

Evaluation of Municipal Solid Waste Management System (Case Study: Graha Padma Estate, Semarang)

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Abstract: Solid waste became one of the major issues in each country. The amount of solid-waste generated in Asian cities has increased tremendously in the last decade, mainly due to the improvement of living standards, rapid economic growth, and industrialization in the cities. The aims are: Describing the waste generation, type and composition in Graha Padma Estate, Analyzing the actual municipal solid waste management in Graha Padma Estate, Describing the implementation of 3R in Graha Padma Estate, and presenting the recommendation of municipal solid waste management in Graha Padma Estate. The result of study is the residents of Graha Padma generated solid waste every day. The solid waste they generated consists of many types. They are kitchen waste, papers, plastics, metals, glasses, and rubbers. By observations, the average weight of waste generated by a Graha Padma resident per day is 2 kilograms that consists of kitchen waste which were 0.92 kilograms, papers which were 0.35 kilograms, plastics which were 0.58 kilograms, glasses which were 0.30 kilograms and irons which were 0.05 kilograms.

Keywords: municipal solid waste management system, solid waste management Graha Padma

Introduction

Nowadays, world population grows so rapidly, especially in urban areas which having a significant impact on the environmental capacity. With the increasing growth of population, the volumes of waste generated to be handled would increase accordingly (Damanhuri, 2005). Solid waste became one of the major issues in each country. The amount of solid-waste generated in Asian cities has increased tremendously in the last decade, mainly due to the improvement of living standards, rapid economic growth, and industrialization in the cities (APO, 2007). Waste is the remnant of human daily activities and/or natural processed in the solid form. Solid waste defined as the waste produced from human activity and animals in the form of solids, which discarded because it was useless or not needed anymore (Tchobanoglous et al, 1993). Damanhuri (2004) state that the average generation of MSW in Indonesia, contains about 70% garbage, is about 2.5 -3.0 kg per capita per day. It means most of solid waste

in Indonesia is organic waste. Solid waste management (SWM) usually relates to both formal and informal sectors. In Indonesia, the formal sector includes municipal agencies and formal businesses, whereas the informal sector consists of individuals, groups and small businesses engaging in activities that are not registered and are not formally regulated (Aprilia et al, 2012). Kardono (2007) state that the centralized system of MSW treatment is not established yet in Indonesia because of its high cost and complicated technology.

Indonesia has the same problems with another country for this Municipal Solid Waste (MSW). The current practice in most municipalities is to dispose of their waste into open garbage dumps. Koh in APO Report 2007 state that many municipalities in Asia have investigated many options, but finding a site for a new landfill is becoming extremely difficult because of the "not in my backyard" (NIMBY) syndrome.

However, waste generation will not be decreased it will continue to grow along with the growth of the human population as well as the higher and the complexity of human activity. Waste generation that getting bigger by the day will reduce space and human activities, so that disrupt the human purpose to improve the quality of life makes it decreases as the problem of waste raises. Waste generation is not only bad for the environment, but the waste generated also disturb the stability of the natural, aesthetic, and as a result most of it is bad for the health in which solid waste is a huge potential for the development of vector and source distribution of various diseases. Because it is bad for the lives and the environment, we need a proper waste management system both management and technical to reduce waste generation while eliminating or at least reducing the negative impact on the environment.

Based on Indonesian domestic solid waste statistics data (2008) MSW handling that being composted & recycled is 7%. It means very small percentage. There are composting activities at any scale including household, community,

mid to big composting. Recycling activities is mainly conducted by informal stakeholders. Nowadays, 3Rs has been put as mainstream policy and strategy in waste management in Indonesia and most local governments are still having less concern to promote and implement 3R in waste management.

Many cities are facing the problem of overburdened landfill because of limited land availability and open dumping sites equipped no sanitary system, such as soil cover, leachate collection and treatment system polluting the environment through CH₄ emission and leachate intrusion into ground and surface water. (Meidiana and Gamse, 2010). This condition happens in many cities in Indonesia, including Semarang. Semarang is one of big cities in Indonesia. Many people live and produce solid waste. Most people live in settlement which has no integrated solid waste management. For example is Graha Padma Estate which is located in West Semarang. Graha Padma Estate has 7 clusters, or about 700 housing units. Currently, the solid waste in the housing managed by the City's Solid Waste Department (Dinas Kebersihan dan Pertamanan/DKP) for further transported to the landfill. As time goes by, the landfill is currently experiencing accumulation of solid waste that finally could not accommodate it from the city.

