

Heavy Metals Configuration in Different Saprobic Level of Water Bodies

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Abstract

The environmental conditions for aquaculture need to be done in line with pollution that occur in waters which is categorized by saprobic index. The heavy metals content in cultured organisms present in the different levels of saprobity was informed by geospatial analysis through the overlay method. The Pb, Cd and Cr content were taken from tissues of milkfish, wild white shrimp and vaname shrimp. An Ikonos satellite Imagery data of Semarang used for geospatial analysis. The research was carried out from June to October 2021 in the brackish water ponds At Tugu district, Semarang, Central Java. The level of saprobity reported in oligosaprobic up to β -mesosaprobic which means lightly polluted to heavily polluted. The content in the water bodies (mg/L) of Pb 0.046 to 0.105, Cd 0.033 to 0.062 and Cr from 0.018 to 0.054 has exceeded the permissible level. Meanwhile, in the pond sediment (mg/kg) : Pb 3.56-6.93; Cr 1.08-3.01 is within permissible limits, however, Cd 1.77-3.53 has exceeded permissible levels. The content of heavy metals (mg/kg) in the tissues of milkfish, wild shrimp and white leg shrimp (*L. vannamei*): Pb 0.27 to 0.39, Cr 0.16 to 0.23 and Cd from 0.12 to 0.22 is still within permissible limits.

Keywords: aquaculture, pollution, heavy metals, Semarang

INTRODUCTION

The quality of aquaculture products as food has to be examined properly, because it could impact on food security. Efforts should be made to ensure the permissibility of aquaculture products as food is to apply a good aquaculture practices. One key factor that could influence the quality of aquaculture products is the environment of the aquaculture site. Evaluation of the environmental conditions of aquaculture site needs to be done in line with pollution that occurred in the waters. The emphasis of pollution in this study is heavy metals pollution in the supply water to be used in the cultivation. This is because the heavy metals in the water are easily absorbed and accumulate biologically in the food chain system (Pratama *et al.*, 2012). Research has been carried out by Yulianto, *et al* (2006) showed that in general on the north coast of Central Java polluted by heavy metals Cd, Cu, Cr, Pb, Ni, Zn, the sediments have been contaminated by metals Hg, Cd, Cu, Cr, and Zn, while the mussels have been contaminated with heavy metals Pb, Cu, and Zn. Research done by Setiadi (2008) mentioned in coastal waters of Semarang was also polluted by heavy metals Cadmium (Cd), Lead (Pb), Sang (Zn), and silver (Ag).

Heavy metal pollution is thought to occur in waters by various wastes, such as industrial waste and household waste. The level of water pollution can be seen from the saprobity level, i.e. saprobic index (SI) and Trophic saprobic index (TSI). Saprobity level can be determined based on the level of contamination of a water body that are less polluted, lightly polluted, heavily polluted water conditions. At various levels of contamination will be tested to see if they contain heavy metals that exist in the cultivated organisms. Saprobity criteria play an important role on the feasibility of the location for aquaculture (Angooro, 1984). At the level of polysaprobic means that the water body is in heavily polluted conditions, so it is not suitable for aquaculture.

Geospatial information system is a method that can be applied to provide information about contaminated areas at various levels saprobities. The pattern of geospatial mapping and coverage area of water conditions can be known by using this method (Radiarta, 2008). Furthermore, the interaction between heavy metals content in the cultured organisms and water can also be informed by geospatial analysis through the overlay method. The advantage of this method is the ability to combine multiple information in one view that can address the evaluation of the environmental conditions at the same time the state organisms that live in it (Kapetsky and Manjarres, 2007). Environmental problems became one of the obstacles in the development of

aquaculture, because it affects the quality of aquaculture products. The cultivation that is carried out in a contaminated environment will produce aquaculture products that also contain contaminants.

District of Tugu, Semarang city is the location of brackish water aquaculture (ponds) that surrounded by an industrial area. Therefore, it is necessary to get attention in the form of an evaluation of the quality of waters sources for aquaculture, which will certainly affect the quality of the cultured organisms. How is the level of contamination that occurs in brackish water ponds in Tugu district area, and how the heavy metals content in organisms cultivated in those the locations. Thus, this study was done to answer those questions.

The purpose of this study was to find out (1) the level of contamination by the saprobity index, (2) the content of heavy metals in water, (3) the heavy metal content in tissue of cultured organisms with different trophic levels through geospatial mapping. Benefits of this research are that this research will provide provides information on the content of heavy metals in the tissue of organisms that been cultured in the waters with different degrees of saprobity. This information will be very useful as the basis for the aquaculture management that could produce good quality products.

