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ASSESSMENT THE LEVELS OF HEAVY METALS AND WATER QUALITY IN CIKUDA RIVER, INDONESIA

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ABSTRACT
This study was conducted to assess the impact of activities in campus University of Padjadjaran (UNPAD) on the water quality as a result of the entery of pollution materials from laboratories, food courts, agriculture and domestic waste in campus UNPAD to Cikuda River. The accumulation of heavy metals in fresh waters has direct consequence to man and ecosystem. This study was aimed to determine the concentration of Pb, Zn and Mn, and water quality in Cikuda River. Samples were collected from nine sites. The total metal contents in water were determined using Atomic Absorption Spectrophotometer (Shimadzn AA-6300) Pb 0.01mg/L, Zn 0.62±0.48mg/L and Mn 0.14±0.13mg/L. Our survey showed that Pb lower than Standards Quality Regulation of the Republic of Indonesia No.82, 2001, about water quality management and control of pollution. Zn and Mn higher than Quality Standards. For the other water quality parameters the results showed that significant pollutional increase at the effluent impacted site. pH 6.93±0.67, BOD 2.68±1.91mg/L, Nitrate 0.60 ±0.96mg/L, Ammonia 0.80 ±0.16mg/L, PO_4 0.29±0.10mg/L, DO 4.28 ±1.45mg/L Temperature 26.65 ±1.22C^0 and Transparency 38.33 ±17.31cm. A close monitoring of water pollution and metals pollution is strongly recommended especially in water.

KEY WORDS: Heavy metals, Pollution, Water Quality, Cikuda River.

INTRODUCTION

Aquatic pollution is one of the current global environmental issues. Due to rapid industrialization and unplanned urbanization many Rivers in Indonesia are experiencing complicated problems of pollution. As a result aquatic sources are highly at risk due to accumulation high concentrations of chemicals from surrondings (Onkar and Sulochana, 2015). It causes reduction in the water quality of water (pH, DO, BOD, *etc*). Thus, water bodies are frquently stores for a large variety of xenobiotics which cause the biochemical and histopathological alterations in fish and other aquatic organisms. From the very dawn of human civilization, due to uncontrolled greed, the over utilization of natural resources has been taken place which caused unparallel devastation. Recently, with the unplanned growth of industrialization, rapid urbanization and degradation of aquatic resources, by using them as dumping grounds for sewage, deforestation, depletion of water resources has played a crucial role in deterioration of aquatic ecosystems on the earth. Rivers are more affected these days because they receives polluted water from various sources through rivers and streams (Onkar and Sulochana, 2015). Heavy metals, including both essential and non-essential elements, have a particular significance in eco-toxicology. They are highly persistent and have the potential to be toxic to the living organisms. Heavy metal concentrations in aquatic ecosystems are usually monitored by measuring their concentration in water (Ebrahimpour and Mushrifah, 2008). Human activities have led to accumulation of toxic metals in the natural environment (Karbassi and Bayati, 2005) and the extensive exploitation of natural resources has led o increased pressure on aquatic ecosystems. Resultantly, due to an increased load of heavy metals the aquatic ecosystems have severely disrupted. Elevated concentrations of pollutants in these systems have resulted in bioaccumulation of toxic metals and a serious environmental problem, which threatens aquatic organisms and human health (Sasmaz *et al.,* 2008). Rivers play a significant role as they serve not only the purpose of water supply for domestic, industrial, agricultural and power generation but also utilized for the purpose of sewage and industrial waste and therefore are put under tremendous pressure (Subin and Husna, 2013). Many large industrial factories including paint manufacturing, plants, pesticide and insecticides and Soyabean factories and many activities in campus University of Padjadjaran are located along the banks of the Cikuda River and discharges polluted water into it. Effluents from these factories have caused severe contamination of water in the Cikuda River. The purpose of this study was to determine the concentrations of lead (Pb), zinc (Zn) and Mangenes (Mn) and water quality in Cikuda River.

