Is the Minamata Convention on Mercury feasible? Can the global mercury agreement lift health threats from lives of millions worldwide?

Noriyoshi Takemura

桐蔭横浜大学法学部

(2014 年 9 月 6 日　受理)

Abstract:

International effort to address mercury has been delivered a significant boost with governments agreeing to a global, legally-binding treaty to prevent emissions and releases. The Minamata Convention on Mercury provides controls and reductions across a range of products, processes and industries where mercury is used, released or emitted. Mercury and its various compounds have a range of serious health impacts including brain and neurological damage especially among young people. However, the convention on mercury is indicated that there are a lot of 'loopholes'. In Minamata, serious health damage occurred as a result of mercury pollution. This damage was caused by the Japanese national policy which prompted to mass-produce fertilizer and speed up food production. After clearing the Minamata case, the meaning, feasibility, actual effects and other related problems of this convention are examined in the global context.

1 Introduction

Mercury is a pollutant of global, regional, and local concern. Humans have mined mercury for millennia, and this silver-colored element is still commonly used in industrial processes and household products. An assessment by the United Nations Environment Programme (UNEP) estimated that 1,960 tonnes of mercury were released into the atmosphere from anthropogenic sources in 2010. At least another 1,000 tonnes were released by human activities into water (UNEP 2013a; H. Selin, p.1).

Mercury (Hg) is released from the Earth's crust through natural processes including volcanic eruptions and the weathering of rocks as well as human activities. During mining, industrial manufacturing, and the disposal of goods, mercury is released into the environment. The burning of coal also emits considerable amounts of mercury into the atmosphere. Mercury poses significant local contamination problems, but in its elemental

Noriyoshi Takemura: Department of Law, Faculty of Law, Toin University of Yokohama, 1614 Kurogane-cho, Aoba-ku, Yokohama, Japan 225-8503

form also travels long distances through the atmosphere before oxidizing and depositing in ecosystems. In aquatic systems, mercury from local and distant sources can convert by biological activity in anaerobic environments into methylmercury, a serious neurotoxin. High-dose exposure can lead to significant neurological damage and fatalities. Low-dose exposure has been linked to developmental delays and neurological damage affecting brain and muscle capacity, especially in small children (H. Selin, p.2) (see Figure1).

The Minamata Convention on Mercury, adopted in October 2013 in the Japanese city where a deadly mercury poisoning incident was recognized in the 1950s, sets out to "protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds" (Article 1). This new convention is a significant international legal and political milestone, as methylmercury, a potent neurotoxin, poses serious environmental and health risks to both children and adults (H. Selin, p.1).

In this research, first, multiplicities of mercury issues are explained and analyzed, second, Minamata Convention on Mercury is explained and critically reviewed, third, mercury as global pollutant and its control are examined.

2 Multiplicities of Mercury Issues

2.1 Health and environmental hazards of mercury

Mercury, whose emissions will be controlled under the new Minamata Treaty, presents a major health risk worldwide. It is released to the atmosphere from industrial activities such as metal and cement production, manufacture of vinyl chloride monomer, municipal waste incineration, fossil fuel combustion and mining. Some 10-15 million miners around the world are exposed to mercury (UNEP 2013a). Mercury is used in a variety of products, including some computer monitors, some batteries, automobile switches, thermostats, medical devices and compact fluorescent light bulbs. When these products are disposed of or broken, the mercury can be released into the environment. Total

