Analysis of the Minamata Convention on Mercury in the Context of Sustainable Development Goals (SDGs)

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Abstract

In response to global mercury pollution, the Minamata Convention on Mercury was adopted in 2013 and enacted in 2017. Parties have developed implementation mechanisms under the Convention. Compared to other multilateral environmental treaties, the Minamata Convention is unique in that its sole target is mercury, which it aims to manage throughout its lifecycle, including mining, trade, usage, emissions, releases, storage and disposal. The Convention also highlights social issues related to mercury, such as vulnerable populations facing risks from mercury, and the informal sector working in the field of artisanal and small-scale gold mining (ASGM). This paper seeks to identify how the Convention may be developed from the perspective of achieving the Sustainable Development Goals (SDGs), which also pursue comprehensive approaches to environmental, social and economic issues. The analysis provided shows that the Minamata Convention addresses all 17 goals of the SDGs, recognizing strong synergies with health (Goal 3), responsible consumption and production (Goal 12), and partnerships (Goal 17) in particular. For further development of the Convention, it is recommended that a gender perspective should be incorporated into the implementation of the Convention. In the context of trade-off relationships, the generation of mercury waste needs to be dealt with properly. By utilizing recovered mercury, mercury from primary mining can be phased-out in advance of the current schedule. ASGM and mercury waste management are still the biggest concerns for fulfillment of the Convention. Formulation of a global scheme of safe mercury waste management will be essential in the long term.

Key words : environmentally sound management, long-term management, mercury waste, Minamata Convention Sustainable Development Goals (SDGs), sustainability

1. Introduction

Mercury is recognized as a substance with significant adverse health effects. There are particular concerns over its harmful effects on infants and unborn children. A global mercury assessment (UNEP, 2002) showed that there was sufficient evidence of significant adverse global impacts from mercury and its compounds. The global transport of mercury pollution in the environment has been a key driver for global action taken by international society to address the problem of mercury pollution. After international discussion based on a scientific evaluation presented in the assessment report, the Minamata Convention on Mercury (UNEP, 2013a) was adopted in 2013 and enacted in 2017.

Compared to other multilateral environmental treaties, the Minamata Convention is unique in that its sole target is mercury, which it aims to manage throughout its lifecycle including mining, trade, usage, emissions, releases, storage and disposal. The Convention also highlights social issues related to mercury, such as vulnerable populations facing risks from mercury, and the informal sector working in the field of artisanal and small-scale gold mining (ASGM). This comprehensive approach, addressing not only environmental issues but also social and economic issues related to mercury, corresponds to the principles of the United Nations' 2030 Agenda for Sustainable Development (UNGA, 2015).

The Agenda was adopted by the United Nations Assembly in September 2015, underpinned by 17 Sustainable Development Goals (SDGs) and 169 targets. The Agenda emphasizes the importance of integrating the three dimensions of sustainable development, namely environmental, social and economic issues, in a balanced manner, with the principle of inclusion represented by the slogan of "no one will be left behind" being consistent with all goals of the SDGs. As Griggs *et al*. (2013, 2014) emphasized, a comprehensive approach is necessary for seeking sustainable development, since all of the goals are deeply interlinked with each other and cannot be

achieved by separate approaches. The SDGs, therefore, can be utilized as a toolkit or a guide to confirm whether policies address all necessary issues for pursuing a sustainable world without sacrificing other issues. After the adoption of Agenda 2030, the world, including international organizations, governments, local governments, the private sector, research institutions, and civil society, has shifted its activities toward pursuing achievement of the SDGs. Therefore, the Minamata Convention also needs to respond to these international expectations of achieving the SDGs by 2030.

This paper explores the relationship between the Minamata Convention and the SDG targets to clarify the possible effect of the Convention on sustainable development, including both positive and negative impacts. Then, this paper seeks to understand the key directions and challenges for further development of the Minamata Convention from the perspective of achieving the SDGs that pursue a comprehensive approach across environmental, social and economic challenges.