2.MATERIALS & METHODS

2.1.Study Area

Regional research areas included in the Watershed Cileles, while more specifically the research in Cikuda River, which became the main focus of many activities. Sub-watershed Cileles in general has a radial drainage pattern in the northern and the southern parts of the drainage pattern of sub-parallel to the morphology of the volcanic hills sloping. Many activity take place in the campus University of Padjadjaran and surrounding area Jatinangor, Sub-District Cikeruh, district of Sumedang Province of West Java, Indonesia.

2.2.Time and Place of the Study

This study was conducted during the wet season 2015, in the field and examination of samples in the laboratories. The analysis of samples were carried out in the laboratory of water quality in Institute of Ecology (UNPAD, Bandung), and for heavy metals were performed in laboratory of basic chemistry, Department of Chemistry, Faculty of Mathematic and Natural Science.

2.3 Method of the Research

The method was used in this study is a survey method, which examines the impact of activities in the UNPAD campus to the water quality (physical and chemical), in Cikuda River.

2.4.Data Collection

Data was collected in the area around Cikuda River in this study and that include: Physical parameters : Temperature and Transperancey, Chemical Parameters include: pH, DO, BOD, NH_3, NO_3-N, PO_4-P, and heavy metals that's include Pb, Zn and Mn.

2.5.Analysis of Water Quality

2.5.1.Analysis of DO and BOD

50 mL of water samples were taken from Winkler bottles by using a pipette and Erlenmeyer inserted into the tube. Titration with 0.025 N $Na_2S_2O_3$ solutions to change the color to yellow. Unused volume is recorded. Then add amylum 1% until the color changes from blue to clear. Dissolved oxygen calculated using the following formula:

$$\text{Dissolved Oxgen (mg/L)} = \frac{8000 \text{ X } Na_2S_2\,O_3 \text{ X N } Na_2S_2\,O_3}{50 \text{ X } (V - \frac{2}{V})}$$

Where;

8000 = molecular weight of oxygen in 100 mL

ml $Na_2S_2O_3$ = Total mL $Na_2S_2O_3$, unused titration

N Na_2S_2 $Na_2S_2O_3O_3$ = Normality $Na_2S_2O_3$, which is used in the titration (0.025)

50= Number mL water sample which was titrated(50 mL)

V= Volume Winkler bottles, which are used (300 mL)

2= The amount of water, which came out at the time Winkler bottles Close.

2.5.2.Measurement of Ammonia (NH_3-N)

Water samples were filtered as much as 25 ml put in a test tube. The sample added 1mL seignette then added 0.5 mL Nessier. The solution was left to stand for 10 minutes then the ammonia levels were measured using HACH spectrophotometer with a wavelength of 425 nm (Swingle, 1969).

2.5.3.Orthophosphate Measurement (PO_4-P)

Water samples were filtered as much as 10 ml and added 0.5 mL of ammonium molybdate and 0.25 mL of $SnCl_2$ (2%). The solution allowed standing for 10 minutes then orthophosphate levels were measured using a HACH spectrophotometer with a wavelength of 650 nm (Swingle, 196 9).

$$\mathbf{PO_4\text{-}P(mg/L)} = \frac{1000}{25\,(\textit{Sample volume})} \boldsymbol{X} \frac{\text{Absorbance } \textit{Sample}}{\text{Absorbance Standard}} \textbf{ X 5} \text{ micrograms}$$

2.5.4. Measurement of Nitrate(NO_3-N)

Water samples were filtered by 25 mL and add 0.5 mL of Sulphanic acid and 5 mL and after that hating until near to be dry and add 1 mL Phenol diselphonic acid and we can put it in water bath until the 80 ^{0}C . after that add NH_4OH (10%) 5 mL Once mixed and allowed to stand for 10 minutes then nitrate levels will be measured by using a HACH spectrophotometer with a wavelength of 425 nm (Swingle, 1969).

$$\mathbf{NO_3\text{-}N\ (mg/L)} = \frac{1000}{25\,(\textit{Sample volume})} \boldsymbol{X} \frac{\text{Absorbance } \textit{Sample}}{\text{Absorbance Standard}} \textbf{ X 5} \text{ micrograms}$$