MATERIALS AND METHODS

The research was conducted in June to October 2200, at brackish water ponds area Tugu District Semarang, Central Java Province. The materials used in this research consisted of (1) Water from the rivers as the water source for pond, and water from the ponds as the media for culturing (3) Data Ikonos satellite image of Semarang (spatial resolution of 1 x 1 m), (3) tissue of cultured organisms (milk fish, tiger shrimp and white shrimp) (4) Equipment and materials used for the sampling and analysis of data include the Garmin GPS 15 sample bottles, cool box, plankton net, Sedgewick Rafter, microscopes and chemicals for the purposes of laboratory analysis

Research Design

This research was conducted in three phases: Phase I: Analysis of water pollution by trophic saprobic index levels using geospatial methods. According Djarwanto and Subagyo, (1990), determination of sampling points based on a certain consideration based on the initial interpretation of research location and limited to the sample unit in accordance with certain criteria to the purpose of research is to determine the point of sampling using purposive sampling method. In this study, samples taken at locations which allegedly affected by the pollution. Phase II: Analysis of heavy metals content in the tissue of cultured organisms: milk fish, and tiger shrimp, and white shrimp. At this stage, the cultured milk fish and shrimps in the ponds were sampled randomly. Phase III: Combining information on phase I and phase III with the overlay method of geospatial analysis so that the resulting information content of heavy metals in the tissue of organisms that been cultured in waters at different saprobity levels.

Variables

The variables observed in this research were (1) the type of plankton in the waters, (2) the abundance of plankton, (3) analysis of metals: Cadmium (Cd), Lead (Pb), Chromium (Cr) content in the river water and pond water, (4) analysis metals Cadmium (Cd), Lead (Pb), Chromium (Cr) in the cultured of the organisms (milk fish, and shrimps).

Sampling methods and data analysis

Phase I: Analysis of water pollution by trophic levels saprobic index using geospatial methods.

- a. Determining the location of sampling: 15 sampling locations are determined by purposive sampling. Noting the latitude and longitude at that location as the basis for mapping and geospatial data analysis.
- b. Water sampling: Samples taken by sampling the water in the river and ponds land at the specified location. The water were then filtered by using a plankton net and preserved using Lugol's solution as a preservative.
- c. Plankton identification: Identify the type of plankton done by looking at plankton using a microscope and identified based on plankton identification book.
- d. Plankton abundance
Plankton abundance is calculated using Sedgewick rafter, with the formula (APHA, 1976):

$$\frac{100 (P \times V)}{0,25 \pi W}$$

where

N = the number of plankton per liter

P = the amount of plankton identified

V = Volume of plankton samples passed through the filter (ml)

W = Volume of plankton samples were filtered (l)

e. Determining the level of saprobity

$$SI = \frac{1C + 3D + 1B - 3A}{1A + 1B + 1C + 1D}$$

where:

SI = saprobic index

A = the number of species of polysaprobic organisms

B = the number of species of α -mesosaprobic organisms

C = number of species of β -mesosaprobic organisms

D = the number of species of oligosaprobic organisms

$$TSI = \frac{1(nC) + 3(nD) + 1(nB) - 3(nA)}{1(nA) + 1(nB) + 1(nC) - 1(nD)} \times \frac{nA + nB + nC + nD + nE}{nA + nB + nC + nD}$$

where:

TSI = Tropic saprobic index

nA = number of individuals making up the polysaprobic group

nB = the number of individuals making up the α -mesosaprobic organism

nC = the number of individuals making up the β -mesosaprobic organism

nD = the number of individuals making up the oligosaprobic organism

f. Mapping environmental conditions based index saprobitas using geospatial methods.

Phase II: Analysis of heavy metals in the water and on the tissue of cultured organisms

- River water sample and pond waters suspected contaminated were taken from seven stations purposively and pond waters suspected contaminated
- The cultured organisms (milk fish and shrimps) were taken from 6 ponds / sampling location randomly
- Analysis of heavy metal content of Cadmium (Cd), mercury (Hg), Lead (Pb), and chromium (Cr) in the tissue of milk fish and shrimps that are reared in the brackish water ponds were analyzed by using Atomic Absorption Spectrometer.
- Data were analyzed using quantitatively to compare the laboratory results of analysis with environmental quality standards.

Phase III: Analysis using geospatial methods to combine information of saprobity level and content of heavy metals in organisms

- Mapping the region based on the saprobity level
The mapping was based on the geospatial method using software Arc View 5.2 and Arc GIS 7.0. The principle used in this method is to analyze the data of physical and administrative component from a geographic object.
- Data Overlay phase I and phase II. Data processing method used is to combine geographical data in a spatial format with attribute data content of heavy metals in organisms at each sampling point.

RESULTS AND DISCUSSION

The research was in the area of brackish water pond at Tapak Village, Tugu District, Semarang. Location of the study was taken based on the distance to the Tapak river embankment allegedly polluted by industries around it. Table 1 shows the coordinates of each location, where the location I to VII successively closer to the sea.

Table 1. Research Location

No.	Locations	Coordinates
1	I	06.57.967 SL / 110.20.777 EL
2	II	06.57.392 SL /110.20.167 EL
3	III	06.57.623 SL /110.20.936 EL
4	IV	06.57.819 SL /110.20.888 EL
5	V	06.57.992 SL /110.20.792 EL
6	VI	06.58.020 SL /110.20.434 EL
7	VII	06.56.021 SL /110.20.200 EL

Trophic Saprobic Index

Analysis trophic saprobic obtained based on the identification of plankton and benthos. The identification results are then classified based on the type of organism into the level of contamination (Table 2).

