論文要旨

論文題目: **Mercury Contamination in Indonesia: A Critical Review and Case Study of Communities Near Gold Mining Areas**

インドネシアの水銀汚染：金採掘地域のレビューおよび事例研究

氏名: **Syafran Arrazy (シャフラン　アラジー)**

Mercury (Hg) is a prevalent pollutant in Indonesia, primarily as a result of its extensive use in gold mining, especially artisanal and small-scale gold mining (ASGM) [1-3]. This activity is responsible for 67% (244 tons) of the total mercury emissions in the country [1]. Approximately 32 percent is released into the atmosphere [2]. ASGM amalgamation techniques release large amounts of mercury into water bodies, polluting aquatic ecosystems and bioaccumulating mercury in fish, a staple meal for many Indonesians. Indonesian mercury contamination has far-reaching effects. Mercury exposure can harm miners and neighbors. [1, 4]. This study aims to evaluate the current status of mercury pollution in Indonesia, analyze the key sources and pathways of contamination, assess the impacts on human health and the environment, and analyze the spatial distribution and risk to the community near ASGM.

The review included 54 studies and found considerable variations in mercury levels across different regions in the country. The arithmetic means of mercury concentrations in air, soil, water, and sediment were 1.97 μg/m3 (n=3), 52.26 mg/kg (n=9), 76.33 μg/L (n=18), and 14.06 mg/kg (n=7), respectively, far exceeding the Indonesian standard values of 1 μg/m3, 0.3 mg/kg, 1 μg/L, and 0.3 mg/kg. Even areas without a history of gold mining showed high mercury concentrations in soil. The study also found that vegetables and aquatic food samples had high mercury concentrations, with arithmetic mean values of 3.52 mg/kg dry weight (n=4) and 0.61 mg/kg wet weight (n=19), respectively. Approximately 50% of vegetable samples and 21% of aquatic food samples exceeded the Indonesian standard values of 0.03 mg/kg and 0.5 mg/kg, respectively. Root vegetables and mollusks had the highest mercury concentration.

A case study in Mandailing Natal District showed results of Hg concentrations in the rice and vegetables were 50 ± 33 μg/kg dw (n = 20) and 2,100 ± 2,500 μg/kg dw (n = 12), respectively, and that in the paddy soil and farm soil were 5,600 ± 12,000 μg/kg dw (n = 20) and 19,000 ± 33,000 μg/kg dw (n = 12), respectively Hg concentrations in the food, soil and drinking water samples decreased statistically significantly with increasing distance from the amalgam burning facility to the sampling site, suggesting that the burning facility is a major source of mercury in this area. All drinking water samples were below the WHO safe value of mercury, whereas 96% of the vegetable and 82% of rice samples exceeded the safe value from the Indonesian National Standard or the FAO/WHO. The non-cancer risk calculated from the hazard quotients for the rice and vegetables exceeded 1 for children and adults. These results suggest potential health risks for residents who rely primarily on locally produced vegetables and rice.

The study highlights the urgency of addressing mercury contamination in Indonesia, especially in ASGM areas, and provides a reference for future research and policy development to reduce mercury exposure. Furthermore, a case study in Mandailing Natal District indicates a possible health risk for people who mostly consume locally grown vegetables and grains. Mercury contamination in vegetables and rice cultivated in the regions of this study will certainly rise over time due to the Hg deposition to the soil by gold mining activities. Further monitoring against Hg contamination is required to reduce the health risks for residents.

参考文献：

[1] IPEN: Mercury Country Situation Report - Indonesia.: International Pollutants Elimination Network; 2018.

[2] UNEP: Global Mercury Assessment 2013: Sources, emissions, releases, and environmental transport. In. Geneva, Switzerland: United Nations Environment Programme; 2013.
[3] UNEP: Global Mercury Assessment 2018. In. Geneva: United Nations Environment Programme; 2019.
[4] Al-Sulaiti MM, Soubra L, Al-Ghouti MA: The Causes and Effects of Mercury and Methylmercury Contamination in the Marine Environment: A Review. *Current Pollution Reports* 2022, 8(3):249-272.