MINISTRY OF ENVIRONMENT AND FORESTRY
REPUBLIC OF INDONESIA

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BASEL & STOCKHOLM CONVENTIONS REGIONAL CENTRE for SOUTHEAST ASIA



# NATIONAL ACTION PLAN

## For Artisanal and Small-Scale Gold Mining in Indonesia In Accordance with the Minamata Convention on Mercury

REPUBLIC OF INDONESIA
2022

# FOREWORD

The Minamata Convention on Mercury is a global agreement to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds due to their characteristics which are toxic, corrosive, persistent, and bioaccumulative. This objective is achieved through setting out a range of measures, including controlling the supply and trade of mercury, controlling mercury products and manufacturing processes that use mercury or mercury compounds and artisanal small-scale gold mining (ASGM).

Indonesia has ratified the Minamata Convention on Mercury through Law No. 1 of 2017 concerning Ratification of the Minamata Convention on Mercury. As a follow-up to the ratification, Indonesia issued Presidential Regulation No. 21 of 2019 concerning the National Action Plan for Mercury Reduction and Elimination (*Rencana Aksi Nasional Pengurangan dan Penghapusan Merkuri*, RAN-PPM). Furthermore, the Minister of Environment and Forestry Regulation No. P.81/Menlhk/Setjen/Kum.1/10/2019 has also been stipulated for the implementation of the RAN-PPM.

As a Party and in accordance with Article 7 of the Convention, Indonesia is obligated to develop and implement a national action plan to reduce, and where feasible eliminate, the use of mercury and mercury compounds in, and the emissions and releases to the environment of mercury from ASGM (National Action Plan for Artisanal and Small-Scale Gold Mining, NAP ASGM). According to RAN-PPM, the use of mercury in ASGM and illegal mining in Indonesia is targeted for elimination by 2025.

This document contains recommendations of strategies based on assessment of national overview of ASGM in Indonesia through literature studies and field visits. In addition to fulfilling Convention obligations, the purpose of preparing this NAP ASGM document is to support the implementation and achievement of RAN-PPM targets in ASGM priority areas and to provide input if the RAN-PPM is to be revised or updated.

With the development of this NAP ASGM document, it is hoped that Indonesia will have an integrated and sustainable work plan comprises policies, strategies and action plans for mercury elimination in ASGM at the national level. It is also hoped that this document will become a guidance that is comprehensive and useful as a reference for other stakeholders in planning and implementing their activities/ programs related to mercury elimination in ASGM.

The success in the development of this NAP ASGM document is achieved through cooperation and support from all stakeholders, including the government, the private sector, academia and society in general. We would like to thank the work team and all experts as well as the Ministries/ Agencies and other relevant stakeholders for their work and contribution in the preparation of this document. Hopefully this NAP ASGM document can be a guideline for all of us for the realization of a mercury-free ASGM in Indonesia.

Jakarta, 2022

Director General of Solid Waste, Hazardous
Waste and Hazardous Substances Management
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Republic of Indonesia



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# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| µg | Microgram |
| AGC | Artisanal Gold Council |
| Amdal | Environmental Impact Assessment |
| ANTAM | Aneka Tambang Company |
| ANU | Australian National University |
| APBD | Local Government Budget |
| APBN | State Budget |
| APRI | Association for Community Miners Indonesia |
| As | Arsenic |
| ASGM | Artisanal and Small-Scale Gold Mining |
| Au | Aurum (Gold) |
| B3 | Hazardous Substances |
| Bapedal | Environmental Impact Control Agency |
| BAPPENAS | Agency for National Planning |
| BCR | Benefit Cost Ratio |
| BCRC-SEA | Basel Convention Regional Centre for Southeast Asia |
| BGR | *Bundesanstalt für Geowissenschaften und Rohstoffe* |
| BLH | Environmental agency |
| BLHD | Regional Environmental Agency |
| BLK | Job Training Center |
| BPOM | National Agency of Drug and Food Control |
| BPPT | Agency for the Assessment and Application of Technology |
| BPS | Statistical Bureau |
| BRI | Biodiversity Research Institute |
| BSCRC-SEA | Basel and Stockholm Conventions Regional Centre for Southeast Asia |
| BUMDes | Village Owned Enterprises |
| CBES | Chindwin Biodiversity and Ecosystem Services |
| CDU | Charles Darwin University |
| CIL | Carbon in leach |
| CIRDI | Canadian International Resources and Development Institute |
| COVID-19 | Coronavirus disease 2019 |
| cm | Centimeter |
| CN | Cyanide |

| | |
|---|---|
| CSR | Corporate Social Responsibility |
| Cu | Copper |
| DANIDA | Danish International Development Agency |
| DED | Detailed Engineering Design |
| DELH | Environmental Evaluation Document |
| DFAT | Department of Foreign Affairs and Trade |
| DI Yogyakarta | Special Region of Yogyakarta |
| DKI Jakarta | Special Capital Region of Jakarta |
| dL | Deciliter |
| DJBC | Directorate General of Customs and Excises |
| DLH | Local Environmental Agency |
| DPLH | Environmental Management Document |
| DPR-RI | House of Representatives of the Republic of Indonesia |
| ESP3 | Environmental Support Programme, Phase 3 |
| EU | European Union |
| FAO | Food and Agriculture Organization |
| FGD | Focus Group Discussion |
| FS | Feasibility Study |
| g | Gram |
| GAHP | Global Alliance on Health and Pollution |
| GEF | Global Environment Facility |
| GEF-GOLD | Global Environment Facility – Global Opportunities for Long-term Development |
| GIZ | *Deutsche Gesellschaft für Internationale Zusammenarbeit* |
| GOI | Government of Indonesia |
| GOLD | Global Opportunities for Long-term Development |
| GOLD-ISMIA | Global Opportunities for Long-term Development – Integrated Sound Management of Mercury in Indonesia's Artisanal and Small-scale |
| GR | Government Regulation |
| GTIS | Global Trade Information Service |
| ha | Hectare |
| HBM | Human Biomonitoring |
| Hg | Hydrargyrum/ Mercury |
| HP | Horse Power |
| ICEL | Indonesian Center for Environmental Law |
| IDR | Indonesian rupiah |
| ILO | International Labour Organization |
| IMA | Indonesian Mining Association |
| INCAM | Indonesian Center for Artisanal Mining |
| INSW | Indonesia National Single Window |
| IPEN | International Pollutants Elimination Network |
| IPR | Small-Scale Mining Permit |
| ISMIA | Integrated Sound Management of Mercury in Indonesia's ASGM |
| ITB | Bandung Institute of Technology |
| IUP | Mining Business Permit |
| IUPK | Special Mining Business Permit |
| JATAM | Mining Advocacy Network |
| JECFA | Joint FAO/WHO Expert Committee on Food Additives |
| kg | Kilogram |
| L | Liter |
| LIPI | Indonesian Institute of Sciences |
| m3 | Meter cubic |
| mg | Milligram |
| MeHg | Methylmercury |
| MIA | Minamata Initial Assessment |
| mm | Millimeter |
| MoCI | Ministry of Communication and Informatics |
| MoEF | Ministry of Environment and Forestry, Republic of Indonesia |
| MoEMR | Ministry of Energy and Mineral Resources |
| MoF | Ministry of Finance |
| MoH | Ministry of Health |
| MoHA | Ministry of Home Affairs |
| MoI | Ministry of Industry |
| Monev | Monitoring and Evaluation |
| MoT | Ministry of Trade |
| MT | Metric tonne |
| NAP | National Action Plan |
| NAP ASGM | National Action Plan for Artisanal and Small-Scale Gold Mining |
| ng | Nanogram |
| NGO | Non-governmental organization |
| NPV | Net Present Value |
| NTB | West Nusa Tenggara |
| NTT | East Nusa Tenggara |
| OPK | Special Production Operation |

| | |
|---|---|
| P3KLL | Centre for Research and Development for Environmental Quality and Laboratory |
| Pb | Plumbum/Lead |
| PDAM | Water Supply Agency |
| Perpres | Presidential Regulation |
| PERS | Prosperous People Gold Program (*Program Emas Rakyat Sejahtera*) |
| Posyandu | Integrated health center |
| ppb | Parts Per Billion |
| ppm | Parts Per Million |
| PUPR | Public Works and Spatial Planning Office |
| Puskesmas | Public Health Centre |
| PT. PPLI | PT. Prasadha Pamunah Limbah Indonesia |
| PTSP | One Stop Service |
| PSIKLH | Center for Standardization of Environmental Quality Instruments |
| PTFI | Freeport Indonesia Company |
| PTWI | Provisional Tolerable Weekly Intake |
| RAD | Local Action Plan |
| RAD-PPM | Local Action Plan for Mercury Reduction and Elimination |
| RAN | National Action Plan |
| RAN-PPM | National Action Plan for Mercury Reduction and Elimination |
| RED | Regional Economic Development |
| RTRW | Regional Spatial Planning |
| SFTP | Secure File Transfer Protocol |
| SIP | Specific International Program |
| SMEs | Small and Medium Enterprises |
| SPPL | Statement of Capability in Environmental Management and Monitoring |
| SWOT | Strengths, Weaknesses, Opportunities & Threats |
| tekMIRA | Mineral and Coal Technology |
| THg | Total mercury concentration |
| TLV | Threshold Limit Value |
| UB | Brawijaya University |
| UHO | Haluoleo University |
| UKL-UPL | Environmental Management Efforts and Environmental Monitoring Efforts |
| UN | United Nations |
| Undana | Nusa Cendana University |
| UNDP | United Nations Development Program |
| UNEP | United Nations Environmental Programme |
| UNIDO | United Nations Industrial Development Organization |
| US | United States |
| USA | United States of America |
| USD | United States dollar |
| USEPA | United States Environmental Protection Agency |
| WALHI | Indonesian Forum for the Environment |
| WHO | World Health Organization |
| WP | Mining Areas |
| WPR | Small-Scale Mining Area |
| WUP | Mining Business Areas |
| XRF | X-ray Fluorescence |
| YEAI | Yayasan Emas Artisanal Indonesia |
| YPESB | Yayasan Pembangunan Ekonomi Sumbawa Barat |
| YTS | Yayasan Tambuhak Sinta/Tambuhak Sinta Foundation |

# CHAPTER I. EXECUTIVE SUMMARY

Indonesia has ratified the Minamata Convention on Mercury through Law No. 1l of 2017 concerning Ratification of the Minamata Convention on Mercury. As a follow-up to the ratification, Indonesia issued Presidential Regulation Number 21 of 2019 concerning the National Action Plan for Mercury Reduction and Elimination (*Rencana Aksi Nasional Pengurangan dan Penghapusan Merkuri*, RAN-PPM). In addition, the Minister of Environment and Forestry Regulation Number P.81/Menlhk/Setjen/Kum.1/10/2019 has also been stipulated for the implementation of the RAN-PPM.

Article 7 of the Minamata Convention requires each Party to develop and implement a national plan of action in accordance with the provisions of Annex C to the Convention if at any time the Party determines that artisanal and small-scale gold mining and processing in its territory is more than insignificant.

The activity "Development of Minamata Initial Assessment and National Action Plan for Artisanal and Small-Scale Gold Mining in Indonesia" is a collaboration between UNEP as the implementing agency in partnership with the Ministry of Environment and Forestry, Republic of Indonesia (MoEF) as the executing agency with funding from the Global Environment Facility (GEF). Basel and Stockholm Conventions Regional Centre for Southeast Asia (BSCRC-SEA) assisted MoEF in the implementation of this activity.

The expected outcome of this activity is the development of a Minamata Initial Assessment (MIA) and a National Action Plan (NAP) for the artisanal and small-scale gold mining (ASGM) sector and endorsed by the national government and key stakeholders facilitating early implementation of the Minamata Convention in Indonesia. Meanwhile, the objective of the activity is the early implementation of the Minamata Convention in Indonesia which contributes to the protection of human health and the environment from the risks posed by unintentional and intentional emissions and releases, and unsound use and management of mercury in Indonesia.

The NAP ASGM document is expected to support the implementation and achievement of RAN-PPM targets in ASGM priority areas and to provide input if the RAN-PPM is to be revised or updated based on the results of literature studies and field visits.

## Practices in ASGM and Processing

Processing of gold with mercury in ASGM is still widely carried out, only a small number of operations have switched to processes that do not use mercury such as the use of cyanide, borax or physical separation by panning (sifting). The gold processing that uses mercury traditionally uses rod-mills (trommels) which are a tool to grind rock to be mixed with mercury (Marwiani, n.d). Worst practices include whole-ore-amalgamation, open burning of amalgam, burning of amalgam in residential areas, cyanidation of mercury-contaminated tailings, and tailings dumping. These worst practices are the norm, rather than the exception, at most hard-rock processing sites (Haris, 2014).

## Baseline Estimates of Quantities of Mercury Used in ASGM

In 2019, a national inventory study performed as part of the MIA and NAP project identified ASGM sites in 29 provinces out of the total number of 34 provinces. Moreover, a more detailed geographic breakdown was also performed at the level of individual regencies and cities. The total mercury used/lost from all existing ASGM activity in Indonesia has been estimated by the national inventory to be approximately 345.5 metric tonnes per annum (MoEF & BSCRC-SEA, 2019). This figure is based primarily on the magnitude of the releases at a number of very prominent sites in the country.

## Information Obtained from Field Visits

In 2010, BaliFokus estimated that there are 163,710 artisanal and small-scale gold miners in Indonesia. The National Overview of Indonesian ASGM (2020) estimated this number to be 179,200. This more recent estimate of miner numbers was made based on information available from locality studies, and by establishing the number of districts with ASGM activity in each regency and city.

Currently, the number of women involved in ASGM is 30% of the total number of workers in ASGM in Indonesia. Another fact is that women get lower wages even though they work as hard as men and face severe health and safety risks (Ratnawati, 2021).

There is currently no nationwide estimation of number of children involved in ASGM in Indonesia although there are some research assessments that provide estimates of numbers of children involved at some ASGM locations. It was estimated that 300-350 children worked at three gold mining sites in Long Iram District, West Kutai Regency, East Kalimantan Province (ILO, 2004a). The ILO also conducted research in Batu Sopang District and Muara Komam District, Paser Regency and Tering District, West Kutai Regency, East Kalimantan Province on the number of child laborers aged 10 to 17 years old. In Batu Sopang and Muara Komam District in 10 sites, there were 17 children working in illegal mining units. Seven (7) of them were found in the Batu Sopang District and ten in the Muara Komam District. Furthermore, there were 52 children working outside of the mining units. In the Kelian Dalam Village of the Tering District, there were 29 children working full time at mining units, and 23 other children who were seen carrying out additional work (ILO, 2004b). Observation and interviews by Jember University showed that there were 6 (six) children aged 13-17 years old who directly worked at ASGM in Blang Leumak Aceh Jaya Village, Beutong District, Nagan Raya Regency, Aceh Province (Sari & Sanova, 2020).

The national inventory study conducted by MoEF and BSCRC-SEA (2019) also estimates that the total gold production from ASGM using mercury is 53.8 tonnes per year. This study also shows the average ratio of Hg (lost) to Au (produced), namely 10 parts of mercury with 1 part of gold for primary gold reserves (hard rock) and 1.3 parts of mercury to 1 part of gold for secondary gold reserves (alluvial and placer).

The study conducted by MoEF, BSCRC-SEA and the field survey team in 2021 for the development of the MIA and NAP ASGM documents also carried out an inventory, laboratory analysis of environmental samples and human biomonitoring in selected ASGM locations to provide a basic estimate for the "Report on ASGM Studies in Indonesia." The study was conducted in Lebak Regency in Banten Province, Tasikmalaya Regency in West Java Province, Mandailing Natal Regency in North Sumatra Province, Bolaang Mongondow Regency in North Sulawesi Province, West Sumbawa Regency in West Nusa Tenggara Province, and Murung Raya Regency in Central Kalimantan Province.

From the study, Hg concentrations in environmental samples such as tailing sludge exceeded the threshold limit value (TLV) in Lebak Regency, Tasikmalaya Regency and Bolaang Mongondow Regency. Hg concentration in samples of garden/consumption crops/plants and local rice also exceeded TLV in Lebak Regency, Tasikmalaya Regency, West Sumbawa Regency, Bolaang Mongondow Regency and Mandailing Natal Regency. Hg concentration in samples of plantation or paddy field soil or soil around rod-mill (trommel) sites exceeded TLV in all 6 (six) regencies. Hg concentration in samples of biota exceeded the TLV in Mandailing Natal Regency and Tasikmalaya Regency.

Hg concentrations in the nails, hair and urine of respondents were generally still below the threshold value in Lebakgedong District, Lebak Regency. In the ASGM location in the Hutabargot District, Mandailing Natal Regency and Karangjaya District, Tasikmalaya Regency, the Hg levels in the nails, hair, and urine of respondents were generally close to the threshold and some even exceeded it. In Taliwang District, West Sumbawa Regency and Lolayan District, Bolaang Mongondow Regency, the Hg levels in the nails, hair, and urine of the respondents were generally still below the threshold but there was one sample in Taliwang District and some in Lolayan District that exceeded it. In Murung Raya Regency, the Hg levels in the respondents' nails and hair were still below the TLV, but several individuals had very high Hg levels in the urine, which reflected a disorder in their kidneys.

HBM score analysis was already at the moderate level in Lebakgedong District, the moderate to high level in Karangjaya District, the high level in Hutabargot District, the alert level in Taliwang District and at chronic levels in Lolayan District. HBM medical scores in Murung Raya Regency were in the moderate category, and some individuals fell in the high category.

Considering that mercury can bioaccumulate and that some respondents have high mercury concentrations in their nail, hair and urine, in addition to some samples of plants, rice and biota that have exceeded the TLV, particular concern is needed for the health of the communities with the higher mercury concentrations (MoEF & BSCRC-SEA, 2021).

## National Objective and Target for Mercury Reduction and Elimination

Presidential Regulation Number 21 of 2019 concerning the RAN-PPM contains strategies, activities and targets for reducing and eliminating mercury. The elimination target is 100 (one hundred) percent of the amount of mercury emitted and released before the RAN-PPM policy in 2025 for the ASGM priority sector.

The RAN-PPM is to be implemented in the period from 2018 to 2030. The target of mercury elimination in the ASGM sector is to use location indicators. The location as referred to in Presidential Regulation Number 21 of 2019 is the location of the regency/city. Based on baseline data on ASGM locations spread across Indonesia in 2018, there were 180-220 ASGM locations, to be precise 180 cities/regencies spread across 30 provinces with details as listed in Annex II to Minister of Environment and Forestry Regulation Number 81 of 2019. The baseline data for the year 2018 is the basis for calculating the success of the RAN-PPM.

## Implementation Strategy and Work Plan

To implement the target of 100% mercury elimination by 2025 in the ASGM priority sector, various strategies have been established as stated in the RAN-PPM. These strategies have been described in various activities and activity descriptions, namely in Annex II of the Presidential Regulation Number 21 of 2019 Part II. Mercury Elimination point a. Small Scale Gold Mining Priority Area (Please see Chapter V **Table 5.1**). The elaboration of the activities and activity descriptions of the RAN-PPM strategies are in accordance with the strategies set out in Annex C to the Minamata Convention.

In the Minamata Initial Assessment document, there are several recommendations for proposed activities related to ASGM. In addition, based on literature reviews and field visits under the NAP project, several recommendations are proposed to assist in the implementation of the RAN-PPM to meet the achievement of the mercury elimination target in the ASGM priority sector. The recommendations considered to be of highest priority are, among others, revising the Minister of Environment Regulation Number 23 of 2008, simplification in granting Small-Scale Mining Permits (*Izin Pertambangan Rakyat*, IPR) and Small-Scale Mining Area (*Wilayah Pertambangan Rakyat*, WPR) with the availability of clear data and not overlapping with licensed gold mining data and drafting a regulation that clearly prohibits cinnabar mining in Indonesia.

### a. Actions to eliminate worst practices

The strategies and activities to eliminate the above-mentioned worst practices under RAN-PPM are as follows:

- Strengthening the commitment, coordination and cooperation between relevant ministries/non-ministerial government agencies:
    - Conducting monitoring and evaluation on the implementation of the MoEMR Regulation concerning the Prohibition of Gold Processing Using Amalgamation.

- Strengthening community involvement through communication, information and education:
    - Including the dangers of using mercury in gold processing in the content of the national formal education curriculum;
    - Development of a community approach to increase knowledge and awareness about the health hazards of mercury;
    - Development of participatory approaches to communities in ASGM locations that aim to increase knowledge about the health impacts of mercury exposure and sustainable behavior change in the community;
    - Increasing the understanding of good mining practices for business actors regarding Small-Scale Mining Permits (IPR).

- Application of alternative technology for mercury-free gold processing:
    - Development of further research and studies on alternative technology for mercury-free gold processing;
    - Development of a Feasibility Study (FS) and Detailed Engineering Design (DED) for gold processing without mercury;
    - Construction of gold processing facilities without mercury.

- Transfer of local community livelihoods:
    - Development of a social study on the impact of mercury use on ASGM activities;
    - Development of an economic study of the impact of mercury use;
    - Social and economic transformation of illegal miners using mercury;
    - Fostering business opportunities;
    - Facilitating the issuance of permits for cooperatives and SMEs.

- Strengthening law enforcement:
    - Control of illegal ASGM using mercury.

## Recommendations

- There needs to be a different approach for provinces with predominantly alluvial mining vs. hard rock mining. In this case, the focus needs to be on gold shops and amalgam burning. It is very difficult to monitor amalgamation sites, but the presence of amalgam can be traced in gold shops. Regarding environmental damage, it is necessary to have other regulations governing it. Therefore, the cases of provinces with dominant whole ore amalgamation are different from those that are predominantly alluvial.

- It is proposed to involve the mining community at the start of mercury-free technology development, introduction, training and in the provision of assistance.

- The RAN-PPM is proposed to also cover other hazardous substances (*Bahan Berbahaya dan Beracun*, B3) management used in ASGM, although not in as much detail as for mercury.

### b. Steps to facilitate the formalization or regulation of the artisanal and small-scale gold mining sector

The strategies and activities to facilitate formalization of the informal or illegal ASGM sector are as follows:

- Strengthening the commitment, coordination and cooperation between relevant ministries/non-ministerial government agencies:
    - Conducting monitoring and evaluation on the implementation of the MoEMR Regulation concerning the Prohibition of Gold Processing Using Amalgamation.

- Strengthening coordination and cooperation between central and local governments:
    - Increasing the understanding of local government officials related to licensed small-scale mining.

- Establishment of an information system:
    - Identification of hotspots, populations at risk, and vulnerable populations due to mercury exposure through cross-sectoral cooperation.

- Strengthening community involvement through communication, information and education:
    - Development of a community approach to increasing knowledge and awareness about the health hazards of mercury;
    - Development of participatory approaches to communities in ASGM locations that aim to increase knowledge about the health impacts of mercury exposure and sustainable behavior change in the community.

- Strengthening law enforcement:
    - Control of illegal ASGM using mercury.

## Recommendations

- Problems in ASGM are multi-dimensional, and therefore require a high level of coordination between relevant ministries/agencies if they are to be solved. Although the NAP aims to protect human health and the environment, it is also necessary to pay attention to the emerging technological, social, economic and institutional issues.

- MoEF needs to establish a pilot demonstration area for gold processing without mercury that is successful, runs well and operates within the WPR/IPR system implemented by community groups/cooperatives to serve as a reference project for other regions. In this regard, MoEF and BPPT has initiated The GOLD-ISMIA project (https://www.goldismia.org/) which is part of the global PlanetGOLD programme (https://www.planetgold.org/indonesia) which is supported by the United Nations Development Program (UNDP) and funded by GEF. The project is supporting 6 ASGM communities (Yogyakarta, West Nusa Tenggara, Gorontalo, North Sulawesi, North Maluku and Riau) in Indonesia, through introduction of mercury-free gold processing equipment.

- The central government can provide further encouragement by providing incentives to local governments that provide guidance to local ASGM communities. On the other hand, disincentives should be handed down to local governments that do not pay attention to the ASGM communities in their areas.

- MoEF, MoEMR and BPPT need to provide assistance in terms of carrying out mentoring activities related to the transfer of gold processing technology to local governments as well as by assisting in the application of WPR and IPR and facilitating NGO assistance.

- Simplifying the process of granting IPR and WPR by making clear data available on land availability and by having data that does not overlap with licensed gold mining data.

- Provincial action plans also need to be flexible enough to accommodate local customs. Based on traditional land claims, gold resources must be handed over to communities based on customary rights, especially if they have been working there for some time, such as in Gorontalo. Traditionally, mined areas should be zoned for WPR.

- Proposals for the determination of WPR areas are only recommended for areas with gold deposits of between 3 g/tonnes to 10 g/tonnes. Areas with a gold concentration of < 3 g per tonnes are not suitable for exploitation and are recommended as social forest areas.

- Miners must apply for permits in groups, and local and central government should help simplify the licensing mechanisms and procedures and the required environmental documents.

### c. Strategies for promoting the reduction of emissions and releases, and the risk of exposure to mercury

The strategies and activities to reduce mercury emissions, releases and exposures in ASGM are planned in the RAN-PPM as follows:

- Strengthening the commitment, coordination and cooperation between relevant ministries/non-ministerial government agencies:
  - Development of guidelines for storage and handling of mercury and waste containing mercury;
  - Development of guidelines for remediation of mercury- contaminated land.

- Strengthening coordination and cooperation between central and local governments:
  - Conducting regular monitoring on environmental quality (multimedia).

- Increasing leadership, institutional and human resource capacities for the elimination of mercury:
  - Development of a national mercury research and monitoring laboratory;
  - Conducting Mercury Research.

- Establishment of an information system:
  - Mapping the impact of mercury emissions and releases on the environment around ASGM locations.

- Strengthening community involvement through communication, information and education:
  - Including the dangers of using mercury in gold processing in the content of the national formal education curriculum;
  - Conducting a campaign on the risk of the impact of mercury use on vulnerable communities and a campaign for gender mainstreaming;
  - Conducting outreach and increasing the capacity of health workers about health risks due to mercury exposure;
  - Development of a community approach to increase knowledge and awareness about the health hazards of mercury;
  - Development of participatory approaches to communities in ASGM locations that aim to increase knowledge about the health impacts of mercury exposure and sustainable behavior change in the community;
  - Increasing the understanding of good mining practices for business actors regarding Small-Scale Mining Permits (IPR);
  - Conducting outreach regarding the guidelines for remediation of mercury-contaminated land.

- Application of alternative technologies for mercury-free gold processing:
    - Development of research and studies on alternative technology for mercury-free gold processing;
    - Remediation of land contaminated with mercury and land rehabilitation due to gold mining activities;
    - Development of a Feasibility Study (FS) and Detailed Engineering Design (DED) for gold processing without the use of mercury;
    - Construction of facilities for gold processing without the use of mercury;
    - Development of FS and DED for the provision of mercury storage facilities;
    - Provision of mercury storage facilities.

- Transfer of local community livelihoods:
    - Development of a social study on the impact of mercury use on ASGM activities;
    - Development of an economic study of the impact of mercury use;
    - Social and economic transformation of illegal miners using mercury;
    - Fostering business opportunities;
    - Facilitating the issuance of permits for cooperatives and SMEs.

- Strengthening law enforcement:
    - Supervising and controlling illegal/unpermitted primary mercury mining (cinnabar mining) activities;
    - Control of illegal ASGM using mercury.

## Recommendations

- Revise Minister of Environment Regulation Number 23 of 2008 concerning the Technical Guidelines for the Prevention of Pollution and/or Environmental Damage Due to Small-Scale Gold Mining.

- The central government needs to allocate a special allocation fund for the environmental sector, both physical and non-physical, to the implementing areas of RAD-PPM for the ASGM sector to finance environmental monitoring activities, namely sampling of water, soil, and food media so that the mapping of mercury pollution levels can be carried out to the maximum and used as a source of materials for advocacy, awareness raising and policy making in the regions.

- The local government and central government to assist pilot facilities for processing gold without mercury outside residential areas.

- Establish special zones for gold processing areas for ASGM.

- Prohibit the sale of tailings or slurry from the dumped slurry and its utilization to become products or other uses, especially for building materials or additional land in agricultural land and rice fields.

- Applying garden land remediation technology for food crops (clean-up).

- Processing can be done centrally, within a WPR or within an adjacent Mining Business Permit (*Izin Usaha Pertambangan*, IUP) owned by a company. To facilitate cleaner processing, companies need to be permitted to buy ore mined within the WPR area from mining communities. Due to the many legal requirements that miners must meet before they can legally process the ore, it is preferable for the company to buy the ore, as long as they can process it in a sustainable and environmentally friendly manner. It would also be good if a company like ANTAM could create a clean artisanal gold brand based on that relationship.

### d. Strategies for managing trade and preventing diversion of mercury and mercury compounds from both foreign and domestic source to use in ASGM and processing

The strategies and activities to manage trade and prevent mercury use in ASGM under RAN-PPM are as follows:

- Strengthening the commitment, coordination and cooperation between relevant ministries/non-ministerial government agencies:
    - Development and revision of regulations regarding the trade system for imports, exports and domestic distribution of mercury.

- Establishment of an information system:
    - Development of a national database system related to the trade, distribution and use of mercury;
    - Development of a map information system for the distribution of cinnabar and mercury-bearing ores in Indonesia;
    - Conduct an inventory and mapping of sources, procurement supplies, distribution, and use of mercury.

- Strengthening law enforcement:
    - Increasing import and export supervision of mercury as a commodity;
    - Supervising and controlling primary mercury mining activities (cinnabar mining) without permit/illegal;
    - Supervising domestic mercury circulation;
    - Control of illegal mercury trade systems.

## Recommendations

- It is proposed that a draft regulation be issued that clearly prohibits cinnabar mining in Indonesia.

- Prevention of the existence of cinnabar smelters as they are very dangerous contaminated areas due to the very large volumes of mercury produced.

- Control of mercury traders and distributors needs to be continued. Mercury needs to be confiscated and this will require short- and medium-term storage solutions in all seven regions of Indonesia.

- It is necessary to encourage the strengthening of the implementation of supervision and control of mercury circulation as carried out by the Police, TNI and the Prosecutor's Office in the regions.

- Prevention of the free trade of mercury online.

### e. Strategies for involving stakeholder in the implementation and continuing development of the plan

The following strategies and activities are planned to involve and increase cooperation among relevant stakeholders to implement and continue development of the national action plan:

- Strengthening commitment, coordination and cooperation between relevant ministries/non-ministerial government agencies:
    - Conducting policy outreach to provincial governments.

- Strengthening coordination and cooperation between central and local governments:
    - Increasing the understanding of local government officials related to licensed small-scale mining;
    - Developing and conducting cooperation to reduce and eliminate the use of mercury and mitigate the impact of mercury with non-governmental organizations, donor agencies, and other countries (bilateral);
    - Conducting regular monitoring on environmental quality (multimedia).

- Increasing leadership, institutional and human resource capacities in the elimination of mercury:
    - Development of a national mercury research and monitoring laboratory;
    - Conducting mercury research.

- Strengthening community involvement through communication, information and education:
    - Including the dangers of using mercury in gold processing in the content of the national formal education curriculum;
    - Conducting a campaign on the risk of the impact of mercury use on vulnerable communities and a campaign for gender mainstreaming;
    - Conducting outreach and increasing the capacity of health workers about health risks due to mercury exposure;

- Development of a community approach to increasing knowledge and awareness about the health hazards of mercury;
- Development of participatory approaches towards communities in ASGM locations in order to increase their knowledge about the health impacts of mercury exposure and to create sustainable behavior change in the community;
- Increasing the level of community understanding about good mining practices, and especially for business actors holding Small-Scale Mining Permits (IPR);
- Conducting outreach on guidelines for remediation of mercury-contaminated land.

## Recommendations

There needs to be further assistance from the central government to local governments for the development, implementation and monitoring of RAD-PPM implementation. In addition, the government can also collaborate with various relevant stakeholders, such as NGOs, with the government acting as the coordinator.

### f. A public health strategy on the exposure of artisanal and small-scale gold miners and their communities to mercury

The strategies and activities to prevent mercury exposure of ASGM miners and their communities are as follows:

- Strengthening the commitment, coordination and cooperation between relevant ministries/non-ministerial government agencies:
  - Development of a standard method for measuring mercury exposure covering nodes 1 - 3 (source, media and receptors) and consisting of sampling and analysis methods.

- Establishment of an information system:
  - Identification of hotspots, populations at risk, and vulnerable populations due to mercury exposure through cross-sectoral cooperation;
  - Identification and improvement of national standards for threshold limit values for mercury exposure to human health.

- Strengthening community involvement through communication, information and education:
  - Including the dangers of using mercury in gold processing in the content of the national formal education curriculum;
  - Conducting a campaign on the risk of the impact of mercury use on vulnerable communities and a campaign for gender mainstreaming;
  - Conducting outreach and increasing the capacity of health workers about health risks due to mercury exposure;
  - Development of a community approach to increasing knowledge and awareness about the health hazards of mercury;
  - Development of participatory approaches to communities in ASGM locations that aim to increase their level of knowledge about the health impacts of mercury exposure and to create sustainable behavior change in the community;
  - Increasing the understanding of good mining practices for business actors regarding Small-Scale Mining Permits (IPR).

## Recommendations

- It is proposed that health workers be involved in the following activities: (1) local capacity building, including doctors and medical personnel at public health centers (*puskesmas*) and integrated health services (*posyandu*) in monitoring and updating health data; (2) providing medical care or services to patients poisoned by mercury, (3) monitoring the health conditions of infants and mothers who are detected as contaminated by mercury; (4) reporting to the central and local governments on diseases that are indicated to be due to contamination by mercury. With this information system, it can be used as material for policy making for the prevention and treatment of mercury contamination.

- Conducting health promotion for all levels of society by suggesting to reduce the intake of local fish and looking for alternative water sources to irrigate rice fields and gardens.

### g. Strategies to prevent the exposure of vulnerable populations, particularly children and women of child-bearing age, to mercury used in ASGM

The strategies and activities to prevent the exposure of children and women to mercury in ASGM are as follows:

- Strengthening the commitment, coordination and cooperation between relevant ministries/non-ministerial government agencies:
    - Development of guidelines for storage and handling of mercury and waste containing mercury;
    - Development of guidelines for remediation of mercury-contaminated land;
    - Carrying out efforts to protect at-risk populations, especially children and women, and controlling the health impacts of mercury exposure through the development of guidelines for controlling risk factors and health impacts due to mercury exposure in the environment and guidelines for handling cases of mercury poisoning.

- Strengthening coordination and cooperation between central and local governments:
    - Conducting regular monitoring on environmental quality (multimedia).

- Establishment of an information system:
    - Mapping the impact of mercury emissions and releases on the environment around ASGM locations;
    - Identification of hotspots, population at risk, and vulnerable populations due to mercury exposure through cross-sectoral cooperation;
    - Identification and improvement of national standards for threshold limit values for mercury exposure to human health.

- Strengthening community involvement through communication, information and education:
    - Including the dangers of using mercury in gold processing in the content of the national formal education curriculum;
    - Conducting a campaign on the risk of the impact of mercury use on vulnerable communities and a campaign for gender mainstreaming;
    - Development of a community approach to increase knowledge and awareness about the health hazards of mercury;
    - Development of participatory approaches to communities in ASGM locations that aims to increase community knowledge about the health impacts of mercury exposure and create sustainable behavior change in the community.

- Application of alternative technology for mercury-free gold processing:
    - Remediation of land contaminated with mercury and land rehabilitation due to gold mining activities;
    - Development of a Feasibility Study (FS) and Detailed Engineering Design (DED) for gold processing without mercury;
    - Construction of facilities for gold processing without the use of mercury;
    - Development of an FS and DED for the provision of mercury storage facilities;
    - Provision of mercury storage facilities.

## Recommendations

- It is recommended that women are provided with relevant information on the dangers of mercury and regarding preventive measures, for example by cleaning the house such as by sweeping and mopping in the morning and afternoon, conducting well water analysis, bathing and self-cleaning after work, drinking coconut water, and other actions.

- Trainings for women working at illegal ASGM so that they can change profession such as be sewing, selling food, etc.

- It is recommended that public health centers conduct health checks for children and women or mothers with mercury concentrations above the standard level in their body, at minimum twice a year.

### h. Strategies for providing information to artisanal and small-scale miners and affected communities

To disseminate relevant information and increase the awareness of ASGM miners and affected communities, the strategy under the RAN-PPM is to strengthen community involvement through communication, information and education, through the following activities:

- Including the dangers of using mercury in gold processing in the content of the national formal education curriculum;
- Conducting a campaign on the risk of the impact of mercury use on vulnerable communities and a campaign for gender mainstreaming;
- Development of a community approach to increase knowledge and awareness about the health hazards of mercury;
- Development of participatory approaches to communities in ASGM locations that aim to increase knowledge about the health impacts of mercury exposure and create sustainable behavior change in the community;
- Increasing the understanding of good mining practices for business actors regarding Small-Scale Mining Permits (IPR).

## Recommendations

- For the establishment of an information system, data should include WPR mapping, health assessments conducted at ASGM sites, guidance on good mining practices, developments in mercury-free gold processing technology and integrated waste management, information on environmental and health hazards of mercury, and mechanisms for formalizing ASGM. This information system must be accessible to relevant stakeholders, including local governments and the ASGM community, both online and conventionally. Periodic updating is required for information systems.

- Educational and outreach materials to communities and health workers also include ways to protect miners, families and communities from mercury exposure. It is proposed that the material for outreach, especially for students, also includes information on the importance of education so that they do not work in the ASGM sector.

### i. Additional strategies including market-based mechanisms or marketing tools

An additional strategy to achieve the mercury elimination target for ASGM as a priority sector under the RAN-PPM is the transfer of local community livelihoods through the following activities:

- Development of a social and economic study on the impact of mercury use on ASGM activities;
- Social and economic transformation of illegal miners using mercury;
- Fostering business opportunities;
- Facilitating the issuance of permits for cooperatives and SMEs.

## Recommendations

- Livelihood transfer programs need to provide social and economic benefits for men, women and children.

- It is proposed to (1) provide incentives to ASGM in the form of eco-labeling, promotion and convenience of buying and selling; (2) for environmental management, local governments allocate 10% of the cost of selling gold from ASGM activities; and (3) increase community income through skills training and innovation in environmentally friendly gold jewelry products and access to capital and markets.

- The local government also provides assistance opportunities for gold artisans to make jewelry and other products in their local area.

In 2019, UNDP and GEF in collaboration with the MoEF and Agency for the Assessment and Application of Technology (*Badan Pengkajian dan Penerapan Teknologi*, BPPT), launched a project to support Indonesia's efforts to reduce mercury use in ASGM called GOLD-ISMIA. GOLD-ISMIA is *Global Environment Facilities - Global Opportunities for Long-Term Development (GOLD) Integrated Sound Management of Mercury in Indonesia's Artisanal and Small-Scale Gold Mining (ASGM)* which is part of the global PlanetGOLD programme (https://www.planetgold.org/indonesia).

The duration of the project is five years and will support ASGM communities in the provinces of Yogyakarta, West Nusa Tenggara, Gorontalo, North Sulawesi, North Maluku and Riau to reduce mercury use by at least 5 tonnes per year starting in the third year of the project so that at the end of the project it will reduce mercury releases by at least 15 tonnes.

In 2020-2021, the Ministry of Health received a grant from the Minamata Convention Specific International Program (SIP), namely "Improving Health Risk Control of Mercury Exposure in Artisanal and Small-Scale Gold Mining (ASGM) and Surrounding Areas by Developing the "Participatory Approach" Model." The objective of the activity is to develop a participatory approach model in controlling health risks from mercury exposure that is carried out holistically at all levels of society involving the community and local health workers. Beneficiaries of the activities are cross-program and cross-sectoral at the central and local levels, professional organizations, universities, community and community organizations.

Institutions conducting the activity are the Directorate of Environmental Health, Ministry of Health and BSCRC-SEA. The locations of the activity are Lebak Regency, Banten; Banyumas Regency, Central Java and West Lombok Regency, West Nusa Tenggara.

## Evaluation Mechanism

The Minamata Convention, under Article 21, obligated each Party to report to the Conference of the Parties, through the Secretariat, on the measures it has taken to implement the provisions of the Convention and on the effectiveness of such measures and the possible challenges in meeting the objectives of the Convention. The reporting should include information as called for in Article 7 of the Convention on ASGM. Indonesia has submitted its complete reports for the first reporting period, of 16 August 2017 to 31 December 2019.

The mechanism for evaluating the implementation of the RAN-PPM and the RAD-PPM is regulated in Article 7 to Article 13 of Presidential Regulation Number 21 of 2019 concerning RAN-PPM and Chapter III of MoEF Regulation Number P.81/Menlhk/Setjen/Kum.1/10/2019 concerning Implementation of Presidential Regulation No. 21 of 2019 concerning RAN-PPM. The evaluation mechanism of the RAN-PPM as the National Action Plan for Artisanal and Small-Scale Gold Mining will assist in fulfilling Indonesia' reporting obligation under the Minamata Convention.

Evaluation of the monitoring results of the RAN-PPM and the RAD-PPM implementation is carried out by the Minister of Environment and Forestry, ministers and/or heads of non-ministerial government agencies, governors, and/or regents/mayors in accordance with their respective authorities. The evaluation is carried out by comparing the realization with the target achievement of reducing and eliminating mercury and knowing the implementation barriers. Evaluation is to be carried out at least 1 (one) time every 3 (three) months (Article 13 and Article 15 of MoEF Regulation Number 81 of 2019).

As for the ASGM priority sector, the achievement of mercury elimination is measured by the amount of mercury use in ASGM businesses and/or activities as well as the success in implementing mercury elimination activities.

Monitoring and evaluation are coordinated by the Minister of Environment and Forestry for the implementation of the RAN-PPM and the governor for the implementation of the provincial RAD-PPM.

# CHAPTER II. INTRODUCTION

The Minamata Convention on Mercury is a global agreement to protect human health and the environment from anthropogenic mercury and mercury compounds emissions and releases. This Convention was adopted in October 2013 in Japan and entered into force in 2017. Mercury is a global pollutant that is toxic, corrosive, persistent and can accumulate in a way that is harmful to human health and the environment. Mercury occurs naturally in nature and is found in many everyday items and is released into the air, soil and water from various sources.

Controlling the anthropogenic release of mercury throughout its life cycle is a key factor in determining the obligations under the Convention. The main provisions of the Minamata Convention include banning new mercury mines, phase-out of existing mines, prohibiting and reducing the use of mercury in a number of products and processes, measures to control emissions to the air and release to soil and water and regulation of informal artisanal and small-scale gold mining (ASGM). The Minamata Convention also regulates the temporary storage and disposal of mercury after it becomes waste, and also addresses mercury-contaminated land and health problems (UNEP, no year).

The Minamata Convention regulates artisanal and small-scale gold mining and processing in which mercury amalgamation is used to extract gold from ore: Article 7 and Annex C on ASGM. Article 7 that requires each Party having significant artisanal and small-scale gold mining and processing within its territory shall take steps to reduce, and where feasible eliminate, the use of mercury and mercury compounds in, and the emissions and releases to the environment of mercury from, such mining and processing.

Furthermore, each Party shall notify the Secretariat of the Minamata Convention if at any time the Party determines that artisanal and small-scale gold mining and processing in its territory is more than insignificant. If ASGM is determined to be significant, the Party shall develop and implement a national action plan in accordance with Annex C of the Minamata Convention.

Indonesia has ratified the Minamata Convention on Mercury through Law No.11 of 2017 concerning Ratification of the Minamata Convention on Mercury. As a follow-up to the ratification, Indonesia issued Presidential Regulation Number 21 of 2019 concerning the National Action Plan for Mercury Reduction and Elimination (*Rencana Aksi Nasional Pengurangan dan Penghapusan Merkuri*, RAN-PPM). In addition, the Minister of Environment and Forestry Regulation Number P.81/Menlhk/Setjen/Kum.1/10/2019 has also been stipulated for the implementation of the RAN-PPM.

This NAP document supports the implementation and achievement of Indonesia's RAN-PPM targets in the priority area of ASGM and further inputs, revisions and updates will be made to the RAN-PPM, based on the results of further literature studies and field visits over time.

The "Development of Minamata Initial Assessment and National Action Plan for Artisanal and Small-Scale Gold Mining in Indonesia" has been a collaborative activity between UNEP as the implementing agency in partnership with the Ministry of Environment and Forestry, Republic of Indonesia (MoEF) as the executing agency with funding from the Global Environment Facility (GEF). Basel and Stockholm Conventions Regional Centre for Southeast Asia (BSCRC-SEA) have assisted MoEF in the implementation of this activity.

The outcome of this activity has been the development of the Minamata Initial Assessment (MIA) and the National Action Plan (NAP) for the artisanal and small-scale gold mining (ASGM) sector and this has been endorsed by the national government and key stakeholders facilitating early implementation of the Minamata Convention in Indonesia. Meanwhile, the objective of the activity is the early implementation of the Minamata Convention in Indonesia which contributes to the protection of human health and the environment from the risks posed by unintentional and intentional emissions and releases, unsound use and management of mercury in Indonesia.

The NAP ASGM document is expected to support the implementation and achievement of RAN-PPM targets in ASGM priority area and to provide input if RAN-PPM is to be revised or updated based on the results of literature studies and field visits.

The preparation of the NAP ASGM document involved relevant stakeholders as can be seen in **Annex I**. Data and information were collected through desk studies, questionnaires, interviews and field visits. The consultation and review process with various stakeholders to obtain input for the NAP ASGM document was carried out through face-to-face meetings, workshops and focus group discussions as well as through written inputs. Due to the ongoing global coronavirus disease (COVID-19) pandemic, meetings since March 2020 have also been held online. Field surveys to ASGM locations which were originally planned to begin in early 2020 could only be carried out at the end of 2020.

Workshops and meetings as well as field surveys that have been carried out for the development of the NAP ASGM document are as follows:

- Inception Workshop "Development of Minamata Initial Assessment and Updating of National Action Plan for Artisanal and Small-Scale Gold Mining in Indonesia," Jakarta, 4-5 December 2017.
- Focus Group Discussion "Development of Minamata Initial Assessment and Updating of National Action Plan for Artisanal and Small-Scale Gold Mining in Indonesia," Jakarta, 8 May 2018.
- National Steering Committee Meeting "Development of Minamata Initial Assessment and Updating of National Action Plan for Artisanal and Small-Scale Gold Mining in Indonesia, Jakarta, 10 April 2019.
- Training for Survey Team of Minamata Initial Assessment (MIA) and National Action Plan for Artisanal and Small-Scale Gold Mining in Indonesia, Jakarta, 9 February 2020.
- Field surveys to obtain samples and data to ASGM locations as follows:
  - Mandailing Natal Regency, North Sumatera Province (October 2020 & March 2021);
  - Lebak Regency, Banten Province (November 2020 & March 2021);
  - Tasikmalaya Regency, West Java Province (December 2020 & April 2021);
  - Bolaang Mongondow Regency, North Sulawesi Province (March 2021);
  - West Sumbawa Regency, West Nusa Tenggara Province (April 2021);
  - Murung Raya Regency, Central Kalimantan Province (June 2021).
- Coordination meetings of the BSCRC-SEA reporting team, coordination meetings with the field survey team from the Bogor Agricultural University (IPB) and consultation meetings with the Ministry of Environment and Forestry.

# CHAPTER III. NATIONAL OVERVIEW OF ARTISANAL AND SMALL-SCALE GOLD MINING IN INDONESIA

## 3.1. Previous Experiences in Addressing ASGM

Previous and current national projects and initiatives are discussed in the following sections.

### 3.1.1. Donor-Led Projects in the ASGM Sector (2000-2020)

The Global Mercury Project (2002 – 2007) was a multi-country project funded by GEF and implemented by UNIDO which focused exclusively on reducing mercury emissions from ASGM. The project was implemented in 6 (six) countries: Brazil, Tanzania, Zimbabwe, Sudan, Lao PDR, and Indonesia. In Indonesia, this project examined both hard rock mining practices with intensive mercury use in North Sulawesi Province and alluvial mining practices in Central Kalimantan Province.

In 2011-2013, a collaborative project between USEPA/UNEP/Blacksmith Institute/YTS went on to implement a further project in Central Kalimantan Province to mitigate mercury emissions from ASGM in Indonesia.

In 2013-2015, the GAHP/YTS project focused on action research into appropriate technology alternatives to mercury use for processing hard rock, leading to the discovery and application of the Manado Method, a low-cost gravity concentration method that captures very fine gold. The project was focused in West Sumbawa Regency, in West Nusa Tenggara Province, and Banyumas Regency, in Central Java Province.

In 2015, UNEP/YTS conducted a further pilot demonstration project in Pacitan Regency, East Java Province, on mercury-free processing techniques, and wastewater management. The project also worked on policy analysis and reform by establishing a forum for discussion at the national level, working with the Ministry of Environment and Forestry. A review was done on the implementation of Ministerial Decree No. 23 of 2008 on the technical guidance to prevent environmental contamination and/or destruction due to artisanal gold mining.

The Sustainable Development of Artisanal and Small-scale Gold Mining in Indonesia Project (2015-2020) or '*Program Emas Rakyat Sejahtera*' (PERS) as it is called in Bahasa Indonesia, was developed by AGC-YTS as a project that aims to improve incomes, health, and the environment of the vulnerable and marginalized men and women dependent on the artisanal and small-scale gold mining (ASGM) economy in targeted areas in Indonesia (https://pers.no-hg.org/welcome/).

The Global Environment Facility – Global Opportunities for Long-term Development of Artisanal and Small-scale Gold Mining (ASGM) Sector (GEF-GOLD): Integrated Sound Management of Mercury in Indonesia's ASGM (ISMIA) project which is part of the global Planet GOLD programme (https://www.planetgold.org/indonesia) is a partnership between UNDP and the Government of Indonesia (GOI) which seeks to address the issue of ASGM formalization in Indonesia. The project aims to support six ASGM communities in Indonesia to reduce mercury use by at least 5 metric tonnes/year starting in year three (3) of the project, which over the five-year (2018-2023) life-span of the project should result in a mercury release reduction of at least 15 tonnes.

Reducing Mercury Use and Releases in Indonesia's ASGM Sector: Restrict Supplies and Secure Storage of Mercury is a relatively new project which is funded by the US Department of State and implemented by the Biodiversity Research Institute (BRI) and Balifokus. The goal of this project is to reduce the supply and availability of mercury in Indonesia.

### 3.1.2. Aims and Approaches of Donor-Led Projects in the ASGM Sector

Previous donor-led projects have not only performed technical interventions, but have also examined health, environmental, socio-economic, and policy aspects. Some projects have also considered gender perspectives in their implementation, as shown by activities such as health awareness campaigns that have also framed women and children as the most vulnerable target groups. Donor-led projects have had slightly different

approaches, and each donor has had different regional priorities. Regional selection can be influenced by various things, including the areas that have been determined in agreements between the Government of Indonesia and donor governments. For example, Central Java Province is one of the priority target areas in the agreement between the Government of Indonesia and DANIDA/ ESP3.

### 3.1.3. GOI-Led Projects in the ASGM Sector

Responsible Ministries: at the national level, there are 3 (three) ministries that play the main role in the management of ASGM in Indonesia: The Ministry of Environment and Forestry; the Ministry of Energy and Mineral Resources; and the Ministry of Health. In addition, it is expected that the Agency for the Assessment and Application of Technology (*Badan Pengkajian dan Penerapan Teknologi*, BPPT) will provide alternative gold processing techniques that are environmentally friendly.

#### Ministry of Environment and Forestry

With support from UNEP, the MoEF (in collaboration with BSCRC-SEA) has taken responsibility for developing the Minamata Initial Assessment: an inventory of emissions and mercury releases in Indonesia. The results of the MIA are intended to be used as the reference point for the improvement of the NAP for Mercury Elimination in ASGM which is expected to be completed in 2021. MoEF has also conducted other activities, such as performing an inventory of degraded lands resulting from ASGM, with consideration towards the future rehabilitation and remediation of mercury-contaminated sites.

In addition to the regulatory sector, the MoEF has also prioritized technological solutions, including the construction of mercury-free gold management facilities at legal ASGM sites.

Bapedal (which became MOE and is now MoEF) has also undertaken various activities related to mercury use in ASGM long prior to the ratification of the Minamata Convention such as introducing technological solutions to reduce mercury vapor and the MOE has long conducted monitoring activities. In the 1990s, at the Central Facility for Environmental Pollution Control, the MOE had conducted mercury monitoring in Pongkor.

In 1992-1993, the Government of Indonesia had a programme funded by the State Budget (*Anggaran Pendapatan dan Belanja Negara*, APBN) to reduce mercury releases from ASGM by using retort technology. The design of the retort followed the model of retort from ASGM in Brazil. The programme was conducted by Bapedal (Environmental Impact Control Agency) together with the Metal Industries Development Centre, Bandung at locations in 3 (three) provinces namely Lanut Village (North Sulawesi), Cineam Regency (West Java) and West Kalimantan. The main focus of the programme was the amalgamation processing which used a lot of drums (trommels) powered by a diesel generator to crush and grind the gold ore mixed with mercury.

In 2012, MoE conducted monitoring activities on mercury concentration in ambient air and river flow at Sekotong (West Nusa Tenggara), Dharmasraya (West Sumatera) and Krueng Sabee (Aceh) and river flow, sediment, soil and fish tissue from Kahayan River in Gunung Mas Regency (Central Kalimantan). The monitoring results carried out by MoE in 2012 for ambient air quality samples and river water for Sekotong, Dharmasraya and Krueng Sabee still met the quality standard according to Government Regulation (GR) No. 41 of 1999 for ambient air quality and GR No. 82 of 2001 for water quality standard.

The analysis results of the samples with significant concentrations of mercury showed indication of pollution of the surrounding environment in ASGM areas. Monitoring was also conducted by analyzing mercury content in hair and by interviewing 171 respondents of gold processors and non-gold processors around ASGM areas. The hair analysis was carried out in the laboratory of Chemistry Affiliation, Faculty of Mathematics and Natural Science, University of Indonesia (MoE, 2012).

In 2017, MoEF created non-mercury gold processing facilities and performed ASGM surveys in 3 (three) locations. In addition, MoEF built a pilot mercury-free gold processing facility in a small-scale mining area in Lebaksitu Village, Lebak Regency, Banten Province. In 2018, MoEF originally planned to build a pilot mercury-free treatment facility in Paningkaban Village in Central Java. However, in the end, MoEF elected to conduct a pilot for alternative livelihoods instead, together with an education center (*Kampung Ilmu*). The learning center is expected to provide pathways to alternative employment to gold mining, especially for young people and women. In the same year, a pilot mercury-free treatment facility was built at

a WPR in Kebonsari Village in East Java and Palu City in Central Sulawesi. MoEF also plans to restore mercury-contaminated land at the former ASGM location in Wamsait Village, Mount Botak, Buru Regency (MoEF, 2017a).

In order to implement the RAN-PPM, the Directorate of Contamination Remediation and Emergency Response on Hazardous Wastes, MoEF, has developed a program and provided funds to carry out several activities, including:

- Remediation of mercury contaminated land in Ciladaeun Village, Lebakgedong District, Lebak Regency in 2019 with the following implementation results:

| | |
|---|---|
| Remediated land area | : 3,014 $m^2$ |
| Volume of conaminated soil remediated | : 1,720 $m^3$ |
| Weight of contaminated soil remediated | : 2,2699.9 tonnes |
| Method of contaminated soil management | : Stabilization/ solidification and then landfilling in PPLI's landfill facility |

- Development of a study on the remediation of mercury contaminated land in Lebak Regency, Banten Province.

  In 2019, the remediation of contaminated land in Lebak, Banten was carried out using the methodology of excavation, transportation and treatment at a licensed hazardous waste treatment service and then landfilled using standard procedures. The processing cost in 2019 was around IDR 4 million per tonnes including transportation costs.

- In 2021, a large ex-gold mine was restored in Mandor District, Landak Regency, West Kalimantan Province. As a green open space, phytoremediation is being applied using plants that are not for consumption. To develop the community's economy, the context is integrated with tourism and crafts.

- Directorate of Remediation of Contamination and Emergency Response of Hazardous Wastes, Ministry of Environment and Forestry has planned to conduct Development of a Feasibility Study Document of Mercury-Contaminated Land in Mount Botak, Waelata.

The above study data is expected to be used by local governments or party/parties who will meet to formulate effective strategies and thus encourage further remediation.

Identification and inventory have been carried out in some areas but this has not yet reached 50% of all contaminated land as many areas are scattered through the landscape. Part of this land is ASGM and some is not ASGM. Considering the large cost of excavating, transporting and treatment methodologies, other methodologies are also carried out by planting plants that can absorb mercury and are not consumption crops, including bamboo and banyan trees. People are warned not to not consume these plants and not to use them as animal feed.

Currently, there are still several spots of ex-mining land with ex-tailings waste with mercury concentrations reaching hundreds of ppm. However, most of the tailing wastes are extracted again for gold using mercury or cyanide, but then dumped on community lands over an area that is often many times greater than the area of the original waste dumps. The concentration is not too high, around > 0.3 ppm-30 ppm, but the amount is estimated to be more than 50% of the contaminated land.

For this reason, it is necessary to think further about handling these lands with relatively low mercury concentrations, which are around tens of ppm but have a large area and are large in number, given the high costs involved.

The RAN-PPM targets four contaminated land locations for remediation. These locations are Sekotong, Poboya, Mount Botak (replacing Palu which was hit by disaster) and Lebak (already done).

## Baseline Studies by Ministry of Environment and Forestry

The Centre for Research and Development for Environmental Quality and Laboratory (*Pusat Penelitian dan Pengembangan Kualitas dan Laboratorium Lingkungan*, P3KLL), a unit within the Ministry of Environment and Forestry that is tasked to do research and development in environmental management, has undertaken the following activities to implement Perpres No. 21 of 2019 concerning the National Action Plan for Mercury Reduction and Elimination.

**Table 3.1 Activities Conducted by P3KLL in Relation to Perpres No. 21/2019**

| No. | Activity Type | Sample Type | Year | Location | Funding |
|---|---|---|---|---|---|
| 1. | Gathering Baseline Data | River water, soil | 2017 | Romang Island, Southwest Maluku Regency, Maluku | APBN |
| 2. | Gathering Baseline Data | Paddy rice soil, water, plants, biota, river water | 2018 | • Sukabumi Regency, West Java<br>• Tasikmalaya Regency, West Java<br>• Lebak Regency, Banten Province | APBN |
| 3. | Gathering Baseline Data | Air, soil, water, plants, biota, river water, hair, blood, socio-economic studies | 2018 | • Wonogiri Regency, Central Java<br>• Merangin Regency, Jambi Province<br>• Dharmasraya Regency, West Sumatera<br>• West Kotawaringin Regency, Central Kalimantan<br>• West Lombok Regency, West Nusa Tenggara (NTB)<br>• East Bolaang Mongondow Regency, North Sulawesi<br>• North Minahasa Regency, North Sulawesi | APBN |
| 4. | Gathering Baseline Data | River water, soil | 2018 | • Mount Botak, Buru Island, Maluku | APBN |
| 5. | Gathering Baseline Data | Hair, socio-economic study | 2019 | Sukabumi, West Java | APBN |
| 6. | Gathering Baseline Data | Paddy rice, soil, water, plants, biota, river water | 2019 | • Kulon Progo Regency, DI Yogyakarta Province,<br>• Pacitan Regency, East Java<br>• East Bolaang Mongondow, North Sulawesi | APBN |
| 7. | Gathering Baseline Data | Paddy rice, soil, water, plants, biota, river water | 2020 | • Bogor Regency, West Java<br>• Sukabumi Regency, West Java<br>• Tasikmalaya Regency, West Java<br>• Bandung Regency, West Java | APBN |
| 8. | Gathering Baseline Data | Air, soil, water, plants, biota | 2020 | • Tatelu, North Sulawesi<br>• Mandor, West Kalimantan<br>• Sekotong, NTB | World Bank |
| 9. | Increasing Institutional Capacity | - | 2020 | • Manado<br>• Gorontalo<br>• Pekanbaru<br>• DI Yogyakarta<br>• Mataram<br>• Ternate | UNDP GOLD-ISMIA |

Source: MoEF, 2020.

### Ministry of Energy and Mineral Resources

During 2014-2016, the MoEMR took some initial steps by conducting awareness raising (West Sumbawa Regency and Wonogiri Regency), preliminary surveys and sampling (West Sumbawa Regency and Kapuas Hulu Regency), coordination meetings (Buru Island), and training on alternative technology (Banyumas Regency, Lebak Regency and Pacitan Regency) for selected ASGM communities (MoEMR, 2017).

### Ministry of Health

The MoH has issued Ministerial Regulation No. 57 of 2016 concerning the National Action Plan (NAP) of Health Impact Control Due to Mercury Exposure in 2016-2020. This NAP is intended to control the risks and impacts of mercury on health in the context of eliminating mercury in Indonesia, including the effects of mercury from the ASGM sector. Through Circular No. HK.02.02/B.III/2535/2017 concerning the Control of Health Impacts from Mercury Exposure, the MoH has encouraged the participation of Local Governments in conducting awareness raising, and provided an understanding of the dangers of mercury for health. Meanwhile, to facilitate the implementation phase, the MoH has published 'Guidelines for Controlling Health Impacts from Mercury Exposure' and 'Guidelines for Controlling Environmental Health Impacts Due to the Use of Mercury in ASGM by Participatory Methods'. Guidelines are provided for health workers and the public to recognize the dangers of mercury and find ways to prevent it (MoH, 2019). During April-May 2017, the MoH conducted awareness raising on the impact of mercury on health workers and the public in 18 (eighteen) provinces and 28 (twenty-eight) regencies.

### Agency for the Assessment and Application of Technology (BPPT)

BPPT has shared responsibility to implement the NAP (2014-2018) on Mercury Removal in ASGM in Indonesia by carrying out the following activities: (1) Construction of laboratories and mineral characterization workshops and metallurgical tests; (2) Characterization of gold deposits in several ASGM locations: Lebak Regency, Banyumas, Pacitan, West Sumbawa, Ketapang (West Kalimantan Province), and Buru Island; (3) Non-mercury-based gold processing design and gold processing impact management process design; (4) Support for the implementation of non-mercury-based gold processing pilot projects and their management (in collaboration with MoEF, MoEMR, the Sub-National Government and ASGM): Lebak Regency; and (5) Collaborate with UNDP and MoEF to support the implementation of the GEF GOLD-ISMIA project (BPPT, 2017). Along with the non-mercury ore-processing technology, BPPT also recommends integrated waste treatment that complies with the environmental standards.

## 3.1.4. Aims and Approaches of GOI-Led Projects in the ASGM Sector

To date, GOI-led projects have mainly focused on three goals: the formalization of target communities; the introduction of mercury-free gold processing techniques; and community awareness-raising campaigns on the dangers of mercury. Government has also examined the question of how to restrict the availability of mercury for ASGM - including primary mercury mining and mercury trading and circulation in Indonesia - as well as related issues: such as the rehabilitation of land damaged by ASGM, mercury storage, and alternative livelihoods.

In addition to the regulatory sector, the MoEF has also prioritized technological solutions, including the construction of mercury-free gold management facilities at legal ASGM sites.

During awareness raising activities carried out at various ASGM locations, the Ministry of Energy and Mineral Resources has provided material on the applicable regulations related to ASGM formalization and mining best practices, whereas MoEF (the National Focal Point of the Minamata Convention on Mercury) has provided material on government programs that show the commitment of the GOI to implementation of the Minamata Convention. The Ministry of Health has provided material on the impact of mercury on health, and BPPT has provided material on environmentally-friendly gold processing techniques. The Ministry of Energy and Mineral Resources has also invited NGOs to share experiences about ASGM projects that are being carried out in other locations. Government stakeholders have also cooperated in developing environmentally friendly gold processing pilots, for example in Lebak, Banten Province, involving MoEF and BPPT.

### 3.1.5. Donor-Led Research Projects in the ASGM Sector (2000-2020)

**Canadian-Funded Research Projects:** From 2015 - 2018, a research project funded by CIRDI provided technical assistance to the Indonesian government at the regency, provincial and national levels to improve the design and implementation of environmental policies for the ASGM sector.

**Australia-Funded Research Projects:** From 2013, the Australian Government (DFAT) supported three years of research into ASGM in the regency of Bombana through the 'Government Partnerships for Development of Artisanal and Small-scale Mining in Eastern Indonesia' project. The project was a collaboration between Charles Darwin University (CDU), Australian National University (ANU), Universitas Haluoleo (UHO – South East Sulawesi), Universitas Nusa Cendana (Undana – West Timor), Environmental Agency of East Nusa Tenggara (Balai Lingkungan Hidup (BLHD) Nusa Tenggara Timur) and the Association for Community Miners Indonesia (APRI). The research project culminated in a conference entitled: "Small-Scale Mining in Indonesia - Minimising harm, maximising benefits" which was held in Jakarta and hosted by APRI (Hobgen et al., 2016).

**Denmark-Funded Research Projects:** Development agencies or bilateral organizations, such as DANIDA and GIZ, have also extended assistance to the GoI to study ASGM issues. In 2014, DANIDA/YTS did a very detailed baseline and feasibility study in Wonogiri Regency, Central Java Province, seeking to introduce alternative practice and technology to substitute mercury in ASGM. In addition to the technical side, the study conducted in Jendi Village also examined ASGM in terms of the overall legality surrounding mining activities, the nature of the social framework, as well as the main actors and stakeholder groups involved. In terms of legality, the study examined the possibility of mining companies holding IUP collaborating with ASGM. The study also produced recommendations that the government and the mining community in Jendi Village collaborate to develop a mercury-free treatment model for similar ASGM villages in Indonesia. The proposed model included the construction of ore-processing facilities to be managed by small-scale mining associations, a health awareness campaign, and monitoring and reporting of the facility constructed.

**German-Funded Research Projects:** In West Nusa Tenggara province (NTB) the GIZ-RED (Regional Economic Development) program has been developing local handicraft industries, including the jewellery sector in Mataram. The project estimated the total ASGM sector employment in Lombok to be 22,446 direct jobs, and that although there have been many changes to social structures in the affected communities, many of these changes have been positive: reflecting increased employment opportunities and incomes (Krisnayanti & Anderson, 2012a).

**NGO Initiatives and Research Projects:** BaliFokus, a local NGO headquartered in Bali and affiliated with IPEN, has conducted a variety of mercury-related programs in recent years, focusing mainly on mercury trading, mercury inventory, mercury in ASGM, and mercury-free health services, and mercury-free dental care. BaliFokus has conducted studies on the production of gold from the ASGM sector, mercury release and inventory, mercury trade and distribution, and the environmental and health impacts of mercury use. A recent study of environmental impacts on health due to the use of mercury in ASGM included work in four provinces: Southeast Sulawesi, Central Java, West Nusa Tenggara, and West Java. Through the Nexus3 Foundation, BaliFokus has studied the health of children affected by mercury-polluted environments.

The health impact of ASGM activities also received attention from the Medicuss Foundation: an NGO centered in the city of Bandung, consisting mainly of health professionals. Medicuss have conducted health studies at many ASGM locations, including in the Sekotong District of West Lombok Regency, the Bombana Regency, the Sukabumi Regency and the Mount Botak site on Buru Island.

On November 27, 2015, the Indonesian Community Miners Association (APRI) announced the "Mercury-Free Declaration Towards the Formalization of Gold Mining in Indonesia" which was a highly significant statement regarding the desire to end mercury use in ASGM from the largest community miner's association in Indonesia.

### 3.1.6. GoI-Led Research Projects in the ASGM Sector (2000-2020)

For the ASGM sector, in 2018 the Ministry of Environment and Forestry conducted a mapping of the impact of mercury on health, environment and socio-economics in collaboration with the Bandung Institute of Technology (ITB) and Brawijaya University (UB). The study was conducted in Wonogori Regency in Central Java Province, West Kotawaringin Regency in Central Kalimantan Province, Dharmasraya Regency in West Sumatra Province, Merangin Regency in Jambi Province, North Minahasa and East Bolaang Mongondow Regencies in North Sulawesi Province, and West Lombok Regency in West Nusa Tenggara Province. Due to the earthquake and tsunami that hit the city of Palu in Central Sulawesi Province in September 2018, the study planned for Palu was cancelled.

For the development of the MIA and NAP ASGM documents, in 2020-2021, MoEF, BSCRC-SEA and the survey team conducted inventory, laboratory analysis of environmental samples and human biomonitoring activities in 6 (six) ASGM locations namely in Lebak Regency Banten Province, Tasikmalaya Regency West Java Province, Mandailing Natal Regency North Sumatra Province, Bolaang Mongondow Regency North Sulawesi Province, West Sumbawa Regency West Nusa Tenggara Province, and Murung Raya Regency Central Kalimantan Province.

## 3.2. Geographic Distribution

### 3.2.1. National Overview of ASGM

Indonesia has more than 17,000 islands, and primary and secondary gold deposits occur in all of the country's seven major geographic regions. As a result, artisanal and small-scale gold mining (ASGM) is a widespread economic livelihood activity across the nation. ASGM sites are found in all seven of the major geographical regions of Indonesia: namely, Sumatra, Java, Kalimantan, Sulawesi, Maluku, Nusa Tenggara, and Papua.

According to data from the MoEMR in 2017, ASGM locations can be found in 32 provinces and 197 regencies/cities, with an estimated 850 ASGM hotspots spread out throughout (MoEF & UB, 2018). The distribution of ASGM activity locations in Indonesia is shown in the figure below. A map of ASGM distribution can also be seen on the website of Geoportal-ASGM mercury by MoEF at this link: https://sitkb3.menlhk.go.id/merkuri/index.php.

**Figure 3.1 Distribution of ASGM Activity in Indonesia**

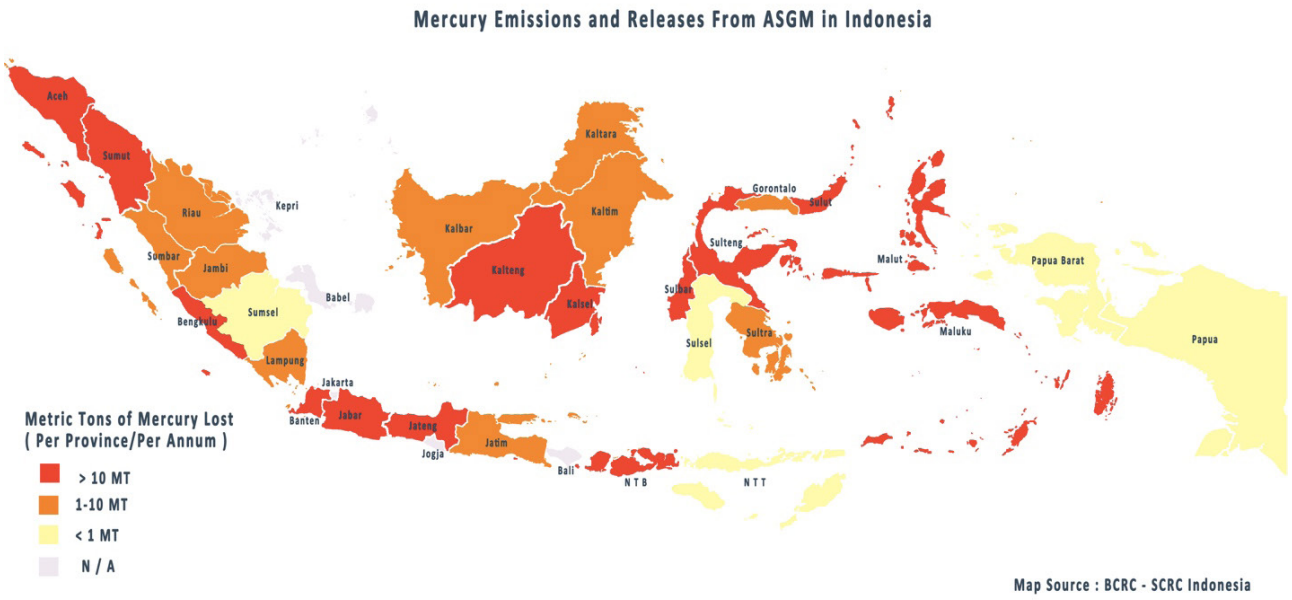



Source: MoEMR, 2016

In 2019, a national inventory study identified ASGM sites in 29 provinces out of the total of 34 provinces (MoEF & BSCRC-SEA, 2019). Moreover, a more detailed geographic breakdown was also performed at the level of individual regencies and cities. The results are presented here, together with prioritization of the most important sites based on total mercury used in ASGM.

The national map below summarizes the level of mercury pollution from ASGM in each of the 29 affected provinces; using a relative scale of impacts that applies three orders of magnitude to the problems faced, according to the total quantity of mercury used[1] each year, as a result of ASGM activities within each province.

**Figure 3.2 Map of National Overview of Mercury Used in ASGM by Province**




Provinces in red and orange colour are estimated to be mainly primary

Provinces in yellow colour are estimated to be only secondary

Source: MoEF & BSCRC-SEA, 2019

[1] Whereby "mercury used" denotes mercury lost to the environment



### 3.2.2. High Priority Provinces

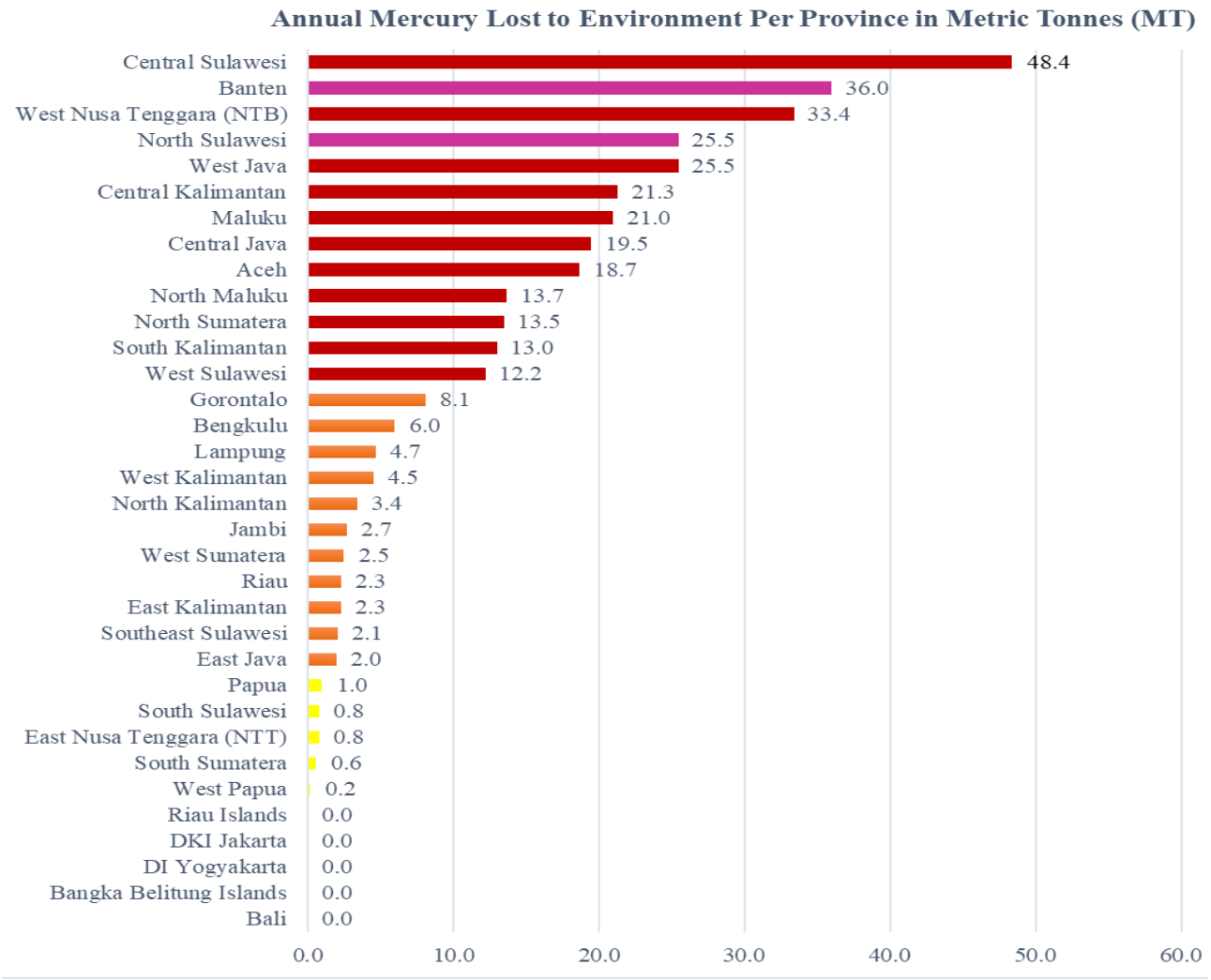
The provinces that are shown in red are affected by extreme levels of mercury pollution, mainly from hard rock mining of primary gold deposits. The provinces that are shown in orange are also heavily affected by the same type of activity, but to a lesser extent. All of the provinces in red and orange are known to host primary gold deposits. The provinces shown in red all have high numbers of miners, and high mercury-utilization rates. The provinces shown in yellow have only alluvial and placer mining of secondary gold deposits. Lastly, there are five provinces with no significant ASGM activity. These provinces are DKI Jakarta, DI Yogyakarta, Bali, Bangka Belitung Islands, and the Riau Islands.

### 3.2.3. Ranking System

#### Rank of Annual Mercury Lost to the Environment per Province

This chart, based on the results of the national inventory, provides a comparison of the situation in each province and a relative ranking. Here, we can see that 24 provinces are responsible for 99% of mercury lost to the environment from ASGM in Indonesia, as follows.