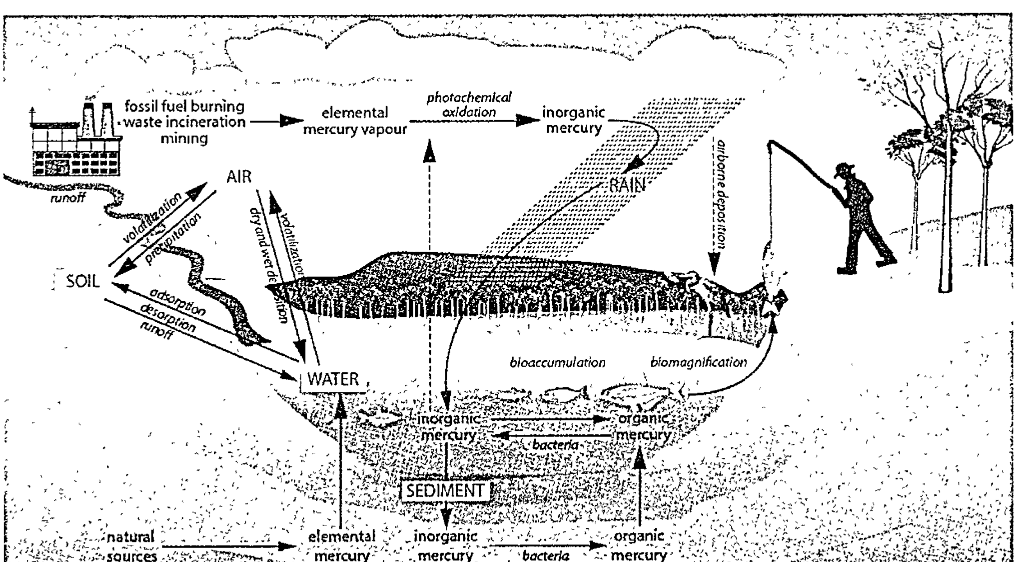

Figure 1: Health and environmental hazards of metals
(Source: UNEP 2013d, p.42,Figure3)

mercury emissions were estimated at 1,960 tonnes in 2010 (UNEP 2013a;UNEP 2013d, p.42).

Mercury contamination affects people along several environmental pathways. Highly toxic methylmercury is formed in wet soil, sediments and water, where it bioaccumulates and biomagnifies. Fish consumption is a main route of human exposure. Infants, children and women of child-bearing age are particularly vulnerable to adverse health effects, which include permanent damage to the nervous system. Mercury can be transferred from mothers to unborn children (UNEP 2013d, p.42).

2.2 Minamata disease and its problems

Minamata disease, which can induce lethal or severely debilitating mental and physical effects, was caused by methylmercury contaminated effluent released into Minamata Bay by Chisso, Japan's largest chemical manufacturer. It resulted in widespread suffering among those who unknowingly ate the contaminated fish. Minamata disease is documented in three phases(EEA2013b, p.15).

The disease first came to prominence in the 1950s. It was officially identified in 1956 and attributed to factory effluent but the government took no action to stop contamination or prohibit fish consumption. Chisso knew it was discharging methylmercury and could have known that it was the likely active factor but it chose not to collaborate and actively hindered research. The government concurred, prioritising industrial growth over public health. In 1968 Chisso stopped using the process that caused methylmercury pollution and the Japanese government then conceded that methylmercury was the etiologic agent of Minamata disease (EEA2013b, p.15).

The second phase addresses the discovery that methylmercury is transferred across the placenta to affect the development of unborn children, resulting in serious mental and physical problems in later life. Experts missed this at first because of a medical consensus that such transfer across the placenta was impossible (EEA2013b, p.15).

The third phase focuses on the battle for compensation. Initially, Chisso gave token 'sympathy money' under very limited criteria. In 1971 the Japanese government adopted a more generous approach but after claims and costs soared a more restrictive definition was introduced in 1977, justified by controversial 'expert opinions'. Legal victories for the victims subsequently made the government's position untenable and a political solution was reached in 1995–1996. In 2003, the 'expert opinions' were shown to be flawed and the Supreme Court declared the definition invalid in 2004(EEA2013b, p.15).

In September 2011 there were 2,273 officially recognised patients. Still, the continuing failure to investigate which areas and communities were affected means that the financial settlement's geographic and temporal scope is still not properly determined. Alongside deep-seated issues with respect to transparency in decision- making and information sharing, this indicates that Japan still faces a fundamental democratic deficit in its handling of manmade disasters(EEA2013b, p.15).

