

Analysis Quality of Environmental Health in Coastal Communities

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Abstract— Health quality of the coastal environment is very critical due to sea water pollution by industrial waste, ports, marine transportation, domestic waste and community activities. Sea water pollution will have an impact on the environment, especially community water resources. Pollutants such as heavy metals pose a threat to public health. This study aims to analyze the quality of the environment and to measure the magnitude of environmental health risks in coastal communities. This is quantitative research that analyzes the concentration of heavy metals in the coastal and public health at risk. Sample subject is the community who use bore well and the sample of the object is bore well around Belawan and sea water. Methods used for analyzing the concentration of Pb and Cd is AAS (Atomic Absorbstion Spectrophotometer), environmental health risks is measured by the EHRA (environmental Health Risks Assessment) method.

The Results is Pb concentration average in marine is 0.052 mg/l and Cd is 0.004 mg /l. Pb concentration in drinking water with an average 0,002 mg /l and Cd is 0.001 mg /l, the amount of health risks RQ <1. Public complaints found were digestive disorders, skin diseases, headaches, arthritis etc. Environmental management by implementing risk management of health needs to be done in an effort to minimize contamination of Pb and Cd in coastal areas of Belawan.

Keywords— Pb and Cd, sea water, drinking water, health risks

I. INTRODUCTION

Major cities in Indonesia are generally located in coastal areas, the characteristics of coastal areas with characteristics towards the land affected by the physical properties of the ocean such as tidal, wind, wave and intrusion and seaward influenced by natural processes on land such as sedimentation, the flow of fresh water from the stream watersheds, domestic sewage, industrial and agricultural. Environmental pollution in coastal areas make the

waters along the shoreline and the beach itself becomes unfit for use by the general public and has become a global health problem [1].

Health quality of the coastal environment is very critical due to sea water pollution by industrial waste, ports, marine transportation, domestic waste and community activities. Polluted sea will have an impact on the environment, especially the quality of community water sources. Belawan is a coastal area in Medan city, heavy metal pollution has taken place in the region's waters of Belawan, as in previous studies which found marine life that has been contaminated with heavy metals Pb, Cd and Cr [2].

Heavy metals are elements that are not degradable (persistent) and can accumulate through the food chain (bioaccumulation), with long-term adverse effects to living beings and can spread far from the original source [3]. heavy metals are very harmful to human health because it cannot be destroyed by microorganisms and accumulates in the environment, especially the water-component parts by forming complex compounds together with inorganic and organic compounds by adsorption and combined [4].

Pb is neurotoxic which can accumulate in the body, Pb high in the body causing disorders of hemoglobin synthesis of blood, neurological disorders (nervous), disorders of the kidneys, the reproductive system, acute or chronic nervous

system, and impaired function of the lungs. In addition, it can lower the IQ of young children if there are 10-20 $\mu\text{gr} / \text{dl}$ in the blood, every increase of 10 $\mu\text{gr} / \text{dl}$ in the blood would reduce IQ by 4 points [5].

Cadmium is a silvery white metal, soft, shiny, insoluble in alkaline, easy action and produce oxides when heated [6]. Cadmium is a metal which when taken into the body will settle and accumulate in certain time which caused damage, not only on the bones and kidneys but also testis, heart, liver, brain and blood system. Cadmium accumulated in the long term can inhibit the action of the lungs, and even lead to lung cancer, nausea, vomiting, diarrhea, cramps, anemia, dermatitis, slow growth, kidney and liver damage, and cardiovascular disorders. Cadmium can also damage bones (osteomalacia, osteoporosis) and increased blood pressure. Cadmium poisoning Common symptoms are pain in the chest, shortness of breath (short), cough, and weakness [7].

