Ariyani, Yetrie Ludang, Indrawan Permana Kamis, Agus Haryono, Vera Amelia, Firlianty. Management of floating waste around the Kahayan riverbanks, Palangka Raya. Acta Scientiae et Intellectus, 7(3); 2021, 20-31.

MANAGEMENT OF FLOATING WASTE AROUND THE KAHAYAN RIVERBANKS, PALANGKA RAYA

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ABSTRACT

Plastic waste floating in the waters can come from land or land activities. Plastic products used in everyday life can be in the form of packaging products, household appliances, transportation equipment parts, construction materials, electrical equipment, industry, textiles, and others. These plastic products will experience a decrease in quality under certain conditions and periods of use so that they become waste. The position of Palangka Raya City which was built from the edge of the Kahayan River is a problem in itself, especially for residents who live on the banks of the Kahayan River who throw garbage into the river. Changes in perception are needed to change people's behavior towards waste. The act of littering will increase if there are no strict sanctions given to trash, even though the arrangement of facilities provided is adequate. Environmental care behavior raised by the community is closely related to environmental education that each individual gets.

Keywords: *floating waste, riverbanks, management, community awareness, environmental education*

INTRODUCTION

Kahayan River is one of the rivers in Central Kalimantan which empties into the Java Sea. Many anthropogenic activities are carried out around the Kahayan River area. Household activities, commercial activities, and industrial activities along the Kahayan River are thought to have an effect on the discharge of plastic waste in the river.

Plastic waste pollution in the aquatic environment today has become a global concern. It is estimated that 90% of plastic waste accumulates in aquatic habitats due to the nature of plastic that is difficult to decompose naturally. In the aquatic environment, plastic waste can be fragmented into microplastics through photolysis, thermal oxidation, hydrolysis, mechanical abrasion, and degradation by organisms (Andrady 2015; Soeun et al. 2019). Furthermore, Surono (2013) said that plastic waste has a negative impact on the environment because it cannot decompose quickly and can reduce soil fertility. Plastic waste that is disposed of carelessly can also clog drainage channels, ditches and rivers, causing flooding.

The position of Palangka Raya City which was built from the edge of the Kahayan River is a problem in itself, especially for residents who live on the banks of the Kahayan River who throw garbage into the river. The houses of residents who live on the banks of the Kahayan River are usually built of wooden construction with high poles to prevent damping when the water overflows. The high pillars of this building cause a gap between the floor of the building and the ground surface, which local residents call "kolong". This pit is the easiest waste disposal site for people living in the area and the behavior of throwing garbage into this pit has become entrenched (Herianto, 2019).

Law No. 18 of 2008 (UU, 2008) concerning Waste Management has mandated that waste needs to be managed in a systematic, comprehensive and sustainable manner, which includes handling and reducing waste. Improving waste management can be done by planning the need for waste management facilities and resources in accordance with the potential for waste generated, while waste reduction is related to ethics and citizen awareness as a source of waste generators to manage waste responsibly.

Changes in perception are needed to change people's behavior towards waste. The perception that a person has affects the behavior that is raised. The act of littering will increase if there are no strict sanctions given to trash, even though the arrangement of facilities provided is adequate. Environmental care behavior raised by the community is closely related to environmental education that each individual gets.

SOLID WASTE MANAGEMENT

According to the Law of the Republic of Indonesia Number 18 of 2008 (UU, 2008) concerning Waste Management, waste is the residue of human daily activities and/or natural processes in solid form. Garbage is solid waste material from household activities, markets, offices, lodging houses, hotels, restaurants, industries, building material debris and scrap metal used for motor vehicles. Garbage is a by-product of human activities that have been used (Sucipto, 2012). Every human activity must produce waste or garbage. The amount or volume of waste is proportional to the level of consumption of goods or materials used daily (Sejati, 2009).

Sources

Solid waste can be classified into several groups based on its origin, namely: markets, commercial places, factories or industries, residential houses, offices, schools, institutions, public buildings, and their yards (Rizal, 2011). According to Suwerda (2012) sources of waste can be classified as follows:

1). Household waste. There are several types of waste generated by household waste, namely organic waste, such as food scraps, waste from gardens/yards and organic waste such as used household equipment, glass, cloth, cardboard, used bags, and so on. In addition, there is also household waste that contains hazardous and toxic materials such as cosmetic materials, used batteries that are no longer used, and others.

