

Examining the Economic Benefits of Urban Waste Recycle Based on Zero Waste Concepts

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Abstract -Garbage still has economic value if used correctly. Waste management from waste sources is an effective way to increase the selling value of waste and reduce waste that dumb into landfills. Waste recycling can provide economic benefits for the community. However, the price of waste or used goods is very dependent on the conditions and conditions of the world market. The percentage of the population Banda Aceh who often do recycle by 5.08%, quite often 3.35, %, while those that are rare and never is 24.57% and 67% respectively. In this paper, we argue that recycling of used goods will provide economic benefits to the urban community if done well. These include waste separation and avoidance, community recycling centers and the provision of incentives and disincentives. This paper is to examine how the economic benefits obtained by the urban community if the implementation of Zero Waste principles is implemented in Banda Aceh. Research method based on surveys, in-depth interviews with various experts from academics and officers from the government, waste activists, and documents reviews.

Keywords: Banda Aceh, recycling center, waste management, waste economy, Zero Waste, waste avoidance

I. INTRODUCTION

Developing countries like Indonesia define Municipal Solid Waste (MSW) as household waste or from commercial activities, industry, particular areas, social facilities and other facilities (Ministry of Environment, 2008). The urban solid waste generation has become a complex environmental problem and causes health and environmental problems for people around the world, especially in developing countries. This problem arises because of the rapid urbanization and rapidly increasing population (Bustos, Borregaard & Stilwell, 2004).

Population in cities in Indonesia is increasing rapidly, causing negative impacts including poor environmental quality and sanitation. All of these problems are exacerbated by poor city waste management in these cities. Nationally it is estimated that only 60% -70% of the total urban waste can be transported to landfill by authorized government agencies (Damanhuri, 2005). The rest cannot be handled by the government so that the waste ends up being burned or thrown away into an open space or river. A small portion of waste is collected by scavengers to be recycled or resold to waste treatment plants.

In 2008, the Indonesian Government passed Law Number 18 of 2008 concerning Waste Management as an umbrella for national law. District/city governments and the local private sector appointed to manage MSW at the regional and provincial level are asked to improve their services using waste management so that all TPAs are environmentally friendly. Besides, the local government is obliged to close all open dumping landfills within a maximum period of 5 years (until 2013). In the same time frame, a new TPA will be built to replace it. Construction of new landfills must use the Sanitary Landfill system following the standards and regulations that apply according to the law (Pemerintah Indonesia, 2008).

Limited availability of natural resources, especially non-renewable resources, forces people to think hard about how to save the remaining natural resources. Zero Waste (ZW) waste management system is one of the solutions that are holistic in managing waste and resources in a city in a sustainable manner (Zaman & Lehmann, 2011). Also, waste that is considered to have no benefit has economic value. The rubbish can even have higher economic value if it is recycled properly, starting from producing waste in its original place (downstream).

The economic value obtained can arise from material savings, resale of waste, utilization of waste into other materials and

avoidance of environmental damage. Waste management from upstream can reduce waste management costs by the government so that waste management becomes more efficient.

II. LITERATURE REVIEW

Several factors influence the composition of the existence of MSW, among others norms and culture, waste management policies, regions, but one of the main factors affecting is community income. Community income influences because consumption habits and lifestyle depend heavily on income. In general, organic waste from countries with low-income populations is huge and vice versa, high-income communities produce less organic waste.

In countries with high-income populations, various ways of processing waste have been practiced so that the state achieves the goal of waste management, for example, to protect human health and the environment and to conserve natural resources. This approach is known as the Integrated Waste Management (IWM), which chooses and implements waste management under technology and management programs that are in line with regional characteristics (Tchobanoglous & Kreith, 2002).

The level of urban waste collection services in many countries with their domestic per capita gross above \$ 1600 / day, has reached 99 percent or more. While most countries that have middle income have at least 95 percent of garbage control, low-income countries are only able to control their waste by 50 percent. Expanding a network of waste management services and minimizing uncontrolled waste disposal is a priority for low and middle-income countries. It is estimated that recycling activities will reach 20-30% wt, as shown in Table I.

TABLE I. THE RECYCLING RATE OF 20 REFERENCE COUNTRIES IN 2009

Income Level	Range (%)	Average (%)	Average contributed by the informal sector
High	30-72	54	0
Upper-middle	7-27	15	15
Lower-middle	6-39	27	16
Low	6-85	27	26

Source: Adapted from Scheinberg *et al.* (2010) and Wilson *et al.* (2010)

Many developing countries and those that are undergoing a transition to developed countries have an informal sector that runs waste recycling, reuse of used goods and repairs of used goods. This activity was driven by the need for cheaply used products by the community. Challenges in integrating the informal sector in the formal area can be handled well through a systematic approach (Velis *et al.*, 2012).