Another phenomenon the location of this study has been found Pb and Cd of freshwater resources of the communities living in coastal areas. Seawater intrusion is suspected as the primary cause in which there has been a process of sea level rise that sea water into the wells of the population. Medan based research [8] states in Belawan sea water intrusion has reached 13 Km of coastline. Seawater intrusion assumed that it could cause heavy metal pollution of freshwater resources population that is shallow wells and deep wells. Belawan coastal Presence of heavy metals Pb, As and Mn in drinking water cause effects on the health effects, especially in infants of pregnant women who consume water that has been contaminated with heavy metals [9]. Research on the risk of consuming contaminated drinking water in Kohistan, North Pakistan in measuring the risk of contamination of Cu, Co, Cr, Mn, Ni, Pb, Zn and Cd in drinking water of the population. The pollution comes from activities geogenic the process of weathering, erosion and anthropogenic activities are mining, industrial waste, domestic and agriculture [10] communities still exist that utilize the artesian well water as a source of drinking water [10].

Pollutants such as heavy metals pose a threat to the health of coastal communities, especially

Belawan, seawater intrusion phenomenon allows community water sources polluted by heavy metals. People who use the water as drinking water in particular will be exposed to heavy metals contained in their drinking water. Further studies can be done is to analyze the risk in people who consume drinking water sourced from clean water from wells in coastal areas.

Studies of environmental health risk analysis is one method of study environmental effects on health. This method is very suitable for the study of environmental impact on public health in the Environmental Impact Assessment is being able to predict the risk of exposure by the projection period ahead. Environmental health Risks Assessment (EHRA) consists of four stages of assessment, namely hazard identification, dose-response analysis, exposure analysis and risk characterization. These measures should not be done sequentially, unless the risk characterization as the last stage [11]. The study method is the result of research EHRA exposure to arsenic in drinking water in Bangladesh society cause of death based on the study cohort [12].

The phenomenon of environmental quality in coastal Belawan pollution source of some concern to human activities cause pollution both at sea and on community water sources. This condition if it continues to be an impact on public health. Based on these studies will be needed to analyze the presence of heavy metals in the coastal environment and quantify health risks in people who are exposed to heavy metals.

II. METHOD

This study is a quantitative study is to analyze the levels of heavy metals in the coastal environment is by measuring the levels of Pb and Cd in the waters, Pb and Cd in drinking water sources and the population large measure on the public health risks. The sample was seawater, drinking water that comes from borewell and the people who live in coastal consume drinking water from the source of the borewell. The data analysis research variables are as follows:

- a. Seawater samples taken 3 points in the territorial waters of the subdistrict of Medan Belawan, Parameters measured were physical quality (odor, taste, clarity),

chemical (temperature, DO, BOD and PH, Cd, Hg, Ar, Pb), and biology then the results were compared with LH Decree No. 51 of 2004 regarding marine water quality standards.

- b. Samples of drinking water taken from wells drilled in the study site there are a number of 89 samples of the wellbore, the determination of sampling wells with a random sampling of a number of parameters measured is the concentration of Cd and Pb in drinking water. The results are then compared with Minister Regulation Number 492 / Menkes / 2010 on drinking water quality requirements. NAB 0:01 Pb mg / L, Cd 0.003 mg / L.
- c. Analysis of environmental health risks conducted the analysis stage of exposure, dose response analysis, risk characterization and risk management. ARKL method by measuring the variables of the public to sample analysis stage exposure is measured variable; concentration of drinking water consumed (mg / l), the rate of intake (l / day), weight (kg), the duration of exposure (years), the time period average (Dt x 365 days) all these variables to measure Intake (intake). This is described in the equation below

- I : Intake mg / kg / day
- C : Risk agent concentration, mg / L for drinking water
- R : Intake or consumption rate, L / day for drinking water
- f_E : Frequency of exposure, day / year (residential 350 days)
- D_t : Duration of exposure, (the real time or projection, 30 years for residential default value)
- W_b : Weight, kg
- T_{avg} : the average of period time (D_t × 365 days / year for non-carcinogens, 70 years × 365 days / year for carcinogens)

$$I = \frac{C \times R \times f_E \times D_t}{W_b \times T_{avg}} \quad (1)$$

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Reference Doses of Pb (RfD Pb) = 4 x 10⁻³
RfD Cd = 5 x 10⁻⁴

III. RESULT AND DISCUSSION

A. Pb and Cd Concentration in The Seawater

Based on laboratory test results to the results obtained tidal conditions and Cadmium Pb concentration is above the quality standard of value, this means has been heavily polluted coastal waters

as well as with the valence of chromium 6 and nitrates also exceeded the quality standard. Suspected pollution sources come from domestic sewage, industrial and harbor. This location has 8 major industries, 15 industries and 32 small home industries.

