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Abstract

The objective of this research is to know of microplastic particles presence, microplastic particles distribution and waste management at the Galuga Landfills, Bogor Regency, West Java, Indonesia. The method used is sampling method, survey, identification of field and Pearson chi-square analysis.

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The result this research showed that the abundance of microplastic types in all samples at Galuga Landfills is dominated by filament types with a total of 52% (1203,445 particles), the distribution of microplastic types in water and sediment in the river flows at Galuga Landfills is mostly located in the downstream with a percentage of 49% (490.65 particles), and the highest distribution of microplastics for the three Kampoeng was in Kampoeng Lalamping around 43% (639.44 particles). Waste management system applied in Galuga final disposal site is open dumping system.

Keywords: microplastic particle presence; microplastic particle distribution; waste management; final disposal site.

1. Introduction

Plastic which has become a major commodity on a global scale is still often used in daily life of people in Indonesia. It is because plastic is not expensive and not weathered easily, lightweight, as well as antirust [1]. Plastic has infiltrated almost every aspect of human life [2]. It was estimated that 8300 million metric tons (Mt) of virgin plastics have been produced to date. The resulting plastic production has subsequently been around 9% recycled, 12% burned, and 79% accumulated in soil or the natural environment. If current trends of waste production and management continue, approximately 12,000 Mt of plastic waste will be in landfills or in the natural environment by 2050 [3]. The pile of plastic waste can disturb the environment [4], disrupts the aesthetics and transfers toxic compounds to the ecosystem and disturbs the living things in it [5].

Plastic waste accounts for 11% of all types of waste [6]. It is estimated at 0.52 kg of waste produced by each person. 83% of the total garbage is not well managed. The amount of rubbish dumped at the Final Disposal Site (TPA)/ landfill areas is 4.2%, 37.6% is burned, 4.9% is disposed of into the river and untreated is 53.3%. 53.3% of waste which is not handled is disposed of in a non-sainted manner which causes pollution.

Plastic waste problem has attracted the attention of many parties in recent years, there have been many initiatives to overcome this problem including from the UN, G7 and G20, European Commission and many national and local authorities, as well as non-governmental organizations [7]. This shows that the problem of plastic waste is a very serious problem, because plastic can break down into smaller particles. The particles of plastic classified into micro-plastic, meso-plastic and nano-plastic [8] are generally disposed of in Final Disposal Site. This is certainly to makes the surrounding area is contaminated and pollution contamination occurs both in the form of gas, liquid and solid waste [9].

According to [10] the size of microplastics is divided into two categories namely macro-plastic > 5 millimeters and microplastics <5 millimeters [11]. Haward [12] said that microplastics are derived either from small particles developed for specific applications, or produced through the breakdown of larger item. This term describes a heterogeneous mixture of particles, which can differ in size (from a few microns to several millimeters), color and shape (from very different shapes of fragments to long fibers) [13].

Microplastic is grouped into 2 types [14], namely primary and secondary microplastics [15]. The first includes small pieces of specially manufactured plastic, such as hand and facial cleansers, shower gels, toothpaste, industrial scrubbers, and plastic micro-nanospheres, etc., while the latter are small pieces of plastic derived from the deterioration of larger plastic waste both at sea and on land [16]. This statement is also reinforced by [13] which states that primary origin microplastics are produced as small particles used in the cosmetics industry (pilling crème etc.) or the chemical industry as a precursor for other plastic products (eg. plastic pellets used in the plastics industry). On the other hand, nano-plastic is defined as particles (nano-spheres, nano-wires/nano-tubes, and nano-films) with smaller dimensions, between 1 and 100 nm [17].

Microplastic is a threat to various ecosystems in the waters [18], biota and humans such as oysters (*Mytilus edilus*), shrimp (*Crango crago*), zooplankton (*Centropages typicus*), barnacles (*Release* sp.), oysters (*Ostrea edulis*), crabs (*Carcinus maenas*) [19]. Ingestion of microplastic provides a potential pathway for the transfer of pollutants, monomers, and plastic-additives to organisms with uncertain consequences for their health. Microplastic particles ingested by plankton can influence advanced tropics through the process of bioaccumulation [20], including man. So, the contamination of environment by microplastics is of concern not only because of the ecological impacts but also because they may compromise food security, food safety and consequently human health [21]. The negative impact of contamination of microplastic content for biota is to inhibit the growth process, disrupt to the digestive system and decrease the rate of reproduction and it will finally affect the condition of the body, the ability to eat, so that it can cause death [22] while the impact on human health can be absorbed by blood circulation and lymph [23].

