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Analysis of the Concentration of Mercury (Hg) in the Soil Around the Gold Mining Processing Area in Buru Regency

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Abstract

Mercury is widely used in Unlicensed Gold Mining (PETI) in Indonesia, one of which is PETI activities in the Buru Regency area. Traditional gold mining in this area began in 2011, initially starting at the Mount Botak location, Wamsait Hamlet, Dava Village, Waelata District, and was subsequently carried out in four other locations, namely in the Lea Bumi, Gogorea, Derlale/Metar and Waepotih/Waedanga areas. This research aims to determine mercury levels in the soil around gold mining locations. This type of research is a survey with a quantitative approach. This research is divided into several stages, namely: (1) Research design; (2) Field research; (3) Data collection; (4) Laboratory analysis; (5) Data processing. The research results show that there is heavy metal mercury contamination in the soil and plants around the gold mining processing area in Buru Regency. For soil samples, of the 43 samples analyzed, 41 samples were detected with mercury concentrations exceeding the quality standard limit, where the highest concentration reached 18,430 ppm. This indicates that unlicensed gold mining in Buru Regency which uses the heavy metal mercury in the processing process has a serious impact on pollution, especially on the land around the gold mining area.

Keywords: *Illegal Gold Mining, Mercury Contamination, Water Quality*

1. INTRODUCTION

The type of waste that has the potential to damage the environment is waste that is included in Hazardous Toxic Materials (B3) which contains heavy metals. Heavy metal is a term used for transition elements that have an atomic density greater than 6 gcm-3. Mercury (Hg), lead (Pb), copper (Cu), cadmium (Cd) and strontium (Sr) are examples of heavy metals in the form of contaminants that originate from outside the soil and are of great concern because they are closely related to human health, agriculture and ecotoxicology. Mercury or quicksilver, symbolized Hg, is an element with atomic number 80, atomic weight 200.5 g (Palar, 2008).

Mercury (Hg) is a metal that occurs naturally in minerals in the earth's crust, and also in fossil fuels. Although mercury is released through natural processes, for example weathering and volcanic eruptions, anthropogenic activities are the main contributor to mercury pollution in the environment (Liu et al., 2012). The presence of Hg from nature and entering an environmental system will have no effect (Widowati, 2008).

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People's mining without a permit or what is known as traditional mining is a community activity in the mining sector in an area that does not have permission from the local government where the activity uses simple tools, such as C excavation mining activities and other general mining businesses such as gold mining, quarrying. valuable objects (Balihristi, 2008 in Lihawa & Mahmud, 2012).

Mercury is widely used in Unlicensed Gold Mining (PETI) in Indonesia, one of which is PETI activities in Buru Regency, and which is active on Mount Botak (Sehol et al, 2023). Traditional gold mining in this area began in 2011, initially starting at the Mount Botak location, Wamsait Hamlet, Dava Village, Waelata District, and was subsequently carried out in four other locations, namely in the Lea Bumi, Gogorea, Derlale/Metar and Waepotih/Waedanga areas.

In PETI activities in the Buru Regency area, one of the processes to obtain pure gold is to use the amalgamation method, which miners in the area have begun to use since the end of 2011. The amalgamation method is carried out by mixing materials containing gold and mercury (Irsan et al., 2023), where the amalgam formation process is carried out simultaneously in an amalgamator called a drum (Male et al., 2013). Drums are used not only in mining areas, but also in residential areas and agricultural areas. The tromel processing waste is dumped into the environment, so it is feared that it will contaminate various abiotic and biotic components, including soil. Heavy metals are pollutants because they cannot be biodegraded and are stable, so they can spread far from their original location. Heavy metals can be dangerous if their concentration limits exceed predetermined limits. Schutzendubel & Polle (2002),

The worry is that people who originally used the land for agricultural or plantation activities will no longer be able to use the land as before. However, this condition is inversely proportional to this, because since the reduction in PETI activities in the Buru Regency area, farmers have returned to using tromel processing land for agricultural cultivation activities, and these agricultural products are traded freely to the community. The agricultural crops cultivated are rice, corn, long beans, cassava, sweet potatoes, cucumbers, chilies, beans, spinach, kale, mustard greens, oranges, dragon fruit, bananas and watermelons, as well as various other agricultural products. Without us realizing, it is possible that these agricultural products have been contaminated with Hg and can endanger our health.

