National action plan for the reduction and abolishment of mercury use: regulation implementation in 2019-2020

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Abstract. As a continuation of the enactment of Law No 11 of 2017 concerning Ratification of the Minamata Convention on Mercury, the Government of Indonesia issued Presidential Regulation No. 21 of 2019 concerning the National Action Plan (NAP) for the Reduction and Abolishment of Mercury (RAM). This regulation contains strategies, activities, and targets for mercury reduction and elimination in the period 2018 to 2030, with priorities in manufacturing, energy, small-scale gold mining, and health. This study aims to analyze the success indicators of the NAP-RAM in 4 priority areas based on the regulations implemented in 2019-2020. The analysis results show that not all regulations that are targeted in 2019 and 2020 have been formed. On the other hand, some existing regulations still require adjustments and improvements. Mercury was found in surface water in several provinces in Indonesia due to artisanal and small-scale gold mining (ASGM) existence. The maximum value of mercury in surface waters was still below the quality threshold standard proposed by Government Act No. 82/2001 but exceeded the WHO’s quality threshold standard. The mercury waste threshold in the Indonesian regulation is higher than those in international regulation such as USEPA (the United States Environmental Protection Agency) or WHO (World Health Organization). Therefore, the government should issue a stricter regulation closer to international regulation regarding the mercury waste threshold in water.

1. Introduction
The issue of mercury in Indonesia has been a concern for the last few years, such as the illegal trade in mercury, mining of cinnabar, mining for gold using mercury, and the mercury-added products in medical instrumentation or other manufactures [1, 2, 3]. The data shows that in 2017, more than 1200 illegal gold mining sites were distributed across Indonesia. Annually, at least 3500 tonnes of mercury were used for generating 60-100 metric tonnes of gold. Several studies reveal that because of the illegal mining, the number of the mercury emission to the environment was around 339,250 kg per year, where 15.5% of that was released into the surface water [4] This condition negatively contributed to the health condition of the smelters' workers and the society who lives nearby the smelters. About 18-23 % of Indonesia miners

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suffered from Chronic Mercury Vapour [5]. In addition to that point, the number of societies who are exposed to mercury and experiencing health problems was increased [6, 7].

These conditions encourage the Government of Indonesia to make various mercury management efforts to minimize the negative impact caused by mercury on human health and the environment. Some of the efforts have been made, such as controlling the artisanal and small-scale gold mining (ASGM) locations that use mercury, closing the cinnabar mine which is the source of raw material for mercury production in Indonesia, and building pilot projects for non-mercury gold processing in various regions.

Apart from making practical efforts above, the Indonesian government has been making efforts to manage mercury at the regulatory level. For example, the Government of Indonesia has ratified the Minamata Convention on Mercury through the passage of Law Number 11 of 2017 concerning the Ratification of the Minamata Convention on Mercury (Law/11/2017) on September 20th, 2017 [8]. By ratifying the convention, Indonesia will more strictly regulate the circulation and utilization of mercury in the community and industry [3].

After ratifying the Minamata Convention, Indonesia as a State Party has the consequences of ratifying the convention. One of the strategies is compiling a National Action Plan for the Reduction and Abolishment of Mercury Use (NAP RAM). The preparation of the National Action Plan is an essential step in managing mercury in Indonesia because apart from being an embodiment of the mandate in the Minamata Convention and serving as a roadmap for reducing and eliminating mercury in Indonesia. This study aims to analyze the implementation of regulatory strategies based on the indicators of the success of NAP RAM in 2019-2020.

2. Method
In this study, the content analysis approach to identify the content of the policy was used [9]. Several studies have used this approach for example to assessed education policy in Bangladesh [10], water, land, and environmental policy in Australia [11], sustainable environmental policy [12] and big data policy in Indonesia [13]. In this study, the content analysis was used to assess the National Action Plan for the Reduction and Abolishment of Mercury Use by looking more closely at its history, policy targets, and implementation.

