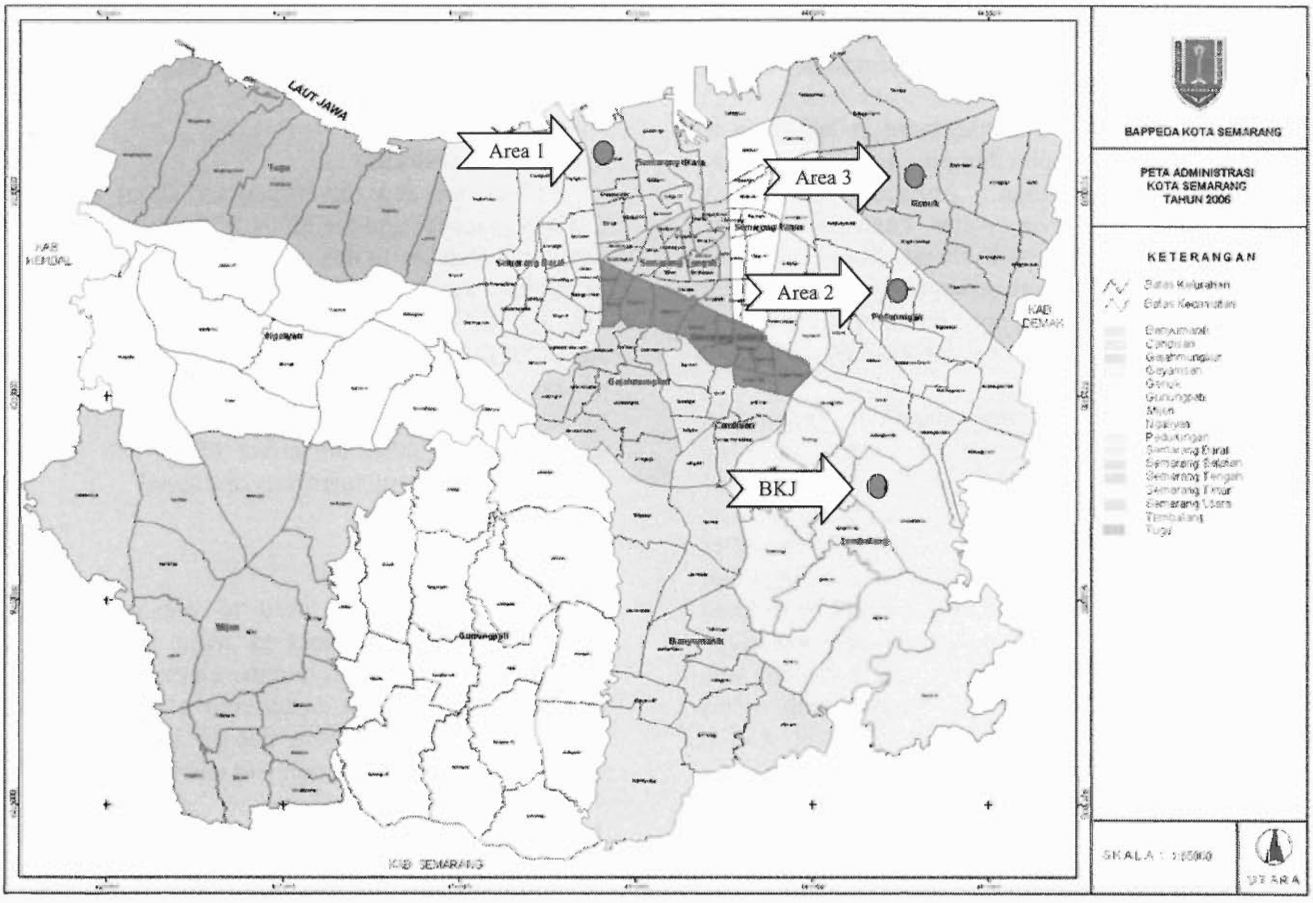

Fig.1. Study area.

inside the landfill area. On the other hand the waste generated at poor MSW service area are burnt or dumped on the side of the roads and rivers.