The recycling rate in a country cannot be determined by how much the population's income is. Figure I shows the recycling rates in some countries where there is no clear relationship between the recycling rate and the incomes of the population. There are highly developed countries with high recycling rates, but there are also developed countries with low recycling rates. While developing countries also have a good recycling rate of garbage between 20-40% (Simonett, 2015).

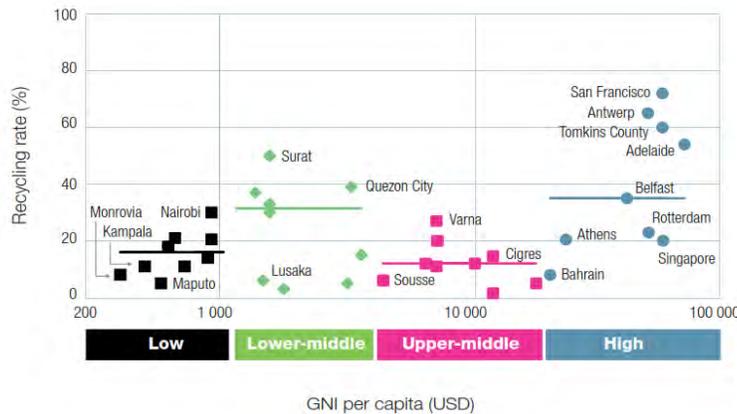
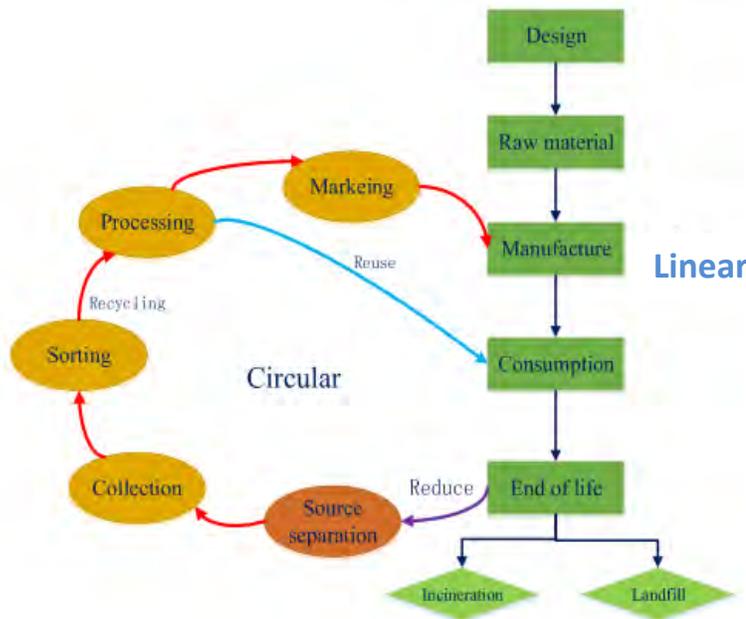


FIGURE I. AVERAGE RECYCLING RATES FOR 39 CITIES BY INCOME LEVEL

The ZW concept is defined by experts as a resource for misallocation resources that must be restored. This definition is different from the opinion of many people who consider waste to be something that is unavoidable and has no value. ZW focuses on avoiding the creation of garbage at the first opportunity (Lehmann, 2011).

ZW philosophy, product design, and waste management principles are considered together to eliminate potential threats to the environment caused by humans and unsustainable behavior. ZW product design ensures that waste can be easily reused or repaired so that product life can last longer. ZW products are made by applying the cradle-to-cradle concept which removes residue from the goods production cycle. ZW management ensures that waste goods can be recycled, restored or degraded by nature without polluting the environment. As a safeguard in the ZW concept, optimal utilization of natural resources is carried out with minimal environmental degradation (Zaman, 2014).

Increased waste generation is caused by a linear material flow rate system where the waste ends in the landfill. However, while the world generates around four billion metric tons of waste, approximately 20% of this waste could be recycled or recovered (Chalmin & Gaillochet, 2009). Currently, the dominant paradigm for the world's garbage is this linear economic system where products end up in a landfill. Rather than a linear system, the concept of Zero Waste (ZW) involves a circular system where at the end of its life, one product becomes the beginning of another product, so that nothing becomes waste. Figure II shows the comparison of the material flow rate between the linear and circular systems.



Source: Song, Li, and Zeng (2014)

FIGURE II. THE FLOW RATE OF MATERIAL ACCORDING TO THE CONCEPT OF CIRCULAR (ZERO WASTE) AND LINEAR

The population census 2010 shows the total population of Indonesia was 237.5 million people, compared to 205.1 million people in 2000. This means that over the last ten years the people of Indonesia has increased by about 32.5 million people with a growth rate of 1.49 % per year (Soleh, 2011). This has created problems at every stage of solid waste management, whether temporary disposal, collection, transportation or final disposal and the issues are compounded at the end point of a landfill (Meidiana & Gamse, 2010). According to Indonesia's Ministry of Environment and Forestry total waste in Indonesia reaches 64 million tons per year, and 14 % of this is the plastic waste (Sudirman, 2016).