Tabel 2. Results of Trophic saprobic Index

No.	Locations	SI-TSI Value	Definition
1	I	0.35	Alfa-mesosaprobic : moderately to heavily polluted
2	II	1.30	Beta-mesosaprobic : lightly to moderately polluted
3	III	1.25	Beta-mesosaprobic : lightly to moderately polluted
4	IV	1.10	Beta-mesosaprobic : lightly to moderately polluted
5	V	0.50	Alfa-mesosaprobic : moderately to heavily polluted
6	VI	1.50	Oligosaprobic : lightly polluted
7	VII	1.50	Oligosaprobic : lightly polluted

Heavy Metals Content in Water

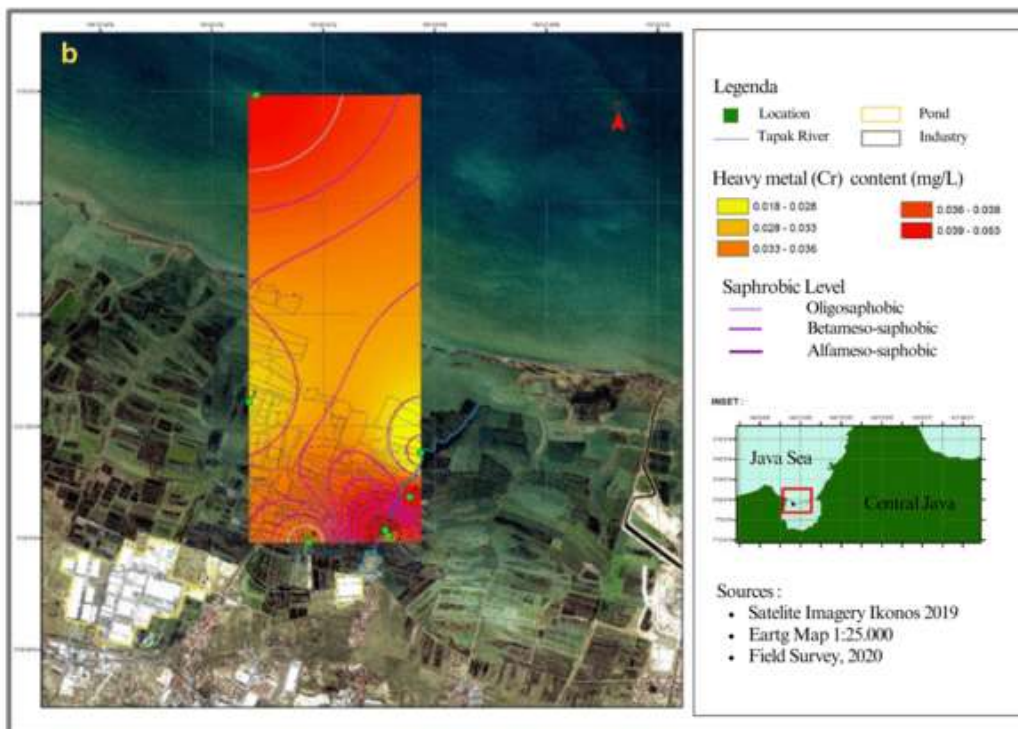
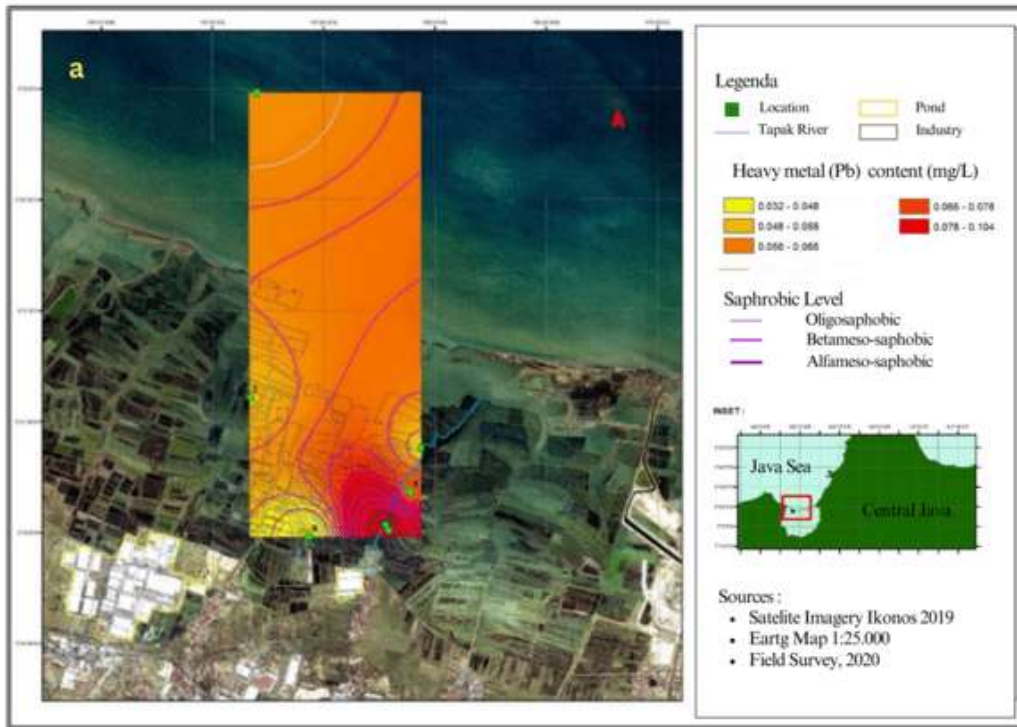
Distribution of heavy metals in the waters were overlaid with waters saphrobity level, it was found that the pollution of the brackish water pond in Tapak Village, Tugu district is lightly to moderately polluted. Those results provide information that the heavy metal Pb, Cd and Cr content has exceeded the water quality standard for aquaculture purposes Table 3. Information regarding the content of Pb in the water at different saprobity levels can be seen in Figure 1a. Furthermore, the content of Cd and Cr in the water can be seen in Figure 1b, and 1c.

