

Life Cycle Assessment Approach on Food Packaging to Build Sustainable Consumption Awareness in Developing Countries

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First submission : 21 March 2017, Revised submission : 21 May 2017, Acceptance 10 June 2017

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Abstract

The increasing number of population will increase the number of household consumption. The household consumption can be divided into nonfood and food products. Indonesia (the 4th biggest most populated country in the world) has a major issue on household waste management system, especially on the environmental awareness through sustainable consumption. This paper focused on the Life Cycle Assessment (LCA) approach on the food packaging. The research methodology is qualitative research by conducting observation and in-depth interview with informants at Setia Asih Village in Bekasi. This village has unique characteristics, such as they have a new waste bank; close by the East Jakarta area; and local people support for regional economic development. The preliminary research showed that the local people and local government know less about the waste management. After the public training or socialization for the waste management and the circular flow of food packaging material, the local people started to understand the connection between their household consumption and the impact to the environment. From 300 people on the socialization session, there were 14 people as the Dusun's representatives to attend the Focus Group Discussion (FGD) and the in-depth interview to set up the waste management system based on their local capability and capacity. LCA approach can be the best method to make local people understand their daily activity from the household consumption on food products and the impact of inorganic and organic waste into the environment. To build sustainable consumption awareness needs routine training and monitoring for local people.

Keywords: *sustainable consumption; life cycle assessment; waste management*

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1. INTRODUCTION

Solid waste is the biggest issue in developing countries and it mostly comes from households. Indonesia (2017) has more than 261 millions of people in and they concentrate in big cities including their surrounding areas [1]. DKI Jakarta as the capital city of Indonesia and other big cities in Indonesia (such as Surabaya, Medan, and Bandung) have the main environmental issue on their household solid waste management system too.

This phenomena exists in Jakarta and the supporting areas, such as Tangerang, Bogor, Depok, and Bekasi (Jabodetabek). In 2011, East Jakarta has the highest unmanaged household waste (2,430 m³/day) compare than other administrative areas (such as Central Jakarta, West Jakarta, South Jakarta, and North Jakarta). In 2016, Jakarta produced 7,099 m³ per day [2]. Bekasi area is close distance with East Jakarta and they have the same public issues on waste management system. Bekasi has the biggest value on their housing sale data per month than other suburban areas. It means people prefer to choose Bekasi location for their housing area and commute to Jakarta to work daily.

The increasing number of population will increase the demand on food and non food products. The daily basic needs are food, clothes, and shelter/house. The demand refers to the increasing input or raw materials for products packaging and also the increasing number of household waste into the environment. The fast growing economy makes change almost in all aspects. For example, before the era of internet (1990s), people go and buy fresh food in the market. They cook it and they eat together with their family at home. After the internet booming (1991), the lifestyle changed where people have less time to cook and eat together at home. Now, people prefer instant food over traditional home-made food. It changed all the way we look at the food packaging.

Economic activities can be separated into three main sectors, such as: agricultural, industrial, and service sectors. The increasing number of food consumption will create more food demand in the market. It leads to have more input from agriculture as their raw material on their food product processing. The fast growing economy also increase the demand for fast food industries and easy-to-go food packaging. On the other side, the food business company will increase their advertisement services to introduce their new food packaging product to the market. Say's Law mentioned that supply creates its own demand [3].

The three economic sectors, such as agricultural, industrial, and service sectors together with the input

(resources) market and product market accelerate the waste and pollution to the environment at the end. We can see the diagram for the linkage between the economic activities and environment (Figure 1). Circular flow of economy is part of the sustainable development (Brundtland Report, 1987) which are economic, social, and environmental aspects [4].

There are advantages and disadvantages from high economic activities and big number of population. Population is not only create more demand on their daily basic needs and waste to the environment but also it can be a potential source to solve their environmental and social issues. The circular flow of economy show us that there is a linkage between household aspect from consumption behavior with the environmental condition. On the other side, there is a linkage also between industrial (firm) aspect through their production process with the environmental condition [5].

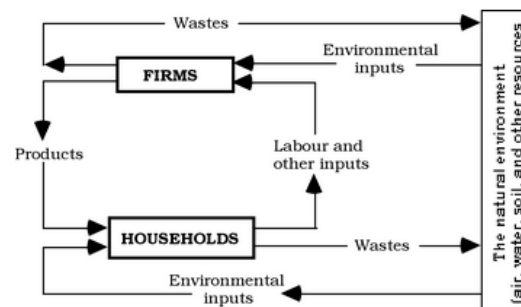


Fig. 1. The Linkage between Economic Activities and Environmental Condition (Source: Thamapilai, 1991)

People used natural resources for their consumption (household level) and production (factory) needs. From the household side, after the consumer/household consumes the non/food products, there will be waste/pollution into the environment. From the firm side, after the producer produce the non/food product, they will sale it in the market and there will be waste/pollution into the environment too. So, the both sides will need environment as their input and the place for their waste.

