

Potential Pollution of Mahakam Cascade Lake Water Pollution (Semayang Lake, Melintang Lake and Jempang Lake) From Garbage and Household Waste

Lariman, Mislan

*Faculty of Mathematics and Natural Sciences, Mulawarman University
Jl. Barong Tongkok No.4 Kampus Gunung Kelua Samarinda, East Kalimantan*

Abstract: Mahakam Kaskade Lake (Semayang Lake, Melintang Lake and Jempang Lake) is the largest flood exposure lake in East Kalimantan. The villages in Semayang Lake, Melintang Lake and Jempang Lake are settlements that are regularly flooded every year, while for generations the people in the research area have used lake water as a source of bathing, washing and latrine (MCK) water. Sources of lake water pollution are domestic waste in the form of organic and inorganic materials from residential areas in water catchment areas and lake borders. The existence of other activities in the form of agriculture, animal husbandry, home industry and tourism will add to the waste of organic and inorganic materials that enter the lake waters, therefore it is necessary to investigate the potential for lake water pollution. This study aims to determine how big the potential for water pollution of Mahakam Kaskade Lake from garbage and household waste. The research was conducted using a survey method, namely conducting interviews and direct observations in the field. The data collected in the form of primary data and secondary data that are relevant to the research objectives. Based on the survey results, it can be seen that Jempang Lake has the potential to be polluted by household organic waste 1.4 – 2.7 tons/day, Melintang Lake has the potential to be contaminated with household organic waste 0.9 – 1.4 tons/day, while Semayang Lake has the potential to be polluted. household organic waste is around 1.7 – 2.7 tons/day, while Jempang Lake has the potential to be polluted by inorganic waste (plastic) about 1.2 tons/day, Melintang Lake has the potential to be polluted by inorganic waste (plastic) about 0, 7 Tons/Day and Semayang Lake has the potential to be polluted by inorganic waste (plastic) of around 1.2 Tons/Day. Therefore, the relevant agencies must immediately try to overcome this pollution problem so that the Mahakan Cascade Lake is not further damaged.

Keywords: Household Waste, Garbage, Mahakam Cascade Lake, Pollution Potential

I. INTRODUCTION

The Regulation of the Minister of the Environment Number 28 of 2009 concerning the Load Capacity of Lake and/or Reservoir Water Pollution defines a lake as a water container and its ecosystem that is formed naturally, including lakes and similar water containers as local terms (MenLH, 2009).

Lakes are freshwater ecosystems based on their water flow, including stagnant water ecosystems (lentic). Lakes can

be formed through various natural processes such as earthquakes (tectonic), faults, volcanic eruptions (volcanic), flood plains, meanders (Hadisusanto, 2015), Semayang Lake, Melintang Lake and Jempang Lake are the largest flood exposure lakes in East Kalimantan.

The Flood Plain Lake is a lake located at a low and shallow elevation and tends to experience continuous silting due to puddles and the development of aquatic plants (Ministry of the Environment, 2014). A flood exposure lake is a natural water reservoir which is part of a river whose water level is directly affected by the direct water level (Permen PUPR No. 28, 2015).

The villages in Semayang Lake, Melintang Lake and Jempang Lake are settlements that are regularly flooded every year. Although the houses of the residents in the three villages were built about 4 m above the water level, in the event of a major flood, the water could reach 1.5 m above the floor of the residents' houses. The traces of the flood are still visible on the walls of people's houses. According to the information obtained, it is explained that the frequency of flooding over the last 5 years has begun to decrease and if there is a flood the height is only about 25 cm from the floor of a resident's house, for around Lake Jempang in the last few years if the flood only inundates the road. To protect themselves from flooding, the houses of residents in Semayang and Melintang villages are usually built in terraces at the back. When there was a flood they moved temporarily to the back of their previously elevated house.