Besides plastic waste, electronic waste is now abundant and has its challenges to manage it. Electronic waste is defined as an unwanted part of an electronic and electrical equipment that is included in the recycling and disposal process. The total number of e-waste generated from Indonesian households in 2015 and 2025 is around 285,000 and 622,000 tons. If Indonesia has the right recycling system, new material sources will be obtained and protect the environment and health (Andarani & Goto, 2014).

Several studies have been conducted in Indonesia revealing good ways of handling waste. One of them is by involving the private sector in treating waste. The processing of non-organic wastes can be done by small businesses where this business can provide adequate benefits in collaboration with scavengers (Aye & Widjaya, 2006). Scavenger income is the same as the minimum wage in some places, but even so, they prefer to work in the informal sector because it is challenging to get another job (Sasaki, Araki, Tambunan, & Prasadja, 2014).

Banda Aceh as one of the developing cities also faces similar challenges in the waste sector. The earthquake followed by a devastating tsunami devastated a large portion of the densely populated Banda Aceh region on December 26, 2004. As part of the reconstruction program, new infrastructure such as housing, transportation, etc. was rebuilt with funding from international institutions. One of the supports provided in urban solid waste management or MSW starting from waste collection, recycling and landfill systems (TPA).

Several programs listed in the Banda Aceh Solid Waste Management Master plan since 2007 have been implemented, such as the introduction of waste recycling, rehabilitation of the old landfill in Kampung Jawa, and the construction of a new Sanitary Landfill in Aceh Besar district (Dinas Kebersihan dan Pertamanan Kota Banda Aceh & Roteb, 2007). There are still many challenges faced by the Banda Aceh city government regarding waste management. These challenges include public awareness that is still relatively low, especially those who sell at the market, lack of garbage collection facilities, and the limited number of hygiene extension workers so that the intensity of extension is still relatively low (Faisal, 2014).

The Banda Aceh City Government has the time to immediately identify solutions to the garbage problems that have been faced. But in reality, so far there has been no significant development of the Waste Management System in Banda Aceh other than collecting garbage and throwing it into the landfill. Even though more and more days the amount of waste produced is increasing and land for landfill is increasingly limited due to population growth and the expansion of residential areas. Separation of recyclable materials such as paper, metal, plastic and glass bottles and consolidating all categories of waste should be the basis for waste management system planning.

The municipality of Banda Aceh through the authorized agency is more focused on waste disposal to landfills alone. Tiny portions of waste are sent to recycling facilities or waste avoidance programs. The level of waste reduction in Banda Aceh has only reached 13% in 2015 (Gunawan, 2017). The runoff from landfills and leach ate produced is a threat to surface water and groundwater. Waste that is just thrown away in landfills still has economic value if it is appropriately used. The waste that is still valuable is recycled so that it can become raw material for other products.

III. METHOD

This paper uses a qualitative method to examine economic benefit urban waste in Banda Aceh. Primary data is obtained from interviews with experts or solid waste practitioners, conducting FGDs, distributing questionnaires to the community as beneficiaries of waste services and field observations as well as conducting studies on existing policy documents regarding solid waste. The policy was analyzed from the Zero Waste perspectives within the Law of the Republic of Indonesia Number 18 the year 2008 on Waste Management (Waste Act) and Qanun Kota Banda Aceh Number 1 the year 2017 on Waste Management (local regulation).

IV. RESULTS AND DISCUSSION

A. Respondent Characteristic

This study conducted in-depth interviews with garbage experts, both from academics, practitioners and government staff. Table II shows the characteristics of in-depth interview respondents.

TABLE II. RESPONDENT CHARACTERISTIC

<i>No.</i>	<i>Description</i>	<i>Amount</i>
1.	Academicians	3 person
2.	Practitioner	8 person
3.	Government Staff DLHK3 Banda Aceh	3 person

As for the community survey to know the habit of recycling waste, the sample was obtained based on the population of Banda

Aceh City with the Slovin formula (Umar, 2004) namely:

$$N = N/(1+n\alpha^2)$$

where n is the minimum sample size, while N is the population size while α is the significance level. The population in this questionnaire study was the Household (KK) who received waste services. For the selection of respondents to represent the entire sample set, the technique used to select respondents is to take a random sample of the population according to the sub-district area (random cluster sample). Table III shows the distribution of samples taken in each sub-district in the city of Banda Aceh.