The Jatibarang landfill has been operated since March 1992, it covers an area of 45 ha with the capacity to contain 4.15 million m^3 of waste. The amount of waste in Jatibarang landfill has reached 5.75 million m^3 in 2009 and 1.6 million m^3 of waste has exceeded the capacity. Since the waste is not covered with soil regularly, there are complaints from residents living around the landfill about odor and vermin. Since the condition of the leachate treatment system in the landfill is poor, untreated leachate would contaminate a nearby river which is used as the source of drinking water intake by PDAM (drinking water regional company). And during the dry season, smokes often break out. Waste slide disaster could be a significant risk from the excess landfilling. However, the construction of a new landfill site is another challenge because of the limited available location for the landfill site and public opposition.

3.2 Waste management in Bukit Kencana Jaya (BKJ)

BKJ is located in the Meteseh village, Tembalang sub-district, Semarang. The CWMS was introduced by an NGO called BINTARI in cooperation with GTZ-ProLH (Indonesia-German environmental programs assisted by GTZ) in 2006. There are 1,016 households in BKJ with 200 ha of area and 12.3 m^3/day of household waste was generated before the implementation of the system[5]. The main composition of waste is organic waste with 68.64%. An organization called PAGARWAJA (*Paguyuban Masyarakat Bukit Kencana Jaya*), consisted of the entire household in BKJ area, is managing the system.

The solid waste flow in BKJ is shown in Figure 3. Household waste is separated into three categories such as organic waste, recyclable waste, and toxic-hazardous waste in households. These wastes are put into plastic bags separately and placed in the trash cans in front of the houses. The wastes are collected and transported to the community's waste treatment facility by the workers employed by PAGARWAJA. In the facility, the organic waste is recycled to compost and recyclable wastes are sorted into plastics, metals, papers, and cardboards. The sorted recyclable wastes are sold to scavengers. Table 2 shows the prices and amounts of recyclables and income from selling recyclables waste calculated from the data of the reference[6]. Some households are also making compost from their organic waste by themselves. Currently 30-40 bags of compost from organic wastes are produced a month. The proceeds from sales of compost and recyclable wastes are used for the operation costs of the system. The toxic-hazardous waste is disposed of in TPS and transported to the landfill site.

The benefits from the system have also been shown such as; increasing of community participation activity, reduction of the amount of waste disposal, increase of waste recycling activity, and improvement of environmental condition.

