HOUSEHOLD SOLID WASTE MANAGEMENT SYSTEM THROUGH SUSTAINABLE CONSUMPTION

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ABSTRACT

The limited of natural resources to serve economic activities can caused social problems, such as poverty, pollution, and waste. Waste can be harmful to the ecosystem.This research explored household consumption pattern (food and non-food) that correlated with waste and build a dynamic model of household consumption and waste management system. Kecamatan Duren Sawit-East Jakarta has the biggest number of households and unmanaged waste problem. The methodology was quantitative data for Spearman's Rho Correlation analysis and qualitative data (interview and questionnaires) for consumption motivation and lifestyle. Human beings is a homo-economicus and a homo-ecologicus. We have rational thinking (maximize our utility and usage value) and we get information from external (socio-culture and advertisement). Based on the questionnaires (100 households), respondents are more likely buying food and non-food products based on their usage value. For non-food product, they have more choices on the market and they tried to reduce their consumption (3R principle). Waste management system still use: collecting, carrying, and disposing the waste at the temporary landfill and the permanent landfill at Bantar Gebang-Bekasi. Respondents do not sort their waste, even though we have law (UU No. 18/2008 for Waste Management). I interviewed the closet stores or markets at 7 sub-district areas or Kelurahan and no punish-rewards system. To reduce the household waste, we need to increase consumer's green motivation that can shift gradually their consumption behavior to be greener lifestyle. Changing consumer behavior is one of the mitigation process to reduce the greenhouse effect.

Keywords: Household Consumption, Solid Waste, Spearman's Rho Correlation, Sustainable Consumption, System Dynamics, Waste Management

INTRODUCTION

Since the Industrial Revolution, there is tremendous change on science and technology. Improvement on medical and healthcare aspects made the number of the population increases and it increases the basic needs of human beings, such as clothes, food, and houses. Unfortunately, the limited of natural resources cannot support all of the human needs and wants. These phenomena caused many socio-economic issues and environmental degradation problems.

Environmental problems usually take beyond place and time. It means that what happens to one place can affect other environmental quality. Pollution and waste are major causes for the greenhouse effect. Waste is one of the major public problems in developing countries. Indonesia is the fourth most populous country in the world with 250 million people in 2013 and DKI Jakarta as the capital city of Indonesia has 9,588,198 people (Sensus Penduduk 2010). Another environmental issues in Jakarta is flooding that happens almost every year. Some of the main cause of this problems are household consumption and people behavior on waste management.

Household consumption pattern in Jakarta is different than thse at other provinces in Indonesia. In 2012, the percentage of people consumed for non-food products (51.62%) and food products (48.38%). It means that there is a shifting on the consumption pattern from food products to non-food products. Based on the Engle's law, this phenomena happened when there is an increase on household income (ceteris paribus: people desire is still at the same level) and people will change their consumption on different products. This shifting relates with the composition of household waste, whether organic or inorganic. Statistically, the volume of waste increased from 26,264 m^3 per day (2005) to 29,217 m^3 per day (2008) in Jakarta. Table 1. shows waste volume in five district areas in Jakarta.

Table 1. Waste Volume in DKI Jakarta Province (2011)

No.	District Area	Volume (m3/day)	Managed (m3/day)	Unmanaged (m3/day)
1.	Central Jakarta	5,479	5,479	0
2.	North Jakarta	4,519	4,517	2
3.	West Jakarta	6,490	5,526	964
4.	South Jakarta	5,696	5,642	54
5.	East Jakarta	6,331	3,901	2,430
	Total	28,515	25,065	3,450

The number of population and consumption behavior add the waste volume daily (include the characteristic of waste composition). Waste volume can be reduce by applying sustainable consumption. So, the purpose of this research is to see correlation between household consumption pattern and waste management system.. The integrated waste management system (IWM) that starts from the smallest level (a family) can give positive impacts to reduce the greenhouse effect globally.

MATERIALS AND METHODS

Environment supplies natural resources for the production process to make food and non-food products. Afler consumer consume the products, the waste will go back again to the environment. Figure 1. shows the relationship and feedback between environment and economic cycle.
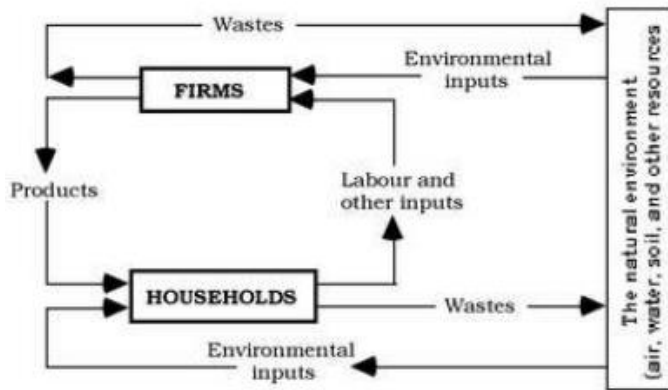