These alarming facts encourage the authors to observe the presence of microplastic particles, especially in the sediment and water in the surrounding waters from the Galuga Landfills. Identifying the distribution and abundance of microplastic particles in water and sediment samples in rivers, community wells and aquatic ponds, and knowing the regulations and management systems in the Galuga Landfills in West Java.

2. Materials and Methods

The research was carried out for 60 days started from 2 September to 2 November 2019 which is located in the Galuga Landfills in West Java Province (Figure 1), with 30 days of field sampling and 30 days of sample observation in the Oceanographic and Environmental Laboratory at Jakarta Technical University of Fisheries. The tools used included plastic samples, parallon tube, sample bottles, filter paper, spatula, camera, microscope, stainless strainer, glass object, bucket, paper label, and plankton net.

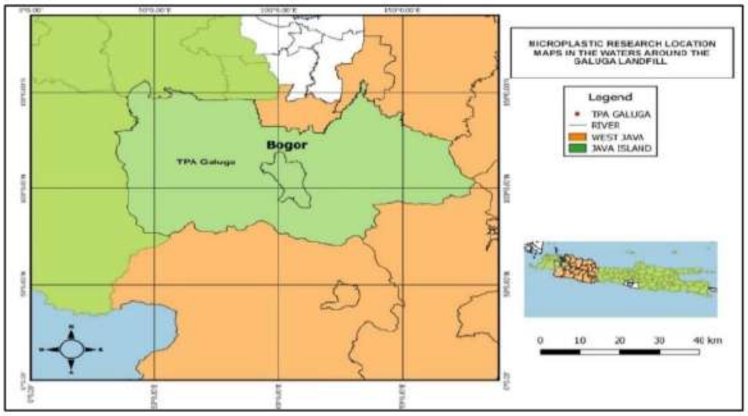

Figure 1: research site

2.1. Research parameters

The parameters observed in this study were categorical frequency distribution, microplastic percentage, Pearson Chi-square analysis.

2.1.1. Categorical Frequency Distribution Analysis

Micro-plastic frequency analysis test is the cumulative frequency type testing of micro-plastic at the research location. The results of frequency analysis will show the most types of micro-plastic. The cumulative micro-plastic frequency results are known by looking at the total of each type of micro-plastic in all locations then added up. This treatment will show which type of micro-plastic is the most of all research locations. Micro-plastic types found were observed based on micro-plastic forms / types (pellets, fragments, filaments, fibers and films). This treatment will show the level of emergence of these elements which are then analyzed by frequency distribution of categories using the Sturges formula:

K = 1 + 3,3 log n [24]

Information:

K = Number of classes

n = Amount of data

2.1.2. Microplastic Percentage

Micro-plastic presence test is the testing hypotheses about micro-plastic percentages based on research locations. The results of micro-plastic percentages can be determined by the following equation:

$\frac{x}{n} \times 100$

Information:

X = Total per location

n = Total of all locations

2.1.3. Pearson Chi-Square Analysis

Chi-Square Test is a hypothesis test about the comparison between the actual sample frequency (observation frequency) and the expectation frequency based on a particular hypothesis in each case (expectation frequency). The SPSS application is used to determine the significant difference between presences of micro-plastics in observational fish species with the following equation:

$$x^2 = \sum \frac{(Oi-Ei)^2}{Ei}$$

Information:

x^2 = Chi-Square Distribution

fo = the observed frequency

fn = the expected frequency [22]

Hypothesis testing is an action in statistics where an analyst tests the assumptions about population parameters with the following assumptions:

H0 = there are no significant differences between the number of micro-plastics in rivers, community wells and aquatic ponds.

H1 = there are significant differences between the number of micro-plastics in rivers, community wells and aquatic ponds.

