The Feasibility of Integrated Transfer Station in Solving Waste Problem in Jakarta, Indonesia

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Abstract

The main objectives this study is observing the best solution in reducing the waste volume at final landfill site of the city. The object of the study is Jakarta, the capital city of Indonesia which has population approximately 10 million people and generates waste approximately 6700 ton/day. As one of the municipal city in developing country, the population increasing by urbanization, the amount of waste generated is getting higher time by time. Meanwhile, the solution to reduce and treat the waste has not been dealt due to many factors such as shortage budget, law enforcement and citizen awareness.

In this study, the neighborhood-based solid waste management approach will be analyzed. The idea in reducing the waste volume to final site is by cutting the transportation frequency by minimized the amount of waste at transfer station. The integrated transfer station is needed to reach the goal of waste reducing by promoting recycling and other advanced treatment methods. All of the possibility will be analyzed and considered through the availability of land, composition of waste and citizen`s willingness.

Keywords:

Waste, Transfer station, Jakarta, Recycling

JEL classifications:

Q01, Q51

1. Introduction

Municipal solid waste is always become an emerging issue in all over the world both in developed country and developing country. With the increasing growth of population and economic activities, the volumes of waste to be handled increase accordingly. Rapid population growth in urban areas, socio-cultural classes' heterogeneity and community participation that is generally not well directed and well organized have caused complex MSW problems for municipalities.

Moreover, the funding situation and relatively low priority in waste handling among local governments are general trends, along with the limitations in proper human resources, adding to the low performance of municipalities in handling the sanitation and waste in urban areas. Many factors are involved in inadequate MSW management, some of which are lack of

support for municipalities to address waste problems systematically, integrally and comprehensively, lack of standard policies that are comprehensive and consistent in matters of waste handling, and lack of discipline among waste managers in terms of applying proper technical procedures (Damanhuri, 2005).

The greatest challenge from the result of rapid population growth that lead to increasing of waste generated is to provide more waste disposal facilities such as landfill to treat the waste (Hassan et al., 2001). Despite the complexity of waste produced, the standards of landfills in most developing countries are still poor; these include inadequate waste treatment facilities, inefficient collection and storage systems, co-disposal of municipal waste with hazardous waste, inefficient utilisation of disposal space, lack of environmental abatement measures and poor documentation (Hassan et al., 2000).

Compared to high-income residents in developed countries, the urban residents of developing countries produce less solid waste per-capita. However, the capacity of developing countries to collect, process, dispose, or reuse the waste in a sustainable manner is highly limited (Bandunee, 2015).

Indonesia is one of the developing countries in Asia facing this problem since long time ago. According to Jakarta Post, Indonesia is the third-lowest ranking in ASEAN country in terms of sanitation quality. Many rivers contaminated by organic materials due to lack of measurement in waste management. Ranked number four as populous country in the world, population of Indonesia reached 253 million people in 2014 (Detik finance). In 2013, the total of waste generated in all of provinces in Indonesia reached 200.000 ton/day.

As the capital city of Indonesia, DKI Jakarta is the most developed city with economic growth 5.9%-6.3% predicted in 2015. (DPRD DKI Jakarta, 2015) This growth is also driven by urbanization in Jakarta. The rapid growth of population in Jakarta Metropolitan Area has created a rapid increasing in waste/garbage from residential and industrial both in volume and in type. According to national census, the population of DKI Jakarta reached 10 million people with the area of land is 664 km2.

Figure 1. Map of Jakarta
(Source: http://ongkirnya.com/daftar-kode-pos-dki-jakarta.html)

Municipal solid waste issue never could be solved caused by the increasing of waste generated and the developing of capacity in managing the waste are not balance. Government as the important key role in solving the problem has to take action in reforming the regulation and waste management as well as encouraging the participation of society in waste reduction.

The objectives of this study; to overview the current waste management in DKI Jakarta, to see the correlation of the optimization the using of transfer station and waste reduction into the

landfill. It`s also expected with the adaption of neighborhood-based waste management can improve and promote the using of transfer station optimally.

2. Municipal Solid Waste Management in DKI Jakarta

MSW management in DKI Jakarta relies on a conventional collect-haul-dispose system. In order to carry this out, the Cleansing Department of Jakarta has divisions in each municipality. It mainly relies on manual labor and nonspecialized trucks to collect and transport the waste to transfer stations and/or the final disposal site (Pasang, 2007).

DKI Jakarta generates waste of 6716 ton/day (2451340 ton/year) recorded in 2012. With total population of 10.187.595 people, it is estimated that the waste generation per capita is 0.65 kg per day. There is increasing of waste volume every year with growth rate almost twice than population growth, 2,85% and 1.6% respectively.

