

# Mercury trade in Asia

An investigative research on mercury flows in Mongolia, Indonesia, Malaysia, Singapore, the Philippines and Vietnam



## About BAN Toxics

BAN Toxics is an independent non-government environmental organization that works for the advancement of environmental justice, health and sustainable development in the area of chemicals and wastes, with a special focus on women, children and other marginalized sectors.

We work closely with government agencies, communities and civil society at local, national and international levels to reduce and eliminate the use of toxic chemicals and support global sustainable development goals through education campaigns, community grassroots interventions, training and capacity-building, policy research and development, and advocacy programs.

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## Executive summary

Artisanal and small-scale gold mining is one of the most significant sources of mercury emissions in the developing world. This report aims to map out the flow of trade in mercury within Asia, specifically the illicit trade in elemental or metallic mercury to artisanal and small-scale gold mining areas in East and Southeast Asia, particularly in Mongolia, Malaysia, Indonesia, the Philippines, Singapore and Vietnam. The research is part of BAN Toxics' work to help reduce and eliminate mercury emissions in the region, specifically emissions from mercury use in artisanal and small-scale gold mining (ASGM).

Managing and controlling the trade of mercury requires a clear picture of the systems by which it is traded, particularly: 1) determining the origins and amount of the traded mercury, 2) identifying the routes and the means by which mercury enters a country, and 3) exposing how mercury is traded and retailed in each country en-route to its final destination to end users in artisanal and small-scale gold mining.

World trade in elemental mercury continues to flourish. While the production, uses and demand for elemental mercury have decreased significantly and have been banned in specific products, uses and trade in most industrialized regions in the world, the demand for mercury has increased in the world's poorer and newly industrializing countries.

Despite mercury's well-recorded and widely known toxic effects, world supply and demand for mercury has changed little in the past 10 years. In little more than a decade old mercury trading centers in Northern Europe and North America, along with large mercury trading corporations, have shifted to hubs in East Asia and Latin America, nearer newly industrializing countries where artisanal and small-scale gold mining is rampant but largely unregulated.

However, there is a dearth of information on mercury trade, particularly on new mercury markets in Asia. With the adoption of the Minamata Convention on Mercury, countries are now beginning the steady march to control mercury. Increasingly, mercury traders are beginning to conceal their activities and it is becoming harder to gather data on trade.

The ASGM sector is the single largest user of elemental mercury in the world and the largest mercury end-user sector, consuming over 1,600 MT per year or a little over 24% of the world's annual supply of mercury.<sup>1</sup> The ASGM

sector is also the single largest source of man-made mercury emissions or pollution in the world, at a conservative estimate of 37% of total emissions per year.<sup>2</sup>

Asia's demand for mercury is the highest in the world, at 70% of the world's mercury supply.<sup>3</sup> But data on mercury trade in Asia is general, sparse and vague. Significant volumes of mercury traded in Asia are not officially listed, by-pass government customs and monitoring by UN Comtrade, and thus are largely unreported. Nonetheless, field reports from Asia-based environmental NGOs and the UN, however few and nascent, when taken with official mercury trade reports, present a more comprehensive view of the mercury market in Asia, particularly in East and Southeast Asia.

Mercury is currently not a prohibited substance in most Asian countries where it is traded and retailed in the open. At the ports of Singapore and Hong Kong for example, host to some of the world's largest brokers of mercury, the chemical is openly imported and exported, advertised and sold. In Malaysia, Indonesia and Vietnam, large-scale brokers and retailers alike advertise and trade amid lax or little regulations, and even sell mercury in wet markets and on the Internet.

Case studies from Vietnam, Malaysia, Indonesia, Singapore, Mongolia and the Philippines show a pattern of illicit trade as complicated and multi-layered as that of the international trade in mercury. Field research conducted by BAN Toxics detail how mercury, after it enters ports or borders, is brought to and retailed to small-scale mining communities.

Preliminary research on mercury trade in Southeast Asia and East Asia confirm two observations: 1) that unregulated trade and use of mercury has increased in ASGM communities which are among Asia's poorest and most environmentally vulnerable areas; and 2), that the trade and use of mercury in Asia continues because of lax laws, the collusion between mercury traders and government officials, and the general disregard for the environment and the health of the poor who are lured into ASGM and mercury use out of desperation.

Any program that aims to ban the trade in and use of mercury must take a realistic hard-nosed assessment of the needs of the sectors that continue to use mercury, especially those in ASGM, and with these sectors, find practical workable alternatives to mercury, as well as safer more sustainable ways to conduct ASGM.

# I. Introduction

## Aim of the report

This report aims to map out the flow of trade in mercury within Asia, specifically the illicit trade in elemental or metallic mercury to artisanal and small-scale gold mining areas in East and Southeast Asia, particularly in Mongolia, Malaysia, Indonesia, the Philippines, Singapore and Vietnam.

Using investigative research and data from secondary sources, the study illustrates how mercury is imported and smuggled into the region and how it finds its way to artisanal and small-scale gold mining communities.

By building a picture of mercury trade flows in the region and examining these flows alongside corresponding measures and actions being taken by governments, this study examines the challenges to mercury elimination in the region and proposes recommendations to address these obstacles with the aim of helping develop policy changes for the improved management of mercury in the region.

This report is intended for use by governments, international agencies and civil society groups involved in mercury reduction and elimination.

## Background of the research

Mercury is globally recognized as a serious environmental pollutant and health hazard, and its use and trade is now regulated and largely banned by an international treaty, the Minamata Convention on Mercury. However, the element continues to be illicitly used and traded internationally.

In developing countries, the most significant use of mercury is for artisanal and small-scale gold mining, an informal economic activity that remains unregulated and unmonitored by most governments.

Artisanal and small-scale gold mining is one of the most significant sources of mercury emissions in the developing world. The United Nations Industrial Development Organization (UNIDO) estimates that nearly 100% of all mercury used in artisanal and small-scale gold mining ends up in the environment.<sup>4</sup>

This research on the trade in mercury in Asia is part of BAN Toxics' work to help reduce and eliminate mercury emissions in the region, particularly emissions from mercury use in artisanal and small-scale gold mining. This can be achieved through the introduction of mercury-free mining methods, formalization of the artisanal and small-scale mining sector and improved regulation and control of mercury production as well as the importation and trade of elemental mercury and mercury-containing products in Asia.

Managing and controlling the trade of mercury requires a clear picture of the systems by which it is traded, particularly:

1. determining the sources or points of origin of the exported mercury, the amounts of exported mercury and the amounts of imported mercury;
2. identifying the routes or the means and forms by which mercury enters a country, whether by open legal shipments or smuggled and hidden or declared as another product in so-called legal imports; and
3. exposing how mercury is traded, sold and retailed in each country en-route to its final destination to end users in artisanal and small-scale gold mining.

Asian governments have a major role in eliminating mercury use and emissions in their respective countries via laws and their actual implementation. Key, too, is the cooperation among all governments concerned in finding ways to control mercury trade and manage its use.

## II. Overview of the global trade in mercury

World trade in elemental mercury continues to flourish. While the production, uses and demand for elemental mercury have decreased significantly and have been banned in majority of developed industrialized regions of the world, in specific products, uses and trade, the demand for mercury has increased in the world's poorer and newly industrializing countries—particularly in countries with artisanal and small-scale gold mining.

Despite mercury's well-recorded and widely known toxic effects on human, plant and animal life, as well as mercury's potential to bio-accumulate exponentially, world supply and demand for mercury has changed little in the past 10 years. In little more than a decade, prior sources of virgin mercury in Europe and the Middle East have simply been replaced by mercury mines in Asia and South America. Old mercury trading centers in Northern Europe and North America, along with large mercury trading corporations, have shifted to hubs in East Asia and Latin America, nearer newly industrializing countries where artisanal and small-scale gold mining is rampant but largely unregulated.

It should be noted, too, that there is a dearth of information on mercury trade, particularly on new mercury markets in Asia. With the adoption of the Minamata Convention on Mercury, countries are now beginning the steady march to control mercury. Increasingly, mercury traders are beginning to conceal their activities and it is becoming harder to gather data on trade. Nevertheless, available data on the supply and demand of mercury and its trade, as well as field research conducted for this study in selected countries in Asia give a general idea of the system and flow of mercury in the region and serve as important pointers for further research and study.

## Mercury supply and demand in the last decade

Mercury supply and demand has remained unchanged in the last ten years. Mercury supply in 2016 averaged from between 2,900 to 3,600 metric tons (MT), about the same as in 2007 where supplies averaged from between 3,100 MT to 3,900 MT.<sup>5</sup>

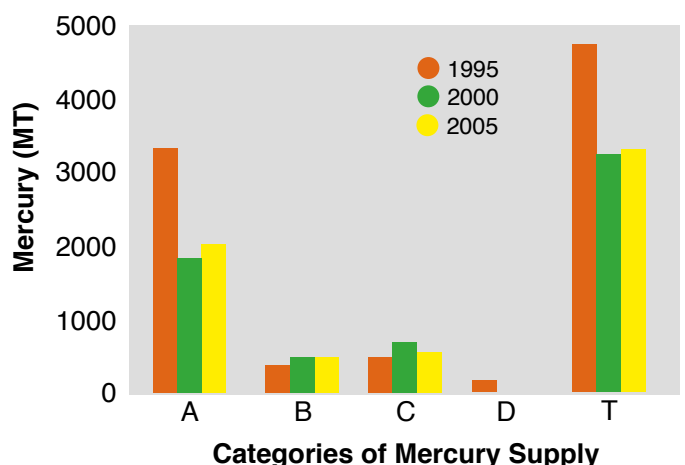
**Table 1: Mercury supply and demand in the last 10 years (in MT)**

	Minimum (MT)	Maximum (MT)
<b>2007</b>	2,900	3,600
<b>2010</b>	3,100	3,900

(Source: UN Comtrade 2016 and Narvaez, Desiree M. 2010 Mercury Storage Project UNEP).

Studies also show that while the global supply for mercury has decreased by almost half since 1995, mercury supplies from mines and by-product mining, as well as from recycled decommissioned chlor-alkali plants have barely changed since the year 2000. By far, mines and by-product mercury production (mercury produced as a by-product of mining and refining other metals or other materials) have remained the biggest sources of mercury since 1995.<sup>6</sup>

**Figure 1: Global mercury supply 1995, 2000 and 2005**



A -Mining and by-product mercury; B - Recycled mercury, C-Mercury recovered from decommissioned chlor-alkali plants; D - Mercury from stockpiles (UNEP 2006).

(Source: Mohapatra and Mitchell, "Mercury Trade in a Globalizing World," Chapter 3. Trade Policy in a Globalizing World 2009 and UNEP 2006.)

## Mercury price in the market

Likewise, the demand for mercury worldwide remained steady in the last decade at almost 4,000 MT, averaging at 3,798 MT in 2005 and at 3,903 MT in 2010.<sup>7</sup>

**Table 2: Mercury demand worldwide. 10-year average in metric tons (MT)**

<b>2005-2015 (average)</b>	4,000
<b>2005</b>	3,798
<b>2010</b>	3,903

(Source: US EPA Mercury Report Dec. 2016)

As researchers note, the trade in mercury is so profitable that, “On an average, some two to three tonnes of elemental mercury appear in international trade statistics for each tonne of mercury consumed during the same year.”<sup>8</sup>

Analysts attribute the continued demand and supply for mercury to new markets in poor and industrializing countries. Over 40% of world mercury goes to artisanal small scale gold mining (ASGM) where mercury is used to extract gold, and about 20% is used as a catalyst in the production of vinyl chloride monomer (VCM), a compound used to manufacture polyvinyl chloride (PVC). And while industrialized countries have generally found and embraced safer substitutes for mercury in many manufacturing processes, developing countries still use mercury in the manufacture of batteries, fluorescent lights, cosmetics, paints and agricultural chemicals.<sup>9</sup>

**Table 3: Highest mercury demand sectors in the world**

<b>ASGM</b>	<b>40%</b>
<b>VCM</b>	<b>20%</b>

(Source: US EPA Mercury Report Dec. 2016)

The price of mercury has increased alongside the increase in the demand for gold. The price of mercury is now the highest it has ever been, at an average of USD 1,850 per 34.47 kg flask (76 lbs) in 2015—13 times higher than the USD 140 price per flask in 2000.

The price of mercury has often followed the price of gold worldwide, and for the most part has always been lower than gold. It was only since 2010 that mercury prices have overtaken gold.

Gold prices in 2000 were about USD 400 per troy ounce (about 1/3 of a kg), and rose in 2015 to little over USD 1,600 per troy ounce, or USD 200 lower than the price of a flask of mercury.<sup>10</sup>

**Table 4: Prices of mercury in 2000 to 2015 versus prices of gold**

	<b>Mercury in USD per 34.47 kg flask</b>	<b>Gold Price in USD per toy ounce</b>
<b>2015</b>	1,850	1,600
<b>2000</b>	140	400

(Source: US EPA Mercury Report Dec. 2016)

From the 1970s to the 1990s, mercury prices dropped sharply. As its toxic effects became known and substitutes were discovered, mercury prices fell as low as USD 4 per kilogram or about USD 137 per flask. Ironically, this drop in the price of mercury and the rise in the price of gold from USD 400 to USD 600 per ounce stimulated a new market for mercury in ASGM countries. By 2004, even as mercury prices began to overtake those of gold, mercury had become an indispensable tool among ASGM communities and newly industrializing countries.<sup>11</sup>

## New centers of mercury trade: the shift from developed to developing countries

As mercury mines closed in the European Union (EU) and the United States of America (USA), new mines opened in East and Southeast Asia as well as in South America. The United States Environmental Protection Agency (US EPA) 2016 Report on Mercury (citing the United Nations Environment Programme [UNEP] 2016 report and sources from Southeast Asia and Mexico), names China, Kyrgyzstan, Mexico and Indonesia as the four remaining countries in the world known to have operational mercury mines.<sup>12</sup> Index Mundi, citing older data from the US Geological Survey, 2013, also names China and Kyrgyzstan as well as Chile, Russia, Peru, Tajikistan and Morocco.<sup>13</sup>

In 2000 mercury mines from Spain, Kyrgyzstan and Algeria<sup>14</sup> were the top mercury producers, supplying over half of the world's mercury demands, with China coming in as fourth. By 2007, only Kyrgyzstan and China were officially listed as sources of mined or virgin mercury. In 2016, UNEP added Mexico and Indonesia as significant world sources of mined mercury.

China remains the world's largest producer of mined mercury, producing about 780 MT of mercury per year or about 20% of the world's annual supply. While most of China's mercury is used internally,<sup>15</sup> from 2006 to 2016 China is known to have exported from about 50 MT to 100 MT to countries with artisanal and small-scale gold mining (ASGM) or to countries known to re-export mercury to ASGM countries, including Togo, Sudan, India, Malaysia, Guyana, Singapore, Vietnam and Bolivia.<sup>16</sup>

Kyrgyzstan's production of mined mercury has declined since 2004 when its biggest customer, China, stopped importing mercury and traditional buyers from Europe and North America stopped imports.<sup>17</sup> Kyrgyzstan once supplied about 10% of the world's mercury supply, its three largest mines producing mercury exclusively for export to industries in China (China bought over 60% of Kyrgyz mercury), Europe and North America. Today, from a peak of from 600 MT to 800 MT in the 1980s and 1990s, mercury production was reported at 300 MT in 2008 and about 70 MT in 2015.<sup>18</sup>

According to the United Nations Comtrade database, mercury exports from Kyrgyzstan averaged 72 MT per year from 2006 to 2015, and peaked at 196 MT in 2008.<sup>19</sup> UN Comtrade has no data on Kyrgyzstan in 2015. After China stopped mercury imports, Kyrgyzstan exported mercury to Brazil, Colombia, India, Hong Kong, Iran, Mexico, Peru, the Russian Federation and South Africa, all of which (except for Hong Kong) are countries where ASGM is present.<sup>20</sup>

Mexico's government estimates mercury production at 38 MT per year, but studies from Mexican Universities reveal the figure to be from around 300 MT to 400 MT per year. Mexico stopped mercury mining in 1994 but researchers found that artisanal and small-scale miners re-opened old mercury mines sometime 2007. By 2011 the Mexican government reported at least three mercury mines were being operated, and in 2016 UNEP researchers found five reopened mercury mines to be in operation, stating that other mercury mines may be operating too.<sup>21</sup>

Mexico's export of mercury rose significantly after 2010, from below 50 MT per year to over 300 MT. Most went to Peru, Colombia, Bolivia, Brazil, Nicaragua, Guyana, Myanmar and Sudan.<sup>22</sup>

Indonesia's government estimates mercury production from local mines at 13 MT per year, although Indonesian NGOs believe it may be higher. In 2015 the Indonesian government admitted that mercury mining is practiced by artisanal and small-scale miners, something environmental NGOs say had been happening long before the announcement.<sup>23</sup>

Indonesia has imported more mercury than it has exported in the last decade. Its mercury exports averaged about 8 MT per year from 2006 to 2014 mostly to Timor-Leste and Malaysia, while its imports averaged about 108 MT per year for the same period. Most of Indonesia's imported mercury comes from Singapore, although 2014 mercury imports were down to 0.7 MT. Most of Indonesia's mercury is used in Indonesian ASGM.<sup>24</sup>



## Other significant sources of mercury

Significant sources of mercury still come from developed countries in Europe, North America and Japan. These include by-product mercury, mercury recovered from chlor-alkali plants, mercury from waste recovery and mercury from other industrial wastes.