2. Methodology

The SDGs consist of 169 targets under 17 goals, which cover the environmental, social, economic and governance spheres, and facilitate a goal-oriented approach (Kanie & Biermann, 2017). Firstly, this paper analyses the interlinkages between the provisions of the Minamata Convention and the SDGs at the target level, examining both synergies and trade-off relations. The main body of the Minamata Convention in association with the regulation of mercury or arrangements by the Parties is a target of analysis in this paper. ICSU (2017) and Nilsson *et al*. (2016) have developed a framework, whereby interactions between the SDGs and targets are classified on a seven-point ordinal scale. The framework identifies categories of causal and functional relationships underlying progress toward or achievement of goals and targets, and gives scores classifying interactions as 'enabling,' 'reinforcing' and 'indivisible' for positive interactions, and 'constraining,' 'counteracting' and 'cancelling' for negative interactions. This framework has been applied in analysis in this paper in a simple manner, focusing on significant positive and negative relationships.

In the case that the provisions of the Convention don't explicitly address the SDG targets, but its effect obviously contributes to achievement of the SDG targets, that kind of synergy is also included, with clarification as "indirect synergy." For instance, reduction of mercury emissions to the atmosphere under Article 8 doesn't explicitly address reduction of marine pollution, which is in SDG 14. According to a recent total mercury budget assessment (UNEP, 2018), however, the main flow of global mercury is anthropogenic emissions to air (2,500 tons per year) and deposition to oceans from the air (3,800 tons per year), which means that Article 8 certainly contributes to SDG 14. In this case, the relationship between Article 8 and SDG 14 is classified as "indirect synergy." Likewise, phasing out fluorescent lamps using mercury under Article 4 doesn't directly link with climate change (SDG 13) or energy efficiency (SDG 7), but it leads to the propagation of LED lamps, which contributes to achieving those SDGs indirectly.

Secondly, based on the above analysis, future challenges are discussed for achieving a sustainable society and fulfilling the purposes of the Minamata Convention.

3. Results

3.1 Synergies between the Minamata Convention and SDGs

Given the purpose of the Minamata Convention prescribed in Article 1, which is "to protect the human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds," it is obvious that the Convention gives the highest priority to Goal 3 of the SDGs, good health and well-being, in particular SDG Target 3.9, which is "by 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination." In line with protection of the environment, Target 12.4, which is "by 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment," is also directly addressed by the Convention.

Table 1 lists synergies between the Minamata Convention and the SDGs at the target level. It reveals that the Minamata Convention covers all 17 goals of the SDGs to a greater or lesser extent, which means the Convention has taken the concept of Agenda 2030 in advance, and implemented it for achieving a sustainable society.

Looking at the synergies at the SDG target level, many articles of the Convention have synergies with Targets 3.9 and 12.4, which are recognized as core targets of the Convention prescribed in the purpose of the Convention as described above. Although Target 3.9 accounts for more than half of the indirect synergies, Target 3.d under *Goal 3* of the SDGs, "Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks" is directly addressed in seven articles of the Convention in the context of health risk assessment, education or capacity building. Other than those two targets, Target 17.16, prescribing a global partnership and multi-stakeholder partnerships that mobilize and share

Table 1 Synergies between the Minamata Convention and the SDGs. ○: direct synergy △: indirect synergy

Minamata Convention	Target of SDGs																										
	1.5	2.4	3.9	3.d	4.4	4.7	5.c	6.3	7.3	8.4	9.4	9.5	9.b	10.b	11.6	12.2	12.4	12.a	12.c	13.2	14.1	15.1	16.10	17.2	17.7	17.9	17.16
Article 3 Mercury supply sources and trade			△													○	○										
Article 4 Mercury-added products		○ Pesticides	△						△ Lamp	△	○				△	○	○			△ Lamp							
Article 5 Manufacturing processes in which mercury are used			△	○						△	○					○	○										
Article 7 Artisanal and small-scale gold mining (ASGM)	○		○	○	○	○	△			△	○	○				○	○							○	○	○	○
Article 8 Emissions to the atmosphere			△								○				○	○	○		○ Coal-fired facilities	○ Coal-fired power plants	△	△					
Article 9 Release to land and water			△					○			○					○	○				○	○					
Article 10 Environmentally sound interim storage of mercury			△					△							○		○	○								○	○
Article 11 Mercury wastes			△					△							○		○	○								○	○
Article 12 Contaminated sites			○	○													○	○								○	○
Article 13 Financial resources and mechanism						△						△		○				○						○	○	○	○
Article 14 Capacity-building, technical assistance and technology transfer						○						○	○					○							○	○	○
Article 16 Health aspects			○	○		○																					○
Article 17 Information exchange				○							△												△				○
Article 18 Public information, awareness and education			△	○		○																	○				○
Article 19 Research, development and monitoring				○								○	○												○		○
Synergy: ○	1	1	3	7	1	4	0	1	0	0	5	3	2	1	3	6	9	5	1	1	1	1	1	2	4	6	10
Indirect synergy: △	0	0	8	0	0	1	1	2	1	3	1	1	0	0	1	0	0	0	0	1	1	1	1	0	0	0	0
Sum	1	1	11	7	1	5	1	3	1	3	6	4	2	1	4	6	9	5	1	2	2	2	2	2	4	6	10