**Figure 3.3 Estimation of Mercury Used (Lost to the Environment) in ASGM by Province**




Source: MoEF & BSCRC-SEA, 2019

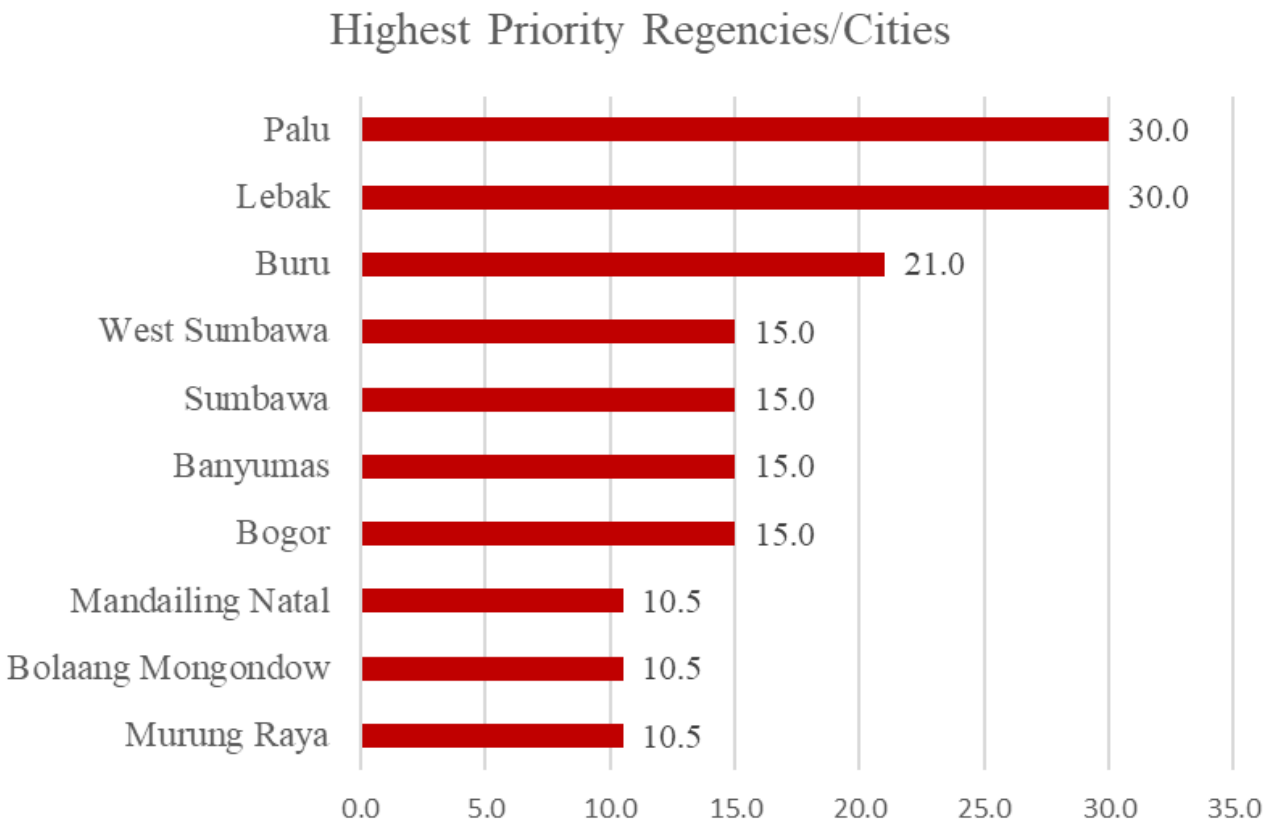
## Primary Gold Mining Districts

The national inventory study shows that there are primary gold mining districts within 70 regencies and cities in 13 provinces. These 70 regencies and cities are listed under the respective provinces in A**nnex II**. They are also color coded in the same way, according to the magnitude of the estimated mercury used.

## Highest Priority Regencies and Cities

The ten regencies/cities listed in the chart below have the highest levels of emissions and releases from ASGM and all fall into the Extreme Category: Hg >10 MT per annum. These 'top ten' regencies are spread across six of the major regions of Indonesia: Sumatra, Java, Kalimantan, Sulawesi, Maluku, and Nusa Tenggara. Only one geographic region is not included, and that is because no ASGM sites with high-intensity mercury use have been identified in Papua to date.

**Figure 3.4 Regencies/Cities with Highest Mercury Used in ASGM**




Source: MoEF & BSCRC-SEA, 2019

## Secondary Gold Mining Districts

In addition to the 70 regencies and cities listed above, there are also 62 regencies and cities with no primary gold mining districts, but having secondary gold mining districts that are mined for alluvial and placer gold. These 62 regencies and cities are listed under the respective provinces in **Annex II**. They are also color coded in the same way, according to the magnitude of the estimated mercury emissions.

## Ranking by Orders of Magnitude

The national inventory study ranks the 34 provinces from highest to lowest priority in terms of the total quantity of mercury that is used (lost) to the environment in the formal and informal ASGM operations. Importantly, this study enables the relative importance of the key gold districts to be compared on the basis of the magnitude of their mercury emissions. The ranking of provinces has been done using

three 'Orders of Magnitude' to separate the categories.

- Category 1 = Extreme: there are thirteen provinces in this category, each having mercury emissions and releases from ASGM in the range of 10-100 tonnes of per annum. The total quantity of mercury lost to the environment from ASGM operations in these thirteen provinces has been estimated to be 301.7 tonnes per annum.

- Category 2 = Very High: there are eleven provinces in this category, each having mercury emissions and releases from ASGM in the range of 1-10 tonnes per annum. The total mercury lost to the environment from ASGM in these further eleven provinces has been estimated to be 40.6 tonnes per annum.

- Category 3 = High: there are five provinces in this category, each having mercury emissions and releases from ASGM in the range of 0-1 tonnes per annum. The total quantity of mercury that is lost to the environment from ASGM in these five provinces has been estimated to be 3.4 tonnes per annum.

- Category 4 = Low: this is the least important category, listing five provinces that do not have any significant ASGM activity. The total mercury emissions and releases from gold mining can therefore be said to be low, although there may also be significant mercury pollution in these provinces resulting from sources other than artisanal and small-scale gold mining.

**Table 3.2 Total Mercury Used (Lost to the Environment) in ASGM by Category**

| Category (1 – 4) | No. of Provinces | Mercury Use (Lost to the Environment from ASGM) |
|---|---|---|
| 1 = Extreme | Provinces = 13 | 301.7 (t) of mercury lost per annum |
| 2 = Very High | Provinces = 11 | 40.5 (t) of mercury lost per annum |
| 3 = High | Provinces = 5 | 3.3 (t) of mercury lost per annum |
| 4 = Low | Provinces = 5 | Not applicable (N/A) |

Source: MoEF & BSCRC-SEA, 2019

## 3.3. Mining and Processing

### 3.3.1. Primary Gold Deposits

### Worst Practices in Hard Rock Mining and Processing

ASGM throughout Indonesia relies on basic technology and limited understanding of mining engineering and mineral extraction. Primary gold deposits are exploited by hand-dug tunnels, with rock carried in sacks from the mine site to the processing area. The rock is ground in and subjected to whole-ore amalgamation and cyanidation to recover gold. Gold extraction is inefficient, and a high concentration of gold remains in the waste after processing. Today, tens-of-thousands of miners extract fine gold from primary ore deposits using mercury amalgamation, which has become the most widely used technique, regardless of the type of ore, due to its simplicity and versatility. Worst practices include whole-ore-amalgamation, open burning of amalgam, burning of amalgam in residential areas, cyanidation of mercury-contaminated tailings, and tailings dumping. These worst practices are the norm, rather than the exception, at most hard-rock processing sites, therefore it is imperative that government can identify successful strategies

to eliminate these improper practices if they are to enforce the current regulations (Haris et al., 2014). The study conducted by MoEF and BSCRC-SEA (2019), as part of the Minamata Initial Assessment and National Action Plan for ASGM in Indonesia, identified the distribution of hard rock mining locations in at least 70 regencies/municipalities in 22 provinces in Indonesia. The figures below show some processing techniques from the field visit (MoEF & BSCRC-SEA, 2021).

**Figure 3.5 Trommels in Operation in Seloto (left) and Lamunga (right) Villages**





Source: MoEF & BSCRC-SEA, 2021

**Figure 3.6 Burning Gold in a Gembosan (Mandailing Natal Regency)**



Source: MoEF & BSCRC-SEA, 2021

**Figure 3.7 Steps of Gold Processing Using Amalgamation Methods in Mangkahui, Datah Kotou, and Konut Villages (Murung Raya Regency)**



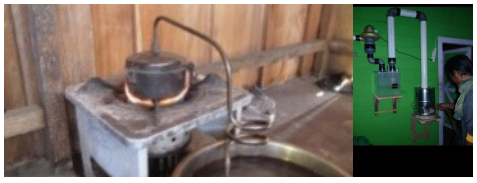
Hard rock is crushed manually using a hammer or crusher machine.



After the rock is smaller in size, the rock is put into a boulder unit, then added a quantity of water and mercury as much as 1000-2000 g, for each trommel with a capacity of 50 kg.



After being extracted for 12-24 hours, the amalgam is separated and then squeezed into a bulb-shape.



The bullion is "cooked" to obtain precious metal oxides (Au, Ag, Cu). Mercury released from the bullion is captured in a water-box for further reuse (up to 95% efficiency) if retort is used.



The precious metal nuggets are then re-cooked in a strong acid solution to separate the elemental gold from the mixture.



Once separated, then the gold is burned to become pure gold.



The pure gold produced is weighed and then sold

Source: MoEF & BSCRC-SEA, 2021

## Further information on Hard Rock Processing and Whole Ore Amalgamation

Processing of gold with mercury in small-scale gold mining (PESK) is still widely carried out, only a small number have switched to processes that do not use mercury such as the use of cyanide, borax or physical separation by panning (sifting). This causes mercury to exist in the environment around the activity as the residue of the process or just wasted into the environmental media.

ASGM or commonly referred to as traditional gold miners usually carry out their activities using simple equipment, to look for mining rock or exploration and exploitation using hoes, crowbars, hammers, shovels and simple conveyances. The rock obtained will be distributed to a number of miners in the group and the owner of the hole/and will also get a share according to the initial agreement.

The gold processing that uses mercury traditionally uses trommels (*gelundung*) which is a tool to grind rock to be mixed with mercury. The sequence of these processes is as follows:

**1. Hard Rock Refining Process**

Hard rock obtained from mining pits or called ore before being processed in trommels is refined by means of pounding/ crushing to get a smaller size by manually pounding it using a hammer or other pounding tool.

**2. Amalgamation Process**

The crushed rock is then put into cylindrical grinding drums/ rod-mills (trommels) and a variable quantity of mercury is then added into the grinding drum either at the start of grinding, or, once a slurry has already been achieved. Different ASGM areas use drums of different sizes. One example is 50 cm long and 32 cm in diameter which will be filled with fine rock (ore) with an amount between 9-11 kg and approximately 20 liters of water. Mercury is added with the aim of binding the gold into an amalgam (the amalgamation process). There are also certain areas that add a handful of cement with the intention of binding other metals in the soil.

The amount of mercury added to the smelting process can vary according to the type of rock and the experience of the miners. To speed up the crushing and mixing, the trommels are also filled with a number of steel or tungsten bars/rods that serve to grind the ore. The rotation time of the drum is also adjusted to the type of rock being processed, if the treated rock is soft/alluvial, it is enough to rotate it for 3-5 hours, while if the rock type is hard, the rotation can be up to 24 hours.

After finishing the grinding, the trommels are opened and the slurry mixture is removed to a container (tub), then the residues that are still attached to the inside of the drum are cleaned out by pouring water into the drum using a hose. During this cleaning process, there is excess water runoff and floured mercury is carried out into the tailings collection ponds. Some tailings ponds are watertight but some are not so excess water can seep into the ground.

The next process is to obtain the mercury from the container filled with slurry which is again done by carefully washing the slurry. Once the mercury has been obtained it is carefully squeezed through cloth to obtain a ball of hard mercury-gold amalgam within the cloth.

**3. Squeezing Process**

To separate out the amalgam, the mercury is squeezed through a cloth. The squeezing results in the formation of a solid ball of gold amalgam within the cloth while the liquid mercury that moves through the cloth is kept and will be reused for the next process. The amalgam usually consists of an equal ratio of mercury and gold unless much silver is also present in the ore. Minor quantities of copper and other metals may also be present in the amalgam.

**4. Amalgam Burning**

Burning of amalgam is then carried out to separate the gold from the mercury that is still attached. Open burning is usually carried out so that the mercury still contained in the amalgam will simply evaporate into the air if there is no system to capture the mercury vapor such as a steel retort or chimney with a water-box condenser system attached.

Burning amalgam results in a gold product (sponge gold) with some impurities as there are still other metal contents such as silver or copper. The miner will weigh and sell the sponge gold at a gold shop where it will be further purified at the gold shop location (Marwiani, n.d).

## Cyanidation of Amalgamation Tailings

Many gold-ores in Indonesia are characterized as having only fine or very fine gold grain-size distribution and are therefore poorly suited to gravity concentration. However, such ores are well-suited to cyanidation. Gold recovery using cyanide can be as high as 90% for such ores; compared to initial recovery rates of only 40% using mercury amalgamation. Knowledge of cyanide's effectiveness is not new: cyanidation has been applied for more than a decade in Indonesian artisanal mining and this has led to the widespread adoption of cyanidation in leaching tanks (tong) across Indonesia. The environmental safety of cyanide is a main concern of the GOLD-ISMIA project (Planet Gold, 2020).

Due to the low efficiency of the mercury amalgamation process, the waste, also referred to as tailings, from this process still contains high gold values, and are therefore usually reprocessed by the owner of the rod-mill a second time or third time using mercury. Following this reprocessing to obtain residual gold values, the tailings may also be purchased and transported for further processing by a cyanide leaching tank operator. The tailings will contain high levels of mercury as a result of the amalgamation of whole ore in trommels. Cyanide leaching in tailings to which mercury has been added without first removing the mercury is one of the worst practices because it leads to generation of mercury-cyanide complexes that are highly mobile in the environment and bioavailable.

Cyanide waste is very dangerous if it does not go through several slow stages of waste treatment processing before being released into the environment. A special storage pond is needed to contain the tailings from the cyanidation process so as not to harm the surrounding environment. If the cyanidation is carried out directly, without prior processing with mercury, then there will be no mercury contamination in the cyanidation process.

The process of cyanidation of mercury-contaminated tailings is as follows:

1. The mercury-contaminated tailing sludge from the trommels is collected in a pond;
2. Contaminated tailing sludge is put into sacks to be lifted;
3. Contaminated tailing sludge is put into a leaching vat for cyanidation;
4. Waste from the leaching vat is contaminated with both mercury and cyanide and pollutes the surrounding environment when released.

Tailing sludge from the trommels is usually put in sacks to facilitate the transport process to cyanide drums. The cyanidation process is carried out in a large vat and waste in the form of water and sludge from the cyanidation process is released and pollutes the environment (GOLD-ISMIA, 2020).

There is no mechanism for waste management in Indonesian ASGM. At the end of the processing cycle, the mine waste (tailings) is discharged to rivers, land, rice paddies or the sea. Heavy metal contaminants in the waste become mobile in the environment, and transfer to water, plants, fish and seafood (Haris et al., 2014).

In Mandailing Natal, the tailings were reprocessed several times before being sold to other entrepreneurs for the cyanide process. Because mercury is dispersed deeply during the milling process, there are residual microscopic mercury grains (called also mercury flour) in the tailings. If there is no containment, the wastewater that is contaminated with mercury flows directly into the groundwater, into ditches, or rivers so that contamination spreads. Estimates of mercury lost during this process vary, depending on the amount of mercury poured into each drum, the type and volume of ore that is processed, how many runs are performed each day, and the worker's level of experience (Sulaiman, 2015).

In NTB province, the tailings slurry is discharged into the area around the mine site including into agricultural land such as rice fields, or further processed at a cyanidation plant. Final cyanide leaching of the amalgamation tailings will usually recover more gold, before the cyanidation tailings are disposed of again to land or water (Krisnayanti, 2018).

## Direct Cyanidation as an Alternative to Mercury Use

Amalgamation can be very inefficient, and the mercury can cause detrimental effects to public health and the environment. In fact, BPPT has conducted comparative studies of processing methods, finding amalgamation to be only half as effective (41%) as direct cyanidation (82%) when recovering gold from the same primary ores. For this reason, BPPT is now promoting the use of direct cyanidation as a viable economic alternative to mercury use in ASGM (Brotokusumo in Hobgen et al., 2016). In North Sulawesi, Whitehouse et al. (2006) found that a successful shift from Hg amalgamation to gravity separation plus cyanidation could be accomplished by miners with only a relatively small capital investment and continued use of existing processing equipment. But he also found that more effective tailings management systems still needed to be developed and enforced (Whitehouse et al., 2006). In fact, in some districts in Indonesia, mercury is gradually being replaced by the direct use of cyanide as the primary gold recovery technology, and thereby preventing mercury pollution, although the widespread use of cyanide is also creating new environmental challenges (Haris et al., 2014).

The environmental safety of the cyanide itself is also one of the main concerns of the GOLD-ISMIA project, and BPPT (as the technology advisor) have found a technology to destroy free cyanide in wastewater from the leach concentration of 200 ppm to as low as 1 ppm in four hours. To achieve environmental standards for discharge from ASGM the cyanide concentration in wastewater must be reduced to 0.5 ppm (Planet Gold, 2020).

## ASGM locations from the Study of MoEF, BSCRC-SEA and Field Survey Team (2021)

### Lebakgedong District, Lebak Regency, Banten Province

In Lebaksitu Village, Lebakgedong District, Lebak Regency, the amalgamated tailings waste is processed by the leaching method using a mixed solution of KCN or NaCN and lime. There are two leaching techniques applied in Lebaksitu Village, namely heap leach (soaking) and carbon in leach (CIL/"*tong*"). Heap leach is a leaching technique, whereby gold ore that has been crushed and ± 1 cm in size is stacked up to ± 50 cm then doused with a cyanide mixture solution continuously for > 2 weeks. The treatment process that produces rich a pregnant solution (containing gold) is included in a closed-circuit process. The gold-rich water from rock leaching is then drained into an activated carbon filter to collect the gold-cyanide compound (AuCN) and then stored in a holding tank to be pumped back into a tank containing a pile of gold ore. Other business actors apply the CIL technique for tailings amalgamation. The treatment process begins by putting the tailings into a leachate tank and mixing it with a KCN or NaCN solution, lime, and catalyst for one day. After one day of the leaching process, activated carbon is added to the slurry to absorb gold-cyanide (AuCN) compounds for another day. After the absorption process is complete, the activated carbon is separated from the slurry using a filter and then burned to ashes and melted to obtain gold bullion. The slurry that no longer contains activated carbon is channeled into simple tailings storage tanks built from piles of sacks filled with tailings (MoEF & BSCRC-SEA, 2021).

In December 2018, MoEF granted a small-scale non-mercury gold processing facility at the small-scale mining area in WPR Kampung Sampay, Lebaksitu Village, Lebakgedong District to the Lebak Regency government. The facility had a capacity of 1,500 kg gold rock per batch (per one time process) using cyanide for three days through five process stages namely comminution, leaching, gold recovery, gold smelting and waste treatment (Bantennews, 2018).

**Figure 3.8 Example of a Trommel Used in Lebaksitu Village**



Source: MoEF & BSCRC-SEA, 2021

**Figure 3.9 Government-assisted Mercury-free Gold Processing Facility**



## Karangjaya District, Tasikmalaya Regency, West Java Province

One of the tributaries that flow in Karang Layung Village is the Cikurawet River. With the spread of the trommel locations in almost all districts, the tailings wastewater flows into the Cikurawet tributary, merging with the Citambal River flow. Apart from the tributary of the Cikurawet River, there are also many trommels where tailings waste flows directly into the Citambal River through irrigation canals or drainage. Many people in the community do not yet have a tailings water reservoir (MoEF & BSCRC-SEA, 2021).

**Figure 3.10 Process of Separating Bullion from Mercury**





Source: MoEF & BSCRC-SEA, 2021

**Figure 3.11 Cyanidation Equipment**




Source: MoEF & BSCRC-SEA, 2021

### 3.3.2. Secondary Gold Deposits

Alluvial gold miners generally use large water pumps and pressure hoses to excavate pits by spraying water jets at soil surfaces in order to access gravel beds where gold may have been deposited. A second water pump is used in the bottom of the pit, to pump the slurry out of the pit, and through a sluice which has been lined with carpet to capture the gold particles. When the carpets are cleaned, the heavy mineral concentrate that is obtained will then be processed by adding mercury to collect the gold particles. The mercury-gold amalgam is usually then brought to a local gold shop (buyer) where it is burned to release the mercury. Because gold shops are typically located in villages, cities and areas of high population density, public exposure to mercury gas is a serious concern (Esdaile & Chalker, 2018). Veiga et al. (2006) estimated that approximately 1-2 grams of mercury is released to the environment for each gram of gold produced by alluvial mining of secondary gold deposits. The study conducted by MoEF and BSCRC-SEA (2019), as part of the Minamata Initial Assessment and National Action Plan for ASGM, identified the distribution of alluvial mining locations in at least 64 districts/municipalities in 21 provinces in Indonesia. The figure below shows an example of secondary gold deposits in Tahujan Ontu River, Murung Raya Regency and Logas Village, Kuantan Sengingi Regency.

**Figure 3.12 ASGM in Secondary Gold Deposits in Tahujan Ontu River, Murung Raya Regency**



Source: MoEF & BSCRC-SEA, 2021

**Figure 3.13. ASGM in Secondary Gold Deposits in Logas Village, Kuantan Sengingi Regency**





Source: GOLD-ISMIA, 2019 (https://www.goldismia.org/gallery/photos)

### 3.3.3. Cinnabar Deposits

Indonesia has known cinnabar mining sites not only in Seram Island (Maluku) but also in West Kalimantan, Southeast Sulawesi, and in Aceh. In West Kalimantan Province (where the local government issued a mercury trade prohibition in 2007) the regency government issued a permit to mine cinnabar in the Kapuas Hulu Regency for a 1,000 ha site, without having any environmental permit or Environmental Impact Assessment study (Balifokus, 2017). The Ministry of Environment and Forestry (MoEF) has since cooperated with the Directorate General of Environmental and Forestry Laws Enforcement to close down the sites where mining and processing of cinnabar was taking place in three provinces affected: Maluku, West Kalimantan, and Aceh (MoEF, 2017b). In December 2017, the police and the military joined forces to curb illegal mining of the cinnabar deposits at Mount Hitu in West Seram, in Maluku province which has been the major source of cinnabar production in Indonesia in recent years (MoEF, 2018). It is estimated that domestic mercury production stemming from cinnabar mining in Seram is approximately 350 tonnes per annum (MoEF & BSCRC-SEA, 2019).

## 3.4. Baseline Estimates of Mercury Used in ASGM

As can be seen in the **Table 3.2**, mercury used in ASGM activity in Indonesia has been estimated by the national inventory to be approximately 345.5 metric tonnes per annum (MoEF & BSCRC-SEA, 2019). This overall estimate was reached by applying standardized metrics to all of the sites included in the geographic database. This figure is based primarily on the magnitude of the releases at a number of very prominent sites in the country.

The National Inventory study as part of MIA and NAP project conducted by MoEF and BSCRC-SEA (2019) has estimated total gold production from ASGM using mercury to be 53.8 tonnes per year. This study has used a systematic and comprehensive approach to data collection and collation. The primary data sets were provided by MoEF and MoEMR. This data was checked against a very substantial volume of information now available online, in order to verify the locations provided in the national data sets, and to create a more detailed and more comprehensive dataset, based upon the existence of recent scientific publications, project reports, site studies, news reports, articles, websites, video productions, and other media.

Firstly, a geographic analysis was performed to identify all of the regencies and cities in Indonesia that have ASGM activity within their jurisdiction. A total of 132 regencies and cities were identified as having ASGM of both primary and secondary gold deposits that are responsible for the mercury pollution arising from ASGM.

Secondly, the type of mining was identified for each mining district. It should be noted that the differentiation between primary gold mining districts and secondary gold mining districts is a highly important aspect of this study, as can be seen in **Figure 3.2**. This is due to the fact that the quantity of mercury lost during the processing of hard rock (primary gold mining) is one order of magnitude greater than is lost during processing of alluvium (secondary gold mining).

Thirdly, estimates of miner numbers were entered for each type of mining. Estimates of miner numbers were made based on the information available in locality studies, and by establishing the number of sub-districts with ASGM activity in each regency and city.

Fourthly, three multipliers (variables) were applied using standardized estimates to represent the nation as a whole. The multipliers used are as follows:

1. The average number of working days per year. In this study, 300 working days per year is considered to be the national average.
2. The average gold production per miner per working day. In this study, 1 g of gold produced per miner per working day is considered to be the national average.
3. The average ratio of mercury lost to gold produced (for each type of mining). In this study, 10:1 (10 g of Hg lost per 1g of Au produced) is considered to be the national average for primary gold mining. And 1.3:1 (1.3 g of Hg lost per 1 g of Au produced) is considered to be the national average for secondary gold mining.

The result of applying these multipliers was the estimated total quantity of mercury used in ASGM (lost to the environment), calculated for each regency/city. Estimation of miner numbers, gold production and mercury used in ASGM for each province and for each regency/city according to primary gold mining districts and secondary gold mining districts are shown in the tables in **Annex II**.

## 3.5. Legal and Regulatory Status

### 3.5.1. Overview of National Laws and Policies Surrounding ASGM

#### National Laws

- ASGM is considered in Law No. 3 of 2020 concerning Amendments to the Law No 4 of 2009 on Minerals and Coal Mining, GR No. 22 of 2010, and GR No. 23 of 2010 which mandates that all mining activity must be conducted within an area that has already been designated for mining purposes. Law No. 3 of 2020 states that small-scale mining area (WPR) is a part of the mining areas (*Wilayah Pertambangan*, WP) designated for the artisanal mining. Upon consultation with the the House of Representatives of the Republic of Indonesia (*Dewan Perwakilan Rakyat Republik Indonesia*, DPR-RI), the Provincial Government designates WPR for determination by the Central Government. Designation of WPR should refer to the provincial or regency spatial plans.

- Law No. 3 of 2020 allows for three different types of permits to be provided to gold miners: namely, a Mining Business Permit (IUP), a Special Mining Business Permit (*Izin Usaha Petambangan Khusus*, IUPK), or a Small-Scale Mining Permit (IPR). Area for 1 (one) IPR which can be granted to individual are maximum 5 (five) hectare or for cooperative maximum 10 (ten) hectare. IPR is granted for a maximum period of 10 (ten) years and can be extended 2 (two) times for 5 (five) years each. Under the law, ASGM may be interpreted as a legitimate small-scale mining activity if it is conducted within a small-scale mining area (WPR). In reality, very few ASGM operators hold a mining permit. Therefore, almost all ASGM is classified as illegal mining activity.

- Law No. 32 of 2009 on Environmental Protection and Management. Chapter VII of the Law regulates on hazardous substances (B3) and hazardous wastes (B3 wastes) management. Article 58 states that each person importing into the territory of Indonesia, generating, transporting, distributing, storing, using, disposing, treating and/or piling B3 is obliged to conduct B3 management. Article 59 obliges each person generating B3 waste to conduct B3 waste management he/she generates. Law No. 32 of 2009 also obliges each business and/or activities having major impact to the environment to have an Environmental Impact Assessment (*Analisis Mengenai Dampak Lingkungan Hidup*, Amdal).

- Law No. 11 of 2020 or the Omnibus Law on Job Creation which was passed on 5 October 2020 revised several laws, including Law No. 32 of 2009. Several provisions regarding Amdal in Law No. 32 of 2009 was revised and provision on obligation to have environmental permits was changed into environmental approvals which are integrated with business permits.

- Law No. 11 of 2017 on Ratification of the Minamata Convention on Mercury. The Minamata Convention put special attention on ASGM as laid out in Article 11.

#### Government Regulation

- Government Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and Management states that every waste containing mercury must be environmentally sound managed. GR No. 22 of 2021 also states that every business plan and/or activity that has an impact on the environment is required to have an Amdal, Environmental Management Efforts and Environmental Monitoring Efforts (*Upaya Pengelolaan Lingkungan dan Upaya Pemantauan Lingkungan*, UKL-UPL) or Statement of Capability in Environmental Management and Monitoring (*Surat Pernyataan Kesanggupan Pengelolaan dan Pemantauan Lingkungan Hidup*, SPPL).

- Government Regulation No. 74 of 2001 concerning Hazardous and Toxic Waste Management states that mercury is classified as a hazardous and toxic material the use of which must be limited.

### Presidential Decrees and Instructions

- Presidential Decree No. 21 of 2019 concerning the National Action Plan for Mercury Reduction and Elimination. Here, it is clearly stated that a strategy to reduce and eliminate mercury must be carried out through the strengthening of governmental and non-governmental institutions, coordination and communication between national and sub-national levels, with public and private sector participation, and by developing information systems and the adoption of environmentally friendly technology. Government at sub-national level is required to develop a Local Action Plan, within a maximum of 1 year after this regulation is issued, that refers to the National Action Plan to Reduce and Eliminate Mercury with assistance from the Central Government. (Minister of Environment and Forestry Regulation No. P.81/MENLHK/SETJEN/ KUM. 1/10/2019).

- The Presidential Instruction on 9 March 2017 included: (1) mercury use in ASGM should be banned; (2) mercury use should be managed and monitored; (3) control over mercury source, including mercury import that is used in ASGM; and (4) that the general public needs to be informed about the mercury hazard, especially to children.

### Ministerial Regulation and Decrees

- Minister of Health Regulation No. 57 of 2016 concerning the National Action Plan to Control Health Impacts due to Mercury Exposure, 2016-2020, indicates that the costs needed for implementation of the National Action Plan should be taken from the National Budget, Local Budget, and other legitimate funding sources in accordance with existing regulations.

- Minister of Trade Regulation No. 47 of 2019 as the Third Amendment to the Trade Minister Regulation No. 44/M-DAG/PER/9/2009 concerning Procurement, Distribution, and Control of Hazardous Materials, in order to further control the distribution of mercury.

- Minister of Energy and Mineral Resources Decree No. 1827K/30/MEM/2018 concerning Implementation Guideline of Best Mining Practices Annex V Implementation Guideline of Environmental Management in Mineral and Coal clearly states that mercury is prohibited to be used in gold processing and refining.

## 3.5.2. Overview of the Formalization Process

### Establishing a Small-Scale Mining Area (WPR)

If an area is designated as a mining area (WP), then a small-scale mining area (WPR) may be established within the mining area: WP ➔ Regional Spatial Planning (RTRW) in Province ➔ RTRW in Regency ➔ WPR. Referring to Article 1 number 1 of Law No. 3 of 2020 concerning Amendments to Law No. 4 of 2009 concerning Mineral and Coal Mining, Small-Scale Mining Areas, hereinafter referred to as WPR, are part of a Mining Area (WP) where people's mining business activities are carried out. Article 9 Paragraph 2 Law No. 4 of 2009 as amended by Law No. 3 of 2020 states that the WPR is determined by the Central Government after being designated by the Provincial Local Government in accordance with its authority and in consultation with DPR-RI. WPR is intended to provide a space for the community to operate a business in the people's mining sector.

UNDP is currently collaborating with the Indonesian government through the project GOLD-ISMIA as part of the global planetGOLD programme to ensure that ASGM governance is improved in order to fulfil community rights in the mining sector. This is done by ensuring a more equitable regulatory framework at the national level for small- and large-scale mining, and assisting mining communities to practice good mining practices. On the formalization aspect, the GOLD-ISMIA project is supporting the establishment of WPR and issuance of IPR and Mining Business Permit (IUP) for Special Production Operations (*Operasi Produksi Khusus*, OPK). IUP-OPK for processing and/or refining for miner's small-scale gold or ASGM. On an institutional basis, the miners will be facilitated to organize themselves into miners' cooperatives. The concept of advocacy based on community rights is aimed at marginalized and/or weak community groups, in order to strengthen their access to social, political and economic resources. Community rights-based advocacy aims to create development that is fair to all levels of society and give an optimal impact on achievement of successful development. On the issue of small-scale mining, there are many instances in which ASGM is facing conflicts with large companies. This is usually caused by seizure of land and or overlapping activities. Hence, the presence of government is very important to carry out its function as a regulator and facilitator. The government needs to ensure that in addition to fulfilling the rights and obligations of each party, they also need to ensure there is justice for small or weak people to be able to do business in the mining sector.

### Obtaining a Small-Scale Mining Permit (IPR)

IPR is a permit to carry out mining business in a small-scale mining area with a limited area and investment. Referring to Law No. 3 of 2020 which amended Article 67 paragraph 1 and 2 of Law No. 4 of 2009, an IPR is given by the Minister of Energy and Mineral Resources to an individual who is a local resident or cooperatives whose members are local residents. In order to obtain an IPR, the applicant must submit an application to the Minister of Energy and Mineral Resources. IPR criteria are based on Article I number 53 of Law No. 3 of 2020 and Government Regulation No. 23 of 2010.

For small-scale mining, licenses for small-scale business activities that include gold refining can also be obtained by application for a Mining Business Permit (IUP) for Special Production Operations (OPK). This is a business license granted for buying, transport, processing, refining and selling mineral commodities.

This refers to the Minister of Energy and Mineral Resources No.11 of 2018 concerning Procedures for Granting Areas, Licensing and Reporting on Mining Activities. In Article 47 it is stated that the IUP-OPK for processing and/or refining of metal mineral, non-metal mineral and coal mining commodities can only be granted to a business entity, therefore cooperatives are excluded from the right to process and refine under the IUP-OPK scheme. With IUP - OPK miners can use machines with a capacity of more than 25 HP but are obliged to prepare an Amdal.

As mentioned in Section 3.5.1, the Omnibus Law on Job Creation revised the obligation of having environmental permit for each business and/or activities which is obliged to have Amdal or UKL-UPL as stated in Law No. 32 of 2009 to having environmental approval which is integrated into business permit. To further regulate the revision of Law No. 32 of 2009, GR No. 22 of 2021 was issued.

## 3.5.3. Determination of a Small-Scale Mining Area

### Legal Definition

In Article 1 paragraph 29 of Law No. 4 of 2009, Mining Zone, hereinafter called a "WP," means a zone that has potential minerals and/or coal and is not bound by governmental administrative boundaries as part of the national spatial planning. In Article 1 Paragraph 30, Mining Business Area, hereinafter called a "WUP," means a part of a Mining Zone that already has data, potential, and/or information about geology available. In Article 1 paragraph 32, "Small-Scale Mining Area," hereinafter called a "WPR," means a part of a Mining Zone where small-scale mining activities are carried out.

### Spatial Planning at Provincial and Regency/City Levels

The granting of Small-Scale Mining Areas (WPR) must refer to the Regional Spatial Planning (RTRW) in the regencies and provinces. In GR No. 21 of 2021 concerning Spatial Planning, it is stated that spatial planning is a system of processes for spatial planning, space utilization and spatial use control. Spatial planning includes the preparation and stipulation of spatial planning in accordance with the provisions of statutory regulations. The provincial spatial plan is prepared by the provincial government and refers to, among other things, the national spatial plan and becomes a reference for, among other things, the preparation of the spatial plan for regencies and cities. The spatial planning for regency/city areas is prepared by the regency/city local government and refers to, among other things, the spatial planning for the national and provincial regions. The preparation of spatial planning for provincial, regency and municipal areas is further regulated in a Ministerial Regulation.

## 3.5.4. Environmental Protection Measures

### Environmental Documents

In GR No. 22 of 2021, every business and/or activity that has an important or insignificant impact on the environment is required to have an environmental approval, as a prerequisite for issuing business permits or government approval. Environmental approval is carried out through the preparation of an Amdal and an Amdal feasibility test or the preparation of a UKL-UPL form and an examination of the UKL-UPL form.

Every business plan and/or activity that has an impact on the environment is required to have an Amdal, UKL-UPL or SPPL. The person in charge of a business and/or activity that has carried out a business and/or activity prior to the enactment of this GR and meets the criteria of Article 86 of this GR, is obliged to prepare an Environmental Evaluation Document (*Dokumen Evaluasi Lingkungan Hidup*, DELH) or Environmental Management Document (*Dokumen Pengelolaan Lingkungan Hidup*, DPLH).

#### Law Enforcement

According to prevailing laws and regulations in the environmental sector, supervision of B3 as well as B3 waste including mercury is to be carried out by the supervisor of the Ministry of Environment and Forestry, and provincial/regency/city governments. In the mining process, according to Law No. 4 of 2009 as amended by Law No. 3 of 2020, the supervision is carried out by mine inspectors. According to Law no. 32 of 2009, in the framework of law enforcement against perpetrators of environmental crimes, integrated law enforcement can be carried out between civil servant investigators, the police and the prosecutor's office under the coordination of the Minister. In recent years, several law enforcement activities have been carried out in the ASGM sector, one example was when the Ministry of Environment and Forestry in collaboration with the local government and police carried out the closure and prosecution of illegal ASGM on Mount Botak in 2018.

### 3.5.5. Changes in Formalization Procedures

In line with Law No.3 of 2020 which states that WPR is approved by the Central Government on areas designated by the Provincial Government upon consultation with DPR-RI, there is also Local Government Law No. 23 of 2014 Article 14 that regulates mining issues.

In the Law on Job Creation Article 176, Article 402 A is added to the Law on Local Government which states that the concurrent division of governmental affairs between the central and provincial governments and regency/city regions as stated in the Annex to Law 23 of 2014 must be read and interpreted in accordance with the provisions which is regulated in the Law on Job Creation.

## 3.6. Leadership and Organization of ASGM at National and Subnational Levels

### 3.6.1. National Level Stakeholders

For the implementation of the Minamata Convention on Mercury, there are several laws and government regulations that mandate ministries or non-ministerial government agencies as in the following.

#### a. Ministry of Environment and Forestry (MoFF)

The Ministry of Environment and Forestry (MoEF) is the focal point for the Minamata Convention. Law No. 32 of 2009 in Article 63 paragraph (1) letter h, as amended by Law No. 11 of 2020 states that MoEF coordinates and carries out control of pollution and/or environmental damage and in paragraph (1) letter k, establishes and implements policies on B3, wastes, as well as B3 wastes. In addition, this authority is also regulated in Government Regulation No. 74 of 2001 and GR No. 22 of 2021.

#### b. Ministry of Trade (MoT)

The mandate for import, export and product trade activities is stipulated by Law No. 7 of 2014 concerning Trade. Related to the scope of trade arrangements are described in Article 4 of the Law. Several provisions of Law No. 7 of 2014 are amended by Law No. 11 of 2020. For the export and import of mercury, it is mandated by Government Regulation No. 74 of 2001 in Article 7 paragraph (3) and Article 8 paragraph (3). This mandate is described in detail in MoT Regulation 47/2019.

#### c. Ministry of Indsutry (MoI)

Law No. 3 of 2014 concerning Industry as amended by Law concerning Job Creation accommodates environmental management into a green industry concept that harmonizes industrial development with the preservation of environmental functions and provides benefits to society. The Minister of Industry prepares and sets green industry standards (Article 79). Regarding mercury management, in Law No. 11 of 2017 concerning Ratification of the Minamata Convention on Mercury, it is explained that regulating the use of mercury or mercury compounds and controlling mercury emissions is one of the references for the government in preparing green industry standards which contain provisions regarding raw materials, auxiliary materials, energy, production processes, products, enterprise management and waste management.

### d. Ministry of Energy and Mineral Resources (MoEMR)

MoEMR's authority in mineral and coal mining management is based on Law no. 3 of 2020 which amended Article 6 of Law No. 4 of 2009 which includes, among others, establishing national mineral and coal management plan, national mineral and coal policy, laws and regulations, national standards, guidelines and criteria, conduct mining investigations and research in all mining jurisdictions, determine the WP after being determined by the provincial government in accordance with their authority and in consultation with the DPR-RI, issuing Business Licensing, providing guidance and supervision to the implementation of mineral and coal mining business activities carried out by holders of Business Licenses, etc.

### e. Ministry of Health (MoH)

The Minister of Health has a mandate based on Law no. 36 of 2009 concerning Health, wherein the government, local government and the community must ensure the availability of a healthy environment that does not pose a bad risk to health. A healthy environment is one that is free from elements that cause health problems, including hazardous chemicals, polluted water, polluted air, and contaminated food (Article 163).

### f. Ministry of Manpower

The Ministry of Manpower has the task of carrying out government affairs in the manpower sector to assist the President in administering the state government, as regulated in Presidential Regulation No. 95 of 2020 concerning the Ministry of Manpower. Article 3 of Law No. 1 of 1970 concerning Work Safety, stipulates conditions for work safety, including providing personal protective equipment to workers and obtaining harmony between labor, work tools, environment, work methods and processes.

### g. Ministry of Finance (MoF)

In accordance with the mandate of Article 8, Law No. 17 of 2003 concerning State Finance, one of the duties of the Minister of Finance is to compile a draft of the State Budget (APBN) and draft changes to the APBN and to approve budget implementation documents. In the elucidation of Article 11 paragraph (5), the environment is included in the details of state expenditure by function. In Annex II, Minister of Finance Regulation No. 102 of 2018 concerning Budget Classification, the Minister of Finance stipulates the Central Government's B3 waste system development activities as one of the Function Classification Codes in determining the amount of the budget for environmental functions. The Minister of Finance establishes general guidelines and allocations of funds for special allocations in the environmental sector each year. With regard to mercury management, the Ministry of Finance is one of the lead agencies within the Indonesia National Single Window (INSW) created by the government to streamline the import process, which is a national system that allows for single and synchronous submission of data and information, as well as single decision making to grant customs permits, and dispensing of goods. Therefore, industries or manufacturers who wish to import B3 from abroad must register through INSW.

### h. Ministry of National Development Planning

The Ministry of National Development Planning/Bappenas has the task of carrying out government affairs in the field of national development planning to assist the President in carrying out the state administration, as regulated in Presidential Decree No. 65 of 2015 concerning the Ministry of National Development Planning. It is expected that Bappenas encourage the preparation of program plans at the MoEF, MoH and related ministries to increase human resource capacity, supervision, use of mercury-free technology and handling mercury waste as well as restoring mercury contaminated land, especially in ASGM locations.

### i. Ministry of Communication and Informatics

The related regulation is Presidential Instruction No. 9 of 2015 concerning Public Communication Management. In this Presidential Instruction, the Ministry of Communication and Information can act as a coordinator for the management of national public communications to promote a particular issue.

### j. Agency for the Assessment and Application of Technology (BPPT)

BPPT is a non-departmental government institution that is directly responsible to the President, based on the Presidential Decree No. 103 of 2001 concerning Position, Task, Function, Authority, Organizational Structure and Work Procedures of Non-Departmental Government Institutions which had been amended several times, the last time with the Presidential

Regulation No. 145 of 2015. BPPT has the task of carrying out government duties in the field of assessment and application of technology in accordance with the provisions of the prevailing laws and regulations.

BPPT has carried out various activities, including in collaboration with the Ministry of Environment and Forestry, the focal point for the national program, in preparing technology designs for non-mercury-based gold processing pilot-scale projects. A non-mercury-based gold processing pilot plant has been built in Lebak Regency, in collaboration with the Lebak Regency government. BPPT has provided training and demonstrations on non-mercury gold processing at several ASGM locations. BPPT plans to make a Detailed Engineering Design in 4 (four) other ASGM locations to support the Ministry of Environment and Forestry in building the same pilot plant, and build a non-mercury-based gold processing pilot plant in the ASGM group in the Kulon Progo Small-Scale Mining Area (WPR), Yogyakarta. Furthermore, BPPT and MoEF plan to build non-mercury gold processing facilities in 14 (fourteen) districts. BPPT and its partners have also initiated the establishment of the Indonesian Center for Artisanal Mining (INCAM), which consists of a research and technology center and a training center.

#### k. Ministry of Transportation

The Ministry of Transportation has the authority to issue business licenses in the sector of B3 waste transportation after receiving recommendations for the transportation of B3 waste from the Minister of Environment and Forestry (GR No. 22 of 2021 Article 313). The Minister of Transportation receives a copy of the report on the implementation of transporting B3 waste from the transporter which is submitted to the Minister of Environment and Forestry (Article 314).

### 3.6.2. Subnational Level Stakeholders

#### a. Local Government

Local governments have the authority to carry out concurrent government affairs as mandated in Law No. 23 of 2014 concerning Local Government which has been amended by Law No. 2 of 2015, Law No. 9 of 2015 and Law concerning Job Creation. Concurrent government affairs submitted to the regions form the basis for the implementation of regional autonomy. As per Article 12, government affairs which fall under regional authority include, among others, the environment, health, agriculture, energy and mineral resources and trade and industry. Furthermore, in the Law on Job Creation, several provisions in Law No. 23 of 2014 have been amended, among others, regarding the division of concurrent government affairs between the central and provincial governments as well as regency/city regions.

The Law on Job Creation which amends Article 59 of Law no. 32 of 2009, in Article 22 states that hazardous waste management must obtain a business license or approval from the central government or local government. The central government or local governments are obliged to include environmental requirements that the B3 waste manager must comply with in the business license or approval of the central or local government.

As mentioned above, Law no. 3 of 2020 amended Article 9 of Law No. 4 of 2009 into a mining area is determined by the central government after being designated by the provincial local government in accordance with its authority and in consultation with the Indonesian Parliament.

#### b. Associations

Mining-related associations in Indonesia include the Indonesian Mining Association (IMA) and the Indonesian People Miners Association (APRI). With regard to mercury, IMA has made efforts, including approaches to civil servant investigators to curb illegal coal and gold mines in Indonesia that use hazardous substances such as mercury. APRI's activities related to mercury include collaborating with the Ministry of Environment and Forestry in surveying and inventorying ex-mining open land throughout Indonesia, holding an International People's Mining Conference in 2016 which was attended by more than 1000 miners and representatives from 10 friendly countries, initiating (negotiation process) of cooperation with several parties, including universities, tekMIRA Research and Development Center, business associations, banks, and several other private parties. In addition, APRI is also working with tekMIRA and MoEMR of West Java Province in determining the most optimal processing system with mercury-free and environmentally friendly technology and equipment to get maximum recovery, which is above 90%. In 2018, APRI has pledged that it will no longer use mercury in gold mining activities.

### c. Non-Governmental Organizations (NGOs)

Several NGOs in Indonesia are involved in mercury management, including BaliFokus, Pure Earth/Blacksmith Institute, Medicuss Foundation, Tambuhak Sinta Foundation (YTS) and Artisanal Gold Council (AGC), Mining Advocacy Network (JATAM), Indonesian Forum for the Environment (WALHI), the Indonesian Center for Environmental Law (ICEL) and Lentera Kartini.

### d. Universities

Various universities in Indonesia have collaborated in capacity building and providing knowledge for activities carried out by associations, NGOs, government and local governments related to mercury management. Activities carried out include research and studies related to mercury, including mapping the impact of mercury on the environment, and health and socio-economics around the ASGM locations such as that carried out by the Bandung Institute of Technology (ITB) and Brawijaya University in collaboration with the Ministry of Environment and Forestry in 2018. This activity was carried out by taking and testing samples in the laboratory as well as interviews and health checks of miners in 8 (eight) ASGM locations to determine the impact of mercury on health and the environment.

Apart from the government, there has also been cooperation between universities and mining-related associations in Indonesia, including a collaboration between APRI and the University of Nusa Cendana Kupang (East Nusa Tenggara), Halu Oleo University (Kendari Southeast Sulawesi) and Pattimura University (Ambon Maluku).

## 3.6.3. Determination of a Mining Area (WP)

It is the National Government's authority to determine mining areas (WP). However, Article 1 number 4 of Law No.3 of 2020 stipulates that the determination of a mining area may only be carried out after the National Government coordinates with the Provincial Government. This is to be based on data held by both parties, and submitted in writing to the House of Representatives. Thus, in the context of selecting and establishing a new mining area, the central and local governments must work together to carry out research on an area, including an investigation and inventory of gold resources, and mining exploration. Part of the authority of the National Government can be delegated to the Provincial Government. Stakeholders basically consist of four parties: National and Provincial Governments; the Local Government; the DPR RI; and Mining Entrepreneurs at large, medium, and small scales.

## 3.6.4. Allocation of a Small-Scale Mining Area (WPR)

Stakeholders include provincial governments, regency/city governments, entrepreneurs, and mining communities. Areas of authority and responsibility are as follows:

- The most important task is for the provincial government to submit recommendations regarding the location of the WPR to the central government for approval by the Ministry of Energy and Mineral Resources.

- The Regency/City government must facilitate the process of formalizing the people's mining business to obtain an IPR. An IPR may be granted based on an application submitted by local residents, either by individuals, community groups, or cooperatives. The Sub-National Government should oversee the implementation of IPR, while the National Government (Mining Inspector) is responsible for technical and environmental aspects. Technical guidance on business, mining techniques and environmental management is provided by the Directorate General of Mineral and Coal. Based on Article 73 of the Mining Law, the obligations of regency/city governments are: firstly, to carry out coaching in the mining community; secondly, to be responsible for the technical security of the people's mining business; thirdly, to appoint a mining inspector; fourthly, to record production results and report these to the minister and governor.

- Mining communities must meet a number of requirements to obtain an IPR, including administrative requirements, technical requirements, and financial requirements.

### 3.6.5. Spatial Planning Stakeholders

Stakeholders in spatial planning are as follow: (1) Institutionally, the provincial government is represented by Public Works and Spatial Planning Office (*Dinas Pekerjaan Umum dan Penataan Ruang*, PUPR); (2) city/regency governments (3) companies or investors, especially those who need a business location. At the level of regencies and cities, the stakeholders are: (1) the regency or city government as represented by the PUPR service; (2) the business world that will operate in the regency/city area; (3) the central government; and (4) the provincial governments.

### 3.6.6. Environmental Documents

Stakeholder roles and responsibilities are dependent upon the level of paperwork required.

- For Amdal: (1). Person responsible for business and/or activities. (2). Directly affected communities which include vulnerable community groups, customary communities and/or groups of men and women with attention to gender equality. (3) Amdal drafting team. (4). Minister of Environment and Forestry, governors or regents/mayors in accordance with their authority. (5) Environmental Feasibility Test Agency established by the Minister of Environment and Forestry (6). Environmental Feasibility Testing Team established by the Environmental Feasibility Test Agency (7). Ministries/non-ministerial government agencies in charge of the business sector and/or activities which are required to conduct Amdal.

- For UKL-UPL: (1). Person responsible for business and/or activities. (2) The Minister, governors or regents/mayors in accordance with their respective authorities.

- For SPPL: (1). Responsible for business and/or activities. (2). The Minister, governors or regents/mayors in accordance with their respective authorities.

### 3.6.7. Barriers to Formalization

The Mining and Energy Law No. 4 of 2009 states that any kind of small-scale mining activity must be licensed. However, an IPR can only be granted within an area that has been already been designated as a small-scale mining area (WPR). In reality, very few small-scale mining areas have been established for gold miners, and it is difficult to designate an area as WPR, as the subnational and national government must first make sure that the area is free from any conflicting issues and has no overlapping permits.

Existing mining communities may propose that a small-scale mining area be established for them, by making a proposal to the Regent. The legal foundation for this is in Article 24 of Law No.4/2009 which states: "an area or location where small-scale mining already takes place but is yet to be designated as WPR should have priority to be designated as WPR".

Article 67 paragraph (1) Law No. 4 of 2009 is amended in Law No. 3 of 2020 to be as follows, "IPR is granted by the Minister to individuals who are local residents or cooperatives whose members are local residents."

Article 68 paragraph (1) of Law No. 4 of 2009 is amended by Law No. 3 of 2020 to be: (1) size of area for 1 (one) IPR that may be authorized to individuals shall be at most 5 (five) hectare or cooperatives shall be at most 10 (ten) hectares; (2) IPR shall be granted for a period of at most 10 (ten) years and are extendable twice for 5 (five) years each.

The long approval process from the ministry is often a problem for the provincial and regency governments, because small-scale mining activities will usually continue in the meanwhile. However, any mining activities that are carried out outside of the WPR are considered illegal. Under these conditions, it is difficult for the regency and provincial governments to provide guidance or business formalization assistance, as the WPR has not yet been established. Unfortunately, there are only a handful of ASGM sites in Indonesia that have satisfied all of the legal requirements above, which are very difficult to achieve. Almost all ASGM in Indonesia can therefore be classified as illegal or informal at this time.

### 3.6.8. Miners Cooperatives

The establishment of a miner's cooperative is the main requirement for small-scale mining. Cooperatives can be ideal business institutions, as they are protected by government laws which allow indigenous organizations and leaders to develop the economic resources of the community.

Cooperatives run by indigenous peoples should therefore be empowered to organize their use of natural, human, and financial resources to build collective strength in accordance with traditional values (*musyawarah dan gotong-royong*) such as working by consensus and through mutual cooperation (APRI, 2015).

### Access to Financial Resources

One of the main management issues faced by indigenous people is the situation in which the utilization of economic resources is done mostly for the benefit of individuals. As government is supposed to support the interests of communities, it is logical for cooperatives or other community-owned enterprises to exist in order to facilitate their economic independence. There are basically four types of financial resources that communities can access to develop a sustainable gold mining business: through a project scheme with donor funding; through fundraising; through loans, or by way of the Local Government Budget (*Anggaran Pendapatan dan Belanja Daerah*, APBD) or the State Budget (APBN). Public-private partnerships can also position indigenous people as rights holders, so that they can become shareholders in enterprises that may generate more financial resources. CSR funding (as regulated in Law No. 40/2007 Chapter V, Article 74, and Government Regulation No. 47/2012 on CSR, as well as in Government Regulation 93/2010 on Tax Incentives) can also be a feasible source of financial resources which will not violate the rights of indigenous communities (APRI, 2015).

### Requirements to Create a Functional Cooperative

Legalization of small-scale mining must follow the stipulations in the prevailing laws and regulations, namely (1) social preparation for the indigenous people, (2) establishment of cooperatives, and (3) preparation to complete the IPR requirements.

In terms of social preparation, the requirements for forming a cooperative are to ensure that: (1) all members have a strong motivation and objective (2) all members understand the aims and objectives (3) an appropriate business model has been determined by the members, and (4) members agree to pay the capital contribution that allows the cooperative to operate.

IPR requirements are based on Article no 48 verse (2) of GR No. 23/2010 which states: "in order to obtain an IPR, the applicants should satisfy (a) the administrative requirements, (b) the technical requirements, (c) the financial requirements. To satisfy these three requirements, Article no 3 point (c) of GR No. 23/2010 states: "the administrative requirements as referred to in verse (2) point (a) for a local cooperative, should at least cover the following: (1) an application letter, (2) a tax identification number, (3) a deed of organization with official endorsement from relevant authorities, (4) a description of the type of commodity to be exploited, and (5) an affidavit from the local village officials.

Furthermore, the financial requirements should follow the Article no 48 verse (5) of GR No. 23/2010: "the financial requirements as referred to in verse (2) point c should be provided in a financial report for the previous year, and only applies to local cooperatives.

In addition to meeting these requirements, the board of the cooperative and its members should have a clear understanding of and be able to fulfil the obligations after being granted the license as regulated by Law No. 3 of 2020.

Provisions of Article 70 Law No. 4 of 2009 as amended by Law No. 3 of 2020 state that IPR holders must: (a) carry out mine activities at the latest 3 (three) months of issue of Small-Scale Mining Permits; (b) comply with laws and regulations in the field of mining occupational safety and health, management of the environment, and meet applicable standards; (c) manage the environment together with the Minister; (d) pay small-scale mining dues; and (e) submit a report on the conduct of small-scale mining activities periodically to the Minister of Energy and Mineral Resources.

Further provisions on procedures for granting Small-Scale Mining Permits shall be governed by government regulation (Article I number 56 Law No. 3 of 2020).

## 3.7. Mercury Trade and Demand

### 3.7.1. Mercury Procurement

#### Mercury Imports into Indonesia

The UN Comtrade database shows that 2,348 tonnes of mercury were exported to Indonesia between 1998 to 2014. However, the Indonesian UN Comtrade database shows only 555 tonnes as having been imported during that period. The Ministry of Trade analysed this discrepancy (BPS-Statistics Indonesia) and found that in 2012 alone, Indonesia imported only 0.99 metric tonnes of mercury, while the Global Trade Information Service (GTIS) data showed the world exported 336 tonnes of mercury to Indonesia. Indonesia first started importing mercury in 1989. Then, from 1989 to 2013, mercury imports grew from 154 to 366 tonnes per annum (Pidani & Mokui, 2017). In 2012, it was estimated that 300 tonnes of mercury entered Indonesia illegally while the imports recognized by the Government of Indonesia only amounted to 2.5 tonnes (DPR-RI, 2017).

#### Domestic Sources of Mercury Supply

Cinnabar is the most common source of mercury in nature and has been mined for thousands of years (Fritz, Maxson et al., 2016 as cited in IPEN, 2018). UNEP has noted that "Between 2011 and 2015, Indonesia and Mexico opened new mercury mines, in both cases before they had ratified the Minamata Convention," (Maxson P, n.d).

#### Cinnabar Mining

In May 2016, a field team from MoEF collected data at the Mount Tembaga cinnabar mine in Seram through observation and in-depth interviews, finding that cinnabar mining had been taking place since December 2012, when there had been 3,000 miners, and which number had dropped to 1,900 miners by March 2016. Most of the miners were immigrants rather than locals. It is estimated that domestic mercury production stemming from cinnabar mining in Seram is approximately 350 tonnes per annum (MoEF & BSCRC-SEA, 2019).

#### Cinnabar Smelting

In Sukabumi, in 2016, there were four districts with cinnabar smelters: Parakan Salak; Bojong Genteng; Kelapa Nunggal; and Parung Kuda. In the village of Kampung Bola (in the Parung Kuda district) there were 30 people that owned cinnabar smelters. Researchers found that 1.5 tonnes of cinnabar would yield 600 kg of mercury with a purity of 50-60%. In one village in Bojong Genteng district alone there were 60 to 70 cinnabar smelters (*tungku pembakaran*). In Parakan Salak district there were about 30 cinnabar distilleries operated by local people supported by powerful financiers and individual investors, producing an estimated 36 tonnes of elemental mercury per day (Balifokus, 2017).

The act of buying, collecting, sending, or doing their own processing by means of distillation carried out by illegal cinnabar businessmen is very contrary to Law No. 4 of 2009 concerning Mineral and Coal Mining.

#### Cinnabar Trade Prevention

On 9 November 2015, the Directorate General of Customs and Excises (DJBC) working with the Ministry of Energy and Mineral Resources, Ministry of Finance, and the police, took control of a shipment of 80 containers filled with illegal minerals, at the Tanjung Priok port in Jakarta. This was the first major action to prevent mercury exports including cinnabar ore, and the minerals were valued at approximately USD 5.5 million. This was the biggest case in 2015. The illegal minerals were to be exported to the Netherlands, Taiwan, Korea, Hong Kong, India, Singapore and Thailand. Prior to this, in August 2015, Indonesian Customs had also halted 13 tonnes of cinnabar ore at Tanjung Priok Port that was going to be exported by 3 companies to Hong Kong and Eritrea. The MoEF officials stated that the exporters failed to provide proper paperwork on where the cinnabar ore had been mined and could not show any permit to mine cinnabar ore (Balifokus, 2017).

Although the cinnabar mine was officially closed at the end of 2017, a shipment of 100 kg of cinnabar was recently intercepted by the Yos Sudarso Port Regional Police, in Ambon. A total of 100 kg of neatly wrapped cinnabar ore was transported by an Ambon Post Office car. The ore was planned to be shipped to Bau-bau, in Southeast Sulawasi. The ore was obtained from Luhu Village, Huamual District, West Seram Regency (Muslimin, 2018).

The West Seram Police Criminal Investigation Unit in Maluku also secured 170 kilograms of cinnabar in Iha Village, Huamual District, on 6 November 2018. The cinnabar was allegedly obtained from the Mount Tembaga location although the mine site was closed by the local government in 2017 (Patty, 2018).

### Mercury Trade and Supply in Indonesia

In 2017, Balifokus published a highly definitive report entitled "Mercury Trade and Supply in Indonesia" in which it lists the contact details of 71 mercury traders who were found to be openly and actively trading mercury online through websites, direct selling, delivery services, and online trading platform transactions. Cinnabar ore and mercury sales and marketing were also found to be conducted widely using the popular B-2-B e-commerce website, social-media platforms such as Alibaba, Facebook, Twitter, and Instagram (IPEN, 2018).

### Police Actions on Local Mercury Traders

In 2019, in Sidoarjo, East Java, police disclosed details of illegal mercury trading that was uncovered by a cyber-patrol team. This was because the mercury was mainly being marketed through social media. In addition, the police uncovered processing and refining of cinnabar by a producer from Southeast Sulawesi. They found purification tools for making mercury from cinnabar and packaging materials. The cinnabar was obtained in Maluku Province, and 500 kg of mercury was made from every 1 tonne of cinnabar ore. This operation had been running since 2006 (Rinanda, 2019).

In Sekotong, it was very easy to find mercury as mercury traders sold it directly at processing locations like ordinary merchandise. Mercury is now more difficult to obtain because of the activities of the "Illegal Mining Task Force" which consists of members of the security forces; and because the government is actively working to cut the mercury supply chain. The impact of this tightening has been that mercury prices have increased sharply. Previously the price of one kg of mercury was IDR 550,000, now it is IDR 1.6 million. In addition to curbing the circulation of mercury, the NTB Illegal Gold Mining Handling Task Force also oversees the circulation of fuel oil and cyanide which are suspected of being supplied for the needs of ASGM activities (Rakhman, 2019).

## 3.7.2. Mercury Trade and Export

### Mercury Exports from Indonesia

In 2015, Balifokus reported that Indonesia exported 283,767 kg of mercury to 15 countries: namely, China (211kg), Eritrea (3,105 kg), Hongkong (105,053 kg), Malaysia (184 kg), Holland (36,896 kg), Papua New Guinea (25 kg), Poland (62 kg), Timor-Leste (450 kg), India (6,417 kg), Singapore (40,828 kg), Vietnam (19,175 kg), Switzerland (63,422 kg), Thailand (24 kg), Emirates (7,863 kg), and the USA (52 kg). Furthermore, Balifokus has reported that in 2015-2016, Indonesia became a mercury exporter (HS code 280540) to some countries, based on data obtained from the UN Comtrade database by searching for export notifications that Indonesia reported to trading partners in 2015 and 2016 (Balifokus, 2017).

In 2015-2016, Indonesia became a mercury exporter to some countries, and is now ranked the world's largest mercury exporter. In 2017, as the mercury export bans in the EU, USA, Colombia and Japan (partial ban) were enforced, the top 5 major exporters of mercury recorded for 2017 were Mexico, Japan, Indonesia, Singapore, and India, respectively. In Indonesia, the production of mercury from small- scale and illegal cinnabar mining has taken place in Seram Island since 2012. The cost of locally-produced mercury is about a quarter of the imported mercury and is sold widely in many ASGM hotspots (IPEN, 2018).

### Mercury Prices

From 2000 to 2005, the price of mercury was in the range of IDR 1.2 to 1.3 Million rupiah per kilo, while in 2005 until 2010 the price of mercury fell to only IDR 0.6 to 0.8 Million per kilo. With the decrease in mercury prices, there was an increase in the amount of mercury used for mining activities. In 2010, due to the cinnabar being mined, a significant price reduction occurred again, falling into the range of only IDR 0.2 to 0.3 Million per kilo (DPR-RI, 2017).

## 3.8. Economic Aspects

### 3.8.1. Legal Financial Entities

In Indonesia, financial entities do not commonly provide loans to the ASGM sector as the sector is typified by high and unmitigated/unmanageable financial risk resulting principally from unproven and/or inconsistent financial returns from mineral production. This situation has become one of the challenges for the Global Opportunities for Long-term Development – Integrated Sound Management of Mercury in Indonesia's Artisanal and Small-scale Gold Mining (GOLD-ISMIA) Project which aims to establish financing lending arrangements through which the legalized ASGM miners/cooperatives can procure/invest in mercury-free processing equipment. In this context, the project aims to establish partnerships with finance entities and build their capacity and understanding to develop financial products that would tailor to this sector and better assess loan applications from miners (Planet Gold, 2019).

### 3.8.2. Economic Benefits of ASGM

ASGM activities began in the Sekotong District of West Lombok Regency in West Nusa Tenggara (NTB) in 2008. Research conducted in two villages found that ASGM contributed to 81.6% of household earnings, and had strongly improved both the income earning potential and employment opportunities of the inhabitants (Suhartini et al., in Hobgen et al., 2016).

In NTB province, Krisnayanti and Anderson conducted health and socio-economic surveys with ASGM workers in Sekotong (Lombok Island) and Taliwang (Sumbawa Island) finding that the overall economic impact of ASGM is positive: leading to jobs, greater income and opportunities for social development. The ASGM sector in the West Sumbawa Region was found to have a large migrant worker population, which provides important economic support to the local community. The average income of the miners before working in the ASGM was € 2.19/day or less, whereas their average income as miners was € 31.99/day or more. The migrant workers stated that they were coming to West Sumbawa Regency to earn more money, and because of unemployment in their hometown (Krisnayanti et al., 2016). However, Krisnayanti and Anderson (2013) also concluded that a degraded environment in the ASGM areas of Lombok could potentially affect the sustainability of tourism on the island, the quality of food produced in ASGM areas, and the health of the mining population.

The economic situation in mining and non-mining communities in Bombana is that the mine workers' incomes are higher than for the non-mining community. The exploitation of high-quality gold deposits in Indonesia has led to an economic boom in the Bombana Regency. However, damage to land, agricultural infrastructure, and fisheries has caused production levels to decrease, and farmers' incomes have dropped dramatically. The higher revenue generated in the ASGM sector means that the miners and their families now depend on their mining work for the long term, thereby making it difficult to control both the mining activity and the resultant environmental degradation (Basri et al., 2017).

Based on the results of the study of the impact of mercury on the community's economy in ASGM locations in North Minahasa Regency, North Sulawesi Province, East Bolaang Mongondow Regency, North Sulawesi Province and West Lombok Regency, West Nusa Tenggara Province, ASGM activities in all locations are able to increase the income of miners and create job opportunities and improve the community's economy. Conflicts can be reduced because there is institutional interaction, both formal and non-formal, in all ASGM locations (MoEF & UB, 2018).

**ASGM Locations from Studies of MoEF, BSCRC-SEA and Field Survey Team (2021)**

Interview results with respondents working in ASGM locations shows that in Lebakgedong District, Karangjaya District and Lolayan District, miners have income of IDR 1-2 million per month. In Hutabargot District and Taliwang District, majority of miners have income of IDR 1-2 million per month and some respondents have income of IDR 2-5 million per month.

The majority of respondents in Murung Raya Regency have an average income of IDR 1 million to IDR 2.5 million per month as workers in the ASGM sector. This amount is sufficient to guarantee to meet the basic needs of the respondents. The income is much higher for those who act as bosses of gold miners and collectors, which can reach more than IDR 10 million per month.

In Hutabargot District, Mandailing Natal Regency, North Sumatra Province, the wages earned by miners from mining activities are quite high. For example, for sack carriers, the wages earned for each kilogram of rocks transported are valued at IDR 2,000/kg, with an average weight of 60 kg for

each burlap sack. In other words, each stone carrier will get a wage of IDR 120,000 for each sack transported. Furthermore, in one day, stone carriers can generally transport the rocks three times a round so that in one day, each stone carrier can earn IDR 360,000. The value of this wage is quite high when compared to similar professions outside the mining sector.

Women in Hutabargot District have a similar economic impact. The women were involved in gold mining activities as stone breakers. For every 1 kg of rock broken down, female workers can have IDR 1,000. Every day, women who work as rock breakers at mining sites can earn IDR 50,000/day. This value is well above the average income as a farm worker in the areas around the mine site.

The community also gets another economic impact in the form of 'tax' money taken from every sack of rock taken from the mining site. For each sack of rock taken, the community quoted the mine managers IDR 20,000/sack. The revenue is used to build facilities and infrastructure for the community, such as schools and public health facilities (MoEF & BSCRC-SEA, 2021).

## 3.9. Demographic and Social Information

### 3.9.1. Estimated Number of Active Gold Miners in Indonesia

In 2010, BaliFokus estimated that there are 163,710 artisanal and small-scale gold miners in Indonesia. The National Overview of Indonesian ASGM (2020) estimated this number to be 179,200. This (more recent) estimate of miner numbers was made based on information available from locality studies, and by establishing the number of districts with ASGM activity in each regency and city. But considering that 132 regencies have now been identified as having ASGM, the total number of miners could well be higher.

**Table 3.3 Number of Miners in National Inventories**

| National Inventory | No. of Miners | No. of Regencies | Avg. per Regency |
|---|---|---|---|
| Balifokus (2010) | 163,710 | 76 | 2,154 miners |
| MoEF & BSCRC-SEA (2020) | 179,200 | 132 | 1,413 miners |

Source: MoEF & BSCRC-SEA, 2020

Currently, the number of women involved in ASGM is 30% of the total number of workers in ASGM in Indonesia. Another fact is that women get lower wages even though they work as hard as men and face severe health and safety risks (Ratnawati, 2021).

The identification of the current situation regarding women in ASGM is that women are not always identified as miners even though many of them have been doing this work for a long time. Women as one of the actors in the mining chain are still not recorded, so they rarely get benefits. Women occupy "additional roles" (cook, stone crusher, waste sack washer, mercury mixer). Female miners are most directly exposed to mercury which is a major problem for women in ASGM. Children in ASGM areas have been exposed to mercury since they were in a woman's womb (Krisnayanti, 2021).

There is currently no nationwide estimation of number of children involved in ASGM in Indonesia. However, some research and assessment has been done to estimate the number of children involved at some ASGM locations. For example, it was estimated that 300-350 children worked

at three gold mining sites in Long Iram District, West Kutai Regency, East Kalimantan Province (ILO, 2004a). ILO also conducted research in Batu Sopang District and Muara Komam District, Paser Regency and Tering District, West Kutai Regency, East Kalimantan Province on the number of child laborers aged 10 to 17 years old. In Batu Sopang and Muara Komam District in 10 sites, there were 17 children working in illegal mining units. Seven (7) of them are found in the Batu Sopang District and ten in the Muara Komam District. On the other hand, there are 52 children working outside mining units. In the Kelian Dalam Village of the Tering District, there were 29 children working full time at mining units, and 23 other children who were seen carrying out additional work (ILO, 2004b). Observation and interview by Jember University showed that there were 6 (six) children aged 13-17 years old directly worked at ASGM in Beutong District, Nagan Raya Regency, Aceh Province (Sari & Sanova, 2020).

The Indonesian Child Protection Commission in cooperation with Yayasan Emas Artisanal Indonesia (YEAI) and supported by AGC and Global Affairs Canada will conduct mapping to profile children working in ASGM, with Lentera Kartini as local partner for Central Kalimantan area and Aliansi Masyarakat Adat Nusantara (AMAN) for North Sulawesi area. Initial mapping will be conducted in 3 (three) ASGM locations namely Bukit Harapan Village, East Kotawaringin Regency, Central Kalimantan Province, Tetelu Village, North Minahasa Regency and Tobongon Village, East Bolaang Mongondow Regency, North Sulawesi Province. Mapping the status of the children will provide an overview of demographic aspects, education, health, employment, family background and others as input in fulfilling civil rights, educational rights, and preventing children from becoming laborers (Coordinating Ministry for Human Development and Cultural Affairs, 2020).

According to a recent study by MoEF, BSCRC-SEA and the field survey team in 2021, in Lebaksitu Village, Lebak Regency, gold is extracted from ore either by amalgamation or cyanidation methods. Rocks that have arrived at the gold processing site are broken down into smaller sizes manually using a hammer, usually done by women and children. The majority of the diggers in mining are male, and the youngest miners are in their teens. Based on interviews, there are very few female workers in the mining area.

In ASGM locations in Hutabargot Dolok Village, Mandailing Natal Regency and in Bolaang Mongondow Regency, the majority of the population consists of miners, processors, and carriers (men); while stone breaking is the work of women and children.

### 3.9.2. Level of knowledge about Environmental and Health Risks

Survey results on the perception of gold miners as respondents regarding the long-term impact of mercury in Sekotong, Lombok, showed that 14 respondents (around 46%) out of the total of 30 respondents interviewed agreed that the use of mercury could cause physical health problems for the miners in the long term. This shows that the mining community is quite aware of the dangers of using mercury in gold processing. However, eight respondents (26%) stated that the use of mercury does not affect the physical health of miners in the long term. In general, the miners who disagreed were people between the ages of 40 and 60 years and over. Younger miners tend to be more aware of the dangers of using mercury because they are more open to new information and knowledge (MoEF & UB, 2018).

### 3.9.3. Social Ills

There is a recurring rhetoric that informal miners are engaged in drugs, and that their 'hedonic culture' contributes to a range of other social ills. However, local discussions in Central Kalimantan with both Dayak and migrant miners identified the use of mining income to pay for daily living costs, purchasing land or a vehicle, building a family house and forming a household, or for their children's schooling. Some miners did report that drugs could be used in order to maintain their energy during times when rich gold strikes were identified, and work continued through the night. A number of parents of young miners also indicated that drugs were an issue in ASGM. However, it is not clear that gold miners are making a highly disproportionate contribution to the province-wide social ills of drugs, alcohol, gambling and prostitution (Barney, 2018).

From the SWOT analysis method in the study by MoEF, BSCRC-SEA and the field survey team in six ASGM locations in 2021, several important socio-economic issues were identified as can be seen in **Annex III.B.**

**Figure 3.14. Socio-economic sampling through interview with respondents**





Source: MoEF & BSCRC-SEA, 2021

### 3.9.4. Conflicts and Resolutions Between ASGM Communities and Mining Companies

Cisitu is located within the Halimun-Salak National Park, in Lebak Regency, in Banten Province. The main economic activities are wet-rice farming, fish ponds, forest-based products, and artisanal gold mining. The site is an indigenous peoples' territory, located inside a national park, and had history and conflict with a state-owned gold mining company. The population of the six Cisitu communities comprises 7,000 people in 1,460 households. Almost 50% of the population is involved in gold mining and processing (Medicuss, 2015).

The main economic activities in the Bombana regency are irrigated rice farming, fisheries and gold mining. There are more than 10 large mining areas, mostly of alluvial type, some of which have had conflicts or overlaps within the concession areas of several medium-sized gold mining companies (Medicuss, 2015).

A case study in Naga Juang District, Mandailing Natal Regency, North Sumatera Province on conflict resolution between a local ASGM community and a mining company showed that the conflict was generally influenced by competition for management access and the utilization of the gold ores found on Tor Sambung between Naga Juang Disctrict community, Mandailing Natal local government and PT. SMM (Ramadhan et.al, 2014).

In Kuantan Singingi Regency, social conflicts were found to stem from the competing interests between the community and the company. This resulted in a strike by company employees in order to claim their indigenous rights and in land disputes between the community and the company. The economic interest of the community was the dominant factor in the occurrence of these natural resource management conflicts so that even the slightest trigger could lead to a wider conflict. Conflict handling in Kuantan Singingi Regency was carried out through deliberation for consensus and also through law enforcement mechanisms (Marta, n.d).

In Petapahan Village, Gunung Toar District, Kuantan Singingi Regency, illegal ASGM conflicts often occurred, with both direct and indirect violence resulting from the many competing interests at the mine site, causing conflict in the midst of the village community. Community and NGOs worked together with the government in a collaborative approach by providing counseling to workers, entrepreneurs and the community about environmental impacts, as well as the negative impacts of illegal ASGM itself (Zuhri, 2015).

In Bombana, it is the property owner who gives the miners the authority to extract the gold under the supervision of the land coordinator, and they will always make an agreement on how to divide the profits obtained from the sale of gold. But although the structural work has defined rules, there are frequent internal conflicts. In workers' conflicts, a verdict is decided by the landowner with assistance from a local field coordinator. In some cases, conflicts that could potentially lead to riots are handled by the local police. While under this threat of police intervention, the capital owners and the mine workers continue to work together, thus creating economic interdependence (Basri et al., 2017).

In the province of Central Kalimantan, Barney (2018) finds that while many villagers have taken part in the successive resource booms, the majority of profits from large-scale resource development have been transferred out of the province. The transition has been too rapid and transformative for local communities to successfully engage with and adapt to the changes. Unsustainable extraction is also evident, with the widespread involvement and varied motivations and practices of miners; significant internal tensions within communities over regulating mining; accelerating mining-linked ecosystem degradation; and the significant numbers of migrants drawn from elsewhere in Indonesia into Central Kalimantan's new gold-mining rushes.

In Mimika, most conflicts could be resolved by the camp leader. Most of the camp leaders are the pioneers of the panning activity in the location. It means almost all camp leaders are in the same age category which is between 30-45 years. Camp leaders have privileges and the power to communicate about issues with terrace owners or site owners. Conflicts in panning sites are divided into two dimensions. The first dimension is conflicts within the organizational structure of the panning group. The various actors are the site owner, the camp leader, and the panners. The hierarchy of power and authority often creates internal frictions within the panning community. Frictions are manifested in the form of territorial disputes, boundary violations, seizures of sediment, and political struggles to move up to higher levels, such as from Camp Leader to Site Owner. The second dimension is conflicts that happen because of ethnic differences (Atma Jaya, 2010).

## 3.10. Environmental Information

### 3.10.1. Impact Mapping

The studies conducted by the Bandung Institute of Technology (ITB) and Brawijaya University (UB) both mapped the impact of mercury on the environment, health, and socio-economic conditions of communities living around the ASGM locations. These seven studies all included: (1) Measuring the concentration of mercury in mining process wastes (tailings) and the natural environment; (2) Analysis of Provisional Tolerable Weekly Intake of Mercury; (3) Measuring the Health of Respondents; (4) Supporting Socio-economic studies.

Five of the sites are characterized by hard rock mining (Wonogiri Regency, Dharmasraya Regency, West Kotawaringin Regency, North Minahasa Regency, West Lombok Regency, and East Bolaang Mongondow Regency) and two are mainly alluvial mining districts (Merangin Regency and Dharmasraya Regency). The study which was originally also to be carried out in City of Palu, Central Sulawesi Province had to be cancelled due to the tsunami.

Of the seven study locations, it is only in East Bolaang Mongondow Regency that the ASGM activities carried out in a WPR with an IPR. The ASGM activities in the other six locations do not take place within a formal WPR area, nor do they have a permit. All seven locations are still carrying out gold processing activities using mercury and this is followed by the cyanidation method in 4 (four) of the locations.

Mapping was carried out through impact assessments on the environment and human health. The environmental impact assessment was carried out by collecting samples of tailings water, inhaled air, ambient air, river water, sediment, fish, soil, solid waste, plants, biota, drinking water, well water, cyanide vat water, and rice. Meanwhile, the health impact assessment was carried out by collecting urine, hair and blood samples from adults and children.

In general, highly elevated concentrations of mercury were found in the environment at almost all locations that greatly exceeded the safe standards, even in plants growing around ASGM activities in 7 (seven) locations. In rice plant samples taken from 4 (four) locations, the rice grown in 3 locations: namely Wonogiri Regency, Dharmasraya Regency, and North Minahasa Regency, was found to have mercury concentrations above any safe standard.