This hypothesis test is performed with the criteria of significance:

1. If the value of asymptotic significant is Pearson Chi-Square >0.05, then the null hypothesis is accepted.
2. If the Pearson Chi-Square asymptotic significant value <0.05, then the null hypothesis is rejected

2.2. Data analysis

The data collected is primary data obtained by observation in the field (in situ) directly by determining the sample point and performing 3 repetitions while the analyzing of the sample was carried out at the laboratory (ex situ). The method used is sampling method, survey and the identification of field. The analysis of data used is the analysis of categorical frequency distribution, percentage of microplastic types, and Pearson chi-square analysis.

3. Result and Discussion

3.1. General Conditions of Galuga Landfill Area

Galuga Landfill is a waste landfill which has an area of 31.8 ha or about 13% of the total area of Galuga village located in the village of Galuga, District Cibumbulang, Bogor Regency, West Java Indonesia. It is used by Bogor city and Bogor regency government. Its management is under the authority of the Bogor city government and the land has been used since 1986.

3.2. Microplastic Presence of Water, Sediment, Aquatic Ponds and Community's Wells at the Galuga Landfill Area

Observations and analysis of data was carried out in the waters at the Galuga landfill of rivers, community wells, and aquatic ponds. They are based on 25 samples consisting of 9 river water samples consisting of 3 samples from the upper Cianten River, 3 samples from at the Galuga landfill and 3 samples from downstream of the Cianten River, 4 samples of water of residents' well and 12 samples of water and sediment of aquatic pond.

The Cianten River, a tributary of the Cisadane River, is a river directly crossed by the Galuga landfill leachate. The river area is a settlement where most of the residents use river water for drinking, cooking, bathing, washing, defecating and also other household needs. The number of water samples taken was 9 samples from 3 sampling points. The first point is taken in the upstream area, the second point is in the directly contact area by the Galuga landfill area (body river), and the third point is taken in the crossed area of landfill (downstream river). Each sampling distance is 5 km respectively.

Microplastic presence in water of the Cianten River at the Galuga landfill area is are presented in Table 1 below:

Table 1: Micro-plastic presence in the water

Microplastic Particles in Water of River at Galuga Landfill								
Microplastic Type	Distribution Percentage %	Particle ml	Sampling Points					
			Upstream		Body stream		Downstream	
			Particle ml	%	Particle ml	%	Particle ml	%
Filament	56.9	349.405	116.67	19	233.35	38	264.05	43
Fragment	18.7	114.831						
Fiber	7.8	47.897						
Film	10.1	62.022						
Pellet	6.5	39.915						
Total number	100	614.07						

The micro-plastic presence in water of river at the Galuga landfill area is 614.07 particles/ ml consisting of 19%

at upstream (116.67 particles/ml), 38% at body stream (233.35 particles/ml) and 43% at downstream (264.05 particles/ml).

The micro-plastic abundance in water of rivers at the Galuga landfill area is 614.07 particles/ml consisting of 56.9% filaments (349.405 particles/ml), 18.7% fragment (114.831 particles/ml), 10.1% film (62.022 particles/ml), fiber 7.8% (47.897) pellet 6.5% (39.915 particles/ml).

The most dominant type of filament micro-plastic is found in water samples in rivers. the filament is derived from waste products of the manufacture of synthetic clothing produced by the textile industry which is a major source of micro-plastic contamination, besides that a household scale can also produce it from the residual washing clothes. Browne and his colleagues [25] stated that filament released into the aquatic environment can reach 1900 particles from the washing of 1 piece of clothing. The high micro-plastic content in the waters at the Galuga landfill area of West Java Province is caused by several factors namely the high use of plastic by the public, the community's habit of littering plastic waste, the speed of river flow, depth and underwater topography. In addition, the dense population of the population at the river also influences the production of considerable plastic waste.

The density of plastic is strongly correlated with the number of people in an area. Plastic produced by human activities at the waters will accumulate and inhibit the flow of the river if it is not moved to a landfill. When the awareness about waste management from the community is still lacking, the micro-plastic content will continue to increase.

Chi-Square analysis of water in the river around the Galuga landfill area are presented in Table 2 below:

Table 2: Chi-Square analysis of river water at the Galuga landfill area

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.652[a]	68	1.000
Likelihood Ratio	10.730	68	1.000
Linear-by-Linear Association	0.178	1	0.673
N of Valid Cases	83		

H0: There is no significant relationship between river water samples and micro-plastic types.