Thus, the management of settlement area, in this case the Graha Padma Management, as a responsible party for solid waste problem in the settlement must fulfill its responsibility to manage the waste that comes from a local housing. That is why they needed an integrated waste management from the source, in this case on Graha Padma Estate. The main of goals is as an effort to decrease bad impact of waste and make a better environment.

Literature Review

Waste Management System

Waste Management System is system associated with controlling waste generation, storage, collection, transfer and transport, processing and disposal of solid waste in a way that refers to the basic which is best about public health, economics, engineering, conservation, aesthetics and other environmental considerations, and also responsive to people's behavior (Tchobanoglous et al, 1993). Waste management is systematic, holistic, and sustainable activities included reducing and handling of waste according to the Asian Productivity Organization (2008), Solid Waste Management may be defined as the discipline associated with controlling the generation, storage, collection, transfer and transport, processing, and disposal of solid waste in a manner that is in accordance with the best principles of health, economics, engineering, conservation, aesthetics, and other environmental considerations, and that is also responsive to public attitudes.

The factors influencing solid waste management are studied in Abeokuta, Nigeria. These affecting factors are educational background, age, gender, cost of waste

collection services and the location of residence, among others (Babayemi, 2009).

Application of the 3Rs (Reduce, Reuse, Recycle)

3R waste management according to Damanhuri, et al (2006) is a waste reduction efforts undertaken as close as possible from the source through reduce (consumptive lifestyle change), reuse (reusing materials as potential waste and refill material) and recycle (recycle through composting, recycling, waste to energy, etc). Methods of waste reduction, reuse and recycling are the preferred options when managing waste. There are many environmental benefits that can be derived from the use of these methods. They reduce or prevent green house gas emissions, reduce the release of pollutants, conserve resources, save energy and reduce the demand for waste treatment technology and landfill space. Therefore it is advisable that these methods be adopted and incorporated as part of the waste management plan.

This picture below is a shifted paradigm of solid waste management in Indonesia based on meeting of 3R Regional Forum Asia.

Method

Description of Graha Padma Estate

This research was taken place in Graha Padma Estate because in this area there was a little attention about the waste and there are still a lot of waste in this area. The method used in this study is quantitative descriptive analytical approach that will be expanded with a qualitative approach. Quantitative approach is used in order to calculate units specified in the numbers. The calculation will be especially for the data of solid waste generation, volume and composition. Qualitative methods are intended to enrich and explain in-depth description of the data analysis. Waste generation sampling will be conducted based on National Standard No. SK SNI 19-3964-1994 on The Method of Municipal Solid Waste Generation and Composition Sampling. The sampling in Graha Padma Estate will be conducted by random sampling in 8 days in a row. This sampling aims to obtain data of daily generation rates in kg/person/day for residential waste, bulk density of solid waste generated in kg/L and composition of solid waste generated in percentage by weight.

Result and Dissection

Waste Generation and Type of Waste in Graha Padma Estate

The residents generally generate only small amount of waste per day, and the solid waste are degradable. Figure 4.2 shows respondents experiences on the types of solid waste. A question about the types of waste and the options of categorical answers that of types of waste were given to the respondents by the qualitative questionnaires. By this figure, it can be seen that 41 % from the total respondents' answers are kitchen wastes, 27 % answers are papers, 26

% answers are plastics, 3 % are metals, and each 1 % of the answers of the total respondents (N = 62) are glasses, Textiles, and rubbers. This percentage combination means that kitchen waste is the most type of waste that was experienced by the respondents from Graha Padma Estate.

Plastics and papers were also experienced as the types of waste, but not as much as the kitchen waste. There are also metals, rubbers, glasses, and textiles but in the very little amount.