Table 3. Heavy Metals (Pb, Cd and Cr) content in Pond Water

No	Locations	Pb (mg/L)	Cd (mg/L)	Cr (mg/L)
1	I	0,105*	0,062*	0,054*
2	II	0,049*	0,040*	0,029*
3	III	0,046*	0,039*	0,018*
4	IV	0,057*	0,054*	0,042*
5	V	0,062*	0,033*	0,030*
6	VI	0,032*	0,046*	0,035*
7	VI	0,053*	0,048*	0,042*
Average \pm sd		0,058* \pm 0,02	0,046* \pm 0,01	0,036* \pm 0,01
** quality standards		0,008 mg/L	0,001 mg/L	0,005 mg/L

Description: * It exceeds the quality standard

** KepMen LH No. 51 of 2004



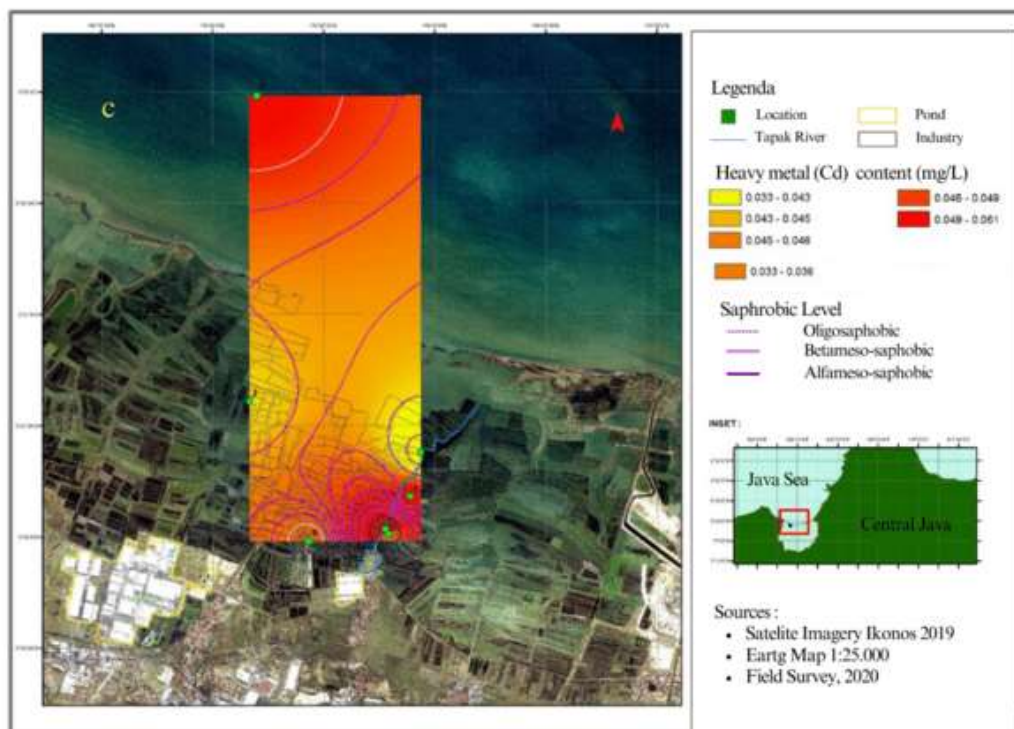


Figure 1. The mapping of heavy metal Pb(a), Cr(b), Cd(c) content in a water with several saprobity index

