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The concentration of lead heavy metal (Pb) in the sediment of Tantui coastal area, Hative Kecil Village, Outer Ambon Bay

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Abstract. The pollution of lead-heavy metal (Pb) not only harmfully towards aquatic organisms, but also to a human directly or indirectly. The objectives of this study were to analyze the concentration of lead-heavy metal (Pb) accumulated in the sediment, to identify human activities potentially increase the lead-heavy metal in the sediment, and to recommend management strategy to minimize lead heavy metal concentration in the sediment surround Tantui coastal area, Outer Ambon Bay. The research was conducted in January 2020. Data on lead heavy metal were sampled purposively from 5 sites along the coastline of Tantui. Samples obtained were then analyzed using Atomic Absorption Spectrophotometry (AAS). Data on human activities were obtained through field observation and interviews using a close questionnaire against respondents taken randomly. Problem tree analysis was used to analyze human activities and produce management strategies. The result shows that lead heavy metal concentration at 5 sampling station range between 0.0975 – 0.1631 ppm. This concentration was not over the standard value allowed. Source of lead-heavy metal identified were marine transportation and domestic waste. Management strategy consent recommended are monitoring on marine transportation, provide littering and sanitation facilities permanently, and beach clean-up as a routine agenda.

1. Introduction

Development in the entire sectors in a state is done in order to prosper the citizens and to advance itself. The advance of a state is indicated by its citizens' life needs fulfillment in primary, secondary and tertiary levels. The citizens' life needs level is straightly compared to amount of population in a state [1, 2]. Population increase in a state especially in a small island contributes more pressure to both the coastal environment and the sea [3, 4], for example public residential building and other public facilities around the coastal environment brings positive and negative effects to the shore.

Ambon as the capital city of Maluku province has become the development and advance centre in many sectors. Ambon city and its development activities has given more ecologic pressure to Ambon Bay where it is located. Ambon city is 377 Km² in landmass or equally to 2/5 of the entire Ambon Island landmass has 384,132 people in 2019 with 3.36% in population growth rate in 2018-2019 period [5]. Prosperity and happiness of the population in Ambon city is the result of the state development success as well as the rise of the environmental problems as the negative effect of the development and the population activities. Various activities has been identified such as sea shore farming, transportation in the bay, waterworks cultivation, river sand and rock mining, and culinary tourism have caused the water environment pollution in Amboina Bay. Moreover, organic and inorganic littering and land development for residential building also caused the sedimentation at the downstream as well as the heavy metal pollution.

Heavy metal pollution in the water contributes some negative effects to human life directly and indirectly. One of the heavy metal that harmfully affected the human life and the water organisms is lead (Pb) [6, 7]. Transportation waste, battery, pipes, paint and some others are the source of lead heavy metal pollution in the water. Previous study also showed that Pb pollution sources of the mangrove in Waiheru area in Ambon are the farming activities, settlement and fishery ships [8]. Tantui



beach is one of the high activity level located in the outer Ambon Bay that has settlements, hospital building, offices, vessels activities and shopping center. These public facilities and activities are the most contributors of Pb pollution in Ambon Bay, which can accumulate in the marine organisms, water column and sediment. Therefore, the objective of the study were to analyze heavy metal lead (Pb) concentration that has accumulated in sediment, to identify the potential of human activities which can increase the lead (Pb) concentration in the sediment and to recommend management strategy to minimize lead concentration in the sediment of Tantui coastal area, Outer Ambon Bay.

2. Materials and Method

2.1. Field work

This study was conducted in January 2020 at Tantui coast Hative Kecil, Outer Ambon Bay, Sirimau District, Maluku Province (Figure 1).