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Figure 1. Environment and Economic Cycle

Human beings can be a homo-economicus and a homo- ecologicus. It means that a person can be rational on making decision for their consumption (a.k.a. maximize utility and usage value). On the other hand, she or he can also help to maintain the environment condition (a.k.a. applying the 3R principle: Reduce, Reuse, and Recycle). These all indicate sustainable development from three main aspects, such as: (a) economic, we can see from the household consumption behavior; (b) social, we can see community participation on some recycle product home-based industry; and (c) environment, by applying the 3R principle, the quality of the environment can still be maintained well.

Waste definition from the Organization for Economic Cooperation and Development (OECD): "Waste refers to materials that are not prime products (that is, products produced for the market) for which the generator has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose." Household waste can be divided into two categories: (a) inorganic waste is composed of material other than plant or animal matter, such as glass, plastic, metal, concrete, and chemicals; and (b) organic waste comes from plants and animals. These categories will affect to the waste composition because of the packaging materials.

The approach of this research is qualitative and used a mixed methods. Quantitative data comes from the Statistical Office (Badan Pusat Statistik or BPS) and Sanitary Department (Dinas Kebersihan Jakarta Timur and Suku Dinas Kecamatan Duren Sawit). Qualitative data comes from the questionnaires that being elaborated from the consumer behavior theory and the hierarchical needs of human beings from Abraham Maslow. The respondents are being chosen through random sampling and the Slovin formula (n=l00 households). In East Jakarta area, the sub-district Kecamatan Duren Sawit has the highest number of household (94,862 Kepala Keluarga or KK) than the other areas, such as: Pasar Rebo, Ciracas, Cipayung, Makasar, Kramat Jati, Jatinegara, Cakung, Pulogadung, and Matraman.

Main variables on statistical analyses are: (a) household consumption for food and non-food products monthly in Rupiahs; (b) products categories food and noon-food products that excluded services and facilities for household; (c) waste volume is for solid waste, such as organic and inorganic; (d) environment quality by observing the unmanaged waste in front of a house or at the temporary landfills; (e) health condition by asking the respondents about the number of sick people in a family; and (g) education level, such as formal education and informal education that related with the environmental quality. I used depth interviewed for getting more information on waste management system, especially on the four sub-district areas at Kecamatan Duren Sawit that had applied the 3R principle.

The questionnaire used the Likert scale (1-5) and the Spearman's Rho Correlation to analyze the relationship among variables. To build a dynamic model, it is important to understand the real story on the society right now for the waste management system in the city. Figure 2. shows the causal loop diagram (CLD) for the system dynamics analyses. Loop

balancing (BI) applied the phenomena that happens in the society right now: (a) the increase volume of the waste in front of the house will increase the volume of the unmanaged waste; (b) the increase volume of unmanaged waste will make people contact or call the sanitary officer to carry the waste to the temporary landfills. This action will reduce the volume of the waste in front of the house but only for short time because the effort to reduce the waste does not come from the internal motivation of the people.

Loop reinforcing (RI) shows the way how the waste management comes from the internal motivation of the people: (a) the increase volume of the unmanaged waste will reduce the environmental quality; (b) bad environmental quality can cause people sick, air and land pollution; (c) the unmanaged waste and bad environmental condition will make people think that they must reduce their household waste, especially from their consumption; (d) the change in the motivation (we called here as green motivation, where people consume products more rational by putting environmental interest as same level as economic interest) will gradually shifting their lifestyle; (e) green lifestyle is a combination of sustainable consumption and society responsibility; (fi green lifestyle will reduce the consumptive behavior of the people and it will reduce the waste percentage; and (g) at the end, it will reduce the waste volume.
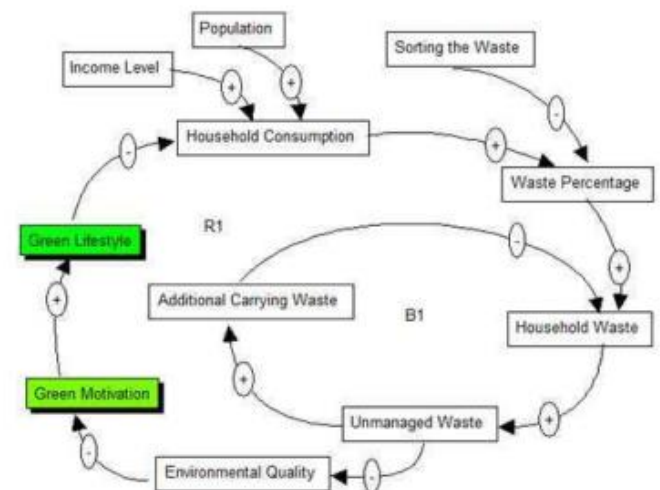