Erosion in the watershed (DAS) / catchment area of the lake has caused silting and narrowing of the lake. Lake silting occurs in both shallow and deep lakes. In shallow lakes the impact is very real and worrying because gradually the status of the lake changes to swamp and then to land. (Ministry of Environment, 2014)

Meanwhile, for generations, people in the research area have used lake water (Semayang, Melintang and Jempang) as a source of bathing, washing and toilet water (MCK). The results of this survey show that almost three quarters (75%) of the people say their MCK water source is taken from lake water, only about 20% of them use well water and PDAM for MCK, while they buy their drinking water from refilled water.

This is understandable because they have been living on the edge of the lake since they were born and have traditionally used lake water for their daily needs. Especially if it is noticed that previously many of them built houses on rafts on the banks of the river. Until now, it seems that there are still some people who live on rafts, although the number is decreasing. Most of them build a place of business on a raft, such as food stalls and a place to sell fuel for ships or motorboats crossing the lake.

Sources of lake water pollution are domestic waste in the form of organic and inorganic materials from residential areas in water catchment areas and lake borders. The existence of other activities in the form of agriculture, animal husbandry, home industries and tourism will increase the waste of organic and inorganic materials that enter the lake waters. (Ministry of Environment, 2014).

There are still many latrines on the outskirts of Semayang Lake, Melintang Lake and Jempang Lake that are used for MCK by people who live in the areas of the three lakes also add to the burden of contamination which is quite dangerous, for example, fecal waste which will cause water pollution from coli bacteria, soap water waste due to Bathing and detergent waste from washing clothes could threaten the life of aquatic biota in the three lakes and also threaten their own health.

II. METHOD

The research was conducted using a survey method, namely conducting interviews (an example of the questionnaire used: a. How many members in your family?, b. How much does your family produce waste a day, c. Is there a garbage dump in your village?, etc) and direct observations in the field. The data collected in the form of primary data and secondary data that are relevant to the research objectives. Primary data is data obtained from primary sources, either through direct observation (observation) from the field and conducting interviews with the community (100 people) and 10 village staff.

The secondary data is needed as a support and is obtained from the Kelurahan Office, and similar research reports. Secondary data collection is done through literature review and sources relevant to this research.

Through this Survey and Monitoring, it is possible to analyze problems regarding pollution that occur in the lake and can find out the resolution of problems that occur in Semayang Lake, Melintang Lake and Jempang Lake.

III. RESULTS AND DISCUSSION

Regulation of the Minister of the Environment Number 01 of 2010 concerning Water Pollution Control Management defines water pollution as the entry or inclusion of living things, substances, energy, and/or other components into water by human activities so that it exceeds the established waste water quality standard (Minister of Environment, 2010).

Pollutants from outside the lake can enter in two ways (Le *et al.*, 2010), namely from a certain source (point source) and from an indeterminate source (non-point source pollutant).

Specific sources refer to industrial and domestic wastewater which have a steady flow to the lake, while indeterminate sources are waste originating from agricultural activities, fisheries, settlements and soil erosion which generally do not have a direct route to the lake (Zhang *et al.*, 2010).

For Semayang Lake, Melintang Lake and Jempang Lake, they get the pollutant load from certain sources, namely domestic waste from settlements around the lake and plantations around the lakeside. From domestic waste it is very clear that there are still many people who live around the three lakes throwing their household waste behind their houses and becoming piles of various garbage, this condition is seen in almost all houses on the banks of the lake, if the water rises it will bring this garbage into the lake so that it pollutes the lake. Another particular source is the existence of plantation activities around the lake, so that soil erosion and herbicide and fertilizer waste directly enter the lake and pollute the lake.

Meanwhile, the source of uncertain pollutants in Semayang Lake, Melintang Lake, and Jempang Lake comes from logging activities in the lake water catchment area (upstream) so that soil erosion/mud is carried by floodwaters into the lake and garbage/waste from settlements on the banks of the river. The upstream Mahakam River dumps its garbage/waste into the river so that water is carried into the lake inlet and everything becomes a pollutant of lake water.