### By-product mercury

Mercury recovered as a by-product from the processing of other metal ores and minerals is called by-product mercury. In 2007 around 400 MT to 600 MT of the world's mercury came from by-product processing.<sup>25</sup> Countries that reported significant amounts of mercury from by-product processing in 2014 actually reported relatively small amounts: Russia at 50 MT, Peru 40 MT, Tajikistan 30 MT, Norway 25 MT and USA at 12 MT, while Chile, Argentina and Morocco all reported 10 MT or less.<sup>26</sup> In Asia, Japan is the biggest and only exporter of by-product mercury averaging 100 MT per year since 2009. Japan's mercury has found its way to ASGM countries such as Brazil, Indonesia and Vietnam, as well as to major mercury trade hubs, such as Singapore, which re-export mercury to ASGM countries.<sup>27</sup>

### Mercury from chlor-alkali plants

In the last 10 years, mercury recovered from decommissioned chlor-alkali plants from the EU and USA has been a significant source of mercury worldwide. From 2005 to 2015 mercury recovered from these plants is estimated to average from 700 MT to 900 MT per year.<sup>28</sup> However, as more and more chlor-alkali plants stop using mercury worldwide, mercury production from these plants is expected to be reduced and eventually cease.<sup>29</sup> Also, all signatories to Minamata Convention are expected to stop mercury cell process by 2025.

### Mercury from product waste recovery

Some 600 MT to 800 MT of mercury per year since 2007 came from recycled products containing mercury, fluorescent lights, electronic switches, thermometers, computers and cellphones. Europe and North America are among the world's leading producers of recycled mercury.<sup>30</sup> Both countries have banned the export of elemental mercury since 2015.

### Mercury from industrial wastes, mine tailings, natural gas and mercury stockpiles

There is no clear data on how much mercury is available from industrial waste, mine tailings, natural gas and old stockpiles, and how mercury from these sources is being recovered and sold. However, a random check of known stockpiles around the world shows that tens of thousands of metric tons of mercury remain in stockpiles, most of them in countries in the EU and North America. In Mexico, in one mining area alone, an estimated 7,000 to 14,000 MT of mercury remains in the tailings. In the USA almost 4,500 MT of mercury is estimated to be stored in an army depot in Nevada,<sup>31</sup> in stockpile partly because of the US export ban on mercury.

Spain has one of the largest commercially available mercury stockpiles, estimated to be between 1,000 to 4,000 MT. This stock of mercury, also partially due to an export ban, accumulated over the years from the operation of the now closed Almadén mine. India, which is exporting mercury, also has large stockpiles of mercury, although no data is available on just how large these stockpiles are.<sup>32</sup>

A 2006 paper research paper on surplus mercury and mercury trade, published by the Environment Directorate General of the European Commission, revealed:

It is likely there are other stocks in Europe as well, especially in light of recent price rises and increased speculation by traders. One of the two major European mercury brokers, Lambert Metals, has storage facilities at the ports of Antwerp (Belgium) and Rotterdam (Netherlands) (Fialka, 2006), where it maintains stocks of mercury, and the company has reportedly purchased mercury from the Kyrgyz Republic in recent years. The major Indian mercury broker has also been very actively searching to purchase mercury during the last two years.

Likewise, there appear to be some other stocks of mercury remaining. Despite claims some years ago by mercury brokers that the former Soviet stockpiles had been depleted, as mercury prices reached 40-year highs in 2005, suddenly 500 tonnes of mercury from "former FSU stocks" became available to the market—whether privately owned or government owned was not clear, although the origin was the Kyrgyz Republic, according to one of the Russian dealers....Lambert Metals...has purchased about half of the 500 tonnes in 2006, and hopes to receive the rest later in 2006 or early in 2007. It is not clear how much more than this 500 tonnes may be available.<sup>33</sup>

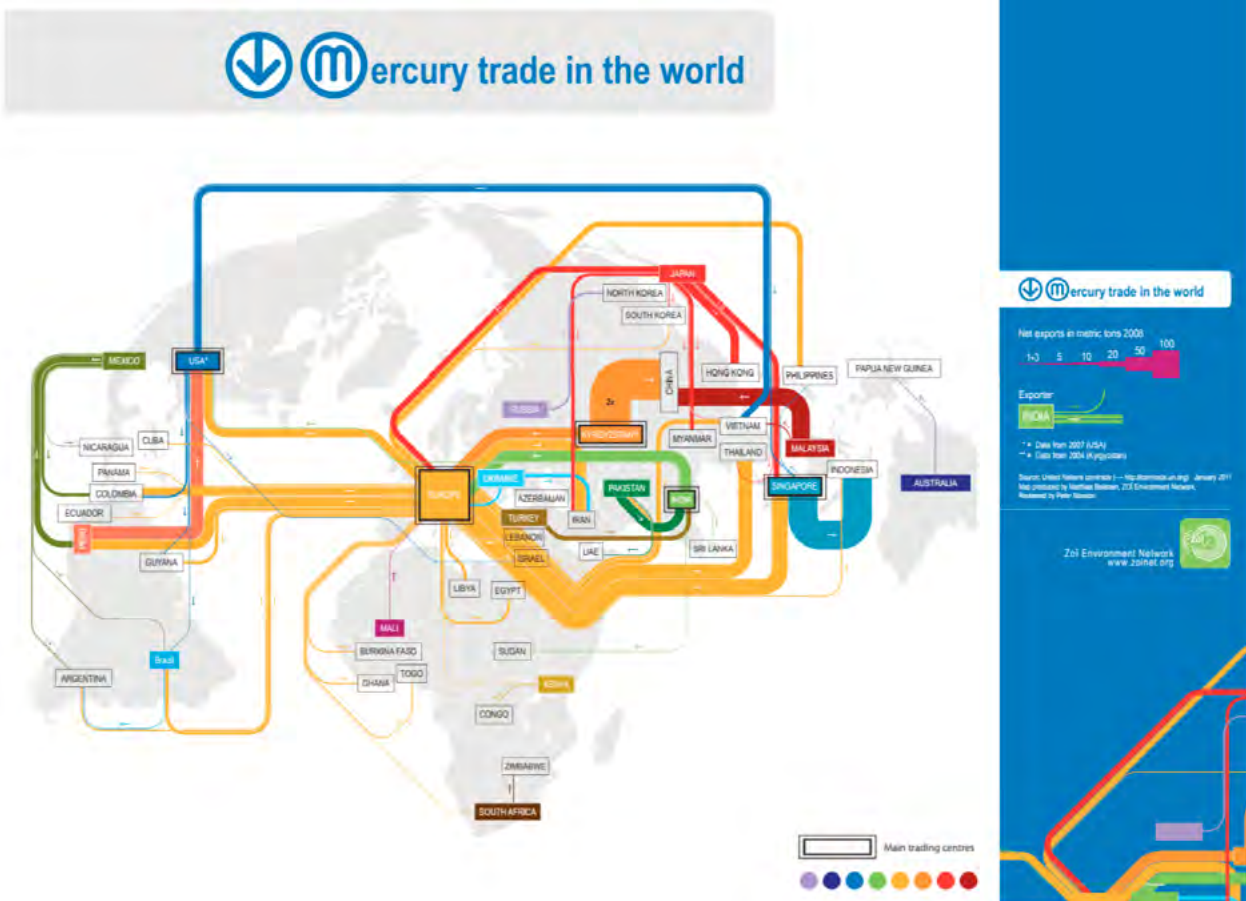
## The new global system of trade in mercury

In less than 10 years, the global market in mercury, once dominated by exporters, importers and end-users from Europe and the USA, has shifted to Asia, South America and Africa.

The heaviest industry users of mercury today, ASGM, VCM and other mercury-dependent manufactures are, for the most part, based in the poorer regions of Asia, South America and Africa. This is not to say that traders previously based in the EU and North America have stopped trading in mercury. Evidence from research on trade data and news reports reveal that big traders from some countries in the EU and the USA are still deeply involved and have only shifted their sites to ASGM and developing countries.<sup>34</sup>

A review of available trade data on mercury also reveals how countries that do not produce or mine mercury, nor use mercury in manufacturing, nevertheless either import or export large volumes of mercury. Trading hubs like Singapore and the Netherlands, and ports like Hong Kong serve as trade centers for large-scale mercury brokers who buy large quantities of mercury, hoard them in storage and resell the mercury to smaller traders or middlemen from end-user countries.<sup>35</sup>

Figure 2: Map of mercury trade routes



(Source: [www.zoi.net](http://www.zoi.net))

In 2006, the world's biggest mercury exporters came from more prosperous countries in the EU and North America, while the top importers were from the EU. By 2012 and 2015, after the mercury export ban in both the US and the EU, Mexico became one of the world's top mercury exporters, joining Singapore, Japan and Hong Kong. It is also important to note that, even as the EU and Canada became signatories to the Minamata Convention in 2013, Canada and a number of EU countries remained on the list of the world's top mercury exporters in 2015.<sup>36</sup>

**Table 5: Top 10 mercury exporters, 2010 and 2015, in MT**

RANK	2012	MT	2015	MT
1	South Africa	951	Mexico	307
2	Singapore	418	Netherlands	172
3	Mexico	262	Singapore	140
4	China	245	Japan	102
5	Argentina	188	Switzerland	202
6	Switzerland	165	India	64
7	Germany	103	China/Hongkong SAR	20
8	Canada	73	Germany	12
9	Japan	69	Canada	9
10	Netherlands	67	Italy	8

(Source: US EPA Mercury Report Dec.2016 quoting UN Comtrade 2016)

Of the top ten mercury exporters for both 2012 and 2015, only South Africa, Mexico and China are known to have mercury mines. The other exporters for both years are either mercury by-product or recycled mercury producers like Japan, Canada and EU countries, or are known major mercury trading hubs like Singapore, the Netherlands and Hong Kong, which buy large amounts of mercury for re-export to poorer ASGM countries.

The USA is not on the 2012 and 2015 list of the world's top exporters. The US officially stopped exporting mercury in 2013. However, it is important to note that between 2006 and 2015 US mercury exports averaged 258 MT per year, peaking in 2009 when the Netherlands (a major mercury trading or brokering center) topped the list of

importers for US mercury. Between 2006 and 2009, top buyers of US mercury were Singapore, India, Spain, Peru, the Netherlands, Guyana, Australia, Canada, Vietnam and Nigeria. US mercury exports declined by 2010 and stopped in 2013.<sup>37</sup>

**Table 6: Top 10 mercury importers, 2012 and 2015, in MT**

RANK	2012	MT	2015	MT
1	Singapore	609	India	154
2	Malaysia	512	Bolivia	136
3	China/Hongkong SAR	348	Singapore	126
4	USA	249	Sudan	79
5	Netherlands	155	China/Hongkong SAR	78
6	India	123	South Africa	52
7	Peru	111	Netherlands	47
8	Sudan	106	Togo	44
9	Colombia	101	Poland	37
10	Guyana	100	Pakistan	35

(Source: US EPA Mercury Report Dec.2016 quoting UN Comtrade 2016)

The list of top mercury importers in 2012 and 2015 again shows the shift in the mercury market to ASGM and developing countries in the past decade. In 2006 EU countries dominated the list of importers, but by 2012, Singapore, Malaysia and China/Hong Kong SAR were listed as the world's top three mercury importers, followed by ASGM countries from Latin America.

By 2015, ASGM countries like India and Bolivia became the world's top mercury importers, with Singapore, a known mercury trading center, third. Interestingly, the Netherlands has consistently been one of the world's top mercury importers for over a decade and was still on UN Comtrade's list in 2012 and 2015.

## Top importers by industry sector

### Vinyl chloride monomer and China

The production of vinyl chloride monomer or VCM is the second largest mercury-using sector in the world. VCM is a chemical used to produce polyvinyl chloride or PVC, a plastic used in construction, medical materials, credit cards and toys. While safer methods of producing VCM have been found, China continues to use mercury-based technology in VCM.<sup>38</sup>

China produces 80 to 90% of the world's VCM and is the only country known to still use mercury to do so. "It was estimated that in 2012, China produced about 10 million metric tons of PVC using 800 metric tons of mercury."<sup>39</sup>

World demand for PVC is increasing. In China alone, the demand for PVC is expected to rise 6.7% per year from 2015 to 2018. Worldwide, PVC production is expected to double from 2010 to 2020. And because mercury-free alternative technologies in VCM production are not yet commercially available in China, China's use of mercury for VCM production is expected to continue.<sup>40</sup>

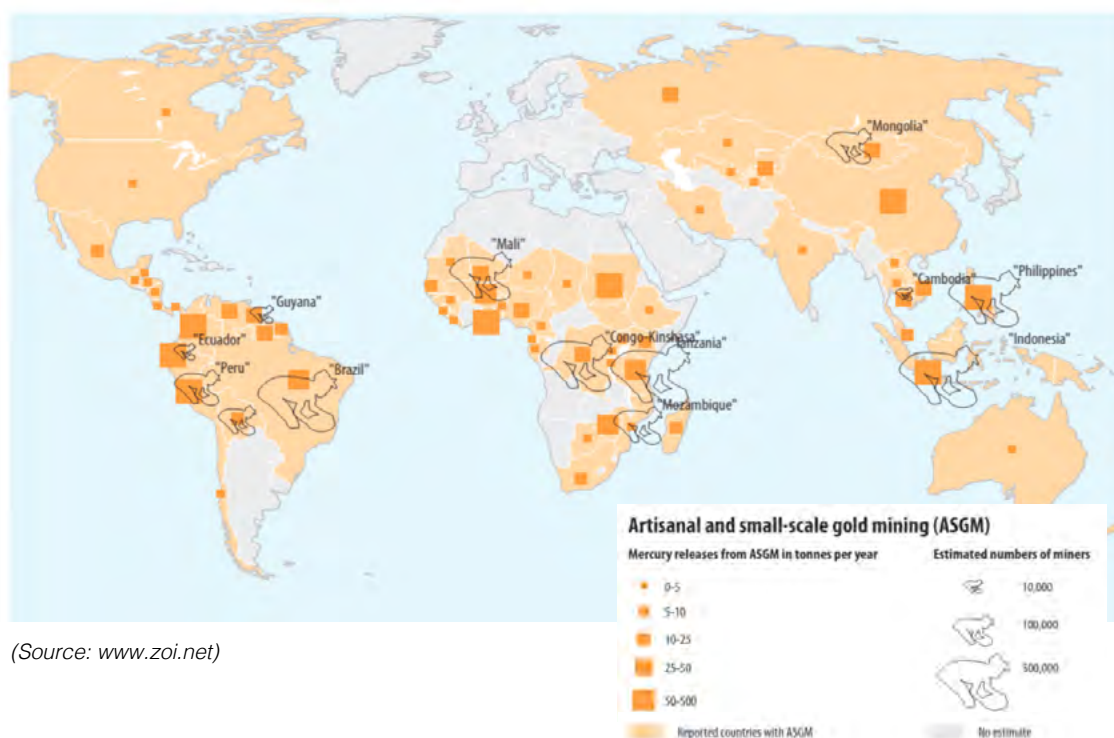
### Artisanal and small-scale gold mining