3. Results and Discussion
3.1. History of NAP RAM
The document of NAP RAM was made in the form of a regulatory product for legal force. Therefore, the NAP RAM document was made into a Draft Presidential Regulation on the Action Plan for Mercury Reduction and Abolishment (NAP RAM). The process of presidential regulation drafting on the NAP RAM started in 2017, shortly after Law 11/2017 regarding the ratification of the Minamata Convention on Mercury was passed. Raperpres NAP RAM has been stipulated as Presidential Regulation Number 21 of 2019 (Peraturan Presiden/Perpres No 21/2019) concerning the National Action Plan for Mercury Reduction and Abolishment (NAP RAM) on April 22, 2019. The Presidential Regulation 21/2019 is a new chapter in mercury management in Indonesia, especially to reduce and eliminate the mercury.

Document of NAP RAM regulates the scope, priority areas, strategies, activities, and targets for sectors related to mercury activities carried out by stakeholders in the context of efforts to reduce and eliminate mercury. The implementation of NAP RAM is prioritized in 4 (four) sectors, including (a) manufacturing, (b) energy, (c) artisanal and small-scale gold mining (ASGM), and (d) health. Besides, NAP RAM document serves as a guideline for stakeholders such as ministries, non-ministerial government agencies, governors, and mayors.
3.2. Target of NAP RAM

The target for mercury reduction and elimination are divided based on the sectors. Mercury reduction targets are only for the manufacturing and energy sector, as well as mercury elimination targets are only for ASGM and the health sector (Table 1).

| Sectors | Mercury Reduction | Mercury Abolishment | Year |
|---------|-------------------|---------------------|------|
| Manufacture | 50% | | 2030 |
| Energy | 33.2% | | 2030 |
| ASGM | 100% | | 2025 |
| Health | 100% | | 2020 |

Source: Presidential Regulation Number 21 of 2019 [14]

To achieve the target, the NAP RAM implementation was carried out based on the reduction and elimination strategies listed in Presidential Decree 21/2019 [14]. Mercury reduction and elimination strategies include strengthening law enforcement, strengthening inter-agency commitment, strengthening coordination and cooperation between central and regional governments, building capacity, establishing information systems, strengthening community involvement, strengthening business community commitment, implementing environmentally friendly alternative technologies, and shifting livelihoods. In their implementation, these strategies, activities, and indicators are listed in Annex II to Presidential Decree 21/2019 [14].

3.3. The implementation of regulatory strategies based on the indicators of success of NAP RAM in 2019-2020

All the ministries that are responsible for the mercury, such as The Ministry of Trade, Ministry of Industry, Ministry of Environment and Forestry, Ministry of Health, and Ministry of Energy and Mineral Resources, should fulfil several regulations to reduce and eliminate mercury from several sectors during 2019-2020.

3.3.1. Manufacturing Sector. The Ministry of Trade should issue the Regulation of Minister of Trade for trade systems for imports, exports, and domestic circulation of mercury in 2019, while the Ministry of Industry should launch Regulation of Minister of Industry to reduce and abolish the mercury use in the industrial sector in 2020 as their success indicators. Table 2 shows the implementation of indicator regulation.

| No | Indicator | Regulation Implementation |
|----|-----------|---------------------------|
| 1  | Regulation on reduction and abolishment for mercury use in the industrial sector | Not Available |
Table 2 shows that until present, the Regulation of the Minister of Industry regarding the reduction and abolishment of mercury in the industrial sector has not yet existed. In July 2019, the Ministry of Industry prepared Regulatory Impact Analysis (RIA) for the Regulation of the Minister of Industry regarding the reduction and elimination of Mercury in the industrial sector. Regulatory Impact Analysis (RIA) is needed in the formation of regulations that have a broad impact. Until now, the results of the RIA are not known. If the results of the RIA are known, the regulatory targets in the industrial sector can be realized immediately.