H1: There is a significant relationship between river water samples and micro-plastic types.

Based on the Chi-Square Test (x2) it is known that Value (1.00)>(0.05) Asymptotic Significance, it can be concluded that H0 is accepted and H1 is rejected. This means that there is no significant influence between river water and microplastic types found around the Galuga landfill area, there are other factors that cause microplastic particles in river water.

Microplastic presence in sediment of the Cianten River at the Galuga landfill area is are presented in Table 3 below:

Table 3: Microplastic presence in sediment

Microplastic Particles in Sediment of River at Galuga Landfill								
			Sampling Points					
			Upstream		Body Stream		Downstream	
Microplastic Type	Distribution Percentage %	Particle ml	Particle ml	%	Particle ml	%	Particle ml	%
Filament	14.27	56.730	51.68	13	119.27	30	226.60	57
Fragment	57.62	229.068						
Fiber	21.05	83.684						
Film	5.19	20.633						
Pellet	1.87	7.434						
Total number	100	397.55						

The microplastic presence in sediment of river at the Galuga landfill area is 397.55 particles/ml consisting of 13% at upstream (51.68 particles/ml), 30% at body stream (119.27 particles/ml) and 57% at downstream (266.60 particles/ml).

Microplastic abundance of sediment in rivers at the Galuga landfill area is 397.55 particles/ml consisting of 14.27% filaments (56.730 particles/ml), 58.13% fragment (231.095 particles/ml), 5.19% film (20.632 particles/ml), fiber 21.05% (83,704) pellet 1.864% (7.41 particles/ml).

The Cianten river sediments are dry and wet suspension sediments trapped between rocks due to reduced flow rates. All river sediment samples tested in the laboratory were 9 samples. The existence of microplastic at the bottom of sediments is influenced by the amount of plastic density which is higher than the density of water, thus causing sinking and accumulating at the bottom of river sediments [26].

The type of microplastic that is often found in river sediments is the type of fragment. The fragment microplastic types are relatively larger in size than other types of microplastics so they are easily submerged in water. The type of microplastic fragment is formed from pieces of plastic that have strong synthetic polymers such as beverage bottles and food packaging.

This fragment type of microplastic that is high in sediments can be caused by the habit of people who throw disposable waste into water such as bottled mineral water into rivers directly.

Chi-Square analysis of water in the river around the Galuga landfill area is presented in Table 4 below:

Table 4: Chi-Square analysis of river sediment at the Galuga landfill area

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	19.163[a]	68	1.000
Likelihood Ratio	28.246	68	1.000
Linear-by-Linear Association	0.104	1	0.747
N of Valid Cases	89		

H0: There is no significant relationship between river sediment samples and microplastic types.

H1: There is a significant relationship between river sediment samples and microplastic types

Based on the Chi-Square Test (x2) it is known that Value (1.00)>(0.05) asymptotic Significance, it can be concluded that H0 is accepted and H1 is rejected. This means that there is no significant influence between river sediment and microplastic types found around the Galuga landfill area, there are other factors that cause microplastic particles in river sediment.

Microplastic presence in water of community wells at the Galuga landfill area is Chi-Square analysis of water in the river around the Galuga landfill area is presented in Table 5 below:

Table 5: Microplastic presence in water of community well

Microplastic Particles in Water of Society Wells at Galuga Landfill								
			Sampling Point					
			Kampoeng Moyan		Kampoeng Cimanggir		Kampoeng Lalamping	
Microplastic Type	Distribution Percentage %	Particle ml	Particle ml	%	Particle ml	%	Particle ml	%
Filament	58	444.44	202.13	26	209.91	27	365.40	47
Fragment	20	153.89						
Fiber	15	112.78						
Film	7	55.56						
Pellet	1	7.78						
Total number	100	777.44						

Microplastic presence in water of society wells at the Galuga landfill area is 316 particles / ml consisting of 26% at Kampoeng Moyan (83 particles/ml), 27% at Kampoeng Cimanngir (86 particles/ml) and 47% at Kampoeng Lalamping (147 particles/ml).