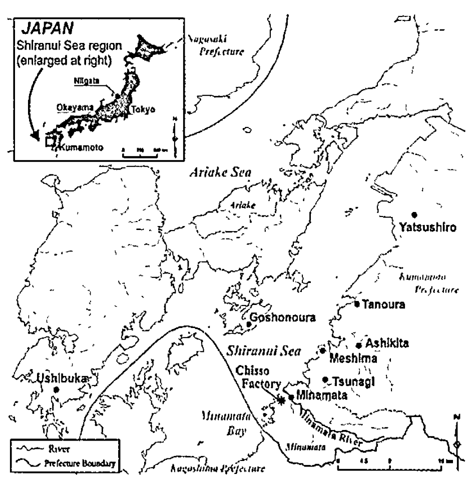

Figure 2: Location of Minamata City
(Source: EEA2013a,p.95,Map5.1)

3 The Minamata Convention on Mercury

3.1 Contents of Minamata Convention

Key provisions of the Minamata Convention can be categorized into five sets of issues: a) supply and trade; b) products and processes; c) emissions and releases; d) artisanal and small-scale gold miming (ASGM); and e) resources and compliance (H.Selin, p.1, 3).

a) Supply and trade

— New mercury mining is prohibited but existing extraction may continue for up to 15 more years after the treaty become legally binding for a party.

— Mined mercury may only be used in permitted products and manufacturing processes, and should be disposed of in ways that do not lead to continued re-use.

— Excess mercury from the decommissioning of chlor-alkali facilities cannot be re-used and parties should identify other major secondary sources and stockpiles of mercury.

— Mercury trades between parties can only take place after the importing party provides written prior informed consent.

— Parties can only export to non-parties that have measures in place to protect human health and the environment and follow treaty provisions on allowed uses, storage and disposal.

— Parties should only allow imports from non-parties proving guarantees that mercury comes from a source allowed under the treaty.

b) Products and processes

— Parties should cease manufacturing, import, and export of nine mercury-added product categories by 2020, but can ask for five plus five years of exemptions.

— Dental amalgam is subject to restrictions with a list of measures for reduced use that parties can elect to take.

— Parties should phase-out mercury use in two kinds of industrial processes by 2018 and 2025 respectively, but can ask for five plus five years of exemptions.

— Parties should reduce mercury use in three kinds of industrial processes where each process has its own requirements.

— Parties should discourage the manufacture and commercial distribution of new mercury-added products and the development of new facilities that use mercury in manufacturing processes.

c) Emissions and releases

— Parties should apply BATs and BEPs to five categories of new point sources to control and where feasible reduce emissions no later than five years after the treaty enters into force.

— Parties should control and where feasible reduce emissions from five categories of existing point sources through emissions limit values, BAT, BEP, or other alternative measures including co-benefits strategies no later than 10 years after the treaty becomes legally binding.

— Parties should control and where feasible reduce mercury releases to land and water from point sources through BAT and BEP or alternative measures including multi-pollutant strategies.

d) Artisanal and small-scale goal miming

— Parties should reduce and where feasible eliminate the use of mercury in, and the releases to the environment of mercury from ASGM mining and processing.

— Parties with 'more than insignificant' ASGM and processing shall develop a national action plan outlining national objectives, reduction targets, and actions to eliminate whole ore amalgamation and open burning or amalgam as well as all burning of amalgam in residential areas.

e) Resources and compliance

— The GEF Trust Fund shall provide financial resources to support treaty implementation, and additional financial resources for a specific international program should be provided on a voluntary basis.

— Parties shall cooperate to provide within their respective capabilities timely and appropriate capacity-building and technical assistance to developing country parties.

— A 15-member committee operating as a COP subsidiary body should promote implementation and address compliance issues.

— The COPs should no later than six years after entry into force begin periodical effectiveness evaluations of the convention.

3.2 Review of Minamata Convention

The convention covers sources collectively responsible for 96 percent of atmospheric emissions included in the UNEP assessment, and its mandates will affect countries, firms, and consumers all over the world. However, initial controls will only have a limited impact on curbing global emissions and releases (H.Selin 2013). In light of the lack of explicit numerical reduction targets to meet its stated environmental and human health goal, the convention mandates must be strengthened and engender support from a broad set of public, private, and civil society actors(H. Selin, p.1).