On the other hand, there are several technical guidelines issued by the Ministry of Industry, namely:

a. Technical Guidelines for Using Mercury in Lights
b. Technical Guidelines for Mercury Emission Control in the Cement Industry Sector
c. Technical Guidelines for Mercury Emission Control for Smelting and Roasting Activities in Non-Ferrous Metal Industrial Activities
d. Guidelines for Controlling Mercury Emissions from Coal Fired Boilers in Power Plants and Industry

Although there are technical guidelines that regulate several matters in priority manufacturing areas, the existence of regulations will further strengthen efforts to reduce mercury in priority manufacturing areas. In terms of regulations concerning the trading system for imports, exports and domestic distribution of mercury commodities, Minister of Trade Regulation Number 47 of 2019 concerning the third amendment to the Regulation of the Minister of Trade Number 44/M-DAG/PER/9/2009 concerning the Procurement, Distribution and Control of Hazardous Materials. This regulation mentions that mercury is one of the materials prohibited from being imported and distributed [15].

Regarding import and export data, the Indonesian Bureau of Statistics does not properly record the mercury trade in and out of Indonesia. The UN Comtrade shows that during 1998-2014 the number of mercury exported to Indonesia was 2,348 ton. However, through the Indonesian Bureau of Statistics, The Ministry of Trade claimed that only a small number of mercury, 0.99 ton, was imported. Since 2014, the Indonesia government has prohibited the trade and utilization of mercury in the mining sector through the Ministry of Trade Regulation No 75 of 2014. However, in 2015-2016, the UN Comtrade data indicates that Indonesia exported 567 and 1,360-ton mercury in that period, respectively. This transaction was claimed as illegal since this data was not recorded in the Central Bureau of Statistic report.
3.3.2 *Energy Sector.* Ministry of Environment and Forestry should issue a Regulation of Minister of Environment and Forestry for Environment Quality Standards for Mercury Emissions in 2020 (see Table 3).

| No | Indicator | Regulation Implementation |
|----|----------|--------------------------|
| 1  | Revision and strengthening of Environment Quality Standards for Mercury Emissions | Regulation of Ministry of Environment and Forestry (Permen LHK No. P.15/MENLHK/SETJEN/KUM.1/4/2019) concerning Emission Standards for Thermal Power Plant [16] |

The Ministry of Environment and Forestry has issued PermenLHK No. P.15/MENLHK/SETJEN /KUM.1/4/2019 concerning Emission Standards for Thermal Power Plants (“Permen LHK 15/2015”) [16]. This regulation contains emission quality standards and technical provisions for emission control, monitoring, and reporting for all thermal power plants. This regulation requires all stakeholders who operate a Thermal Power Plant to monitor emissions in compliance with the Emission Quality Standard. One of the parameters that must be monitored is mercury.

3.3.3 *Health Sector.* According to the Presidential Regulation No 21 of 2019, 15 indicators should be fulfilled in the health sector for supporting the ratification of the Minamata Convention on Mercury as stated on Law No 11 of 2017. Of the 15 indicators listed, it can be classified into six main indicators i.e., i) the existence of policies and regulations in replacement of medical devices containing mercury and mercury waste management; ii) information system in the implementation of policy, the utilization of mercury and identification of mercury emissions from incinerator; iii) the existence of network and partnership; iv) the socialization about mercury; v) implementation of replacement of medical devices containing mercury and implementation of mercury waste management; as well as vi) legal supervision and enforcement.

