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Mercury Emission from Artisanal Buladu Gold Mine and Its Bioaccumulation in Rice Grains, Gorontalo Province, Indonesia

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Abstract; Available forms of mercury (Hg) released from artisanal gold mine activities could be taken up increasingly by plants via root and leaf stomata. Total mercury (THg) concentrations in dry deposit, surface soil and rice grains were investigated as well as the potential risks in september 2011 from three rice fields of concern. The results revealed that the concentrations of THg in dry deposition, top soil (0 to 5 cm depth), sub soil (6 to 10 cm depth) and rice grains (*Oriza sativa* L.) both brown (once milled) and white (twice milled) grains were ranged from 166 to 322 m^{-2} day^{-1}, 484 to 4244 µg kg^{-1}dw, 122 to 1812 µg kg^{-1}ww, and 113 to 1084 µg kg^{-1}ww, respectively. Hazard quotient (HQ) values for dry deposition, top soil and sub soil were ranged from 3 to 7, 5 to 42 and 5 to 36, respectively. Target hazard quotient (THQ) for brown and white rice grains consumptions were found in the range of 0.1 to 1.6 and 0.1 to 1.0, respectively. THQ values through brown rice consumption exceeded the guideline (>1) presented that the brown rice in these areas should not be safe for consumption and are at risks for the whole lifespan. However, the THQ values of both brown and white rice grains in some areas were still low and should be safe for the whole life span consumption.

Introduction

In open burning process, Hg will be released to the environment [1]. Amalgamation process in artisanal Buladu gold mine that mixes elemental Hg with mineral ore is a point source of Hg. In this mine, tromols are used in amalgamation process and Hg is added after three hours of grinding and then solid Hg-gold amalgam is generated. During the open burning process, Hg is vapourized and left behind the gold bullion. In Buladu gold mine, heating process is conducted via open burning system inside residential area as the gold is valuable and needs security [2]. Hg is a highly toxic element because of its accumulative and persistent characters in the environment and biota [3].

In terrestrial habitat, vaporized Hg goes directly into the environment matrix such as air, soil and might be accumulated in the organisms living in the surrounding areas. Some Hg emitted in term of vapor from soil and water will enter the atmosphere, where it might be potentially transported and redistributed over the Earth's surface [4].

Materials and Methods

Study area

Artisanal Buladu gold mine is located in Sumalata District, North Gorontalo Province, Indonesia. It is an active and important gold mine which has been managed both in traditional way by local communities and in technological system by mine factories [2]. Hg distribution in the rice fields