knowledge, expertise, technology and financial resources, has many synergies with the articles of the Convention. Not only the articles regarding cooperation among parties, but also the articles regarding ASGM, interim storage, waste management and contaminated sites explicitly prescribe encouragement of cooperation among parties, relevant intergovernmental organizations such as the Basel Convention, WHO and ILO, and other entities. It can be concluded that the Minamata Convention puts great importance on partnerships in its implementation. In fact, the UNEP Global Mercury Partnership is regarded as one of the main mechanisms for delivery of immediate actions on mercury, and current projects in the eight prioritized areas reflecting the major sources of mercury release categories have been conducted with a wide range of stakeholders including the private sector (UNEP, 2019a).

Looking at the articles of the Convention, Article 7 *(ASGM)* shows the widest coverage among the targets of the SDGs. The ASGM provision under Article 7, Annex C (i) explicitly addresses measures for vulnerable populations as "strategies to prevent the exposure of vulnerable populations, particularly children and women of child-bearing age, especially pregnant women, to mercury used in artisanal and small-scale gold mining," who should be taken into account as important stakeholders in the SDGs.

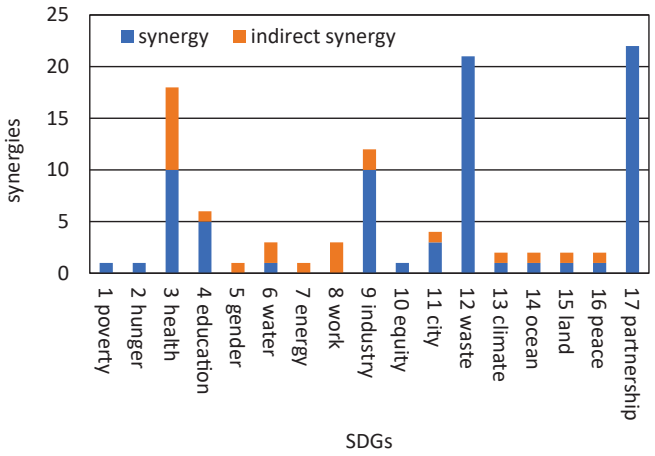

Fig. 1 Synergies of the Minamata Convention with the 17 goals of the SDGs.

Figure 1 summarizes those synergies, classifying them into the 17 goals of the SDGs. It shows that the Minamata Convention addresses *Goal 17 (partnerships),* followed by *Goal 12 (responsible consumption and production)*, and *Goal 3 (health)*, in particular. In addition, *Goal 9 (industries, innovation and infrastructure)* is also an important area dealing with it in the Convention. The Convention is regarded as covering the SDGs in collaboration with environmental, social and economic measures.

3.2 Trade-off Relationships

With respect to trade-off relationships between the Minamata Convention and the SDGs, no strong negative impacts, such as effects detrimental to other targets of the SDGs, have been observed. However, there are potential trade-off relationships, which may constrain achievement of SDG targets to some extent. Table 2 shows a few possible negative relationships between the Convention and the SDGs. For instance, phasing out of thermometers and sphygmomanometers that use mercury may have a negative impact on accessing health care services (Target 3.8) for those who cannot afford electrical measurement.