The study conducted by MoEF, BSCRC-SEA and the field survey team in 2021 for the development of the MIA and NAP ASGM documents also carried out an inventory, laboratory analysis of environmental samples and human biomonitoring in selected ASGM locations to provide a basic estimate for the "Report on ASGM Studies in Indonesia." The study was conducted in Lebak Regency in Banten Province, Tasikmalaya Regency in West Java Province, Mandailing Natal Regency in North Sumatra Province, Bolaang Mongondow Regency in North Sulawesi Province, West Sumbawa Regency in West Nusa Tenggara Province, and Murung Raya Regency in Central Kalimantan Province.

In Lebakgedong District, Lebak Regency, the concentration of mercury (Hg) in general in the environment in tailings, mud sediments, and the riverbed had dramatically exceeded the threshold limit value (TLV) and its levels in plantation soil, garden crops/consumption crops, and local rice. The quality of drinking water was already at the TLV. For surface water, tailings, and wastewater, it was still below the threshold, as was PTWI's estimate. However, it still needs serious attention if the current practice of using Hg continues.

In the ASGM location in the Hutabargot District, Mandailing Natal Regency, mercury (Hg) concentrations in general in the environment in river water and well water were still at normal levels, while sediment trommels and soil had greatly exceeded the threshold limit value (TLV). However, since there was a correlation between the distance of gold rock processing activity and Hg levels in well water, the location of the well should be the main consideration. Hg metal content in local food, biota, and rice crops had exceeded TLV. PTWI based on total intake for water, biota, and rice was also already above TLV, so this condition was very worrying.

In the ASGM location in the Karangjaya District, Tasikmalaya Regency, the general concentration of mercury (Hg) in the environment in river water and well water was still below the threshold limit value (TLV), while for tailings silt and soil sediments, it had greatly exceeded. Likewise, the Hg metal content in plantation soil, paddy field soil, food crops, biota, and local rice had exceeded the TLV. PTWI estimates were already worrying. This needs serious attention by the local government because if the use of Hg metal is still carried out as it is today, it can cause greater damage.

Until now, ASGM activities are still ongoing, and mercury is still traded illegally in Taliwang District, West Sumbawa Regency. The concentration of mercury (Hg) in river water did not meet the requirements for drinking water, although some could still be used for agriculture, animal husbandry, and fisheries. The quality of well water, river sediment, and biota were still below the TLV and wastewater and tailings sediment in the traditional mercury treatment process (trommel). However, samples of soil, plants, and rice already exceeded the threshold value. Although the PTWI estimate calculated based on water intake, rice and biota was still below the TLV, this needs special attention from local governments. Currently, some locations have shifted the use of mercury to cyanide (cyanidation/ watering/soaking vats). The process with this system does not mean that it is free from the threat of environmental damage but can cause other adverse impacts to the ecosystem.

In the ASGM location in the Lolayan District, Bolaang Mongondow Regency, the general concentration of mercury (Hg) in the environment in river water, well water and PDAM, and biota were still under TLV. Similarly, in tailings wastewater in the traditional mercury treatment process (trommel). However, river sediment samples, tailings sediment, soil, plants, and rice had exceeded the TLV set by the applicable rules. Although PTWI's estimates for water, rice, and biota had not exceeded TLV, local governments need to be of particular concern in anticipating toxicity. Currently, some locations have diverted mercury into cyanidation.

Until now, mercury is still used in the practice of ASGM in Murung Raya Regency. In some locations, miners are already using cyanide (cyanidation barrels, watering, or soaking). From environmental aspects, the general concentration of mercury (Hg) in the environment in the form of river water could no longer be used for drinking water, although it can still be used for other purposes (class II, III, and IV). Total Hg in tailings water and tailings sludge, river sediments, river biota, and fish was also currently still below the TLV. However, the total Hg in some plantation soils has shown that the TLV has been exceeded, as reflected in local consumption crops and rice (MoEF & BSCRC-SEA, 2021)

The summary of Hg concentration in environmental samples in the ASGM locations in the 6 (six) regencies can be seen in the tables below. Further information can be found in **Annex III.B.**

**Table 3.4 Hg Concentration in Environmental Samples in Lebak Regency**

| No. | Environmental Sample | Hg Concentration | | |
|---|---|---|---|---|
| | | Maximum Concentration | Minimum Concentration | Average Concentration |
| 1. | Tailing wastewater | 0.003 mg/L | 0.003 mg/L | 0.003 mg/L |
| 2. | Tailings sediment/mud | 4.975 mg/kg | 3.587 mg/kg | 4.281 mg/kg |
| 3. | Riverbed sediments | 5.897 mg/kg | 1.366 mg/kg | 3.215 mg/kg |
| 4. | River water | 0.003 mg/L | < 0.0005 mg/L | 0.0014 mg/L |
| 5. | Garden soil | 5.137 mg/kg | 1.908 mg/kg | 3.3148 mg/kg |
| 6. | Garden/consumption crops | 0.623 mg/kg | 0.054 mg/kg | 0.2967 mg/kg |
| 7. | Drinking/Well water | 0.001 mg/L | 0.001 mg/L | 0.001 mg/L |
| 8. | Local rice | 0.10 mg/kg | 0.10 mg/kg | 0.10 mg/kg |

Source: MoEF & BSCRC-SEA, 2021

**Table 3.5 Hg Concentration in Environmental Samples in Mandailing Natal Regency**

| No | Environmental Sample | Hg levels | | |
|---|---|---|---|---|
| | | Maximum Concentration | Minimum Concentration | Average Concentration |
| 1. | Tailing wastewater | 0.58 mg/L | < 0.0002 mg/L | 0.14565 mg/L |
| 2. | Tailings sediment/mud | 245 mg/kg | 66 mg/kg | 139.2 mg/kg |
| 3. | Riverbed sediments | 0.53 mg/kg | 0.27 mg/kg | 0.402 mg/kg |
| 4. | River water | 0.0007 mg/L | < 0.0002 mg/L | n/a |
| 5. | Garden soil | 14 mg/kg | 0.34 mg/kg | 4.5 mg/kg |
| 6. | Garden/consumption crops | 22 mg/kg | 0.17 mg/kg | 4.633 mg/kg |
| 7. | Drinking/Well water | 0.00027 mg/L | < 0.0002 mg/L | n/a |
| 8. | Local rice | 0.14 mg/kg | 0.12 mg/kg | 0.13 mg/kg |

Source: MoEF & BSCRC-SEA, 2021

**Table 3.6 Hg Concentration in Environmental Samples in Tasikmalaya Regency**

| No | Environmental Sample | Hg levels | | |
|---|---|---|---|---|
| | | Maximum Concentration | Minimum Concentration | Average Concentration |
| 1. | Tailing wastewater | 0.016 mg/L | 0.001 mg/L | 0.008 mg/L |
| 2. | Tailings sediment/mud | 6.683 mg/kg | 6.683 mg/kg | 6.683 mg/kg |
| 3. | Riverbed sediments | 6.871 mg/kg | 1.114 mg/kg | 3.011 mg/kg |
| 4. | River water | 0.001 mg/L | 0.001 mg/L | 0.001 mg/L |
| 5. | Garden soil | 6.718 mg/kg | 1.921 mg/kg | 4.3202 mg/kg |
| 6. | Garden/consumption crops | 0.572 mg/kg | 0.114 mg/kg | 0.3006 mg/kg |
| 7. | Drinking/Well water | 0.001 mg/L | 0.001 mg/L | 0.001 mg/L |
| 8. | Local rice | 0.18 mg/kg | 0.18 mg/kg | 0.18 mg/kg |

Source: MoEF & BSCRC-SEA, 2021

**Table 3.7 Hg Concentration in Environmental Samples in West Sumbawa Regency**

| No | Environmental Sample | Hg levels | | |
|---|---|---|---|---|
| | | Maximum Concentration | Minimum Concentration | Average Concentration |
| 1. | Tailing wastewater | 0.0009 mg/L | 0.0008 mg/L | 0.00083 mg/L |
| 2. | Tailings sediment/mud | 0.27 mg/kg | 0.07 mg/kg | 0.16250 mg/kg |
| 3. | Riverbed sediments | 0.24 mg/kg | 0.05 mg/kg | 0.15 mg/kg |
| 4. | River water | 0.004 mg/L | 0.001 mg/L | 0.002 mg/L |
| 5. | Garden soil | 0.41 mg/kg | 0.13 mg/kg | 0.28 mg/kg |
| 6. | Garden/consumption crops | 0.49 mg/kg | 0.01 mg/kg | 0.19 mg/kg |
| 7. | Drinking/Well water | 0.0004 mg/L | 0.0003 mg/L | 0.00037 mg/L |
| 8. | Local rice | 0.07 mg/kg | 0.05 mg/kg | 0.06 mg/kg |

Source: MoEF & BSCRC-SEA, 2021

**Table 3.8 Hg Concentration in Environmental Samples in Bolaang Mongondow Regency**

| No | Environmental Sample | Hg levels | | |
|---|---|---|---|---|
| | | Maximum Concentration | Minimum Concentration | Average Concentration |
| 1. | Tailing wastewater | 0.0012 mg/L | 0.0005 mg/L | 0.000925 mg/L |
| 2. | Tailings sediment/mud | 3.278 mg/kg | 1.652 mg/kg | 2.5215 mg/kg |
| 3. | Riverbed sediments | 3.211 mg/kg | 1.833 mg/kg | 2.59725 mg/kg |
| 4. | River water | 0.001 mg/L | < 0.0005 mg/L | 0.00086 mg/L |
| 5. | Garden soil | 2.977 mg/kg | 1.764 mg/kg | 2.3774 mg/kg |
| 6. | Garden/consumption crops | 0.324 mg/kg | 0.118 mg/kg | 0.2533 mg/kg |
| 7. | Drinking/Well water | 0.0008 mg/L | < 0.0005 mg/L | n/a mg/L |
| 8. | Local rice | 0.18 mg/kg | 0.16 mg/kg | 0.17 mg/kg |

Source: MoEF & BSCRC-SEA, 2021

**Table 3.9 Hg Concentration in Environmental Samples in Murung Raya Regency**

| No | Environmental Samples | Hg levels | | |
|---|---|---|---|---|
| | | Maximum Concentration | Minimum Concentration | Average Concentration |
| 1. | Tailing wastewater | 0.001 mg/L | < 0.001 mg/L | 0.001 mg/L |
| 2. | Tailings sediment/mud | 0.21 mg/kg | 0.03 mg/kg | 0.124 mg/kg |
| 3. | Riverbed sediments | 0.26 mg/kg | 0.03 mg/kg | 0.1275 mg/kg |
| 4. | River water | 0.002 mg/L | 0.002 mg/L | 0.002 mg/L |
| 5. | Garden soil | 0.37 mg/kg | 0.16 mg/kg | 0.25 mg/kg |
| 6. | Garden/consumption crops | 0.29 mg/kg | 0.02 mg/kg | 0.17 mg/kg |
| 7. | Drinking/Well water | < 0.001 mg/L | < 0.001 mg/L | < 0.001 mg/L |
| 8. | Local rice | 0.16 mg/kg | 0.11 mg/kg | 0.13 mg/kg |

Source: MoEF & BSCRC-SEA, 2021

### 3.10.2. Environmental Degradation

Environmental impacts of ASGM include acid mine drainage, deforestation, soil erosion, river silting, and pollution of soil and water with toxic compounds, and this is especially the case for alluvial mining of secondary gold deposits (Aspinal, 2001). Hydraulic mining operations have high water requirements; therefore, many sluice operations (dompeng) are located either in a river, on a riverbank, or adjacent to a small river. Alluvial mining has a major negative impact on rivers due to accelerated erosion, and suspended sediments which reduce light penetration and oxygen availability in aquatic ecosystems. Landscape-level impacts are also severe, with widespread deforestation resulting from ASGM, and negative impacts on soil fertility due to the loss of topsoil from formerly productive agricultural or forested land (Sulaiman, 2015).

The Ministry of Environment and Forestry (2018) has received reports from local environmental agencies with regard to sites contaminated with cyanide and mercury attributed to ASGM and cinnabar mining as shown in the table below.

**Table 3.10 Recapitulation of Inventory Data on Mercury-Contaminated Land**

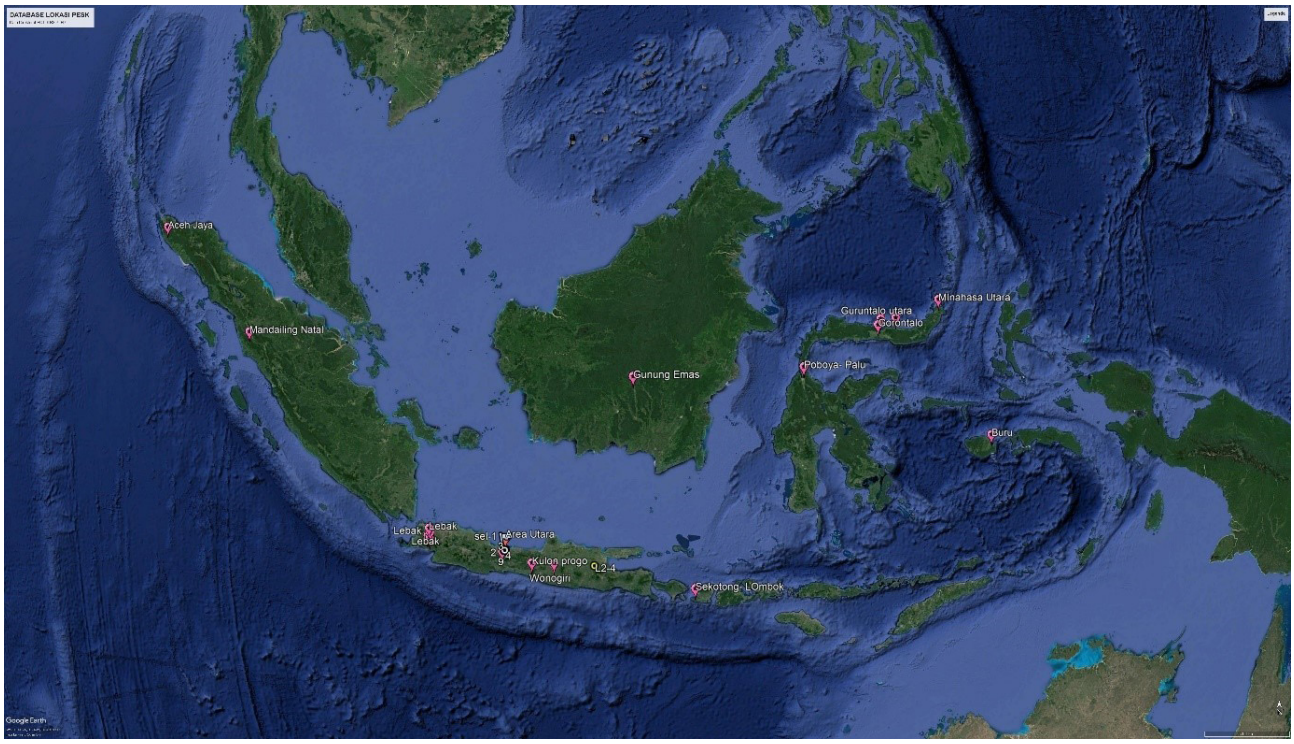
| Location | Type of Hazardous Waste | Estimated Area of Contaminated Sites | Estimated Volume of Hazardous Wastes |
|---|---|---|---|
| Lebak Regency, Banten Province | Cyanide & mercury | 6,803.71 $m^2$ | 2,564.65 $m^3$ |
| West Seram Regency, Maluku Province | Mercury (from cinnabar mining) | 200 ha | 150 tonnes |
| North Bolaang Mongondow, North Sulawesi Province | Cyanide & mercury | N/A | N/A |
| North Minahasa Regency, North Sulawesi Province | Cyanide & mercury | 7.5 ha | N/A |
| Gorontalo Province | Cyanide & mercury | 60 ha | N/A |

Source: Directorate of Contamination Remediation and Hazardous Wastes Emergency Response, MoEF, 2018

## Map and Location of Mercury-Contaminated Land

Based on the results of the identification and inventory of land contaminated with hazardous waste, the area of land contaminated with hazardous waste in Indonesia was identified in 2014-2021 as ± 5,200,000 $m^2$. Around 14.94% of this land is contaminated with B3 waste from non-institutional activities (± 777,000 $m^2$) with a waste volume of ± 271,500 tonnes (already managed ± 25,000 tonnes), including mercury-contaminated land from the ASGM sector covering an area of ± 682,000 $m^2$ with an estimated total land area contaminated with mercury as much as 26,700 tonnes. Of this amount, 2,266.9 tonnes of mercury-contaminated land were recovered in Lebak Regency in 2019. The map and location of mercury-contaminated land in Indonesia can be seen in **Figure 3.15** and **Table 3.11.**

**Figure 3.15 Map of Mercury-contaminated Land in Indonesia**




Source: Directorate of Remediation of Contamination and Emergency Response of Hazardous Wastes, MoEF, 2021

**Table 3.11 Location of Mercury-Contaminated Land in Indonesia**

| No. | Province | Regency | Waste Type | Note |
|---|---|---|---|---|
| 1 | Central Java | Banyumas Regency | B416 (tailing), mercury) | Babakan Village, Gumelar, Report of Local Enviromental Agency |
| | | Wonogiri Regency | B416 (tailing), mercury) | Keloran Village, Report of Local Enviromental Agency |
| 2 | DIY Yogyakarta | Kulon Progo Regency | B416 (tailing), mercury) | Kalirejo Village, Report of Local Enviromental Agency |
| 3 | Banten | Lebak Regency | B416 (tailing), A302-7 (mercury sulphide waste) | Lebaksitu Village Location, FS and DED 2017 |
| | | | | Cimandiri Village Location, FS dan DED 2017 |
| | | | | Cikadu Village Location, FS and DED 2017 |
| | | | | Sukasari Village Location, FS and DED 2017 |
| | | | | Pasirgombong Village Location, FS and DED 2017 |

| No. | Province | Regency | Waste Type | Note |
|---|---|---|---|---|
| | | | | Muncang Village Location, FS and DED 2017 |
| | | | | Girimukti Village Location, FS and DED 2017 |
| | | | | Ciladaeun Village Location, FS and DED 2018, has been remediated in 2,266.9 tonnes in 2019 |
| 4 | North Sumatera | Mandailing Natal Regency | A2268 (mercury), B416 (tailing) | Hutabargot Village Location, Identification and Inventory Data |
| 5 | Central Kalimantan | Gunung Mas Regency | A2268 (mercury) | Identification and Inventory Data |
| 6 | Gorontalo | Gorontalo Regency | A2268 (mercury) | Bumela Village Location, Identification and Inventory Data |
| | | North Gorontalo Regency | A2268 (mercury) | West Ilangata Village Location, Identification and Inventory Data |
| 7 | North Sulawesi | Bolaang Mongondow Regency | A2268 (mercury) | Identification and Inventory Data |
| | | | | Mopuya Village Location, Identification and Inventory Data |
| | | North Minahasa Regency | A2268 (mercury) | Tatelu Village Location, Identification and Inventory Data |
| 8 | Central Sulawesi | Palu City | B416 (tailing), mercury and cyanide | Poboya Location, Identification and Inventory Data |
| 9 | Maluku | Buru Regency | B416 (tailing), A2268 (mercury) | Mount Botak Location, Delineation Study in 2019, FS Study in 2021 |
| 10 | West Nusa Tenggara | West Lombok Regency | B416 (tailing), mercury and cyanide | Identification and Inventory Data |

Source: Directorate of Contamination Remediation and Hazardous Wastes Emergency Response, MoEF, 2021

### 3.10.3. Gaseous Emissions to the Atmosphere

#### Emissions from Amalgam Roasting

Gaseous emissions can be hugely reduced through the use of simple equipment to prevent the release of mercury during the burning process. In the field, miners can use small retorts, and in residential areas, gold shops can use fume hoods that are fitted with mercury condensers to capture the mercury gas and prevent it from being released into the air. This has been well demonstrated in Central Kalimantan, where efforts to distribute such equipment to miners began with the GEF/ UNDP/UNIDO – Global Mercury Project interventions in 2006, when local partner Yayasan Tambuhak Sinta (YTS) first introduced mercury condenser technology to gold shops in the Katingan regency. In 2009, YTS-Blacksmith Institute started to distribute hundreds of retorts to miners and gold shops in Murung Raya District, Gunung Mas District, Katingan District, Kapuas District, Pulang Pisau District and in the City of Palangka Raya. This equipment was estimated to have reduced mercury emissions by about 4,750 kg annually in Central

Kalimantan during 2009-2012 (Blacksmith Insitute & YTS, 2013). Without the use of retort and condenser technology to prevent emissions, the mercury in the amalgam will be released directly into the atmosphere. Furthermore, detailed scientific studies have shown that once it is released into the atmosphere, the mercury can be transported by the air to a radius of one kilometer from the mine (Kono et al., 2012). Thus, elevated THg concentrations can exist in the vicinity of ASGM activities, due to the dry deposition of mercury that results from continuous atmospheric fallout (Mallongi et al., 2015).

In locations in the study by MoEF and ITB and UB in 2018, amalgamation was carried out to recover gold and the results showed that mercury had polluted the air. When compared with the exposure to mercury in the ASGM area in Sekotong District, ASGM in North Sulawesi experienced the highest mercury pollution. Mercury exposure to this environment is known to pollute not only soil and plants, but also the air in public areas around gold processing sites.

Mercury concentrations in the surrounding air in Wonogiri and Dharmasraya show a measurement of up to 50,000 ng/$m^3$, which is 50 times higher than the quality standard set by WHO (1,000 ng/$m^3$).

Detection of mercury exposure with concentrations exceeding the safe threshold value in air, indicates that mercury contamination has occurred in Sekotong District, West Lombok Regency.

#### Emissions from Ball Mills

Ismawati et al. (2015) measured the concentration of mercury vapor in Pongkor, West Java, reading the air quality about 15 m from active ore processing units (trommels) and showing a maximum value of 50,380 nanogram/$m^3$, which far exceeded the safe reference level set by the WHO, which is less than 1,000 nanogram/$m^3$. Furthermore, the average mercury vapor concentration in the village as a whole was 4,150 nanogram/$m^3$.

### 3.10.4. Bioaccumulation in the Food Chain

In the Sekotong study area, some fish species from ASGM sites had mercury concentrations which were above the maximum permissible mercury concentration for edible fish tissue. The mercury concentration in Pilsbryoconcha exilis tissue was 596 ppb, and it was 721 ppb for Sephia officinalis. Furthermore, 50% of the Euthynnus affinis samples had a high level of mercury, well above the World Health Organization (WHO) maximum permissible limit for the sale of fish for human consumption of 0.5 ppb. Thus, the risks associated with mercury exposure from fish consumption can threaten community health (Junaidi, 2019).

In 2001, Kambey et al. analyzed whole fish tissues sampled from an illegal mining region in the Minahasa Peninsula of North Sulawesi which contained four times the levels of mercury recommended by the World Health Organization for consumption restrictions.

The 2007 GEF-UNIDO-UNDP Global Mercury Project reported that mercury in fish in Central Kalimantan around the ASGM site ranged from 0.09 up to 1.6 ppm. Several studies conducted in Jambi (1997), West Kalimantan (2000), North Sulawesi (2002), West Java (2003) and Palu, Central Sulawesi (2008, 2010) have also found high mercury concentrations in the river, soil, and fish, which can affect community and miners' health. A study conducted by BaliFokus also found mercury in both rice and fish, risking the downstream population's health as well as that of the community that lives in the area. Mercury in water and sediment in several ASGM sites ranged from 0.6 ppm up to 4 ppm which is 600 to 3,000 times higher than the WHO standard of 0.001 ppm (BaliFokus, 2015a).

In 2012, MoE conducted monitoring of mercury concentration in fish tissue sample from Kahayan River, Gunung Mas Regency and the result was 1.1 mg/kg, above the limit standard according to "Provisional Standard for Mercury in Fish" (Notification for Ministry of Health and Welfare, Japan in July of 1973 as cited in MoE, 2012), which was 0.4 ppm/kg (MoE, 2012).

Ismawati et al. (2015) measured the THg of rice concentrations from ASGM area in Pongkor, West Java with a portable Hg vapor analyzer and found that the average THg in rice was 143 ppb with a minimum value of 101 and a maximum value of 200 ppb, while the Indonesian's tolerable limit as set by the Decree of the Directorate General of Food and Drugs Surveillance of Indonesia (No. 03725/B/SK/VII/89 dan SNI 01-2729.1-2006) is 50 ppb.

Krisnayanti et al. (2012b) also analyzed samples of paddy-rice grains collected adjacent to the cyanidation tailings ponds, showing methylmercury concentrations greater than 100 ng/g. This is five times above the Chinese permissible level for total mercury in food crops. (Li et al., 2011 cited in Krisnayanti, 2018).

Fish samples taken from around the ASGM locations in Wonogiri as well as plant samples from around ASGM locations in Wonogiri, Merangin, Dharmasraya, West Waringin City, North Minahasa, West Lombok, East Bolaang Mongondow were found to have mercury content that exceeds safe limits (MoEF & ITB, 2018; MoEF & UB, 2018).

### West Nusa Tenggara (NTB)

Krisnayanti and Anderson (2014) proved that ASGM activity in Sekotong, Lombok and Taliwang, Sumbawa has affected environmental and human health. In Lombok and Sumbawa, Krisnayanti et al. (2012b) found that ASGM occurs alongside farming, and the agriculture sector is dominated by rice production. At many locations, rice paddies can be seen directly adjacent to amalgamation or cyanidation operations and cyanidation waste is discharged directly into rice paddies which have been informally re-designated as tailings ponds. These ponds were not designated for proper leachate containment, and therefore soluble complexed mercury, including mercury cyanide, is free to set in the environment. The tailings sampled all exceeded the maximum permissible concentration for mercury in soil set by the Indonesian Government (20 mg/kg).

### North Gorontalo

In 2015, Arifin et al. determined mercury concentrations in the environment (river sediments and fish) and in the hair of artisanal gold miners and inhabitants of the North Gorontalo Regency in order to understand the status of contamination, sources and their impacts on human health. They found that mercury concentrations in the sediments along the Wubudu and Anggrek rivers are already above the tolerable level declared safe by the World Health Organization (WHO). They also found that mercury levels in commonly consumed fish, which were caught in the Sumalata and Anggrek rivers and estuaries, had mercury levels above the maximum tolerable limits of the WHO (Arifin et al., 2015).

The contamination status of groups of inhabitants who are living around the ASGM sites in North Gorontalo (Anggrek and Sumalata) and outside the sites (Monano, Kwandang and Tolinggula) is very high, according to HBM levels. (Arifin et al., 2015).

The mercury concentrations of the Wubudu river sediments of Sumalata are above the threshold limits set by WHO, and the distribution is strongly related to the location of ASGM processing sites along the Wubudu riverbanks. The mercury concentrations of the Anggrek river sediments are already above the threshold limit set by WHO. The mercury levels in commonly consumed fish, which were caught in the Sumalata and Anggrek rivers and estuaries, are also reported. The most commonly consumed fish species (*Lutjanus synagris* and *Ocyurus chrysurus*) in the regency have mercury levels above the maximum tolerable limits of the WHO.

These results suggested that Hg containing wastewater discharged into the Buladu River and the atmospheric fallout from Hg emission were the major sources of Hg in the areas of interest. Consequently, Hg, resulting from Hg released from the gold mine that has been operated for 30 years more, has gradually accumulated in the aquatic ecosystems of the Buladu River and the Sulawesi Sea (Mallongi et al, 2015).

The village of Buladu is one of the major ASGM gold mining districts in Gorontalo Province, and is surrounded by the Celebes Sea in the North, Deme I Village in the East, the Boalemo District in the South, and Wubudu Village in the West. In his study of the Buladu gold mining district, Mallongi found highly elevated THg concentrations in water, sediment, shellfish and fish in the aquatic habitats near and adjacent to the processing area. He concludes that the accumulation of THg in the aquatic habitat is the primary environmental and human health concern due to its potential impact to the environment and the human population surrounding the gold mine.

In the study area, local people consume shellfish and fish as the main source of protein daily and the average daily intake for the adult in the region is 350 g shellfish per week and tuna fish 700 g per week. Mallongi has found that, in comparison with other foods, tuna in the Sulawesi Sea have accumulated a high elevated concentration of THg as all values for tuna in his sample study exceeded the PTWI guideline.

The PTWI recommended by JECFA up to the 89th JECFA (June 2020) for mercury is 4 µg/kg bw and for methyl mercury it is 1.6 µg/kg bw (WHO, 2020).

Furthermore, almost all of the fish samples from the stations in the Sulawesi Sea exceeded the Indonesian National Standard guidelines for human consumption (0.5 mg/kg) and the WHO recommended limit for vulnerable groups (0.2 mg/kg). The bigger the fish size, the higher the Hg concentration in tuna fish.

This indicates that those people who consume such fish in the area of concern might be exposed to health risks. Furthermore, all of the aquatic contaminated food sources that are consumed by local people are also traded to other provinces.

Mining activities generate waste containing heavy metals such as mercury (Hg) to contaminate the environment, and ultimately affect the biota (living organisms). Increasingly heavy metal pollution causes public unrest because of the issues that have occurred in Buyat Bolaang Regency of North Sulawesi Province, Indonesia. On the report of research carried out by the environmental agency of North Gorontalo regency that traditionally gold miners are indicated mercury poisoning.

Although concentrations of mercury may be very low, the methyl mercury accumulation processes in living things will continue and enter into the food webs harmful to human health.

### ASGM locations from the Study by MoEF, BSCRC-SEA and Field Survey Team (2021)

The summary of Hg concentration in fish and biota samples in the ASGM locations in the 6 (six) regencies can be seen in the table below. Further information can be found in **Annex III.B.**

**Table 3.12 Hg concentration in Fish and Biota in ASGM Locations in 6 (Six) Regencies**

| No | Location (Regency) | Hg in fish and biota | | |
|---|---|---|---|---|
| | | Maximum Concentration (mg/kg) | Minimum Concentration (mg/kg) | Average Concentration (mg/kg) |
| 1. | Lebak | 0.383 | 0.015 | 0.175 |
| 2. | Mandailing Natal | 6.20 | 0.22 | 1.43 |
| 3. | Tasikmalaya | 0.542 | 0.025 | 0.193 |
| 4. | West Sumbawa | 0.44 | 0.04 | 0.21 |
| 5. | Bolaang Mongondow | 0.332 | 0.025 | 0.124 |
| 6. | Murung Raya | 0.28 | 0.11 | 0.18 |

Source: MoEF & BSCRC-SEA, 2021

Note: BPOM Regulation No. 5/2018: Hg in fish 0.50 mg/kg

## 3.11. Health Information

### 3.11.1. Exposure Through Air

#### The Municipality of Palu

In Sulawesi, Nakazawa et al. assessed the human health risk due to Hg (0) exposure among the general population of the city of Palu, the capital of Central Sulawesi. The area around the city has more than 60 t of gold reserves, and the nearby Poboya area is the most active gold-mining site in Indonesia. The results show that 93% of the sample population overall is at risk of mercury toxicity that could lead to damage to the central nervous system in the city's population, due to chronic exposure (Nakazawa et al., 2016).

#### Bombana Regency

In the Bombana Regency, the mining sites are spread out in more than 10 sites, are mostly of the alluvial type, and have had conflicts or overlap within the concession areas of several medium-sized gold mining companies. The total population of the ASGM sites in Bombana is about 50,000 people spread out in several districts. A team from Medicuss measured the mercury concentration in the ambient air around the houses of the people suspected to be ill, by using a portable mercury vapor analyzer RA-915+. The results varied from place to place. The lowest mercury reading was 28 nanograms/$m^3$ in one of the houses of a child suspected to be afflicted with mercury poisoning and 41,000 nanograms/$m^3$ in a gold shop. The safe level and reference guidance of WHO and the US Department Health and Human Services are below 1,000 nanograms/$m^3$. Guidance for mercury concentration is that between 1,000 to 10,000 nanogram/$m^3$ – people should prepare for evacuation, while with concentrations of mercury vapor > 10,000 nanogram/$m^3$, people should be evacuated (Medicuss Foundation and BaliFokus Foundation, 2015).

### 3.11.2. Exposure Through Water

In mining areas in Indonesia, cheap mercury has led to severe exposures, reportedly causing birth defects and other detrimental health effects, with mercury in water and sediment at ASGM sites stated to be 600 to 3,000 times the WHO standard (Ismawati, 2016 cited in Spiegel, 2017).

A study by Lestarisa (2010) showed that the release of mercury to river water affected the health of miners and the community who used the river as a source of drinking water. The percentage of miners who participated in the study who suffered from mercury poisoning was found to be 80.5%. Symptoms included malaise, headache, shivering/chills, and stiff joints (Lestarisa, 2010).

### 3.11.3. Exposure Through Food

Cisitu is a small-scale gold mining village in Java. Mercury (Hg) is used to extract gold from ore: heavily polluting air, soil, fish and wet rice fields. Rice in Cisitu is burdened with mercury. The main staple food of the inhabitants of Cisitu is this polluted rice. Medical examinations were performed of 18 people with typical signs and symptoms of chronic mercury intoxication (excessive salivation, sleep disturbances, tremor, ataxia, pathological coordination tests, proteinuria). Mercury levels in urine were increased in eight patients (>7 µg Hg/L urine) and all 18 patients had increased levels in their hair (>1 µg Hg/g hair). 15 out of the 18 patients exhibited multiple symptoms of mercury intoxication and had highly elevated levels of mercury in their specimens. These patients were classified as intoxicated. In Cisitu, rice fields are irrigated with mercury-contaminated water and villagers consume only local food, especially mercury-contaminated rice. Villagers were concerned that the severe diseases they observed in the community might be related to their mining activities, including high mercury exposure. Severe neurological symptoms and increased levels of mercury in urine and hair support were found to be caused by exposure to inorganic mercury in air, and the consumption of mercury-contaminated fish and rice (Bose O'Reilly et al., 2016).

### 3.11.4. General Health Status of ASGM Communities

#### Community Exposure

Mercury use in ASGM and the high levels of environmental pollution were also found to have had a serious impact on public health. In Wonogiri Regency, 60% of the total respondents were categorized as having moderate poisoning and around 14% -29% were in the severe poisoning category. Severe poisoning was also found in Merangin District (8%),

Dharmasraya District (2.21%-9.29%) and West Kotawaringin District (2.6%). Meanwhile, moderate poisoning was also recorded in Merangin District (14%-38%), Dharmasraya District (10.56% -13.42%), and West Kotawaringin Regency (25.71%) (MoEF & ITB, 2018).

Mercury levels in the hair of 50 ASGM residents and miners from Tanoyan, Tobongon, and Kotamobagu city have been reported. The mean mercury level is about 5 ppm. The highest rates were found in female miners and teenagers in Tanoyan. Based on the neurological assessment on several inhabitants and gold miners, nine symptoms were dominantly observed among miners than inhabitants from 12 neurological symptoms, including bluish gum color, stiffness and ataxia, irregular eye movements, field of vision, and tremors. Babinski reflex, labial reflex and salivation and dysarthria, were less frequently observed (Arifin et al., 2020).

### Medical Studies in ASGM Community

The following results were reported by the Indonesian NGO's Medicuss and BaliFokus following a health survey conducted at ASGM sites:

- Medicuss found suspected mercury-intoxicated victims in all three ASGM locations studied: namely, Bombana, Sekotong, and Cisitu. Severe physical problems were noted in 28 children, including seizures, heavy salivation, congenital cataract, skin eruption, vision disorder, congenital deformities, deafness, impaired renal function, upper motor neuron disorder, hydrocephalus, delayed development, synostosis, muscle weakness, permanent shortening of muscles or joints, finger deformities, vitiligo, partial paralysis, ear malformation, epilepsy, cerebral palsy, and skin rashes. A few of these children lived in a neighborhood where the ambient air mercury level reached up to 21,985 ng/m$^3$ around their houses (Medicuss, 2015).

- Some mothers admitted that during their pregnancy, they stayed at home and helped their husbands taking care of the rod-mill operation. Almost every house in the Pangkal Jaya Village, Bogor Regency, has at least one sick family member (child or adult) with health problems (Ismawati et al., 2015).

- Out of 270 people studied (who all came from ASGM villages in Sekotong in West Lombok Regency for a free health check provided by BaliFokus) the results showed that 11% had symptoms of mercury intoxication (BaliFokus, 2015b).

- Medicuss found that 37 out of 140 residents (26.4%) coming from the villages of Situmulya and Kujangsari in Cisitu in Lebak Regency (who sought treatment during activities carried out by Medicuss in collaboration with BaliFokus) were affected by mercury intoxication. In addition, they found that the impact of mercury intoxication generally arose only several years after exposure, when most workers had already gone back to their hometown (Medicuss Group & BaliFokus Foundation, 2014).

### Elevated Levels in Hair, Urine and Blood Samples

In their study of mercury intoxication of ASGM communities in Sekotong, Ekawanti and Krisnayanti (2015) concluded that after five years of constant exposure, both miners and non-miners showed proteinuria and low hemoglobin and hematocrit concentrations due to chronic mercury intoxication as indicated by high urinary and hair mercury levels in which 61% of the miner's urine and 81% of the miner's hair content Hg were at 'alert' and 'high' levels. All participants (100 people) in the study were directly exposed to mercury, either as workers (miners) or as family members (non-miners) living in the contaminated atmosphere, including children that had direct contact with mercury from mercury panning after school and/or standing in close proximity to burning processes. Most of the women were of reproductive age, which means that their pregnancies were also at risk, as mercury affects intra-uterine growth development, especially brain development (Krisnayanti, 2018).

Bose-O'Reilly et al. (2016) found miners in Cisitu, West Java to be intoxicated, showing both the typical mercury-related symptoms such as ataxia, tremor and coordination problems, as well as having elevated levels of mercury in the urine and hair samples. Results from hair analyses showed the examined miners exceeded the alert level of 1 mg/g, and five of them had Hg concentrations above the action level of 5 mg/g with a maximum of 25 mg/g.

The health test results showed that there had been mercury exposure in hair and nail samples of the majority of miners at ASGM locations in North Minahasa District, North Sulawesi Province; East Bolaang Mongondow Regency, North Sulawesi Province and West Lombok Regency, West Nusa Tenggara Province. Exposure to hair and nails indicates long-term exposure, while from blood and urine samples it is known that several miners have been exposed. The human biomonitoring (HBM) test in Sekotong District showed that around 44% of respondents had moderate to high levels of mercury poisoning. In the ASGM location, North Sulawesi Province showed levels of mercury exposure, where the majority was low intensity (MoEF & UB, 2018).

### ASGM locations from the Study of MoEF, BSCRC-SEA and Field Survey Team (2021)

In Lebakgedong District, Lebak Regency, the Hg levels in the nails, hair and urine of respondents were generally still below threshold value. In the ASGM location in the Hutabargot District, Mandailing Natal Regency and Karangjaya District, Tasikmalaya Regency, the Hg levels in the nails, hair, and urine of respondents were generally close to the threshold and some even exceeded it. In Taliwang District, West Sumbawa Regency and Lolayan District, Bolaang Mongondow Regency, the Hg levels in the nails, hair, and urine of the respondents were generally still below the threshold but there was one in Taliwang District and some in Lolayan District that exceeded it.

HBM score analysis was already at the moderate level in Lebakgedong District, moderate to high level in Karangjaya District, high level in Hutabargot District, alert level in Taliwang District and chronic level in Lolayan District.

In Murung Raya Regency, the Hg levels in the respondents' nails and hair were still below the TLV, but several individuals had shown very high Hg levels in the urine, which reflected a disorder in their kidneys. Although PTWI estimates for water, rice, and biota had not exceeded the TLV, this needs special attention from local government. Moreover, the HBM medical score was in the medium category, and some individuals fell in the high category.

Considering that mercury can accumulate and that some respondents have high mercury concentration in their nail, hair and urine, in addition to some samples of plants, rice and biota that have exceeded the TLV, particular concern is needed for the health of the community with the high mercury concentration. (MoEF & BSCRC-SEA, 2021).

The summary of Hg concentration in nail, hair and urine samples from respondents in the ASGM locations in the 6 (six) regencies can be seen in the tables below. Further information can be found in **Annex III.B.**

**Table 3.13 Hg concentration in Nail in ASGM Locations in 6 (Six) Regencies**

| No | Location (Regency) | Hg in Nail Tissue | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Maximum | | | | Minimum | | | | Average Concentration (mg/kg) |
| | | Conc. (mg/kg) | Gender | Age | Profession | Conc. (mg/kg) | Gender | Age (year) | Profession | |
| 1. | Lebak | 0.782 | M | 76 | Miner | 0.054 | F | 32 | Farmer | 0.238 |
| 2. | Mandailing Natal | 2.700 | - F<br>- F | - 60<br>- 25 | Rock breaker | 0.340 | F | 25 | None | 1.445 |
| 3. | Tasikmalaya | 0.451 | M | 19 | Not a miner | 0.022 | M | 9 | Not a miner | 0.248 |
| 4. | West Sumbawa | 0.34 | M | 32 | Miner | 0.04 | -M<br>-M | - 35<br>- 52 | - Miner<br>- Miner | 0.16 |
| 5. | Bolaang Mongondow | 0.101 | F | 71 | Not a miner | 0.011 | -M<br>-M | - 16<br>- 17 | - Not a miner<br>- Miner | 0.043 |
| 6. | Murung Raya | 0.16 | F | 48 | Not a miner | 0.01 | F, M | 4-62 | Child, Miner, not a miner | 0.03 |

Note: Quality Standards WHO & UNEP 2008 Hg in nails 1.6 µg/g (= 1.6 mg/kg)

**Table 3.14 Hg concentration in Hair in ASGM Locations in 6 (Six) Regencies**

| No | Location (Regency) | Hg in Hair Samples | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Maximum | | | | Minimum | | | | Average Concentration (mg/kg) |
| | | Conc. (mg/kg) | Gender | Age (year) | Profession | Conc. (mg/kg) | Gender | Age (Year) | Profession | |
| 1. | Lebak | 1.122 | M | 76 | Miner | 0.154 | M | 23 | Village staff | 0.424 |
| 2. | Mandailing Natal | 2.015 | F | 45 | Miner | < 0.500 | F, M | 12-60 | None, Rock breaker, Miner | - |
| 3. | Tasikmalaya | 0.623 | M | 62 | Miner | 0.061 | M | 9 | Not a miner | 0.425 |
| 4. | West Sumbawa | 0.29 | F | 28 | Farmer | 0.05 | M | 30 | Miner | 0.19 |
| 5. | Bolaang Mongondow | 0.897 | F | 71 | Not a miner | 0.115 | M | 16 | Not a miner | 0.359 |
| 6. | Murung Raya | 0.42 | F | 48 | Not a miner | 0.01 | - F<br>- F | - 27<br>- 4 | Miner<br>Child | 0.07 |

Note: Quality Standards WHO & UNEP 2008 Hg in hairs 2 µg/g (= 2 mg/kg)

**Table 3.15 Hg concentration in Urine in ASGM Locations in 6 (Six) Regencies**

| No | Location (Regency) | Hg in Urine | | | | | | | | Average Concentration (µg/g creatinine) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Maximum | | | | Minimum | | | | |
| | | Concentration (µg/g creatinine) | Gender | Age (Year) | Profession | Concentration (µg/g creatinine) | Gender | Age (Year) | Profession | |
| 1. | Lebak | 6.41 | M | 32 | Miner | 0.13 | - M<br>- M | 6<br>10 | - Child<br>- Child | 1.41 |
| 2. | Mandailing Natal | 7.23 | F | 49 | Rock breaker | 0.04 | F | 4 | Student/ child | 2.41 |
| 3. | Tasikmalaya | 3.53 | F | 12 | Child | 0.01 | M | 12 | Child | 0.56 |
| 4. | West Sumbawa | 6.67 | M | 32 | Miner | 0.08 | M | 44 | Miner | 1.08 |
| 5. | Bolaang Mongondow | 6.94 | M | 48 | Miner | 2.37 | M | 40 | Miner | 4.90 |
| 6. | Murung Raya | - 100.0<br>- 60.0 | - F<br>- M | - 26<br>- 9 | - Miner<br>- Child | 1.1 | M | 5 | Child | 8.85 |

Note: Quality Standards WHO & UNEP 2008: 5 µg Hg /g creatinine

Interviews with residents of Lebakgedong District who are active in using the amalgamation method, revealed that some residents had respiratory problems, especially those who burned gold amalgam. The slow growth of nails and hair is experienced by active workers.

In Hutabargot District, Mandailing Natal Regency, interviews revealed that some of the common direct impacts felt by the community were an increase in skin diseases (itching) after using river water that had been affected by gold processing waste. This has led to an agreement in the community that prohibits gold processing (trommels) from being carried out in the mountains near the mining pit which is near the river upstream. Another impact that is felt by men who are exposed to direct contact with mercury is the slowing of finger nail growth. From another story, a case was reported of the birth of a deformed baby (born without legs) in Hutabargot Village.

**Figure 3.16. Health Examination and Collection of Urine, Nails, Hair Samples, and HBM Data of Respondents**





Source: MoEF & BSCRC-SEA, 2021

Healthcare facilities are relatively lacking in Karangjaya District, Tasikmalaya Regency. There is only 1 public health center for 12,520 residents. There is only one hospital in West Sumbawa Regency, located in Taliwang District. Although the number of polyclinics and public health center is inadequate, the numbers of auxiliary public health centers and pharmacies are adequate.

Healthcare facilities in the form of public health centers are adequate in Lolayan District, Bolaang Mongondow Regency, although there are no hospitals, maternity hospitals and pharmacies. In particular, there are no maternity hospitals and polyclinics in all of Murung Raya Regency, but only one hospital, which is in Murung District. Regarding the availability of other health facilities, the population of Murung District on average received fewer facilities, on the contrary with Tanah Siang District (MoEF & BSCRC-SEA, 2021).

## 3.11.5. Studies of ASGM Communities, Issues and Approaches by Ministry of Health

### Studies of ASGM Communities by Ministry of Health

Through the Health Research and Development Agency and the Center for Environmental Health Engineering, the Ministry of Health has conducted a series of studies on levels of mercury in the environment in several regions of Indonesia and has found especially high levels of environmental mercury pollution around ASGM sites (Inswiasri, 2001). In addition, several studies on public health problems related to mercury exposure have been performed with ASGM communities:

- In Bogor Regency, West Java, there was an increase in mercury metal levels in the hair samples of ASGM workers, exceeding the normal mercury levels set by WHO (Sumantri et al., 2004).

- In Gunung Mas Regency, Central Kalimantan, samples taken from ASGM workers (as well as mercury levels in air, water and environmental biomarkers) all exceeded the WHO standards for settlements (1.0-2.0 mg/m$^3$) and workplaces (0.05 mg/m$^3$) (Inswiasri, 2001).

- In Central Sulawesi Province, mercury levels in children's hair were above the threshold value and there was a correlation between mercury levels in hair samples and low learning achievement in the junior high school (Sarna et al., 2014).

- In Wonogiri Regency, Central Java, average levels of mercury in blood samples were above the toxic threshold set by USEPA for ASGM workers (Aryani et al., 2013).

#### ASGM Issues and Approaches

Regarding the Minister of Health's Regulation No. 57 of 2016 concerning the National Action Plan for Controlling Health Impacts from Mercury Exposure in 2016-2020, and based on the Ministry of Environment's national data collection in 2014, it has been noted that the greatest quantity of mercury emissions results from the ASGM sector, in accordance with global data (US EPA/Environmental Protection Agency, 2015) which shows that ASGM activities contribute greatly to mercury pollution. Thus, the Ministry of Health recognizes that public health impacts from mercury are inseparable from environmental pollution.

With regard to ASGM, the Ministry of Health has highlighted the following concerns:

- the lack of law enforcement regarding the illegal trade of mercury and its use;
- the lack of concern among some stakeholders due to a general lack of understanding and knowledge about the dangers of mercury;
- the existence of various different regional policies on ASGM due to the regional autonomy system;
- the lack of adequate health facilities and the lack of competency among health workers regarding early detection and treatment of health problems due to mercury.

## 3.12. Towards Decision Making Processes

### 3.12.1. Short- and Medium-Term Strategies

#### Technical Interventions to Prevent Mercury Pollution

Provide equipment to miners and gold shops to reduce mercury emissions and minimize the extremely dangerous levels of mercury emissions that are taking place in nearly all provinces, in order to reduce the damaging and deadly impacts on public health and environmental health that are taking place. Different pathways require different strategies to reduce/prevent emissions, and different kinds of controls. Emissions to air from burning amalgam take place primarily in populated areas and are difficult to prevent as can easily be hidden from view. Moving gold trading and amalgam burning businesses to non-residential areas can limit impacts, especially if retorts or condenser technology is made freely available. Immediate technical interventions are the number one priority action.

#### Training Miner Communities in Better Practices

Indonesia has a well-regulated large-scale gold-mining sector, but also an extensive artisanal gold-mining sector which operates in a vacuum of health and environmental safety protocols. A more sustainable ASGM is threatened by poor mining infrastructure, inefficient processing technology, and an absence of waste management. Various attempts to control ASGM have been attempted, but international experience has shown that education, rather than the use of force or formalization campaigns, is the most effective route (Haris et al., 2014).

The main environmental issue identified by Dr. Telmer and Freeport Indonesia is the potential use of mercury to obtain gold in illegal ASGM. Freeport Indonesia has implemented a number of proposals to educate illegal ASGM participants and local officials about the risks of using mercury. Freeport Indonesia is also coordinating with the government authority in developing plans to improve safety and health related to illegal ASGM activities as well as collaborating with local governments to increase education and awareness of the dangers of mercury use for urban residents and individual miners or gold shop owners (PT Freeport Indonesia, 2011).

PT Aneka Tambang Tbk Pongkor Gold Mining Business Unit has a CSR program for the ex-illegal ASGM community. In addition to the assistance of community and environmental development, the ex-illegal ASGM community receives assistance for alternative economic development such as assistance in establishing or developing business in the service sector, agriculture, fisheries, as well as industry sectors (Bogor Agricultural University, n.d).

### 3.12.2. Long Term Strategies

#### Formalization of the ASGM Sector

Formal, large-scale gold mining does not create significant employment in host countries. In contrast, millions of livelihoods all over the world depend on artisanal and small-scale gold mining (ASGM), which constitutes a significant source of income for workers in developing countries' rural economies. Informality is a widespread and long-standing issue in the ASGM sector, but a shift in government attitudes, from using a prohibitive to a facilitative approach, may allow formalization of the ASGM sector to be achieved on a larger-scale in future.

However, the ILO recommends that instead of criminalizing informal ASGM, all governments should work in partnership with civil society to facilitate transitions to formality through capacity-building initiatives and the promotion of small-scale gold mining cooperatives. Formalization of ASGM is an important entry point for ASGM to get assistance from government and/or the private sector, including opportunities to get coaching from the government and/or capital assistance from formal financial institutions.

#### Overcoming Barriers to Formalization

However, in Indonesia, formalization of the ASGM Sector remains a long-term challenge. There are serious systemic issues to address in governance that need to be overcome before this can have any real possibility of accommodating ASGM in the legal framework:

- Scale challenges and local control issues (there does need to be a pilot to show the way and having appropriate technology that meets miner's needs is a critical issue).

- The capacity of local governments, including formalization procedures, roles and responsibilities of each agency, coordination between agencies, and limited financial support for providing assistance to the formalization of ASGM.

- Considering the long processing time and the high cost of formalization, data on gold reserves available at the WPR location or those that will be proposed as WPR are important. In addition, it is also necessary to hear the voices of the local community and mining communities regarding what their problems and needs are, and to take into account other interpretations of the meaning of ASGM and formalization in order to realize the sustainability of ASGM activities, including opportunities for land rehabilitation and assistance for alternative livelihood conversion.

### 3.12.3. Implementing Actions and Interventions in the ASGM Sector

#### National Action Plan

Article 7.3 of the Minamata Convention on Mercury stipulates that any Party to the Convention that determines that artisanal and small-scale gold mining and processing in its territory is more than insignificant must develop and implement a national action plan in accordance with Annex C to the Minamata Convention.

Institutional strengthening, research, monitoring, and technology, are four key work items that need to be addressed within the National Implementation Plan:

1. Legal framework and institutional strengthening – developing programmes that will inform policies for the gradual ban of mercury trade and use. To support the development of mercury trade policy, there is a need to strengthen the technical capacity of institutions and ministries to phase out mercury use. Capacity building within institutions is occurring through these programmes. However, solutions to ASGM issues cannot come about solely through regulation and enforcement.

2. Research and development – to assess the risk of mercury emissions to public health and the environment. Work towards this component incorporates monitoring, modelling, and inventory of mercury use, and the assessment and implementation of alternative technology for gold processing. This component requires: (1) development of a database and (2) database management. The database will inform strategies to phase out mercury use. Research, development, assessment and implementation of mercury-free technology for gold processing are key work items here. There is also a need for research into contaminated tailings management.

3. Awareness and communication – effective communication to ASGM communities will not only help phase out mercury use, but should aim to create long-term positive effects by exploring opportunities for community job training and alternative and more sustainable livelihoods to gold mining.

4. Facilitate the transformation of ASGM into a more responsible small-scale mining - this must be done through increasing the technical capacity and capability of community miners to adopt new technology and requires both awareness raising and training on how to safely handle the chemicals used in gold processing, and on mercury-free technology. It must be recognized that miners are responding to international demand for mineral commodities by using technology and techniques that are available to them. The impacts of ASGM are due to unsafe and unregulated mining systems and a lack of technical knowledge.

# CHAPTER IV. NATIONAL OBJECTIVE AND TARGET OF MERCURY REDUCTION AND ELIMINATION

Presidential Regulation Number 21 of 2019 concerning RAN-PPM contains strategies, activities and targets for reducing and eliminating mercury. Mercury reduction is defined as an effort to gradually restrict mercury distribution activities and mercury use, and to control mercury emissions and releases. The elimination of mercury is defined as an effort to prohibit mercury production, mercury use, and/or replace mercury with alternative substances that are friendly to human health and the environment.

The RAN-PPM places a higher priority on targets for the manufacturing, energy, ASGM and health sectors. Mercury reduction targets have been set for the manufacturing and energy priority sectors, and mercury reduction and elimination targets have also been set for the ASGM sector and the health sector as high priority sectors. The elimination target for the ASGM sector is 100 (one hundred) percent of the amount of mercury emitted and released prior to implementation of the RAN-PPM policy by the year 2025.

The RAN-PPM is being implemented over a period of many years from 2018 to 2030. The geographic targets for mercury elimination in the ASGM sector are now based on specified jurisdictions. These location-specific targets, as referred to in Presidential Regulation Number 21 of 2019 are the jurisdictional areas of 180 specific regencies/cities. Based on baseline data on ASGM locations spread across Indonesia in 2018, there were 180-220 ASGM locations, to be precise 180 cities/regencies spread across 30 provinces with details as listed in Attachment II to Minister of Environment and Forestry Regulation Number 81 of 2019. The baseline data for the year 2018 is the basis for calculating the success of the RAN-PPM.

The targets for the elimination of mercury in the ASGM priority sector are set in Annex II to Presidential Regulation Number 21 of 2019 as in the table below.

**Table 4.1 Target for Achievement of Mercury Elimination**

| Achievement | Year | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
| ASGM priority sector (Elimination of mercury use and illegal mining) | | | | | | | | |
| Baseline (number of regencies/cities having ASGM in their territory) | 180-220 | | | | | | | |
| Reduction percentage (%) | | | | | | | | 100 |

Source: RAN-PPM, 2019

Implementation of the RAN-PPM for the year 2019 and 2020 has been carried out by each relevant national institution to achieve each target with their own internal budget. More information on the status of the RAN-PPM implementation for the year 2019 and 2020 can be seen in **Annex IV**.

# CHAPTER V. IMPLEMENTATION STRATEGY

## 5.1. Strategy and Activities

To implement the target of 100% mercury elimination in the ASGM sector by 2025, various strategies have been established as stated in the RAN-PPM. The strategies and description of activities in the RAP-PPM fulfill those required in Annex C to the Minamata Convention.

The Minamata Initial Assessment document also contains several recommendations for proposed activities related to ASGM. In addition, based on literature reviews and field visits under the NAP project, several further recommendations have been proposed to assist in the implementation of the RAN-PPM to meet the achievement of the mercury elimination target in the ASGM sector. The recommendations considered to be high priority are: revising the Minister of Environment Regulation Number 23 of 2008; simplification in granting IPR and WPR with the availability of clear data and not overlapping with licensed gold mining data; and drafting a regulation that clearly prohibits cinnabar mining in Indonesia.

### a. Actions to eliminate worst practices

There are four worst practices listed under Annex C of the Minamata Convention section 1(b) and these are: whole ore amalgamation, open burning of amalgam, burning of amalgam in residential areas and cyanidation of mercury-contaminated tailings. All four of these worst practices are still commonplace ASGM practices in Indonesia.

The Minister of Energy and Mineral Resources Decree No. 1827K/30/MEM/2018 concerning Implementation Guideline of Best Mining Practices Annex V Implementation Guideline of Environmental Management in Mineral and Coal clearly states that mercury is prohibited to be used in gold processing and refining.

The strategies and activities to eliminate the above-mentioned worst practices under RAN-PPM are as follows:

- Strengthening commitment, coordination and cooperation between relevant ministries/non-ministerial government agencies:
  - Conducting monitoring and evaluation on the implementation of the MoEMR Regulation concerning the Prohibition of Gold Processing Using Amalgamation.

- Strengthening community involvement through communication, information and education:
  - Including the dangers of using mercury in gold processing within the content of the national formal education curriculum;
  - Development of a community approach to increase knowledge and awareness about the health hazards of mercury;
  - Development of participatory approaches towards communities in ASGM locations that aim to increase knowledge about the health impacts of mercury exposure and sustainable behavior change in the community;
  - Increasing the understanding of good mining practices for business actors regarding the Small-Scale Mining Permit (IPR).

- Application of alternative technology for mercury-free gold processing:
  - Development of further research and studies on alternative technology for mercury-free gold processing;
  - Development of a Feasibility Study (FS) and Detailed Engineering Design (DED) for gold processing without mercury;
  - Construction of non-mercury gold processing facilities.

- Transfer of local community livelihoods:
  - Development of a social and economic study on the impact of mercury use on ASGM activities;
  - Social and economic transformation of illegal miners using mercury;
  - Fostering business opportunities;
  - Facilitating the issuance of permits for cooperatives and SMEs.

- Strengthening law enforcement:
  - Control of illegal ASGM activities that continue to use mercury.

**Recommendations**

- There needs to be a different approach for provinces with predominantly alluvial mining as opposed to hard rock mining. In this case, the focus needs to be on gold shops and amalgam burning. It is very difficult to monitor amalgamation sites, but the presence of amalgam can be traced in gold shops. Regarding environmental damage, it is necessary to have other regulations governing it. Therefore, the cases of provinces with dominant whole ore amalgamation are different from those that are predominantly alluvial.

- It is proposed that mining communities should be involved in mercury-free transition projects from the very start of the mercury-free technology development, and throughout the stages of introduction, training, and provision of assistance. This is because the mining community will ultimately be held responsible for, and will be affected by, the implementation of the regulations. Furthermore, they will be the ones expected to adopt the environmentally friendly mining techniques that are introduced.

- Although the NAP focuses mainly on mercury, gold processing in ASGM also uses other hazardous wastes such as cyanide, which can also have a negative impact on the environment and health. Thus, the RAN-PPM proposes to cover other hazardous chemical (B3) management as used in ASGM, albeit in less detail than for mercury.

### b. Steps to facilitate the formalization or regulation of the artisanal and small-scale gold mining sector

Many ASGM activities in Indonesia take place outside of WPR areas and are therefore considered illegal. The main barriers to formalization of these ASGM actors are the onerous and lengthy approval processes and the legal conundrum faced by those regency/provincial governments wishing to provide guidance or business formalization assistance when no legality exists as the WPR areas have not yet been established.

Any mining activities that are carried out outside of the WPR areas are considered illegal. Under these conditions, it is difficult for the regency and provincial governments to provide guidance or business formalization assistance, as the WPR has not yet been established. Unfortunately, there are only a handful of ASGM sites in Indonesia that have satisfied all of the legal requirements, as meeting the full set of requirements is very difficult. Almost all ASGM in Indonesia can therefore be classified as illegal or informal at this time.

The strategies and activities that are proposed in order to facilitate formalization of these informal or illegal ASGM actors are as follows:

- Strengthening commitment, coordination and cooperation between relevant ministries/non-ministerial government agencies:
  - Conducting monitoring and evaluation on the implementation of the MoEMR Regulation concerning the Prohibition of Gold Processing Using Amalgamation.

- Strengthening coordination and cooperation between central and local governments:
  - Increasing the understanding of local government officials related to licensed small-scale mining.

- Establishment of an information system:
  - Identification of hotspots, populations at risk, and populations that are vulnerable to mercury exposure through cross-sectoral cooperation.

- Strengthening community involvement through communication, information and education:
  - Development of a participatory community approach to increasing knowledge and awareness about the health hazards of mercury;
  - Development of participatory approaches towards communities in ASGM locations that aim to increase knowledge about the health impacts of mercury exposure and create sustainable behavior change in the community.

- Strengthening law enforcement.
  - Control of illegal ASGM activities that continue to use mercury.

### Recommendations

- The problems arising from the ASGM sector are multi-dimensional and therefore require a high level of coordination between relevant ministries/agencies to solve. Although the NAP aims to protect human health and the environment, it is also necessary to pay attention to other emerging technological, social, economic and institutional issues at the same time.

- MoEF needs to establish a successful pilot area for gold processing without mercury, with the WPR/IPR system implemented by community groups/cooperatives and this pilot needs to run well in order to serve as a successful reference for other regions. In this regard, both MoEF and BPPT have initiated and taken active role in the GOLD-ISMIA project (https://www.goldismia.org/) which is part of the global PlanetGOLD Programme (https://www.planetgold.org/indonesia) as supported by UNDP and funded by GEF. The project supports 6 ASGM communities in 6 different provinces of Indonesia (Yogyakarta, West Nusa Tenggara, Gorontalo, North Sulawesi, North Maluku and Riau) through the introduction of mercury-free gold processing equipment.

- Local governments have a very important role to play in the management of ASGM. Therefore, local governments need to have a good understanding of formalization, licensing mechanisms and environmentally friendly gold mining and processing techniques. The central government can provide encouragement by providing incentives to local governments that wish to provide guidance to ASGM communities. On the other hand, it is proposed that disincentives should also be given to local governments that do not pay attention to the ASGM communities in their areas.

- MoEF, MoEMR and BPPT need to provide assistance and carry out mentoring activities related to the transfer of gold processing technology to local governments as well as assisting in the application of WPR and IPR and facilitating NGO assistance.

- The granting of IPR and WPR should be simplified through the availability of clear data that is not over-lapping with licensed gold mining data.

- Provincial action plans need to be flexible enough to accommodate local customs. Based on traditional land claims, gold resources must be handed over to communities based on customary rights, especially if they have been working there for some time, such as in Gorontalo. Traditionally mined areas should be zoned for WPR.

- WPR determination should only be recommended for areas with a minimum gold deposit of 3 g/tonnes to 10 g/tonnes. Areas with a gold concentration of < 3 g per tonnes are not suitable for exploitation and should be recommended for use as social forest areas.

- Miners should apply for mining permits in groups, and local and central government should help to simplify the licensing mechanisms and procedures and the required environmental documents.

### c. Strategies for promoting the reduction of emissions, releases, and risks of exposure to mercury

Both MoEF, BSCRC-SEA and the field survey team made field visits to 6 ASGM locations in Indonesia in 2021. The teams conducted sampling and laboratory analysis of mercury concentrations in the environment of river water and well water, tailings silt, soil sediments, garden soil, food crops, river biota, and local rice. The mercury concentrations in some samples were still below the national quality standard while others exceeded or greatly exceeded the national quality standard. Furthermore, the mapping of the impact of mercury on health, environment and socio-economics conducted by MoEF in collaboration with ITB and UB in 2018 revealed that in general, highly elevated concentrations of mercury were found in the environment at almost all locations that greatly exceeded the safe standards, even in plants growing around ASGM activities in 7 (seven) locations. Other studies also reported mercury pollution in ASGM locations in Indonesia resulting from amalgam burning and tailing discharges to land and water.

The strategies and activities to reduce mercury emission, releases and exposures in ASGM are planned in RAN-PPM as follows:

- Strengthening commitment, coordination and cooperation between relevant ministries/ non-ministerial government agencies:
  - Development of guidelines for storage and handling of mercury and waste containing mercury;
  - Development of guidelines for remediation of mercury- contaminated land.

- Strengthening coordination and cooperation between central and local governments:
  - Conducting regular monitoring on environmental quality (multimedia).

- Increasing leadership, institutional and human resource capacities in the elimination of mercury:
  - Development of a national mercury research and monitoring laboratory;
  - Conducting mercury research.

- Establishment of an information system:
  - Mapping the impact of mercury emissions and releases on the environment around ASGM locations.

- Strengthening community involvement through communication, information and education;
  - Including the dangers of using mercury in gold processing in the content of the national formal education curriculum;
  - Conducting a campaign on the risk of the impact of mercury use on vulnerable communities and a campaign for gender mainstreaming;
  - Conducting outreach and increasing the capacity of health workers regarding health risks due to mercury exposure;
  - Development of a community approach to increase knowledge and awareness about the health hazards of mercury;
  - Development of participatory approaches to communities in ASGM locations that aim to increase knowledge about the health impacts of mercury exposure and sustainable behavior change in the community;
  - Increasing the understanding of good mining practices for business actors regarding the Small-Scale Mining Permit (IPR);
  - Conducting outreach on guidelines for remediation of mercury-contaminated land.

- Application of alternative technology for mercury-free gold processing:
  - Development of research and studies on alternative technology for mercury-free gold processing;
  - Remediation of land contaminated with mercury and land rehabilitation due to gold mining activities;
  - Development of a Feasibility Study (FS) and Detailed Engineering Design (DED) for gold processing without mercury;
  - Construction of gold processing facilities without mercury;
  - Development of a FS and DED for the provision of mercury storage facilities;
  - Provision of mercury storage facilities.

- Transfer of local community livelihoods:
  - Development of a social study on the impact of mercury use on ASGM activities;
  - Development of an economic study of the impact of mercury use;
  - Social and economic transformation of illegal miners using mercury;
  - Fostering business opportunities;
  - Facilitating the issuance of permits for cooperatives and SMEs.

- Strengthening law enforcement:
  - Supervising and controlling primary mercury mining activities (cinnabar mining) that are taking place illegally and without a permit;
  - Control of illegal ASGM using mercury.

**Recommendations**

- Revise Minister of Environment Regulation Number 23 of 2008 concerning the Technical Guidelines for the Prevention of Pollution and/or Environmental Damage Due to Small-Scale Gold Mining.

- The central government needs to allocate a special allocation fund for the environmental sector, both physical and non-physical, for the implementation of the RAD-PPM for the ASGM sector and to finance environmental monitoring activities, namely sampling of water, soil, and food media so that the mapping of mercury pollution levels can be carried out to the maximum level and used as a source of materials for advocacy, awareness raising and policy making in the regions.

- The local government and central government are to assist in the establishment of pilot facilities for processing gold without mercury outside of residential areas.

- Establish special zones for gold processing for ASGM.
- Prohibit the sale of tailings or dumped slurry and its utilization in products or other uses, especially for building materials or additional land in agricultural land and rice fields.
- Applying garden land remediation technology for food crops (clean-up).
- Processing can be done centrally, within a WPR or within an adjacent IUP owned by a company. To facilitate cleaner processing, companies need to be permitted to buy ore mined within the WPR area from mining communities. Due to the many legal requirements that miners must meet before they can legally process the ore, it is preferable for the company to buy the ore, as long as they can process it in a sustainable and environmentally friendly manner. It would also be good if a company like ANTAM could create a clean artisanal gold brand based on that relationship.

### d. Strategies for managing trade and preventing diversion of mercury and mercury compounds from both foreign and domestic sources to use in ASGM and processing

Ministry of Trade Regulation Number 47 of 2019 as the third amendment of the Ministry of Trade Regulation Number 44 of 2009 prohibits the import of elemental mercury for the gold mining industry and the distribution of mercury to end users engaged in the gold mining industry. Ministry of Energy and Mineral Resources Decree No. 1827 of 2018 Appendix V prohibits the use of mercury in the gold processing process.

In Indonesia, since 2012, the production of mercury from small scale and illegal cinnabar mining has taken place in Seram Island, Central Kalimantan and Southeast Sulawesi. The cost of locally-produced mercury per kg is about a quarter of the imported mercury and is sold widely in many ASGM hotspots. Besides direct selling, delivery services, and online trading platform transactions, cinnabar ore and mercury sales and marketing are also conducted widely using the popular B-2-B e-commerce website, social media platforms such as Alibaba, Facebook, Twitter, and Instagram (IPEN, 2018).

The Indonesian National Police have succeeded in thwarting various attempts by home industries to manufacture illegal mercury, smuggle and sell mercury, including illegal mercury exports. They have also succeeded in arresting the perpetrators of illegal cinnabar mining and processing and selling of the mercury raw material. In 2020, the Maluku Regional Police closed the illegal cinnabar mine at Mount Tembaga, Seram Island, Maluku, which is the largest mercury raw material mining location in Indonesia. Currently, there is no regulation yet to prohibit cinnabar mining in Indonesia.

The strategies and activities to manage trade and prevent mercury use in ASGM under RAN-PPM are as follows:

- Strengthening commitment, coordination and cooperation between relevant ministries/ non-ministerial government agencies:
  - Development and revision of regulations regarding the trade system for imports, exports and domestic distribution of mercury.
- Establishment of an information system:
  - Development of a national database system related to the trade, distribution and use of mercury;
  - Development of a map information system for the distribution of cinnabar and mercury-rich ores in Indonesia;
  - Conduct an inventory and mapping of sources, procurement supplies, distribution, and use of mercury.
- Strengthening law enforcement:
  - Increasing import and export supervision of mercury as commodity;
  - Supervising and controlling primary mercury mining activities (cinnabar mining) without permit/illegal;
  - Supervising domestic mercury circulation;
  - Control of illegal mercury trade system.

#### Recommendations

- It is proposed to draft a regulation that clearly prohibits cinnabar mining in Indonesia.
- Prevention of cinnabar smelters because they are very dangerous contaminated areas due to the very large volume of mercury produced.

- Control of mercury traders and distributors needs to be continued. Mercury needs to be confiscated and this will require short and medium-term storage solutions in all seven regions of Indonesia. Monitoring mercury suppliers, traders and producers is more effective than monitoring ASGM. Therefore, it is necessary to encourage the strengthening of the implementation of supervision and control of mercury circulation carried out by the Police, TNI and the Prosecutor's Office in the regions.

- It is also necessary to prevent the free trade of mercury online.

### e. Strategies for involving stakeholders in the implementation and continuing development of the plan

Many stakeholders already have activities, projects or initiatives regarding the mercury issue in Indonesia, which involve ministries, non-ministerial government agencies, local government, NGOs, associations and universities. The following strategies and activities are planned to involve and increase cooperation among relevant stakeholders to implement and continue development of the national action plan:

- Strengthening commitment, coordination and cooperation between relevant ministries/ non-ministerial government agencies:
  - Conducting policy outreach to the provincial government.

- Strengthening coordination and cooperation between central and local governments:
  - Increasing the understanding of local government officials related to licensed small-scale mining;
  - Developing and conducting a cooperation to reduce and eliminate the use of mercury and mitigate the impact of mercury with non-governmental organizations, non-governmental organizations, donor agencies, and other countries (bilateral);
  - Conducting regular monitoring on environmental quality (multimedia).

- Increase leadership, institutional and human resource capacities in the elimination of mercury:
  - Development of a national mercury research and monitoring laboratory;
  - Conducting mercury research.

- Strengthening community involvement through communication, information and education:
  - Including the dangers of using mercury in gold processing in the content of the national formal education curriculum;
  - Conducting a campaign on the risk of the impact of mercury use on vulnerable communities and a campaign for gender mainstreaming;
  - Conducting outreach and increasing the capacity of health workers about health risks due to mercury exposure;
  - Development of a community approach to increase knowledge and awareness about the health hazards of mercury;
  - Development of participatory approaches to communities in ASGM locations that aim to increase knowledge about the health impacts of mercury exposure and sustainable behavior change in the community;
  - Increasing the understanding of good mining practices for business actors regarding the Small-Scale Mining Permit (IPR).
  - Conducting outreach of guidelines for remediation of mercury -contaminated land.

#### Recommendations

Coordination and cooperation are very important, including in the form of assistance from the central government to local governments in the preparation, implementation and monitoring of RAD-PPM implementation. In addition, the government can also collaborate with various relevant stakeholders, such as NGOs, with the government acting as the coordinator.

### f. A public health strategy on the exposure of artisanal and small-scale gold miners and their communities to mercury

As described in Chapter 3, various health surveys at ASGM locations in Indonesia revealed that ASGM miners and their communities had symptoms of mercury intoxication such as bluish gum color, stiffness and ataxia, irregular eye movements, field of vision, and tremors. Sampling and laboratory analysis of hair, nail, urine and blood of ASGM communities also showed increased level of mercury concentrations. HBM score analysis in 6 ASGM locations in Indonesia varied from moderate to high, alert and chronic level.

The strategies and activities to prevent mercury exposure for ASGM miners and their communities are as follows:

- Strengthening commitment, coordination and cooperation between relevant ministries/ non-ministerial government agencies:
  - Development of a standard method for measuring mercury exposure that covers the nodes 1 - 3 (source, media and receptors) consisting of sampling and analysis methods.

- Establishment of an information system:
  - Identification of hotspots, populations at risk, and vulnerable populations due to mercury exposure through cross-sectoral cooperation;
  - Identification and improvement of national standards for threshold limit values for mercury exposure to human health.

- Strengthening community involvement through communication, information and education:
  - Including the dangers of using mercury in gold processing in the content of the national formal education curriculum;
  - Conducting a campaign on the risk of the impact of mercury use on vulnerable communities and a campaign for gender mainstreaming;
  - Conducting outreach and increasing the capacity of health workers about health risks due to mercury exposure.
  - Development of a community approach to increase knowledge and awareness about the health hazards of mercury;
  - Development of participatory approaches to communities in ASGM locations that aim to increase knowledge about the health impacts of mercury exposure and sustainable behavior change in the community;
  - Increasing the understanding of good mining practices for business actors in the Small-Scale Mining Permit (IPR).

**Recommendations**

- It is proposed that health workers be involved in the following activities: (1) local capacity building, including doctors and medical personnel at public health centers (*puskesmas*) and integrated health services (*posyandu)* in monitoring and updating health data; (2) providing medical care or services to patients poisoned by mercury, (3) monitoring the health conditions of infants and mothers who are detected as contaminated by mercury; (4) report to the central and local governments on diseases that are indicated to be due to contamination by mercury. With this information system, it can be used as material for policy making for the prevention and treatment of mercury contamination.

- Conducting health promotion for all levels of society by suggesting to reduce the intake of local fish and looking for alternative water sources to irrigate rice fields and gardens.

### g. Strategies to prevent the exposure of vulnerable populations, particularly children and women of child-bearing age, from mercury used in ASGM

Currently, the number of women involved in ASGM is 30% of the total number of workers in ASGM in Indonesia and they face severe health and safety risks. Female miners are most directly exposed to mercury which is a major problem for women in ASGM and children in ASGM areas have been exposed to mercury since the time that they were in the womb. Studies and field visits to ASGM locations in Indonesia revealed that women and children are often exposed to mercury, as indicated by physical problems and the mercury concentration in their hair, urine, nail and blood which have exceeded the international reference value. Cases of birth-defects in ASGM locations have also been reported.

The strategies and activities to prevent the exposure of children and women to mercury in ASGM are as follows:

- Strengthening commitment, coordination and cooperation between relevant ministries/non-ministerial government agencies:
  - Development of guidelines for storage and handling of mercury and waste containing mercury;
  - Development of guidelines for remediation of mercury- contaminated land;
  - Carrying out efforts to protect at-risk populations, especially children and women, and controlling the health impacts of mercury exposure through the development of guidelines for controlling risk factors, health impacts due to mercury exposure to the environment and guidelines for handling mercury poisoning.

- Strengthening coordination and cooperation between central and local governments:
  - Conducting regular monitoring on environmental quality (multimedia).

- Establishment of an information system:
  - Mapping the impact of mercury emissions and releases on the environment around ASGM locations;
  - Identification of hotspots, populations at risk, and vulnerable populations due to mercury exposure through cross-sectoral cooperation;
  - Identification and improvement of national standards for threshold limit values for mercury exposure to human health.

- Strengthening community involvement through communication, information and education:
  - Including the dangers of using mercury in gold processing in the content of the national formal education curriculum;
  - Conducting a campaign on the risk of the impact of mercury use on vulnerable communities and a campaign for gender mainstreaming;
  - Development of a community approach to increase knowledge and awareness about the health hazards of mercury;
  - Development of participatory approaches to communities in ASGM locations that aim to increase knowledge about the health impacts of mercury exposure and sustainable behavior change in the community.

- Application of alternative technology for mercury-free gold processing:
  - Remediation of land contaminated with mercury and land rehabilitation due to gold mining activities;
  - Development of a Feasibility Study (FS) and Detailed Engineering Design (DED) for gold processing without mercury;
  - Construction of gold processing facilities that operate without the use of mercury;
  - Development of FS and DED for the provision of mercury storage facilities;
  - Provision of mercury storage facilities.

**Recommendations**

- It is recommended that women are provided with knowledge on dangers of mercury and preventive measures, for example by cleaning the house by sweeping and mopping in the morning and afternoon, conducting well water analysis, bathing and self-cleaning after work, drinking coconut water, and other actions.

- Training in alternative livelihoods for women working at illegal ASGM so that they can change profession such as by sewing and selling food.

- It is recommended that public health centers conduct health checks for children and women or mothers with mercury concentration above the standard level in their body, minimum twice a year.

### h. Strategies for providing information to artisanal and small-scale miners and affected communities

The survey results in Sekotong, Lombok by MoEF and UB in 2018 shows that the mining community is quite aware of the dangers of using mercury in gold processing. However, a significant proportion of respondents stated that the use of mercury does not affect the physical health of miners in the long term. In general, the miners who expressed their disapproval were people between the ages of 40 and 60 years and over. Younger miners tend to be more aware of the dangers of using mercury because they are more open to new information and knowledge. Surveys at 6 ASGM locations in Indonesia by MoEF, BSCRC-SEA and the field survey team in 2021 also found that in several locations, public knowledge and awareness of mining actors regarding the negative impact of mercury use upon the community and environment is still low.