2.5.5. Measurement of Heavy Metals in Water

The method was used for the testing of heavy metals Pb, Mn and Zn in Cikuda River and obtained from comparing with Government Regulation No. 82, 2001 on Management of Water Quality and Water Pollution Control. Measurements of heavy metals were performed using atomic absorption spectrophotometric (AAS), Heavy metal content measurement procedure carried out by SNI No. 06-6989.6-2004 about Water and Waste Water - Part 8, How to Test Lead (Pb) by Atomic Absorption Spectrophotometer (AAS) - Flash and Part 7, How To Test Zinc (Zn) and Manganese (Mn) by Atomic Absorption Spectrophotometer (AAS) - flame is as the following:

Sample of 100 ml water added to 5 mL of Nitric acid HNO_3. Samples were heating until almost dry Add 50 mL of distilled water, filtered by using Whatman filter paper No. 41, placed as a sign in 100 mL volumetric flask. Samples were measured by Atomic Absorption Spectorphotometer Shimadzn AA-6300 with a wavelength of 283.3 nm Pb, and Zn 213.9 nm.

3.RESULTS

The total metal contents in water were determined using Atomic Absorption Spectrophotometer (Shimadzn AA-6300) Pb 0.01mg/L, Zn 0.62±0.48mg/L and Mn 0.14 ±0.13mg/L. Our survey showed that Pb lower than Standards Quality Regulation of the Republic of Indonesia No.82, 2001, about water quality management and control of pollution. Zn and Mn higher than Quality Standards. For the other water quality parameters the results showed that significant pollutional increase at the effluent impacted site. pH 6.93 ±0.67, BOD 2.68 ±1.91mg/L, Nitrate 0.60 ±0.96mg/L, Ammonia 0.80 ±0.16mg/L, PO4 0.29 ±0.10mg/L, DO 4.28 ±1.45mg/L Temperature 26.65 ±1.22C^0 and Transparency 38.33±17.31cm.

Heavy metal pollution is a serious and widespread environmental problem due to persistent toxicity, non biodegradable and bio-accumulation properties of these contaminants. The mean values of heavy metals detected in water from Cikuda River are presented in Table 1 and are compared to the maximum permissible limits of WHO and standard quality Regulation of the Republic of Indonesia No. 82, 2001, about Water Quality Management and Control of Pollution. The Zn and Mn are above permissible limits prescribed under Regulation of the Republic of Indonesia, No. 82, 2001 and WHO standards and for Pb less than permissible limits.

3.1.Heavy Metals in Water

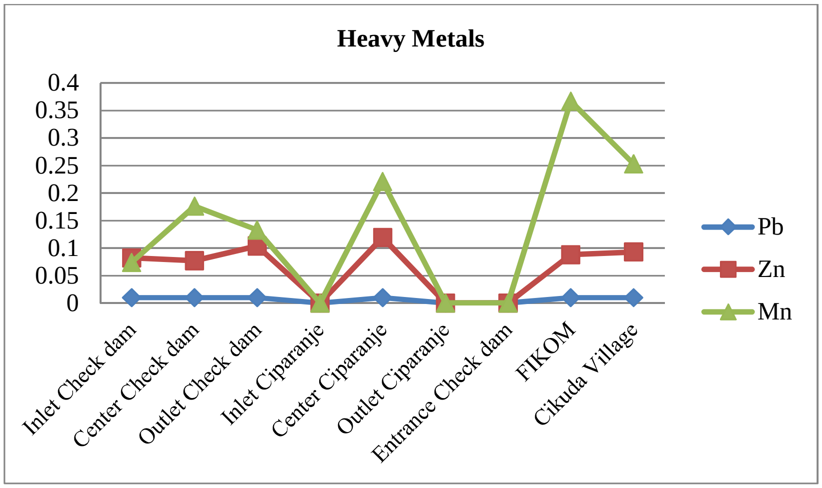

FIGURE 1: Distribution of heavy metals in nine stations

TABLE 1: Mean and Standard Devation of heavy metals and other aquatic parameters

Parameters					Quality standards*	
	Minimum	Maximum	Mean	Std. Deviation	Class III	Class IV
BOD	0.63	5.56	2.68	1.91	6	12
Nitrate	0.08	3.06	0.60	0.16	20	20
Ammonia	0.01	0.50	0.80	0.16	(-)	(-)
Orthophosphate	0.22	0.56	0.29	0.10	1	5
Pb	0.00	0.01	0.01	0.01	0.03	1
Zn	0.00	0.12	0.63	0.48	0.05	2
Mn	0.00	0.37	0.14	0.13	(-)	(-)
DO	2.40	6.50	4.28	1.45	3	0
pH	5.41	7.70	6.93	0.67	6-9	5-9
Temperature	24.00	28.00	26.66	1.22	(-)	(-)
Transparency	12.00	66.00	38.33	17.31	(-)	(-)