The ASGM sector is the single largest user of elemental mercury in the world and the largest mercury end-user sector, consuming over 1,600 MT per year or a little over 24% of the world's annual supply of mercury.<sup>41</sup> The ASGM sector is also the single largest source of man-made mercury emissions or pollution in the world at a conservative estimate of 37% of total emissions per year.<sup>42</sup>

ASGM is practiced in over 70 countries, most from Latin America, Asia and Africa. According to the Mercury Watch Database, the top global users of mercury for ASGM include: Indonesia, Colombia, the Philippines, Peru, Ecuador, Brazil, the United Republic of Tanzania, Burkina Faso, Suriname and Zimbabwe. Each of these countries is listed as using 25 or more tons of mercury for ASGM annually. Conservative estimates place Indonesia's ASGM sector to average about 175 MT of mercury per year, Colombia's ASGM sector at 75 MT, the Philippines and Peru, 70 MT each, Ecuador 50 MT, Brazil 45 MT, Tanzania 45 MT, Burkina Faso 35 MT, Suriname 25 MT and Zimbabwe 25 MT.<sup>43</sup>

China banned ASGM in 1996, but independent studies reveal that around 500,000 to over a million Chinese ASGM miners continue to extract about 60 tons of gold per year using mercury, and release about 240 tons of mercury per year into the environment.<sup>44</sup>

Figure 3: Artisanal and small-scale gold mining (ASGM) worldwide

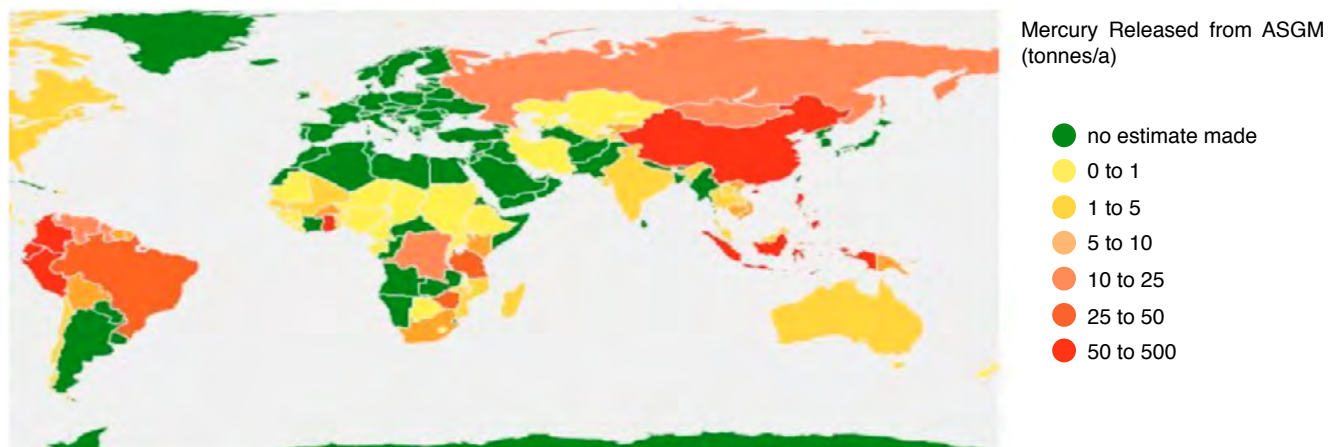


(Source: [www.zoi.net](http://www.zoi.net))

Figure 4: Mercury use and emissions in ASGM

## The Global Context

1600 tons mercury use per year :: Over 70 countries :: 10-20 million miners



(Source: [www.mercurywatch.org](http://www.mercurywatch.org))

## Worldwide mercury trade flows

The US EPA's Mercury Report (December 2016), in trying to make sense of the global system of trade in mercury, described it as a trade system made up of those who supply the mercury, the primary mercury miners and the secondary producers of mercury (by-product and recycled mercury), and those who buy-sell the mercury: large scale buyers, middlemen or dealers and end users.<sup>45</sup>

However, the same US EPA report admitted that while the system of trade in mercury is similar to many other products, the routes and systems by which mercury takes from its sources to end-users makes tracking the world flow of mercury a "complicated web of imports and exports that cross many national borders as it flows from production to use."<sup>46</sup>

Large-scale exporters are not necessarily miners or producers of mercury, large-scale importers are not necessarily end-users. Countries like the Netherlands, Singapore and ports like Hong Kong serve as "trade centers for the international transfer of mercury rather than the receiving country that consumes the mercury... Significant amounts of mercury may be shipped and reshipped several times of the same year,"<sup>47</sup> and because mercury is used, retrieved and recycled in the production and recycling of hundreds of products, it can be reshipped again and again in different forms and products.

Large-scale traders and brokers and their contacts in ports, customs and governments worldwide are key in the trade of mercury, even and especially from ports in countries in the EU where the export, import, sale and exchange of mercury are controlled or banned. Large-scale mercury brokers can often find loopholes in the law or circumvent laws against mercury trade by keeping the mercury on ships and virtually "in transit" and by storing and stockpiling the mercury until it is shipped to other buyers and end-users worldwide.<sup>48</sup>

For instance, while the United States stopped the export of elemental mercury in 2013, in 2014 it exported USD 7,000 worth of dental amalgam containing mercury to the Philippines.<sup>49</sup> Some dental supply stores and even clinics in the Philippines re-sell the mercury amalgam to middlemen who re-sell it to miners, or sell it directly to ASGM miners.<sup>50</sup>

In 2013, 337 MT of what was classified as "sulfide" was exported from the USA to Indonesia. While the shipment was originally classified as elemental mercury, it was later recoded as sulfide and potentially as mercury sulfide. No investigations were conducted even after the incident was reported.<sup>51</sup>

Media reports relate how a German company illegally exported hundreds of metric tons of mercury to Switzerland in the span of several years by covering the mercury with soil and declaring it as mercury-containing waste. Switzerland then re-exported the recovered mercury from the soil overseas.<sup>52</sup>

Thus, while Mexico has become the largest exporter of mined mercury in Latin America and the world, and while new trading centers in Asia, Latin America and Africa have sprung up, a significant amount of the world's supply in mercury can be considered to still flow from the old trading centers of Europe outward to Asia, Africa and Latin America. Despite the ban on mercury trade in the USA and EU, evidence shows that large-scale brokers and mining companies from the EU now facilitate the global trade in mercury in connivance with government officials or by simply smuggling the mercury from port to port.<sup>53</sup>

The shift of worldwide trade in mercury to poor ASGM and developing countries of the world exacerbates mercury pollution and poisoning in many of the world's poorest and most environmentally vulnerable communities in Asia, Latin America and Africa.

East and Southeast Asia are particularly vulnerable to the ravages of mercury pollution as Asia as a whole is now responsible for 50% of global mercury emissions.<sup>54</sup>

China and Indonesia account for the largest mercury emissions in world, China at 200-250 tons per year, and Indonesia at 100-150 tons per year. Brazil, Colombia, Peru, the Philippines, Venezuela and Zimbabwe emit about 10 to 30 tons each per year. All these countries are home to many ASGM communities.<sup>55</sup>

Indonesia and Philippines are two main emitters in Southeast Asia, accounting for 74% of mercury emissions in the region. ASGM is the top mercury polluter followed by coal burning, non-ferrous metal and cement production.<sup>56</sup>

World Health Organization (WHO) papers report that mercury vapors in the air around ASGM mercury amalgam burning sites can be, "alarmingly high and almost always exceed the WHO limit for public exposure of 1.0  $\mu\text{g}/\text{m}^3$ ." Worse, these poisonous emissions also affect communities near, around and downstream of ASGM sites. "The vaporized mercury eventually settles in soil

and the sediment of lakes, rivers, bays and oceans and is transformed by anaerobic organisms into methylmercury. In water bodies, the methylmercury is absorbed by phytoplankton, ingested by zooplankton and fish thereby contaminating the food chain. It especially accumulates in long-lived predatory species including shark and swordfish." Moreover, as mercury use in ASGM countries continues unchecked, it could lead to even higher concentrations of mercury into the environment and increased health burdens from mercury worldwide.<sup>57</sup>

While separate studies of numerous ASGM sites and affected communities have long confirmed the permanent and long term neurological, nerve, kidney, liver and genetic damage caused by mercury poisoning on miners, especially on women, children and the unborn, there is still a need to systematically study the effects of mercury poisoning in and among ASGM communities worldwide. Nonetheless, analysis of available data on mercury poisoning among ASGM communities in several ASGM countries show that between 25% to 33% or about 3.3 to 5.5 million of the 15 million miners in the world suffer from moderate chronic metallic mercury vapor intoxication or CMVVI. From this number alone, it is estimated that affected populations would have lost in total from 94,500 to 1.5 million disability life years or number of years lost due to ill-health, disability or early death—the equivalent of almost USD 9 billion per year.<sup>58</sup>

Other public health studies on mercury pollution predict that unless the use of mercury is stopped, particularly in ASGM and VCM sectors, mercury emissions will increase from a minimum of 25% to a maximum of 50% to 60% between 2005 and 2020, not only increasing the risks on world health and environment, but the costs of ameliorating what could potentially be an irreversible pandemic.<sup>59</sup>

## The Minamata Convention

The Minamata Convention is an international treaty to regulate and eventually stop manmade emissions and releases of mercury in all its forms, in order to protect human health and the environment.

Adopted in 2013, the Convention aims to:

1. Prohibit new mercury mines and phase out existing mercury mines;
2. Control trade and uses of mercury at the global level;
3. Prohibit the production, export and import of a range of mercury-containing products by 2020;
4. Phase out or reduce manufacturing processes using mercury or mercury compounds;
5. Control measures on air emissions and releases to land or water;
6. Create measures for and implement the sound management of mercury and mercury compounds; and
7. Create National Action Plans for addressing mercury use in the artisanal and small-scale gold mining sector or ASGM.

As of February 2017, there were 128 signatories and 38 Parties to the Convention. Entry into force is expected once there are 150 signatories. Of the ten top global users of mercury in ASGM, only Suriname is not a signatory. Indonesia, Colombia, the Philippines, Peru, Ecuador, Brazil, Tanzania, Burkina Faso and Zimbabwe have all signed the convention. In East and Southeast Asia, Cambodia, China, Malaysia, Mongolia, Singapore and Vietnam are also signatories to the convention.<sup>60</sup>

### III. Mercury trade in East and Southeast Asia

Data on mercury trade in Asia is general, sparse and vague. While open sources like UN Comtrade give a broad idea of Asia’s top exporters and importers of mercury and the flow of mercury trade in the region, its data relies only on official trade reports and official customs inventories of mercury. Significant volumes of mercury traded in Asia are not officially listed, by-pass government customs and monitoring by UN Comtrade, and thus are largely unreported. Nonetheless, field reports from Asia-based environmental NGOs and the UN, however few and nascent, when taken with official mercury trade reports, present a more comprehensive view of the mercury market in Asia, particularly in East and Southeast Asia.

#### Demand for mercury highest in Asia

Asia’s demand for mercury is the highest in the world, at 70% of the world’s mercury supply. UNEP estimates (2005) put demand for mercury in Asia from a low of 2,027 MT to a high of 2,722 MT. In contrast, mercury demand in Latin America is at 2,015 MT, and in Central and Eastern Europe 2,011 MT.<sup>61</sup>

**Table 7: World mercury demand per region, 2005 (in MT)**

	Low	High
<b>Asia</b>	2,027	2,722
<b>Latin America</b>	2,015	
<b>Central and East Europe</b>	2,011	

(Source: UNEP 2006)

UNEP estimates show China is the highest user of mercury in Asia, consuming anywhere from 1,425 MT to 1,845 MT per year, followed by other East and Southeast Asian countries at 452 to 608 MT per year, and South Asia from 195 MT to 269 MT.<sup>62</sup>

**Table 8: Top mercury consumers in Asia, 2005, in MT**

	Low	High
<b>China</b>	1,425	1,845
<b>East and Southeast Asia</b>	452	608
<b>South Asia</b>	195	269

(Source: UNEP 2006)

ASGM in Asia uses from 411 MT to 636 MT of mercury, with ASGM from East Asia (excluding China) and South-east Asia using the biggest amounts, from 288 MT to 384 MT. China’s ASGM sector consumes from 120 MT to 240 MT, and South Asia’s from 3 MT to 12 MT. China is the only Asian country to use mercury in VCM, using from 700 to 800 MT of mercury. This means almost all of China’s mercury production goes to VCM.<sup>63</sup>

**Table 9: Volume of mercury used in Asia, 2005 in MT**

	Low	High
<b>Asia (Total)</b>	411	636
<b>East and Southeast Asia</b>	288	384
<b>China</b>	120	240
<b>Southeast Asia</b>	3	12

(Source: UNEP 2006)

#### Top mercury exporters and importers in Asia

Top mercury exporters in Asia since 2012 are Singapore, China Hong Kong/SAR, Japan and India. Other Asian countries known to export mercury are Indonesia, Malaysia and Kyrgyzstan. Top mercury importers since 2012 are Singapore, Malaysia, China/Hong Kong SAR, India and Pakistan.<sup>64</sup>

Singapore does not produce mercury, neither by mining nor by retrieval and recycling. Yet it is considered one of the world’s major mercury trading centers and is home to some of the world’s bigger mercury brokers.<sup>65</sup> Singapore was listed as one of the top three mercury exporters and importers in the world in 2012 and 2015.<sup>66</sup>

Based on research conducted by BAN Toxics, the Singapore government is reluctant to give out trade data on mercury, but UN Comtrade statistics show that Singapore is one of the world’s top mercury exporters. The country exported about 444 MT in 2011, 478 MT in 2012, 293 MT in 2013 and 140 MT in 2015. Over half of Singapore’s mercury exports in 2011 and 2012 went to Indonesia, the rest to other ASGM countries including Guyana, Kenya, Peru and Malaysia.<sup>67</sup>



Singapore is also one of the largest importers of mercury in the world. Singapore imported large amounts of mercury from the USA and EU (before their 2013 export bans took place), and likewise from Russia, Japan and Switzerland. In 2012, Singapore was the world's top mercury importer, buying 609 MT, and was the third largest importer in 2015, importing 126 MT.<sup>68</sup>

While China consumes most of its mined mercury, from 2006 to 2016 it exported around 50 MT to 100 MT to ASGM countries and to major mercury trading centers around the world. Also, China is known to have exported mercury to India, Malaysia, Singapore and Vietnam.<sup>69</sup>

China is one of the world's top mercury importers, though at amounts far less than Singapore, importing 348 MT in 2012, and 78 MT in 2015. Most of the mercury imports are believed to have been used in manufacturing. In December 2013 Philippines Customs officials seized 360 kilograms of mercury worth about PHP 1.8 million (USD 36,000) at the Manila International Container Port. The container van where the mercury was found was from mainland China. No further investigations followed the report.<sup>70</sup>

Hong Kong, like Singapore, is a major mercury trading center in Asia and the world. Mercury exports from Hong Kong averaged 200 MT from 2010 to 2012. Most of its mercury exports went to Singapore and India, followed by ASGM countries Guyana, Kenya and Colombia. Hong Kong is known to import mercury from Japan, Singapore and Kyrgyzstan.

Japan exports the mercury it produces from by-product mercury production and recycling. Before 2013, Japan's mercury exports averaged over 200 MT per year, peaking in 2006 when it exported 250 MT, which went to Iran (81.4 MT), India (34.5 MT), the Netherlands (17.3 MT) and the Philippines (12.9 MT). From 2006 to 2009, most of Japan's mercury went to the Netherlands, Myanmar, India, South Korea, Vietnam, Thailand and Indonesia.<sup>71</sup>

After 2009, Japanese mercury exports averaged around 100 MT per year: 69 MT in 2012, 73 MT in 2013 and 102 MT in 2014. Most exports went to major mercury trading hubs Singapore and Hong Kong, as well as to ASGM countries like India, Brazil, Indonesia and Vietnam.<sup>72</sup>

India exports mercury produced from recycling mercury-laced products, but also imports mercury for both manufacture and ASGM. From 2012 to 2015, India imported an average of 138 MT a year, and exported 64 MT of mercury in 2015.