TABLE I
PB AND CD CONCENTRATION IN THE SEAWATER

Sample Location	Cd (mg/l) TLV =0.002	Pb (mg/l) TLV =0.005	Cr val6 (mg/l) TLV=0.002	PH 7 – 8.5	DO Min 5
MEDAN BELAWAN	TIDE				
1.N 03.79010 E 098.69701	0.0062	0.064	0.019	7.6	5.0
2. N 03.78963 E 098.68475	0.0054	0.032	0.021	6.8	5.03
3. N 03.78898 E 098.67907	0.0032	0.060	0.022	6.6	4.77
Mean:	0.0042	0.052	0.020	7.0	4.93
	LOW TIDE				
1.N 03.79010 ⁰ E 098.69701 ⁰	0.001	0.056	0.017	8.5	8.0
2. N 03.78963 ⁰ E 098.68475 ⁰	0.0017	0.063	0.019	8.2	9.1
3. N 03.78898 ⁰ E 098.67907 ⁰	0.0021	0.053	0.021	8.1	7.9
Mean:	0.0016	0.057	0.019	8.26	8.3

B. Metal Pollution in Borewells

The measurement results Sample some 89 boreholes used by the people as the main source of drinking water in the obtained results mean Pb concentration is 0.0045 mg / l, with a value of Standard Deviation (SD) = 0.0057 and a maximum value of 0.026 mg / l. There are a number of 13 (14.6%) drilled wells have concentrations of Pb exceeds the threshold limit value, Threshold Limit Values for Pb based Permenkes RI. No. 429 / Menkes / PER / IV / 2010 0.01 mg / L.

Cd concentration in the wellbore is still below the threshold value, the value of the average concentration of 0.001 mg / l, SD 0.0006 mg / l and a maximum value of 0.0028 mg / l. Cd concentration was still below the threshold value is 0.005 mg / l. Pollutant sources are assumed waters, seawater intrusion factor as originator of the contamination of the wellbore which is used by the people as a source of drinking water. Sea water intrusion in the city of Medan had reached 13 Km [8] and the results of the health center reports there are some 48.7% reported unhealthy home, wastewater disposal systems directly into the sea.

Results table below describes the characteristics of the wellbore includes Distance wells from pollution sources are assumed to be water, depth, age of the wellbore and the concentration of Pb and Cd in drinking water of the population.

TABLE II
CHARACTERISTIC DISTRIBUTION OF BOREWELL

Characteristic	N	Minimum	Maximum	Mean	SD
Distance	89	1.2	462	144.37	121.64
Depth	89	66	180	94.43	17.84
Pb Concentration	89	0.0005	0.026	0.004	0.005
Cd Concentration	89	0.00004	0.004	0.0013	0.001

C. Environmental Health Risks Assessment

A total of 34 respondents consume drinking water that has been contaminated with Pb, but poses no risk of this can be explained from the calculation analysis of health risks from exposure to lead in drinking water such as in the results table below. Results The mean RQ = 0:04, RQ = 0.020 minimum value, maximum value 0325 with SD = 0:52. The magnitude of health risks (RQ) is still under one (RQ <1) This means that at the time of the study there is no health risk, meaning Pb in drinking water that are resident at the time of measurement do not pose a risk despite being polluted. Pb heavy metal is said to be very dangerous to human health that cannot be destroyed by microorganisms and accumulates in the environment, especially the water-component parts to form a complex compound together with the organic and inorganic compounds by adsorption and combined [14].