***) Quality standards :** Quality Standards Regulation Republic of Indonesia Number 82 Of 2001 on Water Quality Management and Water Pollution Control

(-) no value

3.1.1.Lead

The level of Pb is 0.01 mg/L which is below permissible limits. Water comes from various industries like paint industry, refining and manufacturing of Pb coating goods. It is very toxic in nature and causes many diseases. A remedy must be sought for the gradual phasing out of Pb from various industries by using new technologies.

3.1.2. Zinc

The average concentration of Zn in water is 0.63 mgl/L which is above permissible limit. Zinc is used in plastic industries, cosmetics, steel processing, printing ink and in rubber production.

3.1.3. Manganese

The average abundance of manganese is 0.14 mg/L which is above permissible limit. It is used in metallurgical processes, manufacturing of dry cell batteries and fertilizers.

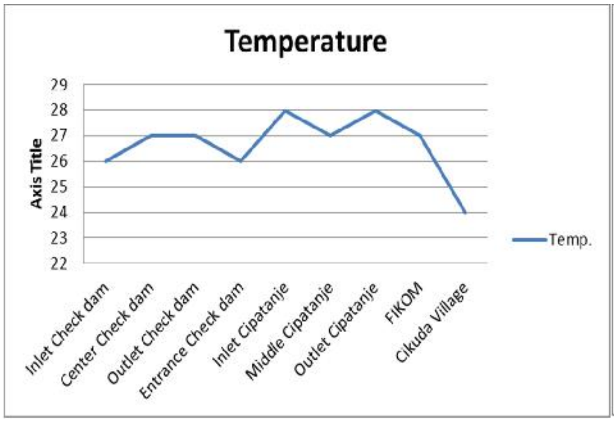

FIGURE 2: Temperature

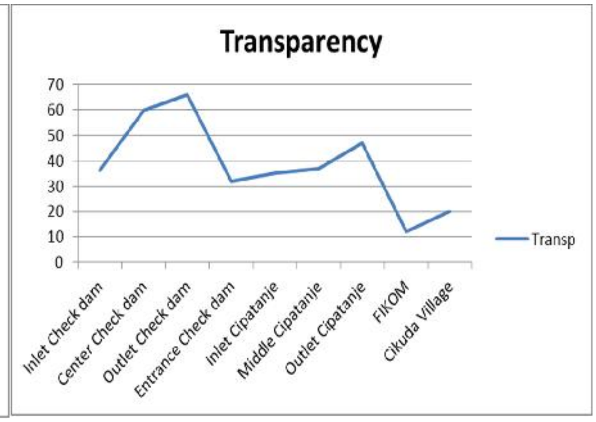

FIGURE 3: Transparency

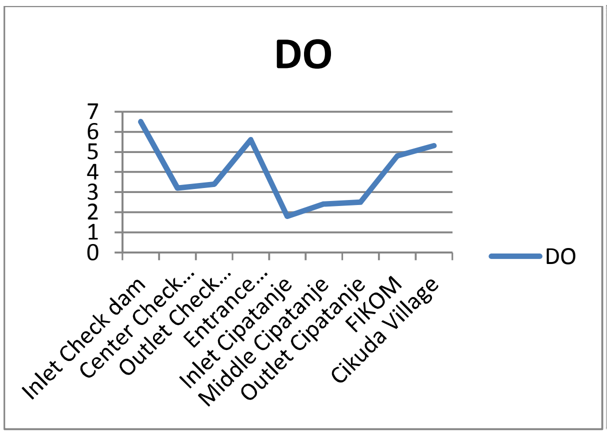

FIGURE 4: Dissolved Oxygen

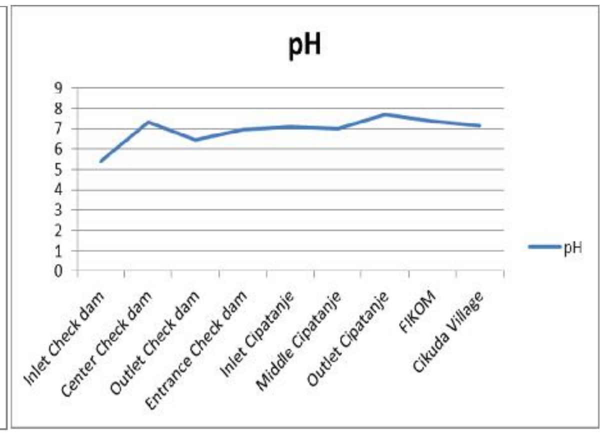

FIGURE 5: pH

4.DISCUSSION

Some studies that reported the allowable limits of the levels of some heavy metals in River water are available elsewhere (FAO, 1985). As recommended by the WHO and Food and Agriculture Organization (FAO) guidelines, the maximum allowable limits of heavy metal concentrations the maximum concentrations of those metals in groundwater and mixed water are depicted as well (Fahad, 2015). It has been found that the levels of Mn, Zn and Pb in both groundwater and mixed water are suitable for irrigation use. High levels of those metals could be attributed to the contribution from anthropogenic sources. Industrial and/or domestic activities may be the source of contribution by Mn in the environment of the study area. On the other hand, the source of Cd could be from phosphate fertilizer that is usually used in that area. Another study conducted in Australia recommended ranges of some heavy metal concentrations that are fit for irrigation consumption. Those ranges are 