2). Agricultural Waste. Agricultural activities can also generate waste which is generally in the form of easily decomposed waste such as organic waste (grass, etc.). In addition to organic waste, agricultural activities also produce hazardous waste such as pesticides and artificial fertilizers. Both of these things require proper handling so that at the time of processing it does not pollute the environment or humans.

3). Building Waste. From building construction activities as well as afterward, they also produce waste such as plywood, pieces of wood, and bamboo. In addition, the waste produced is also like used cans, pieces of iron, pieces of glass, and so on.

4). Trade Trash. Trash from trade usually comes from several places, namely traditional markets.

5). Industrial Waste. Any results from activities in the industry that are not reused or cannot be utilized. Waste from industrial activities produces the type of waste that is in accordance with the raw materials and processes carried out. Waste can be obtained both from the input, production, and output processes.

Management

Waste management is all activities carried out to handle waste from the time it is generated to its final disposal (Sejati, 2009). Waste generation specifications according to SKSNI S-04-1993-03 (DPU, 1993) for medium cities are 2.75-3.25 liters/person/day or 0.7-0.8 kg/person/day and 1 kg/person/day for cities big. Meanwhile, according to SNI 19-3983-1995 (BSN, 1995), the amount of waste generated in small towns is 2.5-2.75 liters/person/day or 0.625-0.70 kg/person/day.

Waste handling activities as referred to in Article 22 of the Law of the Republic of Indonesia Number 18 of 2008 (UU, 2008) concerning Waste Management, include:

1). sorting in the form of grouping and separating waste according to the type, amount, and or nature of the waste;

2). collection in the form of collection and transfer of waste from waste sources to temporary shelters or integrated waste processing sites;

3). transportation in the form of carrying waste from the source and or from temporary waste storage sites or from integrated waste processing sites to the final processing site;

4). processing in the form of changing the characteristics, composition, and amount of waste;

5). final processing of waste in the form of returning waste and or residue from previous processing to environmental media safely.

Integrated Waste

According to Swadaya (2008), the concept of integrated waste management consists of several stages, namely prevent or reduce (prevent or minimize its use), reuse (extend the use period or reuse), recycle (recycle waste into new goods), energy recovery (capture the energy in the waste or use the waste as an alternative energy source), disposal (disposal of waste is the last alternative if all the methods mentioned above have been optimized).

The following is an integrated waste management that can be done by the community, namely:

1). Integrated Rubbish Managing. The Integrated Waste Management System is a system that combines various methods of waste management such as recycling, recycling centers, composting, changing the image of scavengers, making waste crafts, and procuring a Waste Power Plant (Sejati, 2009).

2). Node, Sub Point, and Center Point system. This system is an innovation of an integrated and professional waste management system by dividing the area by center, sub-point, and node. The processing referred to here is changing the

organic waste that has been collected into recycled materials that are ready for use (Sejati, 2009).

3). Waste Management with Independent and Productive Systems. Waste management that involves the participation of the community to jointly manage waste. This system emphasizes the independence of the community in managing the waste they produce, and does not have to always depend on the Government. Related to community empowerment, several important things are needed including growing local initiatives, strengthening community participation, building collaboration with stakeholders. In addition, this system emphasizes the importance of sorting from the household, namely with three garbage bags. Each household separates waste according to its type, such as plastic waste, paper, and cans. Waste packs or sachets are used as recycled products such as bags, wallets, and newspaper holders. Other inorganic waste can be sold. The resulting organic waste is then put into barrels or barrels to be used as compost.

4). Waste Management with Waste Banks. Garbage Bank is a place where service activities for waste savers are carried out by waste bank tellers. The waste bank room is divided into three rooms or lockers where the stored waste is stored, before it is taken by collectors or third parties (Suwerda, 2012). In principle, the service at a waste bank is the same as in a bank in general, the difference is that what is saved is waste. So from the household it has been sorted according to its type and then taken to the waste bank for savings. Garbage banks also carry out waste management by empowering the community. The community is taught to recycle waste, make compost until the waste becomes a product that has economic value.