Figure 2. Causal Loop Diagram (CLD)

RESULTS AND DISCUSSION

The Spearman's Rho Correlation analyses indicated that household income has significant relationship with household consumption for non-food products with p value (sig. value 2 tailed = **0.000)** and the Spearman's Rho value (r value = **0.399,** which is significant with low correlation). In East Jakarta, one household has average 3-4 people as family member and this number is the same as in the Kecamatan Duren Sawit. The waste weight that being observed on this research is 0.75kg per person and this number already considered the standard national of Indonesia (SNI) and other related information from academic journals. The Spearman's Rho Correlation between household income and weight has significant relationship. The p value (sig. 2-tailed = 0.000) and the Spearman's Rho Correlation value (r value = 0.354, which is significant with low correlation).

The percentage of the household consumption for non-food products is relatively higher than for food products. This consumption pattern effects to the characteristic of the waste composition. The household consumption is divided into two categories: food and non-food. For food categories are like rice, yarn/cassava/maize, fish, meats, eggs/dairy, vegetables, fruits, sugar/coffee/tea, cooking oil/spices, beverages, tobacco, and food stuffs. For non-food categories are like clothes/shoes/hats, purpose party/ceremony, and other goods (not including home facilities, transportation home/telecommunication,

tax/insurance/savings, education services, security services/home workers, and health services/physician). Based on the questionnaires, 61% of the respondents said that the highest waste is organic waste and 42% is for bottle or glass. This is approximately the same with the management solid waste report by country from the World Bank (2012) and the research by Yeoh (2006).

Another phenomena that being observed while taking the primary data are: (a) there are 28 temporary landfills in Kecamatan Duren Sawit but most of them do not at the exact address from the official document. It caused shadow temporary landfills. It means that people get used to throw their waste or garbage into empty land or property; (b) the temporary landfills locations do not have permanent building and they do not follow the SNI requirements. There are only three temporary landfills with permanent buildings at the sub-district Pondok Kelapa. I used the GPS to plot the locations on the Kecamatan Duren Sawit map; and (c) on the extreme situation, sometime I see people burn their waste, even though it is disobeyed the law. Waste has methane (CH4) which is dangerous to the greenhouse effect and it must be managed well to reduce it.
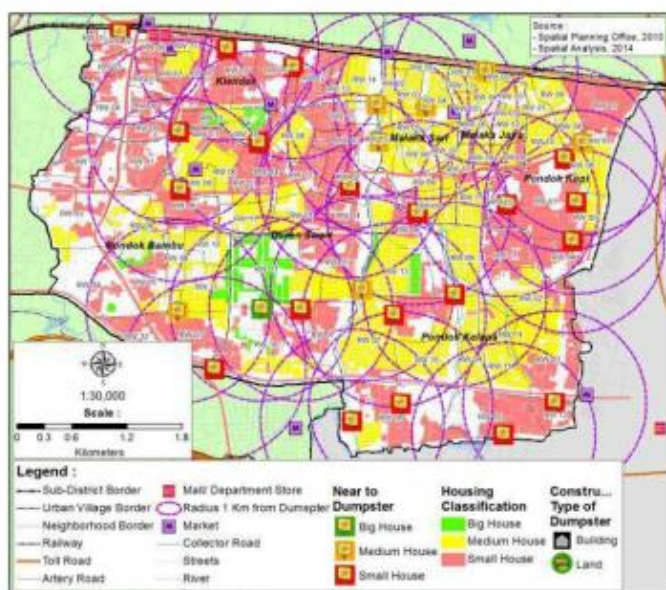

Figure 3. Temporary Landfills at Kecamatan Duren Sawit-East Jakarta

Figure 3. shows us 1 kilometer radius of temporary landfills service area. From the figure, there are red area for small houses, which is unplanned housing area. In this area, people usually after cooking time in the morning and in the afternoon, they collect the waste in their kitchen and they just hang their trash bag up in front of their front door because the area is too narrow for the wheeled bin to take the waste. The sanitary men will take it once every two days. The yellow and green colored area are for medium and big houses. They also collect their waste after the cooking time in the morning and after and put the trash plastics (usually two regular plastic bags 34X35cm) into the trash bin in front of their house. The trash bins in Jakarta and almost at all cities in Indonesia do not separate the organic and inorganic waste. The law UU No. l8/2008 for Waste Management mentioned for sorting the household waste before they carry it into the temporary landfills (tempat pembuangan sempentara or TPS) or the permanent landfills (tempat pembuangan akhir or TPA) at Bantar Gebang-Bekasi.