To disseminate good information and increase the awareness of ASGM miners and affected communities, the strategy under the RAN-PPM is to strengthen community involvement through communication, information and education, through the following activities:
- Including the dangers of using mercury in gold processing in the content of the national formal education curriculum;
- Conducting a campaign on the risk of the impact of mercury use on vulnerable communities and a campaign for gender mainstreaming;

- Development of a community approach to increase knowledge and awareness about the health hazards of mercury;
- Development of participatory approaches to communities in ASGM locations that aim to increase knowledge about the health impacts of mercury exposure and sustainable behavior change in the community;
- Increasing the understanding of good mining practices for business actors regarding the Small-Scale Mining Permit (IPR).

**Recommendations**

- Establishment of an information system begins with basic data as a baseline for determining the overall RAN-PPM target as well as the annual reduction target. The implementation of targets can be used as a tool to measure the effectiveness of the implemented program and make adjustments immediately. Data should include WPR mapping, health assessments conducted at ASGM sites, guidance on good mining practices, developments in mercury-free gold processing technology and integrated waste management, information on environmental and health hazards of mercury, and mechanisms for formalizing ASGM. This information system must be accessible to relevant stakeholders, including local governments and the ASGM community, both online and conventionally. Periodic updating is required for the information systems.

- Educational and outreach materials to communities and health workers also includes ways to protect miners, families and communities from mercury exposure. It is proposed that the material for outreach, especially for students, also includes information on the importance of education. It is hoped that by having knowledge of the risks and impacts of mining activities, students will pay more attention to education so that they do not work in the ASGM sector.

**i. Additional strategies including market-based mechanisms or marketing tools**

Additional strategy to achieve the mercury elimination target for ASGM priority sector under the RAN-PPM is the transfer of local community livelihoods through the following activities:

- Development of a social study on the impact of mercury use on ASGM activities;
- Development of an economic study of the impact of mercury use;
- Social and economic transformation of illegal miners using mercury;
- Fostering business opportunities;
- Facilitating the issuance of permits for cooperatives and SMEs.

**Recommendations**

- Livelihood transfer programs which need to provide social and economic benefits for men, women and children.

- It is proposed to (1) provide incentives to ASGM in the form of eco-labeling, promotion and convenience of buying and selling; (2) for environmental management, local governments allocate 10% of the cost of selling gold from ASGM activities and (3) increase community income through skills training and innovation in environmentally friendly gold jewelry products and access to capital and markets.

- The local government also provides assistance opportunities for gold artisans to make jewelry and other products in the local area.

## 5.2. Work Plan

The strategies in RAN-PPM for ASGM priority sector have been described in various activities and activities descriptions, namely in Annex II. Presidential Regulation Number 21 of 2019 Part II. Mercury Elimination point a. Small Scale Gold Mining Priority Area.

### A. RAN-PPM

The National Action Plan for ASGM as a high-priority sector in the RAN-PPM can be seen in the following table.

**Table 5.1 National Action Plan for Artisanal and Small-Scale Gold Mining according to the Presidential Regulation Number 21 of 2019 (RAN-PPM)**

| Strategy | Activity | Activity Description | Indicator of Achievement |
|---|---|---|---|
| c.1<br>Strengthening commitment, coordination and cooperation between relevant ministries/ non-ministerial government agencies | c.1.1<br>Developing and strengthening regulations and policies | c.1.1.1<br>Conducting policy outreach with the provincial government | Conducting policy outreach with local governments in all 34 provinces |
| | | c.1.1.2<br>Conducting monitoring and evaluation on implementation of the Ministry of Energy and Mineral Resources Regulation concerning the Prohibition of Gold Processing Using Amalgamation | Monitoring and evaluation with local governments in 34 provinces are conducted |
| | | c.1.1.3<br>Development and revision of regulations regarding the trade system for imports, exports and domestic distribution of mercury | One Ministerial Regulation is issued |
| | | c.1.1.4<br>Development of guidelines for storage and handling of mercury and waste containing mercury | One Ministerial Regulation is issued |
| | | c.1.1.5<br>Development of guidelines for remediation of mercury- contaminated land | Availability of guidance documents for remediation of mercury- contaminated land |
| | | c.1.1.6<br>Development of a standard method for measuring mercury exposure covering nodes 1 - 3 (source, media and receptors) consisting of sampling and analysis methods | Availability of 1 standard method |
| | | c.1.1.7<br>Carrying out efforts to protect at-risk populations, especially children and women, and control the health impacts of mercury exposure through the development of guidelines for controlling risk factors, health impacts due to mercury exposure to the environment and guidelines for handling mercury poisoning | Two guidelines are available |

| Responsible Institution | Supporting Institution | Implementation Output During Implementation Period (Number of locations, regulations, guidelines, maps, etc. depending on the specific activity and indicator of achievement) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
| Ministry of Energy and Mineral Resources | Ministry of Environment and Forestry | 5 | 5 | 5 | 5 | 5 | 5 | 4 |
| Ministry of Energy and Mineral Resources | Ministry of Home Affairs | 5 | 5 | 5 | 5 | 5 | 5 | 4 |
| Ministry of Trade | Ministry of Energy and Mineral Resources, Ministry of Trade, Ministry of Environment and Forestry, Ministry of Finance | 1 | | | | | | |
| Ministry of Environment and Forestry | Ministry of Energy and Mineral Resources | 1 | | | | | | |
| Ministry of Environment and Forestry | Ministry of Energy and Mineral Resources | 1 | | | | | | |
| Ministry of Health | Ministry of Environment and Forestry | | 1 | | | | | |
| Ministry of Health | Ministry of Environment and Forestry, Ministry of Women's Empower-ment and Child Protection | 1 | | 1 | | | | |

| Strategy | Activity | Activity Description | Indicator of Achievement |
|---|---|---|---|
| c.2<br>Strengthening coordination and cooperation between Central and Local Governments | c.2.1<br>Strengthen central and local institutions | c.2.1.1<br>Increasing the understanding of local government officials related to licensed small-scale mining | Outreach to local government officials in all provinces in Indonesia |
| | c.2.2<br>Develop research and technology | c.2.2.1<br>Development and conduct cooperation to reduce and eliminate the use of mercury and mitigate the impact of mercury with non-governmental organizations, non-governmental organizations, donor agencies, and other countries (bilateral) | Integrated cooperation is implemented |
| | c.2.3<br>Monitor emission and release status | c.2.3.1<br>Conduct regular monitoring on environmental quality (multimedia) | Monitoring on environmental quality (multimedia) on a regular basis is conducted |
| c.3<br>Increase the capacity of leadership, institutions and human resources in the elimination of mercury | c.3.1<br>Increase the capacity of laboratory facilities, infrastructure and human resources to support the implementation of research and monitoring | c.3.1.1<br>Development of a national mercury research and monitoring laboratory | Capacity of 5 laboratory human resources is increased every year.<br><br>Research and monitoring of mercury are conducted<br><br>Availability of appropriate laboratory equipment for mercury analysis from samples of air, water, soil, foodstuffs, biological/ biomarker monitoring samples, and other materials<br><br>Mercury parameter proficiency tests are conducted |
| | | c.3.1.2<br>Conducting mercury research | Mercury Research is conducted |
| c.4<br>Establishment of an information system | c.4.1<br>Develop database and information | c.4.1.1<br>Mapping the impact of mercury emissions and releases on the environment around ASGM locations | Availability of impact distribution map |
| | | c.4.1.2<br>Identification of hotspots, population at risk, and vulnerable populations due to mercury exposure through cross-sectoral cooperation. | Availability of maps of areas and populations of communities vulnerable to mercury exposure |

| Responsible Institution | Supporting Institution | Implementation Output During Implementation Period (Number of locations, regulations, guidelines, maps, etc. depending on the specific activity and indicator of achievement) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
| Ministry of Home Affairs | Ministry of Energy and Mineral Resources | 7 | 7 | 7 | 7 | 7 | 7 | 6 |
| Ministry of Environment and Forestry | Ministry of Research, Technology and Higher Education, Ministry of Energy and Mineral Resources | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Ministry of Environment and Forestry | Ministry of Energy and Mineral Resources, Ministry of Home Affairs | 1 | 1 | 1 | | | | |
| Ministry of Environment and Forestry | Ministry of Energy and Mineral Resources, Ministry of Health | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Ministry of Environment and Forestry | Ministry of Health, Ministry of Energy and Mineral Resources, Ministry of Trade, Ministry of Research, Technology and Higher Education, Agency for the Assessment and Application of Technology | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Ministry of Environment and Forestry | Ministry of Energy and Mineral Resources | 1 | | | | | | |
| Ministry of Health | Ministry of Environment and Forestry | 3 | 5 | 6 | 5 | 5 | 5 | 5 |

| Strategy | Activity | Activity Description | Indicator of Achievement |
|---|---|---|---|
| | | c.4.1.3<br>Identification and improvement of national standards for threshold limit values for mercury exposure to human health | Availability of mercury exposure threshold values for human health |
| | | c.4.1.4<br>Development of a national database system related to the trade, distribution and use of mercury | Availability of a national database system |
| | | c.4.1.5<br>Development of a map information system for the distribution of cinnabar and mercury rocks in Indonesia | Availability of map information system |
| | | c.4.1.6<br>Conduct an inventory and mapping of sources, procurement supplies, distribution, and use of mercury | Availability of inventory data<br><br>Availability of maps |
| c.5<br>Strengthening community involvement through communication, information and education | c.5.1<br>Mercury STOP Movement Campaign | c.5.1.1<br>Including the dangers of using mercury in gold processing in the content of the national formal education curriculum | Mercury dangers course is included into the national formal education curriculum |
| | | c.5.1.2<br>Conduct a campaign on the risk of the impact of mercury use on vulnerable communities and a campaign for gender mainstreaming. | Information through mass media, social media and other media is disseminated by publishing a minimum of 2 (two) articles per week |
| | | c.5.1.3<br>Conduct outreach and increase capacity to health workers about health risks due to mercury exposure. | Outreach and trainings in 34 provinces are conducted |
| | | c.5.1.4<br>Development of a community approach to increase knowledge and awareness about the health hazards of mercury | Approach in the community and the emergence of public awareness are developed along with collective community action not to use mercury and efforts to reduce the impact of mercury on health |

| Responsible Institution | Supporting Institution | Implementation Output During Implementation Period (Number of locations, regulations, guidelines, maps, etc. depending on the specific activity and indicator of achievement) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
| Ministry of Health | Ministry of Environment and Forestry | | 1 | | | | | |
| Ministry of Environment and Forestry | Ministry of Trade, Ministry of Finance | 1 | 1 | | | | | |
| Ministry of Environment and Forestry | Ministry of Energy and Mineral Resources | 1 | | | | | | |
| Ministry of Environment and Forestry | Statistics Indonesia, Ministry of Energy and Mineral Resources | 1 | | | | | | |
| Ministry of Education and Culture | Ministry of Environment and Forestry, Ministry of Energy and Mineral Resources, Ministry of Health | 1 | | | | | | |
| Ministry of Environment and Forestry | Ministry of Communication and Informatics, the Ministry of Women's Empowerment and Child Protection | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Ministry of Health | Ministry of Home Affairs | | 17 | 17 | | | | |
| Ministry of Health | Ministry of Home Affairs | | 1 | 1 | | | | |

| Strategy | Activity | Activity Description | Indicator of Achievement |
|---|---|---|---|
| | | c.5.1.5<br>Development of participatory approaches to communities in ASGM locations that aim to increase knowledge about the health impacts of mercury exposure and sustainable behavior change in the community | Participatory approaches in 34 provinces are developed |
| | | c.5.1.6<br>Increasing the understanding of good mining practices for business actors in the Small-Scale Mining Permit (IPR) | Guidance and supervision of IPR |
| | | c.5.1.7<br>Conduct outreach of guidelines for remediation of mercury -contaminated land | Outreach of guidelines for remediation of mercury -contaminated land is conducted |
| c.6<br>Application of alternative technology for processing mercury-free gold | c.6.1<br>Develop research and technology | c.6.1.1<br>Development of research and studies on alternative technology for mercury-free gold processing | Availability of documents on the results of research and study of alternative technology for mercury-free gold processing |
| | c.6.2<br>Remediate mercury contaminated land and land rehabilitation | c.6.2.1<br>Remediation of land contaminated with mercury and land rehabilitation due to gold mining activities | Mercury contaminated land in 4 locations is remediated |
| | c.6.3<br>Physical construction of integrated mercury-free gold processing facilities | c.6.3.1<br>Development of Feasibility Study (FS) and Detailed Engineering Design (DED) for gold processing without mercury | Availability of 5 FS and DED documents in 5 locations |
| | | c.6.3.2<br>Construction of gold processing facilities without mercury | Integrated installations in 13 locations are constructed |
| | c.6.4<br>Provide mercury storage facilities | c.6.4.1<br>Development of FS and DED for the provision of mercury storage facilities | Availability of FS and DED documents on the provision of mercury storage facilities |
| | | c.6.4.2<br>Provision of mercury storage facilities | Construction of mercury storage facilities |

| Responsible Institution | Supporting Institution | Implementation Output During Implementation Period (Number of locations, regulations, guidelines, maps, etc. depending on the specific activity and indicator of achievement) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
| Ministry of Health | Ministry of Energy and Mineral Resources, Ministry of Environment and Forestry | 3 | 5 | 6 | 5 | 5 | 5 | 5 |
| Ministry of Energy and Mineral Resources | Ministry of Home Affairs | 2 | 2 | 2 | 2 | 1 | 1 | 1 |
| Ministry of Environment and Forestry | Ministry of Energy and Mineral Resources, Agency for the Assessment and Application of Technology | | 1 | 1 | 1 | 1 | 1 | 1 |
| Agency for the Assessment and Application of Technology | Ministry of Energy and Mineral Resources | 1 | | | | | | |
| Ministry of Environment and Forestry | Ministry of Energy and Mineral Resources, Ministry of Research and Technology and Higher Education, Ministry of Home Affairs | 2 | | | 1 | | | 1 |
| Agency for the Assessment and Application of Technology | Ministry of Energy and Mineral Resources | 2 | 2 | 1 | | | | |
| Ministry of Environment and Forestry | Ministry of Energy and Mineral Resources, Agency for the Assessment and Application of Technology | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| Ministry of Environment and Forestry | Ministry of Research, Technology and Higher Education | 1 | | | | | | |
| Ministry of Environment and Forestry | Ministry of Research, Technology and Higher Education | 1 | | | | | | |

| Strategy | Activity | Activity Description | Indicator of Achievement |
|---|---|---|---|
| c.7<br>Transfer of local community livelihoods | c.7.1<br>Conduct mapping of the social and economic conditions of the mining community | c.7.1.1<br>Development of a social study on the impact of mercury use on ASGM activities | Availability of 1 social study result |
| | | c.7.1.2<br>Development of an economic study of the impact of mercury use | Availability of 1 economic study result |
| | c.7.2<br>Economic and social empowerment of communities outside the Small-Scale Mining Area (WPR) | c.7.2.1<br>Social and economic transformation of illegal miners using mercury | Six productive economic business models are created |
| | | c.7.2.2<br>Fostering business opportunity | Communities in 5 ASGM locations per year are fostered |
| | | c.7.2.3<br>Facilitating the issuance of permits for cooperatives and SMEs | Cooperative and SMEs permits in 5 ASGM locations per year are issued |
| c.8<br>Strengthening law enforcement | c.8.1<br>Increase supervision | c.8.1.1<br>Increasing import and export supervision of mercury as commodity | Availability of import and export control reports on mercury as commodity |
| | | c.8.1.2<br>Supervising and controlling primary mercury mining activities (cinnabar mining) without permit/illegal | There is no cinnabar mining in Indonesia |
| | | c.8.1.3<br>Supervising domestic mercury circulation | 100% action taken |
| | c.8.2<br>Enforcement | c.8.2.1<br>Control of illegal ASGM using mercury | There is no illegal ASGM using mercury |
| | | c.8.2.2<br>Control of illegal mercury trade system | Amount of illegal mercury controlled 10 tonnes per year |

Source: Presidential Regulation Number 21 of 2019 (RAN-PPM)

| Responsible Institution | Supporting Institution | Implementation Output During Implementation Period (Number of locations, regulations, guidelines, maps, etc. depending on the specific activity and indicator of achievement) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
| Ministry of Environment and Forestry | Ministry of Village, Development of Disadvantaged Areas and Transmigration, Ministry of Cooperatives and Small and Medium Enterprises (SMEs), Ministry of Social Affairs, Ministry of Women's Empowerment and Child Protection | 1 | 1 | | | | | |
| Ministry of Environment and Forestry | Ministry of Villages, Development of Disadvantaged Areas and Transmigration, Ministry of Cooperatives and SMEs, Ministry of Social Affairs, Ministry of Women's Empowerment and Child Protection | 1 | 1 | | | | | |
| Ministry of Environment and Forestry | Ministry of Energy and Mineral Resources, Ministry of Cooperatives and SMEs, Ministry of Home Affairs | 1 | 1 | 1 | 1 | 1 | 1 | |
| Ministry of Cooperatives and SMEs | Ministry of Home Affairs | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Ministry of Cooperatives and SMEs | Ministry of Home Affairs | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Ministry of Finance | Ministry of Environment and Forestry, Ministry of Energy and Mineral Resources, Ministry of Trade | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Indonesian National Police | Attorney General | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Indonesian National Police | Ministry of Trade, Attorney General, National Agency of Drug and Food Control | | | | | | | 100% |
| Indonesian National Police | Attorney General | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Indonesian National Police | Attorney General | 10 | 10 | 10 | 10 | 10 | 10 | 10 |

## Funding Sources and Budget for RAN PPM Implementation

According to the Presidential Regulation Number 21 Year 2019, the funding sources for the implementation of RAN-PPM are the APBN, APBD and other legal and unbinding sources in accordance with the provisions of laws and regulations.

Currently, the available information on funding sources and the budget for implementation of RAN-PPM can be seen in the table below. However, activities to achieve the target have been done by each relevant institution with their own internal budget for the year 2019 and 2020, as can be seen in **Annex IV**.

**Table 5.2 Allocation of State Budget of MOEF for ASGM and Mercury Management Activities**

| Fiscal Year | Work Unit | Output | Target | Allocation (Thousand Rupiahs) | Note |
|---|---|---|---|---|---|
| 2018 | Directorate of Hazardous Substances Management, MoEF | Elimination of mercury Use | 7 locations | IDR 39.291.400 | *Rupiah Murni* (RM) |
| 2019 | Directorate of Hazardous Substances Management, MoEF | Elimination of mercury Use | 3 locations | IDR 9.100.000 | *Rupiah Murni* (RM) |
| 2020 | Directorate of Hazardous Substances Management, MoEF | Provision of mercury-free gold treatment facility in ASGM locations | 5 unit | IDR 12.000.000 | • *Rupiah Murni* (RM)<br>• There is budget refocusing for COVID-19 countermeasures becoming IDR 5.611.586.000 with 1 target unit |
| 2020 | P3KLL, MoEF | Construction of Mercury Laboratory and Environmental Metrology | 1 unit | IDR 73.990.000 | SBSN |
| 2021 | Directorate of Hazardous Substances Management, MoEF | Construction of mercury-free gold treatment facility in ASGM locations | 2 unit | IDR 3.600.000 | • *Rupiah Murni* (RM)<br>• There is budget refocusing for COVID-19 countermeasures becoming IDR 2.718.100.000 with 1 target unit (refocusing 2) |
| 2022 | Directorate of Hazardous Substances Management, MoEF | Construction of mercury-free gold treatment facility in ASGM locations | 2 unit | IDR 3.950.000 | • *Rupiah Murni* (RM)<br>• Data record per 16 August 2021 |

Source: The Ministry of National Development Planning/Bappenas, 2021

## B. Recommendations from Minamata Initial Assessment (MIA)

In the Minamata Initial Assessment (MIA) document, there are several recommendations for inclusion in the action plan for the ASGM sector as seen in the following table.

**Table 5.3 Recommendations for Action Plan for the ASGM Sector from the MIA Document**

| Priority | Proposed Action/Activities | Lead Institution or Stakeholder | Timeline |
|---|---|---|---|
| 1 | Revise MoE Regulation No. 23 of 2008. | MoEF | 2022 |
| 1 | Simplify granting of IPR and WPR with the availability of clear data and not over-lapping with licensed gold mining data. | MoEMR and local government | 2022 |
| 3 | To strengthen an environmentally friendly mining system for ASGM, it is necessary to provide incentives by providing an "eco-label" for these gold products and for the government to find a market that accepts the eco-labeled gold products at a good price. Thus, ASGM can use its gold sales proceeds for environmental management. | MoEF | 2025 |

Source: MIA, 2021
* Indicate the level of priority for each of the proposed actions/activities using the following indications: 1= very high; 2 = high; 3 = medium; 4 = low; 5 = very low.

## C. GOLD-ISMIA Project

In 2019, the United Nations Development Program (UNDP) and the Global Environment Facility (GEF) in collaboration with the MoEF and Agency for the Assessment and Application of Technology (*Badan Pengkajian dan Penerapan Teknologi*, BPPT), launched a project to support Indonesia's efforts to reduce mercury use in ASGM called GOLD-ISMIA.

GOLD-ISMIA is Global Environment Facilities-Global Opportunities for Long-Term Development (GEF-GOLD) Integrated Sound Management of Mercury in Indonesia Artisanal and Small-Scale Gold Mining (ASGM) which is part of the global planet GOLD program. The objective of this project is to reduce or eliminate the release of mercury from the ASGM sector by: (i) Strengthening institutions and policy/regulatory framework for mercury-free ASGM; (ii) Increasing mining community's access to finance for the provision of mercury-free processing technology; (iii) Increasing the capacity of mining communities for mercury-free ASGM through the provision of technical assistance, technology transfer and support for formalization; and (iv) Raising awareness and disseminating best practices and lessons learned from eliminating mercury in the ASGM sector.

The duration of the project is five years and will support ASGM communities in the provinces of Yogyakarta, West Nusa Tenggara, Gorontalo, North Sulawesi, North Maluku and Riau to reduce mercury use by at least 5 tonnes per year starting in the third year of the project so that at the end of the project it will reduce mercury releases at least 15 tonnes. More information can be seen at https://www.goldismia.org./ GOLD-ISMIA started in 2019 and is ongoing until 2023. The project is assisting to implement the NAP strategies.

## D. Work Plan of Ministry of Health and Specific International Programme (SIP) Minamata Convention Project (February 2021-March 2022)

In 2020-2021, the Ministry of Health received a grant from the Minamata Convention Specific International Program (SIP), namely "Improving Health Risk Control of Mercury Exposure in Artisanal and Small-Scale Gold Mining (ASGM) and Surrounding Areas by Developing a "Participatory Approach" Model." The objective of the activity is to develop a participatory approach model in controlling health risks from mercury exposure that is carried out holistically at all levels of society involving the community and local health workers. Beneficiaries of the activities are cross-program and cross-sectoral at the central and local levels, professional organizations, universities, community and community organizations.

The institutions conducting the activity are the Directorate of Environmental Health, Ministry of Health and BSCRC-SEA. The locations of the activity are in Lebak Regency, Banten; Banyumas Regency, Central Java; and West Lombok Regency, West Nusa Tenggara.

This activity will complement the Integrated Sound Management of Mercury in Indonesia's Artisanal and Small-scale Gold Mining (ISMIA) supported by the Global Environment Facility (GEF) because this project focuses on managing health risks to mercury exposure. The project will also complement and leverage the outcomes of the GEF-funded MIA and NAP ASGM projects as they target specific stakeholders at the community level.

### Work Plan Activity

Output 1: Assessing the current practice of health service providers in providing health services to populations at risk of mercury exposure as well as those affected by mercury contamination in ASGM areas and identifying major service problems/gaps from 3 locations.

Indicators:

- Assessment of activities in 3 locations are conducted;
- Relevant cross-sector and cross-program actors in the provinces and districts are involved in the assessment and identification of problems.

**Table 5.4 Work Plan for Output 1**

| No. | Detail of Activity | Indicators | Benefits | Timeline |
|---|---|---|---|---|
| 1. | Development of tools for interviews and Focus Group Discussions (FGD) | Instruments/tools for FGD organization in collecting initial data are developed | Availability of instruments/tools that can be used to collect initial data for problem identification and SWOT analysis | March-April 2021 |
| 2. | Training for using the tools | Health workers who are able to collect data using instruments/tools for initial data for problem identification and SWOT analysis | Health workers who are able to collect both primary and secondary data for problem identification and SWOT analysis | April 2021 |
| 3. | Coordination meeting with local health agencies at provincial and regency/city level | Coordination meetings with provinces and districts to prepare for initial data collection are conducted | Coordination with relevant cross-programs and sectors is built | April 2021 |
| 4. | Conduct interviews, FGD and secondary data collection | Interviews, FGDs and secondary data collection at the location are conducted | Availability of preliminary data as an initial baseline description of ASGM locations, so that provinces/regencies can use it as the basis for preparing intervention plans related to ASGM management | April-May 2021 |

Source: Ministry of Health, 2021

Output 2: Development of modules for doctors, nurses, midwives and public health workers on the most important things that must be done to reduce health risks due to mercury use in ASGM communities and to cure and treat patients with mercury poisoning. These modules can be used and applied in other ASGM.

Indicators:

- Modules are developed;
- Accreditation process is conducted.

**Table 5.5 Work Plan for Output 2**

| No. | Detail of Activities | Indicators | Benefits | Timeline |
|---|---|---|---|---|
| 1. | Development of modules | Two training modules are developed as follows:<br>• Training modules for community participatory approaches in ASGM locations and conducting environmental health analyzes.<br>• Training module for diagnosis/ early detection of mercury intoxication for doctors and nurses. | Availability of a module that can be used if another location will carry out its own training | TW 2-3 2021 |
| 2. | Printing of modules | Hard copies of training modules | Availability of hard copies and soft copies of training modules which can be used | TW 2-3 2021 |

Source: Ministry of Health, 2021

Output 3: Development of a referral system for health services and laboratories in health services for those suspected of being exposed to mercury.

Indicators:

- Referral health care guidelines are developed.

**Table 5.6 Work Plan for Output 3**

| No. | Detail of Activity | Indicators | Benefits | Timeline |
|---|---|---|---|---|
| 1. | Development of guidelines | Referral health care guidelines are developed | Availability of guidelines that can be used as a reference when developing a public health referral system with mercury intoxication | TW 2-3 2021 |
| 2. | Printing | Hard copy of guidelines | Availability of a hard copy and soft copy of the guidelines that can be duplicated | TW 2-3 2021 |

Source: Ministry of Health, 2021

Output 4: Capacity building training for health workers and public health workers on minimizing and preventing mercury exposure, including the steps and procedures required to prevent, reduce and manage health problems due to mercury exposure in ASGM areas using the modules and referral system developed in this project.

Indicators:

- Participants have basic knowledge and skills regarding treating and caring those exposed to mercury poisoning;
- Participants are health workers in each location;
- Location of training: in the regency where the activity is located;
- Fields of practice required:
  - Practicing the implementation of a participatory approach to increase community knowledge and awareness as well as triggering collective community action in changing behavior towards healthier and safer practices that do not use mercury;
  - Practicing early detection/diagnosis of people who may be exposed to mercury;
  - Practicing sampling for biomonitoring;
  - Practicing advocacy to community leaders and related agencies to establish commitments and prepare a referral system for people with mercury intoxication.

**Table 5.7 Work Plan for Output 4**

| No. | Detail of Activity | Indicators | Benefits | Timeline |
|---|---|---|---|---|
| 1. | Training of health workers:<br>– Ministry of Health (Directorate of Environmental Health),<br>– Provincial local health agency,<br>– Regency local health agency/ public health centers (environmental health workers, health promotion workers, doctors, nurses) | Health workers in each location are trained | Trained personnel are present in each location and can carry out:<br>– early diagnosis/detection and human matrix sampling,<br>– community empowerment through a participatory approach,<br>– conduct an environmental health analysis with examination data for biomarkers and health symptoms,<br>– carry out advocacy across programs and sectors in the local government | TW 4 2021 |

Source: Ministry of Health, 2021

# CHAPTER VI. EVALUATION MECHANISM

Under Article 21, the Minamata Convention obligates each Party to report to the Conference of the Parties, through the Secretariat, on the measures it has taken to implement the provisions of the Convention and on the effectiveness of such measures and the possible challenges in meeting the objectives of the Convention. The reporting should include information as called for in, among others, Article 7 of the Convention on ASGM. Indonesia has submitted its complete reports for the first reporting period, running from 16 August 2017 to 31 December 2019.

The mechanism for evaluating the implementation of RAN-PPM and RAD-PPM is regulated in Article 7 to Article 13 of Presidential Regulation Number 21 of 2019 concerning RAN-PPM and Chapter III of MoEF Regulation Number P.81/Menlhk/Setjen/Kum.1/10/2019 concerning Implementation of Presidential Regulation No. 21 of 2019 concerning RAN-PPM. The evaluation mechanism of the RAN-PPM as the National Action Plan for Artisanal and Small-Scale Gold Mining will assist in fulfilling Indonesia's reporting obligation under the Minamata Convention.

Evaluation of the implementation of the RAN-PPM and RAD-PPM is carried out periodically to ensure that the main objectives of the RAN-PPM and RAD-PPM are achieved. The number of target achievements, strategies, and actors of the activity agencies make an effective and efficient evaluation very important to do. In general, the fulfillment of achievements is carried out through a process stage so that periodic evaluations are needed to obtain information about obstacles or potential obstacles, so that obstacle management can be carried out as early as possible.

Evaluation of the monitoring results of RAN-PPM and RAD-PPM implementation is carried out by the Minister of Environment and Forestry, ministers and/or heads of non-ministerial government agencies, governors, and/or regents/mayors in accordance with their respective authorities. The evaluation is carried out by comparing the realization with the target achievement of reducing and eliminating mercury and knowing the implementation barriers. Evaluation is carried out at least 1 (one) time in 3 (three) months (Article 13 and Article 15 of MoEF Regulation No. 81 of 2019).

As for ASGM as a high-priority sector, the achievement of mercury elimination is measured by the amount of mercury use that remains in ASGM businesses and/or activities as well as the success achieved in implementing the mercury elimination activities.

To find out information about the achievements of mercury elimination, monitoring of RAN-PPM and RAD-PPM implementation is carried out by the Minister of Environment and Forestry, the ministers and/or heads of non-ministerial government agencies, governors, and/or regents/mayors in accordance with their respective authorities. Monitoring is carried out at least 1 (once) in 3 (three) months. Further procedures for monitoring of RAN-PPM and RAD-PPM implementation are regulated in Annex IV to MoEF Regulation No. 81 of 2019. For ASGM priority area, the procedures for monitoring the RAN-PPM implementation as in Annex IV of the MoEF Regulation can be seen in the **Annex V** to this document.

Monitoring and evaluation are coordinated by the Minister of Environment and Forestry for the implementation of the RAN-PPM and the governor for the implementation of the provincial RAD-PPM. In carrying out the monitoring and evaluation coordination function, the Minister of Environment and Forestry forms a RAN-PPM committee consisting of a chairman, deputy chairperson, secretary and working group. The membership of the RAN-PPM committee comes from ministries/non-ministerial government agencies that are tasked with implementing the RAN-PPM based on Presidential Regulation No. 21 of 2019.

In Annex V of MoEF Regulation No. 81 of 2019 regarding procedures for RAN-PPM evaluation, the results of the RAN-

PPM evaluation are reported to the RAN-PPM committee through the Minister of Environment and Forestry and the results of the RAD-PPM evaluation are reported to the RAN-PPM committee through the Minister of Domestic Affairs.

The evaluation reports of the RAN-PPM and RAD-PPM are subject to further evaluation through:

a. benchmarking the achievement of mercury reduction and elimination with planning targets; and
b. implementation barriers.

The evaluation of the RAN-PPM and RAD-PPM implementation is carried out:

a. at least 1 (once) in 3 (three) months for evaluation conducted by the responsible institution for the RAN-PPM and RAD-PPM; and
b. at least 1 (once) in 6 (six) months for the RAN-PPM committee.

A summary table that shows the relationship between the national objective or targets, strategies and success indicators can be seen hereunder.

**Table 6.1 National Objective/Target, Strategy and Success Indicators in Mercury Elimination for ASGM as a Priority Sector**

| National Objective/Target | Strategy | Success Indicators |
|---|---|---|
| Mercury elimination with a target of 100% elimination by 2025 | c.1. Strengthening commitment, coordination and cooperation between relevant ministries/non-ministerial government agencies | Policy outreach to local governments in 34 Provinces is conducted |
| | | Monitoring and evaluation to local governments in 34 provinces are conducted. |
| | | One Ministerial Regulation is issued. |
| | | One Ministerial Regulation is issued. |
| | | Availability of guidance documents for remediation of mercury-contaminated land |
| | | Availability of 1 standard method |
| | | Two guidelines are available |
| | c.2. Strengthening coordination and cooperation between central and local governments | Outreach to local government officials in all provinces in Indonesia. |
| | | Integrated cooperation is implemented |
| | | Monitoring on environmental quality (multimedia) on a regular basis is conducted |
| | c.3. Increase leadership, institutional and human resource capacities in the elimination of mercury | Capacity of 5 laboratories equipped with appropriate human resources is to be increased every year.<br>Research and monitoring of mercury is conducted.<br>Availability of appropriate laboratory equipment for mercury analysis from samples of air, water, soil, foodstuffs, biological/ biomarker monitoring samples, and other materials<br>Mercury parameter proficiency tests are conducted |
| | | Mercury Research is conducted. |

| National Objective/Target | Strategy | Success Indicators |
|---|---|---|
| | c.4. Establishment of an information system | Availability of impact distribution map. |
| | | Availability of maps of areas and populations of communities vulnerable to mercury exposure. |
| | | Availability of mercury exposure threshold values for human health. |
| | | Availability of a national database system. |
| | | Availability of map information system. |
| | | Availability of inventory data<br>Availability of maps |
| | c.5. Strengthening community involvement through communication, information and education | Mercury dangers course is included into the national formal education curriculum. |
| | | Information through mass media, social media and other media is disseminated by publishing a minimum of 2 (two) articles per week. |
| | | Outreach and trainings in 34 provinces are conducted |
| | | Approach in the community and the emergence of public awareness are developed along with collective community action not to use mercury and efforts to reduce the impact of mercury on health |
| | | Participatory approaches in 34 provinces are developed |
| | | Guidance and supervision of IPR |
| | | Outreach of guidelines for remediation of mercury -contaminated land is conducted |
| | c.6. Application of alternative technology for mercury-free gold processing | Availability of documents on the results of research and study of alternative technology for mercury-free gold processing |
| | | Mercury contaminated land in 4 locations is remediated |
| | | Availability of 5 FS and DED documents in 5 locations |
| | | Integrated installations in 13 locations are constructed |
| | | Availability of FS and DED documents on the provision of mercury storage facilities |
| | | Construction of mercury storage facilities |
| | c.7. Transfer of local community livelihoods | Availability of 1 social study result |
| | | Availability of 1 economic study result |
| | | Six productive economic business models are created |
| | | Communities in 5 ASGM locations per year are coached |
| | | Cooperative and SMEs permits in 5 ASGM locations per year are issued |
| | c.8. Strengthening law enforcement | Availability of import and export control reports on mercury as commodity |
| | | There is no cinnabar mining in Indonesia |
| | | 100% action taken |
| | | There are no illegal ASGM activities using mercury |
| | | Amount of illegal mercury controlled at 10 tonnes per year |

Source: RAN-PPM, 2019

Evaluation of the success of the mercury elimination activities is measured by comparing the output targets of the implementation of mercury elimination activities in the 2019 period with the realization of the implementation of mercury elimination activities in the 2020 period. The results of the evaluation can be seen in **Table 6.2.** The percentage of implementation success of mercury elimination activities for ASGM as a priority sector is 93%. The strategy for transfer of local community livelihoods has had the lowest performance at 23%.

**Table 6.2 Successful Implementation of Mercury Elimination Activities in The ASGM Sector**

| No | Strategy | Output Target | Actualized Number | Performance Achievement |
|---|---|---|---|---|
| 1 | Strengthening commitment, coordination and cooperation between relevant ministries/non-ministerial government agencies | 14 | 17 | 121% |
| 2 | Strengthening coordination and cooperation between central and local governments | 9 | 16 | 178% |
| 3 | Increase leadership, institutional and human resource capacities in the elimination of mercury | 6 | 6 | 100% |
| 4 | Establishment of an information system | 7 | 3 | 43% |
| 5 | Strengthening community involvement through communication, information and education | 8 | 16 | 200% |
| 6 | Application of alternative technology for mercury-free gold processing | 9 | 11 | 122% |
| 7 | Transfer of local community livelihoods | 13 | 3 | 23% |
| 8 | Strengthening law enforcement | 4 | 4 | 100% |
| | **Total** | **70** | **65** | **93%** |

A central achievement from the implementation of the RAN-PPM for the ASGM sector in the year 2020 was reducing the use of mercury by as much as 9.92 tonnes.

The status of mercury elimination in the ASGM sector in the period 2019-2021 was elimination in 2 regencies/cities in 2019, 3 regencies/cities in 2020, and 7 regencies/cities in 2021.

More information on the status of the RAN-PPM implementation for the year 2019 and 2020 can be seen in **Annex IV**.

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# ANNEXES

## Annex I. Stakeholders Involved in the Preparation of the NAP ASGM

Stakeholder institutions involved in the preparation of the NAP ASGM by providing input through interviews, questionnaires, presentation submissions and participation in meetings, workshops and focus group discussions are as shown in the table below.

**Table 1. Stakeholders Involved in the Preparation of the NAP ASGM**

| No. | Office/Institution |
|---|---|
| 1. | Expert Staff of the Minister of Environment and Forestry of the Republic of Indonesia on Hazardous Waste Management Assistance |
| 2. | Secretary of the Directorate General of Waste, Hazardous, Toxic and Waste Management, MoEF |
| 3. | Directorate of Hazardous and Toxic Materials Management, MoEF |
| 4. | Director of Directorate Contamination Remediation and Emergency Response on Hazardous Wastes, MoEF |
| 5. | Director of Performance Assessment of Hazardous Waste and Non-Hazardous Waste Management, MoEF |
| 6. | Directorate of Open Access Land Damage Recovery, MOEF |
| 7. | Directorate of Water Pollution Control, MOEF |
| 8. | Quality Research and Development Center and Environmental Laboratory (P3KLL), MOEF |
| 9. | Head of Center for Environmental and Forestry Standards, MOEF |
| 10. | Directorate of Occupational Health and Sports, MoH |
| 11. | Directorate of Environmental Health, MoH |
| 12. | Directorate of Mineral and Coal Engineering and Environment, MoEMR |
| 13. | Coordinating Ministry for Economic Affairs |
| 14. | Coordinating Ministry for Maritime Affairs and Investment |
| 15. | Coordinating Ministry for Political, Legal and Security Affairs |
| 16. | Directorate of Imports, MoT |
| 17. | Directorate of Supervision of Circulating Goods and Services, MoT |
| 18. | Directorate of Production Export of Industrial and Mining, MoT |
| 19. | Directorate of Customs Technical, Directorate General of Customs and Excise, MoF |

| | |
|---|---|
| 20. | Directorate of Economic Development and Environment, MoFA |
| 21. | Directorate of Public Media Management, MoCI |
| 22. | Directorate of Manpower Supervision and Occupational Safety and Health, Ministry of Manpower |
| 23. | DKI Jakarta Provincial Environment Agency |
| 24. | Lebak Regency Environmental Service |
| 25. | Chemical Research Center, LIPI |
| 26. | Clean Technology Research Workshop, LIPI |
| 27. | Mineral Resources Development Technology Center, Agency for the Assessment and Application of Technology |
| 28. | Indonesian National Police Criminal Investigation Agency |
| 29. | Artisanal Gold Council |
| 30. | BaliFokus |
| 31. | Indonesian Centre for Environmental Law |
| 32. | Medicuss Foundation |
| 33. | Pure Earth/Blacksmith Institute |
| 34. | Tambuhak Sinta Foundation |
| 35. | UN Environment |
| 36. | University of Edinburgh |
| 37. | Basel and Stockholm Conventions Regional Centre for Southeast Asia |
| 38. | PT. Prasadha Pamunah Limbah Indonesia |
| 39. | University of Indonesia School of Environmental Science |

## Annex II. Estimation of Mercury Used in ASGM Locations in Indonesia

**Table II.1. Provinces and Estimation of Miner Numbers, Gold Production and Annual Mercury Used in ASGM**

| No. | Province | Primary Gold Mining | Secondary Gold Mining | Gold Production | Annual Mercury Used (Lost to Environment) |
|---|---|---|---|---|---|
| | | Number of Miners | Number of Miners | Gold (tonne/year) | Hg (tonne/year) |
| 1 | Banten | 12,000 | 0 | 3.6 | 36.0 |
| 2 | Bengkulu | 2,000 | 0 | 0.6 | 6.0 |
| 3 | Gorontalo | 2,500 | 1,500 | 1.2 | 8.1 |
| 4 | Jambi | 0 | 7,000 | 2.1 | 2.7 |
| 5 | West Java | 8,500 | 0 | 2.6 | 25.5 |
| 6 | Central Java | 6,500 | 0 | 2.0 | 19.5 |
| 7 | East Java | 600 | 600 | 0.4 | 2.0 |
| 8 | West Kalimantan | 0 | 11,500 | 3.5 | 4.5 |
| 9 | South Kalimantan | 4,000 | 2,500 | 2.0 | 13.0 |
| 10 | Central Kalimantan | 4,500 | 20,000 | 7.4 | 21.3 |
| 11 | East Kalimantan | 500 | 2.000 | 0.8 | 2.3 |
| 12 | North Kalimantan | 1,000 | 1,000 | 0.6 | 3.4 |
| 13 | Lampung | 1,500 | 500 | 0.6 | 4.7 |
| 14 | Maluku | 7,000 | 0 | 2.1 | 21.0 |
| 15 | North Maluku | 4,500 | 500 | 1.5 | 13.7 |
| 16 | Aceh | 5,000 | 9,500 | 4.4 | 18.7 |
| 17 | West Nusa Tenggara (NTB) | 11,000 | 1,000 | 3.6 | 33.4 |
| 18 | East Nusa Tenggara (NTT) | 0 | 2,000 | 0.6 | 0,8 |
| 19 | Papua | 0 | 2,500 | 0.8 | 1.0 |
| 20 | West Papua | 0 | 500 | 0.2 | 0.2 |
| 21 | Riau | 500 | 2,000 | 0.8 | 2.3 |
| 22 | West Sulawesi | 4,000 | 500 | 1.4 | 12.2 |
| 23 | South Sulawesi | 0 | 2,000 | 0.6 | 0.8 |
| 24 | Central Sulawesi | 16,000 | 1,000 | 5.1 | 48.4 |
| 25 | Southeast Sulawesi | 500 | 1,500 | 0.6 | 2.1 |
| 26 | North Sulawesi | 8,500 | 0 | 2.6 | 25.5 |
| 27 | West Sumatera | 500 | 2,500 | 0.9 | 2.5 |
| 28 | South Sumatera | 0 | 1,500 | 0.5 | 0.6 |
| 29 | North Sumatera | 4,500 | 0 | 1.4 | 13.5 |
| | **Total** | **105,600** | **73,600** | **53.8** | **345.5** |

**Table II.2. Primary Gold Mining Districts and Annual Mercury Used in ASGM**

| Regencies & Cities by Province | Number Per Province | ASGM on Primary Gold Deposits | | ASMG on Secondary Gold Deposits | | Annual Gold Production | Mercury Used | Annual Mercury Used |
|---|---|---|---|---|---|---|---|---|
| | | Number of Miners | Gold Production (Kg/day) | Number of Miners | Gold Production (Kg/day) | Gold (t/year) | Hg (Kg/day) | Hg (t/year) |
| Banten | | | | | | | | |
| Lebak | 1 | 10000 | 10 | 0 | 0.0 | 3.0 | 100.0 | 30.0 |
| Pandeglang | 2 | 2000 | 2 | 0 | 0.0 | 0.6 | 20.0 | 6.0 |
| Bengkulu | | | | | | | | |
| North Bengkulu | 1 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Lebong | 2 | 1000 | 1 | 0 | 0 | 0.3 | 10 | 3.0 |
| Rejang Lebong | 3 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Gorontalo | | | | | | | | |
| Boalemo | 1 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Bone Bolango | 2 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| North Gorontalo | 3 | 1000 | 1 | 1500 | 1.5 | 0.75 | 11.95 | 3.6 |
| Pohuwato | 4 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| West Java | | | | | | | | |
| Bogor | 1 | 5000 | 5 | 0 | 0 | 1.5 | 50 | 15.0 |
| Garut | 2 | 1000 | 1 | 0 | 0 | 0.3 | 10 | 3.0 |
| Tasikmalaya | 3 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Bandung | 4 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Sukabumi | 5 | 1500 | 1.5 | 0 | 0 | 0.45 | 15 | 4.5 |
| Central Java | | | | | | | | |
| Banyumas | 1 | 5000 | 5 | 0 | 0 | 1.5 | 50 | 15.0 |
| Magelang | 2 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Wonogiri | 3 | 1000 | 1 | 0 | 0 | 0.3 | 10 | 3,0 |
| East Java | | | | | | | | |
| Bayuwangi | 1 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1,5 |
| Pacitan | 2 | 100 | 0.1 | 0 | 0 | 0.03 | 1 | 0,3 |
| South Kalimantan | | | | | | | | |
| Banjar | 1 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1,5 |
| Kotabaru | 2 | 2500 | 2.5 | 500 | 0.5 | 0.9 | 25.65 | 7,7 |
| Tanah Laut | 3 | 1000 | 1 | 1500 | 1.5 | 0.75 | 11.95 | 3,6 |
| Central Kalimantan | | | | | | | | |
| West Kotawaringin | 1 | 500 | 0.5 | 2000 | 2 | 0.75 | 7.6 | 2,3 |

| Regencies & Cities by Province | Number Per Province | ASGM on Primary Gold Deposits | | ASMG on Secondary Gold Deposits | | Annual Gold Production | Mercury Used | Annual Mercury Used |
|---|---|---|---|---|---|---|---|---|
| | | Number of Miners | Gold Production (Kg/day) | Number of Miners | Gold Production (Kg/day) | Gold (t/year) | Hg (Kg/day) | Hg (t/year) |
| East Kotawaringin | 2 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Murung Raya | 3 | 3500 | 3.5 | 0 | 0 | 1.05 | 35 | 10.5 |
| East Kalimantan | | | | | | | | |
| Kutai Barat | 1 | 500 | 0.5 | 500 | 0.5 | 0.3 | 5.65 | 1.7 |
| North Kalimantan | | | | | | | | |
| Bulungan | 1 | 1000 | 1 | 500 | 0.5 | 0.45 | 10.65 | 3.2 |
| Lampung | | | | | | | | |
| Pesawaran | 1 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Way Kanan | 2 | 1000 | 1 | 0 | 0 | 0.3 | 10 | 3.0 |
| Maluku | | | | | | | | |
| Buru | 1 | 7000 | 7 | 0 | 0 | 2.1 | 70 | 21 |
| North Maluku | | | | | | | | |
| West Halmahera | 1 | 1000 | 1 | 0 | 0 | 0.3 | 10 | 3.0 |
| South Halmahera | 2 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| East Halmahera | 3 | 500 | 0.5 | 500 | 0.5 | 0.3 | 5.65 | 1.7 |
| North Halmahera | 4 | 1000 | 1 | 0 | 0 | 0.3 | 10 | 3.0 |
| Sula Island | 5 | 1000 | 1 | 0 | 0 | 0.3 | 10 | 3.0 |
| Morotai Island | 6 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Aceh | | | | | | | | |
| Southwest Aceh | 1 | 1000 | 1 | 0 | 0 | 0.3 | 10 | 3.0 |
| Aceh Besar | 2 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Aceh Jaya | 3 | 1000 | 1 | 0 | 0 | 0.3 | 10 | 3.0 |
| Central Aceh | 4 | 1500 | 1.5 | 0 | 0 | 0.45 | 15 | 4.5 |
| Gayo Lues | 5 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Nagan Raya | 6 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| West Nusa Tenggara (NTB) | | | | | | | | |
| West Lombok | 1 | 500 | 0.5 | 500 | 0.5 | 0.3 | 5.65 | 1.7 |
| Central Lombok | 2 | 500 | 0.5 | 500 | 0.5 | 0.3 | 5.65 | 1.7 |
| Sumbawa | 3 | 5000 | 5 | 0 | 0 | 1.5 | 50 | 15.0 |
| West Sumbawa | 4 | 5000 | 5 | 0 | 0 | 1.5 | 50 | 15.0 |
| Riau | | | | | | | | |
| Kampar | 1 | 500 | 0.5 | 500 | 0.5 | 0.3 | 5.65 | 1.7 |
| West Sulawesi | | | | | | | | |

| Regencies & Cities by Province | Number Per Province | ASGM on Primary Gold Deposits | | ASMG on Secondary Gold Deposits | | Annual Gold Production | Mercury Used | Annual Mercury Used |
|---|---|---|---|---|---|---|---|---|
| | | Number of Miners | Gold Production (Kg/day) | Number of Miners | Gold Production (Kg/day) | Gold (t/year) | Hg (Kg/day) | Hg (t/year) |
| Majene | 1 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Mamasa | 2 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Mamuju | 3 | 1500 | 1.5 | 0 | 0 | 0.45 | 15 | 4.5 |
| Central Mamuju | 4 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| North Mamuju | 5 | 500 | 0.5 | 500 | 0.5 | 0.3 | 5.65 | 1.7 |
| Polewali Mandar | 6 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Central Sulawesi | | | | | | | | |
| Banggai | 1 | 3000 | 3.0 | 0 | 0 | 0.9 | 30 | 9.0 |
| Buol | 2 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Poso | 3 | 1000 | 1.0 | 0 | 0 | 0.3 | 10 | 3.0 |
| Tojo Una-Una | 4 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Toli-Toli | 5 | 1000 | 1.0 | 0 | 0 | 0.3 | 10 | 3.0 |
| Palu | 6 | 10000 | 10.0 | 0 | 0 | 3 | 100 | 30.0 |
| Southeast Sulawesi | | | | | | | | |
| Bombana | 1 | 500 | 0,5 | 1000 | 1 | 0,45 | 6,3 | 1,9 |
| North Sulawesi | | | | | | | | |
| Bolaang Mongondow | 1 | 3500 | 3,5 | 0 | 0 | 1,05 | 35 | 10,5 |
| East Bolaang Mongondow | 2 | 1000 | 1 | 0 | 0 | 0,3 | 10 | 3,0 |
| Minahasa | 3 | 2500 | 2,5 | 0 | 0 | 0,75 | 25 | 7,5 |
| Southeast Minahasa | 4 | 500 | 0,5 | 0 | 0 | 0,15 | 5 | 1,5 |
| North Minahasa | 5 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Bitung | 6 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| West Sumatera | | | | | | | | |
| Solok | 1 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| North Sumatera | | | | | | | | |
| Dairi | 1 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| Mandailing Natal | 2 | 3500 | 3.5 | 0 | 0 | 1.05 | 35 | 10.5 |
| South Tapanuli | 3 | 500 | 0.5 | 0 | 0 | 0.15 | 5 | 1.5 |
| **Total** | **70** | | | | | | | **319.3** |

Source: MoEF & BSCRC-SEA, 2019

**Table II.3. Secondary Gold Mining Districts and Annual Mercury Used in ASGM**

| Regencies & Cities by Province | Number Per Province | ASGM on Primary Gold Deposits | | ASGM on Secondary Gold Deposits | | Annual Gold Production | Mercury Used | Annual Mercury Used |
|---|---|---|---|---|---|---|---|---|
| | | Number of Miners | Gold Production (Kg/day) | Number of Miners | Gold Production (Kg/day) | Gold (t/year) | Hg (Kg/day) | Hg (t/year) |
| Bali | | | | | | | | |
| - | | | | | | | | |
| Bangka Belitung | | | | | | | | |
| - | | | | | | | | |
| DI Yogyakarta | | | | | | | | |
| - | | | | | | | | |
| DKI Jakarta | | | | | | | | |
| - | | | | | | | | |
| Jambi | | | | | | | | |
| Batang Hari | 1 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Bungo | 2 | 0 | 0 | 1000 | 1 | 0.3 | 1.3 | 0.4 |
| Kerinci | 3 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Merangin | 4 | 0 | 0 | 2000 | 2 | 0,6 | 2.6 | 0.8 |
| Muaro Jambi | 5 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Sarolangun | 6 | 0 | 0 | 2000 | 2 | 0.6 | 2.6 | 0.8 |
| Tebo | 7 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0,2 |
| East Java | | | | | | | | |
| Jember | 1 | 0 | 0 | 100 | 0.1 | 0.03 | 0.13 | 0.0 |
| Trenggalek | 2 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| West Kalimantan | | | | | | | | |
| Bengkayang | 1 | 0 | 0 | 1000 | 1 | 0.3 | 1.3 | 0.4 |
| Kapuas Hulu | 2 | 0 | 0 | 1000 | 1 | 0.3 | 1.3 | 0.4 |
| Ketapang | 3 | 0 | 0 | 2000 | 2 | 0.6 | 2.6 | 0.8 |
| Landak | 4 | 0 | 0 | 1000 | 1 | 0.3 | 1.3 | 0.4 |
| Melawi | 5 | 0 | 0 | 1000 | 1 | 0.3 | 1.3 | 0.4 |
| Sambas | 6 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Sanggau | 7 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Sekadau | 8 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Sintang | 9 | 0 | 0 | 3500 | 3.5 | 1.05 | 4.55 | 1.4 |
| Singkawang | 10 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| South Kalimantan | | | | | | | | |
| Tanah Bumbu | 1 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |

| Regencies & Cities by Province | Number Per Province | ASGM on Primary Gold Deposits | | ASGM on Secondary Gold Deposits | | Annual Gold Production | Mercury Used | Annual Mercury Used |
|---|---|---|---|---|---|---|---|---|
| | | Number of Miners | Gold Production (Kg/day) | Number of Miners | Gold Production (Kg/day) | Gold (t/year) | Hg (Kg/day) | Hg (t/year) |
| Central Kalimantan | | | | | | | | |
| North Barito | 1 | 0 | 0 | 2000 | 2 | 0.6 | 2.6 | 0.8 |
| Gunung Mas | 2 | 0 | 0 | 6000 | 6 | 1.8 | 7.8 | 2.3 |
| Kapuas | 3 | 0 | 0 | 3000 | 3 | 0.9 | 3.9 | 1.2 |
| Katingan | 4 | 0 | 0 | 3000 | 3 | 0.9 | 3.9 | 1.2 |
| Pulang Pisau | 5 | 0 | 0 | 2000 | 2 | 0.6 | 2.6 | 0.8 |
| Seruyan | 6 | 0 | 0 | 2000 | 2 | 0.6 | 2.6 | 0.8 |
| East Kalimantan | | | | | | | | |
| Berau | 1 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| East Kutai | 2 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Paser | 3 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| North Kalimantan | | | | | | | | |
| Malinau | 1 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Riau Islands | | | | | | | | |
| - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Lampung | | | | | | | | |
| South Lampung | 1 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Aceh | | | | | | | | |
| West Aceh | 1 | 0 | 0 | 2500 | 2.5 | 0.75 | 3.25 | 1.0 |
| South Aceh | 2 | 0 | 0 | 2500 | 2.5 | 0.75 | 3.25 | 1.0 |
| Southeast Aceh | 3 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| North Aceh | 4 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Pidie | 5 | 0 | 0 | 3000 | 3 | 0.9 | 3.9 | 1.2 |
| Subulussalam | 6 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| East Nusa Tenggara (NTT) | | | | | | | | |
| Lembata | 1 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| West Sumba | 2 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| East Sumba | 3 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| North Timor Tengah | 4 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Papua | | | | | | | | |
| Jayapura | 1 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Mimika | 2 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |

| Regencies & Cities by Province | Number Per Province | ASGM on Primary Gold Deposits | | ASGM on Secondary Gold Deposits | | Annual Gold Production | Mercury Used | Annual Mercury Used |
|---|---|---|---|---|---|---|---|---|
| | | Number of Miners | Gold Production (Kg/day) | Number of Miners | Gold Production (Kg/day) | Gold (t/year) | Hg (Kg/day) | Hg (t/year) |
| Nabire | 3 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Paniai | 4 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Kota Jayapura | 5 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| West Papua | | | | | | | | |
| Manokwari | 1 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Riau | | | | | | | | |
| Kuantan Singingi | 1 | 0 | 0 | 1500 | 1.5 | 0.45 | 1.95 | 0.6 |
| South Sulawesi | | | | | | | | |
| Barru | 1 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Luwu | 2 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| North Luwu | 3 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Palopo | 4 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Central Sulawesi | | | | | | | | |
| Parigi Moutong | 1 | 0 | 0 | 1000 | 1 | 0.3 | 1.3 | 0.4 |
| Southeast Sulawesi | | | | | | | | |
| Kolaka | 1 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| West Sumatera | | | | | | | | |
| Dharmasraya | 1 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Pasaman | 2 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| West Pasaman | 3 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Sijunjung | 4 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| South Solok | 5 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| South Sumatera | | | | | | | | |
| North Musi Rawas | 1 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| Ogan Komering Ulu | 2 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| South Ogan Komering Ulu | 3 | 0 | 0 | 500 | 0.5 | 0.15 | 0.65 | 0.2 |
| **TOTAL** | **62** | | | | | | | **25.3** |

Source: MoEF & BSCRC-SEA, 2019

## Annex III. National Baseline Analysis Details

### A. Methodology

#### Mercury Inventory and Description of Gold Mining Process

The method used for the mercury inventory was based on a toolkit formulated by the UNEP (United Nation Environmental Program) entitled "Estimating Mercury Use and Documenting Practices or Processes in Small Scale Gold Mining (ASGM)" (O'Neill & Telmer, 2017). The method has two major parts: the interview process and the calculation process based on the results of the doses or scales in the process carried out by several samples according to local conditions by ensuring that the number of samples taken is representative enough for the procedure. At the interview stage, many possible approaches were taken to estimate the mercury ASGM used. Several approaches and tracing were taken to increase confidence in the final estimate.

The following were some categories of interviewees for estimating mercury use:

a. Interview with mercury sellers. If mercury sellers could be found, they were asked how much mercury can be sold in a month or year and the mercury price per kilogram. The quantity was a rough estimate of mercury that is illegal and inherently confidential but is a helpful starting point for comparisons or other approaches. Anyone can act as a mercury seller, from gold traders, community members, or even community leaders who may be involved in mercury trading.
b. Interview with mercury users. The respondent was asked how much mercury they buy each week or month. The quantity would be a rough estimate but a helpful starting point for triangulation.
c. Estimating gold production and applying mercury:gold (Hg:Au) ratio. Gold production is defined as the amount of pure gold (24K/100%) produced in a certain amount (for example, annual gold production).

In the calculation process, a particular calculation method was prepared in MS Excel, which uses several equations. Some of the equations used in estimating gold and mercury production were as follows (Telmer & Stapper, 2012):

(1) Correcting gross gold to 24K or comparable 100% purity:
If gold purity was expressed in carats (Eq. 1):

$$pure\ gold\ weights = gross\ gold\ weight \times \frac{carat\ impured\ gold}{24} \quad \text{.....Eq. 1}$$

(2) Gold produced from ore (Eq. 2):

$$gold\ yield = ore\ weight \times level\ of\ ore\ content \quad \text{.....Eq. 2}$$

(3) Hg used in gold production:
Several steps need to be done, including the mixture stage and the heating stage. The mixed stage was carried out by:

a. Liquid mercury weighing that was added to the ore before mixing,
b. The mercury weighing that was recovered from the ore after the mixture (containing recovered liquid mercury and amalgam),
c. Weighing the remaining liquid mercury after kneading to remove amalgam.

Heating stage:

a. Amalgam weighing before heating,
b. Mercury weighing recovered (if applicable).
c. Mercury weighing recovered (if applicable).

Thus, the total Hg used is obtained by Eq. 3, Eq. 4, and Eq. 5:

$$\textit{Total Hg used} = \textit{Hg lost to the soil in the mixed-phase} + \textit{Hg lost to air} \quad \text{..... Eq. 3}$$

$$\textit{Mercury lost to the soil in the mixed-phase} = \textit{mass Hg is added} - \textit{mass Hg is liquid from the juice} - \textit{Hg evaporates} \quad \text{..... Eq. 4}$$

$$\textit{Hg lost to air} = \textit{evaporated Hg} - \textit{the mass of Hg from the retort} \quad \text{..... Eq. 5}$$

(4) Mercury:gold ratio (Hg:Au)

The Hg:Au ratio was calculated by:

a. Converting the mass weight of a gold sponge to a mass equivalent to pure gold (multiplied by 24K, 100%),
b. Calculating the total Hg used by subtracting the Hg added by the remaining Hg squeezed,
c. Divide the total Hg used by the mass of pure gold produced.

Hg:Au ratio was calculated by Eq. 6.

$$Hg{:}\,Au\ rasio = \frac{Total\ Hg\ used}{mass\ of\ gold\ sponges\ generated} \quad \text{.....Eq. 6}$$

## Mercury Inventory and Description of Gold Mining Process

### Measurement of Concentration in Tailings

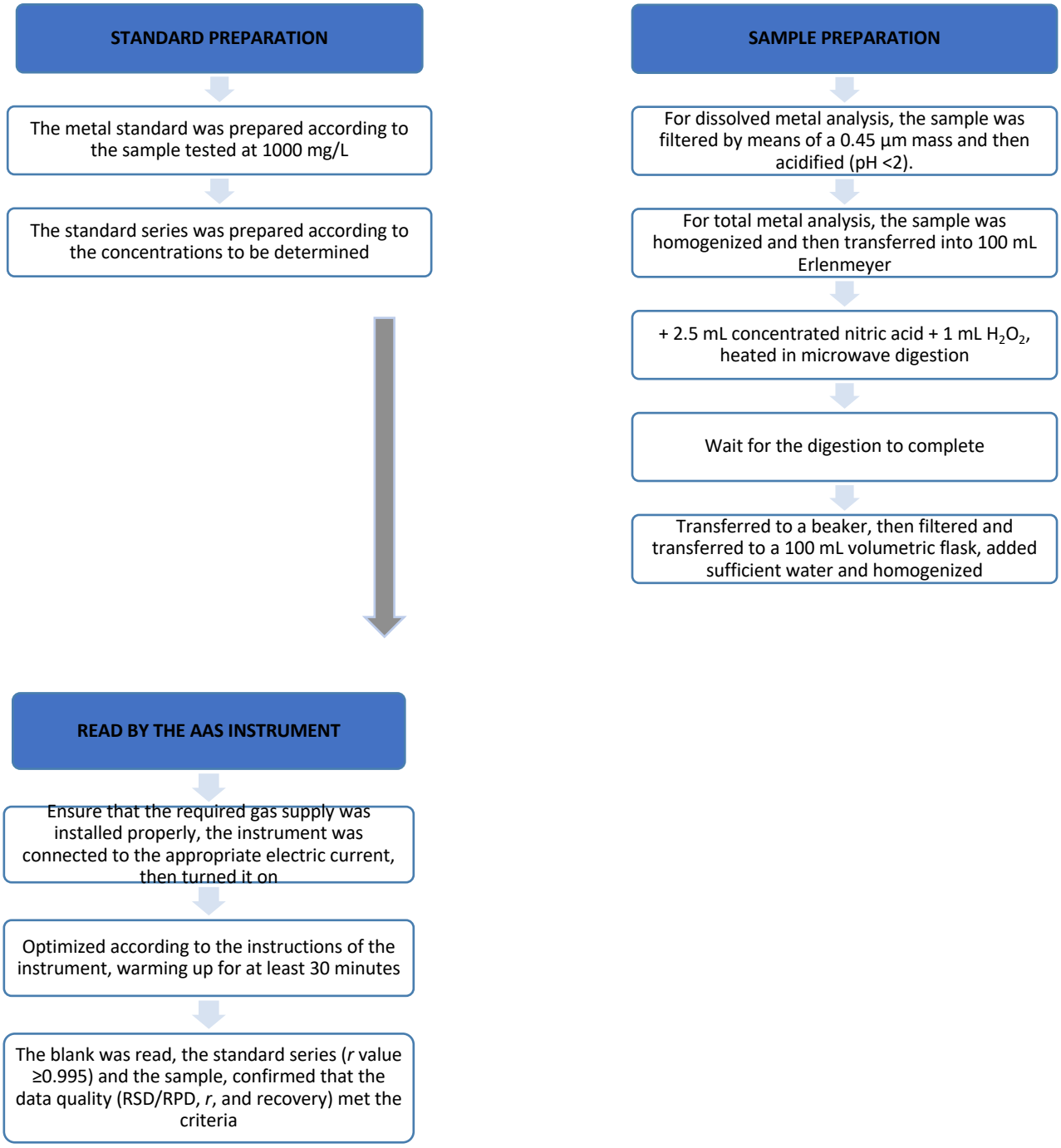
In this study, samples of tailings wastewater were also taken at the mining sites to determine whether mercury was used at the mining process site or not. The tailing wastewater sampling point was determined in the mining location area using simple random and grab sample techniques. Tailing samples were taken directly in the field, while preparation, extraction, and mercury analysis were carried out in the laboratory.

(1) Sampling. Tailing wastewater samples were taken at the location of the mining tailing area and put into 100 mL HDPE bottles, then preserved by adding $HNO_3$ until the pH became ≤ 2 (APHA, 2005). Water samples were labeled and stored in a cool box at 4°C until analyzed in the laboratory.

(2) Sampling extraction. The Hg content in tailings water was determined according to the 2007 APHA method. The procedure was as follows:

- The sample in the bottle was homogenized, then 100 mL of sample water was pipetted into an Erlenmeyer, then added 2.5 mL of concentrated $HNO_3$ and 1 mL of $H_2O_2$.
- The sample was heated in microwave digestion to completion.
- After that, the samples were cooled to room temperature and filtered using Whatman Paper No. 42 into a volumetric flask.
- The sample was homogenized for further analysis using the AAS instrument.
- The complete procedure is given in **Figure III.A.1.**

**Figure III.A.1. Flowchart for determination of Hg metal content in water**



(3) Analysis of the total mercury concentration (T-Hg) and the referred quality standard. The extracted tailing sample was then analyzed for T-Hg content using AAS at the laboratory. From the results, the T-Hg concentration was obtained in µg/L, which was then calculated to obtain the final T-Hg concentration. The final concentration of mercury in the tailing sample was calculated based on SNI 6989.78-2011 using Eq. 7.

$$Mercury\ content\ (\mu g/L) = (DE)\ x\ fp \qquad \text{..... Eq. 7}$$

Mercury levels mg/L = (µg/L)/1000

Where:

*D* = Mercury levels in the tailing extraction sample from the reading in the lab (µg/L)

*E* = Mercury levels in blank samples from readings in the lab (µg/L)

*fp* = Dilution factor

The results were then compared with the quality standard of tailings wastewater in the gold mining process, which is not more than 0.005 mg/L based on the Government Regulation No. 22/2021 concerning Environment Protection and Management.

### Concentration Measurement in River Water Samples

The concentration of mercury in the environment was measured on several matrices, one of which is river water, representing the aquatic environment. The type of sample taken was a grab sample. The location and the sampling stations of the aquatic environment were determined purposively, based on the existence of ASGM activities or potentially contaminated areas, river use areas, the confluence of two rivers, the downstream, and one location in the upstream area.

River water samples to be measured for mercury content and measurement of supporting data such as several chemical and physical environmental parameters were taken directly in the field, while preparation, extraction, and mercury analysis were carried out in the laboratory.

(1) River water sampling. River water samples were taken at a depth of 10 cm below the water surface (Vieira et al., 2018) and put into a 100-mL glass bottle. Further, the samples were preserved by adding $HNO_3$ until the pH became ≤ 2 (APHA, 2005). Water samples were labeled and stored in the cool box at 4°C until analyzed in the laboratory.

(2) Sample extraction. The Hg content in river water is determined according to the 2007 APHA method. The procedure is used as follows:

- The sample in the bottle was homogenized then transferred 100 mL of sample water into the Erlenmeyer, added 2.5 mL of concentrated $HNO_3$ and 1 mL of $H_2O_2$.
- The sample was heated in microwave digestion to completion.
- After that, the samples were cooled to room temperature and filtered using Whatman paper No. 42 into a 100 mL volumetric flask.
- The sample was homogenized for further analysis using the AAS instrument (**Figure III.A.1**).

(3) Analysis of the total mercury concentration (T-Hg) and the referred quality standard. The extracted river water samples were analyzed for T-Hg content using AAS. The results in µg/L unit was then calculated to obtain the final T-Hg concentration. The final concentration of mercury in the tailings sample was calculated based on SNI 6989.78-2011 using Eq. 8.

$$Mercury\ content\ (\mu g/L) = (D\text{-}E)\ x\ fp \qquad \text{..... Eq. 8}$$

Mercury levels mg/L = (µg/L)/1000

Where:

*D* = Mercury levels in the extraction sample from the reading in the lab (µg/L)

*E* = Mercury levels in blank samples from readings in the lab (µg/L)

*W* = Sample weight (g)

*Va* = The final volume of the prepared sample solution (mL)

*fp* = Dilution factor

The results were compared with the water sample quality standards referring to Government Regulation No. 22/2021 Annex VI concerning the National Water Quality Standard, which is 0.001 mg/L for class I water quality standards, to be safe as a drinking water source.

### Measurement of Concentration in River Sediment Samples

Samples from other aquatic environments were also collected from river sediments, taken using the grab sample technique. The location and sampling stations were determined purposively, based on the presence of ASGM activities or potentially contaminated areas, river use areas, the confluence of two rivers, and the downstream; one site was also located in the upstream area. The river sediment sampling location is adjusted to the river water sampling point. River sediment samples to be measured for mercury content were taken directly in the field, while preparation, extraction, and mercury analysis are performed in the laboratory.

Sediment sampling. River bed sediment samples were taken using a shovel. The sampling point was selected in conjunction with water sampling. The sediment sample (250 g) was put into a 100-mL sample bottle, labeled, and stored in a cool box at 4°C until analyzed in the laboratory.

Extraction of river sediment samples. Hg in sediment was extracted according to the US-EPA 7471B (EPA 1998) standard method of Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique). Sediment and homogenized soil samples were weighed (1-2 g) and placed in an Erlenmeyer. A total of 10 mL of 1:1 $HNO_3$, 5 mL of distilled water, and 5 mL of 3:1 aqua regia ($HCl:HNO_3$) were added, heated for 2 minutes at 95 ± 3°C. After that, the solution was cooled, 50 mL of distilled water was added and heated 10-15 minutes at 95 ± 3°C then cooled. After chilling, the solution was added with 5 mL of concentrated $HNO_3$, refluxed for 30 minutes then added with 2 mL of distilled water and 3 mL of $H_2O_2$. The solution was cooled then added 1 mL $H_2O_2$ until the foam disappeared. Next, 5 mL of concentrated HCl and 10 mL of distilled water were added again, covered with a watch glass, and then refluxed for 15 minutes. The solution was filtered using Whatman paper No. 42 into a 100 mL volumetric flask. The complete procedure is given in **Figure III.A.2**.

Analysis of the total mercury concentration (T-Hg) and the referred quality standard. The river sediment samples that had been extracted were analyzed for T-Hg content using AAS. The results were in mg/L units, calculated according to the environmental matrix to obtain the final T-Hg concentration value.

The final concentration of mercury in river sediment samples is calculated based on SNI 06-6992.2-2004 using Eq. 9 and Eq. 10.

$$Water\ content\ (\%) = ((Csb-Cst) \times 100\%)/Csb \quad \text{..... Eq. 9}$$

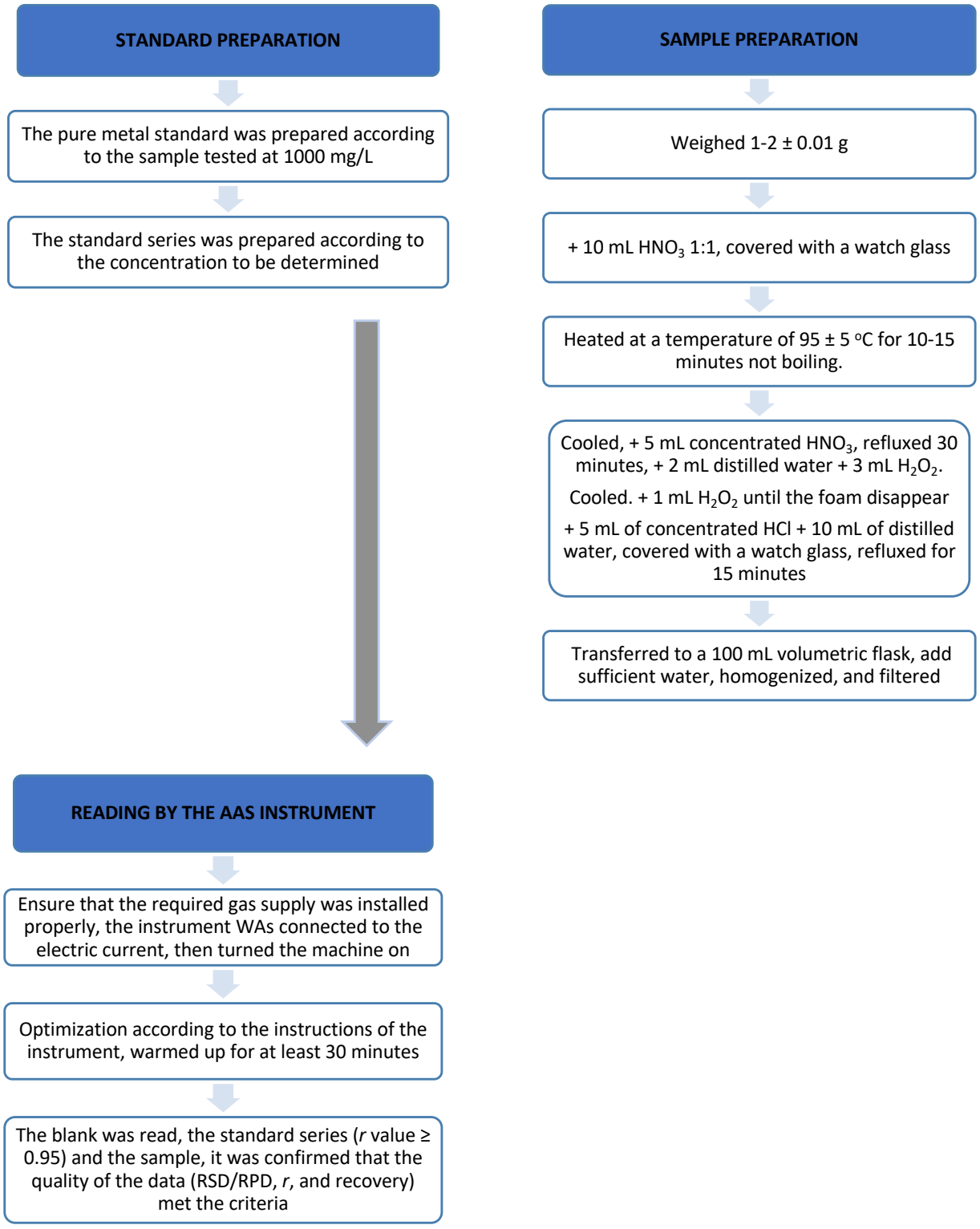
Where:
Csb = weight of the test sample before heating (wet weight) (g)
Cst = Weight of the test sample after heating (dry weight) (g)

$$Mercury\ content\ (mg/kg) = (C \times fp \times Va \times (1\ L)/(1000\ mL))/(W\ (1-MC/100)) \times (1000\ g)/kg \quad \text{..... Eq. 10}$$

Where:
*C* = Mercury levels in sediment extraction samples from the reading in the lab (mg/L)
*W* = Sample weight (g)
*Va* = The final volume of the prepared sample solution (mL)
*MC* = Moisture content
*fp* = dilution factor

The results were compared with the sediment quality standard of 0.3 mg/kg based on the Government Regulation No. 22/2021.

Figure III.A.2 Flowchart for determination of Hg levels in soil and sediment using AAS



### Measurement of Concentration in Biota Samples

Another measurement of mercury concentrations in aquatic environments was in freshwater fish. The samples were taken as a grab sample. Locations and fish sampling stations were determined purposively, based on ASGM activities or areas that are potentially contaminated, river use areas, the confluence of two rivers and the downstream, and one location in the upstream area. Fish samples were taken directly in the field, while preparation, extraction, and mercury analysis were carried out in the laboratory.

Collecting fish samples. Fish samples were obtained using fishing rods and nets. The samples were put into ziplock plastic and preserved using 90% formalin-alcohol, labeled, and stored in a cool box at 4°C until analyzed in the laboratory.

Extraction of fish samples. The extraction referred to the procedure used by the Ministry of the Environment, Japan (Suzuki et al., 2004). The samples were cut into smaller pieces, mashed, and homogenized. Furthermore, 0.5g (maximum for wet weight) was placed in an Erlenmeyer. A total of 9 mL $HNO_3$ and 1 mL $H_2O_2$, 1 mL distilled water, 2 mL $HNO_3$ -$HClO_4$ (1:1), and 5 mL $H_2SO_4$ were added to the Erlenmeyer containing the sample and heated in microwave digestion over a bath at 200-230°C for 30 minutes. The Erlenmeyer, which contains the mixture, was removed and allowed to stand for a while to lowering the temperature, after which it was filtered with Whatman filter paper No. 42, and distilled water was added until the final volume was 25 mL.

Analysis of the total mercury concentration (T-Hg) and the referred quality standard. The extracted fish samples were then analyzed for T-Hg content using AAS. In mg/L units, the analysis results were calculated according to the environmental matrix to obtain the final T-Hg concentration value (**Figure III.A.3**).