PLASTIC WASTE

Definition

According to Kumar (2011), plastic is one of the macromolecules formed by a polymerization process. Polymerization is the process of combining several simple molecules (monomers) through a chemical process into large molecules (macromolecules or polymers). Plastic is a polymer compound whose main constituent elements are carbon and hydrogen. To make plastic, one of the raw materials that is often used is naphtha, which is a material produced from refining petroleum or natural gas.

Plastic is one of the materials that is widely used for the manufacture of household appliances, automotive and so on (Sucipto, 2012). The longer its use increases and of course after it can no longer be used it will become plastic waste.

Plastic Type

Plastics can be grouped into two types, namely thermoplastic and thermosetting. Thermoplastic is a plastic material which when heated to a certain temperature will melt and can be reshaped into the desired shape. Meanwhile, thermosetting is a plastic which, when made in solid form, cannot be recovered by heating (Kumar et al, 2011).

1). Polyethylene Terephthalate (PET/PETE). The majority of PET plastic materials in the world for synthetic fibers (about 60%), in PET textiles are commonly called polyester (30% bottle base material). This PET/PETE type bottle is recommended for single use only. Too often used, let alone used to store warm, let alone hot water, will cause the polymer coating on the bottle to melt and release carcinogenic substances (can cause cancer). Usually, at the bottom of the plastic bottle packaging, the PET recycling logo is printed.

2). High Density Polyethylene (HDPE). High Density Polyethylene (HDPE) is a plastic material that is safe to use because of its ability to prevent chemical reactions between plastic packaging made from HDPE and the food or beverage it packs. HDPE has material properties that are stronger, harder, opaque and more resistant to high temperatures when compared to plastic with the PET code. Usually used for milky white milk bottles, tupperware, gallons of drinking water, folding chairs.

3). Polyvinyl Chloride (PVC). This material is more resistant to chemical compounds, oils, etc. Polyvinyl Chloride (PVC) contains diethyl-hydroxylamine (DEHA) which can react with food packaged with this PVC-based plastic when in direct contact with the food, its melting point is 70–140ºC. This plastic can be found in plastic wrap (cling wrap), and bottles, pipes, building construction.

4). Low Density Polyethylene (LDPE). The mechanical properties of LDPE plastic are strong, slightly translucent, flexible and slightly oily surface. At temperatures below 60oC it is very resistant to chemical compounds, the protection power against water vapor is quite good, but it is not good for other gases such as oxygen. This plastic is recyclable, good for items that require flexibility but is strong, and has good resistance to chemical reactions. Usually this type of plastic is used for food containers, plastic packaging, soft bottles.

5). Polypropylene (PP). The characteristics of PP are clear or colored transparent bottles. Polypropylene (PP) is stronger and lighter with low vapor penetration, good resistance to grease. Its melting point is 165ºC. Usually used for storing food, drinking bottles and most importantly drinking bottles for babies, plastic bags, films, automotive, toy cars, buckets.

6). Polystyrene (PS). Polystyrene is an aromatic polymer that can release styrene material into food when the food is in contact. This material should be avoided, because in addition to being harmful to brain health, disrupting the

female hormone estrogen which results in reproductive, growth and nervous system problems, this material is also difficult to recycle. When recycled, this material requires a very long and long process. This material is commonly used in some styrofoam food containers, CD cases, egg cartons, and others.

7). Other. Material with the words Other means that it can be made from SAN-styrene acrylonitrile, ABS–acrylonitrile butadiene styrene, PC–polycarbonate, nylon. PC – polycarbonate, can release the main ingredient, namely Bisphenol-A into food and beverages which has the potential to damage the hormone system, chromosomes in the ovaries, decrease sperm production, and change immune function. It is recommended not to be used for food or beverage containers because Bisphenol-A can transfer into drinks or food if the temperature is raised due to heating.

Impacts

Most plastics such as PVC, in order not to be stiff and brittle are added with a softener. Some examples of softeners are epoxidized soybean oil (ESBO), di(2-ethylhexyl) adipate (DEHA), and biphenyl polychlorine (PCB), acetyl tributyl citrate (ATBC) and di(2-ethylhexyl) phthalate (DEHP). The use of these softeners can cause health problems, for example, the use of softeners such as PCBs can cause tissue death and cancer in humans (carcinogenic), therefore their use is now prohibited (Karuniastuti, 2014).