The Minamata Convention is part of a cluster of agreements on hazardous substances and wastes, together with the Rotterdam, Basel, and Stockholm Conventions. These earlier treaties were off to similarly modest beginnings as the Minamata Convention, but their respective COPs have strengthened mandates over time. This demonstrates that it is possible to make valuable progress towards better environmental and human health protection during treaty implementation (H.Selin, p.6).

The Minamata Convention is initially more legally and politically important than environmentally significant; it creates a platform for continued cooperation, but many initial mandates are weak and do not take effect for another five, ten, or fifteen years. To achieve the goal of protecting the environment and human health from mercury emissions and releases, collaborative actions must be coordinated across global, regional, national, and local governance scales (N.E. Selin 2011;H.Selin, p.6).

3.3 The Political economy of a global ban on mercury-added products: positive versus negative approaches

There are two regulatory options commonly used in multilateral environmental agreements. In case of the recent global efforts to gradually phase-out the use of mercury-added products, in the first approach no mercury-added products would be allowed unless they are listed in an annex (the negative list), while in the second approach all mercury-added products would be allowed unless they are listed in an annex (the positive list). In both cases countries may have time to make the transition away from these products through the use of exemptions (Soederholm, p.287).

The negative list approach could facilitate a more cost-effective phase-out of mercury, in part since in this case an individual country seeking exemption would bear the burden of identifying the need for the exemption. This requires, though, the use of long-term compliance periods for selected products groups. With the positive list approach, the one country adopted in the Minamata Convention on mercury, it may be more difficult to induce mercury users to reveal their true costs of substituting to other products (Soederholm, p.287).

3.4 Bringing the Convention home to Minamata

In October 2013 a new international convention to control mercury emissions was open for signing in Japan. Named the Minamata Convention on Mercury, the agreement is a response to the realization that mercury pollution is a global problem that no one country can solve alone. The convention was four years in the making, with more than 130 nations agreeing by consensus to a final text in January 2013. It includes both compulsory and voluntary measures to control mercury emissions from various sources, to phase the element out of certain products and industrial processes, to restrict its trade, and to eliminate mining of it (Kessler, p.A308).

The Japanese government pushed for the convention to be named after the Minamata tragedy. Even so, nearly 60 years after that incident came to light, victims' groups say the Chisso Corporation has not been held sufficiently accountable, and the pollution has not been properly cleaned up. And they say the Japanese government has neither fully assessed the damage to human health and the environment nor adequately compensated victims (Kessler, p.A308).

The government officially recognizes fewer than 3,000 patients from the Minamata and Niigata incidents, more than half of whom are now dead. Those patients have received some compensation and medical expense payments, while around 10,000 others have received more modest compensation for having "applicable conditions." Yet more than 65,000 people have reportedly applied for compensation and medical expenses under a new program (Kessler, p.A308).

During the negotiations, several Minamata disease victims' groups and other organizations argued that if the convention was to bear the Minamata name, the Japanese government must resolve these issues at home, and the convention should be strong enough to prevent similar tragedies (Kessler, p.A308).

4 Mercury as a Global Pollutant and its Control

4.1 Science and strategies to reduce mercury risks

Policy activity to date has focused on the mercury problem at a single level of spatial scale, and on near-term timescales. Efforts at the local scale have focused on monitoring levels in fish and addressing local contamination issues; nationalscale assessments have addressed emissions from particular sources; and global-scale reports have integrated long-range transport of emissions and commercial trade concerns. However, aspects of the mercury issue that cross the political-scale (such as interactions between different forms of mercury) as well as contamination problems with long timescales are at present beyond the reach of current policies. It is argued that these unaddressed aspects of the mercury problem may be more effectively addressed by (1) expanded cross-scale policy coordination on mitigation actions and (2) better incorporating adaptation into policy decision-making to minimize impacts (N.E.Selin, p.2389).