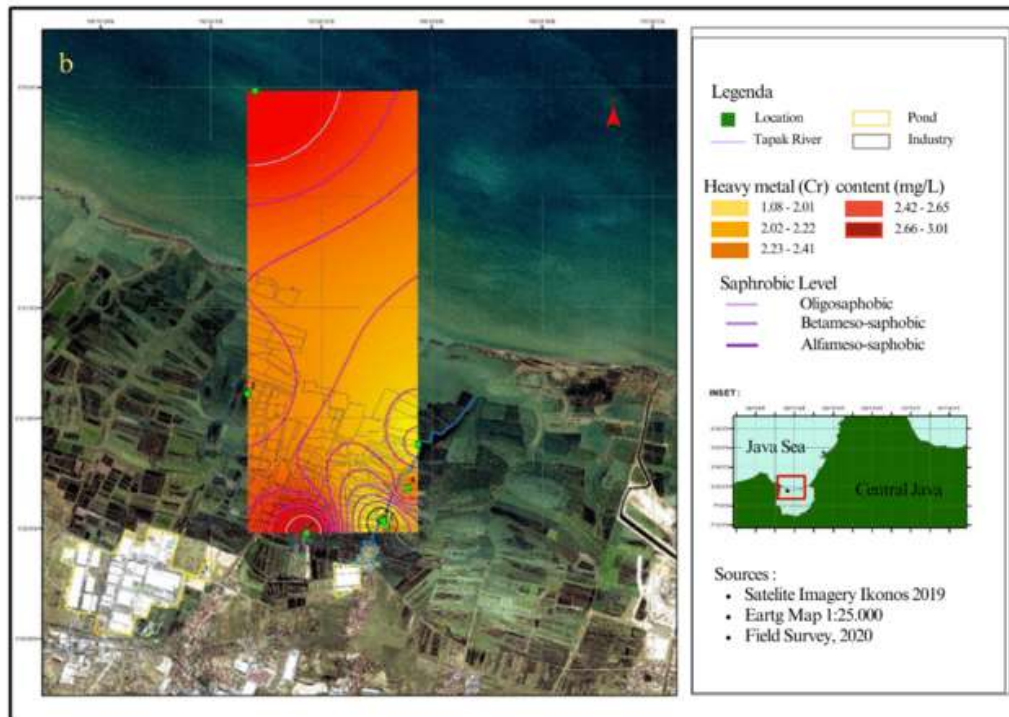
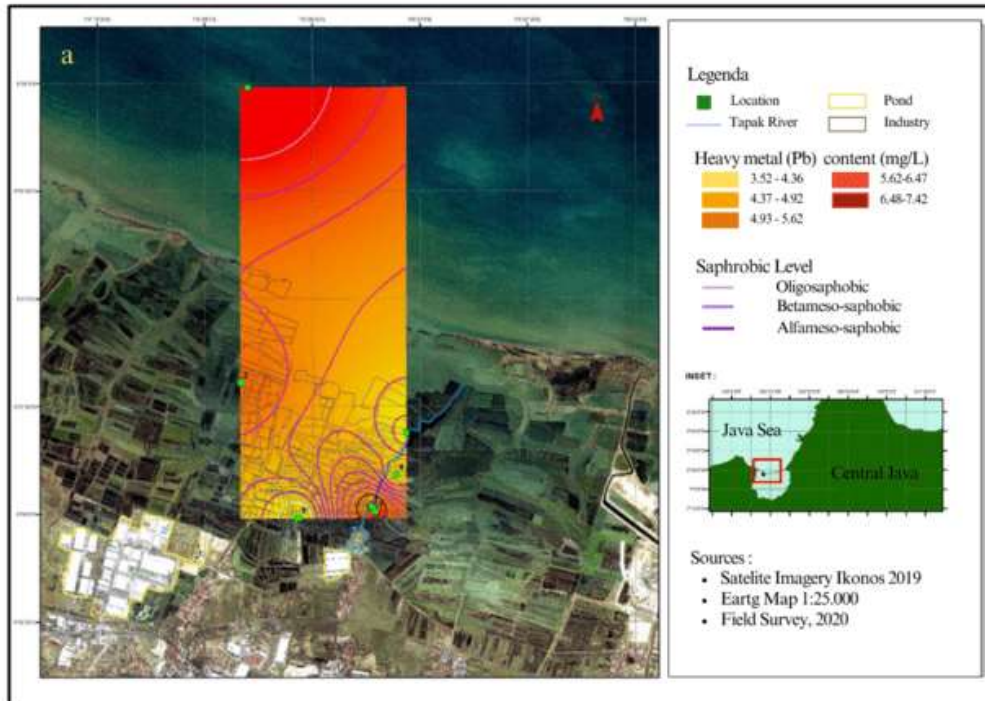
Heavy Metals Content in the Pond Bottom Sediment

Generally, the content of Pb and Cr are at permissible levels, while the Cd content has exceeded the quality standards established by KepMen LH No. 51 of 2004. (Table 4). The distribution map of f heavy metals (Pb, Cd, Cr) in the pond bottom sediments at different saprobity levels are shown in Figure 2a, 2b and 2c.