The environment condition at Setia Asih Village in Bekasi is full with unmanaged waste. The unmanaged waste spread on the empty land/place; in every corner of the road; and in the gutter/river. The village did not have a waste management system (2017) but now they have a new waste bank from one of the state-owned enterprise or Badan Usaha Milik Negara (BUMN) in 2018. Before the new waste bank, the local people just collect their trash and throw it in the gutter or in an empty place. After the new waste bank, the local people not only collect the

trash but also they sort the trash into inorganic and organic waste. Then, they bring it into the new waste bank to be weighted and they will get some money on their savings book.

The main research problem is how people at Setia Asih Village can reduce the number of the unmanaged waste through their household consumption behavior to build the environmental awareness. It is not easy to gather the waste and household consumption data on the lower administrative level in Indonesia, such as village or desa. It is not being provided by the village level government officer.

2. METHODS

This research paper used the qualitative approach and used observation; public training or socialization; and FGD (including the in-depth interview) to collect primarily data on the field [6]. The documentation during the preliminary research, such as photos and videos of the environmental condition are being recorded (February until August 2018). On April 2018, the public training for the villagers is being conducted between the BUMN (Corporate Social Responsibility or CSR program) and the local government. There were around 300 people attended the session and being introduced to the waste management system including the impact of their household consumption behavior to the environment.

The LCA approach is also being introduced in a very simple way to the local people and they were surprised with the environmental impacts (short-run and long-run). The LCA approach can be used to compare alternatives scenarios for the environmental parameters (Cremiato, et.al., 2018) [7]. On the training session, it used direct example on their daily activity, for example: they use single-use plastic bag from the market/store and they throw it easily into the gutter or river. They did not know the plastic (food packaging material) life cycle yet. After the training, they received knowledge about household consumption; food packaging materials; and household solid waste.

To gather more information about how to build sustainable consumption awareness, this research followed local people lifestyle and observed the local markets/stores. Basically, they have traditional market and modern market. Both of these markets give their consumer the single-use plastic bag to cover their non/food products. There was a law to put extra charge for each plastic bag (Rp. 200) but the law did not have any significant impact for the consumer lifestyle and no punishment if people did

not bring a reusable shopping bag [8]. This happened on the modern market, such as mini market.

The public training or socialization took place one day: (a) morning session from 9am-12pm; and (b) afternoon session from 1pm-4pm. It took place at the local government office yard and auditorium. After the public training, there were FGD (one week after the socialization session) and in-depth interview (mid-April 2018). There were 14 people attended the FGD and all of them are very dedicated to environmental improvement activities.

There are eight villages in Bekasi, such as: (a) Setia Asih Village; (b) Pahlawan Setia Village; (c) Pantai Makmur Village; (d) Pusaka Rakyat Village; (e) Segara Makmur Village; (f) Samudra Jaya Village; (g) Segara Jaya Village; and (h) Setia Mulya Village [9]. Only Setia Asih Village has a new waste bank. During the FGD (14 people as each Dusun's representatives), they must know the administrative border among the villages. If they do the campaign for sustainable consumption awareness, they will meet with other villagers from different place or their neighbor village.

The in-depth interview is being conducted with three informants and their age above 35 year old. These men are already know the local condition in Setia Asih Village (social, culture, and economic). The villagers are also know them well. Figure 2 showed that the villagers just throw their trash into the gutter without knowing what happens next to the environmental condition. After the informants saw the picture, the discussion was very intense on how to change local people perception about their household waste and how to reduce the use of single-use plastic bag or kresek in Bahasa Indonesia. It is not easy to make local people understand how dangerous the food packaging material for the environment based on the LCA approach.



Fig. 2. Unmanaged Household Solid Waste

Some of the housewives at Setia Asih Village are already do the recycle product. For example, they make artificial flower from plastic bag. They go to

the market, buy fresh food, and used the plastic bag for the recycled product. They have higher price value and usage value from the plastic trash. It can reduce the percentage of unmanaged waste from the temporarily place or Tempat Penampungan Sementara in Bahasa Indonesia (TPS) to the landfill or Tempat Pembuangan Akhir in Bahasa Indonesia (TPA). The waste management alternatives can be sanitary landfill, selective collection of organic waste for anaerobic digestion and anaerobic digestion after post-separation of organic waste (El-Fadel, 2017) [10]. The informant said that by doing the recycling process, it can reduce the waste around 10% per year. The recycled product can increase the household income around 5%-7%. This number is not standard for each household because not all local people have the same knowledge for the life cycle of the food packaging material (plastic) and not all local people have the same level of sustainable consumption awareness.