TABLE III. THE NUMBER OF RESIDENTS AND HOUSEHOLD IN BANDA ACEH IS SAMPLED BY SUB-DISTRICT

No.	Sub district	inhabitant (person)	Household (KK)	Percentage KK	Sample (KK)
1.	Meuraxa	18.861	6.394	8,57	9
2.	Jaya Baru	24.640	7.161	9,60	10
3.	Banda Raya	22.941	6.446	8,64	9
4.	Baiturrahman	35.218	10.743	14,41	14
5.	Lueng Bata	24.560	7.116	9,54	10
6.	Kuta Alam	49.503	14.978	20,09	20
7.	Kuta Raja	12.819	4.084	5,47	5
8.	Syiah Kuala	35.617	10.652	14,29	14
9.	Ulee Kareung	25.148	6.960	9,33	9
Total		249.307	74.534	100	100

Source: Adapted from BPS Banda Aceh (2015)

B. Waste Management from Downstream

Characteristics of community waste can be seen based on the level of community prosperity which affects purchasing power, consumption, and types of waste. A household has a high purchasing power, so they don't think of an alternative to replace their equipment. Finally, the items they use become rubbish and the people themselves do not want to know where this garbage ends. Avoiding over-consumerism is essential so that waste can be reduced as well.

Banda Aceh has a population that is categorized as a medium city (Kementerian Pekerjaan Umum, 2013). The per capita income of the people of Banda Aceh is Rp. 26 million / capita, below the national average which reaches Rp. 42 million per capita (Rafie, 2018). While the percentage of poor people in Banda Aceh in 2016 was 7.41% (Bappeda Banda Aceh, 2018). The level of population welfare influences the purchasing power of the community where the higher purchasing power of the people, the higher the potential for the solid waste generation. The type of garbage in Banda Aceh is not as diverse as rubbish in other big cities. Industrial waste, electronic waste, waste from reconstruction and development activities are relatively small in Banda Aceh.

The type of residence is essential for waste collection systems and recycling efficiency. For example, types of housing will influence the placement of Temporary Disposal Sites, the construction of recycling centers and transportation modes, thereby creating efficiency in municipal solid waste management. (Cole, 2013). Large industries do not exist in Banda Aceh, only small-scale household industries such as tofu factories, tempeh, and others are available so that it can be said that waste generation comes from all households.

The city of Banda Aceh is generally disposed of into landfills, only a small amount of garbage in Banda Aceh can be reprocessed either through composting or recycling. The waste avoidance program can be started by implementing the waste separation system, which uses sorting facilities. The community can be invited from the initial stage to find out where the garbage ends, where the waste that is avoided is disposed of into landfills. Many types of waste do not need to reach landfills, in other words, can be used again or economically.

Waste management in Banda Aceh is still focused on the technical and technological levels only. The lack of community awareness raising programs such as socialization, community involvement, communication about solid waste, makes the waste management program unsustainable. Technical and technology are just tools, raising public awareness is very important even though it takes a long time. Educating waste issues to people, especially those who do not care about waste matters, need a lot of energy so they must be carried out continuously and continuously. The government's task which is very important is to build a waste management system that can encourage people so that they feel they need to manage their waste.

Waste separation is fundamental in waste management; unfortunately in practice waste sorting does not work as expected. Observations in the city of Banda Aceh get the fact that the separation of waste is not going well, even though sorting bins have been provided. Rubbish is still mixed in vats which are not supposed to be and also if the garbage has been separated in a separation barrel,

the trash will be combined again when transported in a truck. Figure III shows how waste dumped into a separation bin but at the end, waste is mixed in on container.



FIGURE III. THE CONDITION OF SORTING GARBAGE BINS IN BANDA ACEH

The survey also confirmed the habit of sorting garbage by residents of Banda Aceh. Figure IV shows the percentage of people who have done the waste sorting. Very few people do waste sorting, which is only 17.1% (a combination of frequent and quite frequent). While as many as 58.97% of the community never sorts waste. If we put this amount together with people who rarely separate garbage (23.93%), there will be more people who are considered not to sort waste.

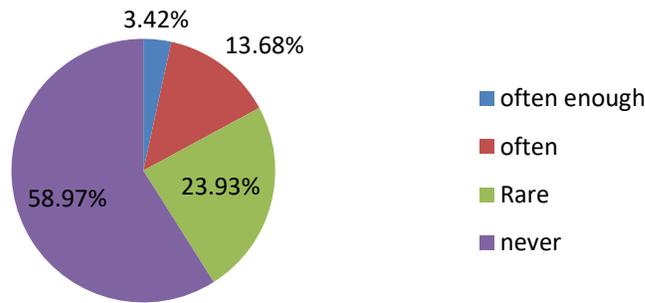


FIGURE IV. PERCENTAGE OF COMMUNITY HABITS TO SORT WASTE

The population of Banda Aceh that often recycled was 5.08%, which recycled quite often 3.35%, while the rare and never recycled were 24.57% and 67% respectively. Figure 5. Shows the percentage of residents of Banda Aceh who recycle waste.