The final concentration of mercury in fish samples was calculated based on SNI 2354.6-2016 concerning Determination of Heavy Metal Mercury (Hg) Levels in Fishery Products using Eq. 11.

$$Mercury\ content\ (mg/kg) = ((DE) \times fp \times Va \times (1\ L)/(1000\ mL))/W \times (1000\ g)/kg \quad \text{..... Eq. 11}$$

Where:

*D* = Mercury levels in fish extraction samples from the reading in the lab (mg/L)

*E* = Mercury levels in blank samples from readings in the lab = (mg/L)

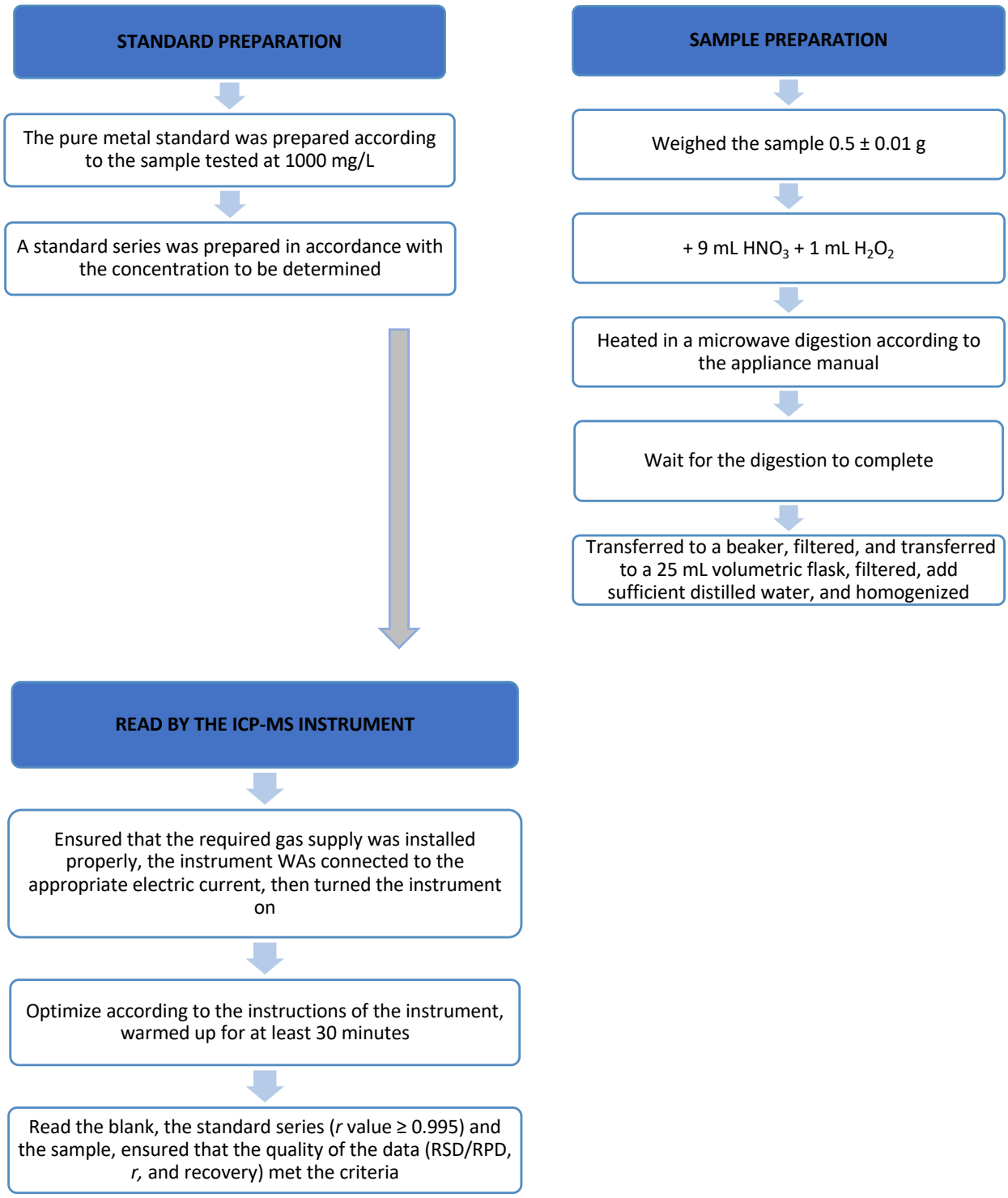
*W* = Sample weight (g)

*Va* = The final volume of the prepared sample solution (mL)

*fp* = Dilution factor

The results were compared with fish quality standards based on National Agency of Drug and Food Control (*Badan Pengawas Obat dan Makanan*, BPOM) Regulation No. 5/2018 concerning Maximum Limit of Heavy Metal Contamination in Processed Foods for Fish and Fishery Products Including Mollusks, Crustaceans, and Echinoderm and Amphibians and Reptiles, which is 0.50 mg/kg for Hg metal (Food and Drug Control Agency). No. 5/2018 on Maximum Limit of Metal Contamination in Processed Grain Food, 2018).

Figure III.A.3. Flowchart for determination of Hg levels in plants, fish, and hair using ICP-MS instrument



### Concentration Measurement in Soil Samples

Soil sampling. Soil samples were taken using a shovel. The sampling point was selected according to representative plant sampling. The soil samples were placed into a 100-mL sample bottle, labeled, and stored in the cool box at temperature 4°C until analyzed in the laboratory. Samples were prepared before extraction to remove the impurities, homogenized, and tested for their mercury content in terms of total Hg (T-Hg).

Extraction of soil samples. Hg in the soil was extracted according to the US-EPA 7471B (EPA, 1998) standard method of Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique). Sediment samples and homogenized soil were weighed (1-2 g) and placed in the Erlenmeyer. A total of 10 mL of distilled water and $HNO_3$ (1:1) and 5 mL of 3:1 aqua regia ($HCl:HNO_3$) were added to the mixture, heated for 2 minutes at 95 ± 3°C. After that, the solution was cooled, 50 mL of distilled water was added and heated for 30 minutes at 95 ± 3°C, then cooled. After chilling, the solution was added with 5 mL of concentrated $HNO_3$, refluxed for 30 minutes, and 2 mL of distilled water and 3 mL of $H_2O_2$. The solution was cooled, added 1 mL $H_2O_2$ until the foam disappeared. Then 5 mL of concentrated HCl and 10 mL of distilled water were added, covered with a watch glass, and refluxed again for 15 minutes. The solution was then filtered using Whatman paper No. 42 into a 100 mL volumetric flask.

Analysis of the total mercury concentration (T-Hg) and the referred quality standard. The extracted river sediment samples were analyzed for T-Hg content using ICP-MS AAS. The T-Hg concentration was reported in mg/L units, calculated according to the environmental matrix to obtain the final T-Hg concentration value (**Figure III.A.2**).

The final concentration of mercury in river sediment samples is calculated based on SNI 06-6992.2-2004 using Eq. 12 and Eq. 13.

$$Water\ content\ (\%) = ((CSB\text{-}Cst) \times 100\%)/Csb \quad \text{.....Eq. 12}$$

Where:

Csb = weight of the test sample before heating (wet weight) (g)

Cst = Weight of the test sample after heating (dry weight) (g)

$$Mercury\ content\ (mg/kg) = (C \times fp \times Va \times (1\ L/(1000\ mL))/(W\ (1MC/100)) \times (1000\ g)/kg \quad \text{.....Eq. 13}$$

Where:

*C* = Mercury levels in sediment extraction samples from the reading in the Lab (mg/L)

*W* = Sample weight (g)

*Va* = The final volume of the prepared sample solution (mL)

*MC* = Moisture content

*fp* = dilution factor

The results were then compared with the standard quality of sediment of 0.3 mg/kg for the total concentration of mercury, in accordance with the determination of soil management contaminated with B3 waste contained in GR No. 22/2021 Annex XIII.

### Concentration Measurement in Plant Samples

Mercury levels in the terrestrial environment were also measured in plants. The point of taking plant samples was determined by a simple random, grab sample. The location and the plant sampling station were conjunctions to the soil sampling. Plant samples were taken directly in the field, while preparation, extraction, and mercury analysis were carried out in the laboratory.

Plant sampling. Crop samples were taken using the hand sorting method. The sample was put into ziplock plastic and made airtightly, labeled, and stored in a cool box at 4°C until analyzed in the laboratory.

Extraction of plant samples. The extraction method referred to the procedure used by the Ministry of the Environment Japan (2004). Fish samples were cut into smaller pieces, mashed, and homogenized. Further, 0.5 g (maximum) samples were placed in Erlenmeyer. A total of 9 mL $HNO_3$ and 1 mL $H_2O_2$, 1 mL distilled water, 2 mL $HNO_3$-$HClO_4$ (1:1), and 5 mL $H_2SO_4$ were added and heated in microwave digestion over a bath at 200-230°C for 30 minutes. The Erlenmeyer containing the solution was removed and allowed to stand for a while to reduce the temperature, filtered the solution with Whatman filter paper No. 42, and added distilled water until the final volume became 25 mL.

Analysis of the total mercury concentration (T-Hg) and the referred quality standard. The extracted plant samples were analyzed for T-Hg content using the AAS instrument. The results, reported in mg/L unit, were calculated according to the environmental matrix to obtain the final T-Hg concentration value (**Figure III.A.3**).

The final concentration of mercury in plant samples is calculated based on SNI 2354.6:2016 using Eq. 14.

$$Mercury\ content\ (mg/kg) = ((DE) \times fp \times Va \times 1\ L/1000\ mL)\ /W \times 1000\ g/kg \quad \text{.....Eq. 14}$$

Where:

*D* = Mercury levels in plant extraction samples from the reading in the lab (mg/L)

*E* = Mercury levels in blank samples from readings in the lab (mg/L)

*W* = Sample weight (g)

*fp* = Dilution factor

The results were compared to the standard quality of plants, namely 0.03 mg/kg based on BPOM Regulation No. 5/2018 concerning The Maximum Limit of Heavy Metal Contamination in Processed Foods for Cereals and Cereal Products, which is 0.03 mg/kg for Hg metal.

### Concentration Measurement in Drinking Water Samples

In this study, samples of drinking water or clean water consumed by the respective community were taken. The sampling points were selected by simple random method, using grab sampling. The samples were taken directly in the field, while preparation, extraction, and mercury analysis are carried out in the laboratory.

Taking drinking water samples. Samples were obtained from drinking water in the respondent's house. Water samples were taken directly from drinking water sources, for example, tap water, water drums, or depending on the condition of the water storage area in the respondent's house. Water samples (250 mL) were stored in HDPE sample bottles and preserved with $HNO_3$, then stored in a cool box at 4°C.

Extraction of drinking water samples. The water sample extraction method refers to APHA 3113B Year 2007 with the following steps:

The sample (100 mL) was added with 2.5 mL of concentrated $HNO_3$ and 1 mL $H_2O_2$, 5 mL $H_2SO_4$, and 2.5 mL $HNO_3$ into an Erlenmeyer, added 15 mL of $KMnO_4$ solution, and let stand up to 15 minutes. If the purple color disappeared, more $KMnO_4$ was added until the solution remains purple. Another 8 mL of $K_2S_2O_8$ was added and heated on a heating plate for 2 hours at a temperature of 95°C. Then the sample is heated in microwave digestion to completion and cooled at room temperature. The samples were cooled and filtered using Whatman filter paper No. 42. The filtrate was transferred into a volumetric flask, and distilled water was added until the final volume of 200 mL. Afterward, the sample was homogenized and stored in an extraction bottle for further analysis using the AAS instrument.

Analysis of the total mercury concentration (T-HG) and the referred quality standard. The extracted drinking water sample was analyzed for T-Hg content, and the results were reported in µg/L units, calculated according to the environmental matrix to obtain the final T-Hg concentration value (**Figure III.A.1**). The final concentration of mercury is calculated based on SNI 7387: 2009 with modifications to the liquid sample using Eq. 15.

$$Mercury\ level\ (mg/L) = ((DE)\ x\ fp\ x\ Va\ x\ 1L/1000\ mL)/Vs \quad \text{.....Eq. 2.15}$$

Where:

*D* = Mercury levels in drinking water extraction samples from the reading in the lab (mg/L)

*E* = Mercury levels in the blank from the reading in the lab (mg/L)

*Vs* = Volume of drinking water sample (mL)

*Va* = the final volume of the prepared sample solution (mL)

*fp* = Dilution factor

The results were compared with drinking water quality standards, namely, 0.001 mg/L based on the Minister of Health Regulation No. 32/2017.

**Measurement of Concentration in Rice Samples**

In the case study, rice samples were taken as the staple food of the respondents. The sampling points were selected by simple random sampling, as grab sample. The samples were taken directly in the field, while preparation, extraction, and mercury analysis were carried out in the laboratory:

1. Rice sampling. The rice samples taken were only the grain. Rice samples were taken from the respondent's house, which usually came from their harvest or bought from a shop. The sample (50 g) was placed in HDPE plastic to be stored in a 4°C cool box.
2. Rice sample extraction. The extraction was based on the Mercury Analysis Manual (Ministry of the Environment Japan 2004) as follows:
   - Sampled rice by mashing it with a mortar;
   - A sample of 0.5 g was added to 1 mL of distilled water, 1 mL of $HNO_3$, 1 mL of $HClO_4$, and 5 mL of $H_2SO_4$;
   - The sample was heated on a heating plate for 30 minutes at 200-230 °C, cooled at room temperature;
   - The cold sample was diluted with 20 mL of distilled water and filtered with Whatman paper No. 42. The filtrate was transferred into a volumetric flask and distilled water was added until the final volume of 50 mL;
   - The samples were homogenized and stored in extraction bottles for further analysis using the AAS instrument (**Figure III.A.2**);
   - Analysis of the total mercury concentration (T-Hg) and the referred quality standard. The rice samples that had been extracted were analyzed for the T-Hg content using AAS. The results, reported in mg/L units, was then calculated to obtain the final T-Hg concentration value.

The final concentration of mercury in rice samples is calculated based on SNI 2354.6:2016 using Eq. 16.

$$Mercury\ level\ (mg/kg) = \frac{(D\text{-}E)\ x\ fp\ x\ Va\ x\ \frac{1L}{1000mL}}{w}\ X\ \frac{1000g}{kg} \quad \text{.....Eq. 16}$$

Where:

*D* = Mercury levels in rice extraction samples from the reading in the lab (mg/L)

*E* = Mercury levels in blank samples from readings in the lab (mg/L)

*W* = Sample weight (g)

*Va* = The final volume of the prepared sample solution (mL)

*fp* = Dilution factor

The results were compared to rice quality standards, which is 0.03 mg/kg based on BPOM Regulation No. 5/2018 concerning Maximum Limit of Heavy Metal Contamination in Processed Foods for Cereals and Cereal Products.

**Measurement of Concentration in Respondent Samples**

**Basics of Sampling**

In measuring mercury levels in humans and medical examinations, several important aspects were considered to achieve an objective, unbiased, efficient, and effective measurement. These include:

1. Preliminary survey. During the preliminary survey, an initial description of environmental conditions had been figured out, the potential sources of mercury pollutants and the number of people exposed to mercury in the study area, and the proper sample size for the study area been determined. At that time, coordination was also carried out regarding the administrative provisions for licensing and communication to the local government and residents.

2. Determination of the type of sample. Mercury enters the human body in the form of inorganic and organic mercury. The duration of exposure can be acute or chronic. Mercury itself has a preference for deposition sites in the body. Based on these various aspects, the following types of samples were selected:
   - In adults in the form of:
     a. Nails and hair. Both samples were easy to obtain and represent chronic mercury deposition and exposure.
     b. Urine on time. This sample is non-invasive and easy to obtain. Mercury levels in the urine represent acute mercury deposition and exposure. The concentration in urine was measured per creatinine unit (protein in urine). Thus, it is necessary to measure the creatinine concentration in urine as well. Measurement of urine protein could also be an indication of kidney damage.
   - In children in the form of urine on time. Mercury concentrations in urine represent acute mercury deposition and exposure. The parameter is essential, primarily if the father works as a miner and/or burns at home or other places that are easily accessible to the children. The concentration in urine was measured per creatine unit (protein in urine), so it is necessary to measure the creatinine concentration in urine. Measurement of urine protein can also be an indication of kidney damage.

3. Determining the type of medical examination. The effects mercury could have on various systems affects the type of physical examination. From various literature, it can be seen that the dominant effect that appears is neurological disorders. Thus, the medical examination was focused on various neurological disorders that may arise. However, it also checks the condition of the body and respiration because mercury is processed by burning. The level of nerve damage and other diseases was also checked using an objective and easily measured method, such as HBM (human biomonitoring).

4. Determination of the number of samples. The number of respondent samples determined, taking into account the duration of the study, the size of the area, the selection of groups, and various medical examinations.

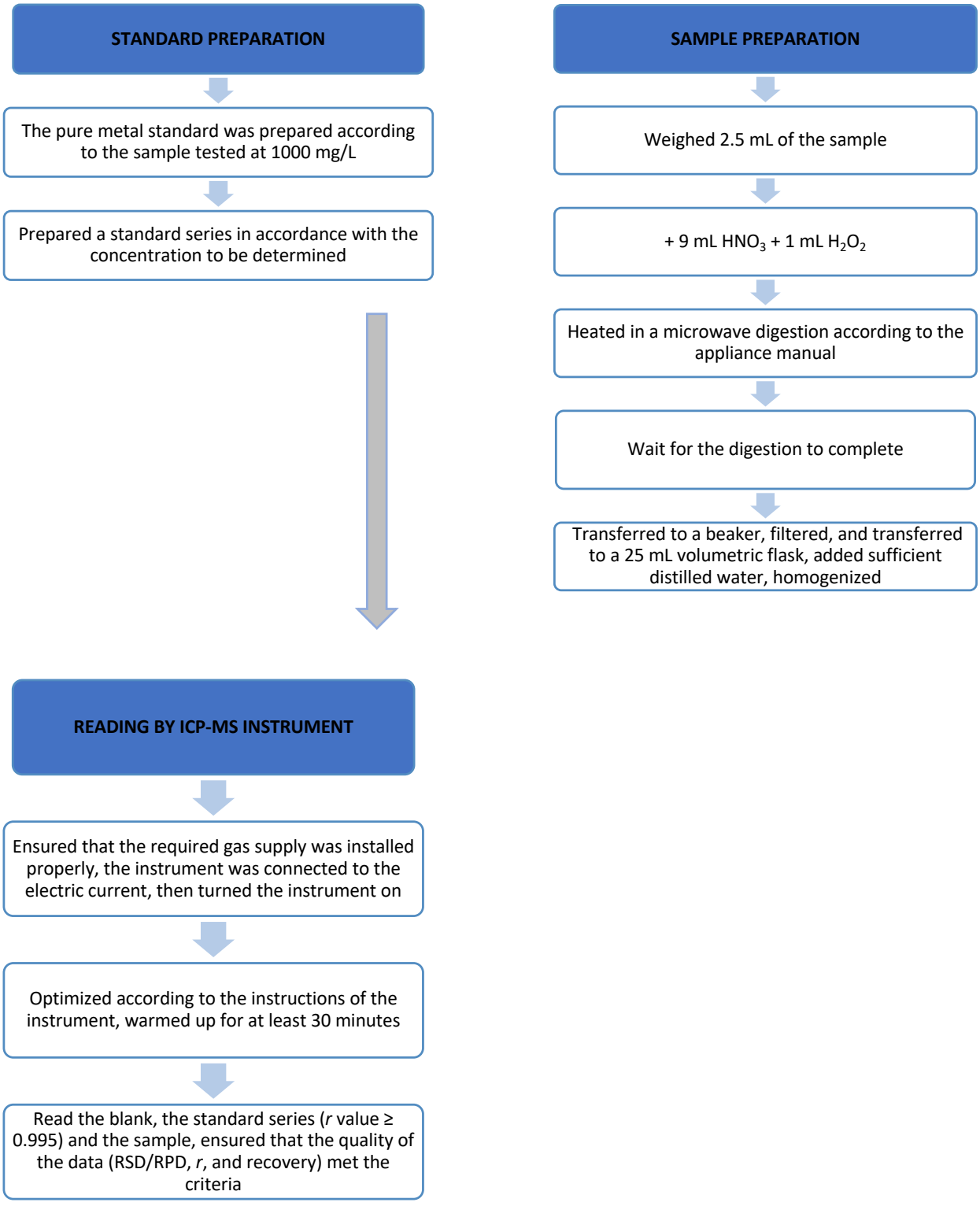
5. Analysis of the characteristics of the respondents. In this activity, interviews were also conducted to assess the likelihood of mercury exposure from other sources, habit patterns, nutrition, and disease, as stated in the interview format, to determine how these things affect the current health condition.

**Measurement of Concentration in Adult Urine Samples**

1. Taking urine samples. Urine samples were taken according to the standards of WHO and UNEP (2008). The urine that is taken is urine at a time. Urine samples were taken and put into two sterile urine pots, each of approximately 30 mL. The first container of urine was not preserved because it was tested for creatinine content in urine, while the second container of urine was preserved in $HNO_3$ to measure the total mercury content, stored in a cool box at 4°C. Creatinine levels were tested in the Clinical Health Laboratory, while the preparation and extraction of urine samples are carried out at the laboratory.

2. Urine sample extraction method. Urine was extracted based on the Mercury Analysis Manual (Ministry of the Environment Japan 2004), as follows:
   - A preserved urine sample was prepared for analysis.
   - 1 mL $HNO_3$ and 1 mL $HClO_4$ were added to the Erlenmeyer.
   - Further, 5 mL of $H_2SO_4$ was added to the sample flask, and 2 mL was added to the Erlenmeyer.
   - All samples were heated on a heating plate for 30 minutes at a temperature of 200 - 230 °C.
   - Afterward, the sample was cooled at room temperature, diluted with 20 mL of distilled water and filtered using Whatman filter paper No. 42.
   - The filtrate was placed into a volumetric flask, and distilled water is added to the final volume of 50 mL, homogenized, and stored in an extraction bottle, and analyzed using the ICP-MS instrument (**Figure III.A.4**).

Figure III.A.4 Flowchart of Hg determination in urine by ICP-MS



(3) Analysis of the total mercury concentration (T-Hg) and the referred quality standard. The mercury content was a number of the mercury concentration in the samples sent, reprocessed to obtain the final mercury concentration.

Mercury levels were calculated using Eq. 17 based on SNI 7387:2009, which was modified for liquid samples as follows:

$$Mercury\ level\ (\mu g/g\ creatinine) = \frac{(D\text{-}E)\ x\ fp\ x\ Va}{Vs} : C\ creatinine \quad \text{.....Eq. 17}$$

Where:

*D* = Mercury levels in the urine sample reading from the lab (mg/L)
E = Level of blank readings from the lab (mg/L)
fp = Dilution factor
Va = Volume of sample extraction solution (L)
Vs = Total sample volume (L)
C = Creatinine level (mg / dL)

The results were then compared with the urine sample quality standard referring to the WHO and UNEP of 5 µg/g creatinine (WHO & UNEP, 2008). Prodia' s laboratory states that creatinine levels in female urine (adult and child) are in the range of 28 mg/dL and for males (adults and children) are in the range of 39 mg/dL.

## Concentration Measurement in Adult Nail Samples

(1) Nail sampling. Nail samples taken had a minimum length of 1 mm. The nails can be fingernails and toes, taken using nail clippers. The nails were first cleaned for dyed nails using acetone before extraction (Sakamoto et al., 2014).

(2) Nail sample extraction method. Nail samples (10 mg) were inserted into the Erlenmeyer, added 1 mL of distilled water, 1 mL of $HNO_3$ and $HClO_4$ each, and 5 mL of $H_2SO_4$, heated for 30 minutes at 200-230 °C. The heated sample was then cooled and added with distilled water to reach a volume of 50 mL (Figure III.A.5).

(3) Analysis of the total mercury concentration (T-Hg) and the referred quality standard. The mercury reading was the number of mercury concentrations in the samples sent. This data is then reprocessed to obtain the final mercury concentration.

The final concentration of mercury was calculated based on SNI 7387:2009 with modifications to the solid sample using Eq. 18.

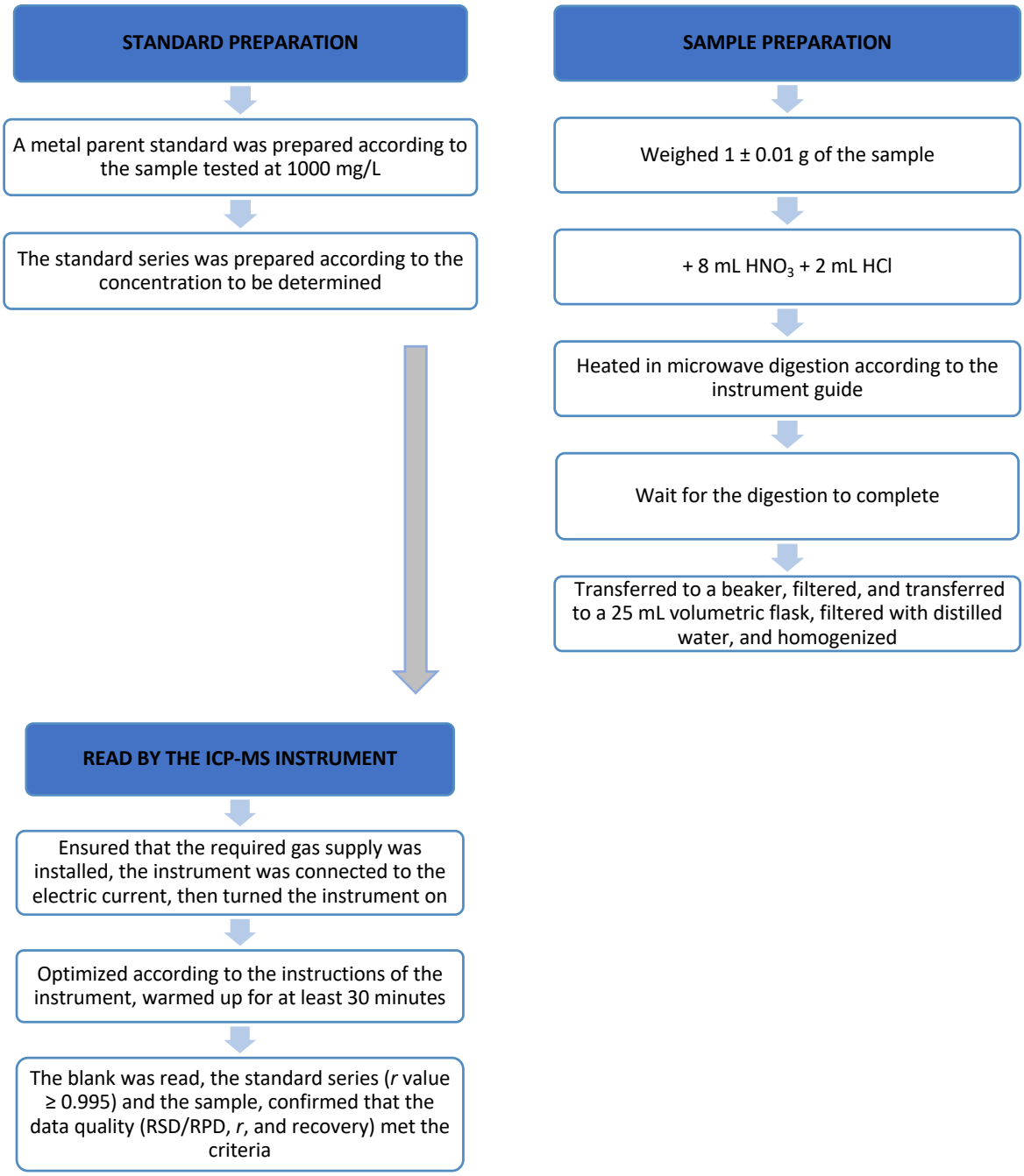
$$Mercury\ level\ (\mu g/g) = \frac{(D\text{-}E)\ x\ fp\ x\ V\ x\ \frac{1L}{1000mL}}{w}\ X\ \frac{1000\ \mu g}{1\ mg} \quad \text{.....Eq. 18}$$

Where:

*D* = Mercury levels in the extracted sample (mg/L) from the reading in the lab
*E* = Sample blank level (mg/L) from the reading in the lab
*W* = Sample weight (g)
*V* = The final volume of the prepared sample solution (mL)
*fp* = Dilution factor

The results obtained were compared with the quality standard of nail samples referring to the Guidance for Identifying Population at Risk from Mercury Exposure published by WHO and UNEP, i.e., 1.6 µg/g.

**Figure III.A.5 Flowchart for determination of Hg metal content in nails using ICP-MS instrument**



## Measurement of Concentration in Adult Hair Samples

(1) Hair sampling. The mercury content in hair is often used as a biomarker for methylmercury exposure because the mercury content in hair reflects the concentration of mercury in the blood when the hair grows. The concentration of mercury in hair is usually around 250-300x blood mercury concentration. The exposure that occurs for a long time can still be known because the hair grows about 1 cm per month. If there is no exposure to inorganic mercury or mercury vapor, almost all of the mercury content in hair is in the form of methylmercury. Therefore, the amount of exposure to methylmercury from food can be determined by measuring the total mercury. However, because people involved in gold mining and gold processing have a high risk of exposure to inorganic mercury and mercury vapors, evaluating methylmercury exposure is only possible by measuring methylmercury itself. Based on the Mercury Analysis Manual (Ministry of Environment Japan 2004), the hair sample is taken from the occipital area of the head and should consist of at least 20 hairs 1 cm long, taken using scissors at the roots. Then the hair samples were placed in a PE bag and stored at room temperature.

(2) Hair sample extraction method. 10 mg of hair samples were inserted into Erlenmeyer and added with 1 mL of distilled water, 1 mL of $HNO_3$ and $HClO_4$ each, and 5 mL of $H_2SO_4$. Furthermore, the mixture was heated for 30 minutes at 200-230 °C. The sample was then cooled and added with distilled water until a volume of 50 mL (**Figure III.A.3**).

(3) Analysis of the total mercury concentration (T-Hg) and the referred quality standard. The reading of mercury results from the laboratory was in mercury concentration.

The final concentration of mercury was calculated based on SNI 7387:2009 with modifications to the solid sample using Eq. 19.

$$Mercury\ level\ (\mu g/g) = \frac{(D-E)\ x\ fp\ x\ V\ x\ \frac{1L}{1000mL}}{w}\ X\ \frac{1000\ \mu g}{1\ mg} \quad \text{.....Eq. 19}$$

Where:

*D* = Mercury levels in the extracted sample (mg/L) from the reading in the lab

*E* = Sample blank level (mg/L) from the reading in the lab

*W* = Sample weight (g)

*V* = The final volume of the prepared sample solution (mL)

*fp* = Dilution factor

The results were compared with the quality standard of hair samples referring to the Guidance for Identifying Population at Risk from Mercury Exposure published by WHO and UNEP, i.e., 2 µg/g.

## Measurement of Concentration in Children's Urine Samples

(1) Taking urine samples. Urine samples were taken from children aged 6-12 years according to standards from WHO and UNEP (2008). The urine that is taken is urine at a time. The child's urine sample was taken and put into two sterile urine containers, each of approximately 30 mL urine. The sample in the first container (for creatinine determination) was not preserved, while the other was preserved in $HNO_3$ and stored in a cool box at 4°C. Creatinine levels are tested in the Clinical Health Laboratory, while the preparation and extraction of urine samples were carried out at the laboratory.

(2) Urine sample extraction method. Urine was extracted according to the Mercury Analysis Manual (Ministry of the Environment Japan 2004), as follows:

- A preserved urine sample was prepared for analysis.
- 1 mL $HNO_3$ and 1 mL $HClO_4$ were added to the Erlenmeyer flask.
- Subsequently, 5 mL of $H_2SO_4$ was added to the sample flask, and 2 mL of urine was introduced to the Erlenmeyer. The mixture was heated on a heating plate for 30 minutes at a temperature of 200–230 °C.
- Afterward, the mixture was cooled at room temperature, diluted with 20 mL of distilled water, and filtered using Whatman filter paper No. 42. The filtrate was transferred into a volumetric flask and distilled water was added until the final volume was 50 mL. The mixture was homogenized and stored in an extraction bottle, and analyzed using the AAS instrument.

(3) Analysis of the total mercury concentration (T-Hg) and the referred quality standard. The mercury reading from the laboratory was reported as the final mercury concentration. Mercury levels were calculated using Eq. 20 based on SNI 7387:2009, which is modified for liquid samples as follows:

$$Mercury\ content\ (\mu g/g) = \frac{(D-E)\ x\ fp\ x\ Va}{Vs} : C\ creatinine \quad \text{.....Eq. 20}$$

Where:

*D* = Mercury levels in the urine sample reading from the lab (mg/L)
*E* = Level blank reading from the lab (mg/L)
*fp* = Dilution factor
*Va* = Volume of sample extraction solution (L)
Vs = Total sample volume (L)
*C* = Creatinine level (mg/dL)

The results were compared with the urine sample quality standard referring to the WHO and UNEP of 5 µg/g creatinine (WHO & UNEP, 2008).

## Adult Health Examination

### Human Biomonitoring

Human biomonitoring (HBM) is a measurement of biomarkers in humans (Bose-O'Reilly et al., 2016). HBM measures the concentration level of a substance or chemical compound resulting from exposure to humans. HBM has been used as a tool to measure exposure to chemicals in humans to inform public health, risk determination, and risk management decisions. HBM can be used as an indicator in determining intoxication by a specific chemical, such as mercury. The chronic effects of mercury exposure can be measured by the HBM method.

There are several tests carried out on respondents, including:

(1) History test. In this test, respondents were asked about their general health conditions related to complaints due to mercury exposure. Questions can be in the form of frequently salivating and several other questions related to smoking habits, work, activities, and the situation of the respondent's residence. After the respondents were asked, the respondents were examined on the palate, inner cheeks, using amalgam tooth fillings or not, and the color of the gums was checked whether they looked bluish-gray or pink.

(2) Ataxia test. The ataxia test is a test to determine the loss of muscle coordination. The ataxia test is carried out in two stages:
- First. Respondents were asked to walk on the floor in a straight line with their eyes open, followed by their eyes closed.
- Second. Respondents stood with open arms about 45 degrees from the side of the body. The sweeping motion was made by swinging the arm so that the fingertips almost touch the tip of the nose with the eyes open, then after smooth doing it with the eyes closed.

(3) Tremor test. This test was to detect vibrations due to repeated and uncontrolled muscle contractions in the hands, arms, eyelids, and other parts of the body. The respondent stood up, stretched his arms forward with open palms, and then placed a sheet of paper. Movement is repeated with the palms face down. If it vibrates, it means that the respondent is experiencing tremors.

(4) Dysdiadochokinesia test. This test is to determine the disturbance of vibration coordination. In this test, the respondent is asked to stand with his arms raised and bent at ear level and then asked to rotate his hands on his wrists. Movement is done over and over with the eyes open then with the eyes closed.

(5) Neuropsychology test. The neuropsychological test is carried out in two stages:
- First. In the test, an empty matchbox was laid on a table; 10 matchsticks were on the left and right of the box, each 15 cm apart. Respondents were asked to enter a matchstick alternating left and right into the matchbox. Healthy respondents will be able to complete it in less than 17 seconds.
- Second. The respondent was asked to make as many random dots on the paper as possible using a pencil or pen. Healthy respondents will be able to make > 45 dots in 10 seconds.

After the examination is complete, all test scores are added, and the total medical score is obtained. Furthermore, mercury concentration in urine and hair was categorized as compared to the respective quality standards. Classification of urine and hair mercury product categories can be seen in **Table III.A1**.

**Table III.A.1 Threshold values for mercury in urine and hair**

| | Hg urine (µg/g creatinine) | Hg hair (µg/g) | Remarks |
|---|---|---|---|
| <HBM I | 0-5 | 0-1 | Normal |
| HBM 1-HBM II | 5-20 | 1-5 | Alert |
| > HBM II | > 20 | > 5 | High |

The HBM classification obtained in Table 2.1 is compared with the results of the total media score to get a diagnosis conclusion whether the respondent has mercury poisoning or not. Guidelines for the classification of a diagnosis of mercury intoxication can be seen in **Table III.A.2**.

**Table III.A.2 Guidelines for the diagnosis of mercury poisoning based on HBM values**

| | | Total medical score | | |
|---|---|---|---|---|
| | | 0–2 | 3–4 | 5–10 |
| Mercury in all specimens | <HBM I | - | - | - |
| Mercury in at least one of the specimens | >HBM I | - | - | + |
| | >HBM II | - | + | + |
| Algorithm for the diagnosis of "chronic mercury poisoning" | | | | |
| HBM = Human Biomonitoring value | | | | |
| Decision: - = intoxicated, + = toxicated | | | | |

## General Health Examination

Respondents' health is generally checked through the following stages:

(1) History. Each subject was asked about recent health complaints and history of illness, both suffered by themselves and their families (hereditary diseases).

(2) Vital sign examination includes:
- Measurement of blood pressure using a spring sphygmomanometer. Interpretation of results was carried out following JNC 7 guidelines, namely normal blood pressure when systole < 120 mmHg or diastole < 80 mmHg. Subjects were classified as hypertension if systole > 130 and diastole > 80.
- The pulse rate was measured manually by counting the number of radial pulse pulses on the wrist using a stopwatch for 1 minute.
- Respiratory rate was measured manually by counting the pattern and frequency of breaths in 1 minute.

(3) General awareness and physical condition. The level of consciousness was generally measured using the Glasgow Comma Scale. General health conditions were examined throughout the body (head-to-toe examination) (Bickley, 2020). The examiner looked at the following parts of the body to check for abnormalities:
- Head area, such as conjunctiva, sclera, pharynx, tongue, neck lymph nodes;
- The chest area, by the method of inspection and auscultation of the heart and lungs;
- Abdominal area, by a method of inspection, auscultation of bowel sounds and palpation;
- Limb area, to see any deformities, skin lesions, edema, and capillary refill time.

(4) Neurological examination. Following the guidelines (Bickley, 2020), which are adapted to the situation and conditions in the study area, a neurological examination is to evaluate the following:
- Light and sharp pressure sensory abilities and motor strength in the extremities. Motor power is measured on a scale of 0-4.
- Babinski's pathological reflex.
- Cranial nerve I-XII examination.
- Movement coordination functions, such as the rapid alternate movement test, finger-nose test, finger tap test, heel-shin test, Romberg test, Gait test, and tremor test.

- Cognition function using Mini-Mental State Examination (MMSE). The results of the MMSE are interpreted as follows:
  - Score < 9, there is severe cognitive impairment
  - Score 10-18, there is moderate cognitive impairment
  - Score 1923, there was a mild cognitive impairment
  - Score > 24, normal

## Interview

Respondents were interviewed using standard question sheets as in Appendix 2 of the field visit reports). The interviewer filled in the data. The information collected includes:

- Identity: name, age, gender, address, height, body weight,
- House conditions,
- Conditions of work and income,
- Diet and nutrition patterns,
- Medical history,
- History of pregnancy and birth, and
- Mercury exposure routes.

## Socio-economic Analysis

The data in this survey were collected using several methods, namely desk study, interviews with questionnaire guides, in-depth interviews, and field observations. Some of these methods aimed to gain a deeper understanding and enrich the interpretation of various existing phenomena:

(1) Literature study (desk study). Data and information were collected through examination and analysis of theories, data, and information from various sources related to ASGM and its impact on the socio-economic demographic conditions of families around the mining area. These sources include textbooks, research reports, development report data, and other planning documents.

(2) Interview. Interviews were conducted with households (head of household or representative) who were selected as respondents. The information collected includes:
   - The socio-economic demographic conditions of the family before mining in the village,
   - Current socio-economic demographic conditions of the family,
   - Participation and involvement of family/family members in mining,
   - Problems faced and felt by families due to mining activities,
   - Family views regarding the impact of mining, both positive and negative,
   - Family hopes for the improvement of the current conditions.

(3) In-depth Interview. In-depth interviews were conducted with key informants using an interview guide in the form of a list of important and sensitive data and information regarding the impact of mining on the socio-economic demographic conditions of the family. In-depth interviews were also conducted with several households that had previously been selected as respondents in the research village.

(4) Field observation. Field observations were intended to observe the visual and actual conditions of mining activities and impacts on the socio-economic demographic conditions of the family. Field observations are equipped with equipment for audio-visual recording. The data were processed through descriptive and qualitative statistical analysis. Descriptive statistical analysis was intended to analyze families' social and economic demographic characteristics around the mining area.

ASGM impact management strategies are formulated based on the results of previous descriptive and qualitative statistical analyzes, tabulated in the SWOT matrix (Strengths-Weaknesses-Opportunities-Threats). The SWOT matrix is a systematic way to identify environmental factors and an effective strategy for the industry. This analysis assumed that an effective strategy would maximize strengths and opportunities and minimize weaknesses and threats (Sarsby, 2016).

The SWOT matrix is a matching tool for business actors in developing four types of strategies, namely SO (Strengths Opportunities), ST (Strengths-Threats), WO (Weaknesses-Opportunities), and WT (Weaknesses-Threats) (Sarsby, 2018), SO uses internal strength to take advantage of external

opportunities. The WO strategy aims to improve internal weaknesses and take advantage of external opportunities. ST strategy uses internal strength to avoid or reduce the influence of internal threats. The WT strategy is a defensive tactic aimed at reducing internal weaknesses and avoiding external threats. The SWOT matrix can be seen in **Table III.A.3**.

**Table III.A.3 SWOT Matrix**

| | Strength-S (Strength)<br>Write down Strengths | Weakness-W (Weakness)<br>Write Down Weaknesses |
|---|---|---|
| Opportunities-O (Opportunities)<br>Write down Opportunities | SO strategy<br>Use strength by taking advantage of opportunities | WO strategy<br>Overcome weaknesses by taking advantage of opportunities |
| Threats-T (Threats)<br>Write down Threats | ST strategy<br>Use force to avoid threats | WT strategy<br>Minimizing weaknesses and avoiding threats |

Source: (Sarsby, 2016)

## B. Results of ASGM Study in Six ASGM Locations in Indonesia by MOEF, BSCRC-SEA and Field Survey Team Year 2021

### B.1. Lebakgedong District, Lebak Regency, Banten Province




**Figure III.B.1.1. Region map of Lebakgedong District, Lebak Regency, Banten Province**

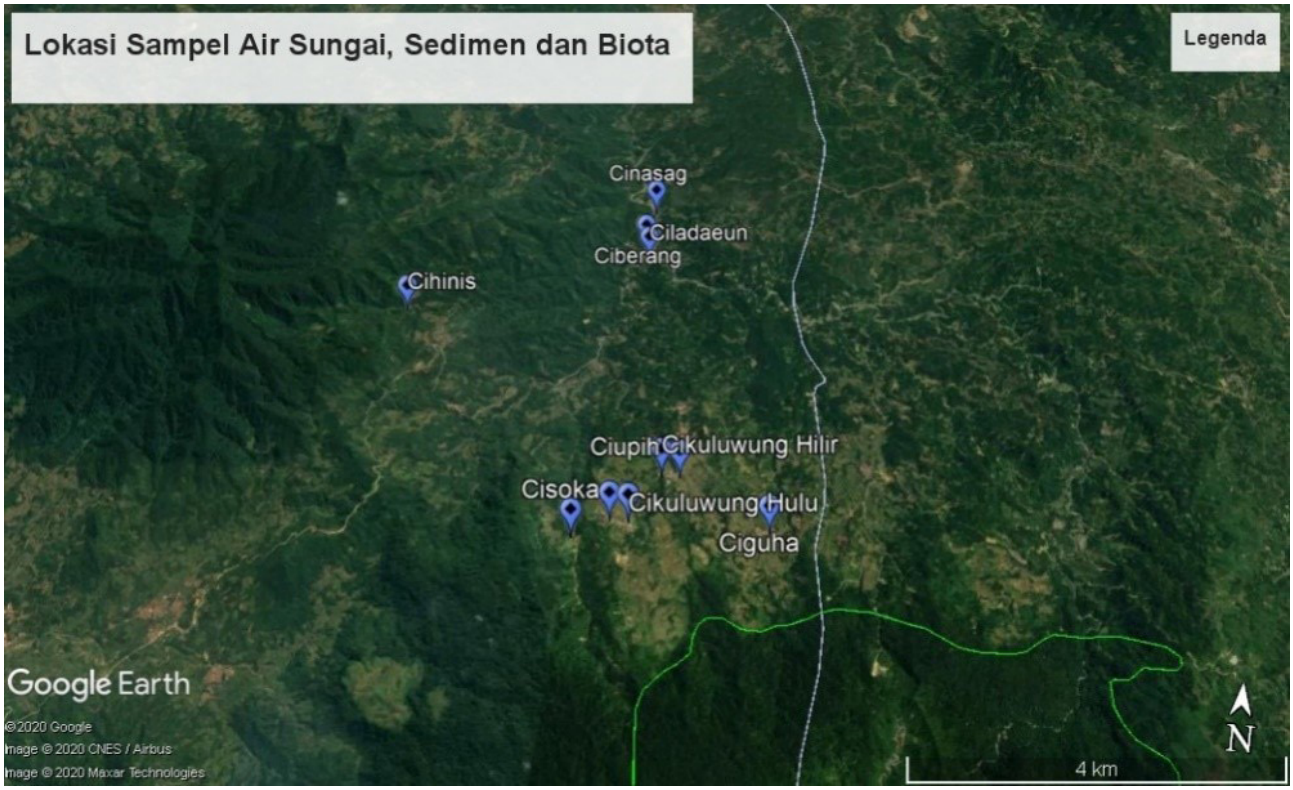



**Figure III.B.1.2. Location of water, sediment and biota sampling in Lebakgedong District**




**Figure III.B.1.3. Location of soil and plant sampling in Lebakgedong District**




**Figure III.B.1.4. Location of river water, sediment, fish, soil and plants sampling in Lebakgedong District**

**Table III.B.1.1. Hg levels in tailings wastewater in Lebakgedong District**

| Location | Sample code | Time | Date | Location | | µg/L | mg/L | |
|---|---|---|---|---|---|---|---|---|
| | | | | East Longitude | South latitude | | Result | * Quality standards |
| Cisoka Trommels rinse water | LG-TA1 | 10:37 | 17-Nov-20 | -6.643 | 106.409 | 2.951 | 0.003 | 0.005 |

Remarks: does not exceed the quality standard of tailings wastewater

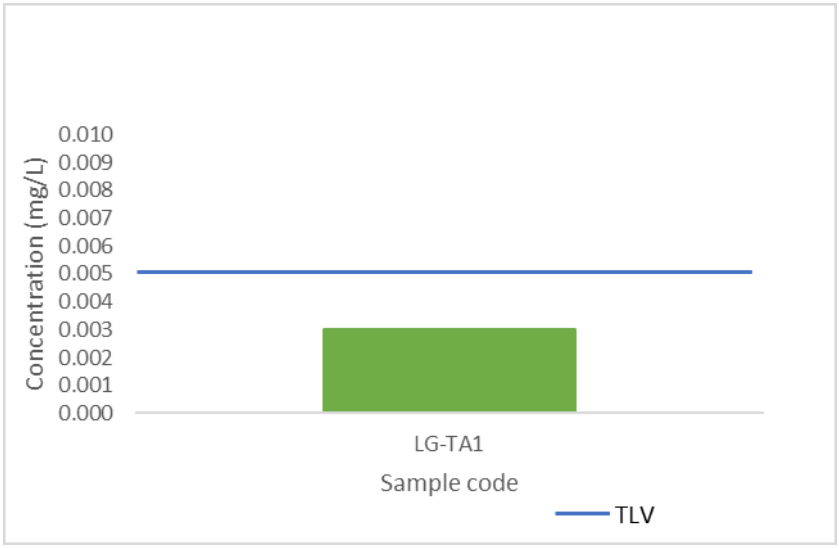



**Figure III.B.1.5. Hg Concentration in tailings wastewater in Lebakgedong District**

**Table III.B.1.2. Hg content in tailings sediment/mud in Lebakgedong District**

| Location | Sample Code | Time | Date | Location | | mg/kg | |
|---|---|---|---|---|---|---|---|
| | | | | East Longitude | South latitude | Result | * Quality standards |
| Trommels Ciladaeun | LG-TS1 | 10:43 | 18-Nov-20 | -6.605 | 106.410 | 4.975 | 0.3 |
| Trommels Cisoka | LG-TS2 | 10:37 | 17-Nov-20 | -6.643 | 106.409 | 3.587 | 0.3 |

Min = 3.587; Max = 4.975; Avg 4.281

Remarks

Exceed Quality Standards

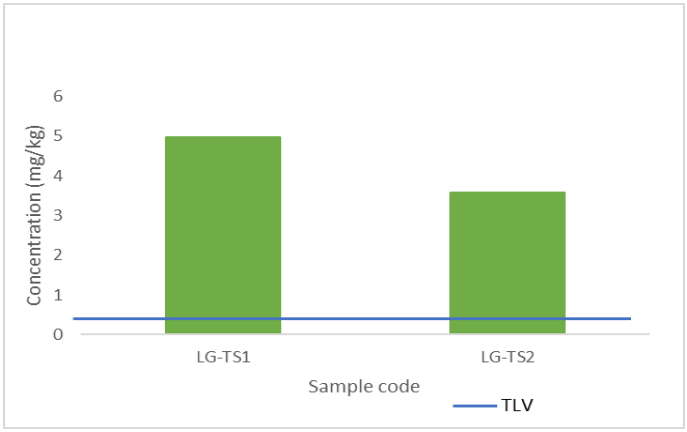



**Figure III.B.1.6. Hg content in tailings sediment/mud in Lebakgedong District**

**Table III.B.1.3. Hg level in drinking water in Lebakgedong District**

| Location | Sample Code | Time | Date | Location | | µg/L | mg/L | |
|---|---|---|---|---|---|---|---|---|
| | | | | East Longitude | South latitude | | Results | *Quality Standards |
| Tub water in Mr. Supra's house (Ciuluwung Hulu) | LG-AM1 | 10:55 | 16-Nov-20 | -6.643 | 106.411 | 0.786 | 0.001 | 0.001 |

* Minister of Health Regulation No 32/2017 concerning drinking water, 0.001 mg/L.

**Table III.B.1.4. Hg level in river water in Lebakgedong District**

| No | Location | Sample Code | Time | Date | Location | | Result Mg/L |
|---|---|---|---|---|---|---|---|
| | | | | | EL | SL | |
| 1 | Cikuwulung Hilir River | LG-AS1 | 14:05 | 16-Nov-20 | - 6.637 | 106.414 | 0.003 |
| 2 | Cilupih River | LG-AS2 | 14:49 | 16-Nov-20 | - 6.637 | 106.416 | 0.001 |
| 3 | Cisoka River | LG-AS3 | 09:35 | 17-Nov-20 | - 6.645 | 106.405 | 0.001 |
| 4 | Ciguha River | LG-AS4 | 11:22 | 17-Nov-20 | - 6.643 | 106.426 | < 0.0005 |
| 5 | Cihinis River | LG-AS5 | 08:41 | 18-Nov-20 | - 6.619 | 106.382 | 0.001 |
| 6 | Ciladaeun River | LG-AS6 | 10:40 | 18-Nov-20 | - 6.607 | 106.410 | 0.002 |
| 7 | Cinasag River | LG-AS7 | 14:56 | 18-Nov-20 | - 6.601 | 106.410 | 0.001 |
| 8 | Ciberang River | LG-AS8 | 17:33 | 18-Nov-20 | - 6.606 | 106.409 | 0.001 |

Min. < 0.0005; max. 0.03 mg/L
Based on GR No. 22/2021, xxx exceeds the quality standard for class I (0.001 mg/L); xxx exceeds class II and III (0.002 mg/L).

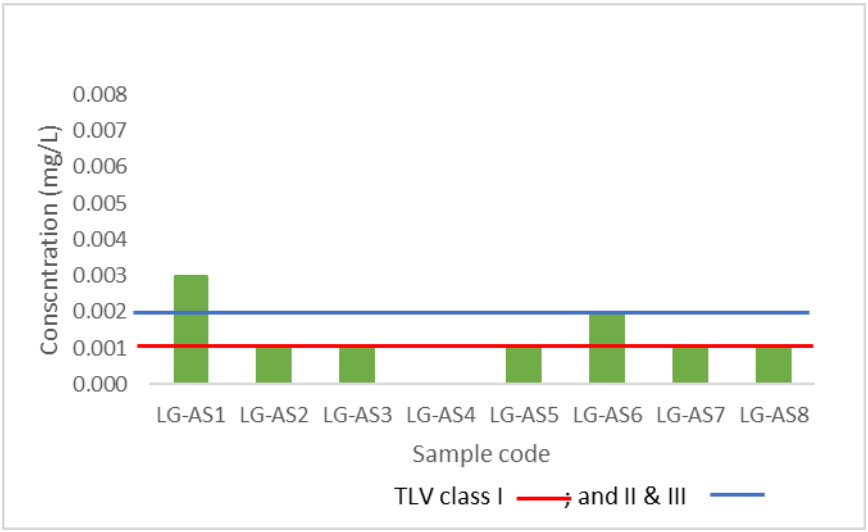



**Figure III.B.1.7. Hg level in river water in Lebakgedong District**

**Table III.B.1.5. Hg Levels in Riverbed Sediments in Lebakgedong District**

| No | Location | Sample Code | Time | Date | Location | | River Sediment mg/kg | |
|---|---|---|---|---|---|---|---|---|
| | | | | | East Longitude | South latitude | Results | *Quality Standards |
| 1 | Cikuluwung Hilir River | LG-SS1 | 14:05 | 16-Nov-20 | -6.637 | 106.414 | 3.131 | 0.3 |
| 2 | Ciupih River | LG-SS2 | 14:49 | 16-Nov-20 | -6.637 | 106.416 | 4.232 | 0.3 |
| 3 | Cisoka River | LG-SS3 | 09:35 | 17-Nov-20 | -6.645 | 106.405 | 1.366 | 0.3 |
| 4 | Ciguha River | LG-SS4 | 11:22 | 17-Nov-20 | -6.643 | 106.426 | 2.793 | 0.3 |
| 5 | Cihinis River | LG-SS5 | 08:41 | 18-Nov-20 | -6.619 | 106.382 | 5.897 | 0.3 |
| 6 | Ciladaeun River | LG-SS6 | 10:40 | 18-Nov-20 | -6.607 | 106.410 | 1.752 | 0.3 |
| 7 | Cinasag River | LG-SS7 | 14:56 | 18-Nov-20 | -6.601 | 106.410 | 2.214 | 0.3 |
| 8 | Ciberang River | LG-SS8 | 17:33 | 18-Nov-20 | -6.606 | 106.409 | 4.336 | 0.3 |

The NAV of contaminated soil is 0.3 mg/kg for the total mercury concentration (Government Regulation No. 22/2021 Annex XIII).

Exceed Quality Standards

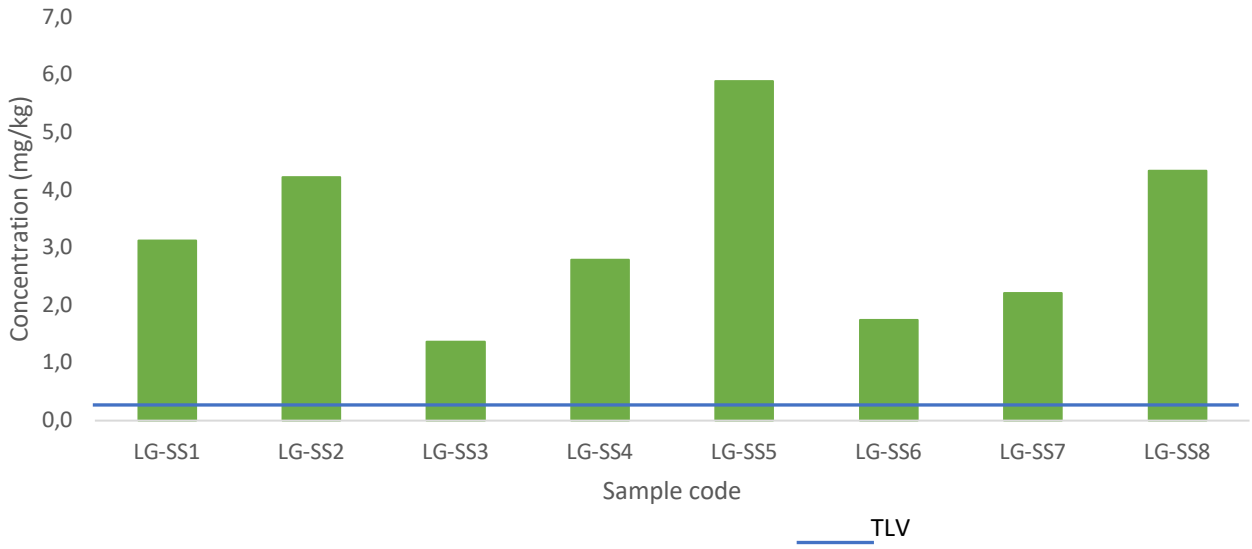



**Figure III.B.1.8. Hg levels in riverbed sediments in Lebakgedong District**

**Table III.B.1.6. Hg content in plantation soil in Lebakgedong District**

| No | Location | Sample Code | Time | Date | Lokasi | | mg/kg DW | |
|---|---|---|---|---|---|---|---|---|
| | | | | | East Longitude | South latitude | Results | *Quality Standards |
| 1 | Ciladaeun garden near trommels | LG-Soil1 | 10:43 | 18-Nov-20 | -6.605 | 106.410 | 2.361 | 0.3 |
| 2 | Cinasag garden | LG-Soil2 | 14:56 | 18-Nov-20 | -6.601 | 106.410 | 4.112 | 0.3 |
| 3 | Cisoka garden | LG-Soil3 | 09:35 | 17-Nov-20 | -6.645 | 106.405 | 2.261 | 0.3 |
| 4 | Ciguha garden | LG-Soil4 | 11:22 | 17-Nov-20 | -6.643 | 106.426 | 3.654 | 0.3 |
| 5 | Ciupih rice field | LG-Soil5 | 14:49 | 16-Nov-20 | -6.637 | 106.416 | 1.908 | 0.3 |
| 6 | Cihinis rice field | LG-Soil6 | 08:41 | 18-Nov-20 | -6.619 | 106.382 | 5.116 | 0.3 |
| 7 | Cikuluwung Hilir rice field | LG-Soil7 | 14:05 | 16-Nov-20 | -6.637 | 106.414 | 3.841 | 0.3 |
| 8 | Near Ciladaeun River | LG-Soil8 | 10:40 | 18-Nov-20 | -6.607 | 106.410 | 2.179 | 0.3 |
| 9 | Ciladaeun Garden of Abah Adung | LG-Soil9 | 08:40 | 19-Nov-20 | -6.602 | 106.409 | 5.137 | 0.3 |
| 10 | Near Ciberang River | LG-Soil10 | 07:40 | 19-Nov-20 | -6.609 | 106.405 | 2.579 | 0.3 |

* The quality standard of contaminated soil is 0.3 mg/kg for the total concentration of mercury for the determination of the management of soil contaminated with B3 waste as stated in Government Regulation No. 22/2021 Annex XIII.

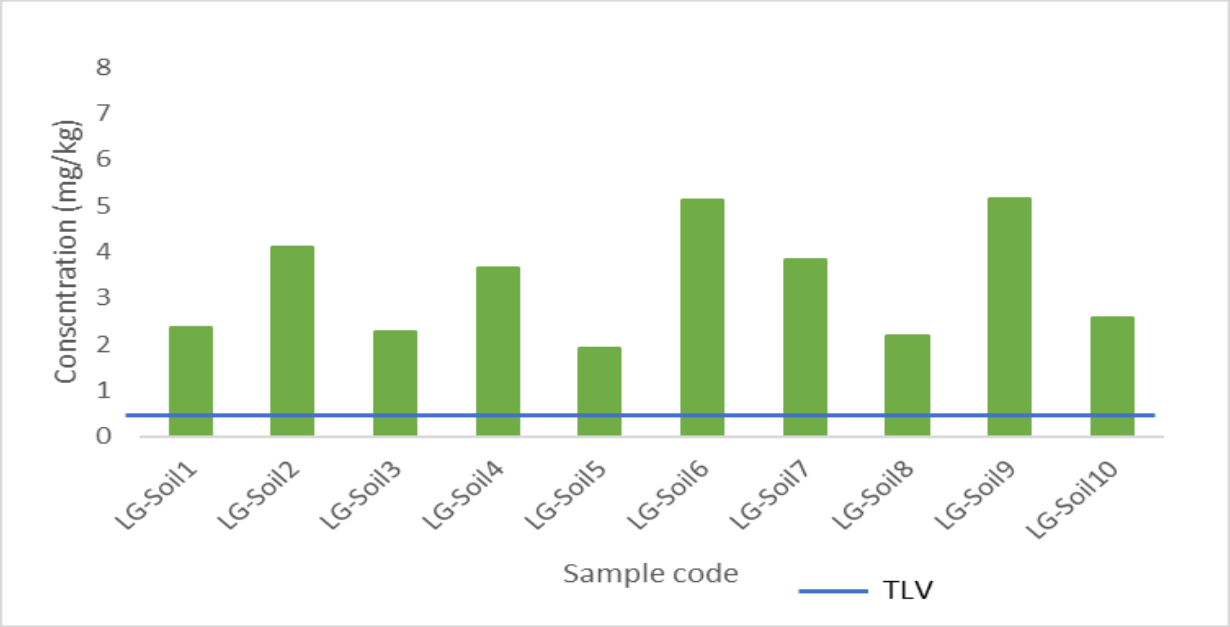



**Figure III.B.1.9. Hg content in plantation soil in Lebakgedong District**

**Table III.B.1.7. Levels of Hg in garden/consumption crops in Lebakgedong District**

| No | Location | Sample Code | Time | Date | Location | | mg/kg DW | |
|---|---|---|---|---|---|---|---|---|
| | | | | | East Longitude | South latitude | Results | *Quality Standards |
| 1 | Ciladaeun garden near trommels | LG-Plant1 | 10:43 | 18-Nov-20 | -6,605 | 106.410 | 0.254 | 0.03 |
| 2 | Cinasag garden | LG-Plant2 | 14:56 | 18-Nov-20 | -6,601 | 106.410 | 0.331 | 0.03 |
| 3 | Cisoka garden | LG-Plant3 | 09:35 | 17-Nov-20 | -6,645 | 106.405 | 0.098 | 0.03 |
| 4 | Ciguha rice field | LG-Plant4 | 11:22 | 17-Nov-20 | -6,643 | 106.426 | 0.054 | 0.03 |
| 5 | Ciupih rice field | LG-Plant5 | 14:49 | 16-Nov-20 | -6,637 | 106.416 | 0.321 | 0.03 |
| 6 | Cihinis rice field | LG-Plant6 | 08:41 | 18-Nov-20 | -6,619 | 106.382 | 0.167 | 0.03 |
| 7 | Cikuluwung Hilir rice field | LG-Plant7 | 14:05 | 16-Nov-20 | -6,637 | 106.414 | 0.623 | 0.03 |
| 8 | Near Sungai Ciladaeun | LG-Plant8 | 10:40 | 18-Nov-20 | -6,607 | 106.410 | 0.418 | 0.03 |
| 9 | Ciladaeun Abah Adung garden | LG-Plant9 | 08:40 | 19-Nov-20 | -6,602 | 106.409 | 0.339 | 0.03 |
| 10 | Near Ciberang River | LG-Plant10 | 07:40 | 19-Nov-20 | -6,609 | 106.405 | 0.362 | 0.03 |

*BPOM Regulation No: 5 of 2018

Exceed Quality Standards

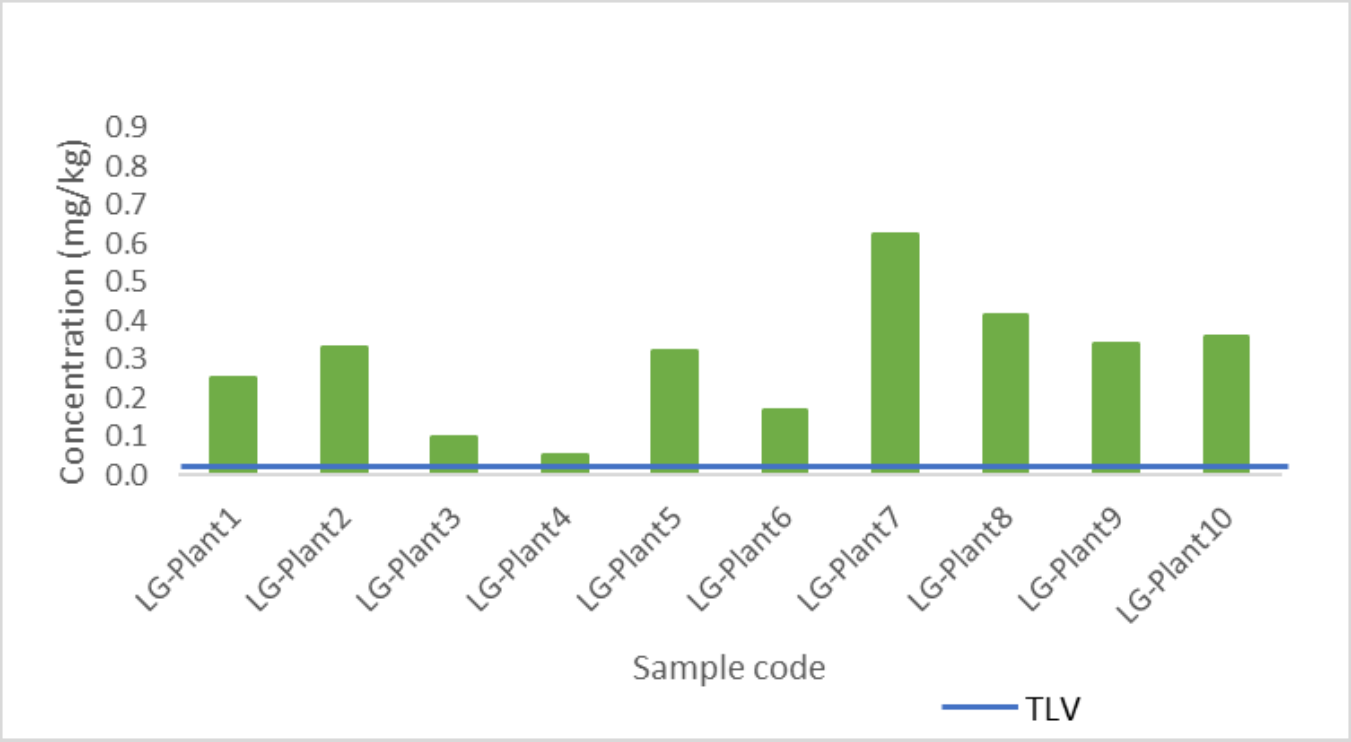



**Figure III.B.1.10. Mercury content in garden crops and consumption crops in Lebakgedong District**

**Table III.B.1.8. Hg levels in river and fish biota in Lebakgedong District**

| No | Location | Sample Code | Time | Date | Lokasi | | mg/kg | |
|---|---|---|---|---|---|---|---|---|
| | | | | | East Longitude | South latitude | Results | Quality Standards |
| 1 | Cikuluwung Hulu River | LG-Bio1 | 10:55 | 16-Nov-20 | -6.643 | 106.411 | 0,.287 | 0.50 |
| 2 | Cikuluwung Hilir River | LG-Bio2 | 14:05 | 16-Nov-20 | -6.637 | 106.414 | 0.322 | 0.50 |
| 3 | Ciupih River | LG-Bio3 | 14:49 | 16-Nov-20 | -6.637 | 106.416 | 0.142 | 0.50 |
| 4 | Cisoka River | LG-Bio4 | 09:35 | 17-Nov-20 | -6.645 | 106.405 | 0.071 | 0.50 |
| 5 | Ciguha River | LG-Bio5 | 11:22 | 17-Nov-20 | -6.643 | 106.426 | 0.015 | 0.50 |
| 6 | Cihinis River | LG-Bio6 | 08:41 | 18-Nov-20 | -6.619 | 106.382 | 0.214 | 0.50 |
| 7 | Ciladaeun River | LG-Bio7 | 10:40 | 18-Nov-20 | -6.607 | 106.410 | 0.383 | 0.50 |
| 8 | Cinasag River | LG-Bio8 | 14:56 | 18-Nov-20 | -6.601 | 106.410 | 0.056 | 0.50 |
| 9 | Ciberang River | LG-Bio9 | 17:33 | 18-Nov-20 | -6.606 | 106.409 | 0.102 | 0.50 |
| 10 | Lebakgedong Public Pond | LG-Bio10 | 08:33 | 19-Nov-20 | -6.698 | 106.335 | 0.155 | 0.50 |

* BPOM Regulation No. 5/2018 concerning Quality Standards of Metal Pollution in Food for Fish and Fishery Products




**Figure III.B.1.11. Hg levels in river and fish biota in Lebakgedong District**

**Table III.B.1.9. Hg level in local rice in Lebakgedong District**

| Location | Sample Code | mg/kg | |
|---|---|---|---|
| | | Results | *Quality Standards |
| Rice Lebaksitu Village | LG-BRL1 | 0.10 | 0.03 |

Keterangan:

Exceed Quality Standards

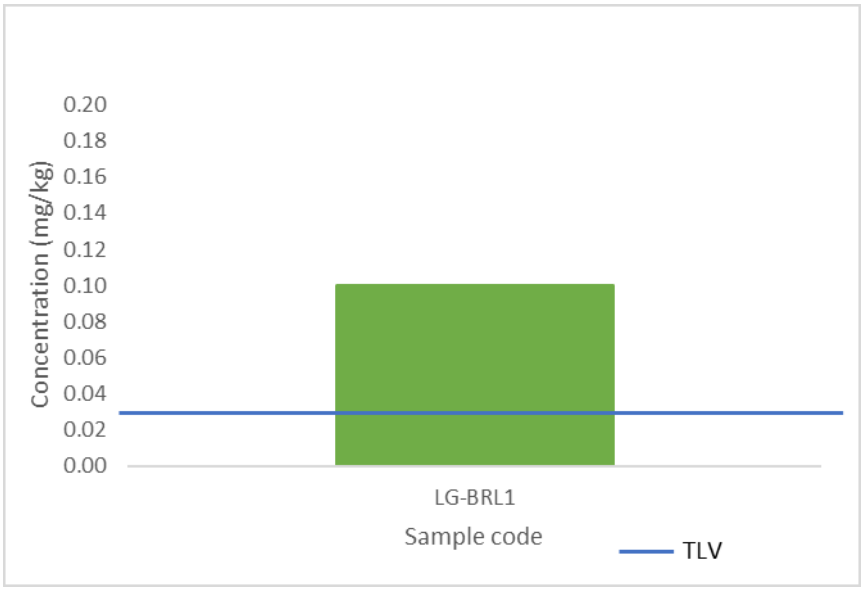



**Figure III.B.1.12. Hg level in local rice in Lebakgedong District**

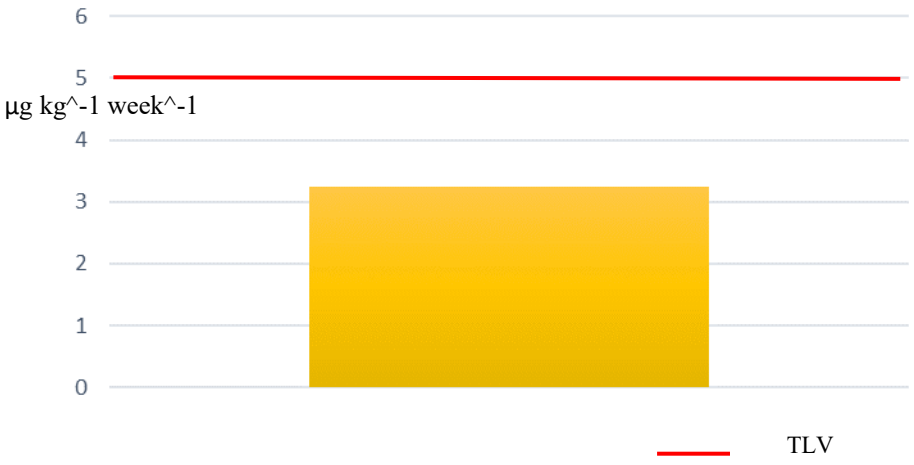



**Figure III.B.1.13. The PTWI value of mercury in respondents compared with the quality standard for Lebakgedong District**

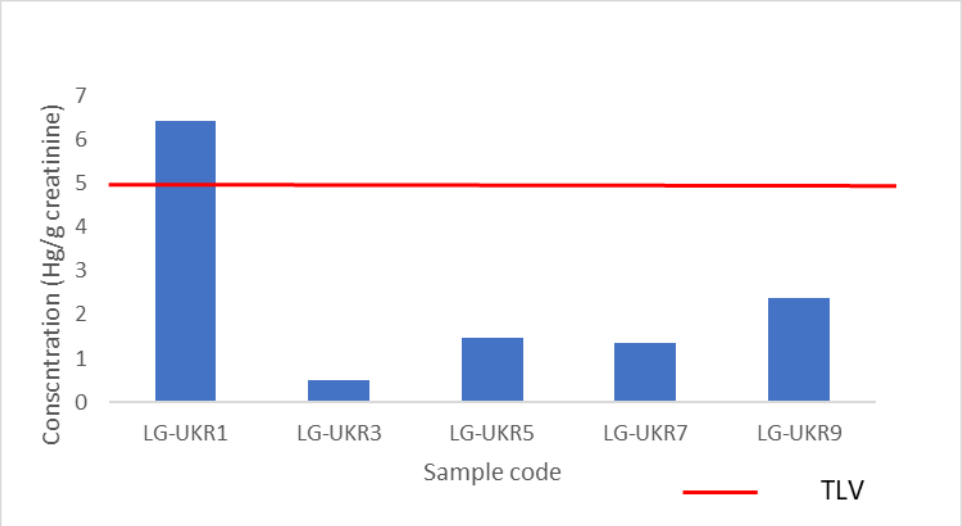



**Figure III.B.1.14. Mercury/g creatinine concentration in adult urine in Lebakgedong District**

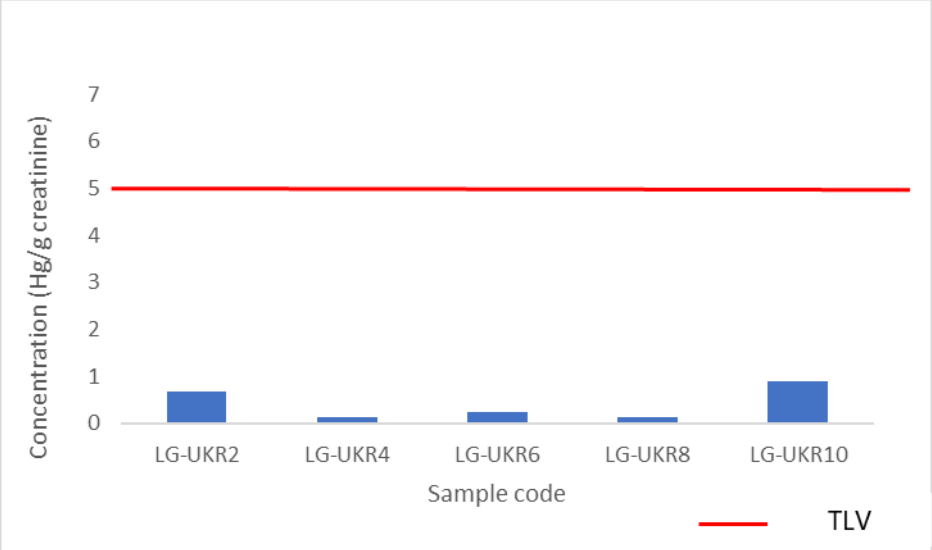



**Figure III.B.1.15. Concentration of mercury/g creatinine in urine of children in Lebakgedong District**

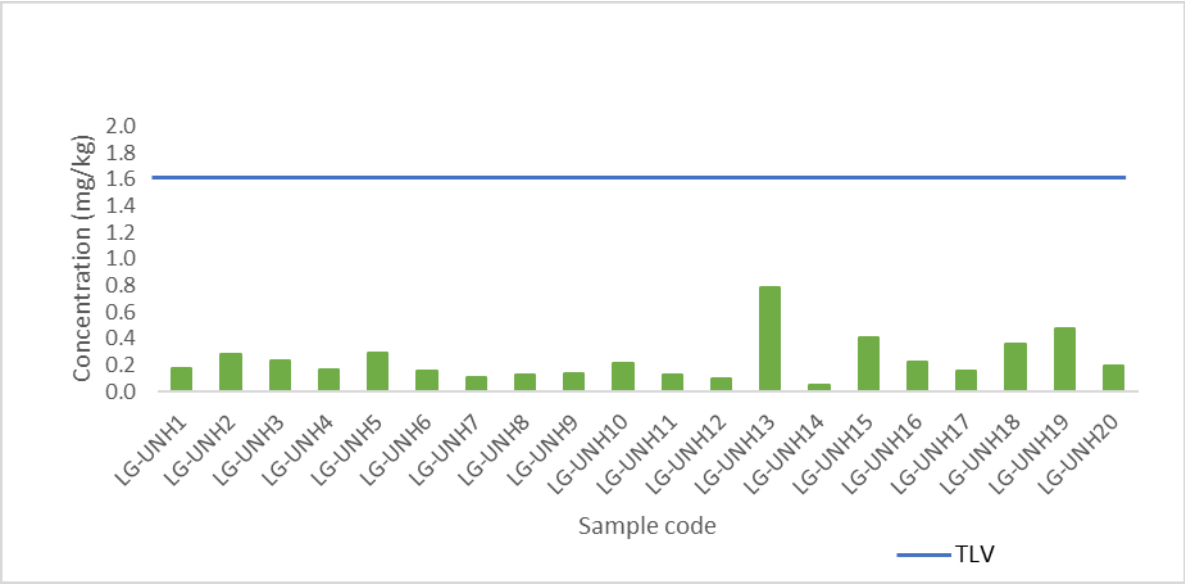



**Figure III.B.1.16. Mercury concentration in adults' nails in Lebakgedong District**

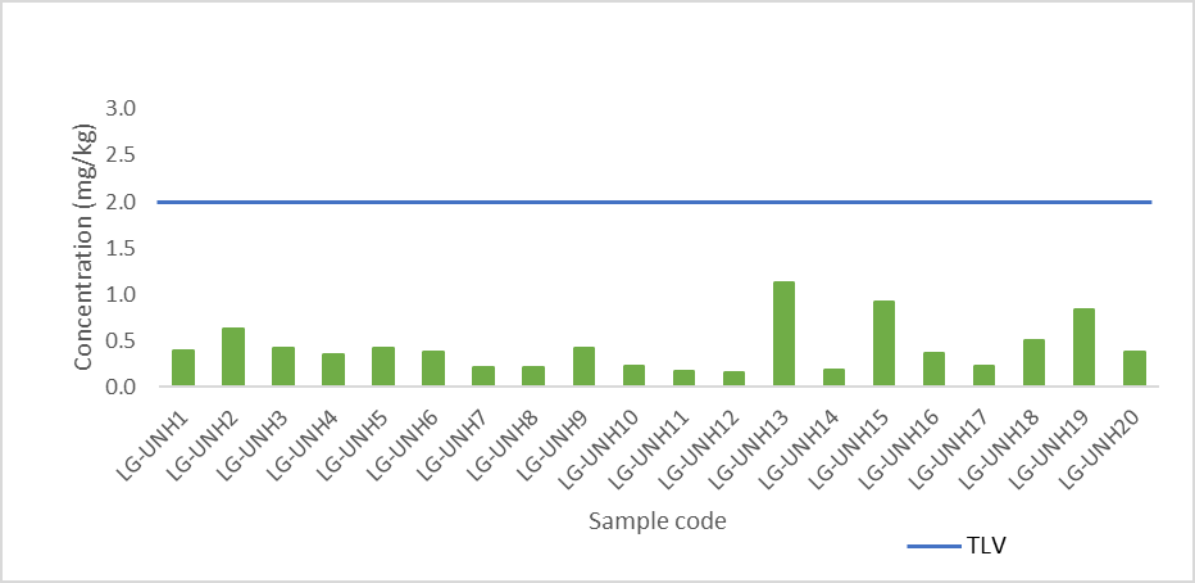



**Figure III.B.1.17. Mercury concentration in adult's hair in Lebakgedong District**

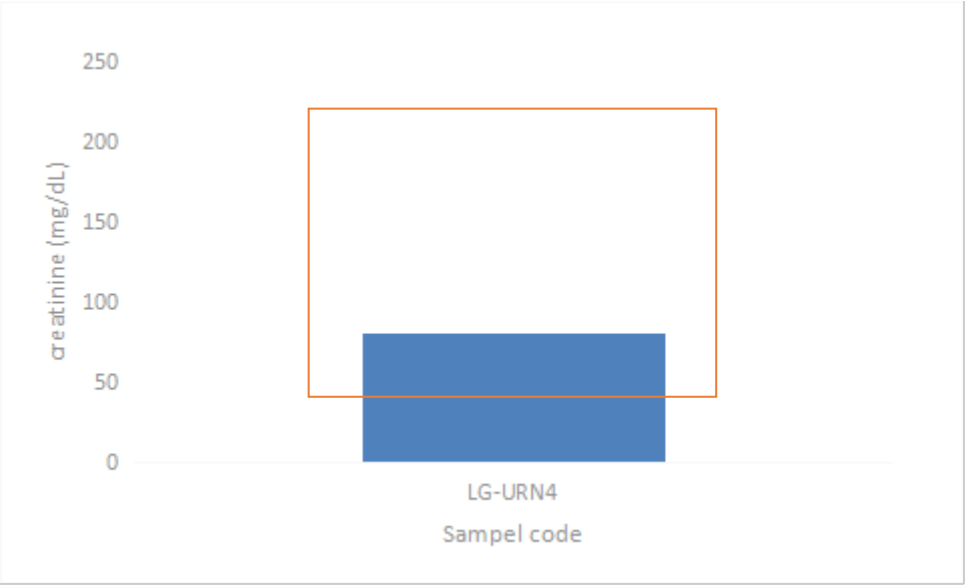



**Figure III.B.1.18. The range of creatinine concentrations in the urine of women (children or adults) in Lebakgedong District**