To check the level of local people knowledge and understanding about the sustainable consumption awareness, the research had done the triangulation (randomly) with the villagers who just go out from the mini market; in the traditional market; and around the school gate or hospital entrance (usually there are many food street sellers) by asking them how they treat the single-use plastic. All of their answer are the same. They do not know the knowledge of the life cycle from the plastic and they do not know how to reduce the amount of the waste. The waste management system should be from the starting point (waste source) to the end point as an integrated waste management system (Forbes, et al., 2001) [11].

Sustainable consumption is still limited to be understood among people around the world, especially in developing countries [12]. Sustainable consumption is household consumption that not only thinking about the plastic kresek usage but also how to recycle the used of plastic kresek to be more higher value. To change the people's perception needs continues training and monitoring on the lowest level of social groups. One of the social institution that available at Setia Asih Village is the new waste bank. In developing countries, social groups play important role on society empowerment.

To complete the qualitative data analysis, the research also analysed about: (a) waste capacity per day; (b) the waste characteristic or composition; (c) the distance among the housing area complexes at Setia Asih Village to the new waste bank location that is around the Setia Asih River; and (d) how the CSR program from the BUMN and the local

government can support to build the sustainable consumption awareness.

Based on the FGD, the waste per person per day at Setia Asih Village is around one kilogram and the average number of children for each family are 4-5 people which is higher than the East Jakarta condition [13]. Based on the administrative record at Desa Setia Asih, the villagers number is 41,548 people in 2016. The documentation is not being published yet. It is still at the Village Chief office. So, the calculation to know the household waste per day is $41,548 \times 1 \text{ kg} = 41,548 \text{ kg}$ without any support from the government to manage it. There is no data on waste composition either.

To complete the data, there was unstructured interview with the local community groups (Karang Taruna Setia Asih Village and the housewives community groups) and the local government officer (Ketua Tabungan Desa). The approximate percentage of waste composition is around 60% inorganic especially from plastic and around 40% organic waste.

Waste can be divided into: (a) organic waste is biodegradable waste that comes from vegetables and fruits; and (b) inorganic waste is non biodegradable waste that come from plastic, glass, and metal. Based on this group, there must be different waste treatment for each group [14]. Beside the small home-industry from the housewife group for the recycled products, there is also the composting (farmer social group) from the organic waste. The villagers already made it as their home-base small business and they use it for their farming. The price from one bottle (330 ml) of the organic liquid fertilizer is Rp. 10,000 (less than 1 USD). The inorganic waste can become recycled products that have more value added and it can be sold to the waste pickers leader or pengepul. Pengepul organization and their market are hidden market because they are not easy to get the price data and they are not an open community (pengepul society group).

Here are some notes from the public training about household consumption activity that gives impact to the environment (last April 2018):

"I don't know where to throw my trash and usually I put it on to the gutter or an empty area that is closer to my house. Other people do the same thing." (Alias: Mrs. Nani)

"We don't know there is a linkage between our consumption activities with the environment

condition overall. We assumed the waste is no value at all.” (Alias: Mr. Toto)

“We are still using the single-use plastic because no fine or penalty. It is more practical to use the single-use plastic than to use our shopping bag.” (Alias: Mrs. Aisah)

Most of the local people in Indonesia do not know very well about the treatment for their own household waste. Watanabe (2015) did the research on Asia Pacific region about the local people knowledge for the household solid waste [15]. It needs more intense and more frequent about waste management system to the society in all level. Widyaningsih found that household consumption plays significant impact to the characteristic of the household solid waste [13].

Below is Table 1. shows the number of stores in each village and household number in each village. The statistic data is based on Kecamatan Tarumajaya Report in 2016. Beside the social and economic conditions, the geographical condition gives affect to manage how to distribute the training/monitoring periodically and the distance to implement the new waste bank location. The land is lowland area with hilly southern parts. 83% of the land area is a stable land and it is good for urban activities. The dominant land-use is for housing complex. There are many housing complexes around Setia Asih Village. Another issue here is the local government does not have the administrative village map. The map will be used to plot the flow of the plastik kresek as the food packaging.

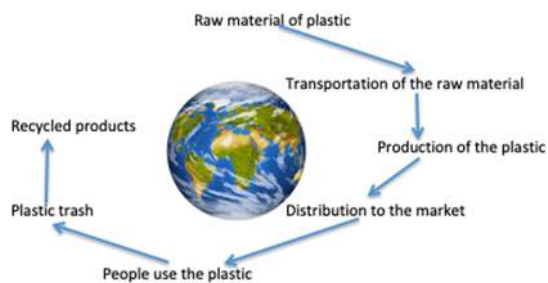


Fig. 3. The LCA of Plastic to Build the Sustainable Consumption

The LCA of the food packaging (Figure 3.) can become expanded into: (a) more value added recycled products before they reach the end of the life point; and (b) the plastic waste can be processed into new products (through the melting and pelletisation process). The first option (making recycled products is easier for local people in developing countries because we have cheap labor). The second option

needs high technology content. Usually, most people do not want to mingle too far into the waste handling after their throw it. It caused by the socio culture from the local people.

