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Ecological risk assessment of heavy metal pollution in surface sediment of Mahakam Delta, East Kalimantan

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Abstract

Spreading heavy metals in the water column may subsequently be accumulated in sediment because of low solubility then become sensitivity indicator for aquatic organism. Ecological risk is assessed through the heavy metals concentration in the surface sediment. Sediment samples were grabbed from 20 stations in Mahakam Delta. Hakanson method was used to identify ecological potential risk of heavy metals pollution. The results showed that Zn (70.63 mg/kg), Cr (4.93 mg/kg), Cd (0.11 mg/kg) and Ni (33.48 mg/kg) exceeded Threshold Effect Level. Furthermore Ni exceeded Probable Effect Level. Ecological potential risk of heavy metals sequence was Pb>As>Cd>Ni>Zn>Cr>Cu. The criteria of ecological risk on Pb and as were considerable risk (E_r^i Pb: 52.18 and E_r^i As: 50.00 and the others were low risk. Moreover, the potential ecological risk sequence of study were ST18> ST3> ST8> ST1> ST7> ST6> ST11> ST20> ST19> ST4> ST16> ST5> ST9> ST15> ST2> ST13> ST14> ST17> ST10> ST12. The criteria of ST 18, ST 3, ST 8, ST 1 and ST 7 belonged to considerable risk, ST 12 was low risk and others location were medium risk. Heavy metals input in Mahakam Delta are possibly caused by human activities such as industrial, mining, household activities, and from natural process by erosion and natural water flow.

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Keywords: ecological risk assessment; heavy metal; surface sediment; Mahakam Delta

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1. Introduction

Sediments have an important role as a habitat for aquatic organisms to grow, evolve and establish in the ecological system. Sediment contamination is one of indicators for the prediction of potential ecological risks in aquatic systems. Circulation of pollutants in the water then will be accumulated through the settling process into sediment, therefore sediment may be regarded as one of the pollutant storage. Heavy metals have low solubility properties, absorbed and accumulated on the bottom sediments [1-3]. Sediment contamination occurs at wetlands, rivers, lakes, dams, harbor area, and in other water environments [4]. Generally, sediment contamination of heavy metal pollution can be affected by several factors including the pipeline construction, wastewater treatment and disposal, runoff, mining, industrial activity, etc. Such factors also have a risk to aquatic ecological system.

Mahakam Delta is an area characterized by sediment disposition from Mahakam River flow along the 770 km and Makassar Strait [5]. Fine sand and mud are dominant sediment substrate in the delta front area of Mahakam Delta, while silt, clay, and thin sand layer sediment are dominant in prodelta area [6, 7]. Besides having a fairly high biodiversity, this area also has a wealth of material resource so there are several mining activities operating in this area. The aim of this study was to identify the concentration of heavy metals in surface of sediments, to assess the ecological risk potential of heavy metal pollution in Mahakam Delta. Furthermore, to identify the source of heavy metal contaminants through a combination of multivariate statistical analysis.

2. Methods

2.1. Sampling location

As much as 20 sampling points in Mahakam Delta area were selected (Fig. 1). Sediment samples were grabbed using Ekman grab.

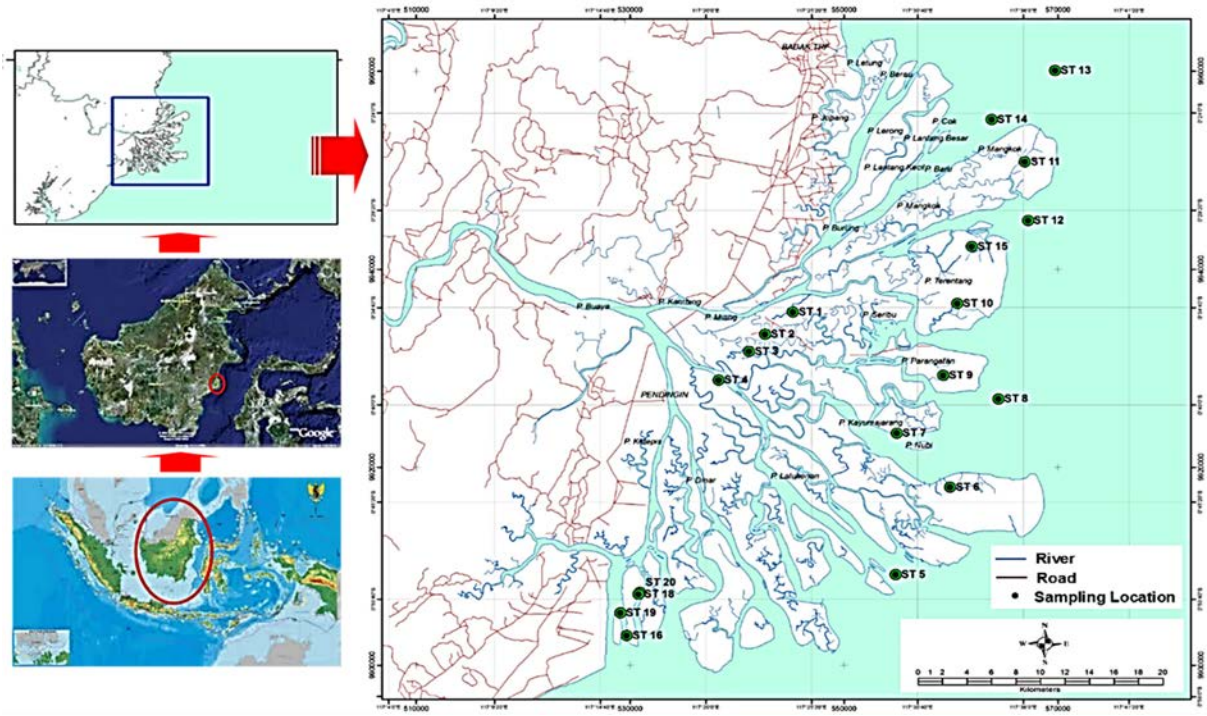

Fig. 1. Sampling location in Mahakam Delta.