Microplastic abundance in water of community wells at the Galuga landfill area is 777.44 particles/ml consisting of 58% filaments (444.44 particles/ml), 20% fragment (153.89 particles/ml), 7% film (55.56 particles/ml), fiber 15% (112.78) and pellet 1% (7.78 particles/ml).

The high value of micro-plastic abundance in the wells of the Galuga villagers is caused by several factors, among others, due to an increase in the amount of organic and inorganic waste as well as limited facilities and infrastructure for wastewater management.

In general, the texture of pond sediments in the sample areas consists of 2 types, namely in the type of clay and sandy clay.

Mostly of Galuga villagers cultivate catfish and tilapia, this is because these fish have a strong immune system against disease. Aquatic pond water samples tested in the laboratory were 12 samples taken in the Galuga Village scattered in Kampoeng Moyan, Kampoeng Cimanggir, Kampoeng Lalamping.

Chi-Square analysis of water of community well around the Galuga landfill area is Chi-Square analysis of water in the river around the Galuga landfill area is presented in Table 6 below:

Table 1: Chi-Square analysis of well water sample in community well at the Galuga landfill area

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	19.00[a]	28	1.000
Likelihood Ratio	3.124	28	1.000
Linear-by-Linear Association	0.000	1	0.747
N of Valid Cases	38		

H0: There is no significant relationship between well water samples and microplastic types.

H1: There is a significant relationship between well water samples and microplastic types

Based on the Chi-Square Test (x^2) it is known that Value (1.00)>(0.05) asymptotic Significance, it can be concluded that H0 is accepted and H1 is rejected. This means that there are other factors that cause microplastic particles to enter the community's well water, such as the community's habit of disposing and leaving trash around the toilet after the people use it.

Microplastic presence in **water of the aquatic ponds** at the Galuga landfill area is Chi-Square analysis of water in the river around the Galuga landfill area is presented in Table 7 below:

Table 2: Presence of microplastic in water of aquatic ponds

Microplastic Particles in Water of Aquatic Ponds at Galuga Landfill								
Microplastic Type	Distribution Percentage %	Particle ml	Sampling Point: Kampoeng Moyan Particle ml	%	Kampoeng Cimanggir Particle ml	%	Kampoeng Lalamping Particle ml	%
Filament	67	352.87						
Fragment	14	73.73						
Fiber	15	79	158	30	179.07	34	189.6	36
Film	4	21.07						
Total number	100	526.67						

Microplastic presence in water of aquatic ponds at the Galuga landfill area is 526.67 particles/ml consisting of 30% at Kampoeng Moyan (158 particles/ml), 34% at Kampoeng Cimanngir (179.07 particles/ml) and 36% at Kampoeng Lalamping (189.61 particles/ml).

Microplastic abundance in water of aquatic ponds at the Galuga landfill area is 526.67 particles/ml consisting of 67% filaments (352.87 particles/ml), 14% fragment (73.73 particles/ml), 4% film (21.07 particles/ml), and fiber 15% (79).

The high microplastic content in water of aquatic ponds at the Galuga landfill area of West Java Province is caused by several factors, namely the massive use of plastic by society, the aquatic water cycle system and the depth of the aquatic pond. These microplastics are produced mostly from the remains of fishing and cultivation activities (including nets and threads). The activity above is thought to be a source of microplastics in ponds. These activities can easily lead to the entry of microplastic particles in aquatic ecosystems that will kill biota, damage habitats and reduce water quality conditions

Chi-Square analysis of water in aquatic ponds at the Galuga landfill area is Chi-Square analysis of water in the river around the Galuga landfill area is presented in Table 8 below:

Table 3: Chi-Square analysis of water sample in aquatic ponds at the Galuga landfill area

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	20.465[a]	92	1.000
Likelihood Ratio	17.990	92	1.000
Linear-by-Linear Association	1.590	1	.747
N of Valid Cases	95		

1

H0: There is no significant relationship between well water samples and microplastic types.

H1: There is a significant relationship between well water samples and microplastic types

Based on the Chi-Square Test (x^2) it is known that Value (1.00)>(0.05) asymptotic Significance, it can be concluded that H0 is accepted and H1 is rejected. This means that there are other factors that cause microplastic particles to enter the water of aquatic ponds, such as the massive use of plastic by society, the aquatic water cycle system and the depth of the aquatic ponds.