The Ministry of Health had already issued the Minister of Health Regulation No 57 of 2016 concerning the national action plan to control health impacts due to mercury exposure [17], before the Presidential Regulation no 21, 2019 was enacted. This regulation consists of 7 (seven) strategies that most of which were listed as indicators in the Presidential Regulation No 21 of 2019. The targets that have been fulfilled in the health sector were listed in Table 4.

| No | Indicator | Regulation Implementation |
|----|----------|--------------------------|
| 1  | Policies and regulations in replacement of medical devices containing mercury | Minister of Health Regulation No. 57 of 2016 concerning the national action plan for controlling the health impacts due to mercury exposure (Strategy 1: policy framework) [17]  
*Surat Edaran Dirjen Farmalkes No. HK.02.02/V/0720/2018* concerning the determination of the period for permit and distribution of medical devices containing mercury [18]  
*Surat Edaran Dirjen Yankes No. HK.02.02/1/2899/2019* concerning the replacement of medical devices containing mercury [19] |
|   | Policies and regulations in mercury waste management emitted by health facilities | Minister of Health Regulation No. 57 of 2016 concerning the national action plan for controlling the health impacts due to mercury exposure (Strategy 1: policy framework) [17]  
  | Surat Edaran Dirjen Yankes No. HK.02.02/V/0361/2019 concerning on obligation of the existence of temporary shelter for hazardous and toxic waste [20] |
|---|---|
| 3 | Policy implementation | Minister of Health Regulation No. 57 of 2016 concerning the national action plan for controlling the health impacts due to mercury exposure (Strategy 4: Strengthening of health institutions and workers) [17]  
  | Guidance issued by the Ministry of Health: a mechanism for removal and replacement of medical devices containing mercury in health service facilities |
| 4 | The use of mercury | Minister of Health Regulation No. 57 of 2016 concerning the national action plan for controlling the health impacts due to mercury exposure (Strategy 2: standardization, database, and surveillance) [17] |
| 5 | Identification of mercury emission from incinerator | Ministry of Environment and Forestry No 7, 2007 (Permen LHK No 7/2007) concerning Emission Standards for steam boilers [21] |
|   | Partnership and socialization |   |
| 6 | The existence of network and partnership | Minister of Health Regulation No. HK.01.07/MENKES/259/2018 concerning health workgroup in controlling the health impact due to mercury exposure [22]  
  | Minister of Health Regulation No. HK.02.02/Menkes/488/2014 concerning the formation of the mercury response team [23] |
| 7 | Socialization about mercury | Surat Edaran Sekjen Kemenkes concerning the control of health impacts due to the utilization of mercury  
  | Guidance issued by the Ministry of Health: the control of health impacts due to the utilization of mercury in ASGM using a participatory method  
  | Minister of Health Regulation No. 57 of 2016 concerning the national action plan for controlling the health impacts due to mercury exposure (Strategy 5: Socialization and advocacy) [17] |
|   | Implementation |   |
| 8 | Replacement of medical devices containing mercury | Minister of Health Regulation No. 57 of 2016 concerning the national action plan for controlling the health impacts due to mercury exposure (Strategy 4: Strengthening of health institutions and workers) [17] |
Mercury waste management emitted by health facilities

Surat Edaran Dirjen Yankes No. HK.02.02/V/0361/2019 concerning on obligation of the existence of temporary shelter for hazardous and toxic waste [20]

Legal supervision and enforcement

Not Available

The Minister of Health Regulation No. 57 of 2016 has covered almost all targets and indicators. However, in the case of replacement of medical devices containing mercury and mercury waste management emitted by health facilities, the ministry should launch the regulation that more specifically regulate these two things including the legal supervision and law enforcement.

3.3.4 Artisanal and Small-Scale Gold Mining (ASGM) Sector. The mercury elimination strategy in the ASGM sector is divided into 9 success indicators (Table 5).