Control of pollutants from uncertain sources is more difficult because it is difficult to stem the flow of pollutants that diffuse into the soil, especially if there are agricultural and livestock practices around the lake (Berka *et al.*, 2001). The agricultural and livestock sectors are the largest sources of water pollution in various parts of the world (Kim *et al.*, 2001; Withers and Haygarth, 2007; Zhang *et al.*, 2013). Agricultural land absorbs inorganic fertilizers rich in nitrogen and phosphorus, two elements that contribute to the greenhouse effect and eutrophication (Kim *et al.*, 2001; Withers and Haygarth, 2007; Savci, 2012).

Although the largest source of pollution comes from agricultural activities, community activities around the lake are also one of the contributors to lake pollution (Bressers and Kuks, 2004). Nitrogen and phosphorus pollution is known to increase along with the increasing population. Factors The more nutrients that enter the lake, the more the condition of the lake towards eutrophication. In the context of aquatic ecosystems, eutrophication refers to an increase in the productivity of biotic communities and a decrease in the metabolic ability of organisms as a form of adaptation to an increase in nutrient supply into aquatic ecosystems (Wetzel, 2001). Eutrophication can occur naturally due to forest fires, erosion, earthquakes or nutrient input from bird droppings, but

most of the eutrophication is caused by human activities (Soeprbowati and Suedy, 2010).

The increasing activity of economic development, changes in land use and increasing population growth have resulted in high pressures on the environment. Lake as part of the environment is currently in poor condition, there is a tendency to change the lake ecosystem as indicated by the degradation of water quantity and quality.

Most of the damage to lakes/streams is caused by human activities, which likens lakes/streams as a dumping ground for garbage and free waste. All kinds of waste and excreta are dumped into lakes/streams without any prior treatment. Rivers that pass through big cities are generally polluted by waste from industry, households, fisheries, and agriculture. The impact on health is very dangerous, because river water (Mahakam River) is still used for daily needs, whether bathing, washing or drinking water. Water pollution will also threaten fish habitat in rivers/lakes. A polluted river/lake from an aesthetic point of view is also uncomfortable, apart from being black in color, there is a lot of floating garbage, and the smell is pungent.

From observations in the field, it can be seen that what happened in Lake Semayang, Melintang and Lake Jempang has become a lake function change by the community, part of the lake border area is filled with residential areas, and during the long dry season the land in the lake is cultivated for rice farming, and tourism activities that pollute the lake area. For now, Lake Jempang has been surrounded by oil palm plantations, starting from Pulau Lanting Village to Ohong Village, the leaf borders have been turned into oil palm plantations.

In managing the aquatic environment of Semayang Lake, Melintang Lake and Jempang Lake, in reality, the community has never received information about the functions and uses of these lakes for human life. This is reflected in the number of people who say that local government officials have never explained the functions and uses of Semayang Lake, Melintang Lake and Jempang Lake to the public. The data once again shows that the state lacks the political will to manage Semayang Lake, Melintang Lake and Jempang Lake responsibly.

Community knowledge about the function and use of the lake looks very limited. In this survey, the community said the functions and uses of Semayang Lake, Melintang Lake, and Jempang Lake as a place to find fish. The public's understanding of the function and use of the lake is formed by the daily conditions of the people who catch fish every day. Some of the people said that the functions and uses of the three lakes could be used as a place for farming and recreation. Agricultural potential has many obstacles to develop due to limited land around the lake. Only at certain times do people carry out farming activities, especially when the lake water is dry during the long dry season.

The knowledge of local government officials about the functions and uses of lakes is also not much different from the knowledge of the community. The results of this survey indicate that almost three quarters of the people say that local government officials explain the function and use of the lake as a place to find fish and a small number of people say it is a place to grow crops. Moreover, from the results of discussions with the local government of Melintang Village which said that the management of the lake from the past until now was mediocre, the community's activities of throwing garbage, and the MCK waste in the lake had no effect on the environment, the decrease in fish catches was solely because increase in population is not due to environmental damage to the lake. This phenomenon is certainly very interesting to study because if the knowledge of local government officials is equal to or lower than the knowledge of the community, it will certainly have an impact on the level of public trust in lake management which has been carried out by the (regional) government.