Another example of a softening agent that can cause problems is DEHA. Based on research in the United States, PVC plastic that uses the softener DEHA can contaminate food by releasing this softener into the food. DEHA has activity similar to the hormone estrogen (feminine hormone in humans). Based on the results of animal tests, DEHA can damage the breeding system and produce malformed fetuses, in addition to causing liver cancer (Karuniastuti, 2014).

Burning PVC plastic containing chlorine will produce the most dangerous dioxin and substances. Chlorine substances in plastic vary widely, so when plastic is burned the chlorine will be released into the air and quickly combine with other substances and will produce dioxin. Dioxins can last a long time, these chemicals are not easily lost or destroyed in the environment, over time this will affect our health. Another threat to plastic packaging is that the color pigments of plastic bags can migrate to food. In colorful plastic bags, the dye used is often unknown. Food grade dyes for food-safe plastic bags already exist, but in Indonesia, manufacturers usually use non-food grade dyes. Important and need to be aware of is the colorless plastic. The clearer, clearer and cleaner the plastic is, the more often it contains chemicals that are harmful and unsafe for human health (Sulchan and Endang, 2007).

The impact of plastic on the environment includes contamination of soil, groundwater, and underground creatures; toxins from plastic particles that enter the soil will kill decomposers in the soil such as worms; PCBs that cannot be decomposed even if eaten by animals or plants will become toxic in the chain according to the order of the food chain; plastic bags will interfere with the way water seeps into the ground; reduce soil fertility because plastic also blocks air circulation in the soil and the space for underground creatures that are able to fertilize the soil; plastic bags that are difficult to decompose, have a long life, and are light will be easily carried by the wind even to the sea; animals can become entangled in plastic piles; marine animals such as dolphins, sea turtles, and seals consider the plastic bags to be food and eventually die because they cannot digest them; when the animal dies, the plastic bag inside its body will not break down into a carcass and can poison other animals; Indiscriminate disposal of plastic waste in rivers will result in silting of rivers and blockage of river flows, causing flooding.

Processing Technology

Plastic waste processing technology that has been used so far is plastic cutting technology, plastic melting and plastic molding (Sucipto, 2012). Only a few recycling entrepreneurs do plastic chopping. The results of the plastic chopping are in the form of plastic flakes or flakes. It is very rare for recyclers to melt plastic to produce plastic ore as raw material for plastic factories.

According to Sucipto (2012), describing the technique of processing plastic waste, namely plastic waste before being put into the chopper machine, it is necessary to sort it according to the type of plastic material. Usually sorting is done manually with visual human power. After sorting according to type, then chopping is done with a chopper machine which usually has a capacity of 350-500 kg/hour. This chopper machine is driven by a large electric motor or directly coupled with a diesel engine. Coming out of the chopping machine, the plastic scrap is crushed into flakes with a size of about 1 cm2 and then goes into the washing process. After finishing the washing process, the plastic is dried. After drying, the plastic is ready to be melted in an extruder machine at a temperature of 150 oC to 250 oC. The melted plastic in the form of a paste will be pushed through holes with a certain size at the end of the extruder machine and into a long tub filled with water. From here, the cooled plastic paste enters the cutting tool to be cut to the size of the plastic ore. This plastic ore is then used by factories as raw material for making tools or new items made of plastic.

Riverbanks

The riverbanks is an area that must be owned by the river, in this case the use of the riverbanks itself is a water catchment area when river water cannot be accommodated by the cross section of the river and overflows. But over time, the riverbanks is often used by the community to be used as residential land, both permanent and semi-permanent buildings. The use of riverbankss is often used by the community to support daily activities. One of the uses made is by building public toilets (washing toilets) on the riverbanks.

In Ferianda's research (2016) there are several factors that influence the inappropriate use of riverbankss, namely the availability of facilities around the river, location security, high income levels in urban areas, the number of job opportunities and distance to work.