| No | Indicator                                                                 | Regulation Implementation                                                                                                                                 |
|----|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Regulations regarding the trading system for imports, exports, and domestic distribution of mercury | Regulation of the Ministry of Trade No 47 of 2019 concerning the third amendment to the Regulation of the Ministry of Trade No 44/M-DAG/PER/9/2009 concerning the Procurement, Distribution, and Control of Hazardous Materials [15] |
| 2  | Regulations on guidelines for storage and handling of mercury and waste containing mercury | Not Available                                                                                                                                               |
| 3  | Guidelines for restoration of mercury contaminated land                    | Regulation of the Ministry of Environment and Forestry No. 101/Menlhk/Setjen/ Kum.1/11/2018 concerning Guidelines for Restoration of Land Contaminated by Hazardous and Toxic Waste [24] |
| 4  | Standard methods for measuring mercury exposure                            | Regulation of the Ministry of Health No 57 of 2016 concerning the National Action Plan for Control of Health Impacts Due to Mercury Exposure 2016-2020 (Strategy 2) [17] |
| 5  | Guidelines for controlling risk factors for health impacts due to mercury exposure to the environment and guidelines for management of mercury poisoning | Regulation of the Ministry of Health No 57 of 2016 concerning the National Action Plan for Control of Health Impacts Due to Mercury Exposure 2016-2020 (Strategy 3) [17] |
| 6  | Integrated cooperation                                                      | The Memorandum of Understanding between Ministry of Environment and Forestry and the Ministry of Energy and Mineral Resources No PKS.7/MENLHK/SETJEN/SEY.1/4/2019 and 03.PJ/05/MEM/2019. One of the scopes is the control of ASGM |
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in the context of transforming the elimination of mercury in accordance with the Minamata Convention

7 Strengthening community engagement Guidance issued by the Ministry of Health in 2018: the control of health impacts due to the utilization of mercury in ASGM using a participatory method

8 Socialization to local government Circular of the Minister of Energy and Mineral Resources No 6 E/37/MEM/.B/2017 to Governors concerning the prohibition of mercury use in gold mining

Implementation

9 Strengthening and law enforcement Law No 4 of 2019 concerning Mineral and Coal Mining [25]
Regulation of the Minister of Energy and Mineral Resources No 11 of 2018 concerning Procedures for Granting Areas, Licensing, and Reporting on Mineral and Coal Mining Business Activities [26]
Regulation of the Ministry of Energy and Mineral Resources No 26 of 2018 concerning Implementation of Good Mining Principles and Supervision of Mineral and Coal Mining [27]
Ministerial Decree of Energy and Mineral Resources No 1827.k/30/MEM/2018 concerning Guidelines for the Implementation of Good Mining Engineering Principles [28]

The regulation regarding the trading system for imports, exports and domestic distribution of mercury commodities has already been covered by the Regulation of the Minister of Trade No 47 of 2019 as mentioned in Table 2. Mercury is one commodity that is already prohibited from importing and distribution, unfortunately, this regulation excluded the export mechanism that is also the targets listed in the NAP RAM.

The Ministry of Environment and Forestry has already issued the regulation about the guidelines for restoration of land contaminated by hazardous and toxic waste. It covers how to remediate mercury as toxic and hazardous waste. Furthermore, to support all the stakeholders in measurement, identification and impact assessment of the mercury, the Ministry of Health through their regulation (No. 57 of 2016 concerning the national action plan for controlling the health impacts due to mercury exposure), already explained in more detail about how to examine mercury and the threshold limit of mercury in several environment matrices and organism.

Whereas, in terms of law enforcement for ASGM, the Ministry of Energy and Mineral resources has issued the guidelines for implementing good mining engineering through the Ministerial decree No. 1827.k/30/MEM/2018 [28], where mercury is prohibited in all stages of gold processing, but still the guideline implementation is more complicated since ASGM is closely related to the socio-economic aspect. Therefore, public awareness and the technology applicable and sustainable for social, economic, and environmental aspects are needed.

3.3.5 Mercury contamination in Indonesia surface water and its regulation. Most ASGM in several Indonesian provinces still use the mercury in the gold refining process, for example, in Central Java [7, 29], Gorontalo [30], and West Java [31]. The amalgamation method used was the potential to cause mercury emission to leak into the surface water in many ways. Atmospheric transport and deposition at average temperature is the pathway delivering Hg to many of the world’s rivers, lakes, and oceans [32], furthermore,
the improper management of tailings will be providing the mercury directly to surface water. The mercury will be accumulated through food chains in the body [7, 32]. For the last two decades, Indonesian has experienced human health cases related to mercury contamination in several provinces such as in North Sulawesi, West Java, Kalimantan, West Sumatera, and Jambi [33].