Indonesia is one of four countries known to have operating mercury mines, although informal and operated by artisanal miners. Indonesia imports more mercury than it exports. Between 2006 and 2014, Indonesia exported about 8 MT of mercury to Timor-Leste and Malaysia and imported an average of over 30 MT per year for the same period, though imports peaked in 2012 at 368 MT. Indonesia imports most of its mercury from Singapore.<sup>73</sup>

Malaysia is not known to mine or to produce large amounts of by-product or recycled mercury for export. But records show Malaysia imports more mercury than it exports, and it is believed most of it is used in ASGM.<sup>74</sup> UN Comtrade data shows Malaysia was the second highest importer of mercury in 2012, at 512 MT, and 55 MT in 2013, although it is not clear what the mercury was used for. Reports mention Malaysia imports mercury from Singapore, China and Indonesia.<sup>75</sup>

Malaysia exported 1 MT of mercury in 2013 and 99 MT in 2014, all to Canada. Nothing is mentioned as to where Malaysia sourced its mercury for export or what Canada used the mercury for.<sup>76</sup> An Internet search for mercury retailers conducted during this research revealed that Malaysian metal companies openly sell mercury online. These companies claim to buy their mercury from India and Singapore.

Kyrgyzstan produces both mined mercury and by-product mercury for export. Mercury exports averaged at 72 MT per year from 2006 to 2015. No data is available for 2015.<sup>77</sup> China used to be Kyrgyzstan's top customer for mercury, but has since stopped imports. Since then, Kyrgyzstan has exported mercury to ASGM countries in Latin American, India, Hong Kong, the Middle East, the Russian Federation and South Africa.<sup>78</sup>

Research studies by the European Commission for the Environment has shown that Kyrgyzstan mercury is still being sold to private metal trading firms from the United Kingdom and the Netherlands. These firms then export the mercury all over the world, including Asia.<sup>79</sup>

## Mercury exporters from North America and the EU

Most of Mexico's mercury goes to other Latin American countries with ASGM, but in 2010 Myanmar was listed as one of its major importers.<sup>80 81</sup>

The USA exported an average of 258 MT of mercury per year, between 2006 and 2015. The biggest Asian buyers of US mercury were Singapore, India and Vietnam. In 2009 the Netherlands bought the largest amount of US mercury. The Netherlands is one of the world's major trading centers for mercury and is known to be home to some of the bigger mercury brokers that ship mercury to Asia.<sup>82</sup>

Spain and Algeria were once the world's top suppliers of mercury in the world. Big metal and mining trading firms from the Netherlands and the UK served as the world's biggest mercury trading centers. In 2000 EU supplied 50% of the mercury demands of East Asia and 90% of South Asia's. Today even while the production of elemental mercury has changed hands, big EU metal and mining companies continue the trade in mercury, not only from ports in their home countries in the Netherlands and the UK, but from East and Southeast Asia and wherever the market for mercury is most active.<sup>83</sup>

As mentioned earlier in the report, companies like Lambert Metals of the UK continue to buy elemental mercury from primary producers and from old stockpiles. They can circumvent the EU mercury ban by keeping mercury stocks in storage facilities at sea ports around the world. Lambert has two known ports within the EU in Belgium and the Netherlands,<sup>84</sup>

## The flow of mercury within the region

Very little is known about how mercury is traded in Asia, much less how the mercury is traded between, among and within the countries of East and Southeast Asia. Nonetheless, the little data that can be had from open sources, along with the information gathered by environmental NGOs, reveal a system of trade as complicated and multi-layered as that of the international trade in mercury. Thus, while the system can be described simply as one that is made up of mercury producers, brokers, middlemen, retailers and end users, the reality on the ground is more complicated.

Mercury is currently not a prohibited substance in most Asian countries where it is traded and retailed in the open. At the ports of Singapore and Hong Kong for example, host to some of the world's largest brokers in mercury, the chemical is openly imported and exported, advertised and sold. In Malaysia, Indonesia and Vietnam, large-scale brokers and retailers alike advertise and trade amid lax or little regulations, and even sell mercury in wet markets and on the Internet.

The same is true for countries like the Philippines and Mongolia where mercury is on the list of controlled and banned chemicals and supposed to be subject to closer monitoring and regulations. Investigative research shows that mercury, for the most part, is allowed to pass through ports and borders with little or no inspection. In these countries, the trade in mercury is an open secret, smuggled in small amounts from neighboring countries to major ports and to remote trading sites, in collusion with a few government officials. It is then re-packed by local traders who in turn transport and resell the mercury to small retailers near or in ASGM communities.

Thus, the trade in mercury in Asia, while more open compared to that in the EU and the US, is also hard to control, and even harder to monitor and track. The UN Comtrade only lists large-scale official imports and exports of mercury to the bigger trading centers like Singapore and Hong Kong, or to major trading ports in Indonesia or Malaysia. After that, nothing more is known as to where the mercury is sold and transported, who uses it and how it is used. Even less is known is the identity of the mercury traders and trading companies in Asia, large or small, multinational or local.

In an effort to better understand how mercury is traded in East and Southeast Asia, BAN Toxics and BaliFokus initiated several research projects and field studies in countries where ASGM is prevalent and mercury is used: Vietnam, Indonesia, Malaysia, Mongolia and the Philippines. The data gathered helps give a clearer picture of the mercury trade in Asia and serve as pointers on questions that need further research.

# Investigation of mercury trade in selected East and Southeast Asian countries

## Vietnam

Vietnam signed the Minamata Convention in 2013. However, Vietnam has not banned the use and trade of mercury. Instead, mercury is listed as a controlled substance subject only to certain conditions for import. And while the government does not allow the use of mercury in ASGM, mercury use is allowed in Vietnam's manufacturing industry for lighting and medical devices, electronic switches and fertilizer. Mercury is also bought and sold openly in public without restrictions.<sup>85</sup>

Mercury importation and trade is legal in Vietnam. Vietnam imports mercury, but it is not a known mercury exporter. Chronological and detailed information on Vietnam's mercury imports are hard to find but separate reports from various sources show that Vietnam has imported substantial amounts of mercury in the last decade.

The US EPA Mercury Report mentions Vietnam as a regular buyer of mercury from Japan, China and the United States after 2009.<sup>86</sup> The Eurostat database lists Vietnam (along with Singapore) as one of the EU's top importers of mercury from 2005 to 2011, importing a total of over 556 MT within that period, or an average of 100 MT per year.<sup>87</sup>

Vietnamese traders have also been buying Chinese mercury for the last ten years, where it is unloaded at either the Cat Lai seaport in Ho Chi Minh City or at the port of Hai Phong in the City of Hanoi. It is not clear if the Chinese mercury is imported legally or if it is smuggled into Vietnam, but most of it enters Vietnam's ports together with other chemicals used in manufacturing. Much of this sort of trade is not openly documented, and the amounts and cost of mercury are not known.<sup>88</sup>

While most of Vietnam's mercury imports are used in the production of fluorescent lights, electronic switches, thermometers, cement and fertilizer, some of the mercury is retailed, either by local dealers or sold by the gram in flea markets. Chemical dealers at the Choi Troi flea market (Nguyen Khoai Street) in the city of Hanoi and at the Kim Bien Market in Ho Chi Minh City are well known retailers of mercury.<sup>89</sup>

Mercury is also sold on the Internet. For example, ten online trading companies claiming to be Vietnamese sell mercury that they say is imported either from Japan or Germany or from China. One company offers 1.5 kg bottles of mercury from Japan at VND 3.5 million each (about USD 155). Another sells mercury from China and Japan by the 34.5 kg flask or by 1.5 kg bottles. Yet another charges USD 42.59 per bottle.<sup>90</sup>

ASGM is legal in Vietnam but use of mercury in ASGM is not. Vietnam's ASGM sector is small compared with that of other SEA countries, and an estimated three to four thousand people are thought to be active in the industry. Almost all ASGM occurs in the remote and mountainous areas of the north, the south and central highlands where some gold deposits are found and large-scale mining also takes place.<sup>91</sup>

While the national government actively campaigns against the use of mercury in ASGM, there is evidence that many miners colluding with some local government officials and businessmen still use mercury in secret. Many simply sift, pan and use mercury to extract the gold in their homes, away from the prying eyes of law enforcers. Surveys have found that mercury levels in soil, water, plants and animals around and downstream of ASGM sites are much higher than the national standard.<sup>92</sup>

In 2016, a team of researchers from BAN Toxics visited artisanal and small-scale mining areas in in Bac Kan Province, Vietnam, around 160 kilometers north of the capital Hanoi. The aim of the research team was to observe the general conditions of the mining area, the extent of mercury use and the method of ore processing.

The sites visited were: 1) the mining area in Ngan Son and 2) Kao Lieu Village in Thoung Quan's Pac Lang Mining site, both in Bac Kan province. The researchers interviewed miners, observed the operations and the community, and visited public markets where mining supplies were sold.

Bac Kan is a mountainous and forested province. Its economy is reliant on mining, forest products, agriculture and tourism. The province has 14 gold mines (six underground mines and eight areas of gold ore placer) operating in the districts of Ngan Son, Na Ri and Ba Be. The gold reserve in Ngan Son is around 22.260 tons and mostly found in Pac Lang of Thuong Quan commune.<sup>93</sup> Gold purity in Ngan Son is said to be 95%-98% and gold coming from the district is known for its high quality.

Ngan Son district is located 222 km north of Hanoi. The mining area is about 300 hundred hectares and employs thousands of mine workers. At its peak in 2006, there were 62 tunnels with at least a hundred mine workers per tunnel. Mining activities are predominantly tunnel or underground mining.

Most of the miners are men. But there are also women and children in the workforce. Women are mainly involved in panning and transporting ore from the tunnel to the processing area. Children, mostly adolescents (around 15-18 years old), were present and were working in the mine site.

Use of mercury is rampant. Mercury is used liberally after grinding and after concentrating the ore, with miners using as much as half a kilogram in one processing. Use of mercury does not usually follow proportions but usually depends on how much gold needs to be recovered. Use is liberal since the mercury is recovered after processing the gold. As observed, large scale mining companies still use mercury to recover gold with improved machinery.

According to miners, the mercury they use comes from China. The substance is hidden in ceramic teapots and smuggled in to the country. Mercury is then retailed and kept in any kind of container, whether glass, plastic or in house wares. The resulting amalgam from mixing mercury with gold is commonly smelted ("cooked") inside the house of the miners using a clay vessel and a gas torch.

Dynamite is also commonly used in the mining area. Aside from poverty, other social problems such as drug abuse (mostly using cocaine), are rampant. As a gold rush area, the mine is a destination of social outcasts including newly paroled prisoners, HIV- and AIDS-infected individuals, as well as the unemployed. Many miners suffer health problems such as damaged skin, skin lesions and intestinal problems. Mining is illegal and the miners take refuge in the intricate network of tunnels to hide from authorities.

Kao Lieu Village is home to 61 households, of which only 10 are migrant households. All the households rely on mining for livelihood. Private companies invest in tunnel operations in the nearby mining area. Four local mining companies used to operate in the area but authorities have ordered these closed in 2015. With the arrival of a new large-scale mining company opened in 2016, villagers have been prohibited from going to the main mining site to harvest ores (rocks). Villagers claim they still get ore secretly but their daily income decreased by half.

The peak season for mining in the village is during the rainy season when sediments from the mountain are washed down the river. The villagers scoop the sediments from the riverbed and sift and sluice the sediments along the banks. Another backyard mining practice is to gather surface soil and pan for gold inside the homes.

Working conditions are harsh for both large-scale and small-scale mining. In tunnels, death from lack of oxygen or from falling rocks is common. Villagers are also exposed to mercury and use mercury liberally, around 100 to 300 grams per processing to capture the gold into the amalgam. However, findings from the research suggest that some villagers have refrained from burning the amalgam when they found out about mercury's toxic effects. Instead, they sell the amalgam to buyers at a lower price than what they would get for gold. According to local calculations, about 0.375 grams of gold<sup>94</sup> can be recovered in one processing, costing around 300,000 VND (USD 13). Gold which is still mixed in the amalgam costs around 250,000 VND (USD 11).

In Ngan Son, the researchers were able to interview three miners: two men and a woman. One of the miners interviewed a miner who was in his thirties. This miner belongs to the Zhao ethnic group and was born and raised in Ngan Son. His family has no other source of livelihood except mining. Like other miners in the area, he knows that small-scale mining is illegal. Their usual practice is to secretly mine or steal ores and process these inside the house.

The researchers were also able to speak with a certain Ms. Tieu Thi Sinh, the mother of the village head. She said that all villagers rely on mining for income and livelihood. Her son is a miner and used to work for a mining company in the area. When the company closed its operation in the village, he followed the company to work in the mine in another province (Cap Bang Province).

Ms Tieu Thi Sinh knows about mercury toxicity and she said that she wears gloves when handling the mercury during amalgamation. She believes that burning the amalgam is very toxic. She stores the mercury in an old plastic bottle in her house's bathing area, which is attached to the kitchen.

The researcher surveyed the periphery of her house and saw equipment for mining work: a sluice, tubs, a grinding machine and a water tank for panning.

Another miner interviewed was Mr. Lam, who is around 50 years old. He says that the mercury they use come from three sources: mercury from France costs around VND 4.5 million (~USD 200) per kg; supply from Japan costs VND 6.5 million (~USD 280); and from China, VND 4 million (~USD 175). The miner said that they usually get their mercury from China since it's much cheaper. He claims that they can guess the origin of the mercury merely by shaking the mercury in a container and observing its movements. He and other miners buy their mercury in the same place they sell gold. Sometimes they ask their neighbors to buy mercury for them.

Mr. Lam says miners sell gold every two to three days in order to provide for their everyday needs. Buyers are able to determine the quality of the gold they sell by comparing it to the buyer's own collection of gold, or from finding out where the gold was mined since they believe that the quality depends on where the ore comes from.

As part of the research, the team visited public markets in Hanoi and Ho Chi Minh Cities. In a public market in Hanoi, at the old quarter, the researchers surveyed 15 stalls, mainly selling household cleaning products and agricultural pesticides. Seven of the 15 stalls indicated knowledge about mercury and around five stalls showed their supply of mercury to the research team. These shops also repacked mercury to sell them in smaller amounts of around two kilograms per container. Two stalls confirmed that they could supply mercury in bulk. According to the stall owner, mercury is stored in another location or warehouse but they can quickly bring it to the shop for the buyer.

In a public market in Ho Chi Minh City (Kim Bien market), researchers surveyed 10 stalls selling household chemicals and agricultural products. Five out of 10 shops visited confirmed that they sell mercury. The stall owners in Ho Chi Minh City seemed more relaxed than the ones in Hanoi and obliged the researchers who posed as customers when they wanted to examine mercury stocks and negotiate the price. However, they did not openly advertise their mercury stocks—the mercury flasks were hidden in empty paint buckets wrapped in black plastic bags.

Under Vietnamese laws, mercury is classified as a controlled chemical, and a chemical of "prohibited use." Vietnamese health officials have also put mercury on the list of "harmful chemicals" subject to strict regulations on importation, monitoring, transport, storage and use. However, policies that are supposed to regulate the trade in, and use of, mercury, are watered down, both by lax law enforcement and by other government laws that allow the large-scale importation and public sale of mercury.