Given the economic burden of coping with regulation under the Convention, the highest concern should be paid to the relationship with economic growth (Target 8.1), which accounts for nine articles with trade-off relationships. However, certain conditions, exemptions, or special considerations are already accommodated in the Convention to minimize the negative impact of regulation. For instance, current mining of primary mercury is allowed for up to 15 years, though primary mercury mining is basically banned under Article 3. Also, the phase-outs of mercury-added products have exemptions if those products are essential for civil protection or military uses, or where no feasible mercury-free alternative for replacement exists, for instance (Article 4).

The trade-off relationship with waste reduction (Target 12.5) needs more careful consideration in the implementation of the Convention. To ban the use of mercury results in generating wastes originating from the products or industrial processes in which mercury is used. For instance, in accordance with Article 5, decommissioning of chlor-alkali facilities results in generation of significant amounts of excess mercury, which is estimated at approximately 10,456 tons globally (UNEP, 2013b), including 8,000 tons in the EU (COWI & BiPRO, 2015) and 1,200 tons in the US (DOE, 2011). To prevent those huge amounts of mercury from reaching the global market, under Paragraph 5 (b) of Article 3, measures shall be taken so that excess mercury from the decommissioning of chlor-alkali facilities is disposed of, not to lead to recycling or re-use. This indicates a trade-off relationship with Target 12.5.

With regard to reduction of mercury emissions to the atmosphere (Article 8), measures could include changes in raw fuels or materials to those containing less mercury, or removal of mercury from exhaust gas. Considering the total material flow of mercury, the latter measure leads to increased mercury waste, such as mercury-contaminated sludge. In this context, Article 8 has a possible negative impact on Target 12.5.

4. Discussion

4.1 Enhancement of Synergies

As the above analysis shows, the Minamata Convention addresses all 17 goals of the SDGs with some gradation from strong to weak linkages. For further development of the Minamata Convention, enhancement of synergies could be one option. In light of strengthening its weak synergies, gender (Goal 5), which showed the weakest synergy with the Convention, should be one target to consider. In the Convention, women of child-bearing age, especially pregnant women are explicitly addressed in terms of preventing their exposure to mercury through the ASGM process. It is estimated that 10 to 15 million miners, including 4 to 5 million women and children, are involved in the ASMG sector (UNEP, 2019b). Since the predominant source sector is ASGM

Table 2 Potential trade-off relationships between the Minamata Convention and the SDGs.

Minamata Convention	Target of SDGs					
	1.2	3.8	7.1	8.1	8.5	12.5
	reduce poverty	achieve universal health coverage	access to affordable energy services	sustain per capita economic growth	achieve full employment	reduce waste generation
Article 3 Mercury supply sources and trade				○	○	
Article 4 Mercury-added products		○ thermometer, sphygmomanometer		○		○
Article 5 Manufacturing processes in which mercury are used				○		○
Article 7 Artisanal and small-scale gold mining (ASGM)	○			○	○	
Article 8 Emissions to the atmosphere			○ Coal-fired power plants	○		○
Article 9 Release to land and water				○		○
Article 10 Environmentally sound interim storage of mercury				○		
Article 11 Mercury wastes				○		
Article 12 Contaminated sites				○		○
Sum	1	1	1	9	2	5

(about 38%) in mercury emissions to air (UNEP, 2018), introducing cleaner technologies in the ASGM sector is an urgent issue together with continuous efforts at formalization, education and organization of miners. To link these efforts to the promotion of the SDGs, it is recommended to consider efforts leading to education and empowerment of women. When an ASGM project under a global partnership of the Convention is formulated, such gender perspectives should be taken into account. Appropriate coordination among other on-going projects is recommended.

4.2 Consideration of Trade-off Relations

For the Convention to accommodate sustainability, it needs to consider possible negative effect of policies. An analysis of the trade-off relationships between the Convention and the SDG reveals that waste issues (Target 12.5) are the biggest concern. The regulations under the Minamata Convention lead to increased amounts of mercury waste, contrary to the SDGs. It should be noted here that mercury waste is generated in two forms, intentional and unintentional.

With respect to mercury waste emitted intentionally, decommissioning of chlor-alkali facilities using mercury in their processes, for instance, results in generation of huge amounts of waste mercury. In terms of preventing mercury from being supplied to the market, it should be appreciated that the Convention prohibits recycling of mercury and prescribes that mercury has to be dealt with as waste. What is important next is whether that mercury waste is treated in an environmentally sound manner or not.