The results of the field survey show that in all villages around the lake, both Semayang Lake, Melintang Lake, and Jempang Lake, some residents throw garbage behind their houses which automatically enters the river/lake waters, even more so for people who have raft houses they throw away their trash. the garbage goes directly to the river/lake.



Figure 1: Garbage behind the house on stilts



Figure 2: Garbage in the lakeside water



Figure 3: Garbage dumped on the raft

From the picture above, both Figure 1, 2 and Figure 3 it is clear that the people around the three lakes dispose of their household waste, both organic and inorganic waste directly

into the lake waters, this is certainly a very large pollutant burden. As illustrated from the results of direct water quality measurements in the field, especially pH and DO experienced a significant decrease.

Tabel 1: Insitu Measurement of Water Quality at Semayang Lake

N O	PARAMETER	UNIT	MEASUREMENT			
			1	2	3	4
1.	Temperature	°C	33,2	31,5	31,9	31,7
2.	Turbidity	mg/L	34,2	35,7	41,0	29,2
3.	DHL	uS	42,3	45,2	42,1	43,1
4.	TDS	mg/l	62,8	71,2	81,0	43,2
5.	pH	-	5,8	6,0	6,1	6,3
6.	DO	mg/l	4,3	3,9	3,7	3,6

Tabel 2: Insitu Measurement of Water Quality at Melintang Lake

N O	PARAMETER	UNIT	MEASUREMENT			
			1	2	3	4
1.	Temperature	°C	31,0	31,1	30,2	31,3
2.	Turbidity	mg/L	38,1	27,6	30,3	41,1
3.	DHL	uS	36,0	31,7	32,7	32,9
4.	TDS	mg/l	35,8	38,5	34,2	61,3
5.	pH	-	6,4	6,2	5,9	5,8
6.	DO	mg/l	4,0	4,0	3,9	3,2

Tabel 3: Insitu Measurement of Water Quality at Jempang Lake

N O	PARAMETER	UNIT	MEASUREMENT			
			1	2	3	4
1.	Temperature	°C	30,2	30,5	30,9	30,7
2.	Turbidity	mg/L	36,7	36,8	42,2	30,3
3.	DHL	uS	42,3	46,7	41,8	43,5
4.	TDS	mg/l	63,2	72,0	67,2	42,3
5.	pH	-	6,1	6,0	6,3	6,2
6.	DO	mg/l	4,2	3,9	3,8	3,7

A. Organic Waste Pollution

From the results of the field survey, organic waste comes from living things, both humans, animals, and plants. Based on the type, organic waste can be divided into two, namely wet organic waste and dry organic waste. Wet organic waste is waste that has a fairly high water content. There are two types of wet organic waste, namely black waste and household waste, examples of household wet organic waste are fruit peels, food scraps, and vegetable residues, while black waste is liquid organic waste produced from toilets. Meanwhile, dry organic waste is another organic material with a small water content. Examples of dry organic waste include paper, wood or tree branches, and dry leaves.

Based on the survey results, it can be seen that Jempang Lake has the potential to be polluted by household organic waste 1.4 – 2.7 tons/day, Melintang Lake has the potential to be contaminated with household organic waste 0.9 – 1.4 tons/day, while Semayang Lake has the potential to be polluted. household organic waste is around 1.7 – 2.7 tons/day, so if it is calculated monthly the three lakes have the potential to be contaminated with household organic waste hundreds of tons/month, not to mention the natural organic waste that enters depending on water conditions. Natural organic waste such as leaves, weed roots, and wood/twigs that enter will be more.

The lake water also receives the burden of pollution from the waste of fish feed left in cages, considering that many people in the three lakes cultivate catfish, tilapia, or carp in cages, the rest of the feed that is not eaten by fish will pollute the lake water.

The above is a big enough threat because although organic waste can be decomposed in water, the decomposition process requires a large amount of dissolved oxygen (DO), so that dissolved oxygen in the water will decrease, thus threatening the life of the biota in the three lakes. This is a serious enough problem to find a solution so that the potential for this pollution can be avoided, if all the organic waste mentioned above enters the lake, there will be pollution of lake water and silting of the lake.