Table 1. Average of Amount of Each Type of Waste per Day in Graha Padma, Semarang Indonesia

type of waste	average amount of waste per day by (Kg) in the begin of month	average amount of waste per day by (Kg) in the mid of month	average amount of waste per day by (Kg) in the end of month	Average amount of waste per day (kgs) in a month
Kitchen waste	0.90	0.53	1.33	0.92
paper	0.50	0.23	0.33	0.35
plastic	0.70	0.43	0.60	0.58
Glass	0.07	0.20	0.03	0.10
Iron	0.13	0.00	0.03	0.05
Total	2.30	1.39	2.32	2.00

Figure 1. Shows the average weight of waste generated by a respondent in a day. The solid waste with heaviest weight is the kitchen wastes (0.90 kg) which are organic waste. There are some composting alternatives to recycle this type of waste, but the management of Graha Padma does not equip the housing complex with recycling installation. The waste is just disposed in the waste bin in front of each house without any recycling efforts. The other type of waste such as papers, plastics, glasses, and irons were collected by waste scavengers when they arrived in the temporary waste disposal. The act of scavenging is inappropriate but it is effective to reduce the waste transported to the landfill.

Solid Waste Management in Graha Padma

Solid waste management in Graha Padma is merely voluntary by the residents. They hire waste collectors to collect waste by hand carts and transfer the waste into the

temporary waste disposal provided by the government. The wastes then are collected by waste collectors provided by the government and then they are transferred to the city landfill. In this procedure, solid waste such as papers, plastics, glasses, and irons are collected by scavengers before they are transferred into the landfill, but in the landfill, there are also scavengers who do the same activities with the scavengers in the housing complexes. The scavengers then transfer the waste they found into waste pool usually managed by private companies. The specified solid waste then transfers the waste into the private recycling companies.

This set of activities is performed in almost every housing complex in Semarang which all of the solid waste generated are transferred to Jatibarang landfill. Although the amount of solid waste in Graha Padma is not large, composting systems will effectively reduce the solid waste that come into the landfill.

Table 2. Amount of Solid Waste per Day, Month, Year, in Graha Padma, Semarang, Indonesia

	average amount of waste per day by (Kg)	amount of solid waste per month (kg)	amount of solid waste per year (kg)
in the begin of month	2.30	69.00	828.00
in the mid of month	1.39	41.70	500.40
In the end of month	2.32	69.60	835.20
Total	6.01	180.30	2163.60

As mentioned before, the collection system is rather fragmented. Intervening in the collection system would

require close co-operation with local governments to restructure waste collection, waste scavenging and

recycling mechanisms and procedures. However this sector has entrenched stakeholder interests and would be difficult to formulate a viable intervention.

The only feasible recycling procedure is the community-participated voluntary procedure. And the residents of Graha Padma are economically capable to manage composting system in their area of living.

Implementing 3R in Graha Padma Estate

3R (Reduce, Reuse, Recycle) is a jargon of community participations on waste management that is usually applied to household environment. This jargon is about three activities that should be done in order to manage the solid waste which are reducing the waste, reusing the waste, and recycling the waste. These three activities can be done by the communities in the household environment because they are simple and cheap, but effective. The most important thing that should be existed in the community is their willingness to do 3R.

In Indonesia, there is Peraturan Pemerintah no. 18 tahun 2012 that regulates the reducing and management of household waste and household waste alike. In this set of regulations, the waste management for household waste and household waste alike are consisted of activities that must be performed by each person in a household who live in Indonesia, and the facilities that must be provided by any housing complexes in Indonesia. 3R is already covered by this set of regulations.

The first activity must be done according to PP no.18/2012 is reducing the waste. According to article 11

in this PP, each person must perform the activities of reducing the waste to avoid mounding waste by using degradable products and products with degradable packaging. Every consumer, according to the regulations, can collect the packaging waste and give the waste back to the producing companies. Every company also must have recycling plans and recycling facilities to recycle the packaging components of the produced products. Using degradable packaging and recollect the waste of the products are also obligations for every company.

The second set of activities must be done is waste management. The obligation of the community related to waste management is participating in the activity of sorting the waste. The waste must be sorted into at least five groups of waste. They are hazardous waste, degradable waste, reusable waste, recycle-able waste, and other type of waste. Every housing complex must facilitate residents' activity of sorting waste with separated waste bins and separated containers as temporary waste disposal. PP no. 18/2012 also regulates punishment for any company that does not provide waste management facility in 5 years after the regulations were made.

