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Health risk analysis of exposure to mercury (Hg) and cyanide (CN) in Kayeli village communities Teluk Kayeli district Buru regency☆

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Abstract

Objective: This study aims to analyze level of risk, target danger and management of health risks due to exposure to mercury and cyanide in river water, well water and plants.

Methods: This study used environmental health risk analysis, data collection through environmental observations, laboratory and questionnaires.

Results: Mercury concentrations in river water and well water were below the detection limit was <0.005 mg/L and plants ranging from 0.0076 μg/g to 0.0517 μg/g while cyanide concentration in river water and well water is <0.01 mg/L and plants < 0.01 μg/g, 40% having risk level (RQ) values > 1 for non-carcinogen effects and for carcinogenic effects all respondents have RQ ≤ 1 while for hazard target values (THQ) non carcinogenic and carcinogenic effects 85 people respondents have THQ value 1.

Conclusion: Community is expected to be able maintain and limit amount of consumption frequency, especially in plants.

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Introduction

Environmental pollution has always been a big problem for the people of the world because it has a negative impact on the lives of living things in the ecosystem. Gold mining activities are basically at risk of causing environmental damage which is very likely to occur, namely erosion and changes in the shape of the soil surface.

According to Gworek, Indonesia has entered a mercury emergency as a result of increasing mercury pollution in various regions.[1] The number of miners is estimated to reach 2 million people in more than 800 ASGM points which produce 100 tons of gold each year. Emissions from these activities contribute 57.5% of total national mercury emissions.

The people's gold mining activities in Buru Regency have been going on since 2011 until now with a mining area 250 hectares using mercury and cyanide in the processing process. The study conducted by Ambon Environmental Health Engineering Center in 2012 by testing eight water samples of water bodies showed that the concentration of mercury ranged from 0.0049 to 0.0529 mg/L, with the highest concentration on the Waepao river at 0.0529 mg/L while study of Salatutin watershed concluded that mercury concentrations had been distributed with concentrations in upstream sediments reaching 0.102 mg/L and in the downstream at 0.031 mg/L.[4] Another study by Male found mercury concentrations in sediments of the Wamsait and Teluk Kayeli rivers were 0.35 and 7.66 mg/kg respectively.[2]

Method

Research design and location

This type of research is observational with an analysis method of environmental health risks. Risk factors are measured at the same time to predict the magnitude of health risks due to exposure to mercury (Hg) and cyanide (CN). The location of the study was in the area of Kayeli Village, Buru Regency. This research was conducted in February–March 2019.

Sample and population

The population in this study were all residents of Kayeli Village, which were 558 inhabitants and dug wells were all dug wells and local plants located. Respondents were residents who lived in Kayeli Village and settled at least 1 year and used dug wells as a source of clean water and consumed plants from the region. Sample size was 85 respondents, for water samples of water bodies (rivers) taken in the upstream, middle and downstream parts, for well water samples were taken at 8 wells using the total population and for purposive sampling the plant samples were taken from local plants in the form of plants corn leaves, peanut leaves and papaya leaves.

Data collection

River water samples taken at three uptake points, upstream, middle and downstream with grap sampling method while for well water samples using the total population method that is as much as eight wells and for five samples of plant leaves are peanut leaves, peanut leaves, corn leaves and papaya leaves which are local plants in Kayeli Village with a purposive sampling method. Data collection was obtained from the results of interviews and direct observation, determination of sampling coordinates as well as measurements of field parameters including pH and temperature and laboratory tests.

Table 1 Concentration of mercury (Hg) and cyanide (CN) on water samples of drilled wells and dug wells.

Samples	Hg	CN
Drilled Wells 1	<0.0005 mg/L	<0.01 mg/L
Drilled Wells 2	<0.0005 mg/L	<0.01 mg/L
Drilled Wells 3	<0.0005 mg/L	<0.01 mg/L
Drilled Wells 4	<0.0005 mg/L	<0.01 mg/L
Drilled Wells 5	<0.0005 mg/L	<0.01 mg/L
Drilled Wells 6	<0.0005 mg/L	<0.01 mg/L
Drilled Wells 1	<0.0005 mg/L	<0.01 mg/L
Drilled Wells 2	<0.0005 mg/L	<0.01 mg/L
Quality standards	0.001 mg/L	0.1 mg/L

Data analysis

Analysis of data for water bodies, well water and plant inspection was carried out by the Makassar Health Laboratory Center, which then carried out risk analysis to calculate the value of Intake, Risk Quotient, Target Hazard Quotient and Risk Management.