The unmanaged waste in the trash bin in front of the house or in the temporary landfills (if it is shadow temporary landfills), people get used to burn the waste or even they just leave it that way. Waste produces emissions of several greenhouse gases, which contribute to global climate change. The most significant gas is methane. Reducing the waste volume helps address global climate change by decreasing the amount of greenhouse 8as emissions and saving energy. One way to reduce the waste IS through sustainable consumption.

For the dynamic model from Figure 2., some assumptions here are: (a) the population growth at Kecamatan Duren Sawit is 1.04% between 2000-2010; (b) the frequency to carry the waste from the trash bin is once in every 2 days; (c) the wheeled bin capacity is 1.5 m^ with 28 TPS locations and each TPS is approximately 30 wheeled bins come every day; and (d) the capacity for the heavy vehicle that used from the TPS location to the permanent landfills is 6.8 m'. After the validation of the model, there is increasing trend of the unmanaged waste from 2009 until 2021. Figure 4. And Figure 5. are the system dynamics simulation model with the Powersim.
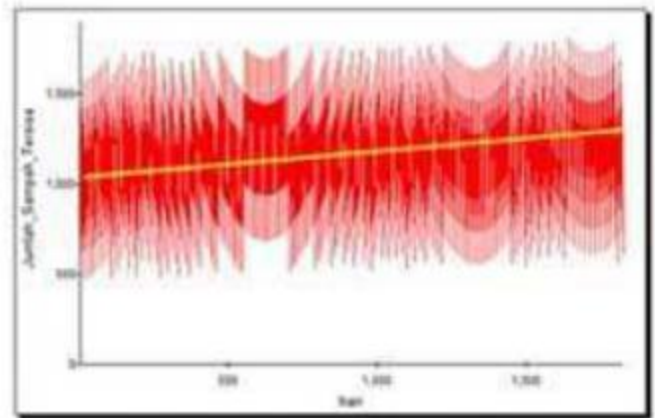

Figure 4. Business as Usual of the Unmanaged Waste

The assumptions for the intervention into the model are: (a) there is self-concept from the household consumption behavior; and (b) 1aw enforcement on the household level. With the green motivation and green lifestyle as the internal factor of the consumption behavior, there will be reducing number of the unmanaged waste. This model does not put all the variables (e.g. the need value, the usage value, the influenced from other, and the advertisement media) because it already being analyzed statistically but it combine on one big variables under green motivation and green lifestyle. This research does not involve producer's point of view. I observed their products to the end- users or consumers who implies the household consumption behavior on the market (e.g. traditional market, mini market, and supermarket/mall).
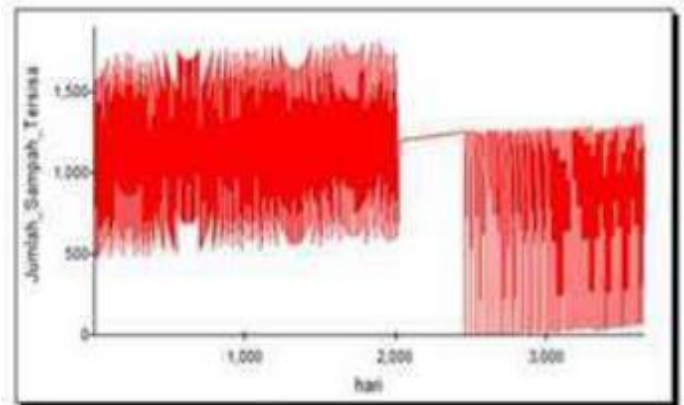

Figure 5. Intervention through Sustainable Consumption

From statistical analyses for variable correlations, spatial analysis for the temporary landfill locations, and system dynamics analyses to build a linkage model between sustainable consumption and waste management system, it gave us some important conclusions, such as: (a) household consumption pattern shifted from food products to non-food products that being caused by the increasing of household income; (b) this shifting related with the packaging materials for food and non-food products; (c) this packaging material gave impact to the waste volume, especially to the characteristic of waste composition; (d) people in Kecamatan Duren Sawit and also like other area in Jakarta, they do not sort their waste and no punish-rewards system for this; (e) the

delayed time to carry the waste from the trash bin in front of the house or even though from the temporary landfills into the permanent landfills will make people burn the waste or they just leave it that way; (fl the gas from waste, especially methane relates to the greenhouse effect that makes worse the global climate change; and (g) green motivation and green lifestyle are the most important aspect to reduce the waste because it comes from the internal and more sustain in the long term.

ACKNOWLEDGMENT

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