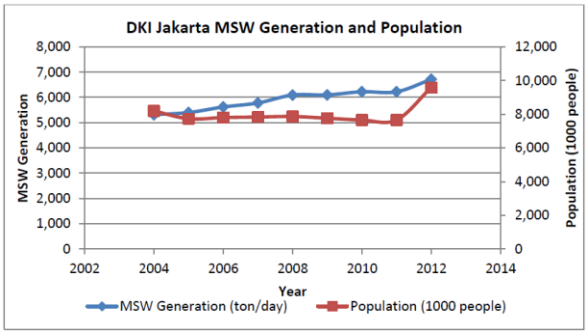

Figure 2. DKI Jakarta MSW Generation and Population 2003-2012
(Source: DKI Jakarta Cleansing Agency, 2014)

Jakarta`s major waste generator is household. 60% of total quantity of waste comes from both single and multiple family per day in the city. Following by office as the second biggest waste source at 22.48% of the total waste. Commercial waste consist of waste coming from with the mainly purpose of trade or business as well as entertainment. Therefore, the total of the waste coming from commercial site in DKI Jakarta is 28,3% of the total waste.

2.1 Waste Collection

The Cleansing Agency of DKI Jakarta has division in 5 municipalities controlling and conducting waste collection that operate directly and indirectly. For household in housing area (non-apartment), the collection is done indirectly. Primary collection is done door-to-door by service officer appointed by community or by household itself. Collected waste will be brought to waste shelter or decentralized transfer station. From this part, the transportation of waste to landfill will be handled by government trough the government itself or by hiring private company. On the other hand, for household in apartment, high income residential and commercial, the collection is done directly by government or hired private company. Waste from Institutional, public area and street is done by government with street sweeping system.

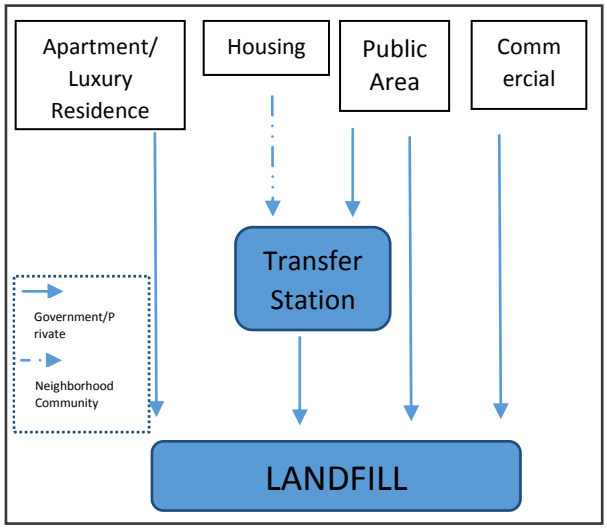

Figure 3. Waste Collection Stream

According to Cleansing Department`s report in 2012, the collection rate of waste is 88% in average. This number is calculated by the estimation of waste generated and waste transported to landfill. 7% of waste total is recycling and 5 % is remained in the street, in the river or burned.

2.2 Waste Composition

As the characterization of waste in developing country, composition of waste is dominated by organic fractions 54% of total waste. Following by paper and plastic 15% and 14% respectively. Additionally, according to survey done by the cleaning agency, the inorganic fractions collected from commercial waste is larger than organic fractions. There is a big potential of recycling if the waste collected is segregated first.

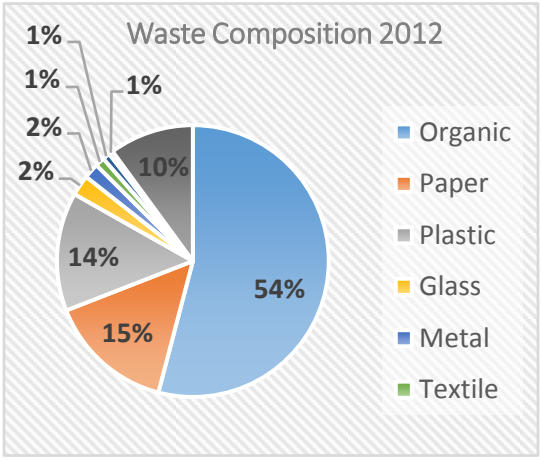

Figure 4. Waste Composition DKI Jakarta 2012 (Source: Cleansing Agency of DKI Jakarta, 2014)

2.3 Waste Treatment

Currently there are two pre-treatment installation in DKI Jakarta i.e. Sunter Transfer station and ITF Cakung-cilincing. Sunter Transfer Station is a waste compacting facility that is treated waste coming from areas in DKI Jakarta that is located far from the landfill. In 2007, the total of actual waste handled in this facility is around 800 ton/day. ITF cakung-cilincing is equipped with Micro Biological Treatment with capacity 1500 ton/day. According to 2012 report, ITF cakung-cilincing handled waste 81.222 ton/year. However no actual updating regarding to the performance of this ITF.

Almost 90% of waste is landfilled in TPST BantarGebang located 40 km far from the central of DKI Jakarta. The location of final landfill become the one of the major issues in collecting and transporting waste. The traffic condition in the city affect the schedule of the transportation which is consumed time double than predicted before.

TPST BantarGebang is a sanitary landfill with total area 108 ha already operated since 1989. This landfill is awarded as the best landfill in Indonesia equipped with leachate collection and Methane Recovery facility that also produce electricity. It produces some 10.5 MWh per day. Moreover there is small composting facility with capacity of waste 400 ton/day.