The results of the samples of underground water in Bagjata India with resources obtained mining waste contamination Pb levels in drinking water sources 0.028 mg / l with RQ) <1 [14]. Although the RQ <1 but the exposure will take place throughout the period, the nature of Pb in the body accumulate and accumulate currently not at risk, but a few years later is likely to cause health effects for society. Symptoms of lead poisoning in the community such as abdominal pain, nausea, diarrhea, neuropathy peripheral nerves, muscle weakness, hands and feet, headaches, depression and anemia.

TABLE III
Result of Risk Assessment Analysis and Risk Quotion Of Pb

Variable	Mean	Median	Min	Max	SD
Concentration (C) mg/L	0.0045	0.0025	0.0054	0.026	0.056
Consumption Rate (R), L/day	1.8795	2.0	1	5	0.69
Frequency of exposure (f _E) day / year	323	350	48	350	59.56
Duration of exposure (Dt) in year	23.2	20.0	1	70	15.96
Weight (W _b),Kg	56.38	59.00	20	94	16.065
T _{avg} the average of period time (D _i × 365 days / year for non-carcinogens	8470	7300	365	25550	5826
Intake (I)	8x 10 ⁻⁵	5 x10 ⁻⁵	5 x10 ⁻⁶	5 x 10 ⁻⁴	8.7x 10 ⁻⁵
RQ Pb	0.0419	0.0241	0.02	0.325	0.525

In Table 4 below the maximum value for Cd 0.78 RQ (RQ <1), this means that the content of cadmium in drinking water do not pose a risk community at the time of measurement lasts. Similarly, the risk Pb at the time of measurement, but still there is no guard against for the foreseeable future.

TABLE IV
Result of Risk Assessment Analysis and Risk Quotion Of Cd

Variable	Mean	Median	Min	Max	SD
Concentration (C) mg/L	0.00127	0.0013	0.00004	0.005	0.0007
Consumption Rate (R), L/day	1.8795	2.0000	1	5	0.69
Frequency of exposure (f _E) day / year	323	350	48	350	59.56
Duration of exposure (Dt) in year	23.2	20.0	1	70	15.96
Weight (W _b),Kg	56.38	59.00	20	94	16.065
T _{avg} the average of period time (D _i × 365 days / year for non-carcinogens	8470	7300	365	25550	5826
Intake (I)	4.8 x10 ⁻⁵	4.1 x10 ⁻⁵	7.1x10 ⁻⁷	3.9x10 ⁻⁴	4.3x10 ⁻⁵
RQ Cd	0.097	0.082	0.001	0.781	0.086

The results showed that the borewells of community werenot contaminated based on the calculation of the environmental health risk analysis (EHRA) was obtained RQ <1. This means that the presence of Cd in drinking water has no health risk to community. RQ is not only depending on the concentration of Cd in drinking water, the amount

of consumption per day; weight and length of stay also play a role. Maximum consumption 4 L per day not show a health risk with maximum $RQ = 0,781$. Nevertheless, the nature of Cd accumulates in the body, if the content of Cd in drinking water has exceeded the NAB (Permenkes 492 in 2010) feared for a long time will have an impact on health. However, any dose above zero is always has effect.

The sources of Cd pollution in humans not through consumption of oral only, but can also by air (inhalation) and through the skin. Cadmium is a heavy metal elements which are not needed by the body and toxic.

IV. CONCLUSION

Pb concentration average in marine is 0.052 mg/l and Cd concentration average is 0.004 mg /l. Pb concentration in drinking water with an average 0,002 mg / l and Cd levels in drinking water with a mean of 0.001 mg / l and the amount of health risks $RQ < 1$. Public complaints found were digestive disorders, skin diseases, headaches, arthritis and so on. Environmental management by implementing risk management of health needs to be done in an effort to minimize contamination of Pb and Cd in coastal areas Belawan so the quality of health of the coastal environment can be improved.

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