All of the potential pollution above only arises from certain sources, meaning that only from the surrounding community whose waste has the potential to directly enter the lake, not yet from indeterminate generation sources whose waste enters through the lake inlet channel, of course, more will increase.

B. Inorganic Waste Pollution

Inorganic waste is waste that cannot be degraded naturally. For example: metal, iron, cans, plastic, rubber, bottles, glass.

For anorganic waste around the three lakes the threat is also quite large Jempang Lake has the potential to be polluted by inorganic waste (plastic) around 1.2 tons/day, Melintang Lake has the potential to be polluted by inorganic waste (plastic) around 0.7 tons/day and Semayang Lake has the potential to be polluted. polluted by inorganic waste (plastic) about 1.2 tons/day, if accumulated per month, the three lakes have the potential to be polluted with inorganic plastic waste of tens of tons/month, this does not include other inorganic waste such as used drums, used cans, used tarpaulins and the bigger one is diapers/pampes whose number is proportional to population growth, the higher the birth rate, the greater the potential for contamination from diapers/pampes.

As reported by Mongabay, disposable diapers are the second largest contributor to marine debris, at 21% according to World Bank research in 2017. In the first place, there is organic waste, which amounts to 44%. In addition, there are

also plastic bags (16%), other waste (9%), plastic wrappers (5%), glass and metal glass (4%), and plastic bottles (1%).

Whereas plastic, diapers/pampers and cans when exposed to mud will gain weight and sink, this will accelerate the silting of the lake, considering that inorganic waste takes hundreds of years to decompose, its presence in the lake is certainly very threatening to the aquatic biota around it.

C. Pollution From Waste

The main means of transportation in the areas of Semayang Lake, Melintang Lake and Jempang Lake are motorboats commonly called "Ces". On average, each household has one Ces. The Ces is not only used as a means of transportation to catch fish, but also as a means of transportation to get to the sub-district capital. Sometimes these Ces are also rented out by residents to attract passengers to and from other areas, especially to the sub-district capital. The results of the discussion in this survey revealed that more than three quarters (90%) of the community already owned a motorboat and only about 10% of the community did not own a motorboat.

Most of the people in the three lakes, Semayang Lake, Melintang Lake and Jempang Lake already have motorized vehicles, both motorbikes and cars, with these motorized vehicles, workshops/services appear which in their activities produce waste that will enter the lake waters, resulting in spilled waste. oil is not only spilled from motorboats but also from workshop/service activities.

We know that Semayang Lake, Melintang Lake and Jempang Lake are in the Mahakam Watershed, and the Mahakam River is used as transportation traffic for all industrial, mining and plantation activities which are located in the upstream area of the Mahakam River. both oil and oil into the waters of the Mahakam River, even a ship carrying CPO oil could leak so that the oil contaminates the Mahakam River. Considering that the three lakes, namely Lake Semayang, Lake Melintang and Lake Jempang are flood exposure lakes that accommodate water from the Mahakam River, the three lakes are also potentially polluted by the oil waste.

Current conditions in the catchment areas of the three lakes have also built oil palm plantations which in their activities such as planting, fertilizing, and spraying grass with herbicides, this is also when it rains water from plantations has the potential to carry chemical waste that pollutes lake water, such as several times then Lake Jempang the water is black, smells and cannot be used for toilet activities because it causes itching, this is thought to be polluted water from waste from plantation activities around it.

Oil waste pollution in lake waters has a negative impact on water as a source of life, on animals that may drink this water, on plants growing on the shores of the lake, moreover that the waters of Lake Semayang, Lake Melintang and Lake Jempang are used for toilet purposes by the

surrounding community. Of course it will harm public health. Oil waste pollution in waters also affects the penetration of sunlight to enter the water, this will interfere with the life of plankton in lake waters, we know that if no light enters the water, photosynthesis cannot be carried out by phytoplankton which ends in oxygen. dissolved in lake water will decrease.

We know that Semayang Lake, Melintang Lake and Jempang Lake are also habitats for various kinds of fish and birds whose lives depend on the lake waters, so if the waters of the three lakes are polluted by oil spills from various community activities, it will disrupt the lives of fish and birds around them.