**Table 10: Mercury usage in Vietnam**

Province / City	Gold mine	Mercury use
An Giang	None	
Ba Ria -- Vug Tau	None	
Bac Lieu	None	
Bac Giang	Cung Mountain, Phong Minh commune, Luc Ngan district Na Luong of Yen The district	Yes
Bac Kan	Pac Lang mine, Thuong Quang commune, and Duc Van commune of Ngan Son district	Yes
	Na Lang mine of Luong Thuong commune of Na Ri district	Yes
	Khau Au mine, Binh Van commune of Cho Moi district Khua and Man villages, Bang Thanh commune of Ba Be district	Yes
	An Thang commune of Pac Nam district	No
	Bo Lieu, Bang Lung, Tay Ban Than of Cho Don district	Yes
Bac Ninh	None	
Ben Tre	None	
Binh Duong	None	
Binh Dinh	An Thuong Tay and An Nghia communes of Hoai An district	No
Binh Phuoc	Phu Rieng and Phu Trung communes of Phu Rieng district	No
Binh Thuan	No	
Ca Mau	No	
Cao Bang	Nam Cao and Dinh Phuong communes, Bao Lam district Le Trung commune of Hoa An district Minh Khai and Quang Trong communes of Thach An district Villages of Dong, Na Dong, Duoc Lang, Tai Soong and Chien of Nguyen Binh district	Yes
	Can Tho	None
	Da Nang	Hoa Bac commune of Hoang Vang district
Dak Lak	None	
Dak Nong	Quang Son, Dak Ha, Quang Hoa and Dak R'mang communes of Dak Glong	Yes
Dien Bien	Hang Tro village, Phi Nhu commune of Dien Bien Dong district	Yes
	Muong Lan commune of Dien Bien Dong district	
Dong Nai	Thanh Son commune of Dinh Quan district	No
Don Thap	None	
Gia Lai	Dak Somei commune, Dak Doa district Poto commune of Ia Pa district IaR bol commune of Ayun Pa district Ha Tay commune of Chu Pah district	Yes

Province / City	Gold mine	Mercury use
Ha Giang	Pa Thay mine, Linh Ho commune of Vi Xuyen district Na Vuong, Yen Phong commune of Bac Me district Tien Kieu and Viet Hong communes of Bac Quang district	Yes
Ha Nam	None	
Ha Noi	Ngoc Thanh, Me Linh district	No
Ha Tinh	Huong Dien commune of Vu Quang district Son Tay commune of Huong Son district Ky Son commune of Ky Anh district	Yes
Hai Duong	None	
Hai Phong	None	
Hau Giang	None	
Hoa Binh	Vai Dao- Cao Dam- Doi Bu of Luong Son district Mieu Mon, Trung Son and Kim Son communes of Kim Boi district TraiKhoi, Phu Minh commune of Ky Son district	Yes
Hung Yen	None	
Kien Giang	None	
Kon Tum	Dak Can commune of Ngoc Hoi district Dak Pet commune of Dak Glei	Yes
Khanh Hoa	Ninh Son commune of Ninh Hoa town Van Hung of Van Ninh district	No
Lai Chau	Then Xin, PhongTho	No
Lang Son	Bac Giang and Ky Cung rivers (Binh Gia and Trang Dinh districts)	Yes
Lao Cai	Sin Ho, Nam Cat, Bac Ha district	Yes
Lam Dong	Ta Nang, Duc Trong district	Yes
Long An	None	
Ninh Dinh	None	
Ninh Binh	None	
Ninh Thuan	None	
Nghe An	Cam Muon, Que Phong district Yen Na, Ca river of Tuong Duong district Ta Soi of Quynh Chau district	Yes
Phu Tho	Trung Nghia commune of Thanh Thuy district	No
Phu Yen	Duc BinhTay commune of Song Hinh district Trang Sim, Tuy Hoa city Cung Son town, Son Hoa district	Yes
Quang Binh	Khe Nang, Tuyen Hoa district Ngan Thuy commune and Kim Thuy commune of Le Thuy district	No

Province / City	Gold mine	Mercury use
Quang Nam	Dac Sa and Bai Go of Phuoc Son district Bong Mieu (Tam Lanh commune of Phu Ninh district and Tra Kot commune of Bac Tra My district) Phuoc Kim - Phuoc Thanh (Village 4, Village 1A, Village 1B, Tra Van) Phuoc Hiep Pu Nep, Trung Mang, Phu Son, Hien Bong Mieu, Tam Ky Tra Duong Tien An, Tra Nui, Tra Giang, Tra My Tien Ha – Hiep Duc, Tien Phuoc	Yes
Quang Ninh	None	Yes
Quang Ngai	Tra Thuy commune of Tra Bong district	Yes
Quang Tri	A Dang, A Vao Dak Rong	
Soc Trang	None	
Son La	Mai Son	No
Tay Ninh	None	
Tien Giang	None	
Ho Chi Minh City	None	
Tuyen Quang	Khuon Nua, Binh An, Tho Binh Vai village, Khuon Phuc, Khuon Khuong, Hoa Phu, Pou Minh of Chiem Hoa district. Villages of Can, Tay Na Hien, Dong Na Hien, Phieng Giao and Son Phu of Na Hang district Dao Vien of Yen Son district	Yes
Thai Binh	None	
Thai Nguyen	Khac Kiem, Lang Vang, Vo Nhai district Gold mine in Van Han, Mo Hoan, Trau Cau, Mountain D, Hoa Khue, La Bung – La Chanh, Tien Bo, Hop Tien, Dong Hy district. Quat Mountain of Pho Yen district	Yes
Than Hoa	Lang Bot, Cam Quy Can Tam, Ba Thuoc, Cam Thuy Roc Dong– Bu Bu	No
Thua Thien Hue	A Pey, Nham commune, A Luoi Loc An commune of PhuLoc district Ta Trach Lake, Duong Hoa commune of Huong Thuy town	Yes
Tra Vinh	None	
Vinh Long	None	
Vinh Phuc	Ngoc Thanh commune of Phuc Yen town	No
Yen Bai	An Phu commune of Luc Yen district	No

(Source: Ban Toxics, 2016)



## Field investigation photos

Photo 1: A view of Kao Lieu Village. Most houses are situated on top of the hilly mining area. (BAN Toxics)



Photo 3: A grinding machine with a launder (a trough for water) for soft ore, in Kao Lieu Village. (BAN Toxics)



Photo 2: Mining equipment near the house of one villager in Kao Lieu Village. (BAN Toxics)



Photo 4: Improvised water storage for gold panning, Kao Lieu Village. (BAN Toxics)



Photo 5: Bags of ore at the back of a house in Kao Lieu Village. (BAN Toxics)



Photo 7: Mercury inside a reused plastic bottle. Photo taken from an ASGM area in Ngan Song District, Bac Kan Province. (BAN Toxics)



Photo 6: A woman miner, Ms Tieu Thi Sinh, shows the researchers her stock of mercury which she keeps in a plastic which she stores inside her house. (BAN Toxics)



Photo 8: Kim Bien market in Saigon. This green flask contains 37 kg of mercury. Mercury is sold in bulk in a trading store selling agri-chemical supplies and products, but is not openly displayed nor advertised in the store. As observed, the flask is hidden in a plastic paint container and wrapped again in a black plastic bag. According to the owner, this pure grade elemental mercury comes from China and sells for USD 3,300 (for 37 kilos). This picture was taken from a big warehouse selling agri-industrial chemicals in Kim Bien market in Ho Chi Minh City.



Photo 9: Mercury packed for retail. Three kilograms of mercury is packed in a glass bottle. As observed, the owner does not openly display their mercury stock and one needs to ask discreetly or be identified as a miner before the owner shows the product. The researchers disguised themselves as miners and investors to get the information and photos. (BAN Toxics)



Photo 11: About one to two kilograms of mercury repackaged in a plastic container. This photo was taken from a stall in Kim Bien market in Ho Chi Minh City, which also sells household chemicals and agricultural pesticides and fertilizers.



Photo 10: Photo taken from a mini store located along the national highway of Thoung Quan town, near Kao Lieu Village, Duc Van, around 18 km from the district's mining area. Based on information given by a miner in Ngan Son village, this is where miners buy mercury. According to the store owner, their mercury comes from the US but was acquired from a supplier in Hanoi. The shop sells mercury for about VND 5 million (USD 220) per kilogram. The shop sells other mining equipment and food items. No other shop sells mercury in the area. The owner can sell the mercury for a much lower price (as low as VND 2.3 million per kilo) if a customer purchases larger volumes. (BAN Toxics)



## Indonesia, Malaysia and Singapore

Mercury enters Indonesia and Malaysia in two ways, via legal imports for manufacturing and via the black market for ASGM.

Official imports by Malaysia, Indonesia and Singapore run up to hundreds of metric tons per year as all three countries are some of the region's biggest importers and users of mercury. In the last few years, as the EU and US have banned mercury exports, all three have increased mercury imports from other Asian countries, notably from China and Hong Kong, and have also bought from and sold mercury to each other.

Singapore is Indonesia's largest supplier of mercury. Indonesia exports some of its locally mined mercury to Malaysia. Malaysia also buys mercury from Singapore and China.

Indonesia, Malaysia and Singapore all signed the Minamata Convention but have yet to ban mercury. They instead classify mercury as a hazardous and controlled substance, subject to strict import and export controls, to vigilant monitoring and regulated use.<sup>95</sup>



(Adapted from: Location of Indonesia in ASEAN By ASDFGHJ - Own work, Public Domain, <https://commons.wikimedia.org/w/index.php?curid=7350841>)

Part of the mercury Indonesia and Malaysia import is used in the manufacture of health equipment like thermometers, dental amalgam, laboratory equipment, fluorescent lights, cement and fertilizer. Singapore is also known to allow the use of mercury in its manufacturing industries.

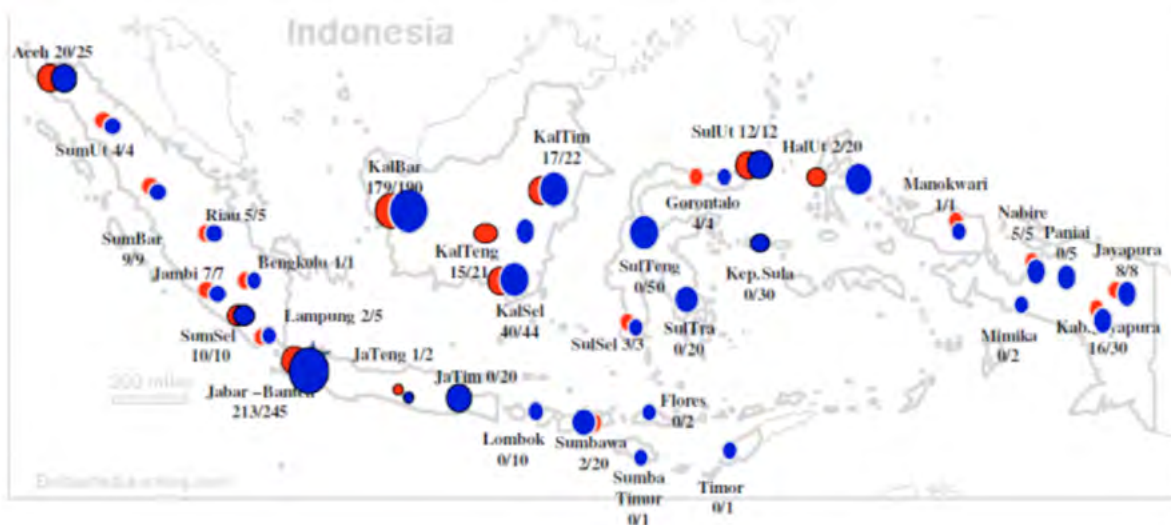
Officially, mercury use by ASGM is not allowed in Indonesia and Malaysia. In reality, mercury use is rampant among ASGM miners in both countries, particularly in Indonesia where mercury poisoning has afflicted almost all one million miners scattered among the 850 ASGM sites all over the country.<sup>96</sup>

It is not clear where the mercury sold to ASGM communities comes from. Some of the mercury may come from Indonesia's ASM mercury mines, although environmental NGO BaliFokus suspects it is smuggled in from Singapore and China, "illegal mercury imports in 2012 were valued at around USD 31 million, traded illegally in as many as 850 locations across the country."<sup>97</sup>

Various data shows large discrepancies in the Indonesian government's official mercury import data. For example, UN figures show that a total of 368 tons of mercury was exported to Indonesia in 2012. A total of 256 tons was from Singapore.<sup>98</sup> However, only two tons were reported in Indonesia's mercury import notification. A government official interviewed said that with numerous ports and borders, "it's easy to smuggle mercury or anything else into the country."<sup>99</sup>

Complicity of law enforcement and the military allows the black market in mercury to prosper. Gatot Sugiharto, founder of the Indonesian People's Mining Association, says miners are forced to give as much as half of their earnings to corrupt police and soldiers who control access to mining areas and demand payment. He alleges that billions of dollars go into the pockets of officials who should be enforcing the law against using mercury.... "The miners lose about 50 percent of their product to pay the extortion," he says. "Sometimes police take it all."<sup>100</sup>

**Figure 6: ASGM sites in Indonesia, which are also mercury hotspots, 2006-2010**



● 2006 - Source: CCOP-GSJ/AIST-GAICASM, Sutrisno, Pusat Sumber Daya Geologi Bandung  
576 hotspots - 50,000 miners - 300,000 population

● 2010 - Source: Yuyun Ismawati, BALIFOKUS, fro various sources  
± 800 hotspots - 250,000 miners - 1,000,000 population

(Source: Ismawati, 2011)

In order to gain a first hand look at customs and border controls and protocols, a BAN Toxics researcher traveled to border towns in Sarawak in Malaysia and West Kalimantan in Indonesia. Sintang Regency in West Kalimantan is a major artisanal and small-scale mining area in Indonesia. West Kalimantan is the only Indonesian province that has border access (via roads) to another country (Malaysia), making the area conducive to trade, legal and illegal.

Field research in Malaysia and Indonesia affirm just how easy it is to smuggle mercury across borders and openly sell mercury at ASGM sites. Checkpoints at the crossing between Singapore and Malaysia are lax, even during a security alert due to the threat of an ISIS attack. According to BAN Toxics researchers, “[The] customs office took five minutes to check the boot of the car [and] did the same with other cars.” Government departments in charge of checking toxic materials like the National Pollution Control Department “had counters [which] were closed on the day, during office hours...signage boards to inform the public on restricted and controlled or prohibited items were general, no mention of chemicals or mercury-related products.”<sup>101</sup>

At Sintang, West Kalimantan, a well-known ASGM site in Indonesia, BAN Toxics saw evidence of how ASGM is being practiced in the open, along rivers and near the homes of fishermen who use the river water for household use.

Jewelry stores and goldsmiths in Sintang and Sungai Kapuas (districts in West Kalimantan) sell bowls where mercury is used to extract gold. One goldsmith shop even had a signboard saying it had mercury for sale. Goldsmiths were reluctant to show mercury to the researcher.

People in Sintang say the mercury used in ASGM is bought from Sarawak in Malaysia for around IDR 400,000 to 600,000 (USD 30 to 45). The mercury is transported from Sarawak, which borders West Kalimantan in Indonesia, via Entikong road,<sup>102</sup> one of the shared open roads between the two countries, then crosses the border via Badau in the District of Kapuas which borders Sarawak, all the way to Sintang. The trip takes about six to eight hours with lax or little border checks

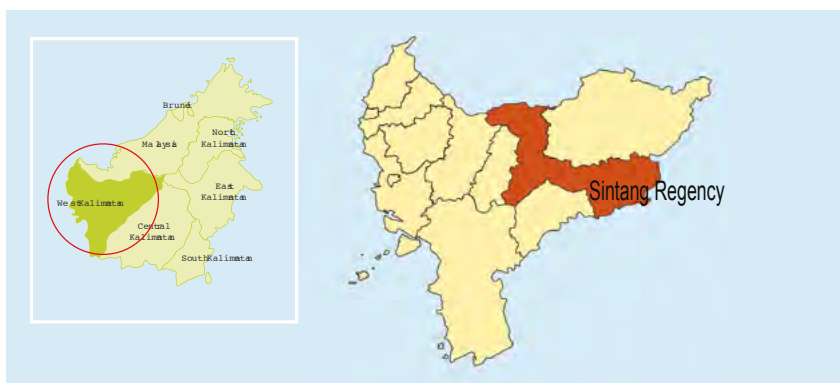
Evidence of ASGM can also be found in the Ketungau and Melawi basins, as well as the hills surrounding the city of Sinkawang near West Kalimantan’s provincial capital of Pontianak. In the city of Ketungau an ounce of mercury in a plastic bag can be bought for IDR 200,000 (USD 15) from a local goldsmith who operates in a boat along the Kapuas River.<sup>103</sup>

Mercury is also traded online by brokers from Singapore and Malaysia who import mercury from Japan, the EU and China and sell it to Indonesian and Malaysian middlemen, who then retail the mercury to individual buyers. BAN Toxics suspects that some buyers of mercury are financiers of ASGM.