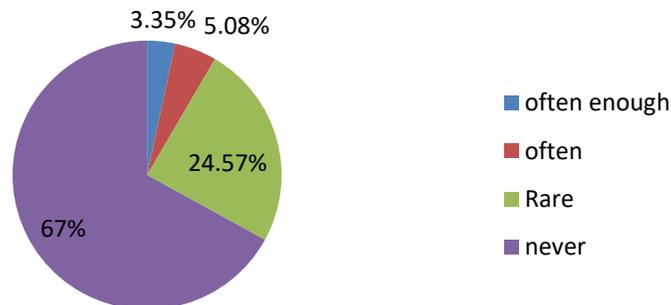


FIGURE V. PERCENTAGE OF BANDA ACEH INHABITANT DOING RECYCLE

Meanwhile, income from selling used goods is 61% of the people get money under Rp.50,000 for one sale, 15.05% get a yield above Rp.50,000 to Rp.100,000, and the rest can't remember how much money they got from selling used goods. Figure 6 shows the amount of money people get by selling trash or used products. People can't remember number since they were very rare selling used good or waste and usually got very little from selling if they did that.

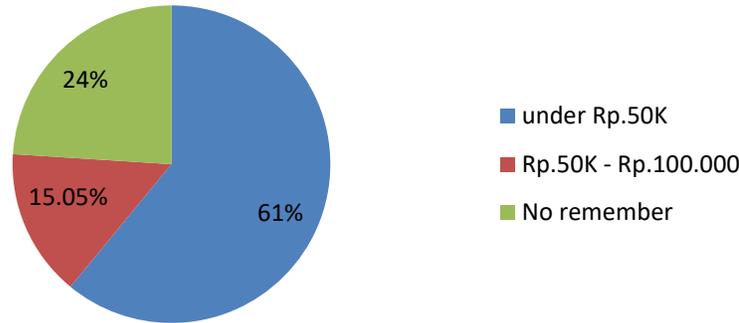


FIGURE VI. COMMUNITY INCOME BY SELLING GARBAGE

C. Economic Benefits of Waste Management

Waste management if done correctly will be a significant source for community income. Like selling used goods, recycling household waste into organic fertilizer or reuse of used products. The economy of the city of Banda Aceh can increase through the contribution of the waste sector, although currently, waste management in Banda Aceh has not become an economic resource for many people to look at.

There are dozens of items of waste that still have selling value. The sale of used goods is an alternative livelihood; the most perpetrators are from the informal sector. The ordinary people sometimes go directly to the used goods depot to sell "garbage," but more scavengers collect garbage from the community and then sell it to the depot. Ordinary people usually sell used goods that are "valuable" if the used goods have accumulated at home but the frequency is irregular.

From the survey in Banda Aceh, data shows that as many as 53.8% of households rarely collect used goods, 31.6% of households never collect used goods, 7.7% of households often collect used goods and the rest often collect used goods. This data shows that the habit of collecting "rubbish" to obtain economic benefits is still very small. Usually, collectors get used goods up to 80% of scavengers while the rest only receives sales from the public around 20% (Irwansyah, Syahputra, Nadir, & Bakri, 2017). The idiom scavenger means that the person works as a collector of used goods.

Garbage collectors in Banda Aceh are still conventional in carrying out their business, working independently, not contracting with certain parties to obtain regular supplies of used goods. Collectors have had some trusted people who routinely sell their used goods to him. Even scavengers, as long as the price is suitable, they ready to release their goods, purely business affairs; there is no business with environmental issues. So far the collectors in Banda Aceh still receive very little guidance from the relevant agencies.

The most common type of waste is plastic waste. The price of plastic waste is very much determined by the global market and the cost of crude oil. The Indonesian government's plan to apply plastic tax and plastic imports can have an impact on the price of plastic waste. The recycled plastic industry is very dependent on these two things. Used plastic business is very vulnerable to price fluctuations (Didi, 2018). Some used plastic collection businesses in Banda Aceh have closed their stores because the price of plastic ore has declined. One way to overcome price fluctuations is to increase the value of goods by processing them before they are resold. There are already entrepreneurs in Banda Aceh who can handle plastics or chop plastic into higher value plastic ore. There is added value for used goods entrepreneurs with the presence of this plastic processing. Secondhand goods entrepreneurs in Aceh sell their goods to factories in Medan who want to receive used plastic that has been cut into small pieces.