2. METHOD

This type of research is a survey with a quantitative approach. This research is divided into several stages, namely: (1) Research design; (2) Field research; (3) Data collection; (4) Laboratory analysis; (5) Data processing.

1. Research Design

The research design stage is the initial stage that must be carried out when conducting research. This is because this stage includes determining the research objectives and approach. The important thing to do at this stage is to determine the sampling and research

location. The next step after this stage is mature is to start collecting the elements used such as capital, computers, human resources, as well as other necessary equipment.

2. Field research

The third stage is the data collection stage. This stage is a continuation of the results of field research, where all the data that has been taken is then collected and classified according to the planned object. Naming and numbering sample data must be adjusted to each sample type.

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4. Laboratory analysis

To see the results, all sample data that has been collected is then tested/analyzed in the laboratory. The laboratory used for analysis of the heavy metal mercury is the IPB Bogor Environmental Productivity Laboratory (Proling).

5. Data processing

The sample data from the analysis is then processed to obtain conclusions about the level of mercury pollution in soil, plants and fruit around the Buru Regency gold mine processing area.

3. RESULTS AND DISCUSSION

This research aims to determine the concentration of the heavy metal mercury in soil, plants and fruit around the Buru Regency gold mine processing area, as well as finding out areas that are safe for agricultural cultivation, and the types of plants and fruit that are safe for consumption based on plant quality standards and fruit.

The soil analyzed came from community plantations and waste from tromeel processing, while the plants analyzed were secondary crops, horticultural vegetables and horticultural fruit. Samples were taken at 18 locations in Buru Regency, the description of which can be seen in the image below.

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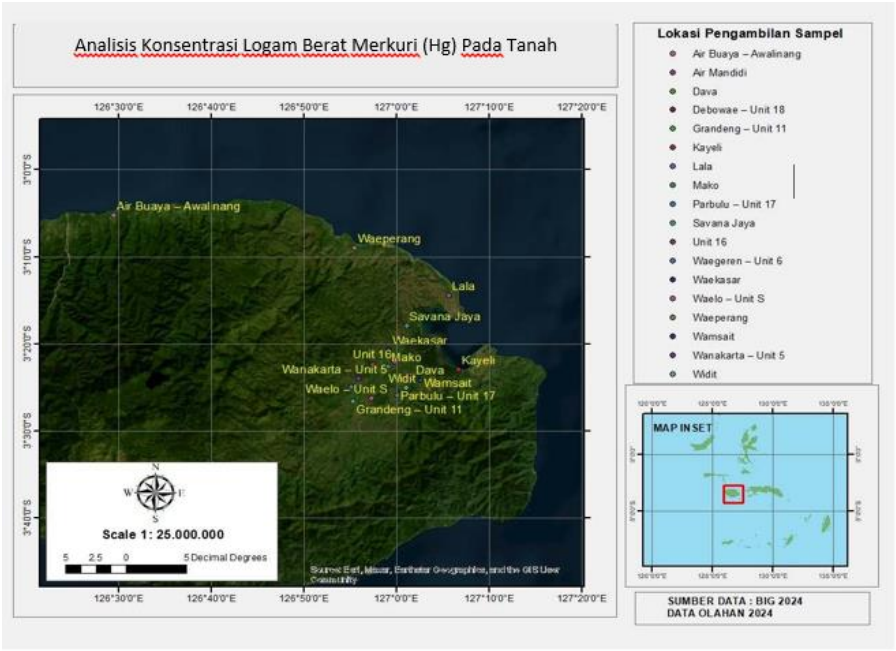

Figure 1. Location of soil sample development

Soil samples were taken from 18 villages in Buru Regency, especially in areas around unlicensed emeas mining. The results of the analysis are shown in the table below