Table 4. heavy metals (Pb, Cd dan Cr) content in the pond bottom sediment

No	Location	Pb (mg/kg)	Cd (mg/kg)	Cr (mg/kg)
1	I	3,90	2,73*	1,08
2	II	5,42	3,32*	2,31
3	III	3,52	2,19*	1,85
4	IV	4,12	2,66*	2,35
5	V	6,93	1,77	2,67
6	VI	3,56	3,53*	3,01
7	VI	7,42	2,19*	2,90
Average ± sd		4,98±1,63	2,63*±0,63	2,31±0,67
** quality standards		** 5 mg/kg	1-2 mg/kg	5 mg/kg

Description: * It exceeds the quality standard ** KepMen LH No. 51 of 2004



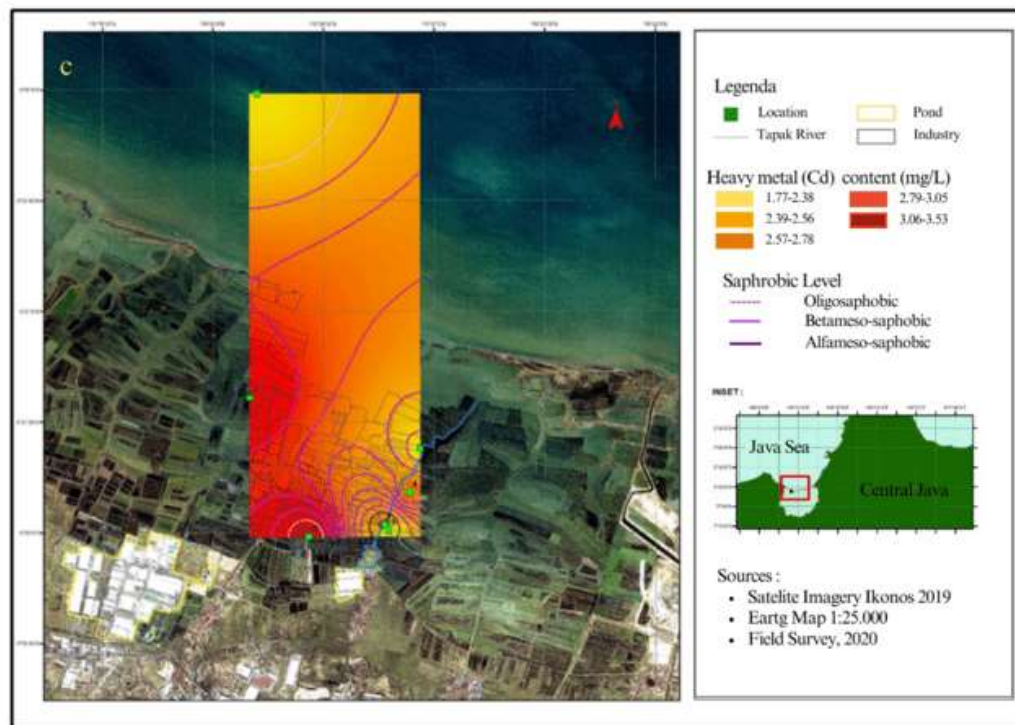


Figure 2. The mapping of heavy metal Pb(a), Cr(b), Cd(c) content in a sediment with several saprobity index

Heavy Metals Content in Tissue of Cultured Organisms

a. Milkfish

The results heavy metals in the tissue of milkfish at different levels of the waters saprobity showed that mostly in the permissible limit, however in location 1 and 2 were higher than permissible limit (Table 5).

Tabel 5. Heavy metals content in the tissue (Pb, Cd dan Cr) of milk fish

Location	Heavy metals content in the tissue (mg/kg)		
	Pb	Cd	Cr
I	0,39±0,07*	0,19±0,06	0,21±0,06
II	0,37±0,06*	0,18±0,05	0,23±0,04
III	0,29±0,11	0,18±0,05	0,19±0,06
IV	0,27±0,13	0,17±0,05	0,18±0,06
V	0,30±0,12	0,16±0,06	0,18±0,05
VI	0,30±0,04	0,12±0,01	0,20±0,01
Quality standard Pb in the fish tissue SNI 7387:2009 and BPOM RI No HK.00.06.1.52.4011		Quality standard Cr in the fish tissue based on European United (EU) standards by 2 mg / kg	
Pb 0,3 mg/kg		Cd 0,2 mg/kg	

b. Vanamae Shrimp

The results show that in general, heavy metals (Pb, Cd and Cr) content in the vanamae shrimp tissue are of still at the threshold safe for consumption (Table 6).

Table 6. Heavy Metals (Pb, Cd and Cr) Content in Tissue of Vaname Shrimp

Lokasi	Kandungan Logam Berat (mg/kg)		
	Pb	Cd	Cr
I	0,29±0,12	0,20±0,05	0,21±0,03
II	0,31±0,01	0,22±0,01	0,22±0,01
III	0,30±0,01	0,20±0,01	0,20±0,01
IV	0,27±0,01	0,18±0,01	0,18±0,01
V	0,25±0,01	0,16±0,01	0,17±0,01
VI	0,22±0,01	0,14±0,01	0,16±0,01
SNI 7378:2009 and BPOM RI No HK.00.06.1.52.4011 2009		BPOM RI No HK.00.06.1.52.4011 2009	
0.5 mg/kg		1.0 mg/kg	2.0 mg/kg

c. White shrimp

Results of the analysis of the content of heavy metals (Pb, Cd and Cr) in White Shrimp meat can be seen in Table 7 below.