Policy makers at multiple levels of scale have attempted to address mercury due to concern about human and environmental exposures. Policy activities to date have been conducted at levels of spatial scale corresponding to typical governmental organization (local, national/regional, international). Policy actions to reduce mercury emissions and manage risks associated with mercury exposure are proceeding at multiple political scales simultaneously, each covering a different aspect of a connected, regional-to-global scientific issue. In addition, the temporal scales of the mercury problem range from days (local transport and deposition of industrial emissions), months (intercontinental transport), years (short-term ecosystem dynamics and fish accumulation), decades (longer-term ecosystem dynamics, fish dietary patterns, consumption patterns), to centuries and longer (global biogeochemical cycling). These temporal scales also match imperfectly with the timescales of policy. More effective governance of mercury risks would require better taking into account the multiscale characteristics of the mercury problem (N.E.Selin, pp.2396-2397).

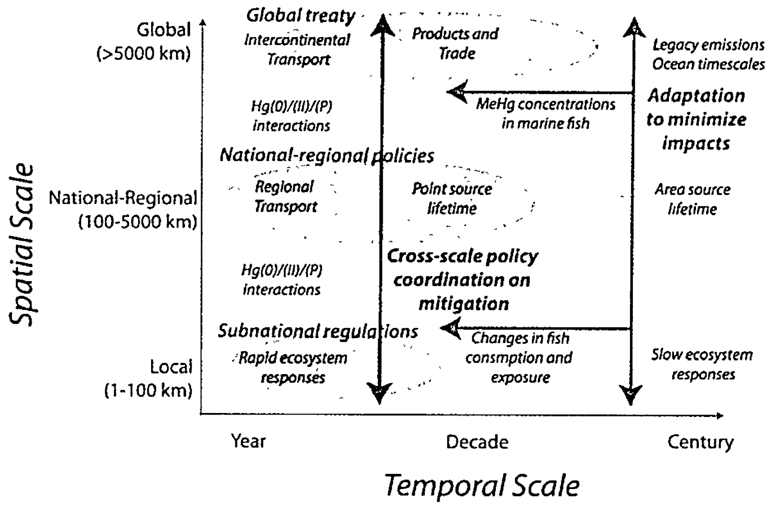

Figure 3: Temporal and Spatial Scale (Source: Selin, N.E., 2011, p.2397, Fig2)

Two types of solutions emerge for the spatial and temporal challenges associated with the mercury problem. These are illustrated in Figure3 arrows. First, to address the elements of the mercury issue that fall between the spatial scales of policy-making, better coordination among political levels is necessary. Second, to address environmental and earth systems problems that occur on timescales longer than the usual political actions, a two-pronged approach is necessary, that combines forward-looking mitigation strategies with adaptation (N.E.Selin, pp.2397-2398).

Making effective policy across scales on environmental issues is an ongoing challenge that is only beginning to be addressed by both the policy and research communities. From a scientific perspective, regulatory developments provide a critical demand-side push for further relevant investigations. Despite decades of policy action and research, mercury remains on political agendas as an environmental problem; it is unlikely to be solved without attention by both scientists and regulators to these cross-scale interactions and connections. This analysis suggests that the mercury regime is best conceptualized as a science-policy system with multiple driving forces and interactions at multiple scales. Cross-scale policy coordination and adaptation to minimize impacts are two strategies that could successfully create solutions not only for mercury, but also may apply to other environmental issues that cross spatial and temporal scales (N.E.Selin, p.2398).

4.2 Complexity, multiple effects and thresholds

Increasing scientific knowledge has shown that the causal links between stressors and harm are more complex than was previously thought and this has practical consequences for minimising harm. Much of the harm is caused by several co-causal factors acting either independently or together. For example, the reduction of intelligence in children can be linked to lead in petrol, mercury and polychlorinated biphenyls (PCBs) as well as to socio-economic factors; bee colony collapse can be linked to viruses, climate change and nicotinoid pesticides; and climate change itself is caused by many complex and inter-linked chemical and physical processes. (EEA2013b, p.39)

In some cases, such as foetal or fish exposures, it is the timing of the exposure to a stressor that causes the harm, not necessarily the amount; the harm may also be caused or exacerbated by other stressors acting in a particular timed sequence. There are also varying susceptibilities to the same stressors in different people, species and ecosystems, depending on pre-existing stress levels, genetics and epigenetics. This variation can lead to differences in thresholds or tipping point exposures, above which harm becomes apparent in some exposed groups or ecosystems but not others (EEA2013b, p.39).