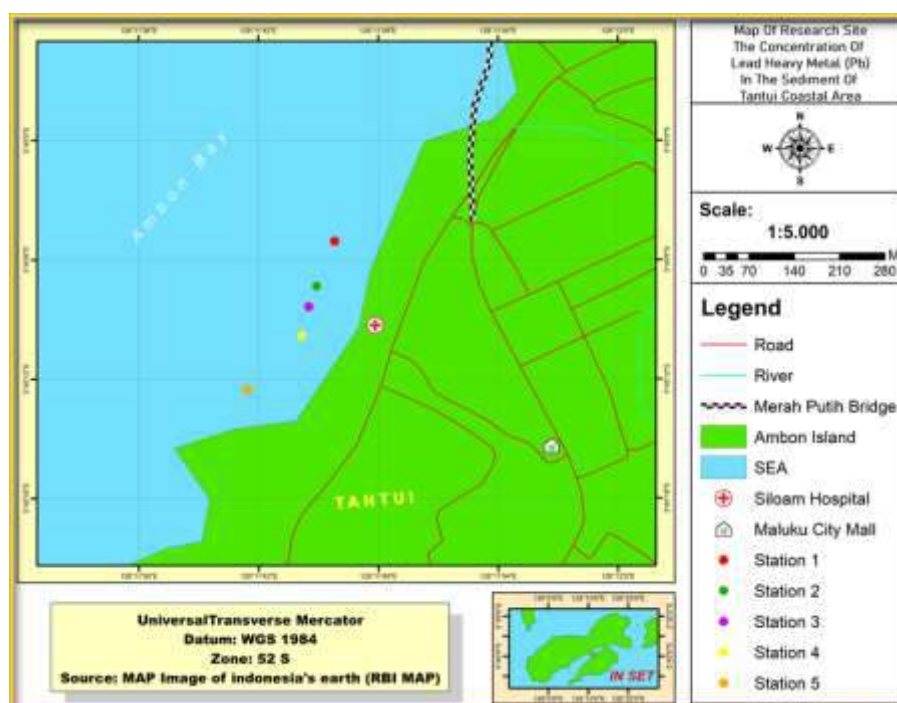


Figure1. Map showing sampling sites

Sample of sediment was taken purposively from five observation sites along Tantui coast during low tide by using a plastic pipe as deep as 20 cm. Two samples of sediment were taken from each sites, one for analyzing lead concentration and the other for analyzing grain size. Data on public activities and management strategy were obtained through interview and questionnaires, which were distributed to the people and the policy maker randomly.

2.2. Sample and data analysis

Sediments were brought to the Standardize and Research Laboratory Ambon to analyze lead concentration by using Atomic Absorption Spectrophotometry (AAS) and its result was then compared to reference value of IADC/CEDA [9]. Meanwhile, particle size of sediment was analyzed by using Wenworth Scale.

Public activities were identified and analyzed descriptively. Problem tree analysis was used to analyze human activities and produce management strategies. Problem tree is a method used to

identify the causes of a problem by creating more structured mindset on cause and effect component according to the relevant priority problem [10].

3. Results and Discussion

3.1. Lead heavy metal (Pb) concentration accumulated in sediment and particle size

The result shows that the lead heavy metal (Pb) at Tantui coast, Hative Kecil values between 0.0975 and 0.1631 mg/kg (Figure 2) and these values is far less than target level of IADC/CEDA [9], so it is not harmful for human health. Station IV has the highest concentration of lead (Pb), while the lowest belongs to station III. The high level of lead heavy metal (Pb) concentration in site IV might be due the effect of solid waste such as plastic bottles, waste tins, detergent plastic bag and waste zinc from settlement and public activities surround the area of Tantui coast.

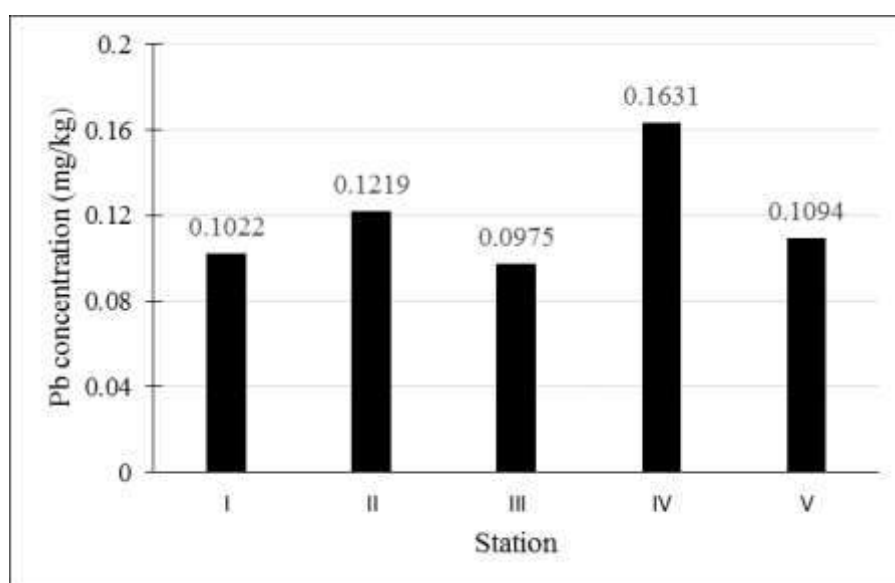


Figure 2. Concentration of Pb in Tantui

Particle size in the study area is dominated by the size of 0.25 mm and its values at station I to station V are 25.55%, 36.12%, 32.97%, 67.84% and 57.24%, respectively. Station IV has higher value of small size particle (0.25 mm) of the sediment than other stations. Heavy metal tends to be absorbed by particles and precipitate in sediment. Heavy metal absorbable in sediment depends on the particle size [11]. So, smaller size particle of sediment in station IV tends to absorb more lead (Pb) compare to other stations. Concentration of lead in this study at Outer Ambon Bay is lower than similar study in Inner Ambon Bay with its sediment was dominated by mud (51.91%) in which lead concentration was 20.075 mg/kg.

3.2. Increase of lead (Pb) concentration in sediment by human activities

Lead (Pb) is used in battery as well as ammunition product, wire coating, pipe and solder [6], while in paint production, lead is used as colorant for its lowest absorbent in water. There are two activities identified in the study that potentially increase lead concentrate in Tantui coast. Firstly, sea transportation activities (Figure 2), which included vessels traffic, loading and boarding activities, ship painting, ship cleaning and other ship maintenance that produce lead (Pb) pollution in the water column as well as in the sediment [13]. Waste fuel of the vessels littered into the sea also contributes to increase lead concentration in the water [8].