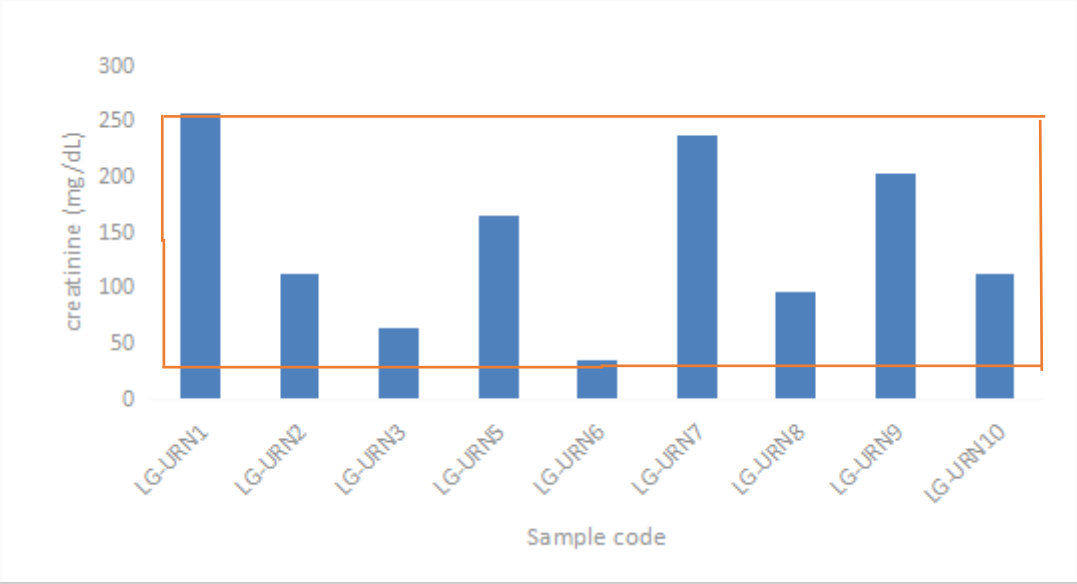



**Figure III.B.1.19. The range of creatinine concentrations in the urine of men (children or adults) in Lebakgedong District**

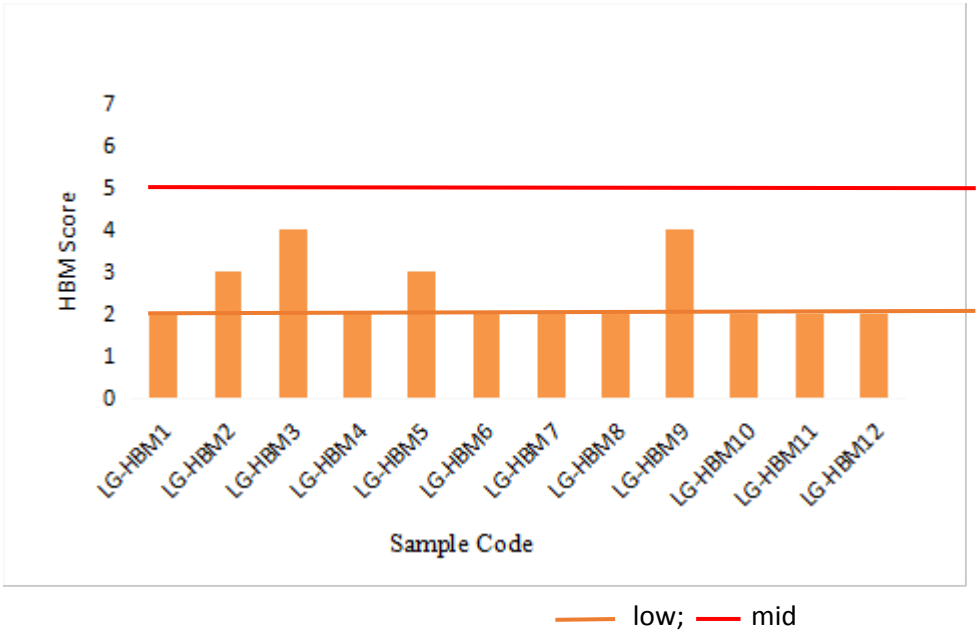



**Figure III.B.1.20. The score of Human Biomonitoring (HBM) for Adult Respondents in Lebakgedong District**

**Table III.B.1.10. SWOT strategy for the socio-economic management of ASGM in Lebakgedong District**

| | **Strength(S):**<br>1. It is an area that has abundant potential of gold mineral resources;<br>2. Some areas are the Mount Halimun Salak National Park areas which is a natural tourist destination; also, a tourist destination in the country above the clouds (Citorek).<br>3. Potential palm sugar production. | **Weaknesses (W):**<br>1. Low public knowledge about mercury.<br>2. It is difficult to formalize ASGM.<br>3. The supporting facilities for post-disaster areas have not been much improved.<br>4. There is no cultivation and processing of palm sugar. |
|---|---|---|
| **Opportunity (O):**<br>1. There is a gold company operating in Lebak Regency area.<br>2. The government facilitates people's mining activities through WPR and IPR permits.<br>3. The government is actively promoting regional tourism potential.<br>4. The government is actively improving the people's economy and MSMEs. | **Strategy S-O:**<br>1. Strive for the integration of small, medium and large-scale mining businesses through mutually beneficial partnerships.<br>2. Strive for publication, inventory and sustainable maintenance of tourism potential.<br>3. Appropriate efforts are needed to protect the natural potential of sugar palm plants by all parties so that the abundant availability of palm trees and their by-products lifts the community's economy | **Strategy W-O:**<br>1. There must be a transfer of standardization related to mining activities between companies holding Contract of Work that have implemented good mining activities and ASGM.<br>2. There needs to be an understanding between the mining community and the local government regarding efforts to formalize ASGM activities.<br>3. Immediately build and repair tourism facilities and infrastructure.<br>4. Immediately efforts are made to preserve the potential of sugar palm plants driven by the local government |
| **Threat (T):**<br>1. It is easy to get illegal mercury.<br>2. The conversion of agricultural land into mining.<br>3. Low supervision from local agencies.<br>4. Areas prone to natural disasters | **Strategy S-T:**<br>1. Strive to increase law enforcement against elements of illegal mercury abusers.<br>2. Immediately socialize the non-mercury gold processing method that has been initiated by the government.<br>3. It is necessary to increase supervision from the relevant agencies on mining activities located in areas prohibited for mining activities.<br>4. It is necessary to increase supervision from relevant agencies on mining activities, by increasing the allocation of supervision budgets for related agencies. | **Strategy W-T:**<br>1. Awareness raising activities from the community regarding the dangers of using mercury should be increased.<br>2. Encouraging the creation of WPR and IPR for ASGM communities. Especially in setting the layout and function of land/areas that can be used for mining activities so that there will be no land conflicts in the future.<br>3. Development must adapt to natural conditions |

**Table III.B.1.11. Local Action Plan Lebak Regent Decree number 660/Kep.573-LH/2017 concerning Mercury Reduction and Elimination**

| Strategic Issues | Objective | Action Plan | Target |
|---|---|---|---|
| Regions do not yet have policies related to RAD for Mercury Reduction and Elimination in ASGM. | Disseminating policies, programs of Mercury Reduction and Elimination in ASGM. | Compilation of the RAD document for the Reduction and Elimination of Mercury in ASGM. | 2017 |
| The illegal trade in mercury is still rampant in Lebak Regency. | Banning the distribution of mercury in Lebak Regency. | No mercury distribution permit issued in Lebak Regency. | Every Year |
| There is no communication forum between stakeholders related to ASGM activities. | Increase cooperation and partnerships at various levels in the context of Mercury Reduction and Elimination in ASGM. | Establishment of a communication forum among stakeholders related to ASGM activities. | 2018 |
| The competence of the apparatus is still low in explaining the dangers of mercury to public health and the environment. | Increased performance capacity of the apparatus in implementing the Mercury Reduction and Elimination Program for ASGM. | Implementation of technical guidance/ socialization activities to increase the capacity of the apparatus in processing non-mercury gold in ASGM. | 2018 and 2019 |
| There is no update on the use of mercury in ASGM. | Knowledge of the level of distribution of mercury in environmental media (water, air, soil). | Conducted inventory studies/mapping of the distribution of mercury in the environment. | 2018-2020 |
| There is no update on mercury contaminants in small-scale gold processing communities. | Knowing the level of mercury contamination in the community in the ASGM area. | Conducted inventory study/mapping of the impact of mercury contamination on humans (affected communities) at ASGM Locations. | Every Year |
| Less than optimal supervision and guidance on the use of mercury in small-scale gold processing. | Managed use of mercury as hazardous substance in small-scale gold processing. | Implementation of supervision and guidance on small-scale gold processors. | 2018 until 2020 |
| Lack of understanding of gold processing actors in the application of technology to process non-mercury gold. | The shift of gold processing technology using mercury to non-mercury gold processing that is more environmentally friendly. | Implementation of socialization/training/ guidance for small-scale gold processing workers on non-mercury gold processing technology for health and the environment. | 2018 until 2020 |
| Lack of concern for the younger generation (links) to succeed in processing gold using mercury about the dangers to health. | Fewer gold processors who use mercury. | The establishment of an environmentally friendly school in a location around a small-scale gold mine, socialization of the dangers of mercury to public health and the environment at educational institutions. | 2018 until 2020, 2 every school year |

Source: (Lebak Regency Regulation No. 2 of 2014 concerning Lebak Regency Spatial Planning 2014-2034, 2014)

## B.2. Hutabargot District, Mandailing Natal Regency, North Sumatera Province

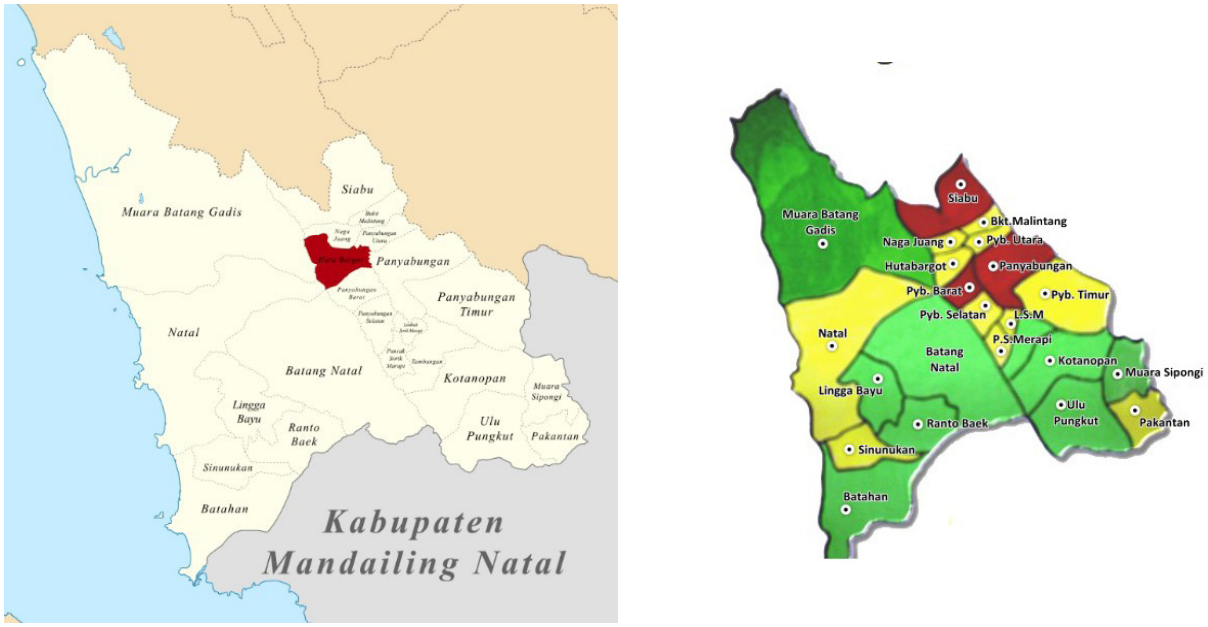



**Figure III.B.2.1. Region Map of Mandailing Natal Regency and Hutabargot District, North Sumatra**

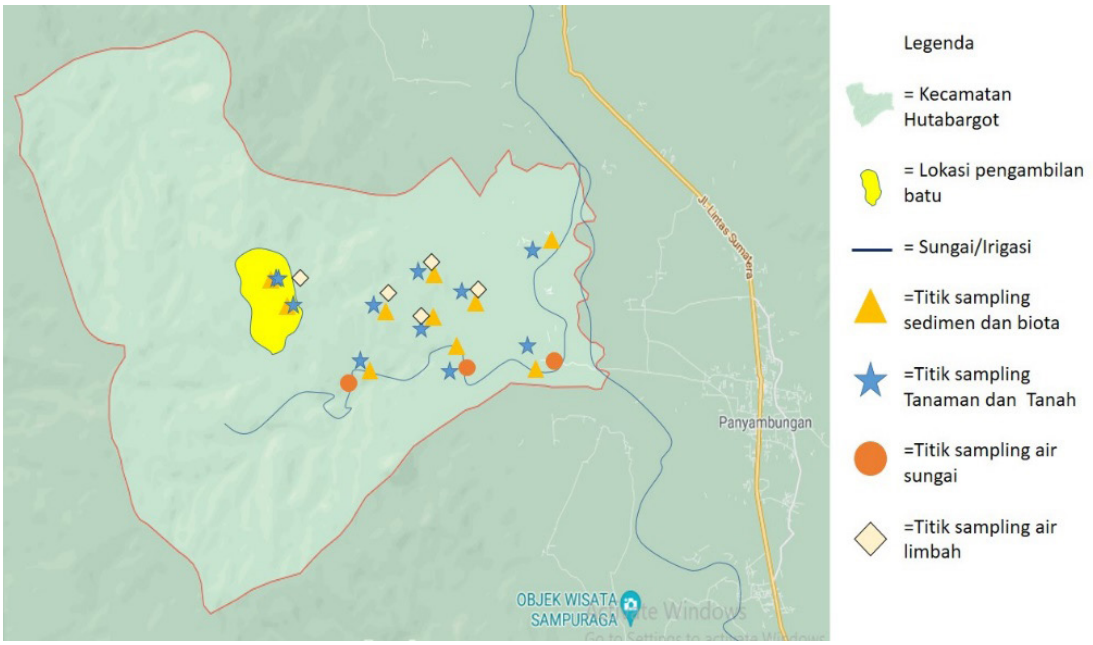



**Figure III.B.2.2. Sampling Location**

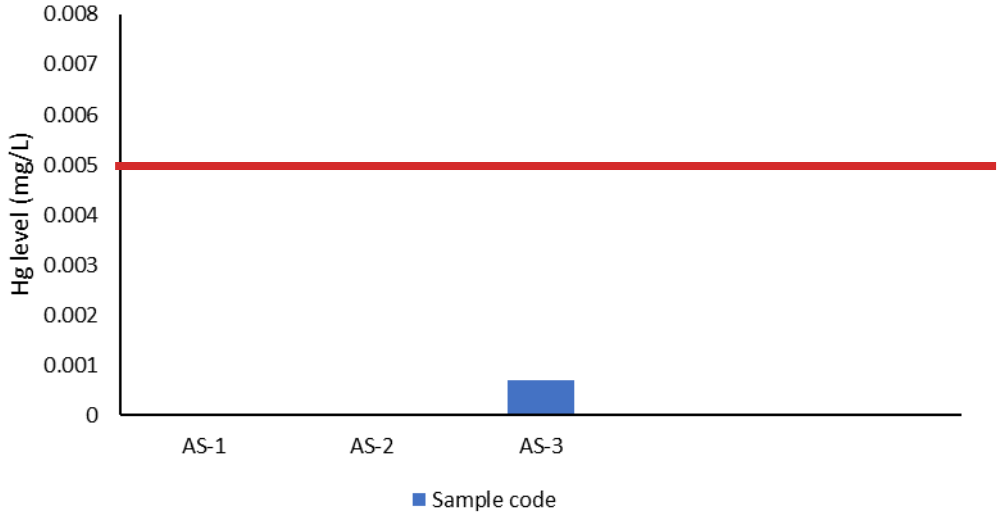



**Figure III.B.2.3. Mercury concentration in sample AS-1 water from the Hutajulu River (upstream); AS-2 Simalagi river water (downstream); and AS-3 mine pit water in the Study Location in Hutabargot District**

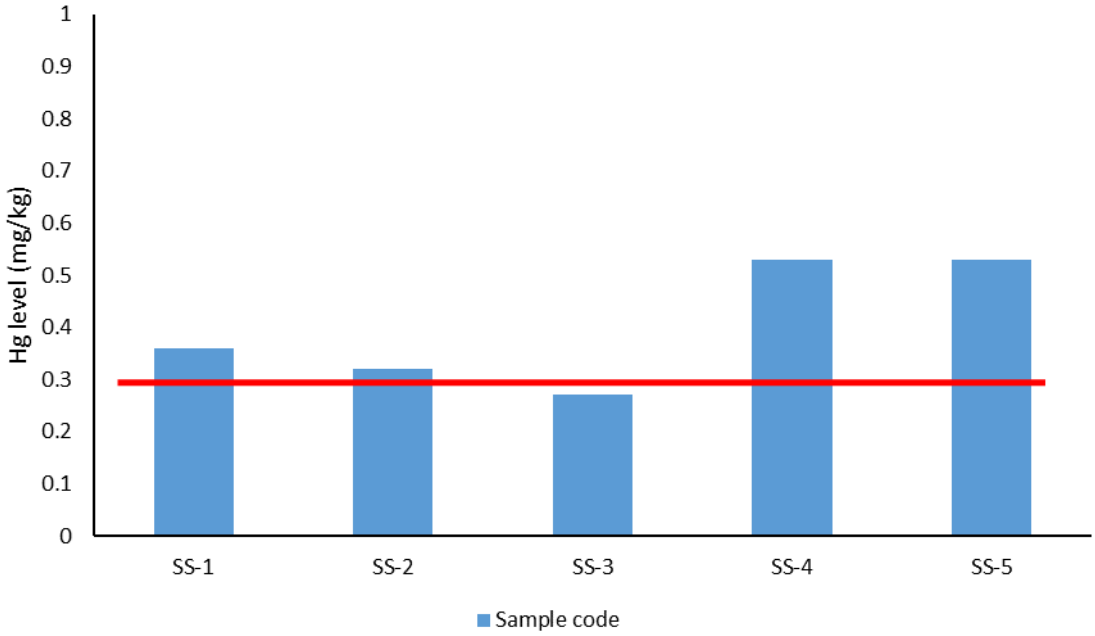



**Figure III.B.2.4. Mercury concentration in SS-1 sample of Simalagi River sediments; SS-2 Trommels A river sediments; SS-3 Trommels B river sediment; SS-4 Trommels C river sediment; and SS-5 Trommels D river sediments in the Study Location in Hutabargot District**

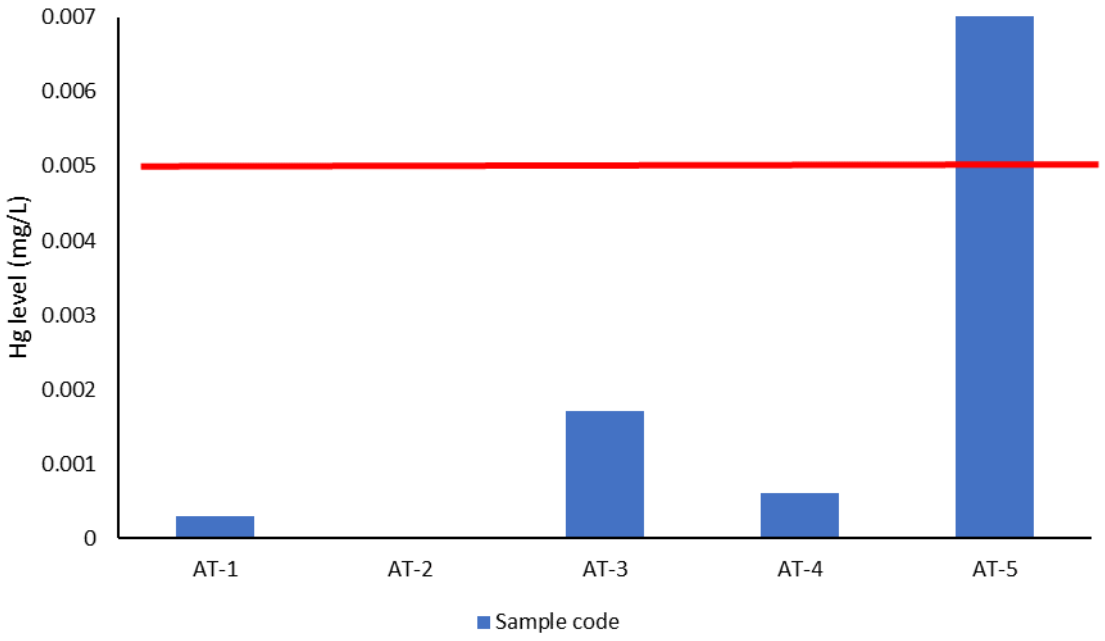



**Figure III.B.2.5. Mercury concentration in AT-1 sample of Trommels A wastewater; AT-2 Trommels B wastewater; AT-3 Trommels C wastewater; AT-4 Trommels D wastewater; and AT-5 cyanide vat wastewater in the Study Location in Hutabargot District**

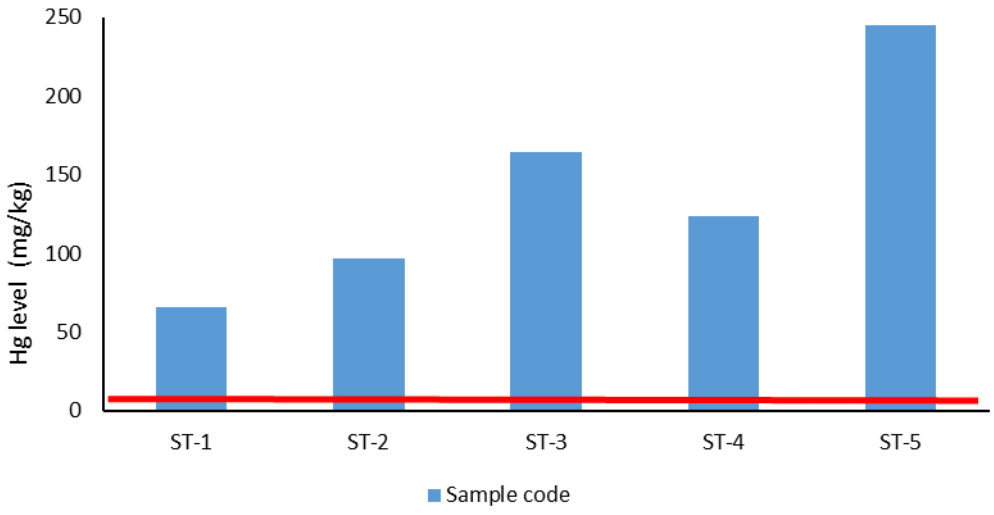



**Figure III.B.2.6. Mercury concentration in the ST-1 sediment sample Trommels A; ST-2 Trommels B sediment; ST-3 Trommels C sediment; ST-4 Trommels D sediment; and ST-5 cyanide vat sediment in the Study Location in Hutabargot District**

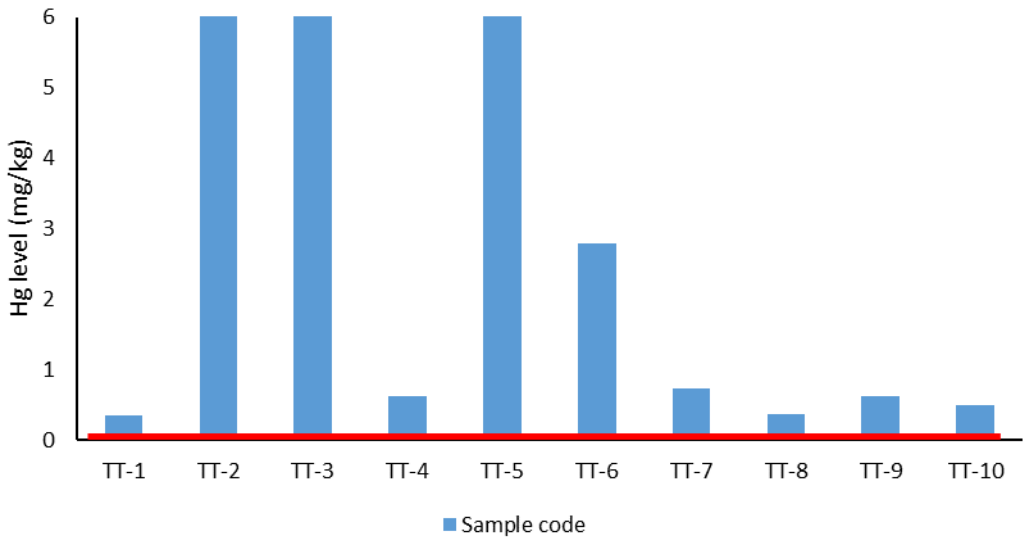



**Figure III.B.2.7. Mercury concentration in soil TT-1 samples at the Hutajulu mine location; TT-2 ground Trommels A; TT-3 ground Trommels B; TT-4 ground Trommels C; TT-5 ground Trommels D; TT-6 cyanide vat earth; TT-7 rice field land in Saba Padang village; TT-8 Saba Padang Garden land; TT-9 Hutabargot garden land; and TT-10 Hutabargot Dolok rice fields in the Study Location in Hutabargot District**

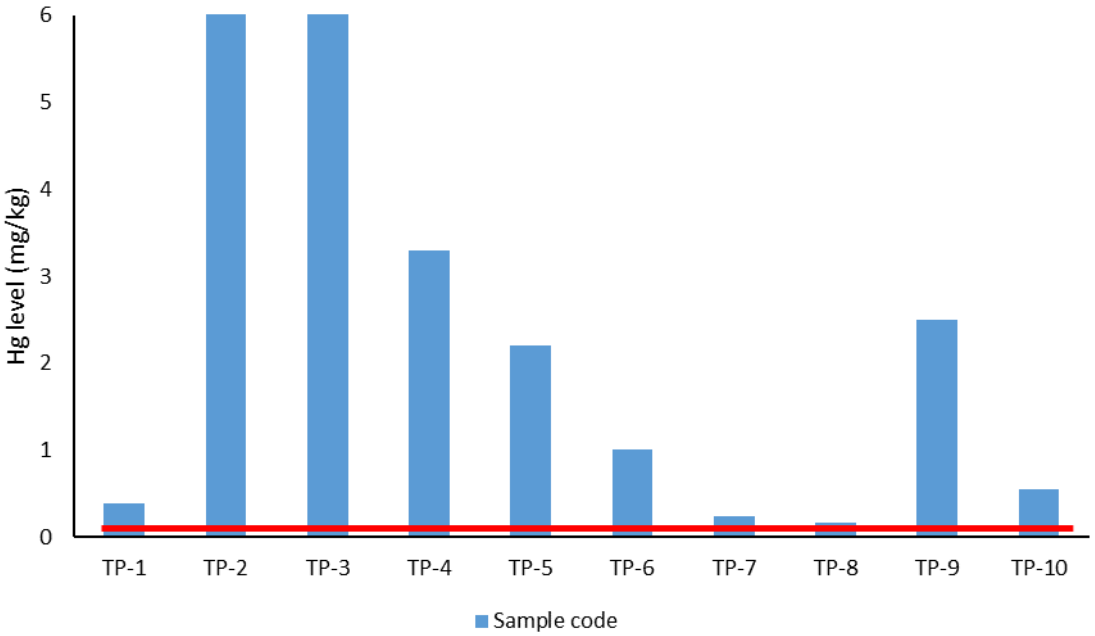



**Figure III.B.2.8. Mercury concentration in samples of TP-1 cyanide cassava plant; TP-2 plant Trommels A; TP-3 Trommels B plant; TP-4 Trommels C plant; TP-5 Trommels D plant; TP-6 rice fields in Saba Padang village; TP-7 garden plants in Hutabargot Dolok village; TP-8 rice fields in Binanga village; TP-9 garden plants in Saba Padang village; and TP-10 rice fields in the village of Hutabargot Dolok in the Study Location in Hutabargot District**

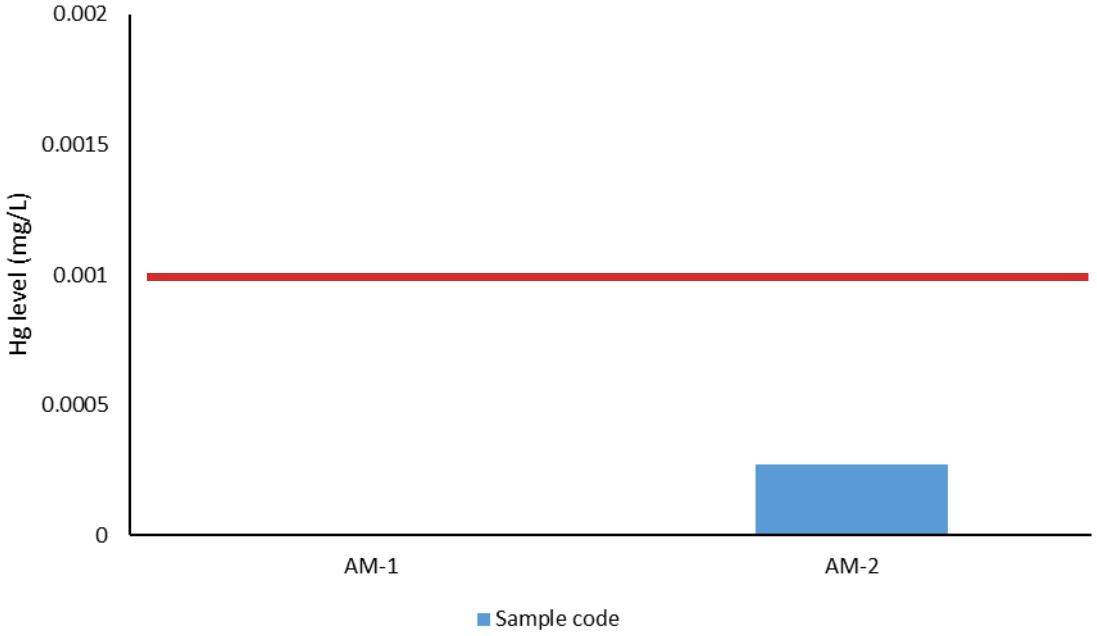



**Figure III.B.2.9. Mercury concentration in samples of AM-1 community well water and AM-2 private well water in the Study Location in Hutabargot District**

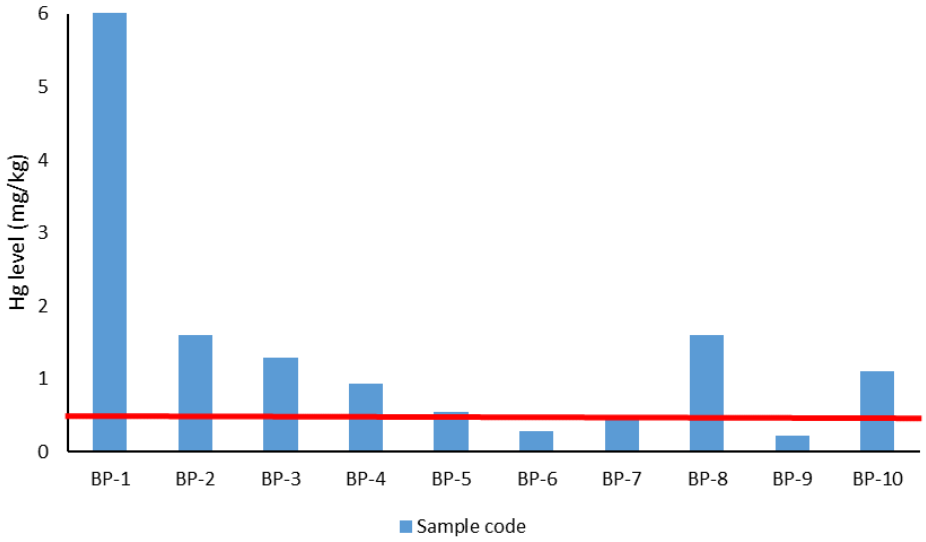



**Figure III.B.2.10. Mercury concentrations on BP-1 samples of shellfish in the river around the A trommel; BP-2 shells in the river around the trommel B; BP-3 shells in the river around the C trommel; BP-4 shellfish in the river around the trommel D; BP-5 worms and fish in the Simalagi River downstream; BP-6 catfish in the central Simalagi River; BP-7 Catfish in the upper Simalagi River; BP-8 piri-piri fish in Aek Lobang River; BP-9 inggit-inggit fish in Saba Padang River; and BP-10 aporas fish in Hutabargot Dolok River at Hutabargot District study site**

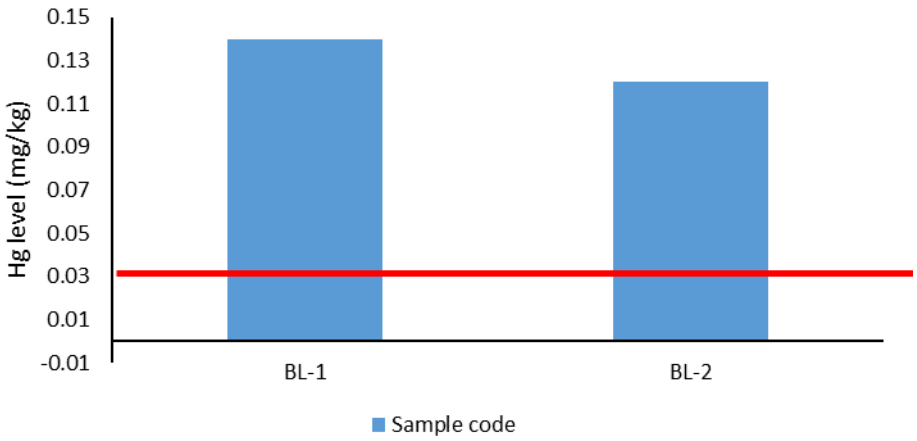



**Figure III.B.2.11. Mercury concentration in BL-1 rice samples from Hutabargot Dolok village and BL-2 rice from Saba Padang village**

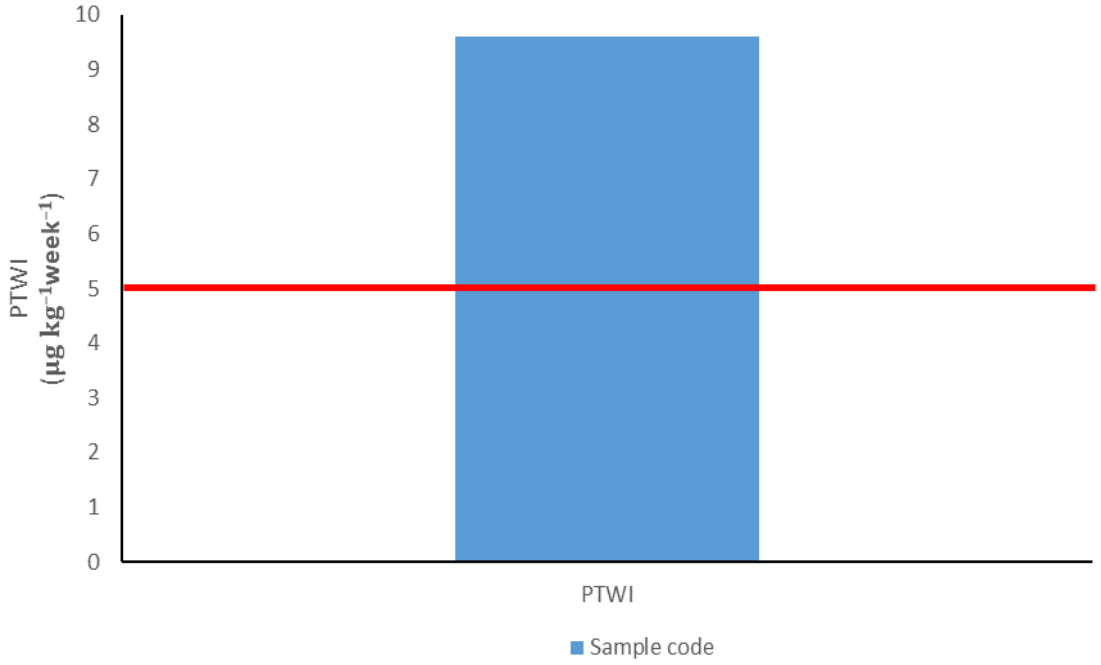



**Figure III.B.2.12. The PTWI value of mercury for water, fish, and rice foodstuffs is compared with the quality standard for the Hutabargot District**

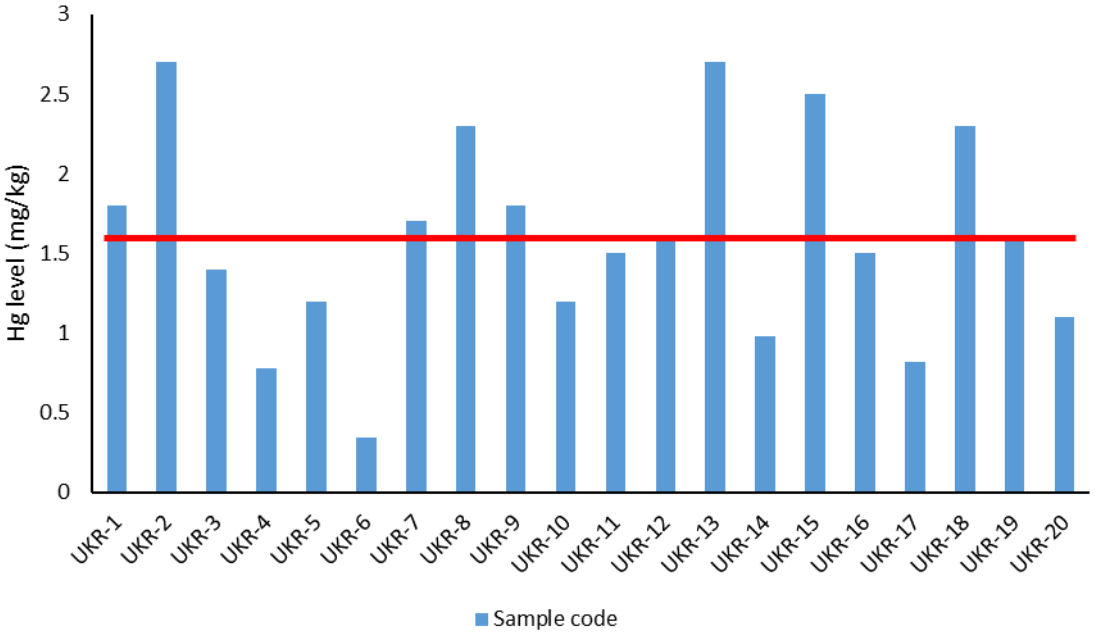



**Figure III.B.2.13. Mercury levels in nail samples of adult respondents in the Study Location in Hutabargot District**

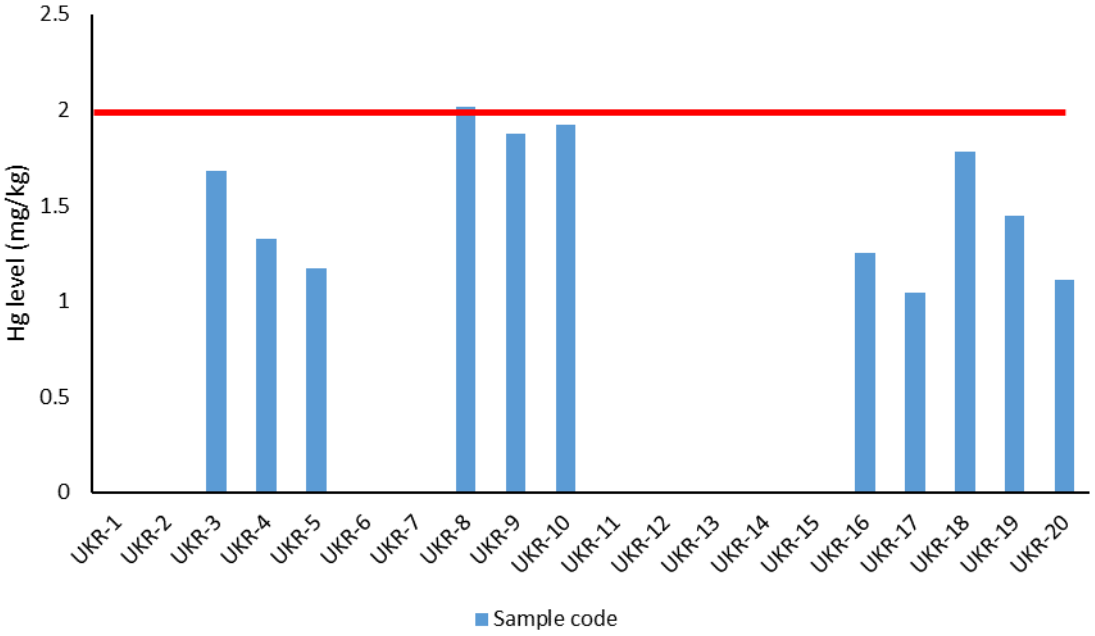



**Figure III.B.2.14. Mercury levels in hair samples of adult respondents in the Study Location in Hutabargot District**

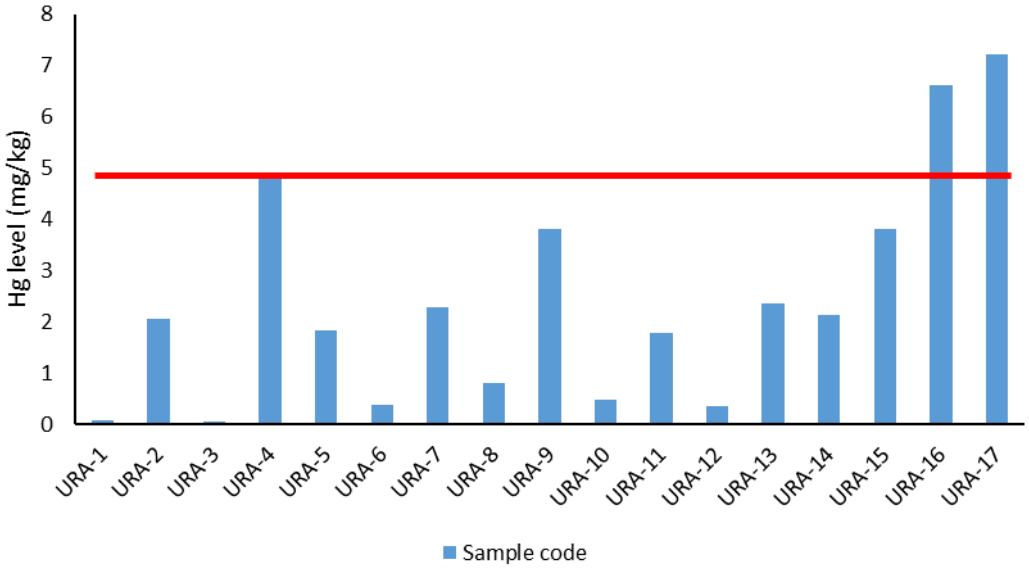



**Figure III.B.2.15. Mercury levels in urine samples of adult respondents in the Study Location Hutabargot District**

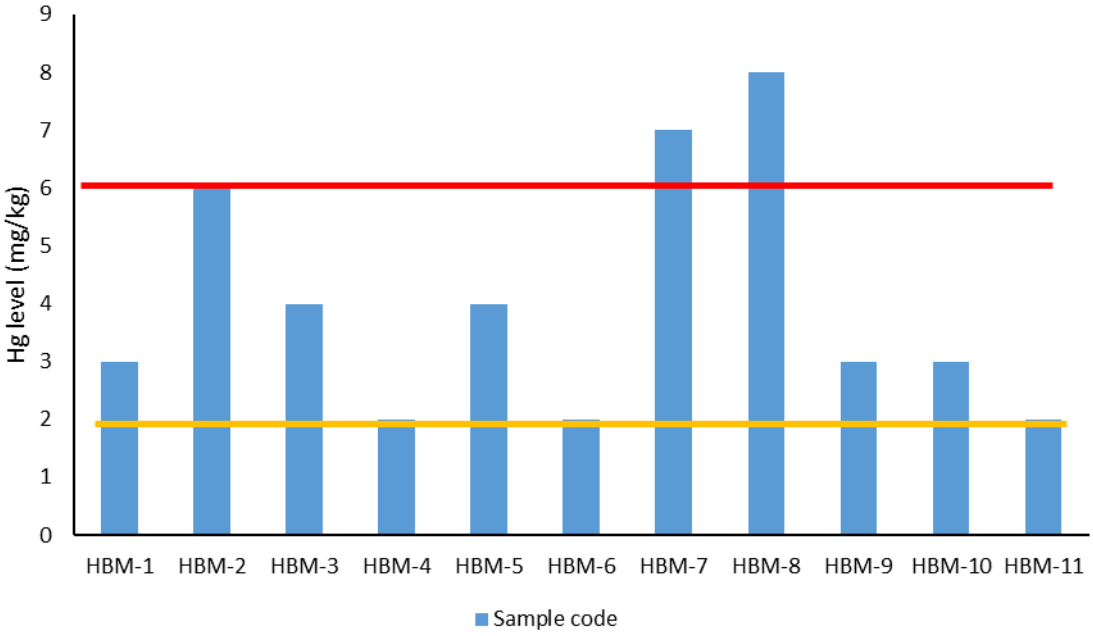



**Figure III.B.2.16. The value of HBM (Human Biomonitoring) of adult respondents in the Study Location Hutabargot District (-Mid; - High)**

**Table III.B.2.1. SWOT strategy for the socio-economic management of ASGM in the Study Location in Hutabargot District, Regency Mandailing Natal**

| | **Strength (S)** | **Weakness (W)** |
|---|---|---|
| | 1. There is a gold mining company located not far from the mine location.<br>2. There are many oil palm plantations that can absorb labor in the districts around Hutabargot.<br>3. There are many rubber plantations around the Hutabargot District with a fairly large production value. | 1. Public knowledge is still low about the negative impact of mercury, as well as the low awareness of mining actors regarding the impact of using mercury on the environment due to low awareness of the dangers of mercury to the community.<br>2. Weak supervision and enforcement of regulations by local agencies.<br>3. Easy access for the community to get mercury in the Mandailing Natal area. |
| **Opportunity (O):**<br>1. Potential needs for labor in various foreign exchange-producing companies, such as palm oil and rubber.<br>2. There has been public awareness about the dangers of using mercury due to the negative impact of mining activities on the health and quality of life of the community. | **Strategy S-O:**<br>1. Optimizing the role of the Vocational Training Center to channel skilled workers to fill labor posts in plantation companies around the mining location.<br>2. Establish communication with related parties, especially companies with high labor needs (plantations).<br>3. Disseminate information about other fields of work to the community, along with factors that can encourage people to switch, such as monthly income, allowance facilities, and the like. | **Strategy W-O:**<br>1. Utilizing public awareness of the impact of mercury so that people stop using it, both for their own use and for other parties who process gold using mercury.<br>2. Evaluate policies, and integrate with existing structures in the community to prevent indiscriminate use of mercury in the field.<br>3. Building a community structure to prevent the use of illegal mercury in the field, accompanied directly by the government and the authorities. |
| **Threat (T):**<br>1. Mandailing Natal residents' rejection of the presence of legal mining companies.<br>2. The low ability of illegal miners to switch jobs to the non-mining sector.<br>3. The amount of income obtained by the community through mining activities.<br>4. The presence of illegal miners from outside Hutabargot who still use mercury as a source of energy | **Strategy S-T:**<br>1. Providing various trainings according to the work needs of plantation companies so that people leave illegal mining practices and mining practices that damage the environment.<br>2. Narrowing the space for illegal miners and miners who do not follow the rules through the establishment of regulations, supervision of the precious metal supply chain, and tightening civilian access to mercury. | **Strategy W-T:**<br>1. Regulate gold mining and its implementation mechanism in the field.<br>2. Tighten the supervision of ASGM activities.<br>3. Raise awareness on the dangers of using mercury to the community and empowering them to be directly involved in preventing mercury abuse.<br>4. Tighten regulations related to population movement to mining areas. |

## B.3. Karangjaya District, Tasikmalaya Regency, West Java Province




**Figure III.B.3.1. Region Map of Tasikmalaya Regency dan Karangjaya District**




**Figure III.B.3.2. Location of sampling of river water and tailing flow to Cikurawet River**




**Figure III.B.3.3. Location of sampling of river water and tailing flow to Citambal River**

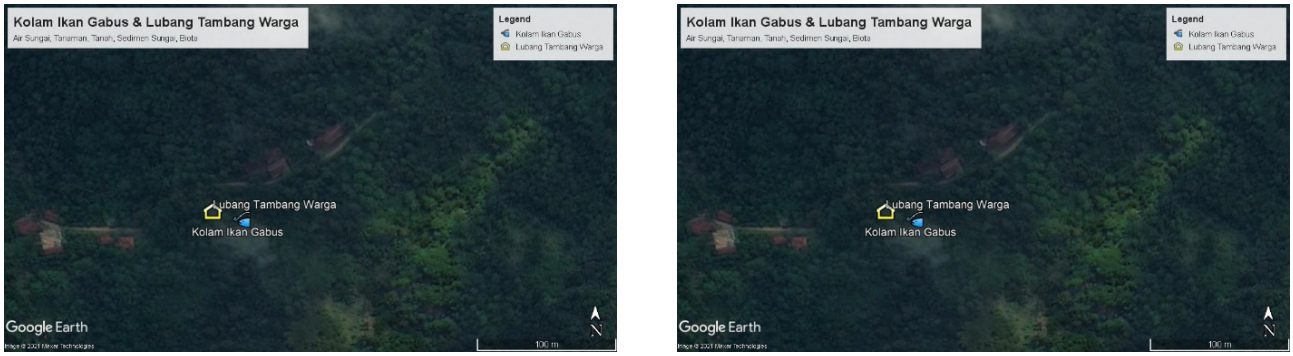



**Figure III.B.3.4. Location of fish pond and biota sampling**




**Figure III.B.3.5. Location of water spring sampling**




**Figure III.B.3.6. Location of river water and community rice field sampling**




**Figure III.B.3.7. Location of Cisarua River estuary water sampling**

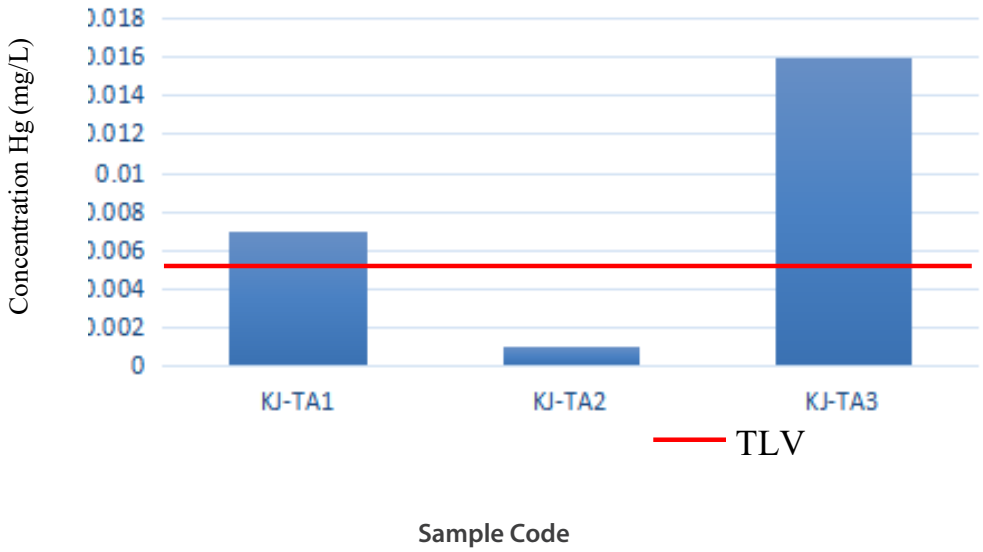



**Figure III.B.3.8. Hg content in tailings wastewater in Karangjaya District**

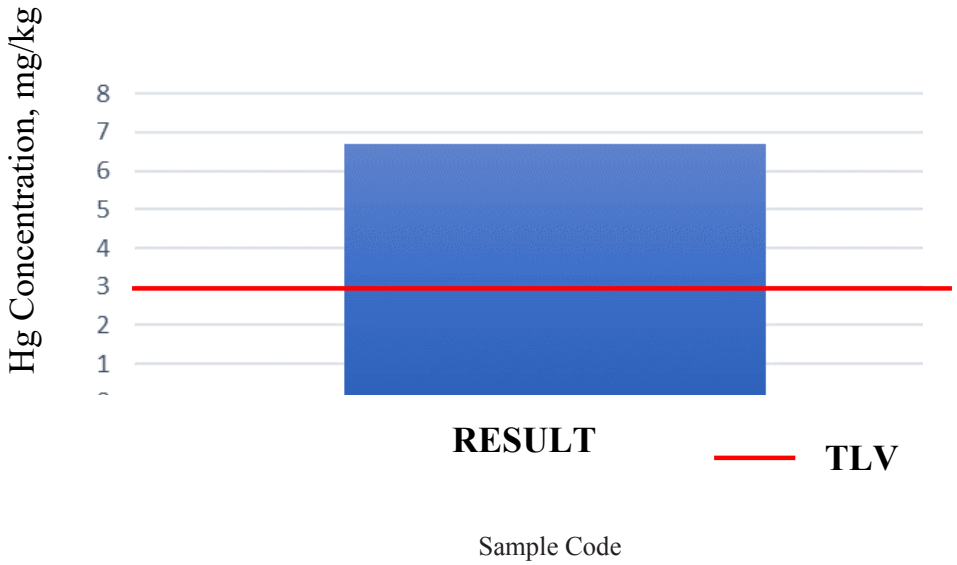



Figure III.B.3.9. Hg content in tailings sludge in Karangjaya District

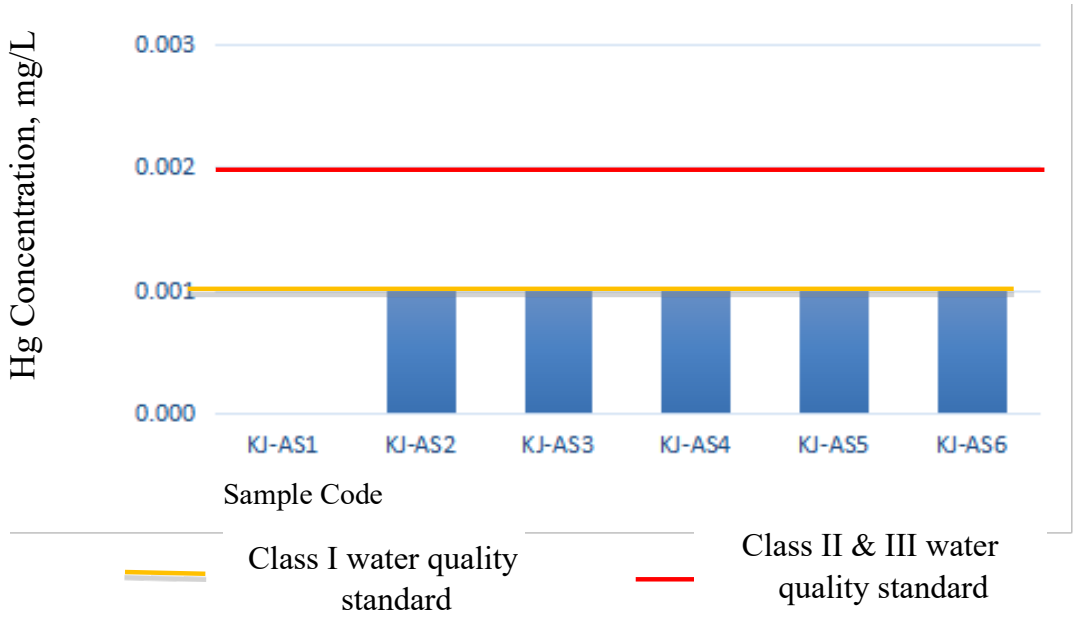



Figure III.B.3.10. Hg levels in river water and fish ponds in Karangjaya District

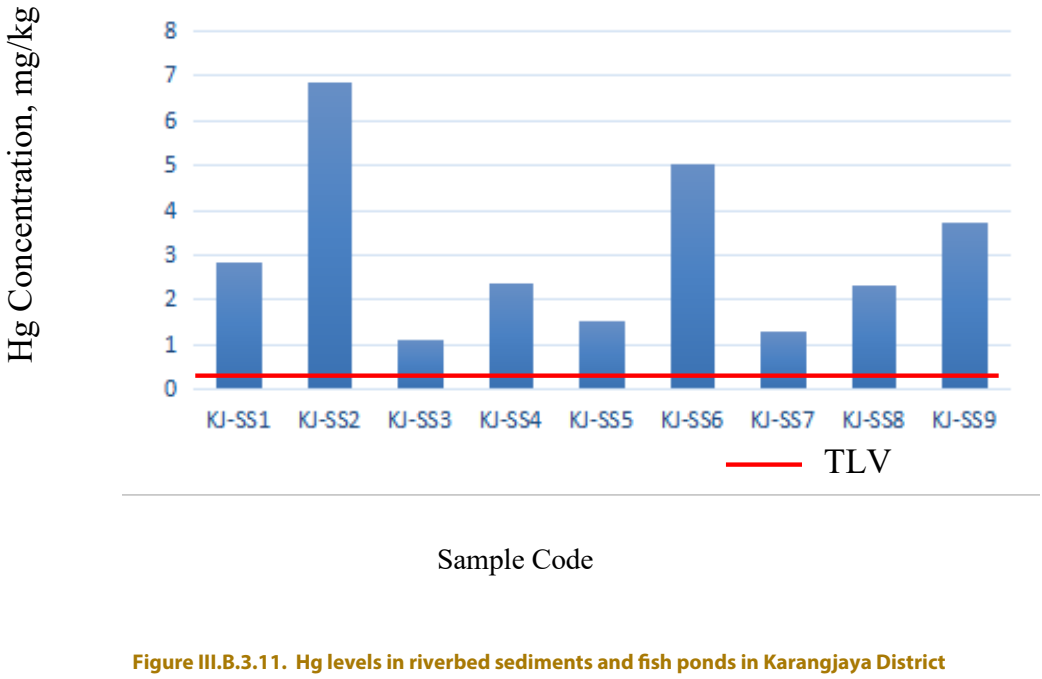



**Figure III.B.3.11. Hg levels in riverbed sediments and fish ponds in Karangjaya District**

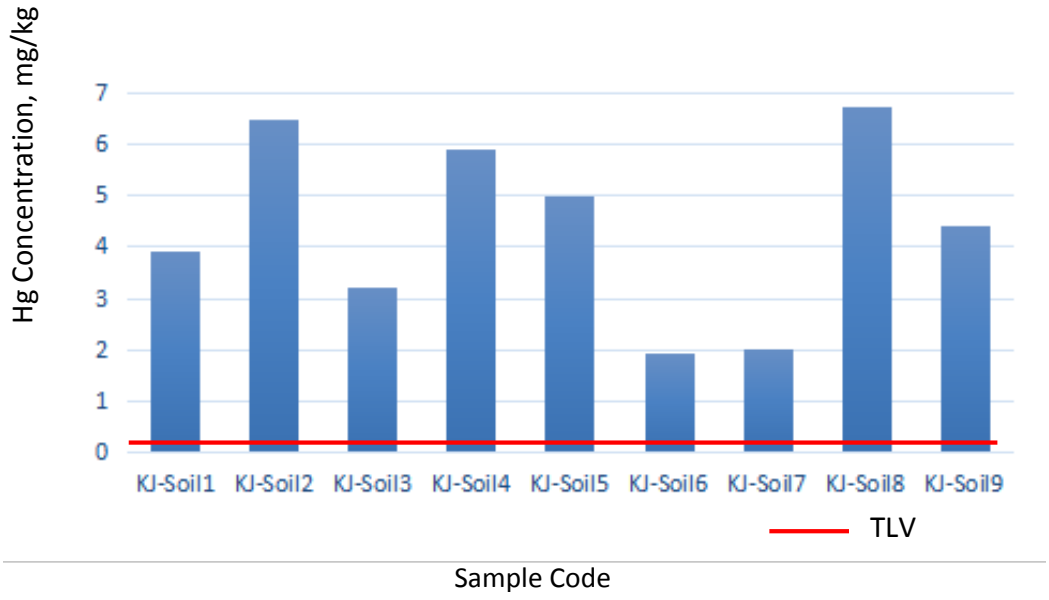



**Figure III.B.3.12. Hg levels in garden soil and rice fields in Karangjaya District**




**Figure III.B.3.13. Hg levels in garden crops and consumption plants in Karangjaya District**

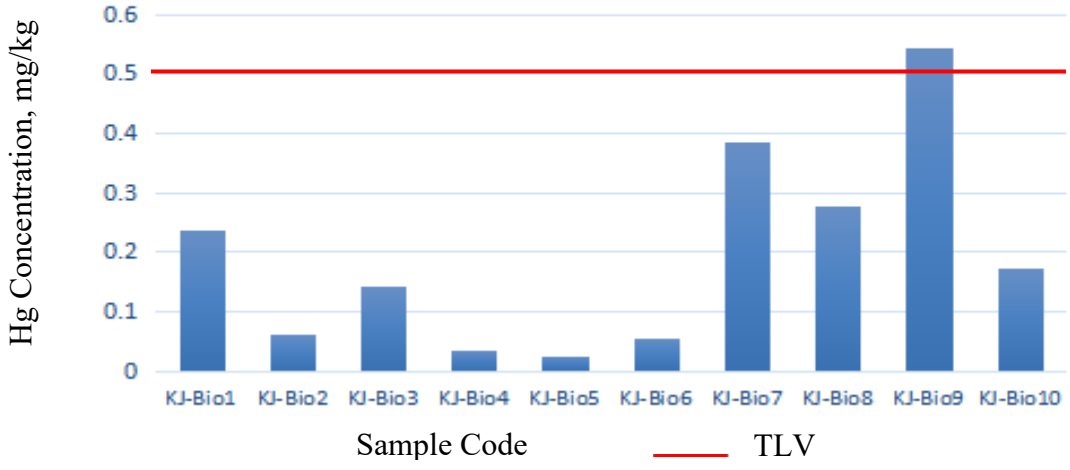



**Figure III.B.3.14. Hg levels in river and fish biota in Karangjaya District**

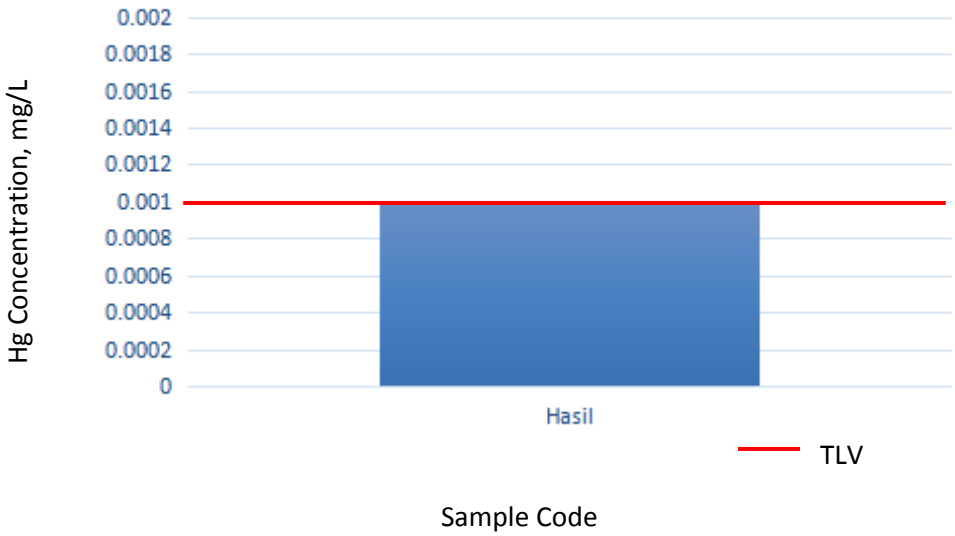



**Figure III.B.3.15. Hg levels in drinking water sources in Karangjaya District**

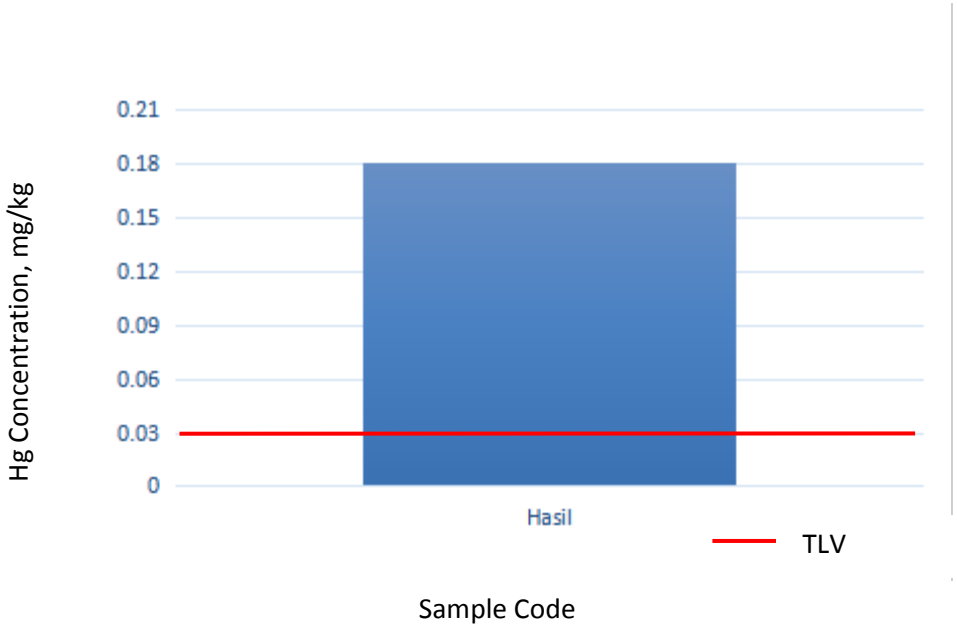



**Figure III.B.3.16. Mercury concentration in local rice in Karangjaya District**

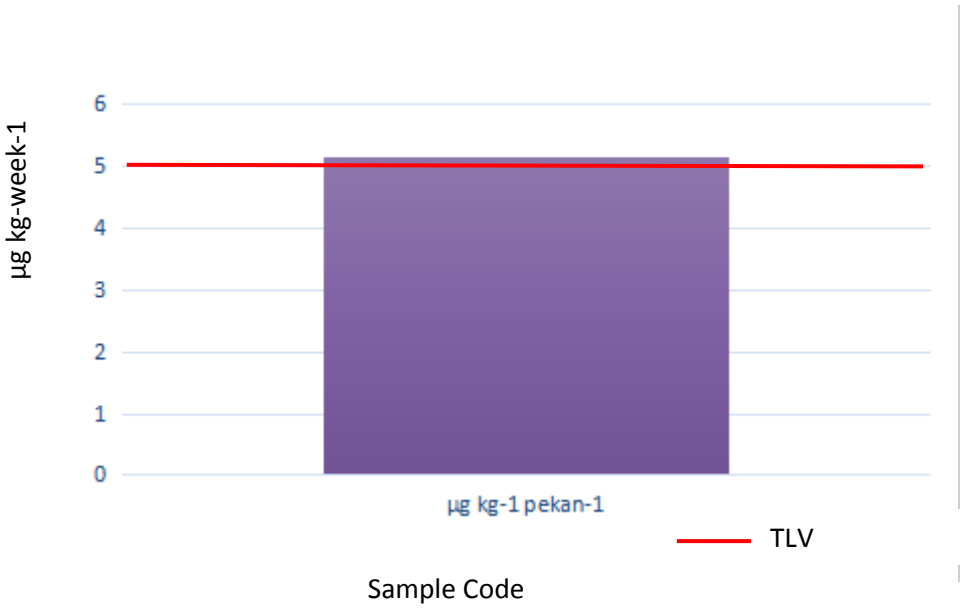



**Figure III.B.3.17. The PTWI value of mercury in respondents is compared with the quality standard for the Karangjaya District**