Several studies regarding monitoring and distribution of mercury in surface water due to ASGM existence has been carried out in several provinces in Indonesia, for example in North Sulawesi [29, 34], Lombok [35], Central Java [29], West Java [31], and Central Kalimantan [36]. These studies show that the mercury concentration in surface water was ranging from below the detection limit 0.05 µg L\(^{-1}\) to 12.5 µg L\(^{-1}\). The highest concentration was found at small-scale gold mining (ASGM) located in Pongkor, West Java [31]. The maximum value of Hg was still below the quality threshold standard proposed by the Government Act No. 82/2001 (1, 2, and 5 mg L\(^{-1}\) for each class, respectively) but exceeded the standards from the WHO and the United States Environmental Protection Agency (USEPA).

According to a study that was carried out by Sari et al. [7], the water after the amalgamation process still contains 37.3 x 10^3 µg L\(^{-1}\), and this concentration is getting lower in leaching water which is only 72.2 x 10^1 µg L\(^{-1}\). This larger value shows that the surface water adjacent to the mining area or gold processing area is still vulnerable to mercury contamination. The studies in North Sumatra shows that the mercury emission and distribution are higher at surface water surrounding the gold processing plants, but also dispersed to several areas downstream through the river system [34].

One of the problems related to mercury contamination in the surface water is not regulated in detail. Both in the Mineral and Coal Law and in the Environmental Protection and Management Act, mercury compounds are not mentioned in writing as prohibited from being used in the mining process. Moreover, through to Government Act No. 82/2001 [37], the government already states the mercury threshold. However, the value is still far higher than international regulation such as USEPA (the United States Environmental Protection Agency) or WHO (World Health Organization). It makes it easier to be fulfilled and permitted water pollution to occur [38]. Furthermore, the change of authority in ASGM management from local to central government through the existence of Law No 23 of 2014 [39], makes the local government no longer have authority to manage the illegal mining or to control the ASGM operation. Hence, the utilization of mercury is still massive and uncontrolled. However, the decentralization in Indonesia does not necessarily make the local government to be more powerful, but they still depend on the national direction to determine the authority, which is worsened by the lack of coordination [38].

The last difficulties for banning the use of mercury are both in Law No 4, 2009 concerning Mineral and Coal [25] and the Law No. 32 of 2009 concerning Environmental Protection and Management [40], the prohibition of mercury used in the mining process does not describe in detail. Then in 2017, the government through the Minister of Energy and Mineral Resources Circular Number 6E/32/MEM.B/2017 concerning the Prohibition of Using Mercury in Gold Mining [41] and Circular of Menkopolhukam Number: B-20/Menkopolhukam/De-V/KM/04/7/2017 concerning Illegal Distribution and Use of Mercury in Mining Activities [42], the prohibition of the utilization of mercury were stated. This shows the overlapping due to the central Government’s authorization, especially for an environmental issue like surface water contamination.

4. Conclusions

Presidential Regulation No. 21 of 2019 concerning the National Action Plan for Mercury Reduction and Abolishment is the right step to reduce and eliminate mercury. The regulations derived from the Presidential Decree must be formed to implement the action plan and as an indicator of the success of the action plan. Besides, the regulations that require adjustments or improvements are also considered. Furthermore, strengthening law enforcement and compliance as well as monitoring and evaluation must be carried out to achieve the objectives. Mercury contaminants were found in surface water in several provinces in Indonesia
due to ASGM existence, but these mercury concentrations were still below the quality threshold standard proposed by Government Act No. 82/2001. Therefore, lowering the threshold value for surface water, strengthening law enforcement, and issuance of the regulation for restriction of mercury in the mining process along with the applicable alternative technology are several strategies to deal with mercury contamination in the surface water.

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