With respect to mercury waste emitted unintentionally, mercury contained as impurities in raw fuel will continue to be emitted from, for example, non-ferrous metal manufacturing industries and coal-fired power plants. While mercury waste emitted intentionally will decrease due to reductions in mercury use in processes and products, it should be borne in mind that mercury waste emitted unintentionally will be continuously generated in the future. Although mercury is still a valuable metal on the global market and will be allowed to be used in certain products or processes that the Convention permits, as a whole, it is obvious that demand for mercury will decline in the near future. Therefore, as far as demand for mercury exists, the mercury supply should consist of recycled mercury recovered and purified from mercury waste and supplied in place of primary mining. In fact, however, as statistics (USGS, 2017) show, primary mining of mercury has been continuously increasing from 2,320 tons in 2013 to 3,790 tons in 2017, revealing that adjustment of primary mining has not been progressing during these years since the Convention was adopted. Given these circumstances, the exception of existing primary mining that allows that mining to continue for the next 15 years should be reconsidered.

4.3 Challenges and Further Discussion

Along with implementation of the Convention, a remaining issue is how to certify long-term management of mercury waste in an environmentally sound manner. Even after demand for mercury nearly disappears in the near future, mercury waste generated unintentionally will continue to be emitted every year. Sodeno and Takaoka (2017) estimate that the amount of surplus mercury will fluctuate from about −2 to 35,000 tons in 2050, depending on scenarios of mercury recovery from the non-ferrous industry. Thus, proper management of mercury waste is the next big challenge for the Convention. It should be noted that under the Convention, details of mercury waste regulation are entrusted to discussions under the Basel Convention. This arrangement should be appreciated in terms of using expertise in the community and promoting partnerships, but concrete measures for regulating mercury waste have yet to be determined other than prescribing that "mercury waste is managed in an environmentally sound manner," even though the "technical guidelines for the environmentally sound management of wastes consisting of elemental mercury and wastes containing or contaminated with mercury" was produced under the regime of the Basel Convention for the Minamata Convention (UNEP, 2015). Although the EU and Japan legislated final disposal of mercury such as mercury sulphide in underground salt mines or hard rock formations or solidified forms in specially controlled landfill sites (EU, 2017; Cabinet of Japan, 2015), permanent mercury stabilization technologies are still new and need further development for certification of safe long-term storage in the environment. Enhancement of mercury waste management capacity in developing countries is also crucial, since many countries lack sufficient general waste management systems. Given that there are only a few companies treating mercury waste commercially in limited countries, a regional approach and establishment of partnerships could be considered in terms of specialization of treatment. Further discussion is needed on formulating a global mercury waste management scheme.

With respect to the contribution of the Convention for achieving the SDGs, a quantitative evaluation should be a future consideration. It has been three years since the Convention was enacted, and the first national reports have been provided by Parties based on Article 21. Using that information, further analysis through quantitative evaluation should be considered, including setting concrete targets for achieving the SDGs and indicating comprehensive measures under the Convention.

5. Conclusions

This paper reveals that the Minamata Convention addresses all 17 goals of the SDGs, covering the

environmental, social and economic spheres. It can be concluded that the Convention contributes to achievement of a sustainable society. In terms of synergies between the Convention and the SDGs, health (Goal 3), responsible consumption and production (Goal 12) and partnerships (Goal 17) have strong interlinkages. For further development of the Convention, it is recommended that a gender perspective be incorporated in implementation of the Convention. In addition, as the Convention emphasizes partnerships, comprehensive approaches for seeking synergies with other policies and enhancing partnerships is important, connecting in areas such as air pollution control, waste management policy, the Basel Convention, the Paris Agreement and, additionally, education and job creation.

In the context of trade-off relationships, generation of mercury waste needs to be dealt with properly. Taking into account the circumstances of developing countries, it is recommended that mercury from primary mining needs to be phased out in advance of the current schedule, considering the balance between global supply from recovered mercury and demand for mercury. ASGM and mercury waste management are still the biggest concerns for fulfillment of the Convention. Mercury never decomposes or vanishes. It is, therefore, essential to formulate a global scheme for safe mercury waste management in the long term.

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