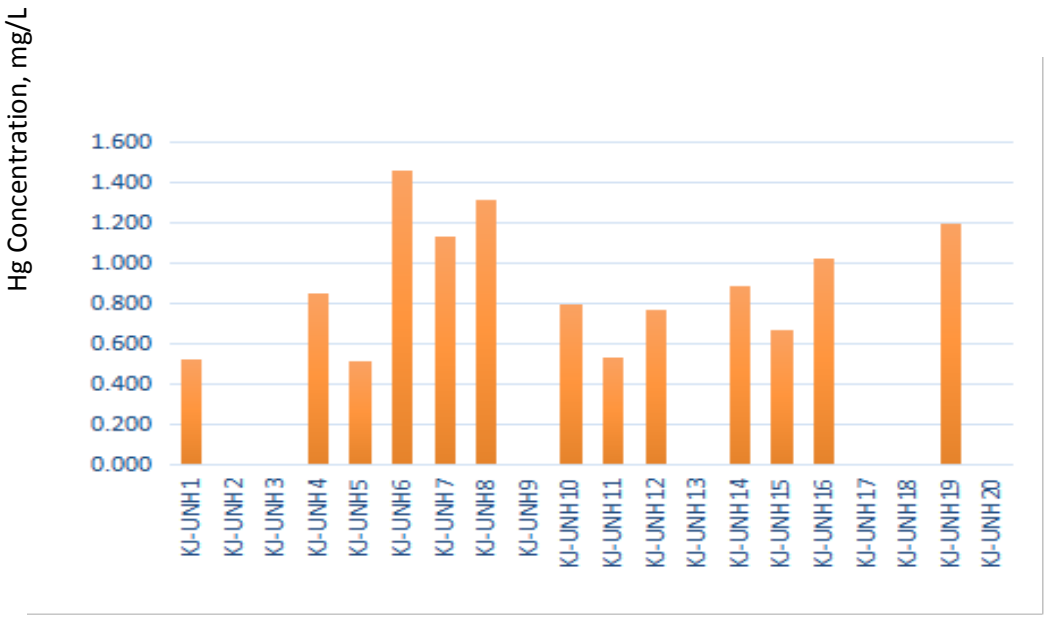



**Figure III.B.3.18. Indicator of mercury accumulation in urine of adult respondents in Karangjaya District**

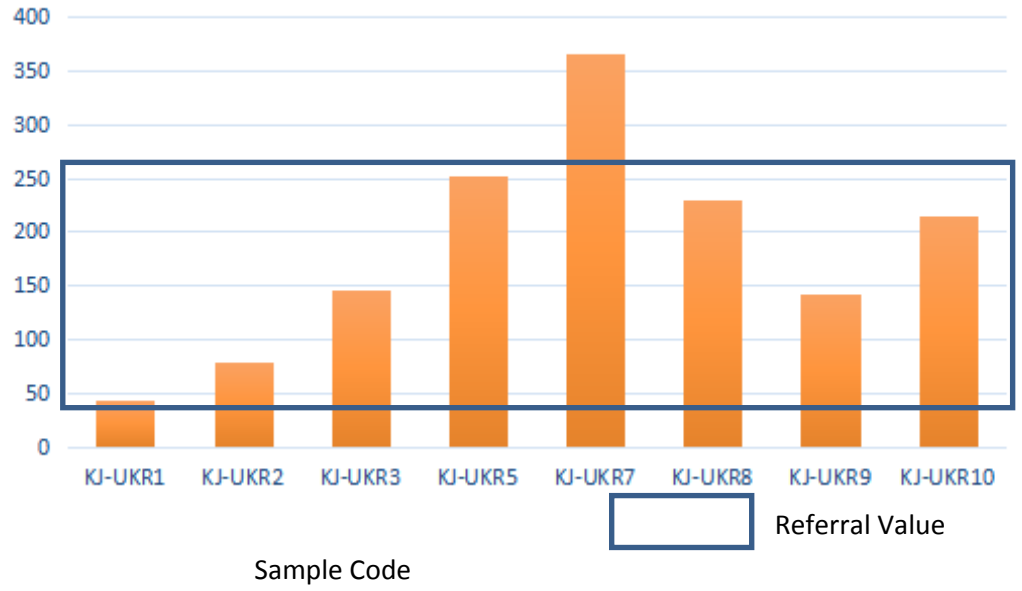



**Figure III.B.3.19. Creatinine levels in urine of male respondents in Karangjaya District**

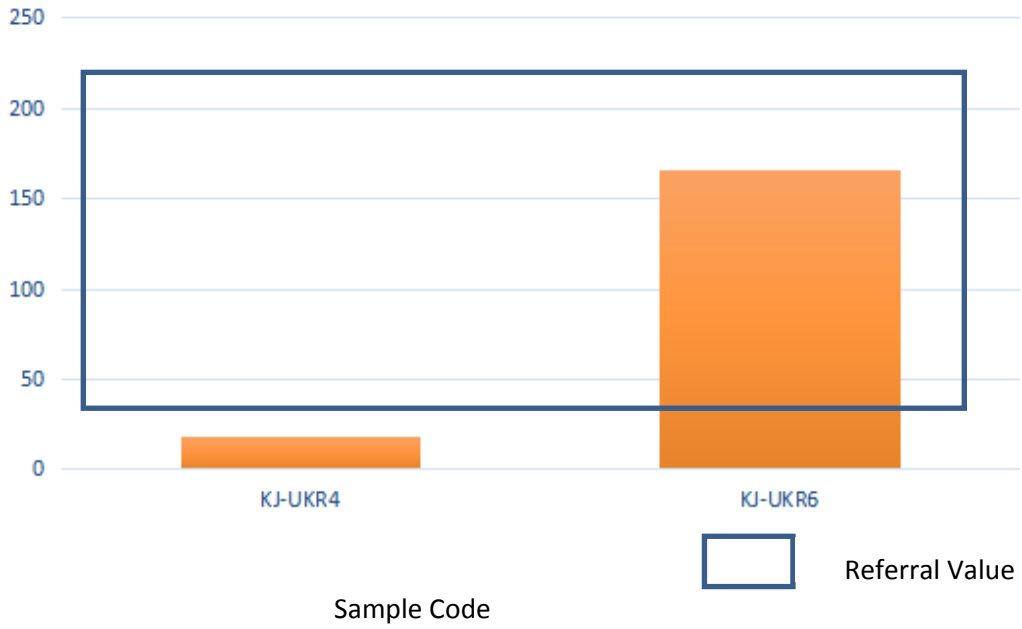



**Figure III.B.3.20. Creatinine levels in urine of female respondents in Karangjaya District**

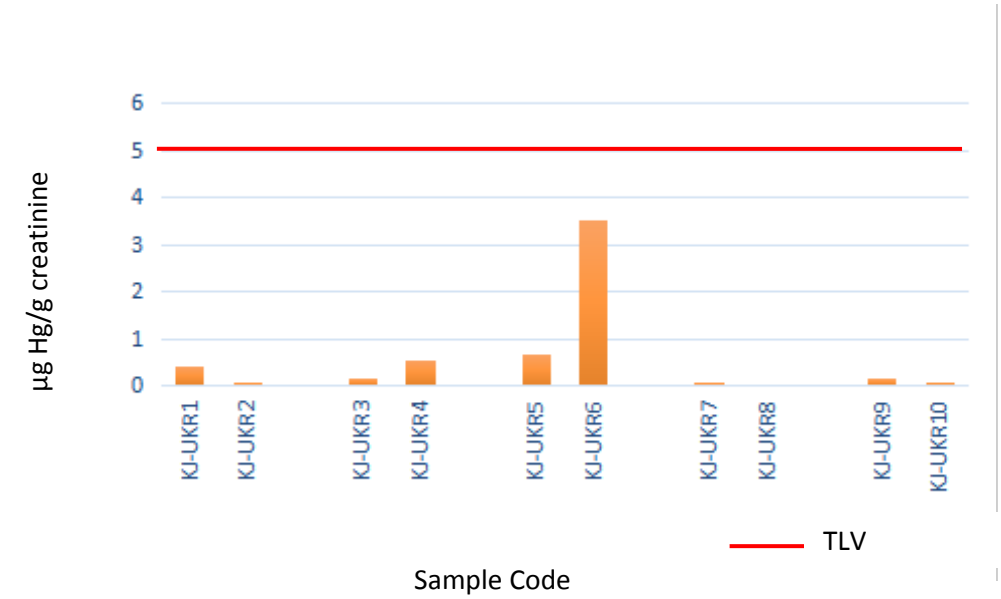



**Figure III.B.3.21. Hg level (µg Hg/g creatinine) in respondent's urine in Karangjaya District**

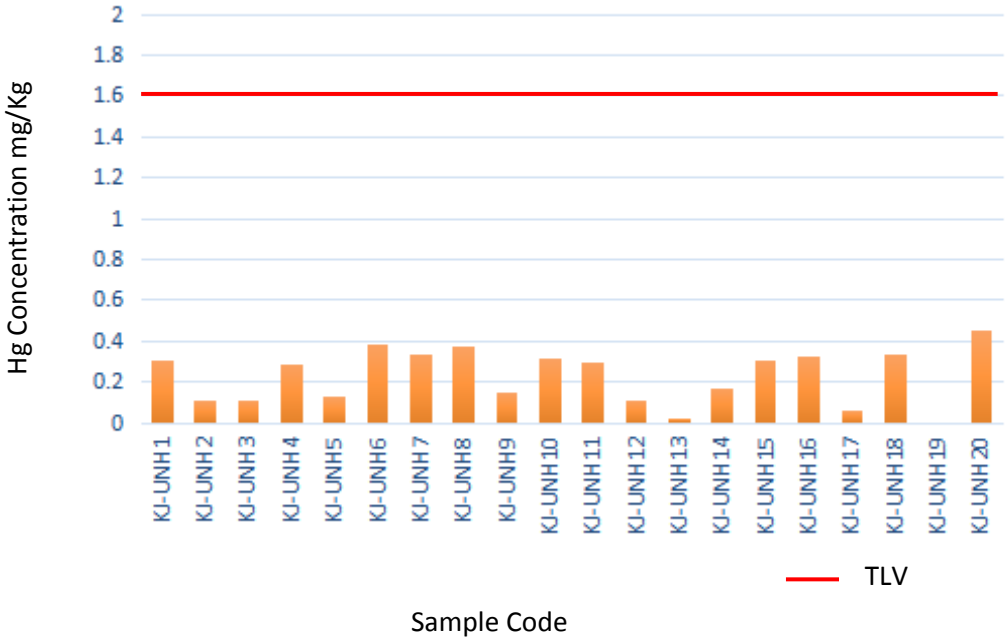



**Figure III.B.3.22. Mercury concentration in adult respondents' nails in Karangjaya District**

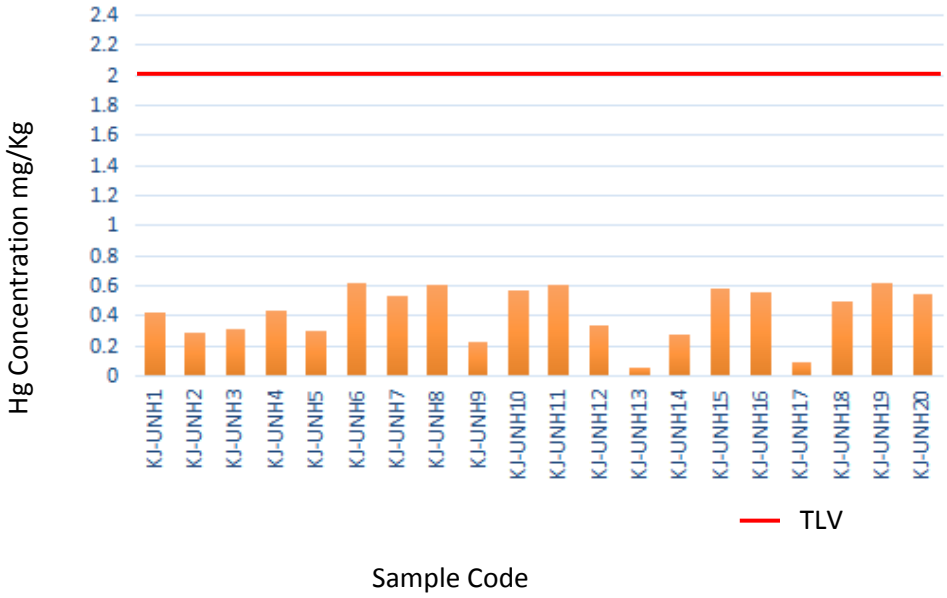



**Figure III.B.3.23. Mercury concentration in hair of adult respondents in Karangjaya District**

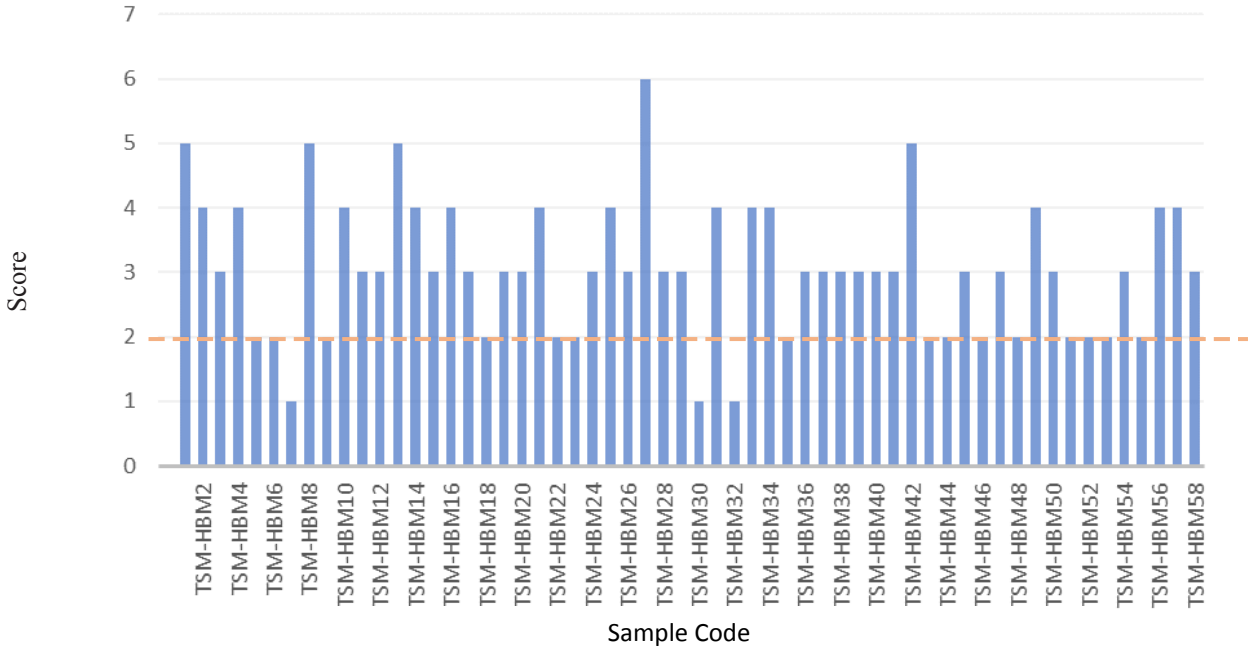



**Figure III.B.3.24. Human biomonitoring (HBM) scores of adult respondents in Karangjaya District**

**Table III.B.3.1. SWOT strategy for the socio-economic management of ASGM in the Study Location in Karangjaya District, Regency Tasikmalaya**

| | **Strength (S):** | **Weakness (W):** |
|---|---|---|
| | 1. There is a gold mining company located not far from the mining location.<br>2. There are many poultry farms and rubber plantations around the Karangjaya District with a fairly large production value.<br>3. There is already a cooperative of miners which can then be fostered in terms of self-protection and prevention of environmental damage. | 1. Public knowledge is still low about the negative impact of mercury, as well as the low awareness of mining actors regarding the impact of using mercury on the environment due to low awareness of the dangers of mercury to the community.<br>2. Weak supervision of regulation enforcement by local agencies.<br>3. Easy access for the community to get mercury in the Tasikmalaya area. |
| **Opportunity (O):**<br>1. Potential needs for workers in various foreign exchange-producing companies, such as rubber.<br>2. The emergence of public awareness about the dangers of using mercury due to the negative impact of mining activities on the health and quality of life of the community. | **Strategy S-O:**<br>1. Optimizing the role of the Job Training Center (*Balai Latihan Kerja,* BLK) to channel skilled workers to fill labor posts in plantation companies around the mining location.<br>2. Establish communication with related parties, especially companies with high labor needs (plantations).<br>3. Raise awareness on other fields of work to the community, along with factors that can encourage people to switch, such as monthly income, allowance facilities, and the like. | **Strategy W-O:**<br>1. Utilizing public awareness of the impact of mercury so that people stop using mercury, both for their own use and for other parties who process gold using mercury.<br>2. Evaluate policies, and integrate with existing structures in the community to prevent indiscriminate use of mercury in the field.<br>3. Build community structures to prevent illegal mercury use in the field, accompanied directly by the government and authorities. |
| **Threat (T):**<br>1. Tasikmalaya residents reject the presence of legal mining companies.<br>2. The low ability of illegal miners to switch jobs to the non-mining sector.<br>3. The amount of income obtained by the community through mining activities.<br>4. The presence of illegal miners from outside Karangjaya who still use mercury as the main gold processing medium. | **Strategy S-T:**<br>1. Presenting various trainings according to work needs in plantation companies so that people leave illegal mining practices and mining practices that damage the environment.<br>2. Narrowing the space for illegal miners and miners who do not follow the rules through setting regulations, monitoring the precious metal supply chain, and tightening civilian access to mercury. | **Strategy W-T:**<br>1. Regulate gold mining and its implementation mechanism in the field.<br>2. Tighten the supervision of ASGM activities.<br>3. Raise awareness on the dangers of using mercury to the community and empowering the community to be directly involved in preventing mercury abuse.<br>4. Tighten regulations related to population movement to mining areas. |

## B.4. Taliwang District, West Sumbawa Regency, West Nusa Tenggara Province

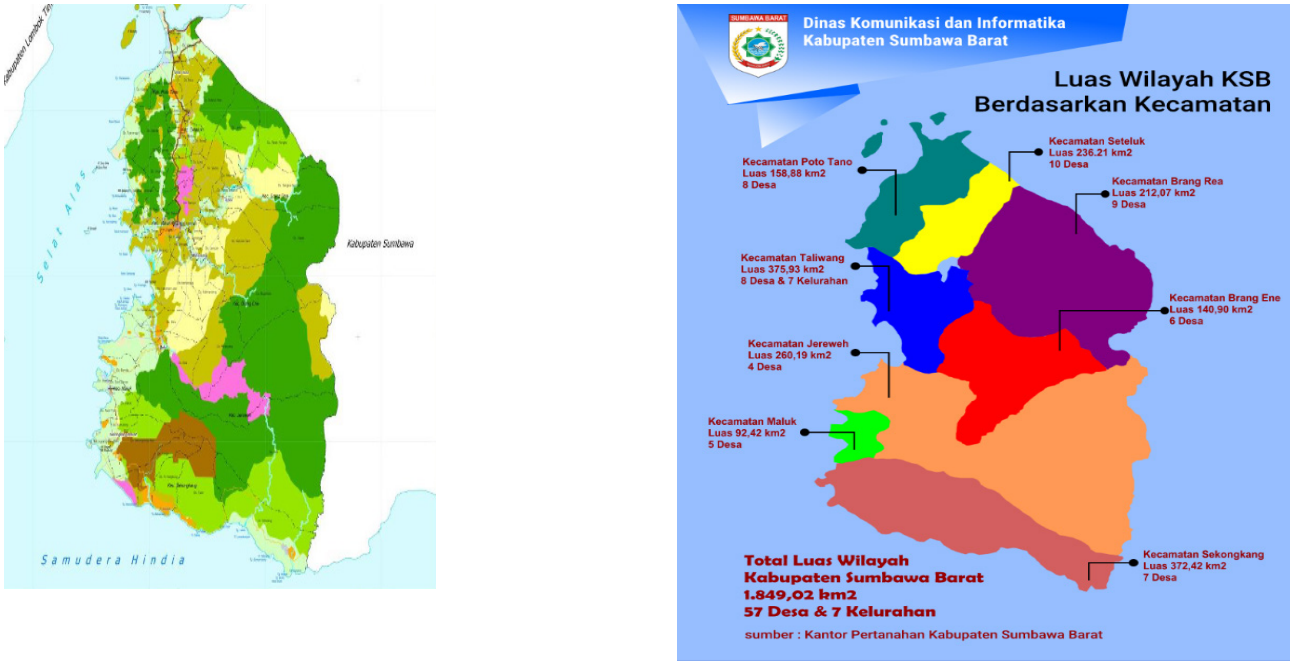



**Figure III.B.4.1. Region Map of West Sumbawa Regency and Taliwang District, West Nusa Tenggara**

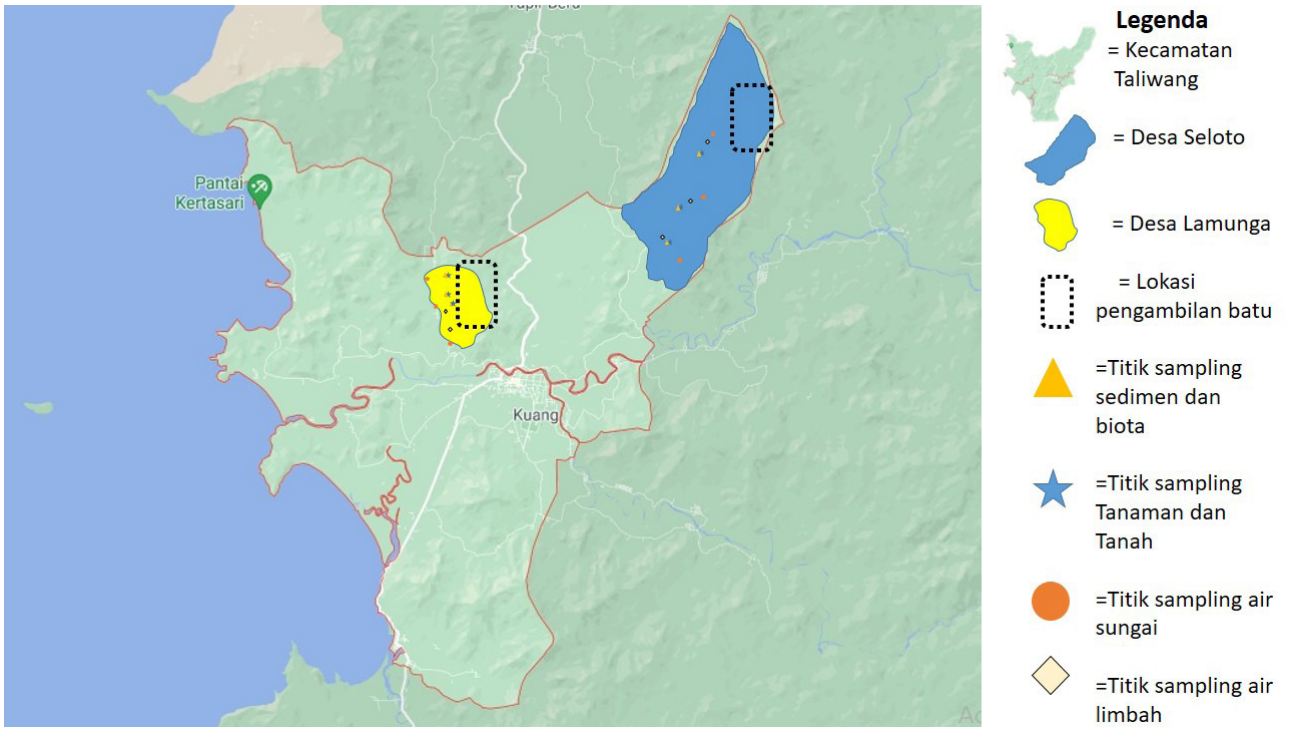



**Figure III.B.4.2. Location of sampling in Lamunga Village (left) and Seloto Village (right) in Taliwang District, West Sumbawa Regency**

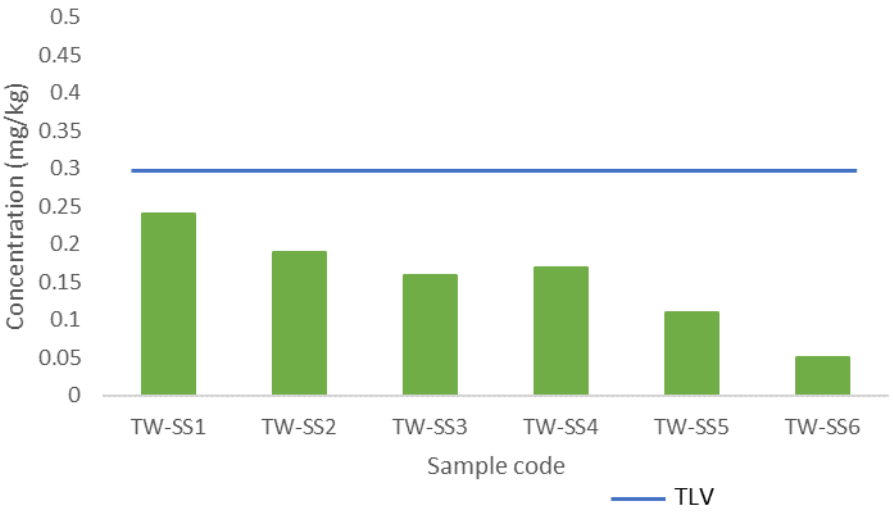



**Figure III.B.4.3. Concentration of mercury in sample TW-SS1 river sediments in Seloto Village (upstream); TW-SS2 river sediments in Seloto Village (middle); TW-SS3 river sediments in Seloto Village (downstream); TW-SS4 river sediments of Lamunga Village (upstream); TW-SS5 river sediments of Lamunga Village (middle); and TW-SS6 river sediments of Lamunga Village (downstream) in the study site, Taliwang District.**

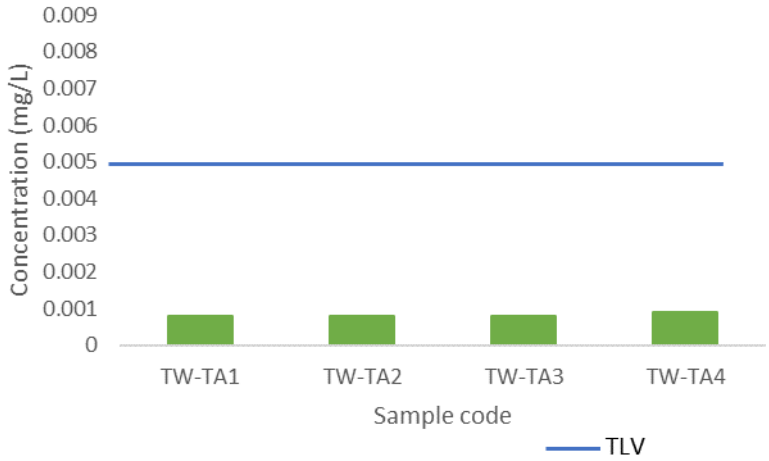



**Figure III.B.4.4. Concentration of mercury in sample TW-TA1 of trommel wastewater in Seloto Village 1; TW-TA2 wastewater of Seloto Village 2 trommels; TW-TA3 wastewater from Lamunga Village 1 trommel; and TW-TA4 wastewater from Lamunga Village 2 in the study location, Taliwang District**

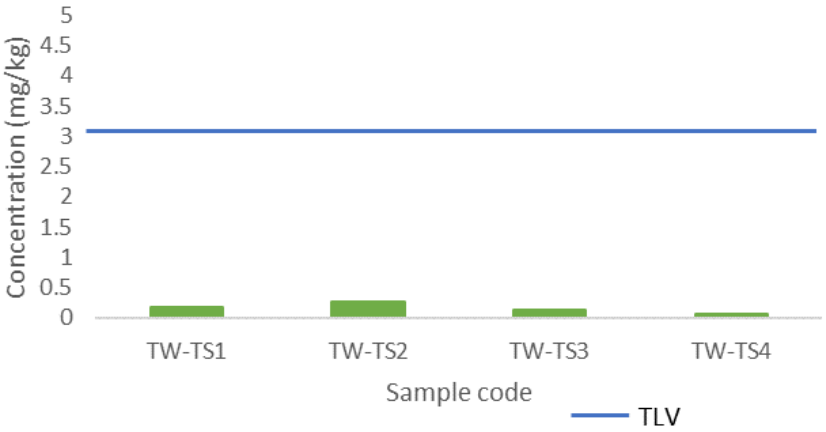



**Figure III.B.4.5. Mercury concentration in TW-TS1 sedimentary sediment Trommels Seloto Village 1; TW-TS2 Sediment Trommels Seloto Village 2; TW-TS3 Sediment Trommels Lamunga Village 1; and TW-TS4 sediment Trommels Lamunga Village 2 in the Study Location Taliwang District**

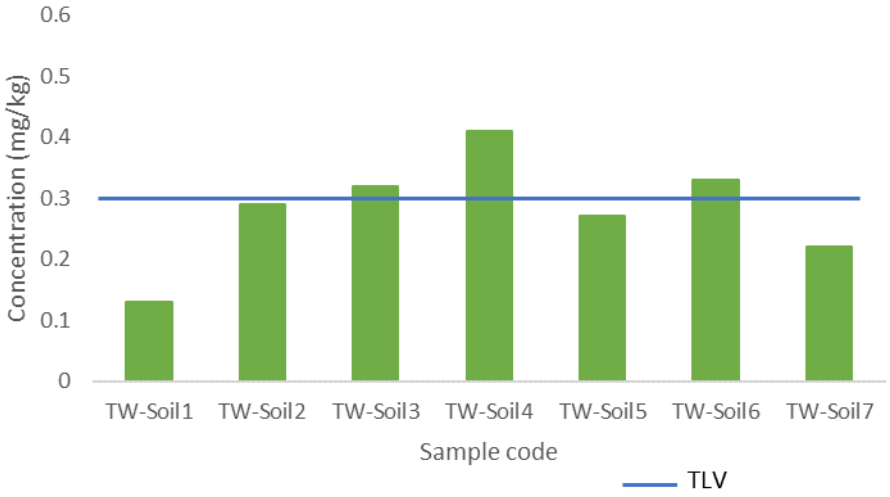



**Figure III.B.4.6. Mercury concentration in TW-soil1 of soil samples at the Trommel 1 processing site in Seloto Village; TW-soil2 of soil at the site of processing trommel 2, Seloto Village; TW-soil3 of the soil at the site for processing trommel 3, Seloto Village; TW-soil4 of the soil at the site for processing trommel 1 Lamunga Village; TW-soil5 of the soil at the location of the trommel processing 2 Lamunga Village; and TW-soil6 of the soil at the trommel 3 processing site in Lamunga Village in the study site, Taliwang District.**




**Figure III.B.4.7. Concentration of mercury in samples of TW-Plant1 plants at the Trommel 1 processing location in Seloto Village; TW-Plant2 plants at the location of processing Trommel 2 Seloto Village; TW-Plant3 plants at the location of processing Trommel 3, Seloto Village; TW-Plant4 plants at the location of processing Trommel 1 Lamunga Village; TW-Plant5 plants at the location of the processing Trommel 2 Lamunga Village; and TW-Plant6 plants at the location for processing Trommel 3, Lamunga Village, in the study area, Taliwang District**

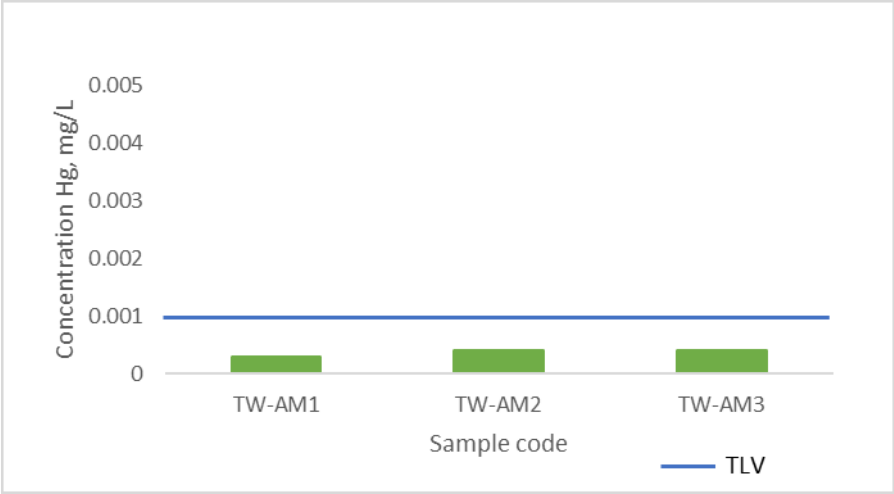



**Figure III.B.4.8. Mercury concentration in the TW-AM1 sample of PDAM water from the Seloto Village community; TW-AM2 well water for the Lamunga Village community; and PDAM water for the people of Lamunga Village in the study location, Taliwang District.**

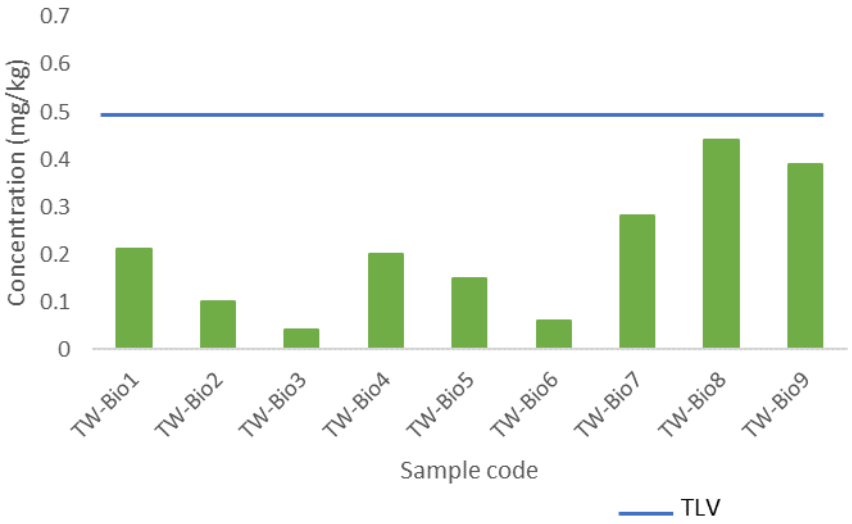



**Figure III.B.4.9. Concentration of mercury in samples of TW-Bio1 biota in the upstream river of Seloto Village; TW-Bio2 biota in the middle of the river Seloto Village; TW-Bio3 biota downstream of the Seloto Village river; TW-Bio4 biota in the upstream of Lamunga Village; TW-Bio5 biota in the middle of the river Lamunga Village; TW-Bio6 biota in the downstream river of Lamunga Village; TW-Bio7 Fish pond in Seloto Village; TW-Bio8 Fish Ponds in Lamunga Village 1; and TW-Bio9 pond fish in Lamunga Village 2 in the study area, Taliwang District**




**Figure III.B.4.10. Concentration of mercury in samples of TW-BRL1 rice from Seloto Village and TW-BRL2 rice from Lamunga Village in the study location, Taliwang District.**

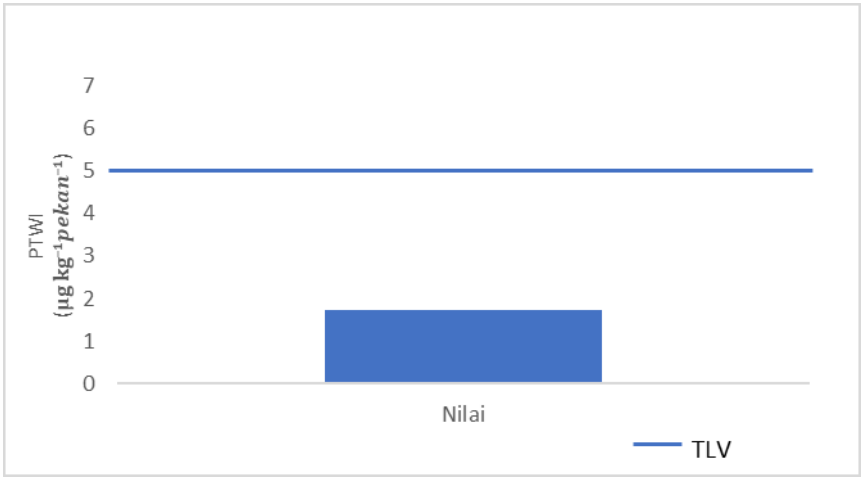



**Figure III.B.4.11. PTWI value of mercury for food, drinking water, fish, and rice compared to TLV for Taliwang District**

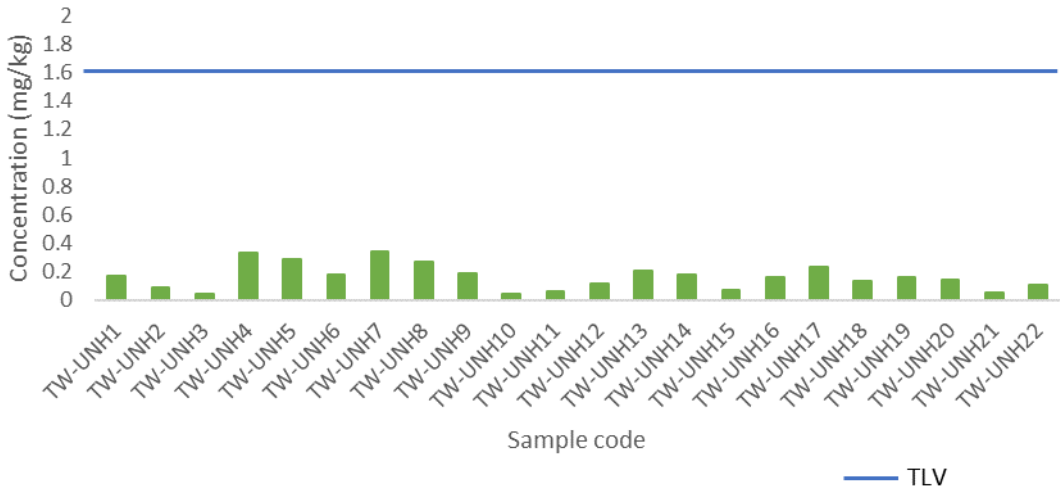



**Figure III.B.4.12. Mercury levels in nail samples of adult respondents in the Study Location Taliwang District.**

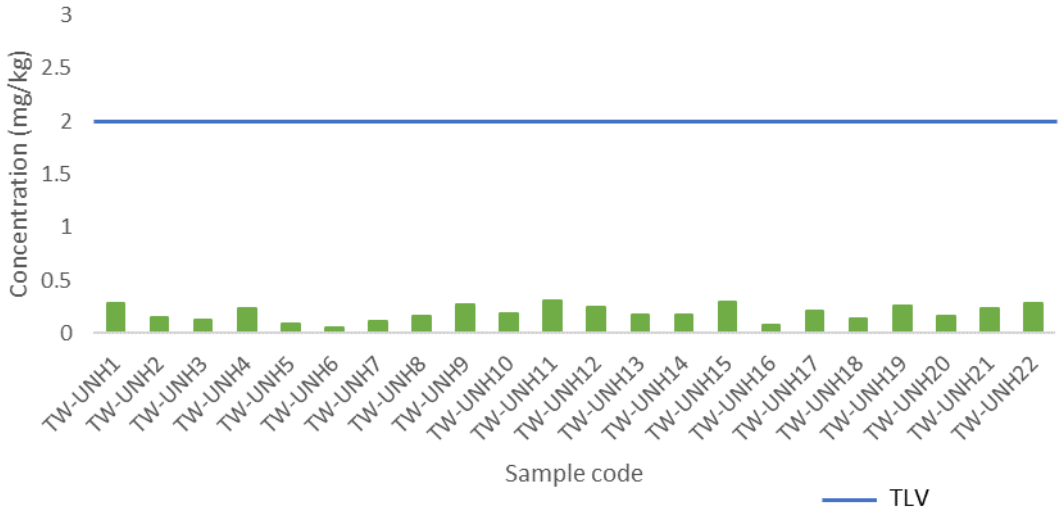



**Figure III.B.4.13. Mercury levels in hair samples of adult respondents in the Study Location Taliwang District.**




**Figure III.B.4.14. Concentration of mercury/g creatinine in adult urine in the Study Location of Taliwang District**

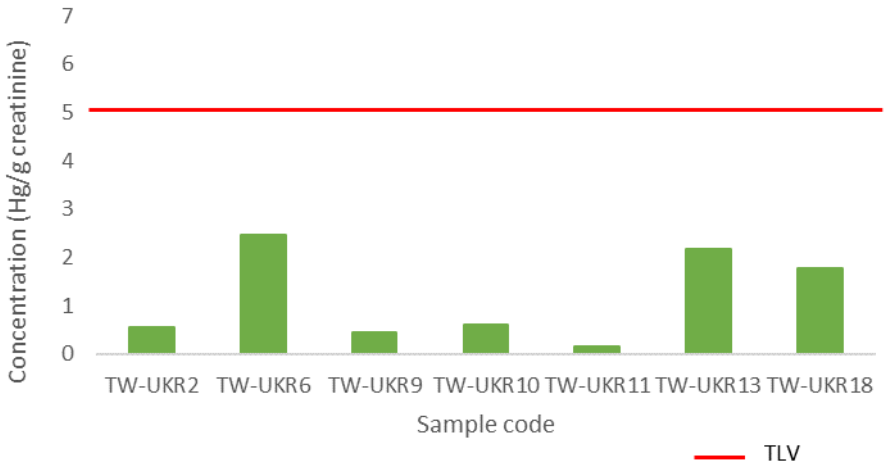



**Figure III.B.4.15. Concentration of mercury/g creatinine in children's urine in Study Location Taliwang District**

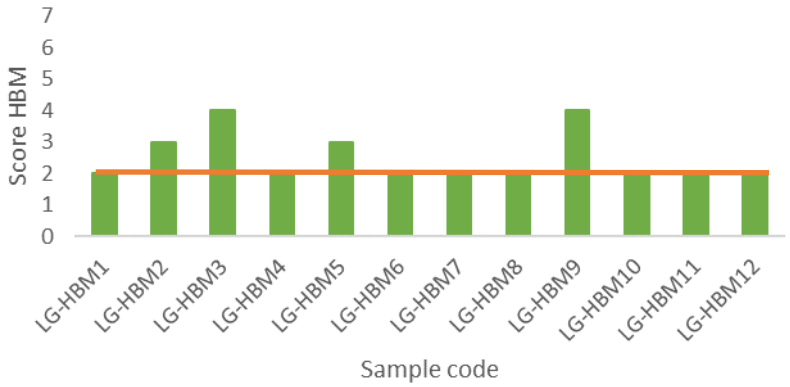



**Figure III.B.4.16. HBM (Human Biomonitoring) scores of adult respondents in the Study Location of Taliwang District**

**Table III.B.4.1. SWOT Strategy for socio-economic management of ASGM at The Study Location of Taliwang District, West Sumbawa Regency, West Nusa Tenggara Province**

| | **Strength (S):**<br>1. The existence of natural resources management companies in West Sumbawa.<br>2. The availability of Village Owned Enterprises as a local commodity-based economic institution at the village level to build the economy in West Sumbawa.<br>3. West Sumbawa Regency has the potential in the form of Village Owned Enterprises that focus on the development of agribusiness and MSMEs with easy credit facilities for the community. | **Weakness (W):**<br>1. The low impact that Village Owned Enterprises can have on the community due to the low quality of human resources owned. Village Owned Enterprises only have a save-to-borrow program.<br>2. Weak regulatory enforcement oversight of illegal gold mining practices.<br>3. Easy access to mercury for use in the processing of illegal mines. |
|---|---|---|
| **Opportunity (O):**<br>1. Potential labor needs in companies managing produce and natural resources in the West Sumbawa region.<br>2. Some official mining companies have community development programs that focus on improving people's welfare and standard of living.<br>3. The existence of a local business development program YPESB that focuses on fostering farmers, farmers, and the building industry through cooperation with related parties both from academics and practitioners in the related industry.<br>4. West Sumbawa has a high agricultural potential. | **Strategy S-O:**<br>1. Optimization of Village Owned Enterprises to improve the economy of the community through integration with local resource development institutions such as YPESB, along with related stakeholders.<br>2. Optimizing the role of the Job Training Center (BLK) to form skilled personnel to fill labor posts in natural resources management companies in West Nusa Tenggara. | **Strategy W-O:**<br>1. Evaluate policies to prevent the growth of illegal mines and limit the haphazard use of mercury in the field.<br>2. Strengthening the role of communities in the society to suppress the growth of illegal miners through economic growth based on local wisdom.<br>3. Evaluating the performance of Village Owned Enterprises and training Village Owned Enterprises executives in the field to improve skills and insights related to business and economic activities. |
| **Threat (T):**<br>1. Low public awareness of health, both in terms of cleanliness and the use of mercury without standards.<br>2. Low public concern for the environment.<br>3. There is social turmoil in the community due to interactions with migrants and because of dissatisfaction with mining companies.<br>4. The low ability of miners to switch jobs to non-mining sectors. | **Strategy S-T:**<br>1. Encourage the Job Center to establish communication with related companies in order to explore the needs of the workforce within the company (especially in terms of expertise and expected level of knowledge).<br>2. Provide trainings for the community in accordance with the needs of work in the company.<br>3. Optimizing the role of Village Owned Enterprises to improve the economy of the community to reduce the potential for horizontal turmoil, as well as build the capacity of the community to engage in broader economic activities. | **Strategy W-T:**<br>1. Establish regulations on gold mining and its mechanisms of application in the field.<br>2. Tightening regulations related to the transfer of residents to mining areas.<br>3. Narrowing the wiggle room of illegal miners and miners who do not follow the rules through regulatory determination, supervision on the supply chain of precious metals, and tightening civil access to mercury. |

## B.5. Bolaang Mongondow Regency, North Sulawesi Province



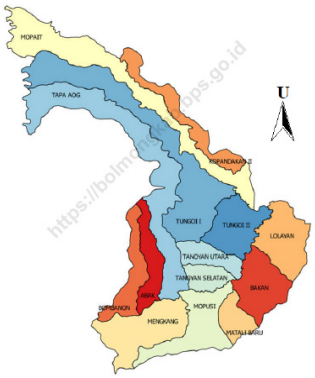




**Figure III.B.5.1. Region Map of North Sulawesi Province and Bolaang Mongondow Regency**

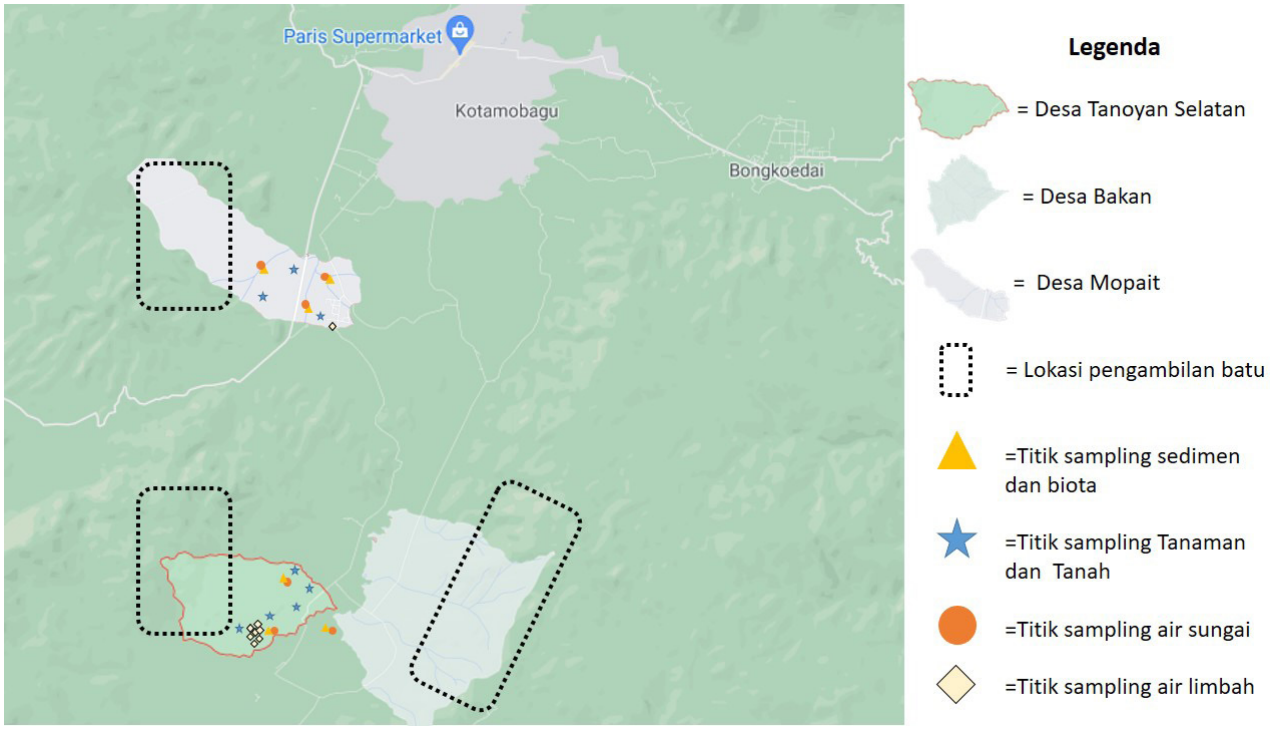



**Figure III.B.5.2. Sampling location in South Tanoyan Village, Bakan Village and Mopait Village in Lolayan District, Bolaang Mongondow Regency**

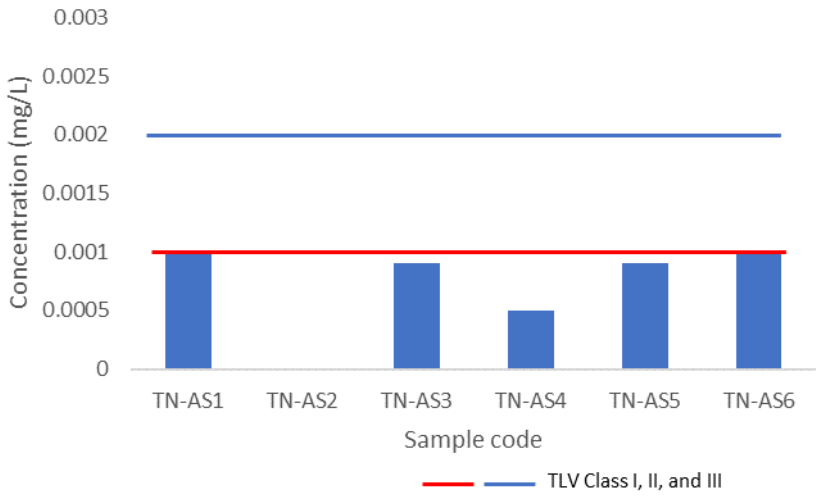



**Figure III.B.5.3. Mercury concentration in TN-AS1 samples of Tanoyan Irrigation River water, TN-AS2 water wells Pak Rais (Tanoyan Village), TN-AS3 water wells Pak Yosi (Bakan Village), TN-AS4 Mopait river water, TN-AS5 Tanoyan River water, TN-AS6 Mopait irrigation river water**

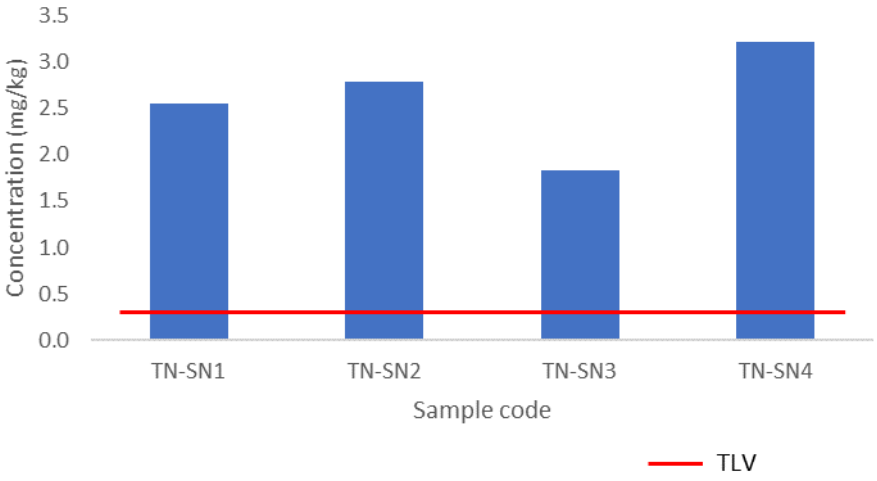



**Figure III.B.5.4. Mercury concentration in TN-SN1 samples of Tanoyan irrigation sediment, TN-SN2 sediment of Tanoyan River, TN-SN3 of Mopait irrigation sediment, and TN-SN4 of Tanoyan River sediment in the Study Location of Lolayan District.**

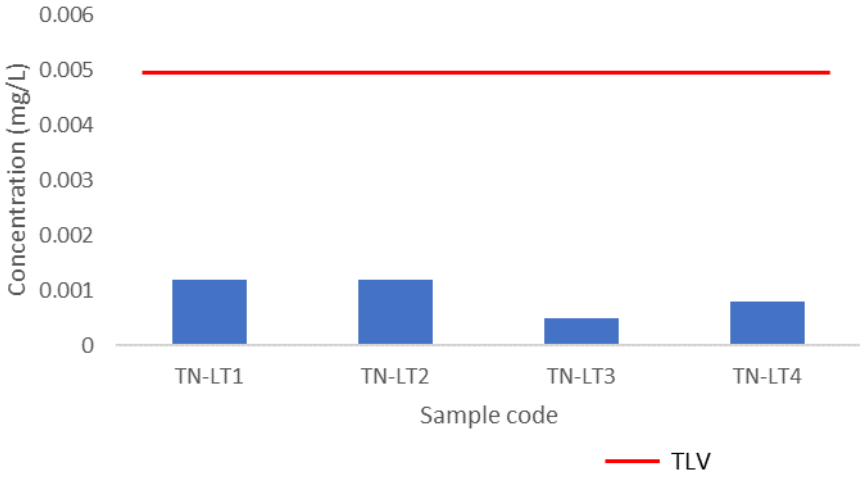



**Figure III.B.5.5. Mercury concentration in TN-LT1 samples of Mopait trommel tailings water, TN-LT2 water tailing trommel Tanoyan 1, TN-LT3 water tailing trommel Bakan, and TN-LT4 water tailing trommel Tanoyan 2 in the Study Location of Lolayan District.**

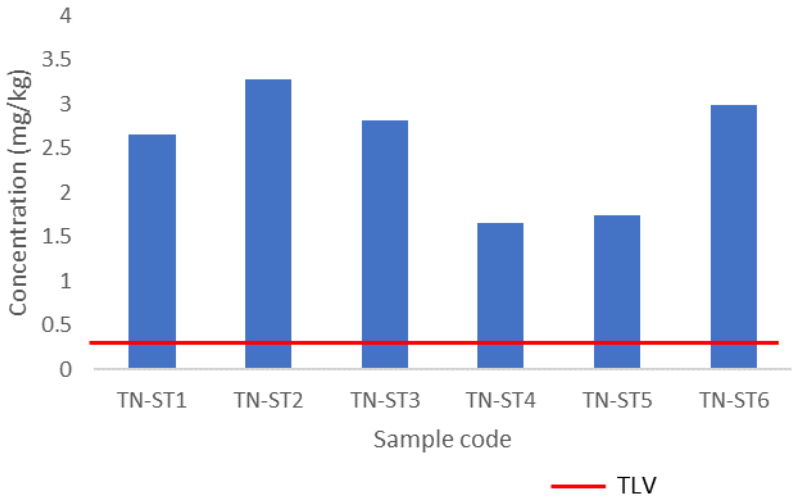



**Figure III.B.5.6. Mercury concentration in TN-ST1 samples of Mopait trommel sediment, TN-ST2 sediment trommel Tanoyan 1, TN-ST3 sediment trommel Tanoyan 2, TN-ST4 sediment trommel Bakan, TN-ST5 sediment trommel Tanoyan 3 and TN-ST6 sediment trommel Tanoyan in the Study Location of Lolayan District.**

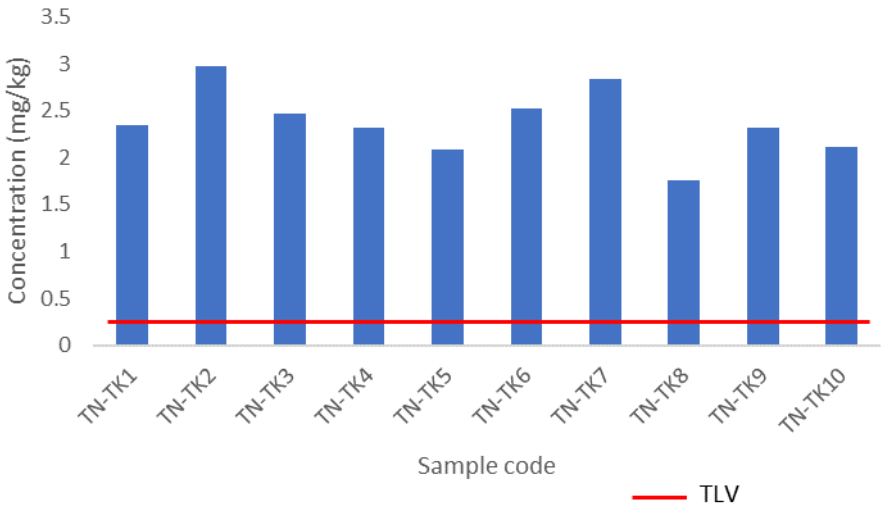



**Figure III.B.5.7. Mercury concentrations in TN-TK1 samples of soil around Mopait trommel, TN-TK2 land around trommel Tanoyan 1, TN-TK3 land around trommel Tanoyan 2, TN-TK4 land around trommel Bakan, TN-TK5 land on the banks of the Tanoyan River, TN-TK6 former garden land cyanidation process, TN-TK7 land around trommel Tanoyan 3, TN-TK8 land around trommel Tanoyan 4, TN-TK9 land around trommel Tanoyan 5, and TN-TK10 Mopait village garden land in the Study Location of Lolayan District.**

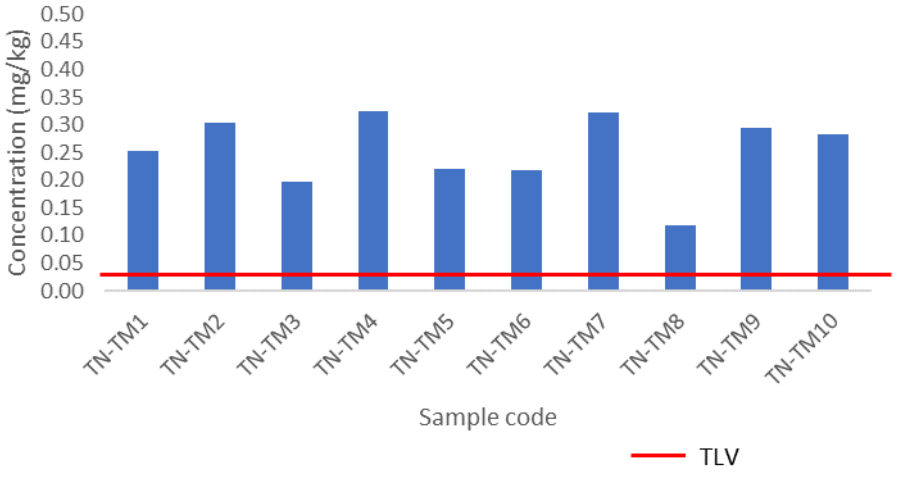



**Figure III.B.5.8. Mercury concentrations on TN-TM1 samples of soil around Trommel Mopait, TN-TM2 soil around Trommel Tanoyan 1, TN-TM3 soil around trommel Tanoyan 2, TN-TM4 soil around trommel Bakan, TN-TM5 land on the banks of the Tanoyan River, TN-TM6 garden land former cyanidation process, TN-TM7 land around trommel Tanoyan 3, TN-TM8 land around trommel Tanoyan 4, TN-TM9 land around trommel Tanoyan 5, and TN-TM10 Mopait village garden land in the Study Location of Lolayan District.**

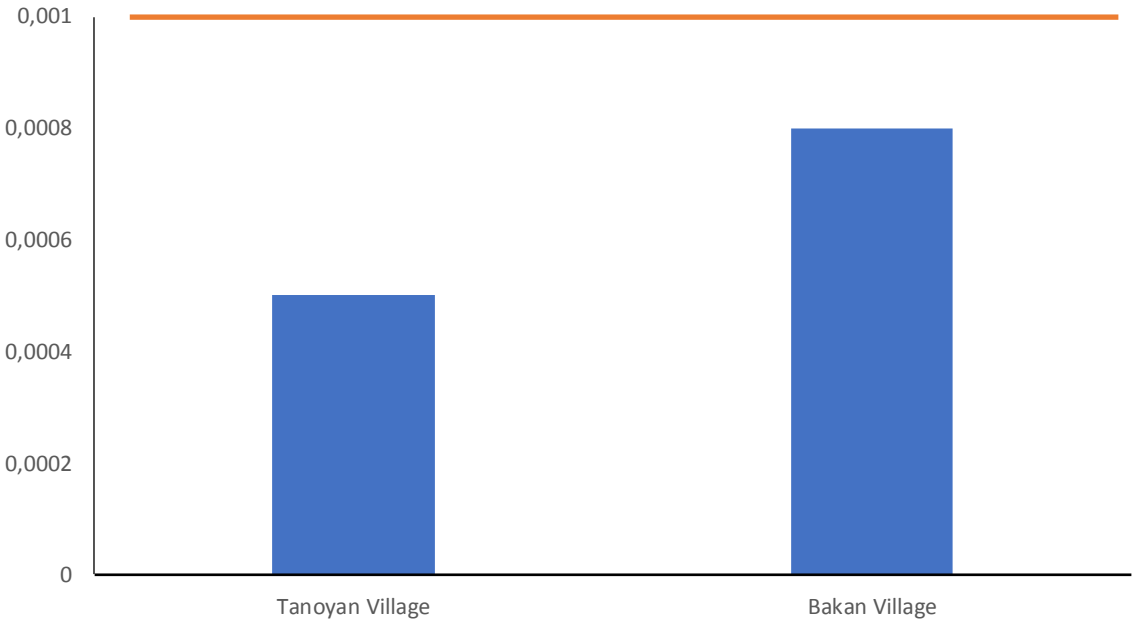



**Figure III.B.5.9. Mercury concentrations in the well water sample of Bakan Village and PDAM water sample Tanoyan Village in the Study Location of Lolayan District.**

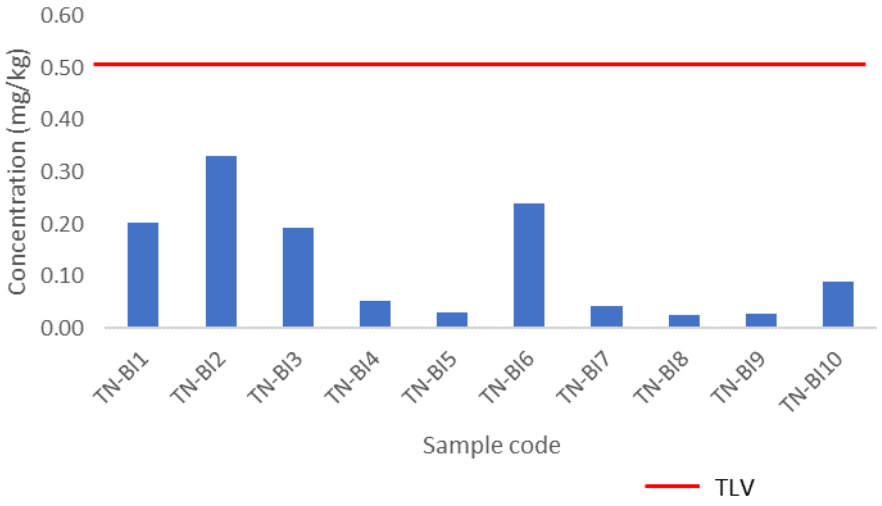



**Figure III.B.5.10. Mercury concentration in samples tn-bi1 biota irrigation Mopait river, TN-BI2 biota Tanoyan River, TN-BI3 biota Mopait river, TN-BI4 biota pool Mopait 1, TN-BI5 biota pool Mopait 2, TN-BI6 biota pool Mopait 3, TN-BI7 biota pond residents Tanoyan 1, TN-BI8 biota pond residents Tanoyan 2, TN-BI9 biota pond residents Tanoyan 3, and TN-BI10 biota pond residents Tanoyan 4 in the Study Location of Lolayan District.**

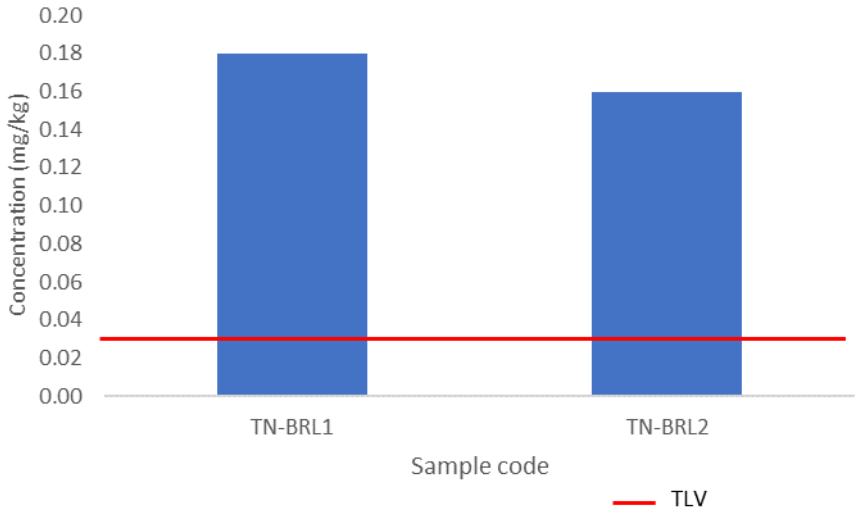



**Figure III.B.5.11. Mercury concentration on rice sample of TW-BRL1 Mopait Village and TN-BRL2 Tanoyan Village**

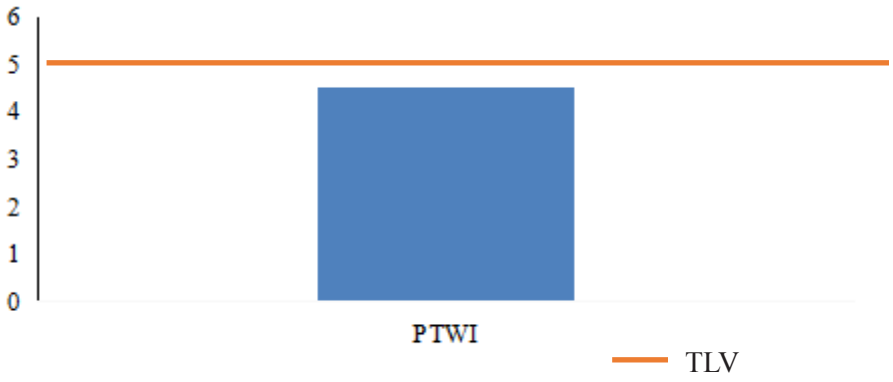



**Figure III.B.5.12. PTWI mercury value for drinking water foodstuffs, fish, and rice compared to the quality standards in the Study Location of Lolayan District.**

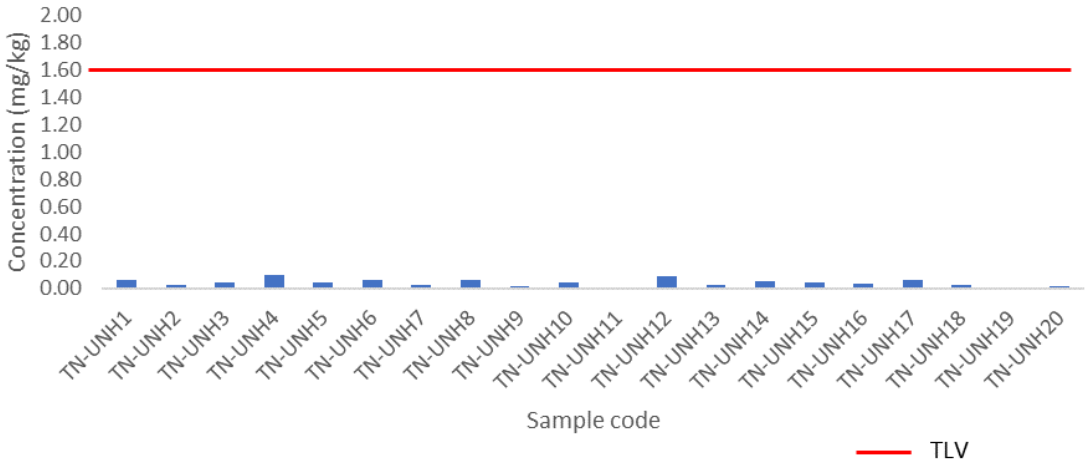



**Figure III.B.5.13. Mercury levels in nail samples of adult respondents in the Study Location of Lolayan District.**

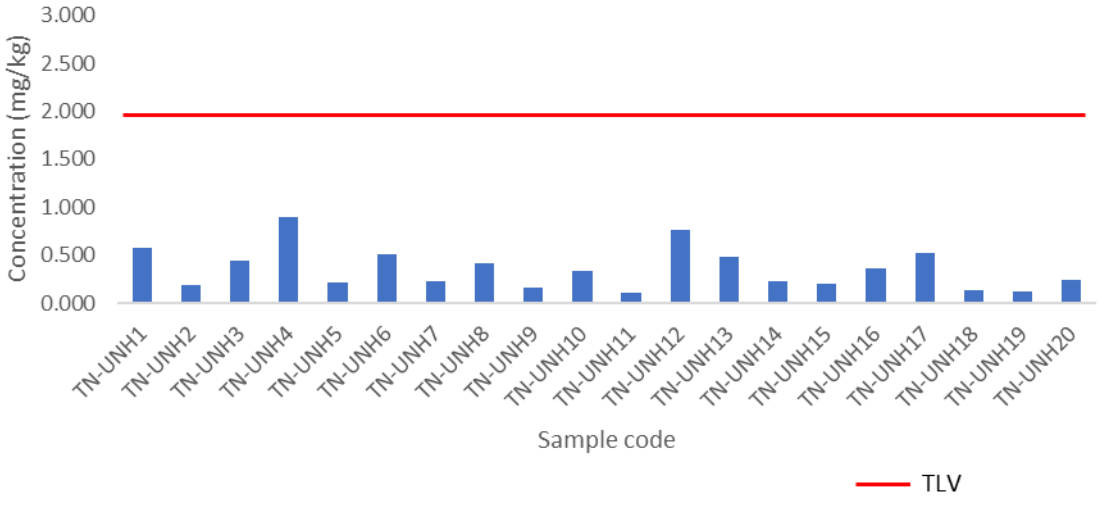



**Figure III.B.5.14. Mercury levels in a sample of adult respondents' hair in the Study Location of Lolayan District.**

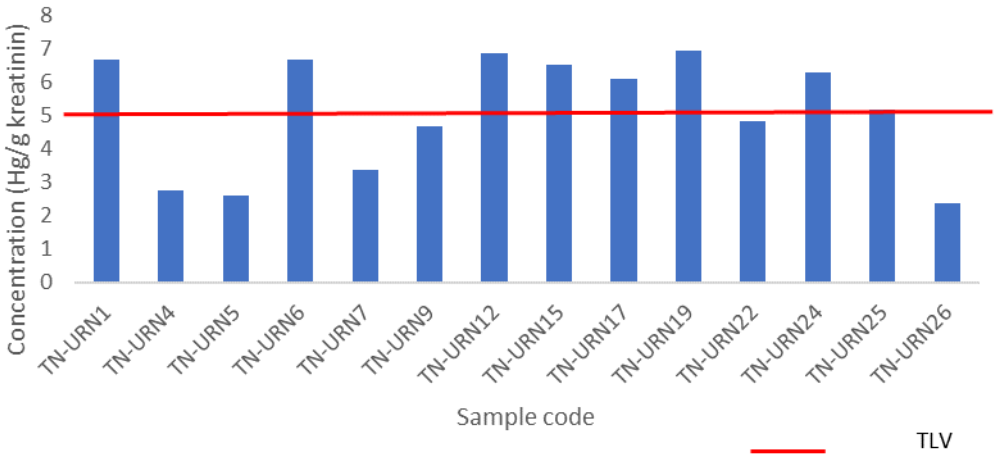



**Figure III.B.5.15. Concentration of mercury/g creatinine in adult urine in the Study Location of Lolayan District.**

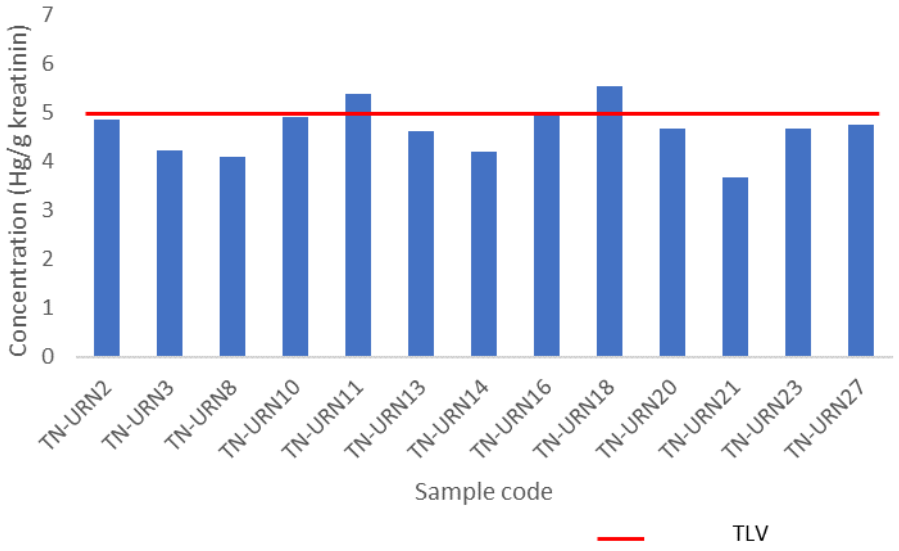



**Figure III.B.5.16. Concentration of mercury/g creatinine in children's urine in the Study Location of Lolayan District.**




**Figure III.B.5.17. HBM (Human Biomonitoring) value of adult respondents in the Study Location of Lolayan District.**

**Table III.B.5.1. SWOT Strategy for socio-economic management of ASGM in the Study Location of Lolayan District., Bolaang Mongondow Regency, North Sulawesi Province**

| | **Strength (S):** | **Weakness (W):** |
|---|---|---|
| | 1. The existence of a natural resources management company in the Regency.<br>2. The amount of economic potential spread in the Regency area as well as the market potential in the surrounding areas that have not been utilized optimally. | 1. Weak regulatory oversight of illegal gold mining practices.<br>2. Easy access to Hg use by illegal miners in the Regency. |
| **Opportunities (O):**<br>1. Potential labor needs in produce and natural resources management companies in district.<br>2. Awareness in the community due to the impact of the use of Hg in mining. There are complaints about damage to food crop production due to exposure to wastewater for irrigation. | **Strategy S-O:**<br>1. Optimize the role of BLK to channel skilled personnel to fill labor posts in produce management companies around the Regency, thus it is expected to reduce the number of workers involved in ASGM activities.<br>2. Raise awareness on the environmental impact of ASGM activities to the community. The attention that has emerged about the impact of mercury on the agricultural sector can be used to encourage public awareness. | **Strategy W-O:**<br>1. Evaluate policies and integrate existing structures in the community with regulators to prevent haphazard use of Hg in the field.<br>2. Build community structures to prevent the use of illegal Hg in the field accompanied directly by the government and the authorities. |

| Threat (T): | Strategy S-T: | Strategy W-T: |
|---|---|---|
| 1. Low public awareness of health aspects, both in terms of cleanliness and the use of Hg without standards.<br>2. Low public concern for the environment.<br>3. The mining sector is still the largest source of GDP and reflects economic activity in the Regency.<br>4. Mining activities that have penetrated the forests and mountains of Bakan and Tanoyan. Land transfer is highly calculated.<br>5. The low ability of illegal miners to switch jobs to non-mining sectors. | 1. Encourage BLK to establish communication with related companies to explore the needs of the workforce in the company, especially in terms of expertise and the level of knowledge expected.<br>2. Provide training that suits the needs of the work in the relevant company. | 1. Issue regulations on gold mining and its mechanisms of application in the field.<br>2. Tighten supervision of mining activities, especially in terms of encroachment of forests and mountains.<br>3. Tighten regulations related to the displacement of residents to the mine area.<br>4. Narrowing the wiggle room of miners who do not comply with the rules through regulatory determination, supervision on precious metal supply chains, and tightening civil access to mercury. |

**Table III.B.5.2. Local Action Plan related to ASGM until 2025 (Presidential Regulation No. 21/2019)**

| National strategy | | North Sulawesi Provincial Government Action until 2025 | |
|---|---|---|---|
| 1. | Strengthening commitment, coordination, and cooperation between relevant institutions | 1.1. | In accordance with the ministerial regulation to be published, adhere to the guidelines for storage and handling of Hg and waste containing mercury. |
| | | 1.2. | Comply with procedures in accordance with mercury contaminated land recovery guidelines documents. |
| | | 1.3. | In accordance with the guidelines to be published by the MoH, seek the protection of at-risk populations, especially children and women, and control the health impacts of mercury exposure. |
| 2. | Strengthening coordination and cooperation between the central government and local governments | 2.1. | Improving the understanding of local government apparatus related to licensed mining. |
| | | 2.2. | Develop and implement cooperation on reducing and eliminating the use of mercury and countering the impact of mercury with non-governmental organizations, NGOs, donor agencies, and other institutions (bilateral). |
| | | 2.3. | Monitor the quality of the environment (multimedia) periodically. |
| 3. | Capacity building of leadership, institutional and human resources in the elimination of mercury | 3.1. | Participating in the implementation of mercury research and monitoring. |
| 4. | Establishment of information systems | 4.1. | Participate in mapping the impact of emissions and mercury release around ASGM location. |
| | | 4.2. | Identifying pollution points (hot spots, at-risk populations, and vulnerable populations due to Hg exposure through sector cooperation. |
| | | 4.3. | Also develop a national database system related to trade, circulation, and use of mercury. |
| | | 4.4. | Also inventory and map the source, supply of procurement, circulation, and use of mercury. |

| National strategy | | North Sulawesi Provincial Government Action until 2025 | |
|---|---|---|---|
| 5. | Strengthening community engagement through communication, information, and education | 5.1. | Campaigning for the risk of the impact of Hg use on vulnerable communities and gender mainstreaming campaigns. |
| | | 5.2. | Awareness raising and improving the ability of health workers about health risks due to exposure to mercury. |
| | | 5.3. | Develop an approach to society to increase knowledge and awareness of the dangers of mercury to health. |
| | | 5.4. | Developing a community participation approach at Location ASGM aimed at improving knowledge about the health impacts of mercury exposure and sustainable behavioral changes in the community. |
| | | 5.5. | Improving understanding of good mining practices for IPR businesses. |
| 6. | Application of alternative technology of mercury-free gold processing | 6.1. | Raise awareness on guidelines for the recovery of mercury contaminated land. |
| | | 6.2. | Also restore mercury contaminated land and land rehabilitation due to gold mining activities. |
| | | 6.3. | Provision of mercury storage facilities. |
| 7. | Transfer of local people's livelihoods | 7.1. | Preparing a social study of the impact of mercury use on ASGM activities. |
| | | 7.2. | Preparing an economic study of the impact of mercury use. |
| | | 7.3. | Economic and social empowerment of communities outside WPR. |
| | | 7.4. | Actively transforming the social and economic illegal miners of mercury users. |
| | | 7.5. | Coaching on business opportunities. |
| | | 7.6. | Facilitating the issuance of cooperative and SME licensing. |
| 8. | Strengthening law enforcement | 8.1. | Control of Illegal ASGM using mercury. |
| | | 8.2. | Control of Illegal mercury trading system. |