D. MCK Waste Pollution

Currently, environmental issues have become a very sensitive commodity, especially if the issue is already in contact with the interests of the community. The increasing population growth will also affect the water quality.

The population in Semayang Lake, Melintang Lake and Jempang Lake is increasing, which of course also increases the construction of houses around the lake. The daily use of lake water that has been carried out by the community for generations and continuously has an impact on the behavior of people who think that the existing water is always available and has never been polluted.

The culture of dependence of community activities on the aquatic environment makes them unable/uncomfortable to be away from the water, so many of them build floating houses/raft houses which of course are complete with latrines on the edge of the lake and this activity results in contamination from their daily toilet activities. Moreover, the culture of the community cannot be far from this, it is still very strong so that people who already have houses on land are still building latrines by the lake for their MCK activities, of course adding to the burden of polluting the lake from their MCK waste.

Human waste (feces) is a source of spread of disease, diseases that can be spread by human feces include: typhus, dysentery, cholera, various worms (roundworms, pinworms, mines, ribbons), (Notoatmodjo, 2011). The spread of disease originating in feces can be through water, hands, vectors (flies), soil. After that through food, drink, vegetables. After that it reaches the host, which can cause the host to get sick (Notoatmodjo, 2011). The effect on clean water sources and drinking water, improper disposal of feces is often associated with a lack of clean water supply, these conditions will have an impact on health. Besides that, it can affect the environment, foul smell, and ethics (Chandra, 2012).

Disposal of human feces that do not meet health requirements is often associated with a lack of clean water and other health facilities. The latrine can have a direct or indirect effect on the health status of the population. The direct effect, for example, can reduce the incidence of certain diseases, while the indirect effect is related to the environmental

sanitation component. Diseases that are transmitted through feces include: Amobiasis, Cholera, Stigellosis, Poliomyelitis, and Typhus.

The impact of water pollution caused by garbage and residential waste has consequences or impacts including:

- a. The reduced amount of dissolved oxygen in the water because most of the oxygen is used by bacteria to carry out the process of decomposition of waste.
- b. Inorganic waste into rivers, can result in blocking sunlight so that it inhibits the photosynthesis process of aquatic plants and algae, which produce oxygen.
- c. Detergents are very difficult to break down by bacteria so they will remain active for a long time in the water, contaminating water and poisoning various aquatic organisms.
- d. The use of detergents on a large scale also increases phosphate compounds in river or lake water which stimulates the growth of algae and water hyacinth (*Eichhornia crassipes*).
- e. The uncontrolled growth of algae and water hyacinth causes the water surface of the lake or river to be closed thereby blocking the entry of sunlight and resulting in the inhibition of the photosynthesis process.
- f. Aquatic plants (water hyacinth and algae) that die as a result of the decay process of these plants will deplete the supply of oxygen.
- g. The decaying material of aquatic plants will precipitate and cause siltation.

IV. CONCLUSION

The condition of Semayang Lake, Melintang Lake and Jempang Lake is currently experiencing quite severe silting due to mud sedimentation carried by floods into the lake, besides that silting is also accelerated by the presence of garbage/waste entering the three lakes.

The number of people living around Semayang Lake, Melintang Lake, and Jempang Lake is quite large. This large population produces a lot of waste/waste (Hundreds of Tons) per month, if their waste/waste is not managed properly/environmentally friendly then it has the potential to enter the lake and will accelerate the silting of the three lakes.

It is necessary to provide education/training to the community around Semayang Lake, Melintang Lake and Jempang Lake to manage the waste/waste they produce in an environmentally friendly manner. We must equip them with the ability to utilize/recycle the waste/waste they generate.

Some people who live around Semayang Lake, Melintang Lake and Jempang Lake also build latrines and carry out MCK activities in rivers/lakes, their MCK waste entering the lake also becomes a source of water pollution for the three lakes, even though they use the lake water. for MCK activities, if they are not immediately educated, it is possible

that they will experience a water crisis because the lake is shallow and the water is polluted.