Used plastic such as clear plastic bottles, bottles of oil, drink glasses, etc., about 9-10 types of used plastic can be traded in Banda Aceh. Collectors will sort the items they receive before they are chopped or converted into plastic ore. Cutting plastic into small flakes is economical because it makes the volume of material denser so that the goods are shipped more with the same shipping costs. Used goods business is the same as other businesses, has risks. But often the bankruptcy of the used goods business is not because of the loss of business but because of poor business management. So far the plastic chopping business has excellent prospects as long as

other materials do not yet exist besides plastic. All types of plastic waste are primarily sold only on different economic values. Table IV shows the prices of used plastic materials in Banda Aceh. Used collectors also have to pay more for the cost of cleaning and sorting the used plastic.

TABLE IV. PRICES OF USED PLASTIC MATERIALS IN BANDACEH

No.	Description	Buying price (Rp/kg)	Information
1.	Plastic (PET) bottle, dirty, label not removed	1500	
	Plastic (PET) bottle, dirty, label removed	2700 – 3000	
	After sorting - Clear bottle - Bluebottle	2000 3000 - 3200	
2.	Colored bottle, eq sprite, coca cola, mizon etc	1000	(cheap since color)
3.	Cup plastic (PP) mambo eq aqua cup, Cleo, sling, etc Quality: A1 A2 A3	2000-2500 6500 4000 2000-2500	
4.	White plastic cup eq mount tea, ale-ale, etc	1000-2000	
5.	HD Plastic eq shampoo container, fry oil container, etc	3500-4500	
6.	Color plastic (atom) such as chair plastic desk, etc	2500-2800	
7.	Paralon eq water paralon, etc.	1200	
8.	Plastic bag (kresek) - Plastic bag HD - Plastic bag PE (clean) - Plastic bag PE (dirty)	800 5000 1500	

Source: An interview with Nadir and Indra (2017)

One of the obstacles to the plastic recycling business is that it is difficult to get the latest price information because the price of plastic is very volatile. Price changes can occur per week because the rate of plastic raw materials is affected by world oil prices and plastic ore imports from China. Therefore it is necessary to have the right import policy to protect the costs of domestic recycled plastics.

The supply of used plastic from the community is relatively stable, and the source can come from various places such as markets, temporary landfills, and so on. Government officials who work to transport garbage can also collect garbage, scavengers at the Kampung Jawa landfill also get sustenance from the trash. Trash turnover is so smooth that many people get economic benefits from plastic waste. But collecting used plastic waste requires extra effort. Used plastic because it is light, it needs a lot of used plastic to achieve its economic value. Table V shows the most widely distributed packaging waste, the weight of used plastic packaging and the amount.

TABLE V. TYPES OF PLASTIC WASTE, WEIGHT, AND NUMBER

No.	Plastic	Weight per unit	The amount within 1 kg
1.	Plastic bottle 1,5 Ltr	30 gram	33,33 unit
2.	Plastic bottle 600 ml	20 gram	50 unit
3.	Plastic cup	5 gram	200 cup

Other used materials that also often become waste and have a value are metals. Over time, certain types of metals have been increasingly difficult to find, especially since the development of material engineering is increasingly advanced. Many metal materials have changed to cheaper materials. For example, now the optical fiber material that used to be made of brass is now from the plastic material. The development of material performance has reduced the diversity of metal materials. Plastic and iron types are increasing, while materials made of brass and copper are increasingly lacking. Zinc metal enters the low-quality type of iron metal by collectors, so the price is low.

Some used goods that used to have economic value but due to material development, are now increasingly worthless. For example, used synthetic leather or Spartacus which is now very cheap, so scavengers are less interested in looking for it. While the price of the used paper is stable because its demand and supply always exist. Maybe in five or 10 years, this condition can change due to increasingly paperless technological advances.

The number of recycling depots in Banda Aceh is in an ideal amount. But this cannot be separated from the economic law, depending on supply and demand. There are around 30 used goods depots in Banda Aceh, an amount suitable for the city of Banda

Aceh. This business is fit to be located in densely populated areas because there are many "producers" of used goods. The Banda Aceh City Government has the only waste recycling depot in Indonesia, which operates under DLHK3, established in 2009 with a capacity of 146 tons / 8 months, and in 2016 produced 162 tons. Depo has provided income for PAD wherein 2016 the recycling depot recorded income of Rp. 600,360,890, from the sale of 5 types of plastic (DLHK3 Banda Aceh, 2016).

Now many people do not know the price of used goods for sure because the information is known to certain people. For people engaged in the used goods business, the experience is significant in estimating the sale value of used goods. There are still less commendable behaviors than some used goods sellers, for example, there are consumers who mix their goods with items that are not valuable when selling to collectors. Experience can determine the price of used goods, must know the value of goods to be able to benefit. Being a collector of used products can promise prosperity if taken seriously.