Microplastic presence in **sediment of the aquatic ponds** at the Galuga landfill area is Chi-Square analysis of water in the river around the Galuga landfill area is presented in Table 9 below:

Table 4: Microplastic particle in sediment of aquatic ponds

Microplastic Particles in Sediment of Aquatic Ponds at Galuga Landfill								
Microplastic Type	Distribution Percentage %	Particle ml	Sampling Point					
			Kampoeng Moyan		Kampoeng Cimanggir		Kampoeng Lalamping	
			Particle ml	%	Particle ml	%	Particle ml	%
Filament	1	1,68	43.9	26	40.52	24	84.44	50
Fragment	84	141,.6						
Fiber	5	8.44						
Film	6	10,13						
Pellet	4	6.75						
Total number	100	168.86						

Microplastic presence in water of aquatic ponds at the Galuga landfill area is 168.86 particles/ml consisting of 26% at Kampoeng Moyan (43.9 particles/ml), 24% at Kampoeng Cimanngir (40.52 particles/ml) and 50% at Kampoeng Lalamping (84.44 particles/ml).

Microplastic abundance in water of aquatic ponds at the Galuga landfill area is 168.86 particles/ml consisting of 1% filaments (1.68 particles/ml), 84% fragment (141.6 particles/ml), 6% film (10.13 particles/ml), and fiber 5% (8.44).

The high microplastic content of the sediment in fish ponds at the Galuga landfill area in West Java Province is caused by several factors including traditional fisheries management patterns, slow pool water cycles and depth of the ponds and lack of tree planting at the ponds.

Chi-Square analysis of water in aquatic ponds at the Galuga landfill area is Chi-Square analysis of water in the river around the Galuga landfill area is presented in Table 10 below:

Tabel 10: Chi-Square analysis of pond aquatic sediment at the Galuga landfill area

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	41.013[a]	92	1.000
Likelihood Ratio	41.330	92	1.000
Linear-by-Linear Association	0.209	1	0.648
N of Valid Cases	60		

H0: There is no significant relationship between pond aquatic sediment samples and microplastic types.

H1: There is a significant relationship between pond aquatic sediment samples and microplastic types.

Based on the results of Chi-Square Test (x2) known Value (1.00)>(0.05) Asymptotic Significance, it can be concluded that H0 is accepted and H1 is rejected, which means there is no significant effect between aquatic pond sediments and microplastic types found at the Galuga landfill area. It means that there are other factors that cause the presence of microplastic particles in sediment ponds.

3.3. Plastic Waste Management and Aquatic Environment

Waste management system applied in Galuga final disposal site is open dumping system. Types of garbage dumped consist of household, market, industry and hospitals garbage. The 30 years (at least) operated Galuga final disposal site is also equipped with open windrow composting facility. However, the obtained product could not counter balance the increasing volume of municipal garbage. From 1100 tons/d municipal garbage entering Galuga final disposal site only 250 – 300 tons/d capable of being sorted by scavengers. Galuga final disposal site is a controlled landfill, however, it has not been managed appropriately. This situation created environmental problems such as bad odor and fluctuated quality of leachate. Technology and economic breakthrough is needed to overcome a huge pile of domestic garbage in Galuga final disposal site. And the law enforcement is a must to the regulation has been made. The central and local Government has made some regulations that can be made as a legal basis for managing plastic waste, including:

1. Regulation of the Minister of Environment of the Republic of Indonesia Number 13 of 2012 on Guidelines for the Implementation of Reduce, Reuse and Recycle through Waste Banks
2. Local West Java Provincial Regulation Number 12 of 2010 on Waste Management in West Java.
3. Local Bogor Municipality Regulation Number 9 of 2012 on Waste Management
4. Bogor Mayor Regulation Number 61 of 2018 on Reduction of Using Plastic Bags

There are also several regulations that have been made as a legal basis for preserving water resources, including:

1. Government Regulation of the Republic of Indonesia Number 82 of 2001 on Water Pollution Control in order to guarantee water quality in accordance with quality standards through controlling water pollution efforts and restoring environmental quality.
2. Government Regulation Number 18 of 1999 concerning Management of Hazardous and Toxic Waste

(B3)

3. The Government Regulation of the Republic of Indonesia Number 19 of 1999 on Control of Marine Pollution/ Destruction
4. Law of the Republic of Indonesia Number 32 of 2009 on Environmental Protection and Management.