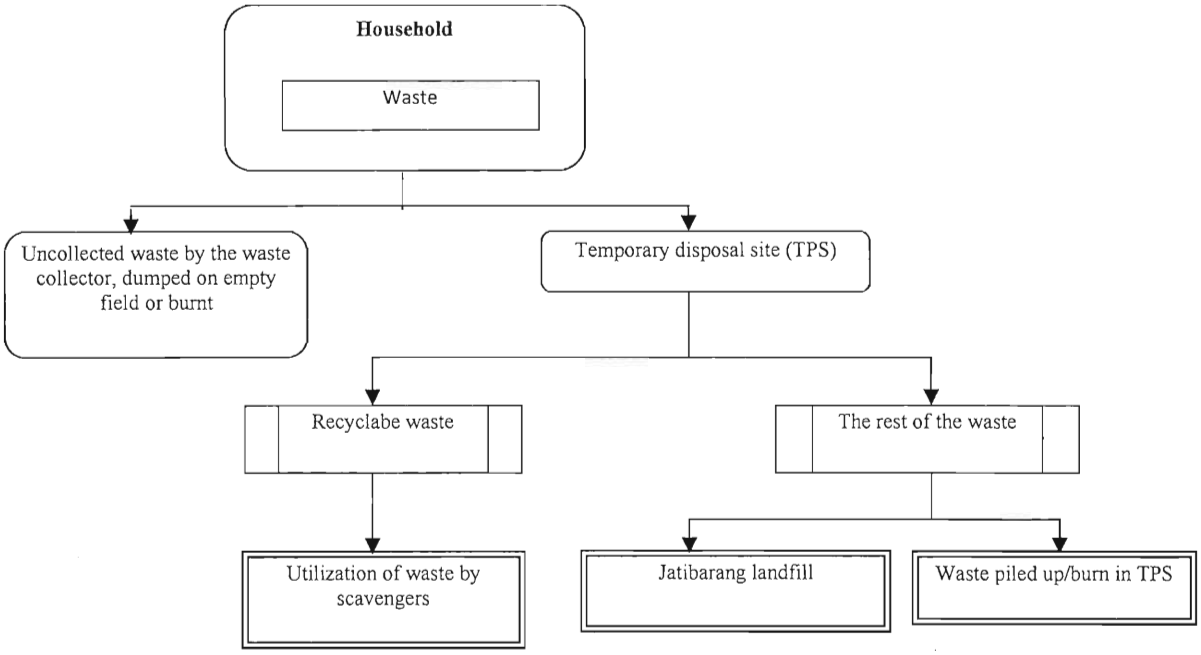

Fig.2. Typical waste management flow in Semarang.

Table 2. The amounts of rrecyclable wastes and the prices per year.

Type of waste	Weight (kg)	Selling Price (Rp/kg)	Income (Rp)
Plastic	14,709.5	600	8,825,700
Thin plastic	2,920	1,000	2,920,000
Big plastic bottle	4,485.85	1,000	4,485,850
Plastic glass	2,555	2,500	6,387,500
Newspaper/book	10,950	800	8,760,000
Cardboard	11,125.2	600	6,675,120
Can	3,285	200	657,000
Metal	1,642.5	1,000	1,642,500
Total	51,673.05		**40,353,670**

Source: Survey by BINTARI, 2009[6].

4. RESULTS OF QUESTIONNAIRE

Frequency waste discharge was asked and the result is shown in Figure 4. There is no significant difference on the frequency between areas, and more than 75% of respondents answered to dispose their waste every day. This is a common practice in Indonesia, since there are no rules for discharge frequency in front of their houses.

Figure 5 shows the type of the waste handling. Respondents in BKJ and Area 1 mostly put their waste in the containers in front of their houses, however the percentage of those are only about 50% in Area 2 and Area 3. In BKJ about 10% of respondents are composting the organic waste by themselves. On the other hand some negative behaviors are shown from the respondents in Area 2 and Area 3 such as throwing their waste on the side of the road or into the river and burning. These behaviors could be caused by the poor waste management service and the lack of available waste facilities such as temporary waste disposal site in the area.

The tendency of waste burning practice is increasing with the area class lower (Figure 6). The percentage of waste burning practice is lowest in BKJ, since people in BKJ already have proper system for handling of their waste. Uncontrolled waste burning is prohibited by government act No. 18 year 2008. Consequently, it is expected that the implementation of the CWMS can reduce the waste burning practice and to prevent illegal waste burning behavior.

Relating to questions about waste management issues awareness and the best waste management in future (Figure 7 and Figure 8), the respondents were asked to give scores from 1 to 5 to each issue (score 5 considered as the most important issue), and the average scores of each item were calculated. Concerning with waste management issues awareness, the odor problem is the highest interest on each area (Figure 7). Since organic waste is stored at TPS in residential area for a few days, people would have a negative and significant impression of the odor. Interestingly, the score of BKJ is higher than those of other areas. The reason could be that the odor from not only TPS but also from the composting facility located near from the residential area. For the water contamination by leachate issue, the score of BKJ is the lowest. Since the residents in BKJ realize that the amount of the waste carried to the landfill is already reduced, their awareness of issues concerning with landfill site would be lower. The score of illegal dumping issue