Table 7. Content of Heavy Metals (Pb, Cd and Cr) in White Shrimp Meat

Lokasi	Kandungan Logam Berat (mg/kg)		
	Pb	Cd	Cr
I	0,39±0,07	0,19±0,06	0,21±0,06
II	0,37±0,06	0,18±0,05	0,23±0,04
III	0,29±0,11	0,18±0,05	0,19±0,06
IV	0,27±0,13	0,17±0,05	0,18±0,06
V	0,30±0,12	0,16±0,06	0,18±0,05
VI	0,30±0,04	0,12±0,01	0,20±0,01
SNI 7378:2009 and BPOM RI No HK.00.06.1.52.4011 2009		BPOM RI No HK.00.06.1.52.4011 2009	
0.5 mg/kg		1.0 mg/kg	2.0 mg/kg

DISCUSSION

Content of Heavy Metals in Water

Based on laboratory results Pb content obtained in the 7 sampling locations ranged from 0.053 to 0.105 mg / L with a mean of 0.058 ± 0.023 . This value indicates that the levels of Pb in water in ponds and Tapak river already exceeds the threshold by KepMen LH No.51 Tahun 2004 that the threshold is determined at 0.008 mg / L. Based on the distribution of Pb content in Figure 1, it can be seen that at the location immediately adjacent to River Site, the content of Pb exceeds the threshold. Similarly with Cd and Cr content. Cd content ranging from 0.033 to 0.062 mg / L with a mean of 0.046 ± 0.010 mg / L, while Cr content 0.018 to 0.054 mg / L with a mean of 0.036 ± 0.012 mg / L. This relates to the pollution caused by industrial waste flowing in the river. Based on the results of spatial analysis, it appears that heavy metal is concentrated in the area around the river, where the map is an area that is red, and then headed out to sea, has a lower concentration, indicated by the color orange. This means that the heavy metals in the waters of diminishing with distance from the source of pollutants. Heavy metal pollution in waters will run into precipitation, dilution and the dispersion are then absorbed by living organisms in the waters because heavy metals have persistent properties (Yolanda *et al.*, 2019). Heavy metal can enter the human body through food chain, if humans consume the biota found in the area is contaminated with the heavy metal Cu then the concentration of the heavy metal copper will settles in the human body. Effect side effects resulting from copper poisoning such as nausea, illness, jaundice, hypotension, blood in the urine, diarrhea, kidney problems, coma and death. (Dewi *et al.*, 2017). At the location, there are 14 industries that are in the vicinity of the Tapak River. These industries produce organic and inorganic waste dump wastes into water bodies. The heavy metal contained in waters sourced from use chemical fertilizers as well caused by household activities or industry. Phenomenon occurs corrosion of pipes and consumer products such as detergents will cause these heavy metals to enter waters (Putra *et al.*, 2019)

Heavy Metals Content in Sediments

At the time of discharge of industrial waste into the waters, there will be a process of deposition in the sediments, this led to the concentration of contaminants in the sediment increases. Results of heavy metal content in the sediment at each sampling point indicated different values (Table 5). The content of Pb in sediments ranged from 3.52 to 7.42 mg/kg with a mean of 4.98 ± 1.63 mg/kg, Cr content ranged from 1.08 to 3.01 mg/kg with a mean of 2.31 ± 0.67 mg/kg, and Cd metal content ranged from 1.77 to 3.53 mg/kg with a mean of 2.63 ± 0.63 mg/kg. The test results showed that the content of Pb and Cr in sediments in ponds and Tapak river still within permissible limits Based on Environmental Agency decree No. 51 of 2004, the maximum limit of Pb metal content is 10-70 mg/kg and 5 mg mg/kg. That on the location of the red is the location that contains a lot of heavy metals Pb and Cr. In contrast, Cd content in the sediment ponds and Tapak river known almost exceeds a predetermined threshold. Based on Environmental Agency decree No. 51 of 2004, that the maximum limit of Cd heavy metal content in the sediments is 1-2 mg/kg.

The highest Pb content was found sampling location 7 with the value of 7.42 mg/kg, similarly with Cr content to the amount of 2.90 mg/kg. This may be due to the sampling location which is located at the Tapak river where the disposal of industrial and household wastes located. Metals Pb and Cr also increased at the same point again that the point of 6 with value Pb 6.93 mg/kg and 2.671 mg/kg with a mean of 1.63 ± 0.67 mg/kg and 2.31 ± 0.67 mg/kg although the increase but still below the threshold.

High metals content in the sediment not necessarily occur at the metal content in the water because of the metal contained in the water will settle and accumulating in the bottom waters, and therefore, the content of heavy metals in the water is different to the content in sediment, Heavy metals into waters will experience the deposition process. Heavy metals have properties that easily bind to organic matter and settles in the bottom waters and sediments that are united with the heavy metal content in the sediments is higher than in water (Hutagalung, 1991). Heavy metals have properties that easily ties and settles in the bottom waters and sediments, therefore the content of heavy metals in sediment is higher than in water (Putra et al, 2019).