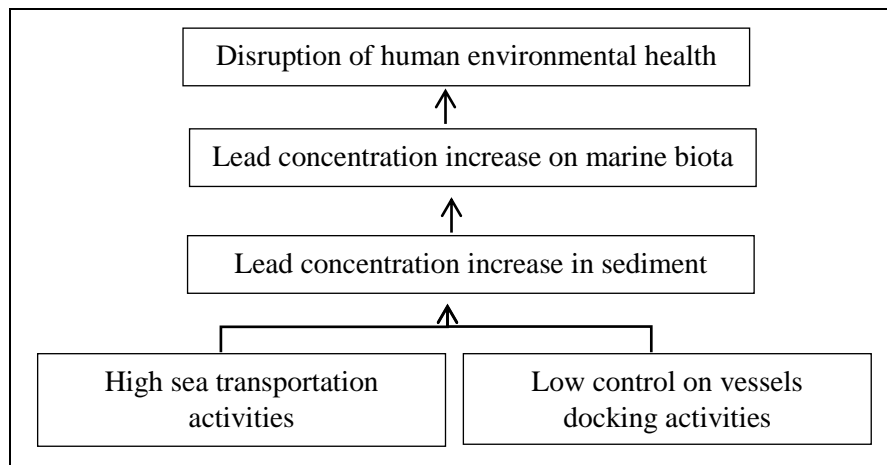


Figure 2. Sea transportation activities problem tree

Secondly, people littering surround the area and the rubbish brought by the stream (Figure 3). The study area is located near to the settlements and The Wairuhu River. During rainy season, wastes and rubbish flow down through Wairuhu River and covered Ambon Bay. Even not all waste and rubbish potentially increase the lead concentration, but they potentially rise lead presentation in the water column and in the sediment through food chain and other process. Lead heavy metal is harmful to marine organism because it can damage the nerve system that cause decrease of swimming balance, or sudden death of the fish when it sticks on the gill [6]. Lead heavy metal contaminates human through food chain, and it is harmful to human health, so it is important to decrease lead concentration in the waters and sediment.

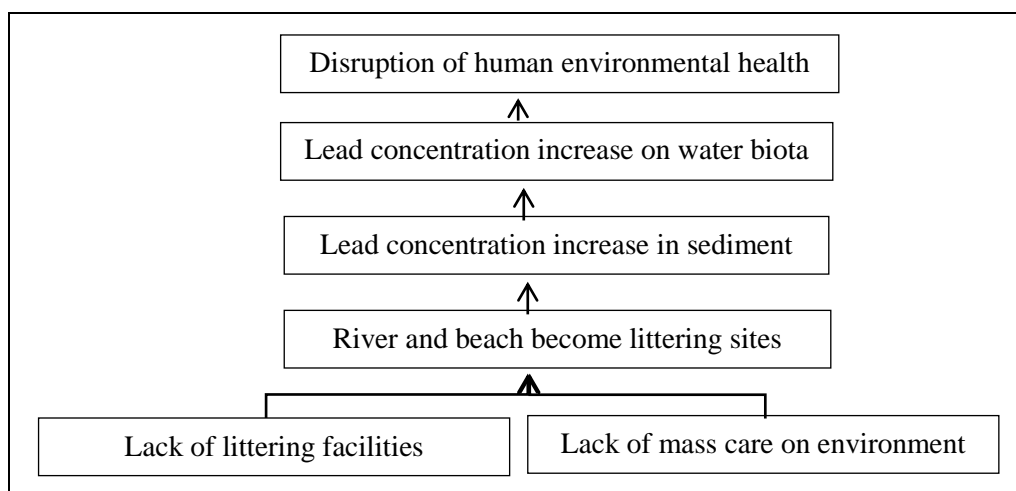


Figure 3. Littering activities problem tree

3.3. Management strategy to minimize lead (Pb) concentration accumulated in sediment

Based on the description of the problems of human activities that originate from marine transportation and waste disposal, some following management strategies can be proposed to reduce the concentration of Pb in sediments and in the waters column of Tantui Beach namely:

:

1. To execute public and government control on sea transportation activities especially on vessels docking. Public control can be conducted by public care group with sea and coastal environment conservation interest;
2. To provide littering and sanitation facilities permanently which are easily accessed by the society and sanitation fleet;
3. To do cleaning activities regularly on the land as well as the coastal to decrease the waste and litters on Ambon Bay

4. Conclusion

Based on the result of this study, it can be concluded that lead (Pb) concentration in the sediment of Tantui Coast is less than the lower limit, so it is not dangerous yet for human health. However, some action such as control of transportation activities especially vessel docking, provide littering and sanitation facilities as well as do regular cleaning should be considered to minimize lead (Pb) concentration in Ambon Bay.

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