A survey of 25 online mercury traders from Malaysia proved just how easy it is for almost anyone to buy and sell mercury online. The trading companies sell 34.5 kg mercury flasks from USD 40 to 400 per flask, and even send pictures of their products and guarantees of the purity of their products, including certificates of analysis. One company claims the mercury is imported from Spain and Malaysia. Most claim to be importers of various chemicals or assorted goods—from foodstuffs to office supplies to chemicals and metals including mercury. All companies give out addresses and contact numbers, although based on the experience of the researchers, they are easier to contact via email.<sup>104</sup>

**Figure 7: Map of Kalimantan Island (Borneo), showing the provinces of Indonesia and the border with Malaysia showing Sintang in West Kalimantan.**

(Sources: Map of Kalimantan by Kawaputra fixed by P. Lebrun - Own work, Public Domain, <https://commons.wikimedia.org/w/index.php?curid=4236846> and Sintang Regency in West Kalimantan [Sintang.svg] by Hugo.arg, licensed under CC BY-SA 3.0



## Field investigation photos

Photos 12 and 13: Pictures of an active mining site in Sintang Regency, West Kalimantan. (BAN Toxics)



Photo 13 (BAN Toxics)



Photos 14 and 15: Inactive mining site in Sintang, West Kalimantan. (BAN Toxics)



Photo 15 (BAN Toxics)



Photos 16, 17 and 18: Pictures of goldsmith shops that sell mercury and other ASGM equipment and chemicals in West Kalimantan. (BAN Toxics)



Photo 17 (BAN Toxics)

Photos 19, 20 and 21: Pictures of floating houses and boats which sell mercury in Ketungau. (BAN Toxics)



Photo 20 (BAN Toxics)



Photo 18 (BAN Toxics)



Photo 21 (BAN Toxics)





## Mongolia

Mongolia is barely mentioned in official trade lists of mercury exporters and importers. Mongolia does not produce mercury and imports only about 10 tons a year, a small amount compared to other Asian countries. However, its problems with ASGM and mercury pollution, as well as government efforts to address these issues (including finding ways to stop the border trade in mercury with Russia and China), have made Mongolia a testing ground for sustainable artisanal mining.<sup>105</sup>

The Mongolian government banned the importation and use of mercury in 2007 after surveys found mercury pollution from ASGM had already affected large tracts of land in 120 ASGM sites in 10 out of the country's 21 provinces. Especially worrying was how mercury and cyanide in about 200,000 tons of ASGM mine tailings was seeping into ground water, contaminating dozens of wells and streams which the majority of the rural population depended on for drinking, household, pasture and agricultural use.<sup>106</sup>

In 2008, the government closed down 145 mercury amalgamation mills and estimated that 10 tons of mercury was smuggled into the country annually. The mercury ban affected the livelihood of about 25,000 primary gold miners. Some miners resorted to extracting gold using mercury amalgamation inside their homes.<sup>107</sup>

However, despite the mercury ban, the open borders and policy of free trade between Russia and China facilitate the continued smuggling of mercury into Mongolia, as well as its continued use (in secret) by ASGM miners.

ASGM was unknown in Mongolia until the 1990s after the collapse of the Soviet Union, Mongolia's major export partner. Consecutive years of drought from 1997 to 2002 destroyed much of the country's export crops and decimated livestock. Tens of thousands of people lost their jobs. "In ten years, from the 1990s to 2003, artisanal small scale mining rose from zero to 100,000," involving 20% of the rural population and 3.5% of the total population."<sup>108</sup>

Illegal in the 1990s, the government formalized ASGM in 2010 in an effort to promote sustainable mercury- and cyanide-free artisanal mining. Still, today, only 7,000 out of the 100,000 ASGM miners and their families have joined the program.<sup>109</sup> Destructive ASGM continues, along with the use of mercury.

The mercury sold to ASGM miners in Mongolia often comes in vials small enough to fit in a pocket. Many of these ambulant mercury traders travel in SUVs, moving from one ASGM site to another, selling mercury and buying gold. The gold is said to be sold at markets like Naran Tuul in Ulaanbaatar, or smuggled across the borders to China or Russia. A few years ago, miners willingly sold their gold to Mongolia's Central Bank, but these days most of the gold is sold to Chinese traders who are willing to pay more.<sup>110</sup>

From May to June 2016, BAN Toxics traveled to three provinces with known ASGM sites, near the national capital of Ulaanbaatar and the border with Russia, namely the provinces Selenge, Dharkan and Tov. From interviews with community leaders and miners at ASGM sites, as well as with mercury traders, researchers were able to piece together a picture of how mercury trade persists despite the government ban on its importation and use.

In all of the three provinces visited, researchers encountered families and teams of ASGM miners at work digging or panning for gold, as well as evidence that most of the miners continue to use mercury. At Barung Kharaa and Selenge Aimag, the research team visited two mining sites in Bortolgoisoum. According to their field journal, they saw a number of active tunnel operations along the way. However, no miners were around. They went around the mining campsite and went inside a shack and found various mining equipment inside. "We found tracks of recent mining activities and this confirmed views that mining is still very much active in the area."<sup>111</sup>

At the Sharyn Gol mining site, the team confirmed that mining activities revolve around a big pond in a big open area. So-called "ninja miners"<sup>112</sup> operate in groups of two to ten. During the research survey, there were about 50 groups converging in various locations in the area—shoveling and sluicing surface soil into their mobile sluice with a submersible pump. Each group had their own set of mining equipment and a mini van, or a small four-wheel drive vehicle.

Tradesmen buy mercury purchased at the Russian or Chinese borders and usually hide the contraband among food items, clothing and other goods. Once they leave the border, the mercury can be sold in two ways. One, the supplier sells the mercury indirectly to interested but vetted buyers, via a trusted hawker at markets like Ulaanbaatar's famous Naran Tuul market (also known as the Black Market or Khar Zakh). Another way is to sell the mercury directly to ASGM miners at ASGM sites, where ambulant vendors peddle goods door to door. Mercury suppliers are often also gold buyers, waiting at the mining sites while the miners extract the gold using the mercury they provided.<sup>113</sup>

At the Naran Tuul Market, the biggest and busiest market in Ulaanbaatar, the team—under the pretense of being gold mining investors—went around the market area and visited a number of gold buying stalls, including blacksmiths. They observed that, “All the five stalls we visited knew about mercury and very discreetly gave us a number to contact if we were interested in buying mercury. We called the number and talked to a guy who refused to divulge any information about mercury trading unless the buyer talks to him in person. The gold buyers and blacksmiths said that they do not sell mercury but discreetly give numbers to call for people to make further inquiries.”<sup>114</sup>

At Sharyn Gol, a mining town about three hours away from Ulaanbaatar, researchers came across two women who sold mercury from their truck. They said, “We noticed a fancy looking yellow Hummer on standby with two young women sitting in front. We found out that these young women are gold buyers. Disguising ourselves as local reporters, we found out that they know someone who can supply miners with mercury. They said that they can help us get it if we pay the money in advance. After series of negotiations and small deposit, they agreed to send a picture of the mercury vial. We got the photo and we did not show up the next day to get our vial of mercury.”<sup>115 116</sup>

## Field investigation photos

Photos 22-25: ASGM campsite in Bor Tolgoi.  
(BAN Toxics)



Photo 23 (BAN Toxics)



Photo 24 (BAN Toxics)



Photos 25 (BAN Toxics)



Photo 26: Mine tunnel near the Bor Tolgoi mine camp.  
(BAN Toxics)



Photo 27: Mining equipment near the Bor Tolgoi mine camp.  
(BAN Toxics)



Photo 28: An ore crushing machine at the Bor Tolgoi mine camp. (BAN Toxics)



Photo 31: Surface mining in Sharyn Gol. (BAN Toxics)



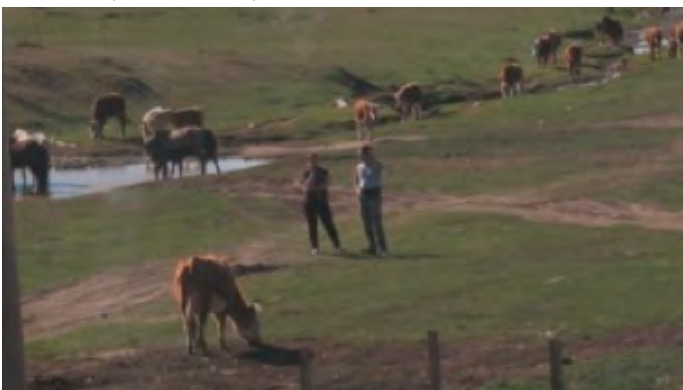
Photo 29: A sluice at the Bortolgoi mine site.(BAN Toxics)



Photo 32: A family slucing and panning in Sharyn Gol. (BAN Toxics)



Photo 30: Animals grazing near a stream where tailings from the Bor Tolgoi mine camp are dumped. Communities in this part of Mongolia are traditional horse and cattle herders. (BAN Toxics)



Photos 33 and 34: Gold buyers, who are frequently also mercury dealers, travel from camp to camp in the mining areas in Sharyn Gol. In the first photo, the gold buyer/mercury peddler is in the yellow 4x4 vehicle (Hummer). The second photo shows the vial of mercury obtained from the gold buyer. (BAN Toxics)

Photos 35 and 36: Large scale mining concessions in Zamaar, Töv province. (BAN Toxics)



Photo 34 (BAN Toxics)



Photo 36 (BAN Toxics)



Photos 37-38: Zamaar “ninja miners” operate in the peripheries of large mining concessions; new “ninja miners” trail alongside more experienced ones for quick tips and lessons about mining and finding free gold (gold not attached to rock). (BAN Toxics)



Photo 38 (BAN Toxics)



Photos 39-40: A “ninja miner” uses a gold detector at the Zamaar mine site. In the second photo, the miner displays the free gold he obtained. (BAN Toxics)



Photo 40 (BAN Toxics)



## The Philippines

The Philippines once produced an annual average of 127 MT of primary mercury from a mine in the province of Palawan. After the mine closed in 1976, all of the Philippines' mercury needs were provided by imports. Before 2011, almost all of the mercury came from the EU, particularly Spain and Germany. Some amount was imported from the US. Significant mercury imports also came from China/Hong Kong SAR, Russia, the Netherlands, Japan and Switzerland. In 2011, the whole year's official mercury supply came from China/Hong Kong SAR. In 2012 all the official mercury imports were sourced from the US.<sup>117</sup>

Philippine imports of mercury for the most part have been small and have followed the worldwide price of gold. From an average of less than 30 MT from 2000 to 2005, imports jumped to highs of 39.9 MT in 2006 and peaked at 53.52 MT in 2009 as gold prices doubled worldwide. (Gold prices rose from USD 500 in 2005 to over USD 1,000 per troy ounce in 2009). Mercury imports fell once more to 33 MT in 2010, down to an average of 6 MT in 2011 and 2012 as gold prices stabilized at USD 1,500 per troy ounce. Around this time, big mining corporations stopped using mercury in anticipation of the EU and US ban on mercury exports.<sup>118</sup>

The only major industries in the Philippines known to use significant amounts of elemental mercury in their production processes are mining (particularly ASGM) and chlor-alkali production. Dental amalgam,<sup>119</sup> while counted as another significant source of mercury emissions in the country, is imported.<sup>120</sup>

No data is available on how much mercury is consumed by each industry sector. However, estimates on mercury emissions by sector reported by the Philippines Department of Environment and Natural Resources (DENR) show that the mining and ASGM sectors account for the highest volume at about 130 tons/year or 34% of the national total of 378.89 tons per year. "Specifically, the primary contributors to mercury and mercury-containing wastes in the country are from unintentional releases in artisanal gold and silver mining, with 113.49 tons per year," or 29.9% of the national total.<sup>121</sup>

Emissions from mercury-using industries, including chlor-alkali production<sup>122</sup> follow at 106 tons per year or 24% of total emissions.<sup>123</sup>

The Philippine government lists mercury as a controlled commodity and a hazardous chemical, subject to strict regulations and monitoring. At the same time however, the government allows its importation and continued use by granting exemptions to certain industries and sectors. These exceptions have had the effect of countervailing the very restrictions designed to prevent mercury's unregulated trade and use. The exemption of dental amalgam, in particular, has allowed illegal traders—abetted by some dental supply stores and clinics—to sell mercury to ASGM suppliers or directly to miners.<sup>124</sup>

Several attempts have been made to regulate and control the illegal entry and trade in mercury for ASGM use at the national level but none has been able to stop mercury from being transported and sold at ASGM sites throughout the country. Negligence and apparent complicity of some customs and local government officials, and obvious ignorance of and even disinterest by other government officials on how the mercury trade is conducted and who are involved, allow the trade to continue.

In 2006 for example, a survey on mercury use by small-scale miners in a notorious and polluting mining site at Mount Diwata, Monkayo, Compostela Valley in Southern Mindanao, showed that, despite the growing health and pollution problems from the use of mercury in the area, five mercury dealers were given permits by the local government to sell a whopping 366 MT of elemental mercury to small-scale miners in the area.<sup>125</sup>

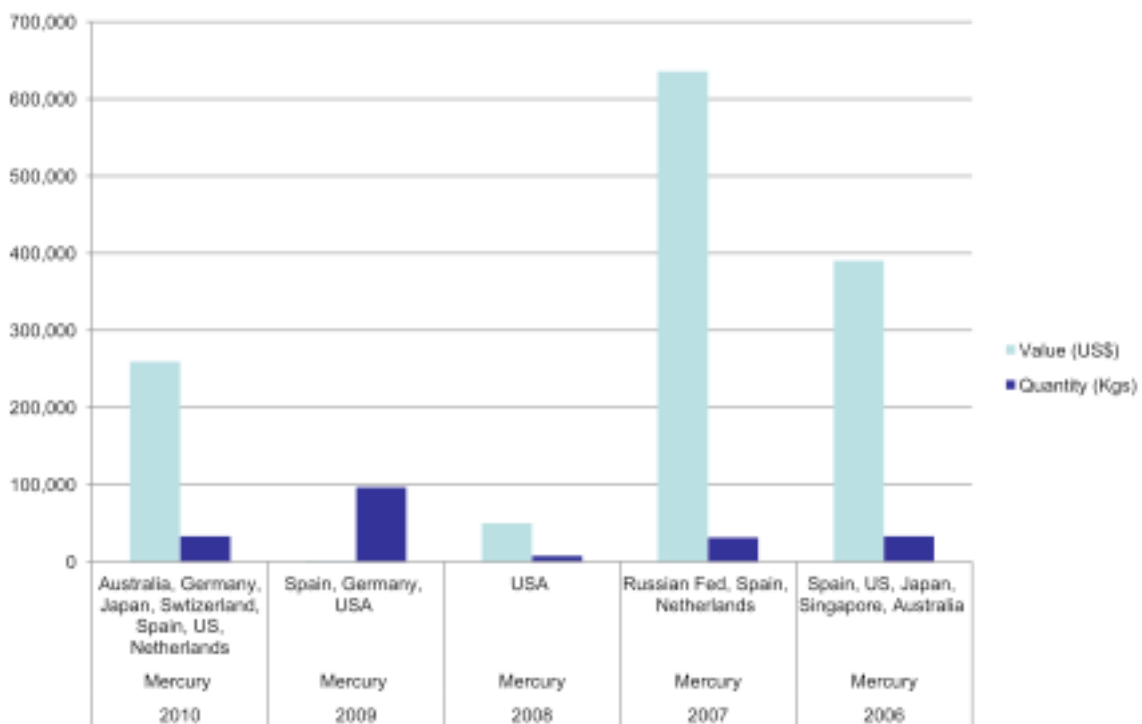
The trade in mercury for ASGM use may be a part of the uglier side of the Philippines underground economy. Interviews by BAN Toxics with miners, suppliers, middlemen and environmentalists expose a network of smugglers, suppliers, middlemen, local government officials, neighborhood stores and dental supply stores and clinics, who all collude to bring in, transport and retail the mercury to ASGM sites around the country.<sup>126</sup>

**Figure 8: Reported sources of mercury supply that enter the Philippines**



(Source: BAN Toxics)