They throw garbage into the lake because they are compelled to not have proper waste management facilities, to overcome this, the relevant agencies must strive for the realization of proper waste management facilities, such as TPA (similar), TPS, waste transportation facilities, and trash bins so that they can dispose of garbage / waste in its place.

Therefore the relevant agencies must invite and or provide counseling and provide environmentally friendly waste/waste management ideas.

To overcome the problem of waste/waste in the vicinity of the three lakes mentioned above, the relevant agencies must seek the availability of waste/waste management facilities, such as TPA, TPS, waste transport equipment and trash bins, so that people can dispose of their waste in the right place.

We must also educate them that the goal of waste management is to make waste have economic value or turn it into materials that do not harm the environment. With proper household waste management, we can help to reduce the negative impact of waste on the environment.

ACKNOWLEDGMENTS

Communities around Semayang Lake, Melintang Lake and Jempang Lake for their participation in providing information about the condition of the Mahakam Kaskade Lake

REFERENCES

- [1] Kementerian PUPR. (2015). Permen PUPR No. 28. Jakarta: Kementerian PUPR.
- [2] Kementerian Lingkungan Hidup. (2014). Grand Design Penyelamatan Ekosistem Danau Indonesia. Jakarta: Kementerian Lingkungan Hidup
- [3] Azwar Azrul. 1986. Pengantar Ilmu kesehatan Lingkungan. Jakarta: Mutiara Sumber Widya.
- [4] Ismoyo IH. 1994. Kamus Istilah Lingkungan. Jakarta: PT. Bina Rena Pariwara. Miles. Huberman. 1992. Analisis Data Kualitatif. Diterjemahkan oleh tjetjep rohendi. Jakarta: Universitas Indonesia.
- [5] Moleong. L. J. 2004. Metodologi penelitian kualitatif. Bandung: Remaja Rosdakarya.
- [6] Nitikesari, Putu Ening. 2005. Analisis Tingkat Partisipasi Masyarakat dalam Penanganan Sampah Secara Mandiri di Kota Denpasar. Tesis Magister Program Pascasarjana Universitas Udayana, Denpasar.
- [7] Sutopo, Heribetus. 1988. Pengantar Penelitian Kualitatif Dasar Teoritis dan Praktis. Surakarta: Pusat Penelitian UNS.
- [8] Sutoyo, Bagong. 2013. Fenomena gerakan mengolah sampah. Jakarta: Pusat Komunikasi publik kementerian pekerjaan umum.
- [9] Tim Penulis PS. 2008. Penanganan pengolahan sampah. Jakarta: Penebar Swadaya.
- [10] Undang-Undang No.23 Tahun.1997 tentang Pengelolaan Lingkungan Hidup.
- [11] Undang-Undang No. 18 Tahun 2008 tentang Pengelolaan Sampah. <https://www.google.co.id/search?q=definisi+limbah&hl=id#hl=id&q=definisi+sampah&start=10>. 6 Agustus 2013
- [12] Chandra, B. (2007) Pengantar Kesehatan Lingkungan. Jakarta: Penerbit Buku Kedokteran.
- [13] Departemen Kesehatan Republik Indonesia (1985) „Syarat Jamban Sehat“. Jakarta: Departemen Kesehatan Republik Indonesia.

- [14] Departemen Kesehatan Republik Indonesia (2008) „Keputusan Menteri Kesehatan Republik Indonesia no 852/MENKES/SK/IX/2008 tentang Strategi Nasional Sanitasi Total Berbasis Masyarakat“ Jakarta: Departemen Kesehatan Republik Indonesia.
- [15] Departemen Kesehatan Republik Indonesia (2009) Undang-undang Republik Indonesia Nomor 36 Tahun 2009 tentang Kesehatan. Jakarta.
- [16] Djabu (1990) Pedoman Bidang Studi Pembuangan Tinja dan Air Limbah Pada Institusi Pendidikan Sanitasi Atau Kesehatan Lingkungan. Jakarta: Pusat Kesehatan Departemen Kesehatan RI.