Results

Mercury and cyanide concentrations in dug and bore wells in Kayeli village are still below the quality standard in accordance with the Regulation of the Minister of Health of the Republic of Indonesia No. 32 of 2017 (Table 1).

Mercury and cyanide concentrations are still below the quality standard in accordance with Government Regulation No. 82 of 2001 where laboratory results are smaller than 0.0005 mg/L (Table 2). All plant samples it was found to contain mercury with the highest mercury concentration in the papaya leaf sample of 0.0517 μg/g (5.17×10^{-5} mg/g) while for cyanide all sample concentrations are <0.01 μg/g or below the detection limit (Table 3).

It can be seen that for non-carcinogenic effects due to exposure to mercury respondents who have RQ > 1 34 people with the highest RQ reaching 2.206. Respondents with RQ > 1 mean that there are 33 respondents who are at risk of non-carcinogenic effects of mercury if they continue to consume these vegetables for 30 years (Fig. 1). and we can be seen that for the carcinogenic effects of mercury all respondents (100%) have RQ ≤ 1. This means that for carcinogenic effects all respondents are not at risk of carcinogenic effects of mercury if they continue to consume vegetables for 70 years (Fig. 2).

Table 2 Concentrations of mercury (Hg) and cyanide (CN) in Kayeli river water samples.

Sample	Hg	CN
Upstream	<0.0005 mg/L	<0.01 mg/L
Middle	<0.0005 mg/L	<0.01 mg/L
Downstream	<0.0005 mg/L	<0.01 mg/L
Quality standards	**0.005 mg/L**	**0.02 mg/L**

Table 3 Concentration of mercury (Hg) and cyanide (CN) in plants.

Plant type	Hg		CN
	µg/g	mg/g	
Peanut leaves	0.0076	0.0000076	<0.01
Corn leaves	0.0222	0.0000222	<0.01
Corn leaves	0.0222	0.0000222	<0.01
Papaya leaf	0.0238	0.0000238	<0.01
Papaya leaf	0.0517	0.0000517	<0.01
Quality standards	**0.03 mg**		

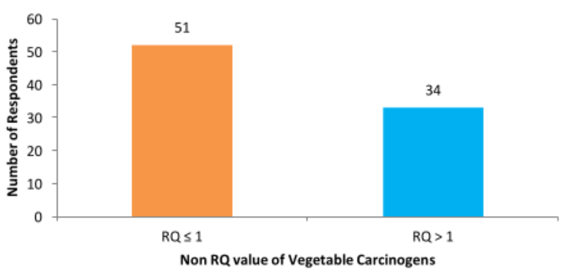

Figure 1 Risk level (RQ) of respondents due to exposure to Mercury (Hg) in 30-year (non-carcinogenic) vegetable plants.

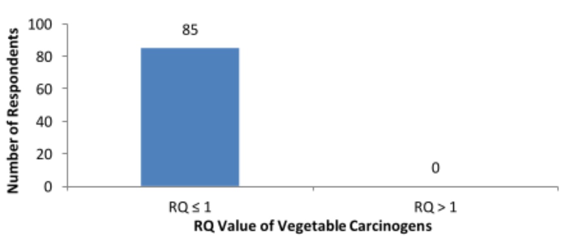

Figure 2 Risk level of respondents due to exposure to mercury in vegetable plants for 70 years.

Discussion

This study identified dangers of exposure to mercury and cyanide as pollutant material sourced from the processing of gold material which took place in Kayeli. However, the identification of these hazards can only be done on plant samples for the mercury parameter considering that cyanide parameters based on laboratory tests.