In the Regulation of the Minister of Public Works No. 63/PRT/1993 (DPU, 1993) article 11 explains that the community can use river border areas for various activities including:

a. For agricultural cultivation with permitted plant types.

b. For commercial activities, excavation and stockpiling.

c. For the installation of billboards, counseling and warning boards, and job signs.

d. For the installation of electric cables, telephone cables and drinking water pipes.

e. For the erection of poles or foundations for road/bridge infrastructure, both public and railway.

f. For the implementation of social and community activities that do not cause adverse impacts on the sustainability and security of the river's physical and function.

g. For the construction of water traffic infrastructure and water intake and disposal buildings.

However, for people who want to carry out these activities, they must first have permission from the authorized agency, as well as the specified conditions. According to Anggani (2005), maintenance of riverbanks is part of the river area that is useful for accommodating and draining water from part of the flood flow. However, the residential pattern of the community in the environment generally views the river as a place to dispose of useless goods (Karim, 2010). In connection with that, on the banks of the river should be prohibited from littering and constructing buildings for dwellings that do not have the potential to be built. This confirmed with the results of Husni et al. (2018) and Ludang (2010).

Public Facilities

Public facilities are a general term that refers to facilities or infrastructure or equipment or tools provided by the government that can be used for common interests in carrying out daily activities, one of which is a trash can in a public space. Well-maintained public facilities will make you feel at home and comfortable spending time in public spaces to relax for a moment from the hectic daily routines in urban areas.

According to Bappenas (2005), one of the challenges faced by urban managers is handling the problem of solid waste. This is due to several things, including population growth and rapid urbanization which has led to higher waste generation in urban areas, transport vehicles that are inadequate in number and condition, inappropriate and environmentally unfriendly landfill management systems, and the implementation of the reduce approach, reuse and recycle.

In waste management there are two aspects, namely technical and non-technical aspects. The technical aspects consist of storage, waste collection, waste transportation, final disposal, recycling, and composting. While the non-technical aspects consist of finance, government institutions and agencies, community participation and government regulations (Nadiasa et al., 2009).

User Activity and Attitude

Behavior or activity is an act or human action in a public space, both negative and positive. Humans are creatures who can think, have perceptions and can make decisions in their interactions with the environment. The expression of user activities in an area can cause differences or similarities in human behavior towards the environment.

Every resident in Indonesia in 1995 produced an average of 0.8 kg of waste per capita per day. In big cities such as Jakarta and Surabaya, the volume of waste generated generally grew by 6% and 5%, respectively. It is estimated that the volume of urban waste generated in Indonesia will increase 5 times by 2020 (Sudarma, 2003).

Social and cultural conditions are very important factors to determine people's behavior habits in waste management. In addition, the consumptive pattern of the local community and the lifestyle of the community will also affect the amount of waste heap and the composition of the waste owned. So that education (Murhaini & Ludang, 2020; Rina et al., 2020) is needed in the form of knowledge of good waste management and management. Factors that influence people's attitudes in disposing of waste include: personal experience, the influence of other people who are considered important, the influence of culture and the mass media. Human behavior is the biggest cause of environmental damage. This behavior is influenced by several factors, namely: Individual Habits, Motives and

Reasons, Knowledge, Awareness and Responsibility, Availability of Facilities, Environment, and Government Policy.

River water pollution due to waste disposal has a negative impact on human health, especially with the increase in diarrheal diseases and the increasing cost of raw water treatment for drinking water. In fact, it often happens, especially during the dry season, that the quality of raw water has been heavily polluted and so it is difficult to process it into drinkable water.

CONCLUSION

Solid waste, plastic in particular, creates complicated problems in a society that lacks sensitivity to the environment. Another factor that makes the waste problem in riverbanks more complicated is the increasing standard of living of the community, which is not accompanied by a harmony of knowledge about waste and also the participation of people who are less concerned about disposing of waste in its place.