4. Conclusion

1. The abundance of microplastic types in all samples at Galuga Land Fills consisting of samples of river water, community wells and aquaculture ponds is dominated by filament types with a total of 52% (1203,445 particles) and the distribution of microplastic types in water and sediment in the river flows at Galuga landfills is mostly located in the downstream with a percentage of 49% (490.65 particles), whereas the highest distribution of microplastics for the three Kampoeng was in Kampoeng Lalamping around 43% (639.44 particles)

2. The results of the chi-square test stated that there was no significant relationship between the water area around the landfill and the types of microplastics found at the Galuga Land Fills.

3. The waste management method at Galuga Land Fills still uses open dumping method, which is a method of disposing and piling up waste in open land. This method is still a simple way to dispose of waste by utilizing the topography of the land

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References

[1] Thompson, R. C., Olsen, Y., Mitchell, R. P., Davis, A., Rowland, S. J., John, A. W. G., Mcgonigle, D., & Russell, A. E. "Lost at Sea: Where Is All the Plastic?" Brevia, 304, 838. 2004. https://doi.org/10.1126/science.1094559

[2] Brooks, A. L., Wang, S., & Jambeck, J. R. "The Chinese import ban and its impact on global plastic waste trade". Science Advances, 4, 1–8. 2018.

[3] Geyer, R., Jambeck, J. R., & Law, K. L. "Production, use, and fate of all plastics ever made". Science Advances, 3, 25–29. 2017.

[4] Galgani, F., Hanke, G., & Maes, T. "Global Distribution, Composition and Abundance of Marine Litter", in Marine Anthropogenic Litter. Bergmann, M., Gutow, L., Klages M., Eds. 2015. https://doi.org/10.1007/978-3-319-16510-3

[5] Septiani, B. A., Arianie, D. M., Risman, V. F. A. A., Handayani, W., and Kawuryan, I. S. S., " Plastic waste management in Salatiga: Practices and challenges," Journal of Environmental Science, vol. 17, no. 1, pp. 90-99, May. 2019. https://doi.org/10.14710/jil.17.1.90-99 (Translated)

[6] Jambeck, J.R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., Narayan, R., Law, K. L. "Marine pollution: Plastic waste inputs from land into the ocean". Science, 13, 347(6223), 768-71. 2015. 10.1126/science.1260352

[7] Sebille, E., Aliani, S., Law, K. L., Maximenko, N., Alsina, J. M., Bagaev, A., Bergmann, M., Chapron, B., Chubarenko, I., Cózar, A., Delandmeter, P., Egger, M., Fox-Kemper, B., Garaba, S., Goddijn-Murphy, L., Hardesty, B., Hoffman, M., Isobe, A., Jongedijk, C., Wichman, D. "The physical oceanography of the transport of floating marine debris". Environ. Res. Lett. 15(2020), 023003. 2020. https://doi.org/10.1088/1748-9326/ab6d7d

[8] Fendall, L. S., & Sewell, M. A. "Contributing to marine pollution by washing your face : Microplastics in facial cleansers". Marine Pollution Bulletin, 58(8), 1225–1228. 2009. https://doi.org/10.1016/j.marpolbul.2009.04.025

[9] Chadar, S.N., & Chadar, K. "Solid Waste Pollution: A Hazard to Environment". Recent Adv. Petrochem Sci. 2(3), 41–43. 2017. https://doi.org/10.19080/RAPSCI.2017.02.555586

[10] Arthur, C., Baker, J., & Bamford, H. Proceedings of the International Research Workshop on the Occurrence, Effects, and Fate of Microplastic Marine Debris. Sept 9-11. NOAA Technical Memorandum NOS-OR&R-30. 2009.