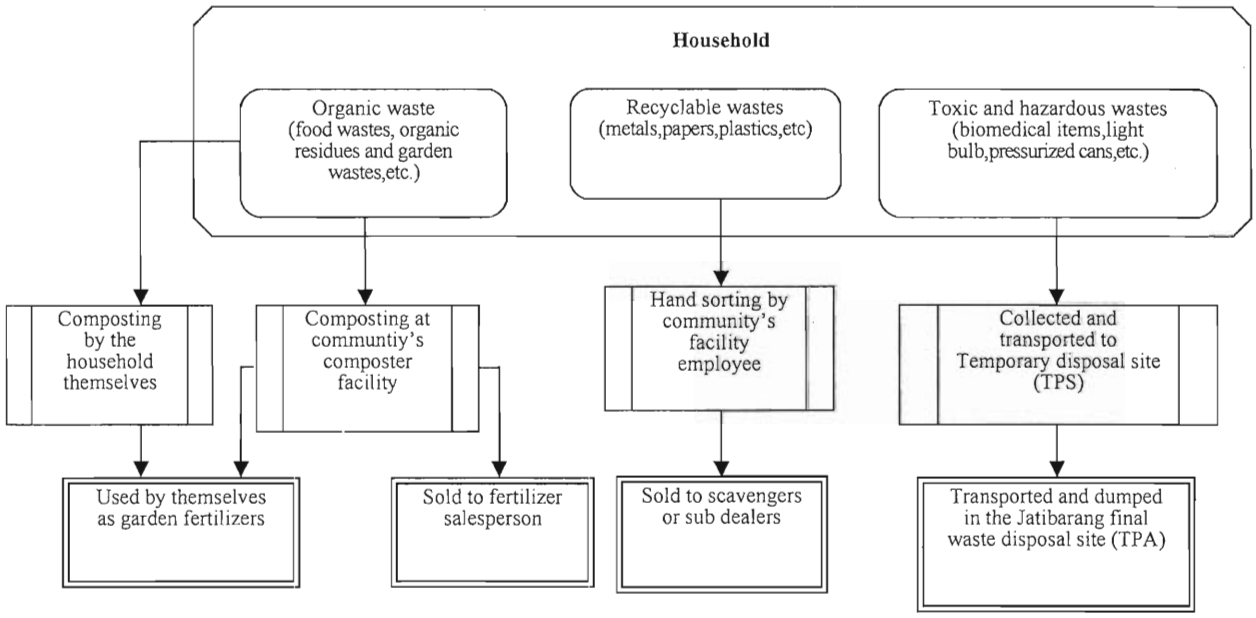

Fig.3. Waste flow in BKJ.

is lower in Area 3 and 4. Because of the inadequate waste service and infrastructure such as waste collection frequency and inconvenience location of respondents TPS in these areas, people often dump their waste on the side of the road or on river. Consequently the scores in Area 3 and 4 are lower than those of other areas.

Figure 8 shows the waste management preference of the respondents. The result shows that the average score of separation is higher and the following is composting. The score of incineration increases with the area rank lower with the lowest percentage is BKJ.

Figure 9 shows the satisfaction level on the current waste management system. More than 70% of respondents are not satisfied with the current waste management system.

Figure 10 shows the percentages of residents who have received 3R information and who are willing to cooperate in 3R system. It is found that 83% of households in BKJ have received information about 3R. The percentage decreases with the area rank lower. In BKJ, BINTARI trained the CWMS and introduced the concept of 3R to the people. Moreover, the willingness to cooperate in the 3R system of BKJ is higher than those of other areas. This result indicates there would be a relation between dissemination of 3R information and willingness to cooperate in the CWMS.

Figure 11 shows the allowance of expenses for waste management fee. Half of respondents of all areas think that the current expenses for waste

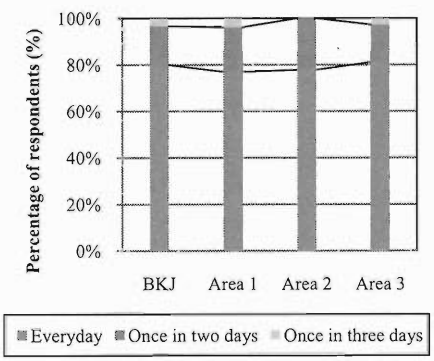

Fig.4. Frequency of waste discharge.

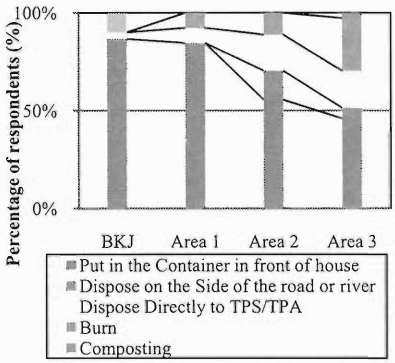

Fig.5. Way of waste discharge.