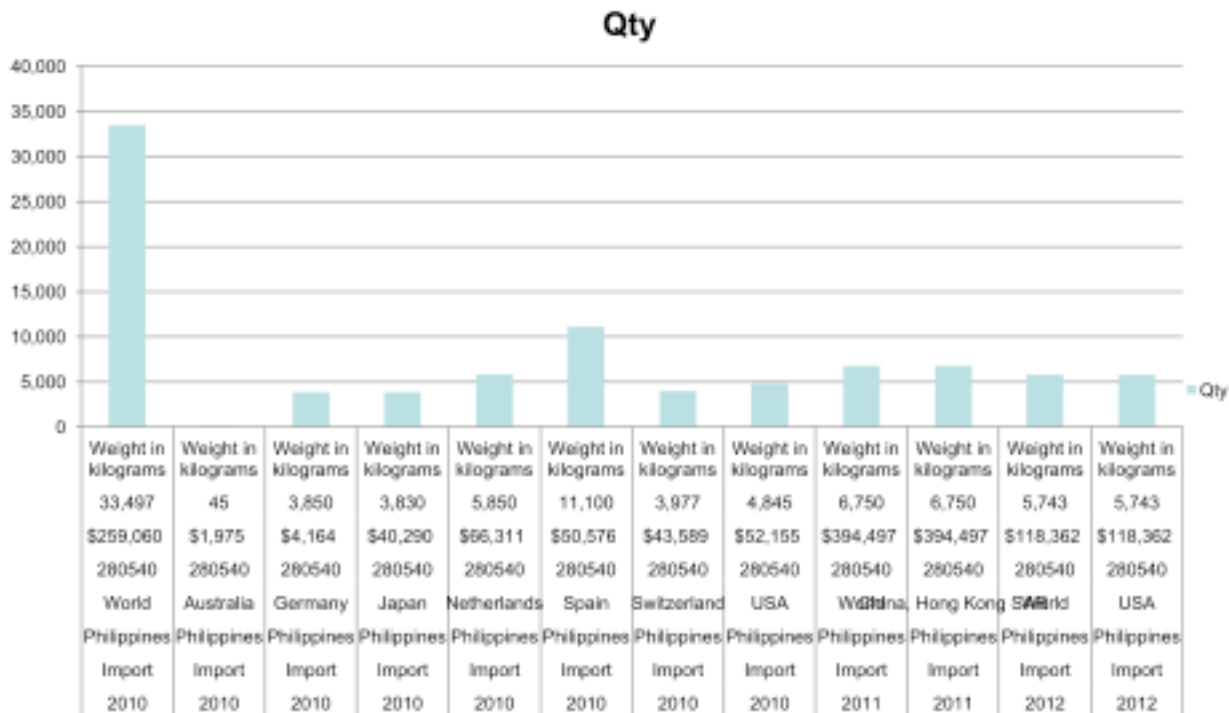
**Figure 9: Amount of mercury imported into the Philippines, 2006 to 2010**



(Source: BAN Toxics)

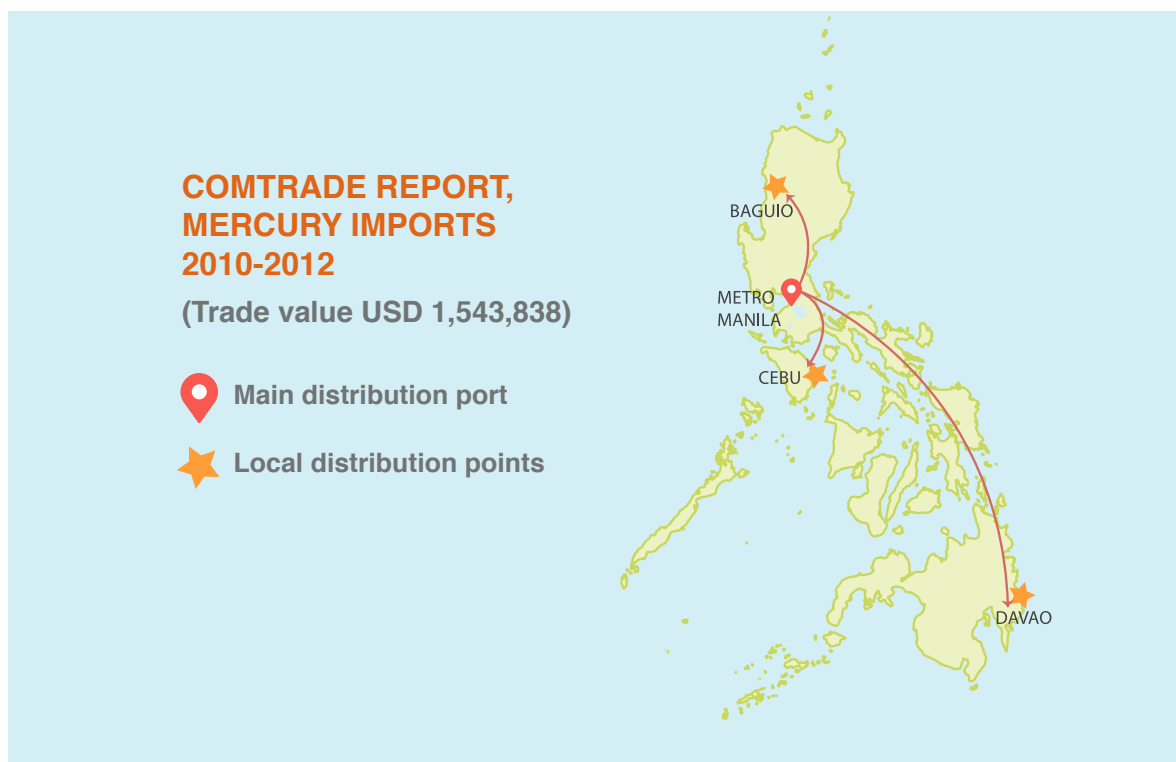


Figure 10: Mercury imports to the Philippines from 2010 to 2012



(Source: BAN Toxics)

Figure 11: Flow of mercury from Manila to distribution points in other provinces.



(Source: BAN Toxics)

Mercury is shipped illegally to the Philippines from other countries through usual methods of transport for illicit goods: via mis-declaration, smuggling, or hidden in welded compartments inside the hold of a cargo ship, or thrown overboard to be fetched by fishermen hired to collect the illicit goods.

According to a source from the retired Bureau of Customs Police, mis-declaration of cargo is the most common technique employed by mercury traders and importers. In Mindanao, a local informant revealed that speedboats from Sarangani Bay and Tawi-Tawi smuggle mercury, drugs, guns, ammunition and other illegal cargo from Malaysia and Indonesia to the Philippines. Another local informant from Davao City disclosed that sometimes, illegal goods, including mercury flasks, are hidden in soldered compartments underneath cargo ships from other countries. When the ship docks at the port of Davao, the compartment is opened and the mercury flask is delivered to local buyers.

The practice of throwing illicit shipments overboard to be picked up by smaller boats is called the “bomb method” because of the bomb-like sound made when the goods hit the water. An interview with a source from the Philippine Ports Authority revealed that this is common practice for illegal shipments. According to local informant in the port of Navotas in Metro Manila, fishermen are contracted to pick up the cargo from the sea using their small boats to bring the goods to the shores of Navotas.

Based on interviews with importers and traders, mercury supply for ASGM enters the Philippines in two ways: 1) through main seaports such as Manila Harbor in the nation’s capital, hidden and undeclared in container vans filled with other legitimately imported items; and 2) smuggled in from neighboring countries by small boats and outriggers and unloaded at any one of the country’s smaller ports. This second route often takes place in Mindanao, the island closest to Malaysia and Indonesia, where smuggling of all sorts of goods between the island of Sabah and Mindanao’s three major fish ports in Zamboanga, South Cotabato and Sarangani are the norm.

As soon as it leaves the ports, the mercury is transported and traded like any other product. From the ports, it is delivered by land to suppliers in the country’s major cities.

The mercury from the port of Manila often goes to two traders in Manila who supply the mercury demands of the island of Luzon. These traders sell the mercury only to trusted middlemen who in turn bring the mercury to retailers near or based in ASGM sites.

In Metro Manila, mercury is sold in bulk by chemical companies, dental supply importers and dental supply stores which were issued permits to import and sell mercury. A BAN Toxics researcher posing as a customer tried to purchase mercury from a company but was told that a permit from the DENR’s Environmental Management Bureau (DENR-EMB) is required before they can sell mercury to any customer. However, upon verification with a DENR-EMB official, the researcher was told that the EMB does not issue permits since the importation of mercury was banned.

To find out which chemical companies still trade mercury, BAN Toxics researchers obtained a list of mercury importers issued permits by the DENR-EMB in 2007. The researchers visited the websites of these companies and discovered they were still importing and selling mercury. Merck, Inc., Phils. imports mercury manufactured and exported by Mercury ICP Standard, a German company. Sytengco Phils. Corp. (or SBS Phils.) imports mercury from Malaysia manufactured by Gremont Agrochem. The company has a warehouse located in San Francisco Del Monte, Quezon City.<sup>127</sup>

Mercury is also traded in Bulacan province through jewelry makers and gold buyers, and is also sold in pawnshops and mining supply stores. The mercury is placed in small plastic bottles and displayed together with other goods, but the flask is stored away from the store and only sold to known buyers.<sup>128</sup>

In Northern Luzon, the center of mercury trade is Baguio City. Mercury is sold in mining supply stores and hardware stores, and by gold buyers in the public market. Based on an interview with a mercury seller in Baguio City, they usually get their mercury supply from Davao City whenever the supplier from Bulacan and Metro Manila cannot deliver their order.<sup>129</sup>

In the Visayas, two Cebu City-based mercury traders are said to supply ASGM sites in the provinces of Masbate and Negros Occidental. One of them also supplies to retailers in Davao City. Both traders supply mercury to other traders in the city of Bacolod in Negros Occidental.<sup>130</sup>

In Mindanao, BAN toxics researchers uncovered that Tagum City in Davao Del Norte is the biggest mercury trade hub in southern Philippines. According to local informants, gold buyers and mercury resellers from ASGM communities in Davao Del Norte, Compostela Valley, Agusan, Surigao, Bukidnon, and North and South Cotabato sell their gold and buy mercury in this town. This information was confirmed when a researcher posed as a buyer and visited gold buying centers, pawnshops, mining equipment stores and even a big grocery store, as well as a hotel in Tagum City, which were all involved in mercury trading.<sup>131</sup>

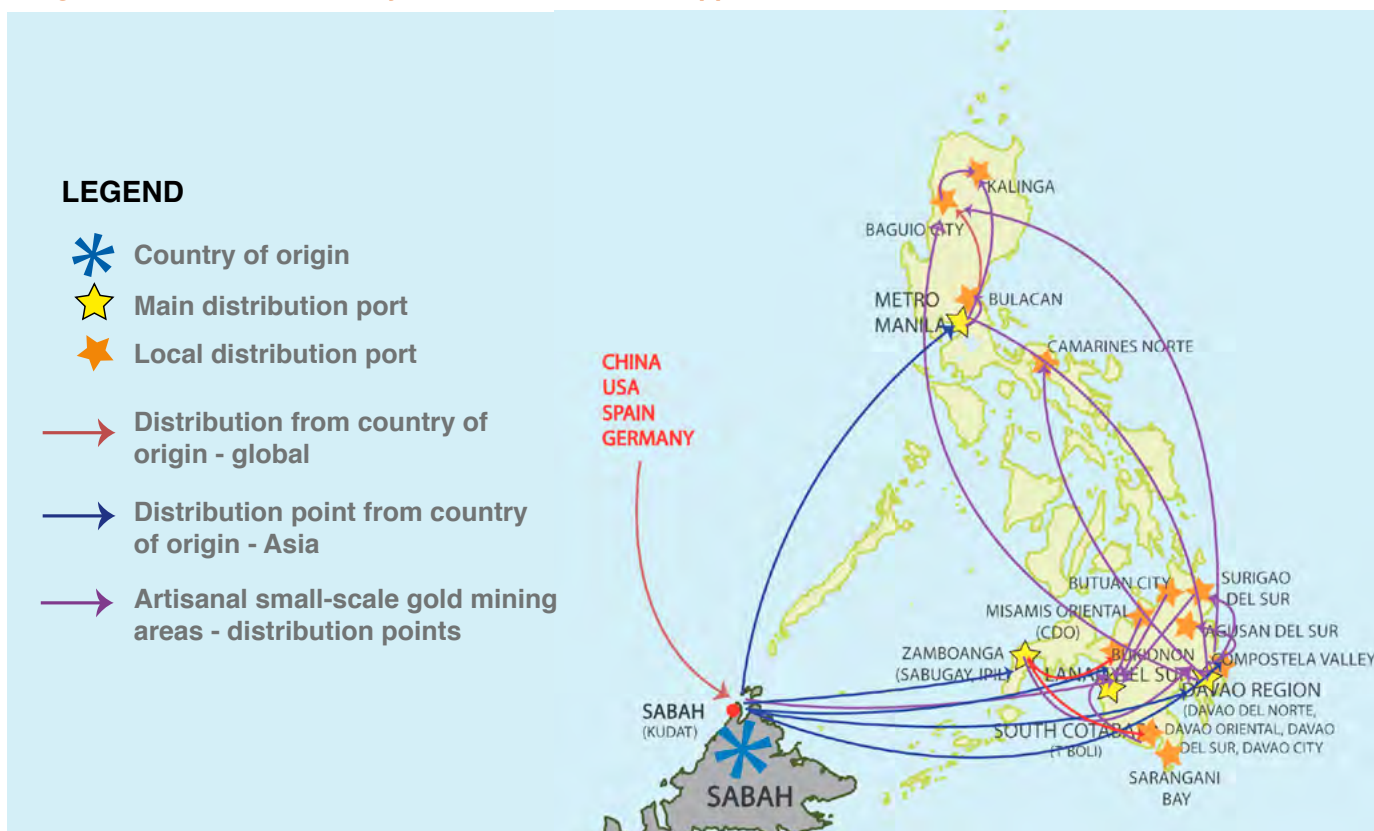
According to an informant from T’Boli, South Cotabato, large volumes of mercury are traded in Tagum City because big gold buyers in the city trade gold in exchange for mercury and other goods in the ports of Malaysia and Indonesia, via backdoor trade in Tawi-Tawi, the island province in the southernmost tip of the Philippines. This was confirmed by an informant (a retired coast guard previously assigned to Tawi-Tawi) who has had firsthand experience of confiscating a mercury flask from Malaysia.

<sup>132</sup>

Another center of mercury trade in Mindanao is Marawi City in Lanao Del Sur province. ASGM miners from Zamboanga, Bukidnon, Surigao and Agusan provinces, and also miners from the Visayas region, buy mercury in Marawi. According to an informant who has a direct link to a mercury supplier in Marawi City, local traders who are also gold buyers barter gold for mercury and drugs in Malaysia.<sup>133</sup>

In Davao City, two traders are said to supply the mercury demands of ASGM sites in the provinces of Zamboanga, Bukidnon, Agusan del Norte, Davao del Norte, Compostela Valley and South Cotabato. Mercury can be found in hardware stores and sold by local traders in Barangay Forestal along the city’s Quimpo Boulevard. According to a mercury reseller from the ASGM site in Mt Diwata, Compostela Valley, in order to buy mercury they just need to send the supplier a text message via mobile phone and the supplier will deliver it to the mining area.<sup>134</sup>

**Figure 12: Backdoor mercury distribution in the Philippines**



Bulk mercury in flasks reaches distribution centers hidden among other goods and wrapped in cloth or plastic and delivered by cargo forwarders. These are then sold by the kilogram by traders. Gold buyers and medium scale miners who can afford to buy large volumes carry the mercury flask in their own vehicles.

Once mercury reaches ASGM areas and communities, mercury is retailed in public. It is sold by the gram and repackaged in small containers, usually in plastic bags or plastic or glass bottles. Police, local government officials and community leaders are aware of this trade in mercury, but most choose to look the other way.

Retailers in ASGM areas are often proprietors of small neighborhood groceries called “*sari-sari* stores”—or in cases where the shipment of mercury is in the form of dental amalgam, dental supply dealers or owners of dental clinics. In pawnshops, jewelry shops and gold buying stations, small bottles of mercury are displayed on the shelf. But in hardware stores, hotels, dental clinics and larger grocery stores, mercury is sold to known buyers only.