## B.6. MURUNG SUBDISTRICT AND SOUTH TANAH SIANG SUBDISTRICT, MURUNG RAYA DISTRICT, CENTRAL KALIMANTAN PROVINCE

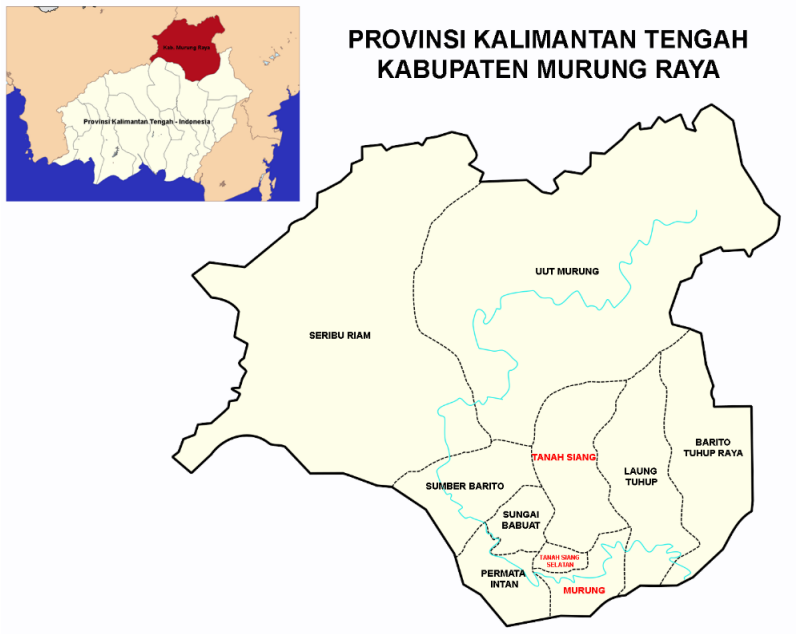



**Figure III.B.6.1. Regional Map of Murung Raya Regency, Central Kalimantan Province**




**Figure III.B.6.2. Location of environmental sampling in Mangkahui Village**




**Figure III.B.6.3. Location of environmental sampling in Kotou Village**

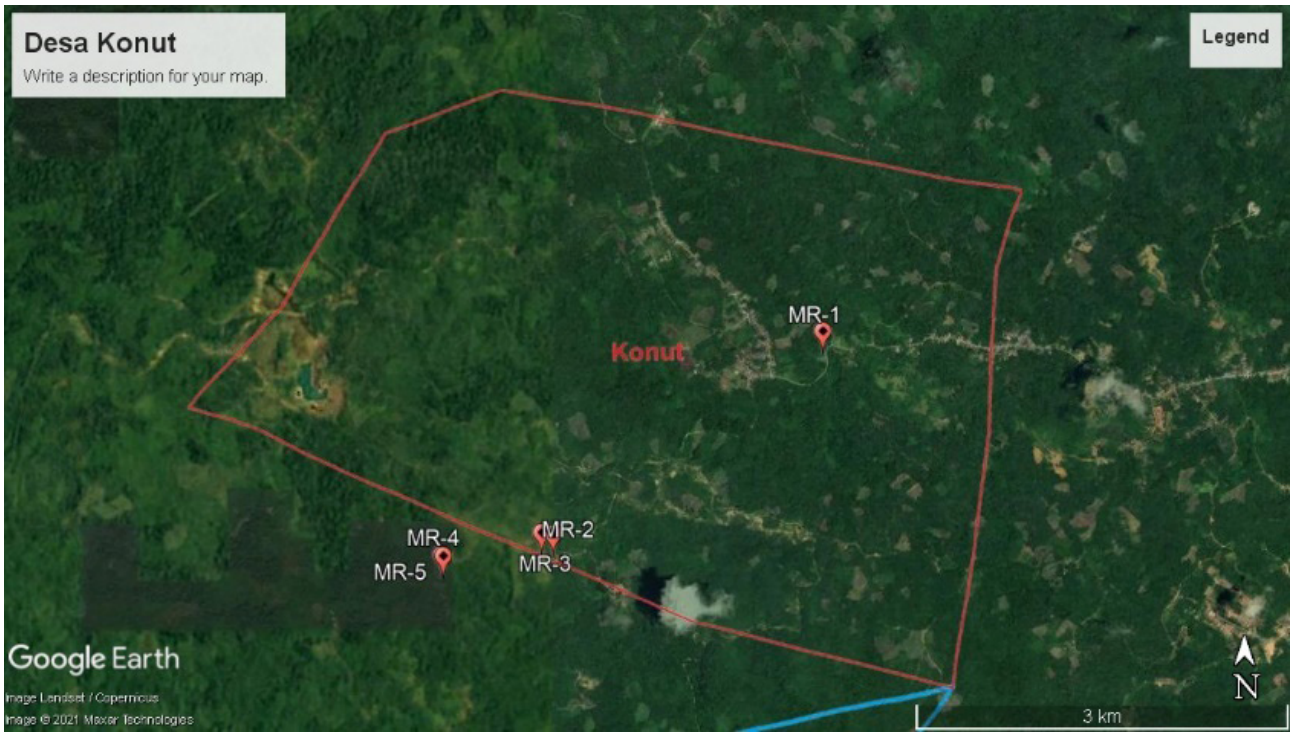



**Figure III.B.6.4. Location of environmental sampling in Konut Village**

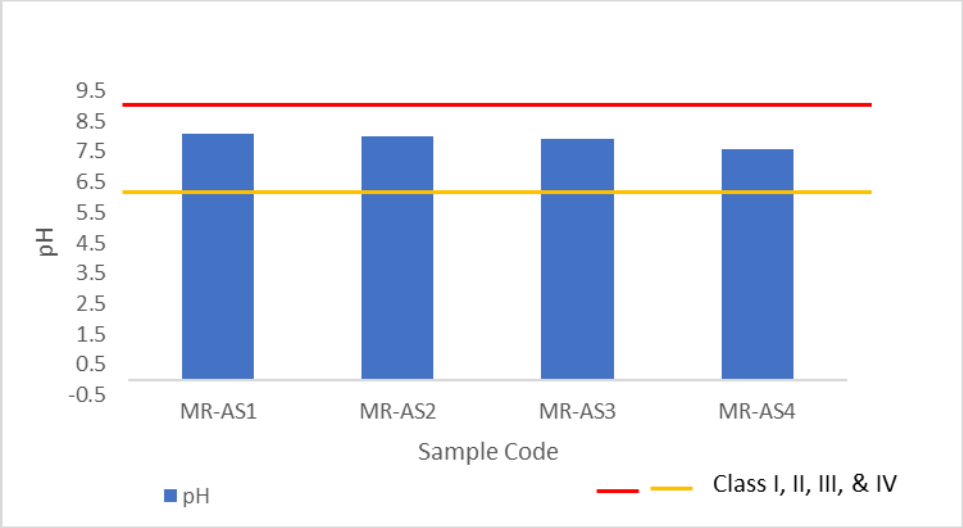



**Figure III.B.6.5. pH of Murung Raya Regency river water compared to Government Regulation No. 22/2021**

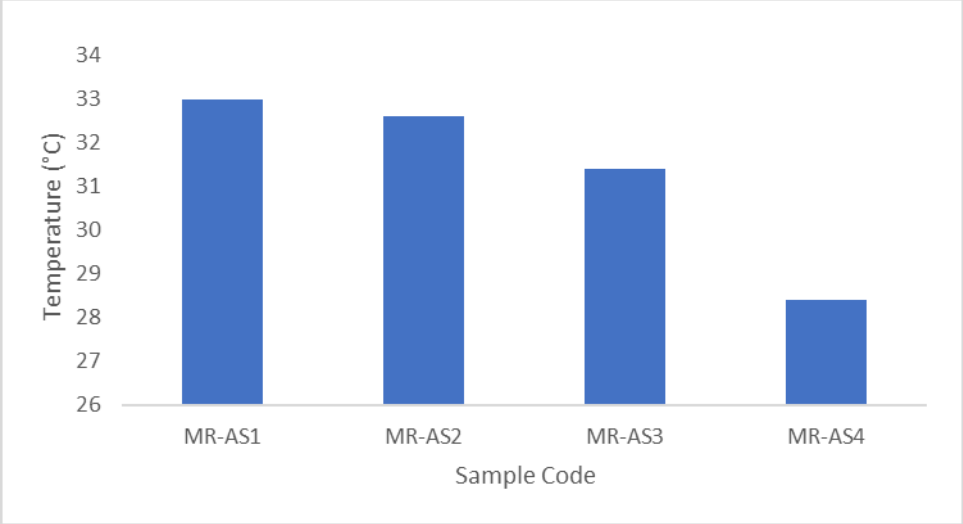



**Figure III.B.6.6. River water temperature of Murung Raya Regency compared to Government Regulation No. 22/2021**

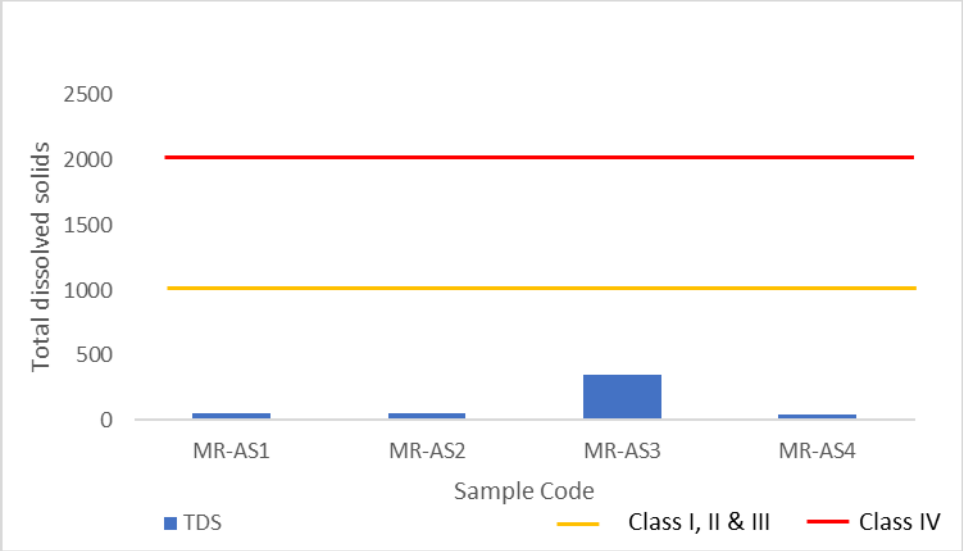



**Figure III.B.6.7. TDS of river water in Murung Raya Regency compared to Government Regulation No. 22/2021**

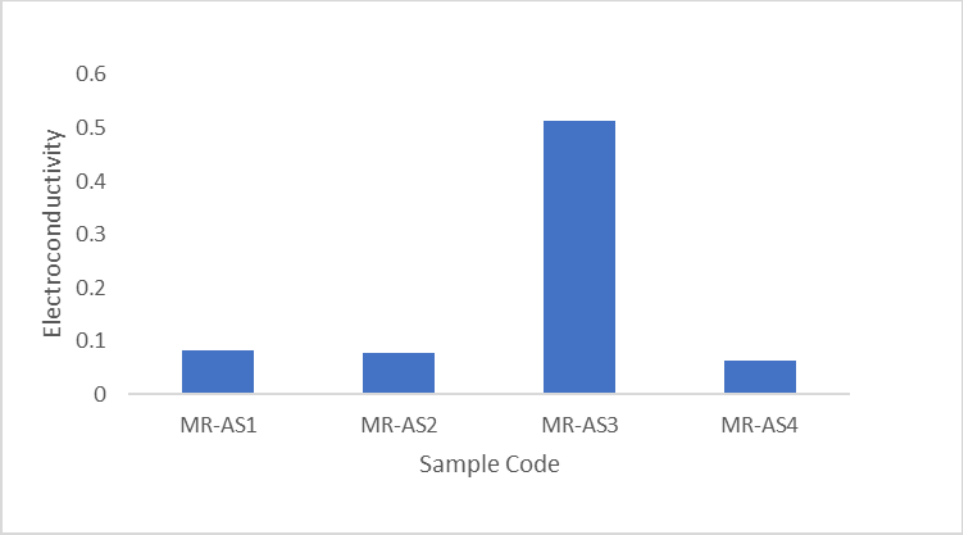



**Figure III.B.6.8. Electroconductivity of river water in Murung Raya Regency**

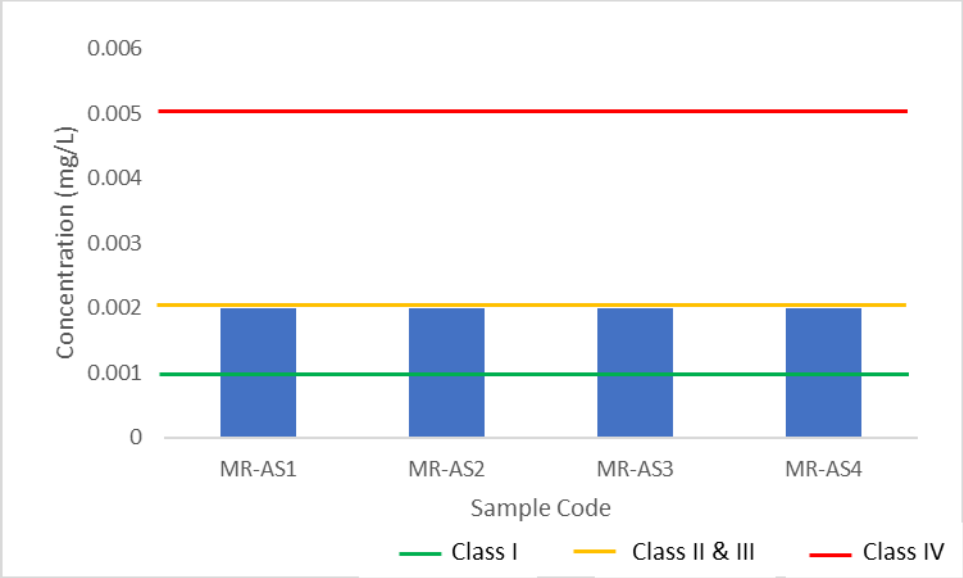



**Figure III.B.6.9. Total mercury of Murung Raya Regency river water**

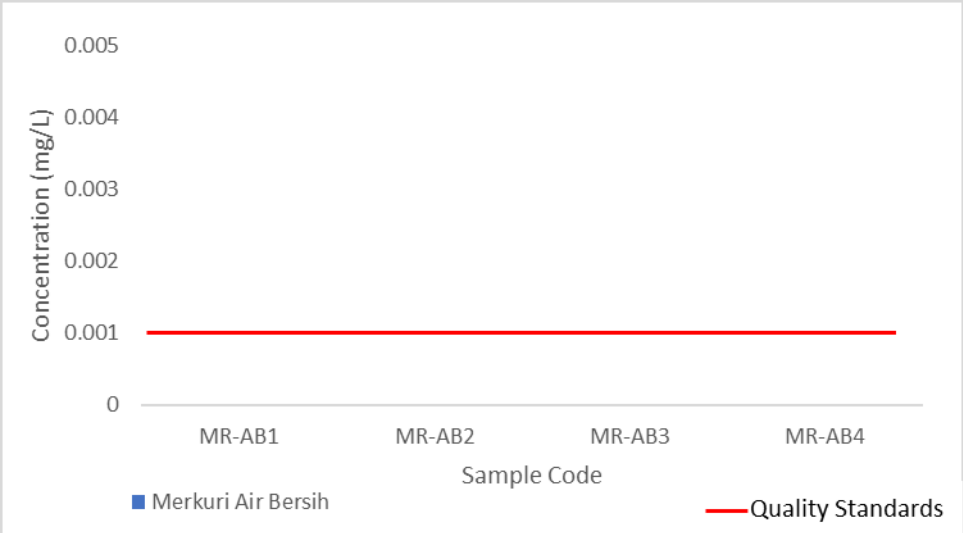



**Figure III.B.6.10. Total mercury in clean water in Murung Raya Regency**

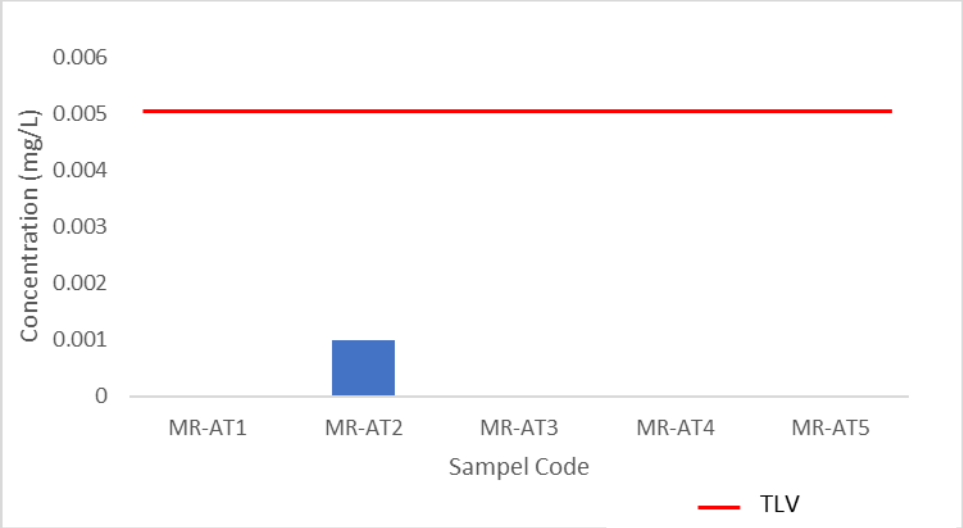



**Figure III.B.6.11. Total mercury in tailings water in Murung Raya Regency**

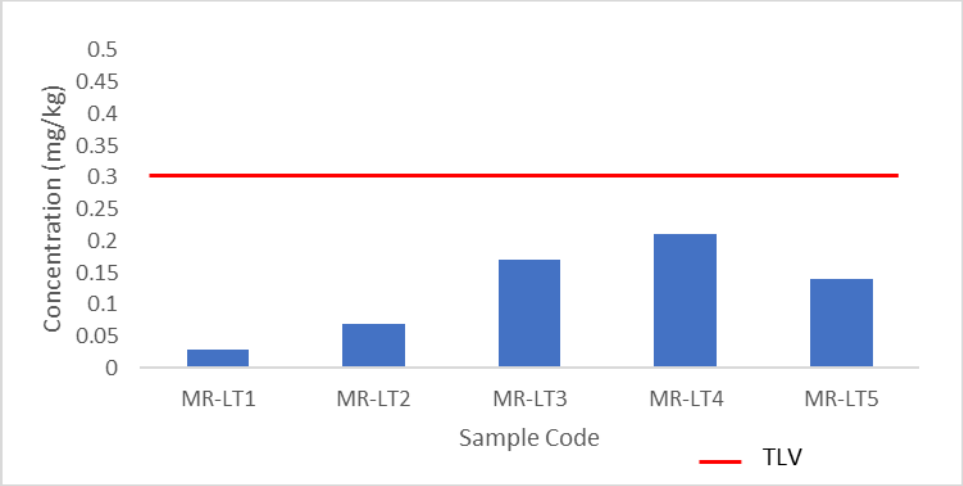



**Figure III.B.6.12. Total mercury in tailings sludge in Murung Raya Regency**

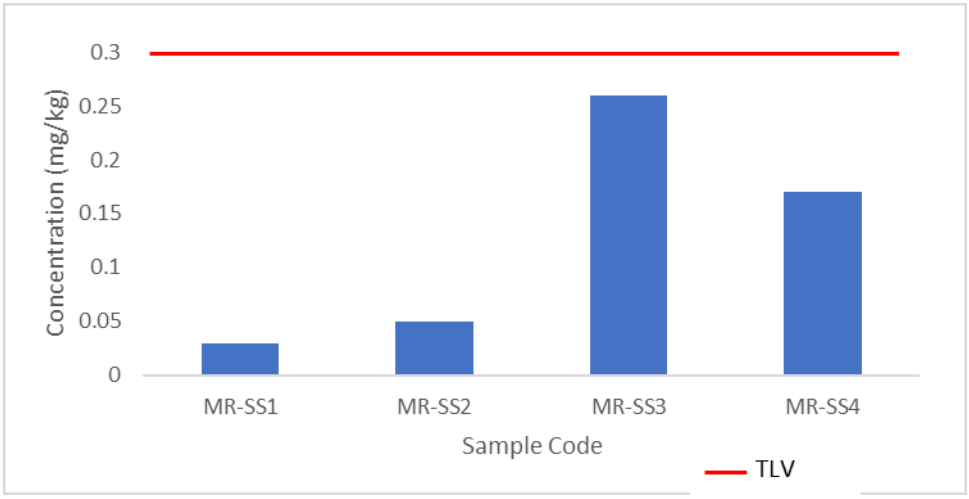



**Figure III.B.6.13. Total mercury in river sediment in Murung Raya Regency**

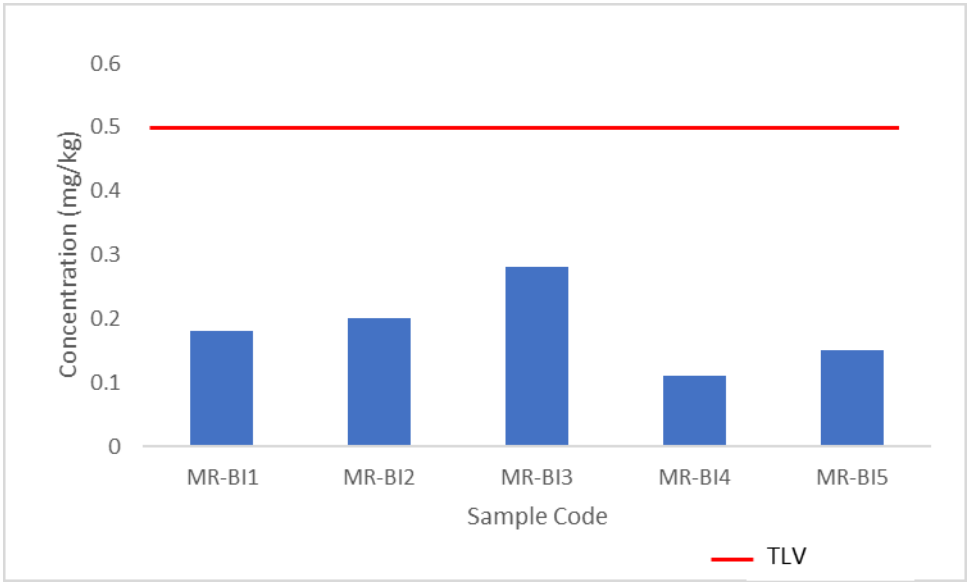



**Figure III.B.6.14. Total mercury in biota and fish in Murung Raya Regency**

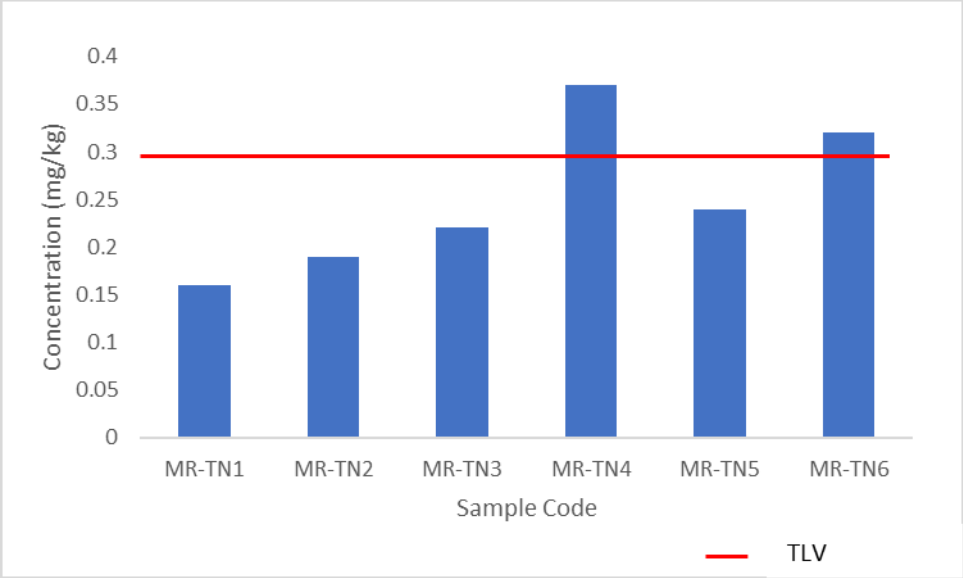



**Figure III.B.6.15. Total mercury in the soil in Murung Raya Regency**

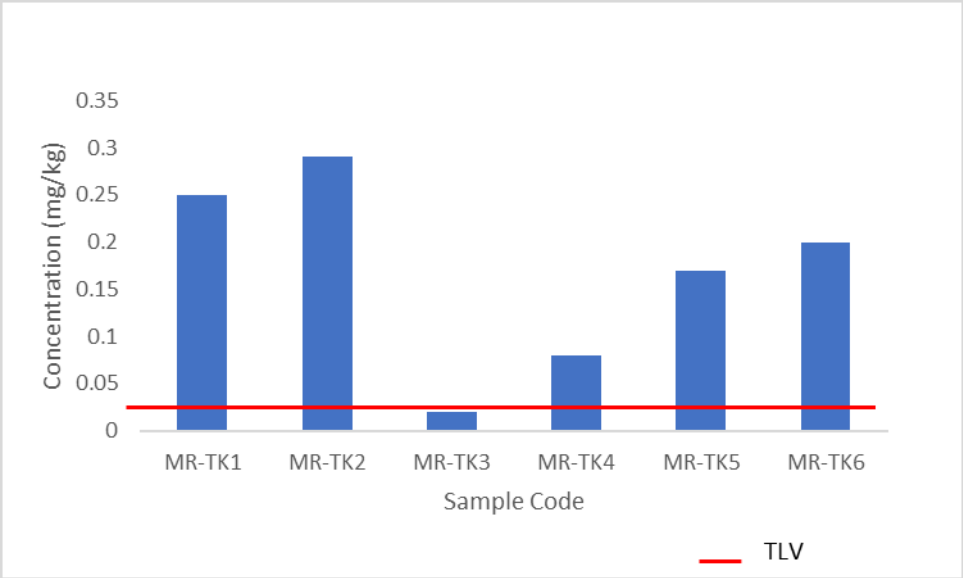



**Figure III.B.6.16. Total mercury in crops in Murung Raya Regency**

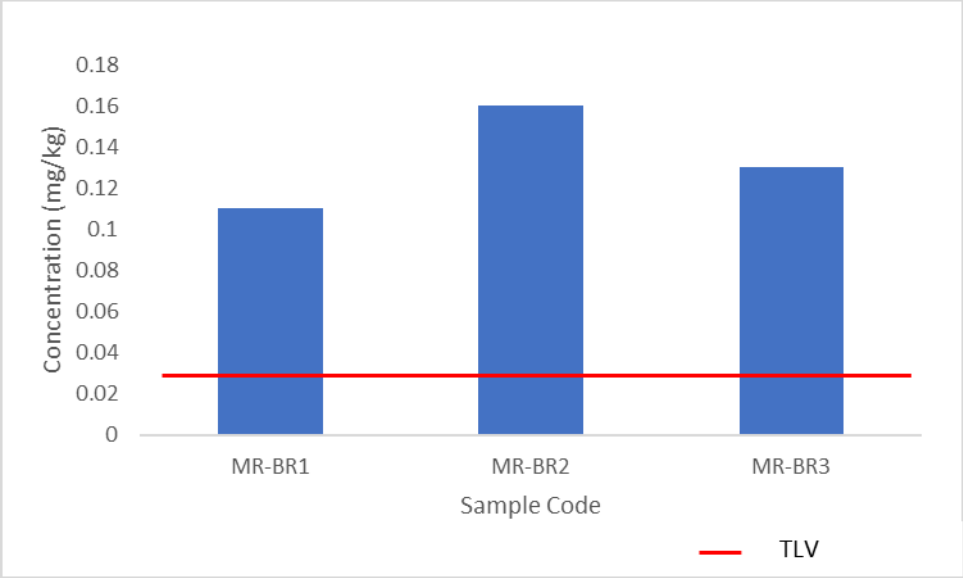



**Figure III.B.6.17. Total mercury in local rice in Murung Raya Regency**

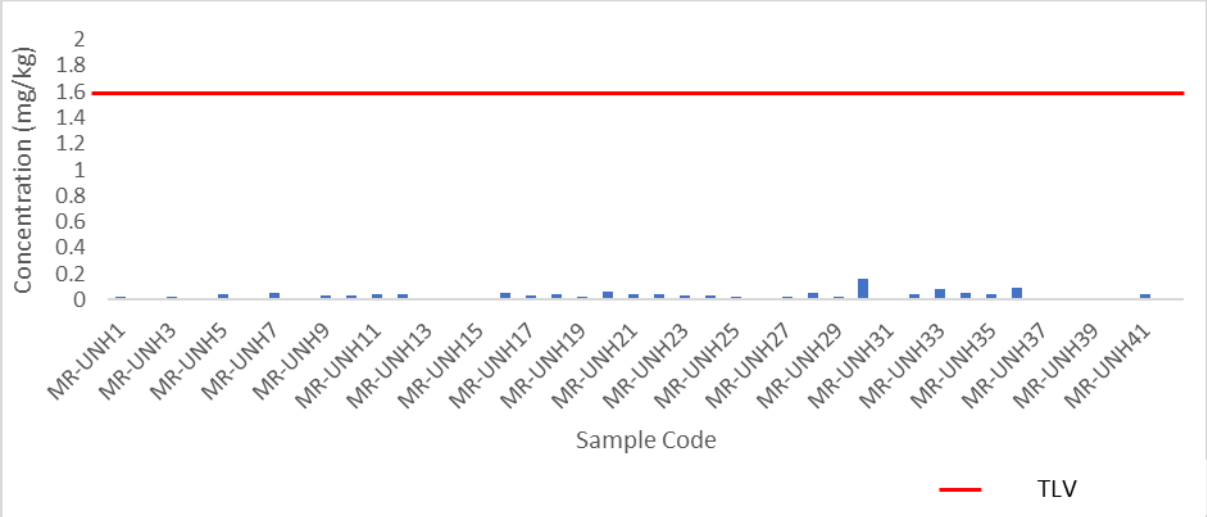



**Figure III.B.6.18. Total mercury in respondents' nails in Murung Raya Regency**

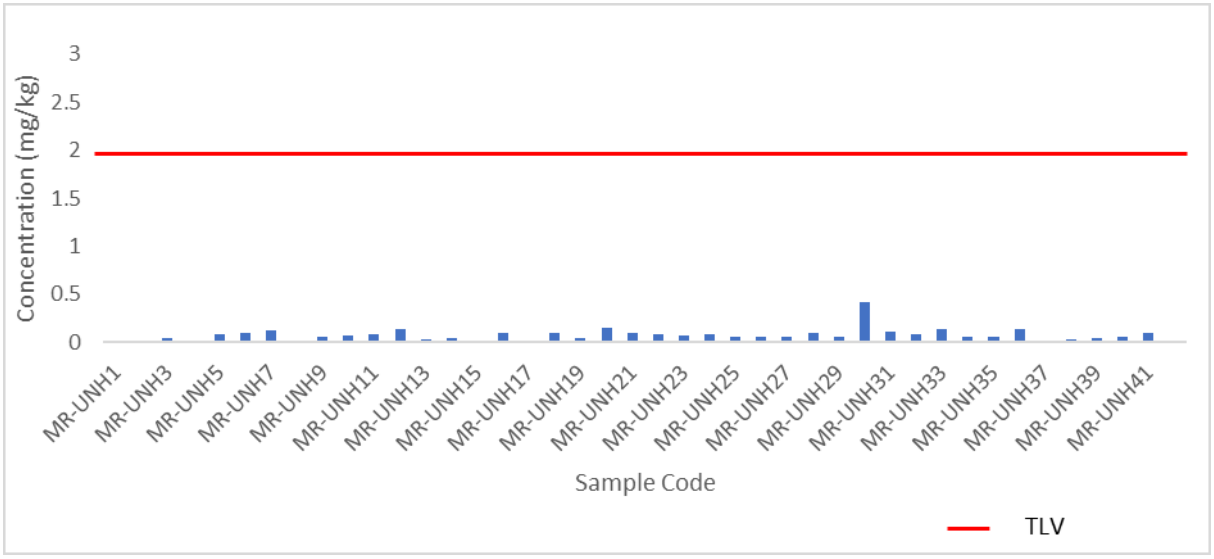



**Figure III.B.6.19. Total mercury in respondents' hair in Murung Raya Regency**

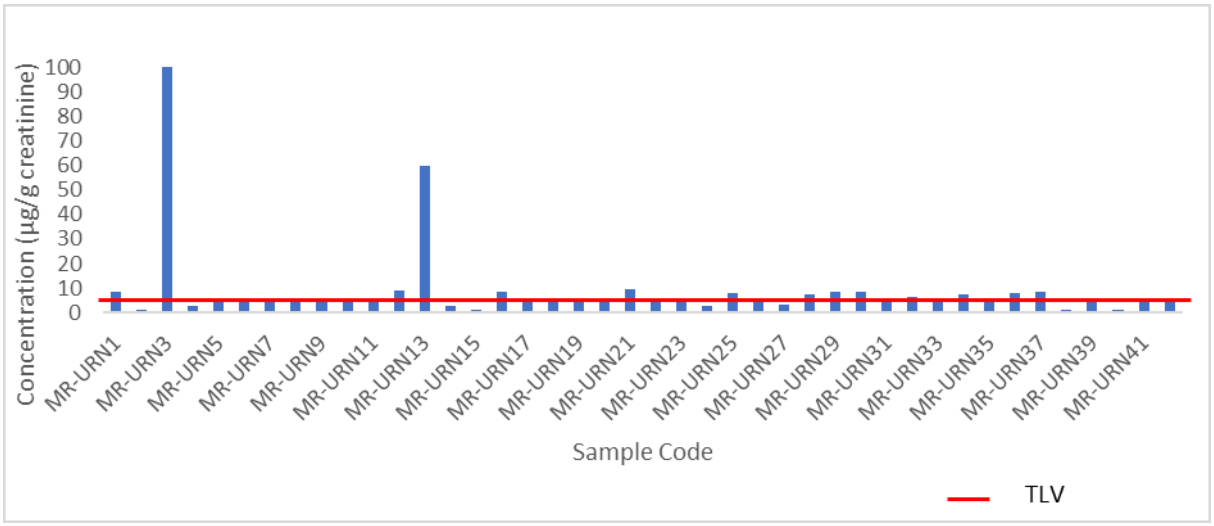



**Figure III.B.6.20. Total mercury in respondents' urine in Murung Raya Regency**

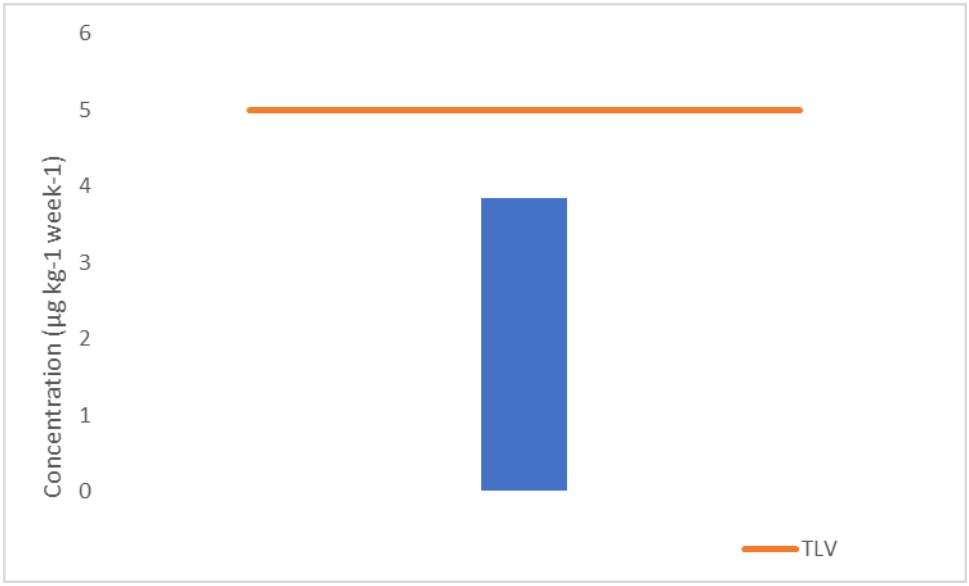



**Figure III.B.6.21. PTWI value of mercury for water, fish, and rice foodstuffs compared to quality standards for Murung Raya District**

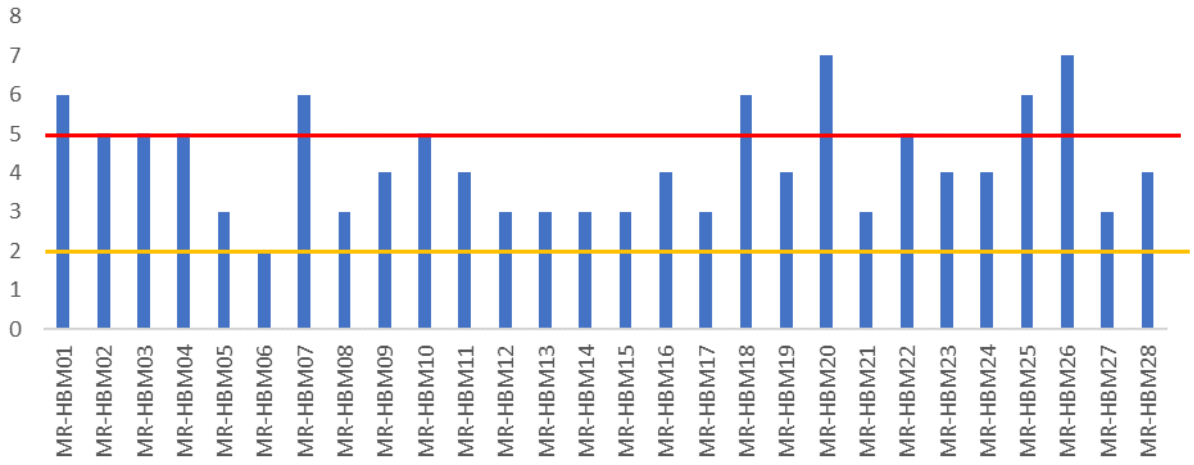



**Figure III.B.6.22. Human biomonitoring (HBM) value of adult respondents in Murung Raya Regency**

**Table III.B.6.1. SWOT strategy for socio-economic management of ASGM in the study location of Murung Raya Regency, Central Kalimantan Province**

| | **Strength (S):** | **Weakness (W):** |
|---|---|---|
| | 1. Provincial Goverment's commitment to implement the Law on Minamata.<br>2. The existence of natural resources management families in Central Kalimantan.<br>3. West Murung Raya Regency has potential in agriculture and forestry sector.<br>4. The existence of NGOs focused on ASGM | 1. Weak regulatory oversight of illegal gold mining practices.<br>2. Easy access to mercury for use in the processing of illegal mines. |
| **Opportunity (O):**<br>1. Potential labor needs in natural resources companies in central Kalimantan.<br>2. Some official mining companies have CSR programs focused on improving welfare.<br>3. The development program of YTS focuses on coaching miners through cooperation with related parties of academics and practitioners.<br>4. The potential of the agricultural sector is high. | **Strategy S-O:**<br>1. Optimization of NGOs to improve the economy of the community through integration with local resource development institutions, along with related stakeholders.<br>2. Optimizing the role of BLK to form skilled personnel to fill labor posts in natural resources management companies in Central Kalimantan. | **Strategy W-O:**<br>1. Evaluate policies to prevent the growth of ASGM and limit the haphazard use of mercury in the field.<br>2. Strengthening the role of communities in the community to suppress the growth of illegal miners through improving the economy based on local wisdom. |

## C. Knowledge Gaps

Knowledge gaps and problems in the baseline estimates

1. PTWI's calculation does not yet use the latest official data. All assumptions still use old data from BPS-Statistics Indonesia. This method needs to be validated.
2. The source of mercury used by miners is indeed difficult to obtain in the field.
3. Methods of estimating the use of Hg are still diverse, need to be validated.

## Annex IV. Status of Implementation of RAN-PPM for ASGM Priority Sector in Year 2019 and 2020

**Table IV.1. Status of Implementation of RAN-PPM for ASGM Priority Sector in Year 2019**

| Activity | Description of Activities | Indicator of Achievement | Institution | Implementation Status |
|---|---|---|---|---|
| c.1.1 Develop and strengthen regulations and policies | c.1.1.1 Conducting policy outreach to the provincial government | Policy outreach to local governments in 34 provinces is conducted | Responsible institution: MoEMR<br><br>Supporting institution: MoEF | In 2019, MoEMR held an outreach on the mercury elimination in ASGM in 6 provinces together with the Coordinating Ministry for Maritime & Investment Affairs, MoEF, MoH and BPPT:<br>1. South Sulawesi Province - Makassar City (2/08/2019)<br>2. Gorontalo Province (29 August 2019)<br>3. North Maluku Province (South Halmahera Regency) – Bacan City (18 September 2019)<br>4. North Sulawesi Province – Manado City (4/10/2019)<br>5. DI Yogyakarta Province – Yogyakarta city (16 October 2019)<br>6. Riau Province (13 November 2019)<br><br>note : 1 (one) outreach related to Minister of Environment and Forestry Regulation No. 81 of 2019 concerning the Implementation of Presidential Regulation 21 of 2019 concerning RAN-PPM in Lebak Regency, Banten Province. |
| | c.1.1.2 Conducting monitoring and evaluation on the implementation of the Ministry of Energy and Mineral Resources Regulation concerning the Prohibition of Gold Processing Using Amalgamation | Monitoring and evaluation to local governments in 34 provinces are conducted. | Responsible person: MoEMR<br><br>Supporting institution: MoHA | In 2019, MoEMR together with the Coordinating Ministry for Maritime & Investment Affairs, MoEF, MoH and BPPT have monitored and evaluated the implementation of the Minister of Energy and Mineral Resources Decree No. 1827/K/30/MEM/2018 concerning the prohibition of gold processing using mercury in 6 provinces as follows:<br>1. South Sulawesi Province - Makassar City (2/08/2019)<br>2. Gorontalo Province (29 August 2019)<br>3. North Maluku Province (South Halmahera Regency) – Bacan City (18 September 2019)<br>4. North Sulawesi Province – Manado City (4/10/2019)<br>5. DI Yogyakarta Province – Yogyakarta city (16 October 2019)<br>6. Riau Province (13 November 2019) |
| | c.1.1.3 Development and revision of regulations regarding the trade system for imports, exports and domestic distribution of mercury | One Ministerial Regulation is issued | Responsible person: MoT<br><br>Supporting institution: MoEMR, MoI, MoEF, MoF | The Minister of Trade Regulation No.47/2019 concerning the third amendment to the Minister of Trade Regulation No.44/M-DAG/PER/9/2009 has been issued regarding the procurement, distribution and supervision of hazardous materials. |
| | c.1.1.4 Development of guidelines for storage and handling of mercury and waste containing mercury | One Ministerial Regulation is issued | Responsible person: MoEF<br><br>Supporting institution: MoEMR | The draft ministerial regulation related to guidelines for storage and handling of mercury and waste containing mercury is available, currently awaiting approval. |

| Activity | Description of Activities | Indicator of Achievement | Institution | Implementation Status |
|---|---|---|---|---|
| | c.1.1.5 Development of guidelines for remediation of mercury-contaminated land | Availability of guidance documents for remediation of mercury-contaminated land. | Responsible person: MoEF<br><br>Supporting institution: MoEMR | Guidelines for mercury contaminated land remediation guidelines havee been developed. |
| | c.1.1.7 Carrying out efforts to protect at-risk populations, especially children and women, and control the health impacts of mercury exposure through the development of guidelines for controlling risk factors, health impacts due to mercury exposure to the environment and guidelines for handling mercury poisoning | Two guidelines are available | Responsible person: MoH<br><br>Supporting institution: MoEF and Ministry of Women Empowerment and Child Protection | Two (2) guidelines have been developed:<br>Guidelines for controlling health effects due to mercury exposure for health workers are available.<br><br>Guidelines for controlling environmental health impacts due to the use of mercury in ASGM with the participatory method for health workers are available. |
| c.2.1 Strengthen central and local institutions | c.2.1.1 Increasing the understanding of local government officials related to licensed small-scale mining | Outreach to local government officials in all provinces in Indonesia | Responsible institution: MoHA<br><br>Supporting institution: MoEMR | Outreach has been carried out to local government officials (EMR Agency Environmental Agency and Health Agency) from 9 provinces. |
| c.2.2 Develop research and technology | c.2.2.1 Development and conduct cooperation to reduce and eliminate the use of mercury and mitigate the impact of mercury with non-governmental organizations, donor agencies, and other countries (bilateral). | Integrated cooperation is implemented | Responsible institution: MoEF<br><br>Supporting institution: Ministry of Research, Technology and Higher Education, MoEMR | 1. Implementation of the cooperation agreement between P3KLL-BLI-MoEF with:<br>a. LIPI Biology research center, December 23, 2019 PKS.11/P3KLL/PED/HMS.0/12/2019 and B-5067/IPH.1/KS.02.04/XII/2019 ;<br>b. Tambuhak Sinta Foundation, December 23, 2019 Number: 004/G-MOU/YTS/XII/2019 and Number: PKS.12/P3KLL/PED/HMS.2/12/2019;<br>c. Nexus3/Bali Focus Foundation, December 23, 2019 Number: 092/04/VIII/BF-NEXUS3/2019 and Number: PKS.13/P3KLL/PED/HMS.2/12/2019;<br>2. Implementation of a cooperation agreement between MoEF, BPPT, and UNDP in the GOLD-ISMIA project to reduce and eliminate the use of mercury in ASGM in 6 locations.<br>3. The implementation of the Artisanal Gold Council (AGC) project cooperation agreement. |

| Activity | Description of Activities | Indicator of Achievement | Institution | Implementation Status |
|---|---|---|---|---|
| c.2.3 Monitor emission and release status | c.2.3.1 Conduct regular monitoring on environmental quality (multimedia) | Monitoring on environmental quality (multimedia) on a regular basis is conducted | Responsible institution: MoEF<br><br>Supporting institution: MoEMR and MoHA | Environmental quality monitoring (multi-media) has been carried out in 5 (five) locations (Pacitan Regency, Kulon Progo Regency and East Bolaang Mongondow Regency, Sukabumi Regency, and Bayah Subdistrict, Lebak Regency). |
| c.3.1 Increase the capacity of laboratory facilities, infrastructure and human resources to support the implementation of research and monitoring | c.3.1.1 Development of a national mercury research and monitoring laboratory | • Capacity of 5 laboratory human resources is increased every year.<br>• Research and monitoring of mercury are conducted.<br>• Availability of appropriate laboratory equipment for mercury analysis from samples of air, water, soil, foodstuffs, biological/ biomarker monitoring samples, and other materials.<br>• Mercury parameter proficiency test is conducted. | Responsible institution: MoEF<br><br>Supporting institution: MoEMR and MoH | 1. The quality of 4 (four) laboratory human resources has been improved:<br>a. Mercury workshop activity in Japan on March 13-1, 2019 (1 person);<br>b. Participated in the atmospheric mercury monitoring training workshop on 10-14 July 2019 in Taiwan (1 person);<br>c. Participated in the mercury-contaminated site workshop at ICMGP 14 in Poland on 7-13 Sep 2019 (1 person);<br>d. Participated in capacity strengthening of multi media mercury monitoring on 5-30 October 2019 (1 person).<br>2. Mercury research and monitoring have been carried out in the form of hair sampling and socio-economic studies of the community in ASGM Sukabumi Regency in February - March 2019.<br>3. Appropriate laboratory equipment is available for mercury analysis. (Measurement equipment of mercury in ambient air and solid samples). |
| | c.3.1.2 Conducting mercury research | Mercury research is conducted | Responsible institution: MoEF<br><br>Supporting institution: MoH, MoEMR, MoI, Ministry of Research, Technology and Higher Education, BPPT | Research has been carried out on the influence of socio-economic factors that affect mercury exposure to communities around ASGM in Sukabumi Regency and 1 (one) research on measuring the amount of mercury used by ASGM and environmental quality analysis around ASGM locations in Bayah District, Lebak Regency by BPPT. |

| Activity | Description of Activities | Indicator of Achievement | Institution | Implementation Status |
|---|---|---|---|---|
| c.4.1 Develop database and information | c.4.1.1 Mapping the impact of mercury emissions and releases on the environment around ASGM locations | Availability of impact distribution map | Responsible institution: MoEF<br><br>Supporting institution: MoEMR | • Impact distribution map is available.<br>• In 2019 in 3 locations (Pacitan, Kulon Progo and East Bolaang Mongondow).<br>• Availability of a map of the distribution of mercury's impact on the environment and public health in 7 (seven) national priority locations (A study of mercury mapping on the environment, health and socio-economic community in ASGM, collaboration between MoEF and Bandung Institute of Technology and Brawijaya University in 2018).<br>• Indicative map of mercury pollution index scale 1:50,000 in 7 priority locations (Minut Regency, Bomotim Regency, Dharmasraya Regency, Merangin Regency, Wonogiri Regency, Kobar Regency).<br>• Indicative map of mercury pollution index scale 1:10,000 in Keloran Village, Selogiri District, Wonogiri Regency and Cibeber Village, Cibeber District, Lebak Regency. |
| | c.4.1.2 Identification of hotspots, population at risk, and vulnerable populations due to mercury exposure through cross-sectoral cooperation. | Availability of maps of areas and populations of communities vulnerable to mercury exposure | Responsible institution: MoH<br><br>Supporting institution: MoEF | Identification process has been carried out in 2017, where there are at-risk populations in 235 regencies/cities in 32 provinces and there are 478 public health centers with ASGM working areas.<br><br>Map of areas and population of vulnerable communities due to mercury exposure is not yet available. |
| | c.4.1.4 Development of a national database system related to the trade, distribution and use of mercury | Availability of a national database system | Responsible institution: MoEF<br><br>Supporting institution: MoT, MoF | • Availability of Hazardous Substances (B3) Import E-Reporting Application Ver 2.0 (http:// sitkb3.menlhk.go.id/epib3/index.php/user/login);<br>• Availability of One Stop Service (*Pelayanan Terpadu Satu Pintu*, PTSP) and INSW Integrated Hazardous Substances Registration Database System (http://ptsp.menlhk.go.id/);<br>• Availability of a Secure File Transfer Protocol (SFTP) application integrated with INSW application equipped with PMK for Hazardous Substances (B3) Import Units;<br>• A Mercury Spatial/Geoportal Database System is available; (http://sitkb3.menlhk.go.id/Merkuri/) in collaboration with JIGN Planologi MoEF;<br>• Android application: I-Merkuri Mobile is available. |
| | c.4.1.5 Development of a map information system for the distribution of cinnabar and mercury rocks in Indonesia | Availability of map information system | Responsible institution: MoEF<br><br>Supporting institution: MoEMR | There is an information system of map of cinnabar and mercury distribution in Indonesia in the following applications:<br>• The GeoPortal-PESK Mercury application is based on a website (http://sitkb3.menlhk.go.id /Merkuri/). The application contains information about:<br>a. Distribution of cinnabar processing activities.<br>b. Distribution of mercury usage in ASGM locations per administrative area in Indonesia |

| Activity | Description of Activities | Indicator of Achievement | Institution | Implementation Status |
|---|---|---|---|---|
| | c.4.1.6 Conduct an inventory and mapping of sources, procurement supplies, distribution, and use of mercury | 1)Availability of inventory data<br>2) Availability of maps | Responsible institution: MoEF<br><br>Supporting institution: BPS-Statistics, MoEMR | 1. Data on the inventory results of the circulation, use and supply of mercury procurement are not yet available.<br>2. Availability of Mercury inventory data in Lebak Regency.<br>3. Thematic maps available:<br>a) Distribution of ASGM locations (coordinates) in 3 locations where Mercury levels were measured;<br>b) Mercury content map compared to environmental quality standards in environmental media.<br>4. Availability of the Android-Based Mercury Survey Data Collection Application (I-Merkuri Mobile) as a Mercury data survey tool at ASGM locations for the government and local governments.<br>5. Availability of acquisition data from UAV Drone mapping Data ortho, DEM and 3D ASGM locations and the use of mercury in Bogor Regency (Bantar Karet/Pongkor Village).<br>6. The basic framework of the mercury usage database and mercury content in the environment has been created due to ASGM activities. |
| c.5.1 Mercury STOP Movement Campaign | c.5.1.1 Including the dangers of using mercury in gold processing in the content of the national formal education curriculum | Mercury dangers course is included into the national formal education curriculum | Responsible institution: Ministry of Education and Culture<br><br>Supporting institution: MoEF, MoEMR, MoH | No information available |
| | c.5.1.2 Conduct a campaign on the risk of the impact of mercury use on vulnerable communities and a campaign for gender mainstreaming. | Information through mass media, social media and other media is disseminated by publishing a minimum of 2 (two) articles per week | Responsible institution: MoEF<br><br>Supporting institution: Ministry of Communication and Informatics and Ministry of Women Empowerment And Child Protection | There are 4 articles available on the mercury info portal and mercury-related materials have been posted on social media Instagram of the Directorate of Hazardous Substances (B3) Management of the Ministry of Environment and Forestry.<br><br>There are 2 journals and 3 home magazines on mercury available. |
| | c.5.1.5 Development of participatory approaches to communities in ASGM locations that aim to increase knowledge about the health impacts of mercury exposure and sustainable behavior change in the community . | Participatory approaches in 34 provinces are developed | Responsible institution: MoH<br><br>Supporting institution: MoEMR and MoEF | MoH has disseminated health impacts to health workers in areas where ASGM activities are carried out in 15 regencies/ cities in 12 provinces. |

| Activity | Description of Activities | Indicator of Achievement | Institution | Implementation Status |
|---|---|---|---|---|
| | c.5.1.6 Increasing the understanding of good mining practices for business actors in the Small-Scale Mining Permit (IPR) | Guidance and supervision of IPR | Responsible institution: MoEMR<br><br>Supporting institution: MoHA | MoEMR has disseminated the understanding of Good Mining Practice to 2 IPR holders in Tatelu Village and Talawaan Village (Batu Emas Cooperative and Batu Api Cooperative), North Sulawesi Province on October 4, 2019. |
| c.6.1 Develop research and technology | c.6.1.1 Development of research and studies on alternative technology for mercury-free gold processing | Availability of documents on the results of research and study of alternative technology for mercury-free gold processing | Responsible institution: BPPT<br><br>Supporting institution: MoEMR | Research and study on gold processing technology without mercury has been carried out. |
| c.6.2 Remediate mercury contaminated land and land rehabilitation | c.6.2.1 Remediation of land contaminated with mercury and land rehabilitation due to gold mining activities | Mercury contaminated land in 4 locations is remediated | Responsible institution: MoEF<br><br>Supporting institution: MoEMR, Ministry of Research, Technology and Higher Education, MoHA | The remediation of mercury contaminated land has been carried out in 2 (two) locations in Lebak Regency and land rehabilitation due to gold mining activities in one location in Dharmasraya Regency. |
| c.6.3 Physical construction of integrated mercury-free gold processing facilities | c.6.3.1 Development of Feasibility Study (FS) and Detailed Engineering Design (DED) for gold processing without mercury | Availability of 5 FS and DED documents in 5 locations | Responsible institution: BPPT<br><br>Supporting institution: MoEMR | FS and DED have been developed for integrated mercury-free gold processing in Lebak Regency, Banyumas Regency, Pacitan Regency, and Kulon Progo Regency. |
| | c.6.3.2 Construction of gold processing facilities without mercury | Integrated installations in 13 locations are constructed | Responsible institution: MoEF<br><br>Supporting institution: MoEMR and BPPT | An integrated mercury-free gold processing plant has been built in 3 locations, namely Pohuwato, Halmahera, Pulang Pisau. |
| c.6.4 Provide mercury storage facilities | c.6.4.1 Development of FS and DED for the provision of mercury storage facilities | Availability of FS and DED documents on the provision of mercury storage facilities | Responsible institution: MoEF<br><br>Supporting institution: Ministry of Research, Technology and Higher Education | FS and DED Documents are available for mercury storage facilities.<br><br>BPPT has designed and made a prototype of a 2 L capacity mercury metal container. |

| Activity | Description of Activities | Indicator of Achievement | Institution | Implementation Status |
|---|---|---|---|---|
| | c.6.4.2 Provision of mercury storage facilities | Construction of mercury storage facilities | Responsible institution: MoEF<br><br>Supporting institution: Ministry of Research, Technology and Higher Education | Mercury storage facilities are not yet available.<br><br>Discussions are still ongoing regarding the location for the construction of mercury storage facilities. |
| c.7.1 Conduct mapping of the social and economic conditions of the mining community | c.7.1.1 Development of a social study on the impact of mercury use on ASGM activities | Availability of 1 social study result | Responsible institution: MoEF<br><br>Supporting institution: Ministry of Village, Development of Disadvantaged Areas and Transmigration, Ministry of Cooperatives and Small and Medium Enterprises (SMEs), Ministry of Social Affairs, and Ministry of Women Empowerment and Child Protection. | There has been a social study of the impact of mercury use on ASGM activities in Banyumas Regency. |
| | c.7.1.2 Development of an economic study of the impact of mercury use | Availability of 1 economic study result | Responsible institution: MoEF<br><br>Supporting institution: Ministry of Village, Development of Disadvantaged Areas and Transmigration, Ministry of Cooperatives and Small and Medium Enterprises (SMEs), Ministry of Social Affairs, and Ministry of Women Empowerment and Child Protection. | There has been an economic study on the impact of the use of mercury in Banyumas Regency. |

| Activity | Description of Activities | Indicator of Achievement | Institution | Implementation Status |
|---|---|---|---|---|
| c.7.2 Economic and social empowerment of communities outside the Small-Scale Mining Area (WPR) | c.7.2.1 Social and economic transformation of illegal miners using mercury | Six productive economic business models are created | Responsible institution: MoEF<br><br>Supporting institution: MoEMR, Ministry of Cooperatives and Small and Medium Enterprises (SMEs), and MoHA | A productive economic business model is available outside the Small-Scale Mining Area (WPR) in Banyumas Regency. |
| | c.7.2.2 Business opportunity coaching | Communities in 5 ASGM locations per year are coached | Responsible institution: Ministry of Cooperatives and Small and Medium Enterprises (SMEs),<br><br>Supporting institution: MoHA | Not implemented yet |
| | c.7.2.3. Facilitating the issuance of permits for cooperatives and SMEs | Cooperative and SMEs permits in 5 ASGM locations per year are issued | Responsible institution: Ministry of Cooperatives and Small and Medium Enterprises (SMEs),<br><br>Supporting institution: MoHA | Not implemented yet |
| c.8.1 Increase supervision | c.8.1.1 Increasing import and export supervision of mercury as commodity | Availability of import and export control reports on mercury as commodity | Responsible institution: MoF<br><br>Supporting institution: MoEF, MoEMR, MoT | Import and export monitoring reports on mercury commodities are available (data from Customs). |
| c.8.1 Increase supervision | c.8.1.2 Supervising and controlling primary mercury mining activities (cinnabar mining) without permit/ illegal | There is no cinnabar mining in Indonesia | Responsible institution: Indonesian National Police<br><br>Supporting institution: Attorney General | There is no cinnabar mining in Indonesia anymore. |

| Activity | Description of Activities | Indicator of Achievement | Institution | Implementation Status |
|---|---|---|---|---|
| | c.8.1.3 Supervising domestic mercury circulation | 100% action taken | Responsible institution: Indonesian National Police<br><br>Supporting institution: MoT, Attorney General, and National Agency of Drug and Food Control (BPOM) | Prosecution has been taken.<br>In 2019: there were 110 cases handled in 23 provinces. |
| c.8.2 Enforcement | c.8.2.1 Control of illegal ASGM using mercury | There are no illegal ASGM using mercury | Responsible institution: Indonesian National Police<br><br>Supporting institution: Attorney General | Control has been carried out in 3 provinces: Maluku, West Java and Banten. |
| | c.8.2.2 Control of illegal mercury trade system | Amount of illegal mercury controlled 10 tonnes per year | Responsible institution: Indonesian National Police<br><br>Supporting institution: Attorney General | Since 2017-2019: 34.9 tonnes of mercury and 36.29 tonnes of cinnabar have been confiscated. |

**Table IV.2. Status of Implementation of RAN-PPM for ASGM Priority Sector in Year 2020**

| Activity | Description of Activities | Indicator of Achievement | Year | Institution | Implementation Status |
|---|---|---|---|---|---|
| c.1.1 Develop and strengthen regulations and policies | c.1.1.1 Conducting policy outreach to the provincial government | Policy outreach to local governments in 34 provinces is conducted | Year 2019 - 2025 with a frequency of 4-5 provinces every year | Responsible institution: MoEMR<br><br>Supporting institution: MoEF | It has been carried out in 5 provinces (Central Sulawesi, Southeast Sulawesi, DIY, Central Kalimantan, North Sumatra) online together with assistance in the preparation of the Local Action Plan for Mercury Reduction and Elimination on 11 June 2020. |
| | c.1.1.2 Conducting monitoring and evaluation on the implementation of the Ministry of Energy and Mineral Resources Regulation concerning the Prohibition of Gold Processing Using Amalgamation | Monitoring and evaluation to local governments in 34 provinces are conducted. | Year 2019 - 2025 with a frequency of 4-5 provinces every year | Responsible person: MoEMR<br><br>Supporting institution: MoHA | It has been carried out in 5 provinces (Central Sulawesi, Southeast Sulawesi, DIY, Central Kalimantan, North Sumatra) online together with assistance in the preparation of the Local Action Plan for Mercury Reduction and Elimination on 11 June 2020. |
| | c.1.1.6 Development of a standard method for measuring mercury exposure covering nodes 1 - 3 (source, media and receptors) consisting of sampling and analysis methods | Availability of 1 standard method | 2020 (1 success indicator) | Responsible institution: MoH<br><br>Supporting institution: MoEF | Drafting of biomarker guidelines in 2019 and finalization to be carried out in 2022. |
| c.2.1 Strengthen central and local institutions | c.2.1.1 Increasing the understanding of local government officials related to small-scale mining permit | Outreach to local government officials in all provinces in Indonesia | 2019 dan 2025 (7 provinces per year until 2024 dan 6 provinces in year 2025) | Responsible institution: MoHA<br><br>Supporting institution: MoEMR | The target in 2020 has not been achieved due to the COVID-19 pandemic. |
| c.2.2 Develop research and technology | c.2.2.1 Development and conduct cooperation to reduce and eliminate the use of mercury and mitigate the impact of mercury with non-governmental organizations, donor agencies, and other countries (bilateral). | Integrated cooperation is implemented | 2019 -2025 (at least 1 success indicator per year) | Responsible institution: MoEF<br><br>Supporting institution: Ministry of Research, Technology and Higher Education, MoEMR | • Collaboration with donor agencies has been implemented<br><br>• Already implemented cooperation with UNDP with the GOLD-ISMIA project (Training for representatives of small-scale gold miners) |

| Activity | Description of Activities | Indicator of Achievement | Year | Institution | Implementation Status |
|---|---|---|---|---|---|
| c.2.3 Monitor emission and release status | c.2.3.1 Conduct regular monitoring on environmental quality (multimedia) | Monitoring on environmental quality (multimedia) on a regular basis is conducted | 2019 -2021 (once per year) | Responsible institution: MoEF<br><br>Supporting institution: MoEMR and MoHA | Environmental quality monitoring (multi-media) has been carried out in 4 locations (Tasikmalaya, Bandung, Sukabumi and Bogor). |
| c.3.1 Increase the capacity of laboratory facilities, infrastructure and human resources to support the implementation of research and monitoring | c.3.1.1 Development of a national mercury research and monitoring laboratory | • Capacity of 5 laboratory human resources is increased every year.<br>• Research and monitoring of mercury are conducted.<br>• Availability of appropriate laboratory equipment for mercury analysis from samples of air, water, soil, foodstuffs, biological/ biomarker monitoring samples, and other materials.<br>• Mercury parameter proficiency test is conducted. | 2019 – 2025 (5 indicators per year) | Responsible institution: MoEF<br><br>Supporting institution: MoEMR and MoH | a.1. In House Training on mercury sampling in rainwater.<br>a.2. In House Training on mercury sampling in ambient air.<br>a.3. In House Training testing of mercury in ambient air using Thermal Desorption.<br>b.1. Collaborating with Nexus3 in the context of data collection activities for determining mercury baseline data in ASGM areas (World Bank project).<br>b.2. Evaluation of mercury pollution data in ambient air in ASGM areas as the basis for compiling national quality standards.<br>c.1. Procurement of mercury testing equipment from rainwater (CV-AFS).<br>c.2. Procurement of total mercury measurement equipment for water matrix (CV AAS), solid matrix (CV AAS).<br>c.3. Procurement of equipment for measuring methyl mercury parameters in various media (GC ECD and CV AAS).<br>c.4. Construction of contaminant-free testing facilities.<br>c.5. Verify the sampling method and analysis of mercury in ambient air (gold column method).<br>c.6. Develop the concept of Indonesian national standards for mercury parameters in ambient air.<br>c.7. Conducting a trial of the mercury parameter proficiency test in clean water<br><br>MoH:<br>• Identification of testing labs for monitoring and training is being carried out for human resources.<br>• Lab maps and identification that need improvement will be prepared. |

| Activity | Description of Activities | Indicator of Achievement | Year | Institution | Implementation Status |
|---|---|---|---|---|---|
| | c.3.1.2 Conducting mercury Research | Mercury Research is conducted | 2019 – 2025 (1 indicator per year) | Responsible institution: MoEF<br><br>Supporting institution: MoH, MoEMR, MoI, Ministry of Research, Technology and Higher Education, BPPT | • PSIKLH: Bioremediation research has been carried out in the context of developing mercury bioremediation techniques using bacteria.<br>• BPPT: Research on chemicals to replace mercury in ASGM (2016), research on the use of mercury inventory in ASGM in Lebak (2019), research on tailings processing in ASGM (Lombok) (2019), has designed a storage container for elemental mercury (research for raw materials, materials research) (2020). |
| c.4.1 Develop database and information | c.4.1.2 Identification of hotspots, population at risk, and vulnerable populations due to mercury exposure through cross-sectoral cooperation. | Availability of maps of areas and populations of communities vulnerable to mercury exposure | Years 2019 to 2025 with an output of 3-5 provincial maps per year | Responsible institution: MoH<br><br>Supporting institution: MoEF | Not yet implemented, waiting for reports from the preparation of RAD-PPM. |
| | c.4.1.3 Identification and improvement of national standards for threshold limit values for mercury exposure to human health | Availability of mercury exposure threshold values for human health | 2020 (1 success indicator) | Responsible institution: MoH<br><br>Supporting institution: MoEF | TLV for drinking water is already available, for health not yet available. |
| | c.4.1.4 Development of a national database system related to the trade, distribution and use of mercury | Availability of a national database system | 2019 - 2020 (1 success indicator per year) | Responsible institution: MoEF<br><br>Supporting institution: MoT, MoF | • Availability of Hazardous Substances (B3) Import E-Reporting Application Ver 2.0 (http:// sitkb3.menlhk.go.id/ epib3/index.php/user/login);<br>• Availability of One Stop Service (*Pelayanan Terpadu Satu Pintu*, PTSP) and INSW Integrated Hazardous Substances Registration Database System (http://ptsp.menlhk.go.id/);<br>• Availability of a Secure File Transfer Protocol (SFTP) application integrated with INSW application equipped with PMK for Hazardous Substances (B3) Import Units;<br>• A Mercury Spatial/Geoportal Database System is available; (http://sitkb3.menlhk.go.id/ Merkuri/) in collaboration with JIGN Planologi MoEF;<br>• Android application: I-Merkuri Mobile is available. |

| Activity | Description of Activities | Indicator of Achievement | Year | Institution | Implementation Status |
|---|---|---|---|---|---|
| c.5.1 Mercury STOP Movement Campaign | c.5.1.1 Including the dangers of using mercury in gold processing in the content of the national formal education curriculum | Mercury dangers course is included into the national formal education curriculum | 2019 (1 success indicator) | Responsible institution: Ministry of Education and Culture<br><br>Supporting institution: MoEF, MoEMR, MoH | Not yet implemented. |
| | c.5.1.2 Conduct a campaign on the risk of the impact of mercury use on vulnerable communities and a campaign for gender mainstreaming. | Information through mass media, social media and other media is disseminated by publishing a minimum of 2 (two) articles per week | 2019-2025 (2 success indicators per year) | Responsible institution: MoEF<br><br>Supporting institution: Ministry of Communication and Informatics and Ministry of Women Empowerment And Child Protection | Mercury-related articles are available on the Sib3pop portal, post 5 mercury items on IG – PB3KLHK |
| | c.5.1.3 Conduct outreach and increase capacity to health workers about health risks due to mercury exposure. | Outreach and trainings in 34 provinces are conducted | 17 provinces in year 2020 and 17 provinces in year 2021 | Responsible insitution: MoH<br><br>Supporting institution: MoHA | Through funding from the SIP Minamata Convention, training on participatory approaches and early detection/diagnosis of mercury exposure will be carried out to public health centers' officers in 3 locations (Lebak Regency, Banyumas Regency, and West Lombok Regency). |
| | c.5.1.4 Development of a community approach to increase knowledge and awareness about the health hazards of mercury | Approach in the community and the emergence of public awareness are developed along with collective community action not to use mercury and efforts to reduce the impact of mercury on health | 2020 and 2021 (1 success indicator per year) | Responsible institution: MoH<br><br>Supporting institution: MoHA | • Guidelines for a participatory approach to ASGM communities have been developed to control mercury exposure.<br><br>• A training module on a participatory approach will be developed for ASGM communities and the implementation of training for public health centers' officers through funding from the SIP Minamata Convention. |

| Activity | Description of Activities | Indicator of Achievement | Year | Institution | Implementation Status |
|---|---|---|---|---|---|
| | c.5.1.5 Development of participatory approaches to communities in ASGM locations that aim to increase knowledge about the health impacts of mercury exposure and sustainable behavior change in the community | Participatory approaches in 34 provinces are developed | 2019 until 2025 with target of 3-6 provinces per year | Responsible institution: MoH<br><br>Supporting institution: MoEMR and MoEF | It will be implemented in 3 provinces, namely: Banten (Lebak Regency), Central Java (Banyumas Regency), and NTB (West Lombok Regency). |
| | c.5.1.6 Increasing the understanding of good mining practices for business actors in the Small-Scale Mining Permit (IPR) | Guidance and supervision of IPR | 2019 until 2025 to 1-2 gold IPR holders per year | Responsible institution: MoEMR<br><br>Supporting institution: MoHA | It has been implemented for IPR holders from North Minahasa, North Gorontalo and Kulon Progo. |
| | c.5.1.7 Conduct outreach of guidelines for remediation of mercury -contaminated land | Outreach of guidelines for remediation of mercury -contaminated land is conducted | 2020-2025 (1 success indicator per year) | Responsible institution: MoEF<br><br>Supporting institution: MoEMR and BPPT | Outreach has been conducted in 28 provinces |
| c.6.3 Physical construction of integrated mercury-free gold processing facilities | c.6.3.1 Development of Feasibility Study (FS) and Detailed Engineering Design (DED) for gold processing without mercury | Availability of 5 FS and DED documents in 5 locations | 2 locations in year 2019 and 2020, 1 location in year 2021 | Responsible institution: BPPT<br><br>Supporting institution: MoEMR | In 2019 there were 4 FS DED available for the construction of mercury-free gold processing equipment, namely in Lebak Regency, Banyumas Regency, Pacitan Regency, and Kulon Progo Regency.<br><br>In 2020, there has been 1 FS DED Pilot Project for mercury-free gold processing in Kuantan Singingi Regency, Riau Province. |
| | c.6.3.2 Construction of gold processing facilities without mercury | Integrated installations in 13 locations are constructed | 2 locations (2019-2024) and 1 location in year 2025 | Responsible institution: MoEF<br><br>Supporting institution: MoEMR and BPPT | Integrated installation has been built (1 location in Kuantan Singingi, Riau). |

| Activity | Description of Activities | Indicator of Achievement | Year | Institution | Implementation Status |
|---|---|---|---|---|---|
| c.6.4 Provide mercury storage facilities | c.6.4.2 Provision of mercury storage facilities | Construction of mercury storage facilities | 2019 (1 success indicator) | Responsible institution: MoEF<br><br>Supporting institution: Ministry of Research, Technology and Higher Education | Not yet implemented. |
| c.7.1 Conduct mapping of the social and economic conditions of the mining community | c.7.1.1 Development of a social study on the impact of mercury use on ASGM activities | Availability of 1 social study result | 2019 - 2020 (1 success indicator per year) | Responsible institution: MoEF<br><br>Supporting institution: Ministry of Village, Development of Disadvantaged Areas and Transmigration, Ministry of Cooperatives and Small and Medium Enterprises (SMEs), Ministry of Social Affairs, and Ministry of Women Empowerment and Child Protection. | Not yet implemented. |
| | c.7.1.2 Development of an economic study of the impact of mercury use | Availability of 1 economic study result | 2019 - 2020 (1 success indicator per year) | Responsible institution: MoEF<br><br>Supporting institution: Ministry of Village, Development of Disadvantaged Areas and Transmigration, Ministry of Cooperatives and Small and Medium Enterprises (SMEs), Ministry of Social Affairs, and Ministry of Women Empowerment and Child Protection. | Not yet implemented. |

| Activity | Description of Activities | Indicator of Achievement | Year | Institution | Implementation Status |
|---|---|---|---|---|---|
| c.7.2 Economic and social empowerment of communities outside the Small-Scale Mining Area (WPR) | c.7.2.1 Social and economic transformation of illegal miners using mercury | Six productive economic business models are created | Each 1 business model per year in the 2019-2025 period | Responsible institution: MoEF<br><br>Supporting institution: MoEMR, Ministry of Cooperatives and Small and Medium Enterprises (SMEs), and MoHA | Not yet implemented. |
| | c.7.2.2 Business opportunity coaching | Communities in 5 ASGM locations per year are coached | 2019-2025 (5 locations per year) | Responsible institution: Ministry of Cooperatives and Small and Medium Enterprises (SMEs),<br><br>Supporting institution: MoHA | • Fostering business capacity development and financing aspects in the ASGM sector (4 locations: Gorontalo, North Sulawesi, South Halmahera, Riau-Kuantan Singingi)<br>• Development of technical capacity in 2 locations (Kulon Progo, DIY and Kuantan Singingi, Riau)<br>• Fostering and raising awareness about the dangers of mercury in 1 location (West Lombok) |
| | c.7.2.3. Facilitating the issuance of permits for cooperatives and SMEs | Cooperative and SMEs permits in 5 ASGM locations per year are issued | 2019-2025 (5 locations per year) | Responsible institution: Ministry of Cooperatives and Small and Medium Enterprises (SMEs),<br><br>Supporting institution: MoHA | Still in the process, the formation of a cooperative has been carried out in Kulon Progo. |
| c.8.1 Increase supervision | c.8.1.2 Supervising and controlling primary mercury mining activities (cinnabar mining) without permit/ illegal | There is no cinnabar mining in Indonesia | 2019-2025 (1 indicator per year) | Responsible institution: MoF<br><br>Supporting institution: MoEF, MoEMR, MoT | Import and export supervision reports on mercury commodities are available (data comes from Customs). |
| | c.8.1.3 Supervising domestic mercury circulation | 100% action taken | 2019-2025 (none) | Responsible institution: Indonesian National Police<br><br>Supporting institution: Attorney General | There is no longer cinnabar mining in Indonesia. |

| Activity | Description of Activities | Indicator of Achievement | Year | Institution | Implementation Status |
|---|---|---|---|---|---|
| c.8.2 Enforcement | c.8.2.1 Control of illegal ASGM using mercury | There are no illegal ASGM using mercury | 2019-2025 (none) | Responsible institution: Indonesian National Police<br><br>Supporting institution: MoT, Attorney General, and National Agency of Drug and Food Control (BPOM) | Not yet implemented, there are still ASGMs that use mercury illegally. |
| | c.8.2.2 Control of illegal mercury trade system | Amount of illegal mercury controlled 10 tonnes per year | 2019-2025 (10 tonnes success indicator per year) | Responsible institution: Indonesian National Police<br><br>Supporting institution: Attorney General | There is enforcement action. |

## Annex V. Procedures for Monitoring of Implementation of National Action Plan for Reduction And Elimination of Mercury for ASGM Priority Sector

### A. Scope of Monitoring

In accordance with the obligations in Perpres No. 21 of 2019 concerning RAN-PPM, the monitoring scope for ASGM priority sector is the achievement in mercury elimination for ASGM priority sector.

Based on this scope, the matrix for monitoring the achievement of the implementation of the RAN-PPM and RAD-PPM for the ASGM priority sector can be seen in **Table V.1**.

**Table V.1. Measurement of Achievement in Mercury Elimination**

| Sector | Area | | |
|---|---|---|---|
| | National | Province | Regency/City |
| ASGM | Amount of mercury used in ASGM businesses and/or activities at national level | Amount of mercury used in ASGM businesses and/or activities at provincial level | Amount of mercury used in ASGM businesses and/or activities at regency/city level |

### B. Actors in Monitoring of RAN-PPM Implementation RAN-PPM

Actors involved in the monitoring activities of RAN-PPM implementation can be seen in **Table V.2**.

**Table V.2. Actors and Scope of Monitoring of RAN-PPM Implementation**

| Actor | Monitoring Achievement |
|---|---|
| Minister of Environment and Forestry | Overall RAN-PPM and RAD-PPM throughout Indonesia |
| Minister/Head of Non-Ministerial Government Agency | Overall RAN-PPM |
| Governor | Overall Provincial RAD-PPM and Regency/City RAD-PPM |
| Regent/Mayor | Overall Regency/City RAD-PPM |

## C. Matrix of Monitoring Activities of RAN-PPM Implementation

The monitoring activities for ASGM priority sector can be described in the matrix of monitoring of RAN-PPM implementation as shown in **Table V.3**.

**Table V.3. Matrix of Monitoring Activities of RAN-PPM Implementation**

| Target/Object | Monitoring Instrument | Reference | Data Source | Subject |
|---|---|---|---|---|
| Achievement Target | 1. Information System for Monitoring and Evaluation (Monev)<br>2. Status of RAN-PPM Implementation<br>3. Random test and field visit | 1. Annex I to Perpres No. 21 of 2019<br>2. Guidelines for Implementation of Perpres No. 21 of 2019 | 1. Information System for Monev<br>2. Status of RAN-PPM Implementation | 1. Minister of Environment and Forestry<br>2. Minister and Head of Agencies Lembaga<br>3. Governor<br>4. Regent/Mayor |
| Success Indicator | 1. Information System for Monev<br>2. Status of RAN-PPM Implementation | 1. Annex II to Perpres No. 21 of 2019<br>2. Guidelines for Implementation of Perpres No. 21 of 2019 | 1. Information System for Monev<br>2. Status of RAN-PPM Implementation | 1. Minister of Environment and Forestry<br>2. Minister and Head of Agencies<br>3. Governor<br>4. Regent/Mayor |
| Continuity | 1. Minutes of Committee Coordination Meetings<br>2. Minutes of Working Group Coordination Meetings<br>3. Report of implementation obstacles | 1. Guidelines for Implementation of Perpres No. 21 of 2019<br>2. Guidelines for RAD Development | 1. Minutes of Committee Coordination Meetings<br>2. Minutes of Working Group Coordination Meetings<br>3. Information System for Monev<br>4. Report of obstacles | 1. Minister of Environment and Forestry<br>2. Minister and Head of Agencies<br>3. Governor<br>4. Regent/Mayor |

## D. Method of Monitoring

Monitoring activities are carried out through stages as follows:

### a. Data and Information Collection

The first stage in the monitoring activities is collection of data and information on mercury elimination achievement as presented in **Table V.4**.

**Table V.4. Data and Information on Mercury Elimination Achievement**

| Data and Information Required | Data and Information Source | Method |
|---|---|---|
| Amount of mercury use in ASGM businesses and/or activities | 1) number of IPR issued for each regency/ city;<br>2) report of ASGM formalization activities;<br>3) report of enforcement on illegal ASGM | 1) conduct inventory of ASGM located in WPR;<br>2) collection of data on formalization activities;<br>3) collection of data on enforcement on illegal ASGM;<br>4) random test and field visit |

## b. Measurement of Activities Achievement

The second monitoring step is measuring the monitoring indicators. Measurements are important to do to monitor the progress of the RAN-PPM implementation activities numerically so as to make evaluations easier. The unit used in the measurement is the percentage of activity progress both in comparison to the current year and to the overall target. The scope of measuring the achievement of activities for ASGM priority areas includes measuring the achievement of mercury elimination and management of implementation barriers.

### b.1 Measurement of Achievement in Mercury Elimination

The measurement of the achievement in mercury elimination is carried out on the amount of mercury use in ASGM businesses and/or activities.

Data to measure the amount of mercury use in ASGM businesses and/or activities is obtained from:

i) mining permits issued to ASGM;
ii) formalization report; and / or
iii) report of enforcement on illegal ASGM

One of the requirements for issuing mining permit to an ASGM is a technical provision for gold processing which prohibits mercury use. With the issuance of a permit, it can be ensured that ASGM holding a mining permit does not use mercury in its gold processing. Monitoring, supervising, and evaluating the reporting of ASGM activities that has a mining permit can prevent the use of mercury in the ASGM. ASGM that does not have a permit will be processed through enforcement activities, so that enforcement data can be used as measurement for amount of mercury used in ASGM.

Measurement of mercury elimination achievement in the ASGM priority sector is conducted by comparing the number of locations (regencies/cities) as the results of the formalization with the baseline in 2018 which is 180 locations (regencies/cities) that have ASGM in their territory. Number of locations (regencies/cities) as a result of formalization are regencies/cities where all their ASGM have obtained mining permits and/or undergone through prosecution process. A location (regency/city) is declared to meet achievement if all ASGM in that location already have a mining permit.

$$\text{Achievement of year x} = \frac{\text{number of locations with all formalized ASGM}}{180} \times 100\%$$

### b.2. Measurement of Achievement in Implementation of Mercury Reduction and Elimination Activities

Measurement of achievement in implementation of mercury reduction and elimination activities is conducted by calculating the achievement of the success indicators listed in Annex II to the Perpres No. 21 of 2019. Provisions for measuring the success of the implementation of activities include:

1) the output data is calculated when it is finished or not in the formulation process;
2) activities that are in process are not considered as output data;
3) output data which is not achieved in the current year will be the target of output data in the following year;
4) the achievements of the RAN-PPM success indicators are accumulative of the achievements of all fields, strategies, activities, and activity descriptions; and
5) measurement results are presented in percentage of target achievement.

Examples:

- the success of ministerial regulation drafting activities, must be proven by a ministerial regulation promulgated by the Ministry of Law and Human Rights;
- the success in monitoring mercury emissions and releases in the form of a monitoring report document; or
- the success of mapping the source, supply, distribution, and use of mercury must be proven by the existence of an informative map showing the location of sources, procurement supplies, distribution and use of mercury.

## c. Preparation and Updating of RAN-PPM Implementation Status

The implementation status of the RAN-PPM is required so that the evaluation can be carried out quickly. The implementation status of the RAN-PPM is a summary of the measurement of the achievement in mercury reduction, measurement of the achievement of mercury elimination, measurement of the achievement of indicators of success, and overcoming obstacles. Preparation and updating of the implementation status of the RAN-PPM shall be conducted at least 1 (once) in 3 (three) months prior to the working group coordination meeting. The Chairperson of the Working Group is responsible for coordinating the preparation of the implementation status of the Priority Sector RAN-PPM. The Chairman of the Committee is in charge of coordinating the preparation of the implementation status of RAN-PPM. The content in the implementation status of the RAN-PPM can be seen in the following table.

**Table V.5. Content in RAN-PPM Implementation Status**

| Monitoring | Status Content |
|---|---|
| Mercury Elimination Achievement | Percentage of achievement in mercury elimination for ASGM sector |
| Success Indicator Achievement | Percentage of achievement in success indicator for each activity and strategy. |
| Implementation Obstacles | Report of management of RAN-RAD-PPM implementation obstacles |

## E. Monitoring Period of RAN-PPM Implementation

Monitoring of RAN-PPM implementation can be seen in the following table.

**Table V.6. Actors and Monitoring Period of RAN-PPM Implementation**

| Actor | Period |
|---|---|
| Minister of Environment and Forestry | 1 (once) in 3 (three) months |
| Minister/ Head of Non-Ministerial Government Agencies | 1 (once) in 3 (three) months |
| Governor | 1 (once) in 3 (three) months |
| Regent/Mayor | 1 (once) in 3 (three) months |

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