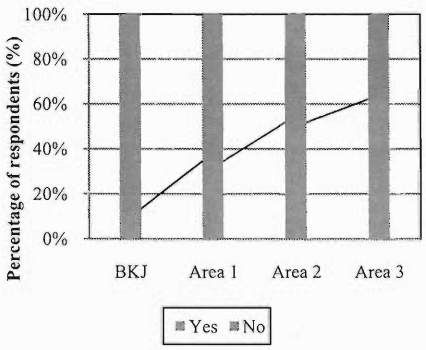

Fig.6. Practising waste burning.

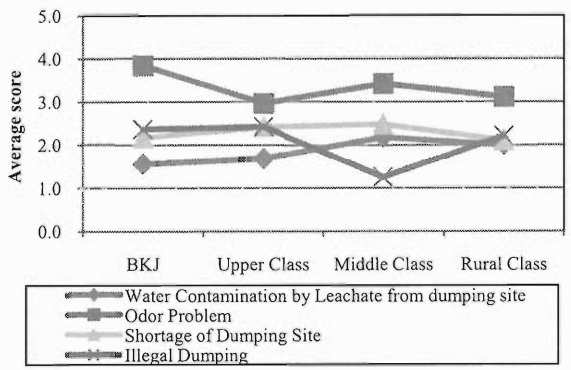

Fig.7. Waste management issues awareness.

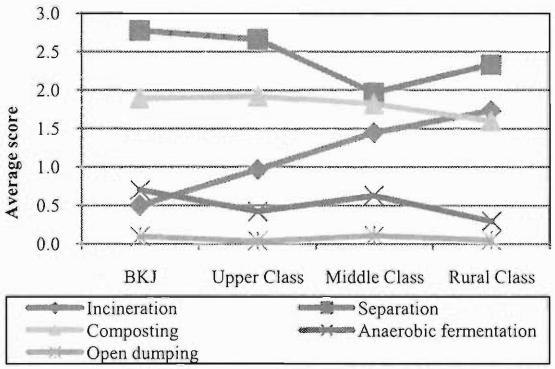

Fig.8. The best waste management in the future.

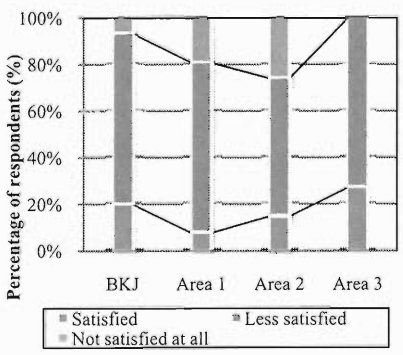

Fig.9. Satisfaction level.

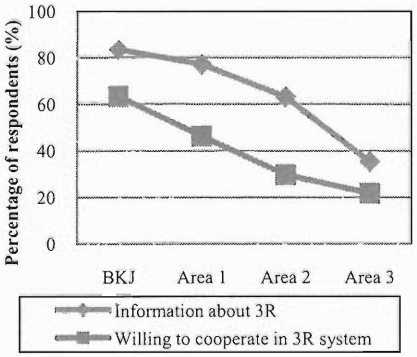

Fig.10. Received 3R information and willingness to cooperate.

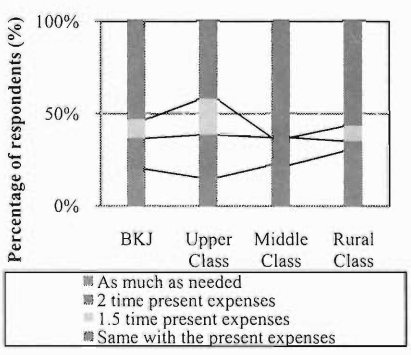

Fig.11. Expenses can be afford.

management is already enough, while the rest of respondents think that they still can afford more than the current expenses to get better waste management.

5. CONCLUSIONS

In this paper the detailed CWMS in BKJ, and typical waste flow in Semarang were described. And the effect of CWMS on people's behavior towards waste management between different areas was investigated. It is found that people in BKJ have treated their waste properly. It implies that the implementation of CWMS give effect to the level of people's willingness to cooperate is highly related to the level of 3R information. It means that provision of information about 3R is important to promote proper waste management and prevent illegal dumping. These results show important conclusions for policy makers in planning and implementing municipal waste management system. For future study it is necessary to evaluate the cost benefit of the CWMS to the community.

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