REFERENCES

1) Andrady A.L. (2011). Microplastics in the marine environment. Mar Pollut Bull 62:1596-1605.
2) Anggani, H. (2005). Analisis Lingkungan Pemanfaatan Bantaran Sungai Banjir Kanal Timur (Studi Kasus di Kelurahan Kaligawe Semarang). Thesis. Semarang: Program Pasca Sarjana, Universitas Diponegoro.
3) Bappenas (2005). Badan Perencanaan Pembangunan Nasional. Pembangunan Jangka Panjang (Pjp). Tahun 2005-2025, Tentang Permasalahan Sampah Perkotaan Indonesia.
4) BSN, 1995. Badan Standardisasi Nasional. SNI 19-3983-1995. Spesifikasi Timbulan Sampah Untuk Kota Kecil dan Kota Sedang di Indonesia.
5) DPU, 1993. Departemen Pekerjaan Umum.1993. Spesifikasi Timbulan Sampah untuk Kota Kecil dan Kota Sedang di Indonesia. SK SNI–S–04–1993-03. Bandung: Yayasan LPMB.
6) Ferianda, S. (2016). Identifikasi Ketidaksesuaian Peruntukan Ruang Kawasan Lindung Sempadan Sungai Pedindang di Kota Pangkalpinang. Fakultas Geografi, Universitas Gadjah Mada.
7) Herianto (2019). Kajian teknis pengelolaan sampah di kota Palangka Raya. Tesis Program Studi Magister Ilmu Lingkungan. Sekolah Pascasarjana. Universitas Diponegoro. Semarang.
8) Husni Kotta, Sarwoko Mangkoedihardjo, Yetrie Ludang, Slamet Trisutomo (2018). The design of riparian zone in waterfront area of

Tanjung Bunga, Makassar. International Journal of Civil Engineering and Technology, 9(8): 580-584.

9) Karim, Tony (2010). Pengaruh Penataan Bantaran Sungai Bau-Bau Terhadap Pola Hunian Masyarakat Di Kelurahan Tomba Dan Batara guru Kota Bau-Bau. Thesis. Semarang, Program Pasca Sarjana, Universitas Diponegoro.
10) Karuniastuti, N. (2014). "Bahaya Plastik Terhadap Kesehatan dan Lingkungan". Forum Teknologi Vol. 03 No. 1
11) Kumar S., Panda, A.K., dan Singh, R.K., (2011). A Review on Tertiary Recycling of High-Density Polyethylene to Fuel, Resources, Conservation and Recycling Vol. 55 893– 910.
12) Ludang, Y. (2010). A brief review on the role of community to lessen the rate of global warming. Middle East Journal of Scientific Research, 6(1): 69-75.
13) Murhaini, S. & Ludang, Y. (2020). Sociological Aspects of Transferred Land to Settlements in Indonesia. International Journal of Management, 11(3): 247-255.
14) Nadiasa, M., D.K. Sudarsana, dan I.N. Yasmara (2009). Manajemen Pengangkutan Sampah Di Kota Amlapura. Jurnal Ilmiah Teknik Sipil. Volume 13 Nomor 2 Juli 2009. 92-100.
15) Rina Oktavia, Agus Haryono, Yohanes Edy Gunawan, Yetrie Ludang, Abdul Hadjaranul Fatah, Alpian (2020). The effectiveness of blended learning method by using environmental pollution materials. Acta Scientiae et Intellectus, 6(3): 87-97.
16) Sejati, K. (2009). Pengolahan Sampah Terpadu. Yogyakarta: Kanisius.
17) Soeun Eo., Hong, S.H., Song, Y.K., Han, G.M., & Shim, W.J. (2019). Spatiotemporal distribution and annual load of microplastics in the Nakdong River, South Korea. Water research, 160, 228-237.
18) Sucipto, C.D. (2012). Teknologi Pengolahan Daur Ulang Sampah. Gosyen Publishing: Yogyakarta.
19) Sulchan, M. Endang N.W. (2007). Keamanan Pangan Kemasan Plastik dan Styrofoam. Majalah Kedokteran Indonesia Vol. 57 No. 2: 54-59.
20) Surono, U.B. (2013). Berbagai Metode Konversi Sampah Plastik. Jurnal Teknik, 3(1), 32-40.
21) Suwerda, B. (2012). Bank Sampah (Kajian Teori dan Penerapan) Disertai Penerapan Bank Sampah "Gemah Ripah" di Dusun Badegan Bantul. Yogyakarta: Pustaka Rihama.
22) Swadaya (2008). Penanganan dan Pengolahan Sampah, Penebar Swadaya, Depok.
23) UU, 2008. Undang-undang Republik Indonesia Nomor 18 Tahun 2008 tentang Pengelolaan Sampah.