[11] Cordova, M. R., & Prayudha, B. "Occurrence and abundance of microplastics in coral reef sediment: a case study in Sekotong, Lombok-Indonesia". AES Bioflux. 10, 1, 23-29. 2018. https://doi.org/10.5281/zenodo.1297719

[12] Haward, M. "Plastic pollution of the world's seas and oceans as a contemporary challenge in ocean governance". Nature Communications, 9–11. 2018. https://doi.org/10.1038/s41467-018-03104-3

[13] Viršek, M. K., Palatinus, A., Koren, Š., Peterlin, M., Horvat, P., & Kržan, A. "Protocol for Microplastics Sampling on the Sea Surface and Sample Analysis". J. Vis. Exp. 118. 2016. https://doi.org/10.3791/55161

[14] Thompson, R. C., Moore, C. J., Saal, F. S. V., & Swan, S. H. "Plastics, the environment and human health: Current consensus and future trends." Philos Trans R Soc Lond B Biol Sci. 364(1526), 2153–2166. 2009. https://doi.org/10.1098/rstb.2009.0053

[15] Andrady, A. L. "Microplastics in the marine environment." Marine Pollution Bulletin, 62, 8, 1596–1605. 2011. https://doi.org/10.1016/j.marpolbul.2011.05.030

[16] Poerio, T., Piacentini, E., & Mazzei, R. "Membrane Processes for Microplastic Removal." Molecules. 24, 4148. 2019.

[17] Lares, M., & Ncibi, M. C. "Occurrence, identification and removal of microplastic particles and fibers in conventional activated sludge process and advanced MBR technology." Water Research. 133, 8, 236–246. 2018. https://doi.org/10.1016/j.watres.2018.01.049

[18] Ory, N., Chagnon, C., Felix, F., Fernández, C., Lia, J., Gallardo, C., Garcés, O., Henostroza, A., Laaz, E., Mizraji, R., Mojica, H., Murillo, V., Ossa, L., Preciado, M., Sobral, P., Urbina, M. A., & Thiel, M. "Low prevalence of microplastic contamination in planktivorous fish species from the southeast Pacific Ocean." Marine Pollution Bulletin, 127, 211–216. 2018. https://doi.org/10.1016/j.marpolbul.2017.12.016

[19] Auta, H. S., Emenike, C. U., & Fauziah, S. H. "Distribution and importance of microplastics in the marine environment: A review of the sources, fate, effects, and potential solutions." Environment International, 102, 165–176. 2017. https://doi.org/10.1016/j.envint.2017.02.013

[20] Gies, E. A., Lenoble, J. L., Noël, M., Etemadifar, A., Bishay, F., Hall, E. R., & Ross, P. S. "Retention of microplastics in a major secondary wastewater treatment plant in Vancouver, Canada." Marine Pollution Bulletin, 133, 553–561. 2018. https://doi.org/10.1016/j.marpolbul.2018.06.006

[21] Gong, J., Kong, T., Li, Y., Li, Q., Li, Z., & Zhang, J. "Biodegradation of microplastic derived from polyethylene terephthalate) with bacterial whole-cell biocatalysts." Polymers (Basel), 10(12). 2018. https://doi.org/10.3390/polym10121326

[22] Bergmann, M., Gutow, L., & Klages, M. Marine anthropogenic litter. 2015. https://doi.org/10.1007/978-3-319-16510-3

[23] Lee, J. Economic valuation of marine litter and microplastic pollution in the marine environment: An initial assessment of the case of the United Kingdom. (London, UK: SOAS-CeFiMS), 1–16. 2015.

[24] Dogan, N., & Dogan, I. "Determination of the Number of Bins / Classes Used in Histograms and Frequency Tables: a Short Bibliography." TurkStat, Journal of Statistical Research. 7, 77-86. 2010.

[25] Browne, M. A., Crump, P., Niven, S. J., Louise, E., Tonkin, A., Galloway, T., & Thompson, R. C. "Accumulation of microplastic on shorelines worldwide: sources and sinks." Environ. Sci. Technol. 45, 21, 9175–9179. 2011. https://doi.org/10.1021/es201811s

[26] Claessens, M., Meester, S. De, Landuyt, L. Van, Clerck, K. De, & Janssen, C. R. "Occurrence and distribution of microplastics in marine sediments along the Belgian coast." Marine Pollution Bulletin, 62(10), 2199–2204. 2011. https://doi.org/10.1016/j.marpolbul.2011.06.030

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