Heavy Metals Content in Tissue of Milkfish, Vaname shrimp and White Shrimp

Based on the results of the analysis of Pb, Cd and Cr in the tissues of milkfish, Vanamae shrimp and white shrimp showed that Pb, Cd and Cr in the tissues of milkfish, Vanamae shrimp and white shrimp cultured in the brackish water pond of Tapak Village, Tugu district are still below the threshold set by the government and related organizations. As stated by BPOM No.HK.00.06.1.52.4011-year 2009; SNI 7378:2009 specifies that the maximum content of Pb in fish and shrimp tissue as a food ingredient was 0.3 mg / kg, and Cd content of 0.1 mg / kg, while the threshold limit of Cr based EU states that the maximum value of Cr in fish and shrimp tissue at 2 mg / kg (Wu et al., 2009). This is more clearly seen in Table 5,6,7 which provide information that the metals content is at the stage safely as food for consumption.

The heavy metals in the water entered the aquatic organism through three main processes, i.e., through respiration (gill surface), through the surface of the body (skin) and through food, and water particles that enter the digestive system (Connell & Miller, 1995; Wu *et al.*, 2009). The metals are then absorbed by blood, binds to blood proteins which are then distributed to all body. The highest metal accumulation usually in detoxication in liver and excretion in kidney (Suryanto, 2002). Estimation of the accumulation rate of Pb, Cd, Cu, Zn and Ni in green mussels (*Perna viridis* L) measuring > 4.7 cm in the waters of Kamal Muara, Jakarta Bay. Thesis. Marine Science Study Program. Faculty of Fisheries and Marine Science. Bogor Agricultural Institute. Bioaccumulation of heavy metal that occurs in milkfish and shrimps is the effects of heavy metal pollution occurring in the waters of the pond where the cultivation is done and gradually the metal content in the milkfish and shrimps' tissue will increase equivalent to an increase in environmental pollution.

Heavy Metals Content in the water of different Saprobity levels

Water saprobity is the state of water quality caused by the addition of organic matter in the water, which is usually indicated on the amount and composition of the aquatic organisms. Saprobity level identified through analysis TROSAP (Trophic saprobic). This analysis focuses on suitability parameters (Trophik indicator), which indicates the amount of primary productivity as a result bioactivity of aquatic organisms. As for the pollutant parameters (saprobic indicator), shows the decomposition of dead organic matter together bioaccumulation microorganisms against contaminants.

The saprobity level of the research location is an oligosaprobik, α -mesosaprobik and β -mesosaprobik, which means these waters condition is lightly to heavily polluted. Results of overlaid analysis of this saprobity index with other parameters, it can be seen that the waters at the research location 1 and 5 where the location is directly related to the regional sewage plant on the river contain α -contamination at a level mesosaprobic (Figure 1-3). Oligosaprobik classification reflects the quality of water (associated with non-polluted waters) that describes the mineralization process is going well and normal oxygen content and phytoplankton dominated by Desmidiaceae and Chlorophyceae. B-mesosaprobik waters are polluted waters mild; phytoplankton Chlorophyceae and dominated by diatoms, and Euglenophyceae began rare / disappearing, with dissolved oxygen began to rise. α -mesosaprobic waters are being polluted waters: phytoplankton is dominated by Euglenophyceae, blue algae and diatoms. Polisaprobic waters reflecting the heavily polluted waters: phytoplankton is dominated by Euglenophyceae with low dissolved oxygen content (Nemerow 1991) Based on the contour patterns which was analyzed by geospatial methods, it can be seen that the purple area is an area with moderate saprobity conditions, or β -mesosaprobic which is lightly to heavily polluted waters. These results are also in line with the content of heavy metals Pb, Cd and Cr in the waters, which is informed by orange areas. This provides information that there is quite large heavy metal contamination in the waters with β -mesosaprobic level. While at locations 6 with oligo-saprobic condition, Pb content is still in minimum threshold. The GIS data processing method with overlay the basic principles, can simultaneously provide information on the content of heavy metals in milkfish and shrimps. It can be seen that heavy metal content in the tissue of milkfish and shrimps is still relatively safe at different saprobity levels of waters. However, this needs to be aware, in order to avoid further increase in heavy metals that accumulated in the waters and further in the cultured organisms

CONCLUSION

The pollution level in the water categorized by oligosaprobic to β -mesosaprobic which means lightly polluted to heavily polluted. In those condition, heavy metal content was observed exceeded permittable limit for Pb 0.046-0.105 (mg/L), Cd 0.033-0.062 (mg/L), Cr 0.018-0.054 (mg/L) in water and in Cd is 1.77-3.53 (mg/kg) in sediment. However, Pb 3.56-6.93 (mg/kg) and Cr 1.08-3.01 (mg/kg) in sediment revealed in the permittable range. Nevertheless, heavy metal content (mg/kg) in milkfish, vaname shrimp and white shrimp, Pb (0.27-0.39), Cr (0.16-0.23) and Cd (0.12-0, 22) respectively was within permittable limits.

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