Our increased knowledge of complex biological and ecological systems has also revealed that certain harmful substances, such as polychlorinated biphenyls (PCBs) and dichlorodiphenyltrichlorethane (DDT) can move around the world via a range of biogeochemical and physical processes and then accumulate in organisms and ecosystems many thousands of kilometres away (EEA2013b, p.39).

The practical implications of these observations are threefold. First, it is very difficult to establish very strong evidence that a single substance or stressor 'causes' harm to justify timely actions to avoid harm; in many cases only reasonable evidence of co-causality will be available. Second, a lack of consistency between research results is not a strong reason for dismissing possible causal links: inconsistency is to be expected from complexity. Third, while reducing harmful exposure to one co-causal factor may not necessarily lead to a large reduction in the overall harm caused by many other factors, in some cases the removal of just one link in the chain of multi-causality could reduce much harm A more holistic and multi-disciplinary systems science is needed to analyse and manage the causal complexity of the systems in which we live (EEA2013b, pp.39-40).

As experiences from mercury, nuclear accidents, leaded petrol, mobile phones, BPA, and bees show, there can be a significant divergence in the evaluations of the same, or very similar, scientific evidence by different risk assessment committees. In such instances, differences in the choice of paradigm, assumptions, criteria for accepting evidence, weights placed on different types of evidence, and how uncertainties were handled, all need to be explained. Risk assessors and decision makers also need to be aware that complexity and uncertainty have sometimes been misused to shift the focus away from precautionary actions by 'manufacturing doubt' and by waiting for 'sound science' approaches that were originally developed by the tobacco industry to delay action (EEA2013b, p.41).

5 Conclusions

As mercury pollution continues to pose environmental and health risks all over the world, it is essential that concerted abatement measures are carried out in connection with the implementation of the Minamata Convention. Action — or inaction — that occurs today will have a long-lasting effect on levels of mercury exposure for generations to come (H.Selin, p.7).

One thing that has become clearer over the past decade is that certain chemical substances are highly stable in nature and can have long-lasting and wide ranging effects before being broken down into a harmless form. The risk of a stable compound is that it can be bio-accumulated in fatty tissues at concentrations many times higher than in the surrounding environment. Predators, such as polar bears, fish and seals, are known to bio-magnify certain chemicals in even higher concentrations with devastating consequences for both humans and ecosystems. So exposure to toxic chemicals and certain foodstuffs are at risk of causing harm, especially to vulnerable groups such as foetuses in the womb or during childhood when the endocrine system is being actively built. Even with small dose exposures, the consequences can in some instances be devastating with problems ranging from cancer, serious impacts on human development, chronic diseases and learning disabilities. Here the power to act could be more properly set by well-informed individuals and communities (EEA2013b, p.7).

The relationship between knowledge and power lies at the heart of many researches. The implicit links between the sources of scientific knowledge about pollutants, changes in the environment and new technologies, and strong vested interests, both economic and paradigmatic, are exposed. Some researchers also explore in greater depth, the short-sightedness of regulatory science and its role in the identification, evaluation and governance of natural resources, physical and chemical hazards. By creating a better understanding of these normally invisible aspects, it is hoped that communities and people become more effective stakeholders and participants in the governance of innovation and economic activities in relation to the associated risks to humans and the planet (EEA2013b, p.7).

Note:

This paper is based on two papers. The one was titled "Prevention and Reduction of Mercury Pollution in Global Context: Why Minamata? Past, Present and Future" and presented at the 13th Annual Conference of the European Society of Criminology, 4-7 September, 2013, Budapest, Hungary. The other was titled "Is the Minamata Convention on Mercury feasible? Can the global mercury agreement lift health threats from lives of millions worldwide?" and presented at the 69th Annual Meeting of the American Society of Criminology, November 20-23, 2013, Atlanta, Georgia, U.S.A

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