**Figure 13: Retail prices of mercury in ASGM areas in the Philippines, 2013 and 2017**

Area / mining site	Retail price (in PHP/kg)	
	2013	2017
Jose Panganiban, Camarines Norte	8,000 - 9,000	2,500
Paracale, Camarines Norte	9,000	2,500
Mount Diwata, Monkayo, Compostela Valley	10,000 - 10,500	5,000
Tagum, Davao del Norte (main business area in Compostela Valley)		3,500 (estimate)
Aroroy, Masbate	9,500 - 10,000	3,300
T'boli, South Cotabato		6,000
Pasil, Kalinga	30,000	50,000
Davao City	7,500	
Sitio Balagbag, Bayog, Zamboanga del Sur	8,000	
Baguio City	15,000	

(Source: Mercury Trade in the Philippines, BAN Toxics 2013; 2017 data was gathered from local informants and miners in the ASGM areas)

## Field investigation photos

Photos 41 and 42: Pictures of a mercury flask originating from the US. The photo was taken by an ASGM miner from T'boli, South Cotabato. (Used with permission from source)



Photo 43: Mercury flask originating from China but traded in Malaysia. This photo was taken by an informant from Mt Diwata, Compostela Valley. The miner bought the flask in Tagum City, which is near the mining area in Compostela Valley. (Photo used with permission from source)



Photo 44: Another mercury flask originating from China and acquired from traders in Malaysia. The miner (from T'boli, South Cotabato) who owns the flask and took the photo shared that his stock of mercury originally came from Malaysia. He said that many miners from the province who own ball mill facilities buy mercury in bulk from a large tuna fishing boat based in Sarangani province and General Santos City. The researcher observed that this flask of mercury is stored in the miner's living room. (Photo used with permission from source)



Photos 45 and 46: Mercury re-tailed at neighborhood shops in ASGM sites in the Philippines. Mercury is re-tailed in small amounts in repurposed cosmetics vials or in plastic bags. (both photos: Luis Liwanag/BAN Toxics).



Photos 46 (Luis Liwanag/BAN Toxics).



Photo 47: Mercury re-tailed at neighborhood shops in ASGM sites in the Philippines. Mercury is spooned into a vial in a neighborhood grocery shop in Caramines Norte Province in Southern Luzon, Philippines. (AC Dimatatac/BAN Toxics).



Photos 48 and 49: Local mercury retailers. Mercury is sold in a local pawnshop in a gold mining area in Labo, Camarines Norte. Photo 49 shows that mercury is stored in a plastic bottle, openly displayed in the shop. (BAN Toxics)



Photo 50: Mercury is sold in local gold buying shops in Mt Diwata, Compostela Valley. This shop sells mercury in the open. (BAN Toxics)



Photos 51 and 52: Mercury sold in dental supply shops in Metro Manila. Field research by BAN Toxics in 2015 confirmed that Liberty and Standard dental supply stores in Manila's Quiapo district sell mercury. (BAN Toxics)



Photos 53 and 54: Mercury sold in dental supply shops in Metro Manila. On a research visit to New Citizens and Centro dental supply stores in Manila's Quiapo district in 2015, store personnel said they no longer sold mercury. (BAN Toxics)



Photo 55: Retailed mercury in dental supply shops in Manila's Quiapo district. The white plastic bottle contains 1 kg of mercury and is sold for PHP 7,500 (USD 150). The small brown bottles each contain 50 grams and are sold for PHP 950 (USD 20) a piece. Photos were taken inside Liberty Dental Supply in 2015. Standard Dental Supply carries the same stock, sold for the same price. (BAN Toxics)





## IV. Conclusions and recommendations

The preliminary research on mercury trade in Southeast Asia and East Asia that this report has put together confirms that:

1. Trade (both legal and illegal) and use of mercury has increased in ASGM communities which are located in Asia's poorest and most environmentally vulnerable areas;
2. Despite the presence of domestic laws aimed at controlling or stopping mercury use, trade (particularly illegal trade) and use of mercury continues in Asian countries (such as the Philippines) where ASGM is practiced;
3. Global mercury trade has shifted firmly from the developed West to Asia;
4. Despite official reports on the decrease in use and trade in mercury, data from the ground, particularly in East and Southeast Asia, show there has been little change in mercury use and trade, especially in and among ASGM communities; and
5. Laws to control and stop mercury use may be in place, but enforcement is either lacking or does not exist for various reasons, including corruption.

This investigative report further shows how little is known about the volume of trade in mercury, globally and in Asia, particularly once mercury crosses borders and is traded within a country. It may be said that the investigation has raised more questions in its attempt to draw a picture of the illicit trade of this chemical.

Any program that aims to ban, or even manage the trade in and use of mercury, must take a realistic hard-nosed assessment of the mercury supply chain in the region and within each country. This supply chain assessment must be nuanced, with a critical understanding of the needs of the sectors that continue to use mercury, especially those in ASGM.

To address these issues steps need to be taken at the individual county level as well as from a regional and global level.

- The first step is for the immediate ratification and entry into force of the Minamata Convention. All the Southeast Asian and Asian countries impacted by mercury trade must ratify the Minamata Convention as soon as possible. The sooner global controls are in place, the migration of mercury traders to Asia in order to exploit lax regulations will be minimized, if not altogether eliminated.
- Strengthen regional agreements to support the implementation of the Minamata Convention. The Association of Southeast Asian Nations (ASEAN) is a viable platform for both enforcement and information sharing on mercury-related issues. Key ASGM countries are part of ASEAN. Thus, utilizing existing ASEAN structures and processes can possibly simplify regional approaches to address mercury trade and use.
- There is a need to increase capacity of customs and law enforcement to monitor, identify and control the entry of mercury into vulnerable countries via border and port controls. Basic training on mercury and the modus operandi of smugglers can be a good start.
- Effective, inexpensive and safe substitutes to mercury in the ASGM sector must be introduced in parallel with control measures in use and trade.
- There is a need to conduct more research on global mercury stockpiles and the stockpiling of mercury by local traders in anticipation of the entry into force of the Minamata Convention.
- Local government units and law enforcement units must be involved to implement laws against mercury import and use.
- Governments must classify illegal, confiscated or excess mercury within a country as waste. The lack of legal definition or classification of confiscated, illegal or excess mercury within a country creates some uncertainty on how the mercury will be handled. By classifying these as wastes, governments will be immediately applying environmentally sound management of mercury wastes, as per Basel Convention guidelines and Minamata Convention requirements.

## Endnotes

- <sup>1</sup> Mercury Watch Database, 2016; Artisanal Gold Council, 2016; US EPA, 2016
- <sup>2</sup> UNEP, 2013
- <sup>3</sup> UNEP, 2009; Narvaez, D., 2016
- <sup>4</sup> UNIDO, 2013
- <sup>5</sup> UN Comtrade 2016; Narvaez, D. 2010
- <sup>6</sup> Mohaptra and Mitchell, 2009; UNEP 2006
- <sup>7</sup> US EPA 2016 US EPA 2016
- <sup>8</sup> Mohaptra and Mitchell 2009; Pirrone and Mahaffey 2005
- <sup>9</sup> US EPA 2016; Mohaptra and Mitchell 2009
- <sup>10</sup> *Ibid.*
- <sup>11</sup> *Ibid.*
- <sup>12</sup> US EPA 2016
- <sup>13</sup> Index Mundi, 2013
- <sup>14</sup> Most of Algeria's mercury and metal production were exported to France, other EU countries and later Russia. Algeria was a former colony of France, and most of its metal and mineral mines were financed by French multinational companies.
- <sup>15</sup> China ratified the Minamata Convention in August 2016 and will be expected to stop mining mercury in 15 years.
- <sup>16</sup> US EPA 2016; UNEP 2013
- <sup>17</sup> Kyrgyzstan has not joined the Minamata Convention
- <sup>18</sup> *Ibid.*
- <sup>19</sup> UN Comtrade 2016
- <sup>20</sup> US EPA 2016; Bender and Narvaez 2016
- <sup>21</sup> US EPA 2016; Bernaudat, L. 2016
- <sup>22</sup> US EPA 2016; UNEP 2013; Bender and Narvaez 2016
- <sup>23</sup> US EPA 2016
- <sup>24</sup> US EPA 2016; UN Comtrade 2016
- <sup>25</sup> US EPA 2016; Narvaez, D. 2010
- <sup>26</sup> US EPA 2016; Narvaez, D. 2010; UN Comtrade 2016
- <sup>27</sup> UN Comtrade 2013 and 2016
- <sup>28</sup> US EPA 2016; UNEP 2009; Euro Chlor 2015
- <sup>29</sup> Euro Chlor 2015
- <sup>30</sup> US EPA 2016; Narvaez, D. 2010; UN Comtrade 2016
- <sup>31</sup> US EPA 2016; European Commission 2006; UNEP 2013
- <sup>32</sup> US EPA 2016; UNEP 2009
- <sup>33</sup> European Commission for Environment 2006
- <sup>34</sup> Mohaptra and Mitchell 2009
- <sup>35</sup> US EPA 2016; UNEP 2013
- <sup>36</sup> US EPA 2016; UN Comtrade 2016; UNEP 2013
- <sup>37</sup> US EPA 2016; UN Comtrade 2013 and 2016
- <sup>38</sup> US EPA 2016; UNEP 2013
- <sup>39</sup> *Ibid.*
- <sup>40</sup> US EPA 2016; UNEP 2008 and 2013; European Commission 2006
- <sup>41</sup> Mercury Watch Database 2016; Artisanal Gold Council 2016; US EPA 2016
- <sup>42</sup> UNEP 2013
- <sup>43</sup> Mercury Watch Database 2016; Artisanal Gold Council 2016; US EPA 2016
- <sup>44</sup> Gunson, A. 2002
- <sup>45</sup> US EPA 2016
- <sup>46</sup> *Ibid.*
- <sup>47</sup> *Ibid.*
- <sup>48</sup> US EPA, 2016; Mohaptra and Mitchell, 2009; Pirrone and Mahaffey, 2005
- <sup>49</sup> USGS Mercury, 2015
- <sup>50</sup> BAN Toxics, 2013
- <sup>51</sup> Zero Mercury Working Group, 2015
- <sup>52</sup> *Ibid.*
- <sup>53</sup> US EPA, 2016; Mohaptra and Mitchell, 2009
- <sup>54</sup> UNEP, 2013
- <sup>55</sup> UNIDO, 2013; Gunson, A., 2002
- <sup>56</sup> UNIDO 2015
- <sup>57</sup> WHO 2013
- <sup>58</sup> Tobolik and Plass, 2016
- <sup>59</sup> Sundseth, K. and Pacyna, J, 2016
- <sup>60</sup> <http://www.mercuryconvention.org>
- <sup>61</sup> UNEP 2009; Narvaez, D. 2016
- <sup>62</sup> UNEP 2009; Narvaez, D. 2016
- <sup>63</sup> UNEP 2009; Narvaez, D. 2016
- <sup>64</sup> US EPA 2016; UN Comtrade 2016
- <sup>65</sup> Asia Mercury Private Limited, which claims to be one of the "world's leading suppliers of raw virgin liquid mercury at 99.99% purity...used in processing of gold" in 34.5kg flasks is based in Singapore and openly advertises and sells its products online and in the open market.
- <sup>66</sup> US EPA 2016; UN Comtrade 2016
- <sup>67</sup> Zero Mercury Working Group 2013 and 2015; Cochrane, J. 2014
- <sup>68</sup> Zero Mercury Working Group 2013 and 2015; Cochrane, J. 2014; US EPA 2016
- <sup>69</sup> US EPA 2016
- <sup>70</sup> Interaksyon 2014
- <sup>71</sup> BAN Toxics 2010; UN Comtrade 2009
- <sup>72</sup> EEB 2013
- <sup>73</sup> US EPA 2016; UN Comtrade 2016; Ismawati, Y. 2014; Cochrane, J. 2014
- <sup>74</sup> US EPA 2016; UN Comtrade 2016
- <sup>75</sup> US EPA 2016; UN Comtrade 2016

- <sup>76</sup> Zero Mercury Working Group 2015
- <sup>77</sup> US EPA 2016; UN Comtrade 2016
- <sup>78</sup> US EPA 2016; Bender and Narvaez, 2016
- <sup>79</sup> European Commission Directorate General for Environment, 2006
- <sup>80</sup> US EPA 2016; Bender and Narvaez 2016
- <sup>81</sup> Mexico ratified Minamata Convention in September 2015 and will have to close the mercury mines within 15 years.
- <sup>82</sup> US EPA 2016; Bender and Narvaez 2016
- <sup>83</sup> Pirrone and Mahaffey, 2005
- <sup>84</sup> European Commission for Environment 2006
- <sup>85</sup> BAN Toxics Vietnam 2016
- <sup>86</sup> UN Comtrade 2013 and 2016
- <sup>87</sup> Zetti and Lassen, 2015
- <sup>88</sup> Da Giang-Nam Long 2015
- <sup>89</sup> DuchHai 2015
- <sup>90</sup> Nguyen DuyTiem, 2010
- <sup>91</sup> UNIDO 2015; BAN Toxics Vietnam 2016
- <sup>92</sup> Survey National Institute of Hygiene and Epidemiology Vietnam, BAN Toxics Vietnam 2016
- <sup>93</sup> CGFED and BAN Toxics, draft ASGM and Mercury Use in Vietnam, 2016
- <sup>94</sup> 0.375 grams is one-tenth of one chi, the local unit of measurement for precious metals.
- <sup>95</sup> Blacksmith Inst. 2010; National Environment Agency Singapore 2016; Occupational Safety and Health Act Malaysia 2000
- <sup>96</sup> Ismawati, 2015.
- <sup>97</sup> Jakarta Globe, 2013
- <sup>98</sup> UN Comtrade 2012, [http://www.sr-indonesia.com/in\\_the\\_journal/view/gold-mercury-and-the-next-minamata?pg=all](http://www.sr-indonesia.com/in_the_journal/view/gold-mercury-and-the-next-minamata?pg=all)
- <sup>99</sup> [https://www.nytimes.com/2014/01/03/business/international/mercury-trade-eludes-international-controls.html?\\_r=2](https://www.nytimes.com/2014/01/03/business/international/mercury-trade-eludes-international-controls.html?_r=2)
- <sup>100</sup> Paddock, Richard, 2016
- <sup>101</sup> BAN Toxics Field Research Reports 2016
- <sup>102</sup> West Kalimantan and Sarawak have open roads between countries Pontianak - Entikong - Kuching (Sarawak, Malaysia) along approximately 400 km and can be reached about six to eight hours of travel.
- <sup>103</sup> All pictures and information from Field Research Reports in Indonesia, BAN Toxics 2016
- <sup>104</sup> All pictures and information from Field Research Reports in Indonesia, BAN Toxics 2016
- <sup>105</sup> UNEP 2012; Asia Foundation 2016
- <sup>106</sup> UNEP 2012; Purevjav, B. and Stacey, J., 2016
- <sup>107</sup> UNEP, 2011
- <sup>108</sup> *Ibid.*
- <sup>109</sup> Peruvjav and Stacey 2016
- <sup>110</sup> Stanway, D., 2012
- <sup>111</sup> BAN Toxics Field Journal for Research at Mongolia ASGM sites May 26 to June 8, 2016
- <sup>112</sup> "Ninja miner" is a nickname for ASGM miners in Mongolia. They are named thus because of the green bowls/basins they carry on their backs used for panning gold, that make them look like Teenage Mutant Ninja Turtles, a group of popular cartoon superheroes.
- <sup>113</sup> BAN Toxics, Field Journal for Research at Mongolia ASGM sites May to June 2016
- <sup>114</sup> *Ibid.*
- <sup>115</sup> *Ibid.*
- <sup>116</sup> Sharyn Gol is coal mining town, where the Sharyn Gol coal mine is located.
- <sup>117</sup> BAN Toxics Philippines 2013; UN Comtrade 2012; Gutierrez, R. 2016; Macro Trends 2017
- <sup>118</sup> *Ibid.*
- <sup>119</sup> Dentists used to mix dental amalgam by hand. Today, dental amalgam comes in sealed capsules with two compartments: one side with mercury and the other a mixture of alloys in powder or tablet form. The capsule is shaken to break the membrane and mix the contents.
- <sup>120</sup> Zero Mercury Working Group 2009; UNEP 2009
- <sup>121</sup> DENR/EMB-Unitar 2015
- <sup>122</sup> The Philippines has two chlor-alkali plants that have not yet committed to decommission mercury-using manufacturing processes by 2020. Both plants have a combined capacity of 14 MT per year.
- <sup>123</sup> Zero Mercury Working Group 2009
- <sup>124</sup> DENR ADMINISTRATIVE ORDER NO. 97-38 December 23, 1997
- <sup>125</sup> Hayden, Lars, 2006
- <sup>126</sup> BAN Toxics Philippines 2013
- <sup>127</sup> BAN Toxics, 2015
- <sup>128</sup> *Ibid.*
- <sup>129</sup> *Ibid.*
- <sup>130</sup> *Ibid.*
- <sup>131</sup> *Ibid.*
- <sup>132</sup> *Ibid.*
- <sup>133</sup> *Ibid.*
- <sup>134</sup> *Ibid.*

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