On the other side, there is waste pickers groups who sort the household solid waste regularly. For example, there are waste pickers groups for taking the plastic cup only from the household trash bin; there are waste pickers group to take only the paper trash; and there are waste pickers group to take glass/metal waste only. Table 1 below is the store number at Kecamatan Tarumajaya ini 2016 [16].

Table 1. Number of Store and Household by Village

No.	Kecamatan Tarumajaya		
	Village	Stores	Household
1	Pusaka Rakyat	250	5,108
2	Setia Asih	397	10,085
3	Pahlawan Setia	37	2,602
4	Setia Mulya	47	3,466
5	Segara Makmur	78	5,327
6	Pantai Makmur	146	2,983
7	Segara Jaya	122	4,376
8	Samudra Jaya	15	1,536



Fig. 4. Setia Asih Village Map

The next research collecting data tool is used the FGD to gather more deeply information about how the local people handle their household waste based on their local capability and capacity. The village does not have the administrative map. They put the map from the Google search engine at the Village Chief office. The Setia Asih village map (after digitalized) is as shown below:

From the map, we see that in the middle area is still look like an empty area (with green based color). That is an empty place where people use it to throw their household waste. The other light brown color area is a busy area from local community activities, such as housing area, schools, mosques, stores, hospital, and other small business activities. Setia Asih Village has a lot of housing complex or zones, such as: Green Ara and Cluster Somerset; Perumahan Wahana Harapan; Perum Pesona Bumi Insani; Perum Puri Harapan; and others [17].

3. RESULTS AND DISCUSSION

From the observation, public training and the FGD, the conclusion of the paper are: (a) the sustainable consumption awareness is limited among local people and local government; (b) single-use plastic is the main food packaging at tradisional and modern market; (c) there is no penalty or law enforcement to ban the single-use plastic; (d) many villagers do the composting and use it for their local farming; and (e) there are some home-base small industries but no statistic data available.

Below is the diagram (Figure 5) that shows the higher value on the household waste based on the LCA approach at Setia Asih Village. The food packaging materials can be transforming into other stuffs that people can use it for another purpose.

The LCA approach can create sustainable consumption awareness in people mind-set during their consumption decision-making process. Sustainable consumption is consumption that consider the environmental value beside the economic price and social value. To build the sustainable consumption need efforts and supports from all stakeholders (local people and government including business sectors). The result can be seen in short period of time but in the long run, the quality of the people.

4. CONCLUSIONS

The knowledge limitation about the environmental awareness through sustainable consumption from the local people and local government needs special treatment based on each regional capability and capacity. People at Setia Asih

Village started to understand the life cycle of the single-use plastic that they get everyday from the traditional and modern market. There is no penalty for people who do not bring their own reusable shopping bag. Until now, there is no significant impact on the people mind-set to build environmental awareness through sustainable consumption.

It takes endless effort on training and monitoring the local people and local government to build the environmental awareness through the sustainable consumption. It also needs coordination among all the stakeholders (government, business, and society).

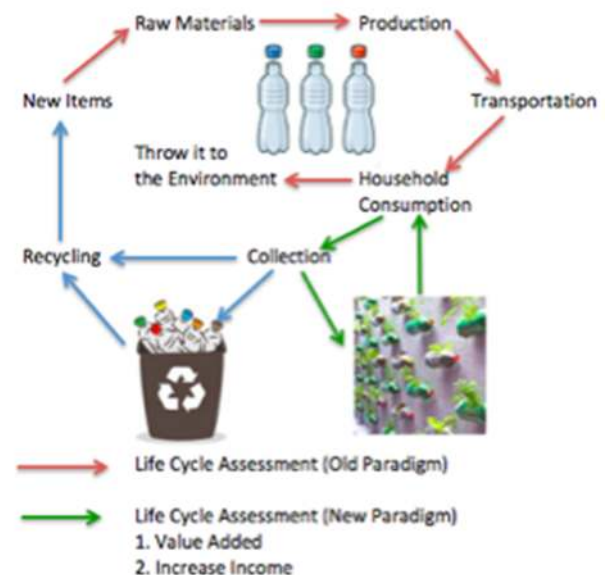


Fig. 5. LCA Approach Diagram

ACKNOWLEDGEMENT

I would like to thank all my Urban Planning colleagues at Esa unggul University for their support and spirits. I have endless words of thank you for all my families and friends who already in my school life and academic career.

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