Table 1. Results of analysis of the concentration of the heavy metal mercury (Hg) in the soil

Location Sampling	Concentration of Heavy Metal Mercury (Hg) (ppm)	Information
They called him	2,206	Above Quality Standards
	7,423	Above Quality Standards
	1,871	Above Quality Standards
	18,430	Above Quality Standards
Case	17,008	Above Quality Standards
	2,763	Above Quality Standards
Debowae - Unit 18	0,447	Above Quality Standards
	1,029	Above Quality Standards
	11,336	Above Quality Standards
Parbulu - Unit 17	0,909	Above Quality Standards
	0,965	Above Quality Standards
	0,852	Above Quality Standards
Widit	1,149	Above Quality Standards
Waelo – Unit S	1,186	Above Quality Standards
	0,265	Above Quality Standards
	0,770	Above Quality Standards
Grandeng – Unit 11	2,047	Above Quality Standards
	0,764	Above Quality Standards

Waegeren – Unit 6	1,006	Above Quality Standards
Wanakarta - Unit 5	0,982	Above Quality Standards
	1,714	Above Quality Standards
	0,324	Above Quality Standards
Week	1,386	Above Quality Standards
	1,185	Above Quality Standards
Waekasa	1,510	Above Quality Standards
	1,314	Above Quality Standards
Waetele – Unit 15	0,705	Above Quality Standards
Air Market	1,646	Above Quality Standards
	0,974	Above Quality Standards
Savana Jaya	2,025	Above Quality Standards
	0,551	Above Quality Standards
	0,712	Above Quality Standards
	0,393	Above Quality Standards
Unit 16	0,267	Above Quality Standards
	0,835	Above Quality Standards
Kyle	18,189	Above Quality Standards
	1,455	Above Quality Standards
	<0,004	Below Detection Limit
Lala	0,107	Above Quality Standards
	<0,004	Below Detection Limit
Waewar	0,713	Above Quality Standards
Crocodile Water - Awaliang	1,080	Above Quality Standards
	3,770	Above Quality Standards

Source: Research Result Data, 2024.

The results of the analysis of the heavy metal mercury in soil samples in 18 villages in Buru Regency, totaling 43 samples (table 1), show that the heavy metal mercury was detected in almost all research locations, where only 2 samples were below the detection limit, namely not detected by the AAS tool or concentration. <0.004 ppm. Meanwhile, 41 samples were detected with concentration values that exceeded the quality standards for the heavy metal mercury in soil based on Alloway (1995), where the normal range for heavy metal mercury (Hg) in soil is 0.01 - 0.3ppm and the critical concentration is in the range of 0.3- 0.5ppm. This condition indicates that mercury contamination in the soil at these locations is very significant and potentially dangerous. The distribution of mercury in the soil at each sampling location can be seen in Figure 2.

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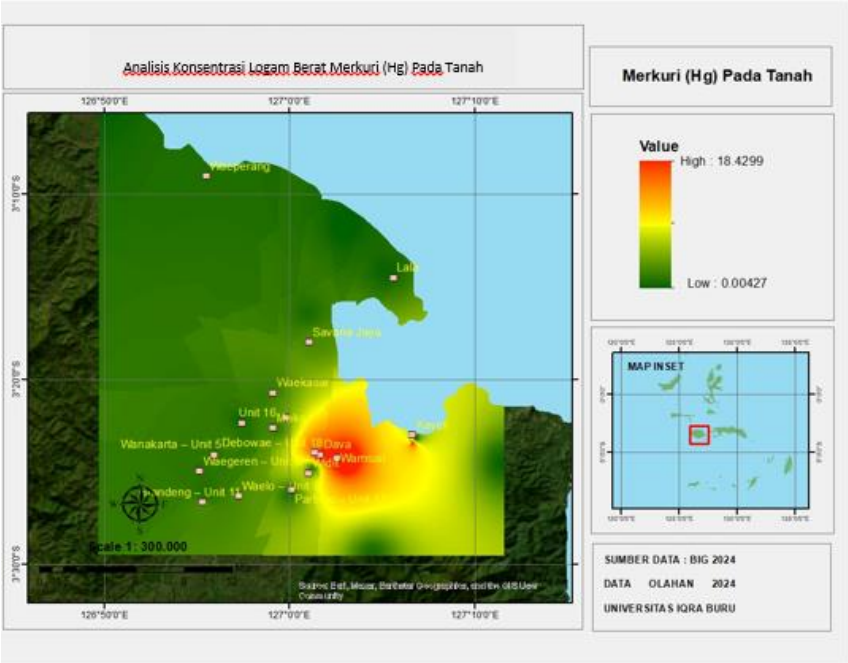