The low mercury concentration in river water and well bore/excavated water is due to the processing of gold materials using drum machines which have not been operating for 3 months due to the temporary closure of bald mountain mines by the local government. Besides that, processing wastes from drum machines are not directly disposed or flowed into the river but are accommodated in tanks that will be reused in the process of washing the material. Tuaputty on dug well water samples in Lanut Village found that from the three samples taken showed that the highest mercury levels were point 1 with a content of 0.0012 mg/L.[3]

Salluti, concentration of mercury analyzed at several sampling locations on the Waeapo River found mercury concentrations of 0.003–0.102 ppm.[4] Research by Singga, analysis of mercury exposure health risks in Bulawa Subdistrict, average value of respondents' RQ from Nyiur Hijau Village with an average duration of 6 years exposure which is 0.2113 while respondents from Mamungga Village have an average duration of exposure 27.36 years have an average value of RQ 1.0138 and Kaidundu Village exposure of 37.45 years have an average RQ 1.5429.[5] In line with the research Hartono showed that there was significant relationship between the duration of exposure and respondent's RQ and had a positive relationship pattern.[6]

Research Novitasari analyzed the risk of arsenic and phenol exposure in the Kokoda City where average RQ value of river water phenol for non-carcinogenic effects was 26% had $RQ \leq 1$ and 74% with $RQ > 1$ while average RQ value in well water has 40% have $RQ > 1$.[7] For average RQ values for exposure to river water arsenic there are 63% with $RQ > 1$ while average RQ value of well water contained 63% with $RQ > 1$.

THQ is the target of a potential hazard if someone consumes by oral/ingestion of mercury and cyanide pollutants. Both of these pollutant ingredients are classified as toxic contaminants which are non-carcinogenic. The calculation of mercury exposure in 85 respondents was entirely not risky, research Juliana on gold craftsmen in Malimongan Urban Village, found a realtime hazard target of 3.92×10^{-3} and lifetime 7.550×10^{-3} where both have not shown non-carcinogenic risks due to copper exposure because $THQ \leq 1$ while average value of the realtime time hazard target of 5.95×10^{-5} and lifetime 1.14×10^{-4} both also have not shown non-carcinogenic risk due to exposure to NO^2 because $THQ \leq 1$.[8]

Conclusion

The concentration of mercury and cyanide in river water, well water and plants in the form of peanut leaves, corn leaves and papaya leave still meet existing quality standards. The results stated that all respondents did not show non-carcinogenic and carcinogenic health risks. Risk management that can be carried out in an effort to control the impact of risk agent exposure in this study is to reduce the concentration of mercury in vegetables consumed, reduce consumption rates, and limit duration of exposure to mercury from vegetables consumed.

Conflict of interest

The authors declare no conflict of interest.

References

1. Gworek B, Dmuchowski W, Baczewska AH, Brągoszewska P, Bemowska-Kałabun O, Wrzosek-Jakubowska J. Air contamination by mercury, emissions and transformations—a review. Water Air Soil Pollut. 2017;228:123.
2. Male YT, Brushett AJ, Pocock M, Nanlohy A. Recent mercury contamination from Artisanal Golg mining on Buru Island Indonesia-potential future risk to environment health. J Mar Pollut Bull. 2013;77:428–33.
3. Selvi Tuaputy U, intan Kumala Puti E, Anna Z. Eksternalitas pertambangan emas rakyat di kabupaten buru maluku. JAREE. 2014;1:71–86.
4. Salatutin F, Batawi C, Lessil C, Male Y. Analysis of mercury (Hg) distribution in the Waeapo river irrigation area, Buru Regency, Maluku Province Gold Mining Without Permission Result In Botak Mountain Area. Indo J Chem Res. 2015;3:270–6.
5. Singga S, Maran AA. Bahan penggunaan bahan bakar dan faktor risiko kejadian ispa pada balita di kelurahan sikumana. Jurnal Info Kesehatan. 2013;11:348–54.
6. Hartono B [Thesis] Distribusi risiko kesehatan logam merkuri di lokasi pertambangan emas kabupaten Minahasa Selatan Provinsi Sulawesi Utara tahun 2004. Universitas Indonesia; 2006.
7. Novita S. Health risk analysis due to phenol and arsenic exposure to surface and underground water in the Kokoda Community of Sorong City West Papua Province. Postgraduate University of Hasanuddin; 2016.
8. Juliana N. Analysis of the risk of exposure to copper (Cu) and nitrogen dioxide (NO_2) in gold craftsmen in Malimongan Village, Wajo District Makassar City. Postgraduate University of Hasanuddin; 2016.

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