D. Economic Benefits of Electronic Waste

Another type of waste that still faces a significant challenge in overcoming it is the electronic waste because its reuse, both reused and recycled in Banda Aceh is still lacking. But in the past few years, many people have realized that electronic used materials can be bought and sold because they are valuable and the buyers already exist. Electronic goods that still use analog systems usually have Printed Circuit Board (PCB) circuit boards which are located on the inside and these PCB boards sell well. Players in this business are limited, PCB board prices can reach 40,000 / kg even PCB boards from cell phones are even more expensive. But now more and more electronic equipment uses digital systems so that PCBs are increasingly difficult to obtain and the prices are getting cheaper. In addition to PCBs, there are at least 4-5 types of material that can be extracted from electronic equipment. For example, the VCD player that is made of many types of plastic atoms, zinc, aluminum, copper, PCB boards, all can be sold out which is part of the VCD.

The most widely sold electronic equipment parts are the Central Processing Unit (CPU) and the standard Uninterruptible power supply (UPS) commonly used in homes. Inside, there is a dry battery weighing 2 kg and has a transformer made of metal. Under the times, transformer-making materials are now increasingly diverse. For example, the transformer made in China where the transformer material is built of aluminum so that the Chinese transformer is sold cheaper. Companies continue to develop material engineering so that their products are more competitive and can be accessed by the wider community. Phone batteries to date have not been sold because they tend to be small, so people are not interested in collecting them. Currently, laptop batteries are wasted because there is no buyer in Banda Aceh. The same is true for cellular number chip cards because there is no request to process it so that it becomes garbage.

Waste recycling entrepreneurs hope the government gives attention or business facilities to them. Besides, large companies can work together to recover their packaging or products through collectors of used goods. At present, the government is urging producers to recall their unused products, but their nature is still voluntary while in some developed countries this scheme is mandatory. This is the responsibility of the producer which is extended or commonly referred to as the extended producer responsibility (EPR).

V. CONCLUSION

Waste management based on the concept of Zero Waste has been listed in the policy both at the national level and the city of Banda Aceh. Some principles in this concept have been implemented even though they are not optimal due to the limitations of the legal umbrella that supports them, available funds and cooperation between the government and the community. Still, need strong encouragement and participation from various parties so that the economic benefits program of this waste can work well. If the Zero Waste concept is implemented correctly, it will provide great economic benefits for the community. Also, it can also reduce the operational costs of municipal waste management.

The economic benefits of the zero waste concept can increase income for the community, but still, need to be examined further what percentage of the regional financial increase from waste activities. In the concept of zero waste, all waste is a material resource for making other objects.

REFERENCES

- Andarani, P., & Goto, N. (2014). Potential e-waste generated from households in Indonesia using material flow analysis. *Journal of Material Cycles and Waste Management*, 16(2), 306–320. <https://doi.org/10.1007/s10163-013-0191-0>
- Bappeda Banda Aceh. (2018). *Statistik Banda Aceh 2017*. Banda Aceh.
- BPS Banda Aceh. (2015). *Banda Aceh dalam Angka 2015*. Banda Aceh, Indonesia: BPS Banda Aceh.