Figure 2. Mercury Distribution Map on Soil

Figure 2 shows that the highest concentration of the heavy metal mercury was obtained in 4 different villages, but they were still located around the gold mining area without a permit, namely Wamsait Village with a mercury metal concentration of 18,430 ppm, Kayeli Village with a concentration of 18,189 ppm, Dava Village 17,008 ppm and Debowae Village (Unit 18) with a concentration of 11,336 ppm. The concentration of mercury metal in these four samples was far above the quality standard compared to the others.

The high concentration of the heavy metal mercury in these four soil samples is because these samples were samples taken from trommel processing waste that was still actively operating or that was no longer actively operating. As is known from PETI activities in the Buru Regency area, one of the processes to obtain pure gold is the amalgamation method which uses a drum with one of the mixed ingredients being mercury (Male et al, 2013). When materials are processed with mercury, the processed waste can accumulate, causing high concentrations of mercury in the soil mixed with the waste. This finding is in line with the results of other research, where the soil/sediment in tailings waste is higher than soil taken not from tailings or gold material processing disposal. Mirdad et al (2013), found that the mercury content in all soil and tailings samples taken at the gold mine processing area in Poboya Village, Palu City was very high than the specified threshold. The tailings samples ranged from 84.15 ppm – 575.16 ppm, which is higher than the concentration of mercury in the soil at the research location which is not from tailings. Hindratmo et al (2019), through research conducted, found that the mercury

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content in soil used from gold processing activities on Mount Botak, Buru Regency was higher than soil taken from non-processed gold material.

If you look at table 1, in areas far from unlicensed gold mining areas, namely in Lala Village, Waewar Village and Air Buaya Village (Awaliang), mercury concentrations in soil samples were detected, even in Air Buaya Village the concentrations exceeded the quality standards. This is of course related to various factors, including the processing of gold material with tromel, because gold material originating from gold mining without a permit in Buru Regency is not only processed in the area around the gold mine, but the processing is also carried out in other areas far from the gold mining area, including in areas adjacent to the sampling area, so that this metal can be distributed in these locations. Apart from that, the atmosphere can also be a factor involved in causing the heavy metal mercury to move from gold mining areas without permits to other areas further away. This is because mercury can evaporate into the atmosphere and then settle in distant locations through a deposition process. Lindberg et al. (2007) noted that mercury released into the air can travel long distances before returning to the ground surface. Other factors that can also play a role are biogeochemical processes, as well as agricultural activities that use fertilizers or pesticides containing Hg, which can cause the accumulation of mercury in the soil. Biogeochemical processes, including biological transformations, can change the form of Hg into a form that is more easily accumulated.

4. CONCLUSIONS AND SUGGESTIONS

Based on the results of research regarding the analysis of the concentration of the heavy metal mercury (Hg) in the soil around the gold mining processing area in Buru Regency, it can be concluded that: There is heavy metal mercury contamination in the soil and plants around the gold mining processing area in Buru Regency. For soil samples, of the 43 samples analyzed, 41 samples were detected with mercury concentrations exceeding the quality standard limit, where the highest concentration reached 18,430 ppm. This indicates that unlicensed gold mining in Buru Regency which uses the heavy metal mercury in the processing process has a serious impact on pollution, especially on the land around the gold mining area.

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