Graha Padma Estate and the community who live in this large scale housing complex can fulfill the obligations in PP no. 18/2012 and also implement 3R started by the provisions of separated waste bins and the provision of integrated temporary waste disposal and recycling facilities for organic waste by the management of the housing complex. The community then can start perform the activity of sorting the waste, and the collectors can collect the waste as usual to the temporary waste disposal.



Figure 2. The Flow of the Sorting Waste Activities in Graha Padma

A consortium must be engaged by the community and the management to manage the quantity of the collectors and the wage of the collectors that must be increased because within the separated waste bins, the collectors must collect each type of waste every day. The collecting activity

needs more time and more collectors if the waste are separated. The engagement of the consortium must be started by the engagement of the members of the Graha Padma community who care about the waste problem

Table 3. Alternatives of Waste Management can be Applied in Graha Padma

Alternatives	Components	Results
Only sort the waste	Separated waste bins and well-paid collectors	Separated waste
Sort the waste and reuse the organic waste	Separated waste bins, well-paid collectors, and animals	Separated waste and reused organic waste
Sorting the waste and recycle the organic waste	Separated waste bins, well-paid collectors, and composting facilities integrated with temporary waste disposals	Separated waste and organic fertilizers that can be used to fertilize the plants in Graha Padma parks. The organic fertilizers can be sold to the other communities.
Sorting the waste, recycle the organic waste and recycle the plastic waste	Separated waste bins, well-paid collectors, composting facilities, and collaboration with recycling companies	Separated waste, organic fertilizers, and zero plastic waste
Sorting the waste, recycle the organic waste, and recycle the plastic waste	Separated waste bins, well-paid collectors, composting facilities, and plastics recycling facilities	Separated waste, organic fertilizers, and recycled plastic waste, the plastic waste can be re-distribute to the community, and then recycled again.

Publication and Socialization of Waste Management that can be applied in Graha Padma

Regarding the lack of sorting willingness and the absence of the perceptions about waste management in Graha Padma residents, there must be efforts on the publication and socialization about solid waste that can be applied to the Graha Padma residents. The publication and socialization can be initiated, funded, and done by Graha Padma management as the starting point of obeying PP no. 18/2012.

The management can make booklets with the contents about waste management to socialize the waste management plans including the sorting plan. The booklet must contain invitation to the member of the Graha Padma community to involve in the consortium of waste management. The booklet then can be spread into each household with questionnaires about the willingness of the society to involve in the waste management. A focus group discussion that is participated by the member of the community, the management, and experts on waste management should be held to socialize the waste management plan. The consortium can be engaged in this meeting.

This procedure can built perceptions in the mind of the community of Graha Padma residents and the waste management plan can be started to become the realization procedure. The Graha Padma Estate then can perform waste management and become the ideal housing complex in Semarang.

Conclusions

The residents of Graha Padma generated solid waste every day. The solid waste they generated consists of many types. They are kitchen waste, papers, plastics, metals, glasses, and rubbers. By observations, the average weight of waste generated by a Graha Padma resident per day is 2 kilograms that consists of kitchen waste which were 0.92 kilograms, papers which were 0.35 kilograms, plastics

which were 0.58 kilograms, glasses which were 0.30 kilograms and irons which were 0.05 kilograms.

These solid waste then were thrown into waste bins in front of each houses and they are collected by the hired garbage men. The garbage men, who are paid 50,000 IDR per month by each household, then put the waste into hand carts and transfer the waste into the temporary waste disposals. The solid waste gathered in the temporary disposal then collected by waste trucks provided by the government to be transported into the city landfill in Jatibarang.

The residents of Graha Padma mostly do not have any perception on solid waste management; therefore there are no 3R activities in Graha Padma Estate. The management of the housing complex also do not provide the separated waste bins in front of each house, although the government had regulated the provisions of sorting waste facilitation and also recycling facilitation by PP no.18/2012. There are many alternatives of effort on waste management that can be applied in Graha Padma, but to anticipate the lack of knowledge and perceptions about solid waste management, publication and socialization should be applied by the housing complex management to the community of Graha Padma Estate.

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