However, the capacity of Landfill which is 3000 ton waste per day, accepting waste 5800 ton/day. This volume of waste transported to the landfill is almost twice the amount of waste should they accept. Lack of treatment facility and capacity make the condition of waste at landfill is not controlled.

Recent years, recycling has been promoting in DKI Jakarta. It was recorded in until 2009 the recycling rate reached 7% of total waste through 3R (Reduce, Recycle, and Reuse) program. Most of the recycling process is done by the informal waste picker and residence community or recently called as waste bank. 5% of inorganic waste is recycled and 2% of organic waste is composted. This rate of recycling has proved the potential of waste treatment before government interfere.

Waste collection rate is still far from 100% because of many issues. 5% of uncollected waste is still remained at transfer station, street, river and burned that lead to increasing of air pollution, health problem and city esthetic. Those transfer station becomes dump site because no treatment equipment and cover and waste remains for several days.

3. Methodology and Discussion

3.1 Transfer Station

Transfer stations are an integral part of present-day in municipal solid waste management systems. The main criteria used to decide on the location of a transfer station has traditionally been the minimization of transport costs, since it is cheaper to transport great amounts of waste over long distances in large loads than in small ones (Bovea*et al*., 2007)

Where the distance from the waste collection area to the waste treatment facility is large, a transfer station may be used to bulk up the waste for more efficient transport by a larger truck (Bovea*et al*., 2007).

According to Gil & Kellerman (1989), there are three reasons why transfer stations are useful. First, because small or medium sized communities may not generate sufficient waste to support a disposal facility. Second, if the distance to the disposal plant is long the use of small collection trucks may be unnecessarily high. Third, the location of a single disposal plant in a remote location to serve several communities will remove negative environmental impacts from residential areas.

The main criteria used to decide the feasibility of incorporating a transfer station into a waste management system has traditionally been the minimization of the economic costs of transport to and from the station, since it is cheaper to transport large amounts of waste over long distances in large loads than in small ones (Tchobanoglous*et al*., 1993).

Most of waste coming from household and public area are unloading at transfer station before transported to disposal landfill. DKI Jakarta has 1612 points of intermediate collection point of waste within five municipalities. Among those spaces, the area of 130 points of them is more than 300 m2. In current situation these areas looks like dumping sites because of uncollected waste are remained there for days.

Figure 5. Transfer Station at DKI Jakarta

Through this research, I proposed an Integral transfer station as the solution in reducing waste to final disposal site. According to research done at Surabaya city, reforming the dump site type of transfer station with MRF (Material Recovery Facility) equipped with storage for dry waste and composting facility for organic waste is possible. It needs at least 300 m2 land depends on the facility will be installed to support the MRF. (Pratiwi,2011)

3.2 A Neighborhood-based waste management

Community-based of waste management has been applying and promoting since long time ago by government and NGO. However, inn Jakarta neighborhood-based organizations (NBOs) are different than community-based organization (CBOs). The main difference

between the two lies in their status and function. In Jakarta, NBOs are formal organizations within local government, while CBO's are not part of the local government structure.

Category	NBO	CBO
Status	Formal	Informal
Management	Local government	Non-government
Willingness	Force	Voluntary
Funding	Continuously	Project based
Player	All income household	Small-medium income
Successful rate	Depends on Rule	Depends on Leader
Continuation	No change in participation	Depends on participant

Figure 6. Differences of NBOs & CBOs

The collaboration of citizen and government participation will bring the improvement in waste management continuously in DKI Jakarta. There is also differences in scale of waste could be handled between CBOs and NBOs.

Municipal waste management system in DKI Jakarta is centralized with one final disposal site at TPST BantarGebang. Without support of sufficient treatment facility in one landfill site, all of the total waste generated in DKI Jakarta cannot be handled completely.

One of the obvious advantages of a decentralized system is the improved aesthetic and hygiene condition in the locality. Also it will not require a secondary garbage collection service by the municipality. Decentralized schemes provide better income and employment options to the underprivileged sections of the society (Pastore,2005).

3.3 Integrated Waste Management Model-2 (IWM)

IWM-2 (Integrated Waste Management Model 2) is a software tool which allows you to model thewaste collection, treatment and landfilling of Municipal Solid Waste (MSW).

The model predicts overall environmental burdens of municipal waste management systems and includes a parallel economic model. The model has been designed as a decision-support tool for waste managers in both industry and local government, who need to decide between various different options for waste management.

By using this model, I would like to introduce some possibly scenarios to manage the waste flow start from separating, collection and treatment. By using this model, we can compare the technology using for composting, bio-gasification, RDF, thermal combusted and incineration. Moreover, this software is not only provided the output of waste total but also from environmental perspective and cost calculating both initial and maintenance cost.

4. Future Works

For the next step of this research, I will use IWM-2 software to find the result of each scenario that will be proposed. From the calculation of cost for collection, transportation, treatment and disposal, we can get the cost and economy benefit of transforming the transfer station into 3R transfer station with participation of both citizen and government.

Not only from the economical aspect, I will consider the effect from environmental aspect. Each collection way and treatment options has their own effect to environmental and society. By considering all of aspect, we can get the best scenario that could be applied in DKI Jakarta.

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