0.2–10.0, 2.0–5.0, and 2.0–5.0 mg/L, for Mn, Zn, and Pb, respectively. In the current study, it has been also found that the levels of all heavy metals are in the range of the Australian study especially for Mn and Zn above Pb less than Australian study. It could be concluded that the levels of Mn, Zn, and Pb in the Cikud River are suitable for irrigation purpose. The wide range of the levels and the high level of Zn in wastewater reflect that some sites in the study area could be enriched from man-made effluents.

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REFERENCES

Ebrahimpour, M., Mushrifah, I. (2008) Heavy metal concentrations in water and sediments in Tasik Chini, a freshwater lake, Malaysia. -Environmental Monitoring and Assessment 141: 297-307.

Fahad, N. Assubaie (2015) Assessment of the levels of some heavy metals in water in Alahsa Oasis farms, Saudi Arabia, with analysis by atomic absorption spectrophotometry. Arabian Journal of Chemistry Volume 8, Issue 2, March 2015, Pp 240–245.

FAO (1985) Water quality for agriculture. Irrigation and drainage paper 33. FAO, Rome.

Karbassi, A., Bayati, G.R.N.-BI. (2005) Environmental geochemistry of heavy metals in a sediment core off Bushehr, Persian Gulf. -Iranian Journal of Environmental Health Science and Engineering 2: 255-260.

Onkar, B. & Sulochana, J. (2015) Evaluation of Water Quality Pollution Indices for Heavy Metal Contamination Monitoring in the Water of Harike Wetland (Ramsar Site), India. *Int. J of Sci and Research Publications*, Volume 5, Issue 2, February 2015, ISSN 2250-3153

Sasmaz, A., Obek, E., Hasar, H. (2008)The accumulation of heavy metals in Typha latifolia L. grown in a stream carrying secondary effluent. -Ecological Engineering, 33: 278-284.

Subin, M.P. & Husna, A.H. (2013) An Assessment on the Impact of Waste Discharge on Water Quality of Priyar River Lets in Certain Selected Sites in the Northern Part of Ernakulum District in Kerala, India. International Research Journal of Environment Sciences 2(6): 76-84.

Swingle (1969) Standarisation of Chemical and Analysis Water and Pond Muds, FAO, Roe. Fisheries Report 44(4): 325-397.