- Bustos, B. N., Borregaard, & Stilwell, M. (2004). *The Use Of Economic Instruments In Environmental Policy: Opportunities And Challenges*.
- Chalmin, P., & Gaillochet, C. (2009). From Waste to Resource: An Abstract of World Waste Survey 2009.
- Cole, N. J. (2013). *Getting to Zero Waste in the City : The Case of Oakland, California*. Technical University of Berlin.
- Damanhuri, E. (2005). Some Principal Issues On Municipal Solid Waste Management In Indonesia. In *In Expert Meeting on Waste Management in Asia-Pacific Islands, Oct (Vol. 2729)*. Tokyo: Expert Meeting on Waste Management in Asia-Pacific Islands.
- Didi. (2018). Indonesia Terancam Jadi Pengimpor Sampah plastik Terbesar di Dunia. Retrieved July 18, 2018, from <https://www.gatra.com/rubrik/ekonomi/320610-Inaplas:-Kebijakan-Cukai-Kemasan-Plastik-Tidak-Efektif-Kurangi-Sampah>
- Dinas Kebersihan dan Pertamanan Kota Banda Aceh, & Roteb. (2007). *Laporan Master Plan Kota Banda Aceh Pasca Tsunami Republik Indonesia (Solid Waste Management Master Plan - Report for Post-Tsunami Banda Aceh Republic of Indonesia)*. Banda Aceh, Indonesia.
- DLHK3 Banda Aceh. (2016). *PROFIL DLHK3*. Banda Aceh.
- Faisal, M. (2014). Analisis Laju Alir Sampah Dan Emisi Carbon Yang Dihasilkan Kota Banda Aceh. *Jurnal Teknik Kimia USU*, 3(4), 6–11.
- Gunawan, A. (2017). *Laporan Upaya Pengurangan Timbulan Sampah Banda Aceh*. Banda Aceh, Indonesia.
- Irwansyah, Syahputra, I., Nadir, M., & Bakri, G. (2017). *Indepth interview on Waste Community*. Banda Aceh.
- Kementerian Pekerjaan Umum. (2013). *Materi Bidang Sampah I, Diseminasi dan Sosialisasi Keteknikan Bidang PLP*. Jakarta, Indonesia: Ditjen Cipta Karya.
- Lehmann, S. (2011). Resource Recovery and Materials Flow in the City: Zero Waste and Sustainable Consumption as Paradigms in Urban Development. *Sustainable Development Law & Policy*, 11(1).
- Meidiana, C., & Gamse, T. (2010). Development of Waste Management Practices in Indonesia. *European Journal of Scientific Research*, 40(2), 199–210.
- Ministry of Environment. (2008). *Indonesian Domestic Solid Waste Statistic Year 2008*. Jakarta, Indonesia.
- Nadir, & Indra. (2017). *Wawancara dengan Pengepul barang bekas*. Banda Aceh.
- Pemerintah Indonesia. UU Republik Indonesia No. 18 Tahun 2008 tentang Pengelolaan Sampah (2008). Indonesia: DPR RI.
- Rafie, S. A. K. (2018, April). Perekonomian Aceh 2017. *Koran Serambi Indonesia*. Banda Aceh. Retrieved from <http://aceh.tribunnews.com/2017/01/02/perekonomian-aceh-2017>
- Sasaki, S., Araki, T., Tambunan, A. H., & Prasadja, H. (2014). Household income, living and working conditions of dumpsite waste pickers in Bantar Gebang: Toward integrated waste management in Indonesia. *Resources, Conservation and Recycling*, 89, 11–21. <https://doi.org/10.1016/j.resconrec.2014.05.006>
- Scheinberg A, DC, W., & L, R. (2010). *Solid Waste Management in the World's Cities. Earthscan for UN-Habitat*. London.
- Soleh, A. (2011). Pertumbuhan Ekonomi dan Kemiskinan di Indonesia. *Ekombis Review*, 2(2), 197–209.
- Song, Q., Li, J., & Zeng, X. (2014). Minimizing the increasing solid waste through zero waste strategy. *Journal of Cleaner Production*, 1–12. <https://doi.org/10.1016/j.jclepro.2014.08.027>
- Simonett, O. W. D. C. R. L. M. P. S. R. C. A. V. K. (2015). *Global Waste Management Outlook*. UNEP.
- Sudirman. (2016). Sampah di Indonesia Capai 64 Juta Ton Per Tahun. Retrieved December 10, 2016, from <https://m.tempco.co/read/news/2016/02/21/083746865/sampah-di-indonesia-capai-64-juta-ton-per-tahun>
- Tchobanoglous, G., & Kreith, F. (2002). *Handbook of Solid Waste Management*. New York. USA: McGraw-Hill.
- Umar, H. (2004). *Metode Penelitian untuk Skripsi dan Tesis Bisnis (VI)*. Jakarta, Indonesia: PT Raja Grafindo Persada.
- Velis, C. A., Wilson, D. C., Rocca, O., Smith, S. R., Mavropoulos, A., & Cheeseman, C. R. (2012). An analytical framework and tool (‘ InteRa ’) for integrating the informal recycling sector in waste and resource management systems in developing countries. *Waste Management & Research*, 30, 43–66. <https://doi.org/10.1177/0734242X12454934>
- Wilson, D. C., Rodic, L., Scheinberg, A., & Alabaster, G. (2010). COMPARATIVE ANALYSIS OF SOLID WASTE MANAGEMENT IN CITIES AROUND THE WORLD. In *Proceedings of Conference Waste 2010: Waste and Resource Management – Putting Strategy into Practice* (pp. 28–29). Stratford-upon-Avon, UK.
- Wilson, D. C., Rodic, L., & Velis, C. A. (2013). Integrated sustainable waste management in developing countries. In *Proceedings of the Institution of Civil Engineers* (Vol. 166, pp. 52–68).
- Zaman, A. U. (2014). Identification of key assessment indicators of the zero waste management systems. *Ecological Indicators*, 36, 682–693. <https://doi.org/10.1016/j.ecolind.2013.09.024>
- Zaman, A. U., & Lehmann, S. (2011). What is the ‘Zero Waste City’ Concept? *Online*. Accessed At < <Http://W3.Unisa.Edu.Au/Artarchitecturedesign/ZeroWasteSAREsearchCentre/Docs/ZWC%20Concept.Pdf> > [Consulted on 01-05-2012], 7, 11–18.