ASGM sites: Poboya and Sekotong in Indonesia

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Introduction

In 2009, the Governing Council of the United Nations Environment Programme (UNEP GC) decided to develop a global legally binding instrument on mercury to reduce risks to human health and the environment (UNEP GC25/5). The UNEP GC noted that mercury is a substance of global concern due to its long-range transport, persistence, ability to bioaccumulate, and toxicity. Its conclusions were based in part on the 2002 UNEP Global Mercury Assessment which noted that mercury is present in fish all over the globe at levels that adversely affect humans and wildlife (UNEP 2002).. In humans, hair is widely accepted as a matrix for reliable estimations of the body burden of methylmercury, which likely comes from eating fish (Grandjean, Weihe et al. 1998); (Harada, Nakachi et al. 1999); (Knobeloch, Gliori et al. 2007); (Myers, Davidson et al. 2000).

This report focuses on two sites of Artisanal and Small-scale Gold Mining (ASGM) in Poboya and Sekotong, Indonesia. We examined levels of mercury in hair of population living and working at both ASGM sites to confirm the trace of mercury used in gold extraction process in human hair from these two locations. In addition, since local mercury releases become global problems due to long range transport we considered how the draft treaty text will address ASGM sites such as the two selected for this study in Indonesia.

ASGM hot spots in Indonesia

ASGM hotspots in Indonesia have doubled in the last six years due to the high price of gold. As gold traders increased their investments in many places, the amount of elemental mercury traded illegally also increased. In 2010, about 280 tons of illegal mercury was imported to Indonesia for ASGM. This figure was doubled in 2011 (Ismawati 2011). Gold recovery processes that use mercury for amalgamation in ball-mills are easily found in almost all Indonesia's ASGM hot spots including in residential areas in Sekotong village and in the Poboya area in Palu.

The first hotspot chosen for this report is Poboya, Palu City, Central Sulawesi Province. It is located located in a grand forest park, about 12.5 km from northeast part of Palu, the capital city of Central Sulawesi Province, about 190-300 meter above the sea level. The mining and processing areas spread out in four villages: Poboya, Kawatuna, Tanamodindi dan Lasoani involving about 35,000 miners and more than 200 ball-mills plants. See also map at Figure 2.

Another hotspot chosen for this report is Sekotong, a famous site for surfers and tourists located about 28.7 km, southwest part of Mataram City, the capital of West Nusa Tenggara Province, about 50-200 meter above the sea level. The mining and gold processing areas spread out in three villages within the Sekotong Sub-District areas: Buwun Mas, Kerato, Pelangan Village, with approximately 20 hot spots, involving about 5,000 miners and about 100 ball-mills plants. Figure 3 shows the location of Sekotong hotspot.

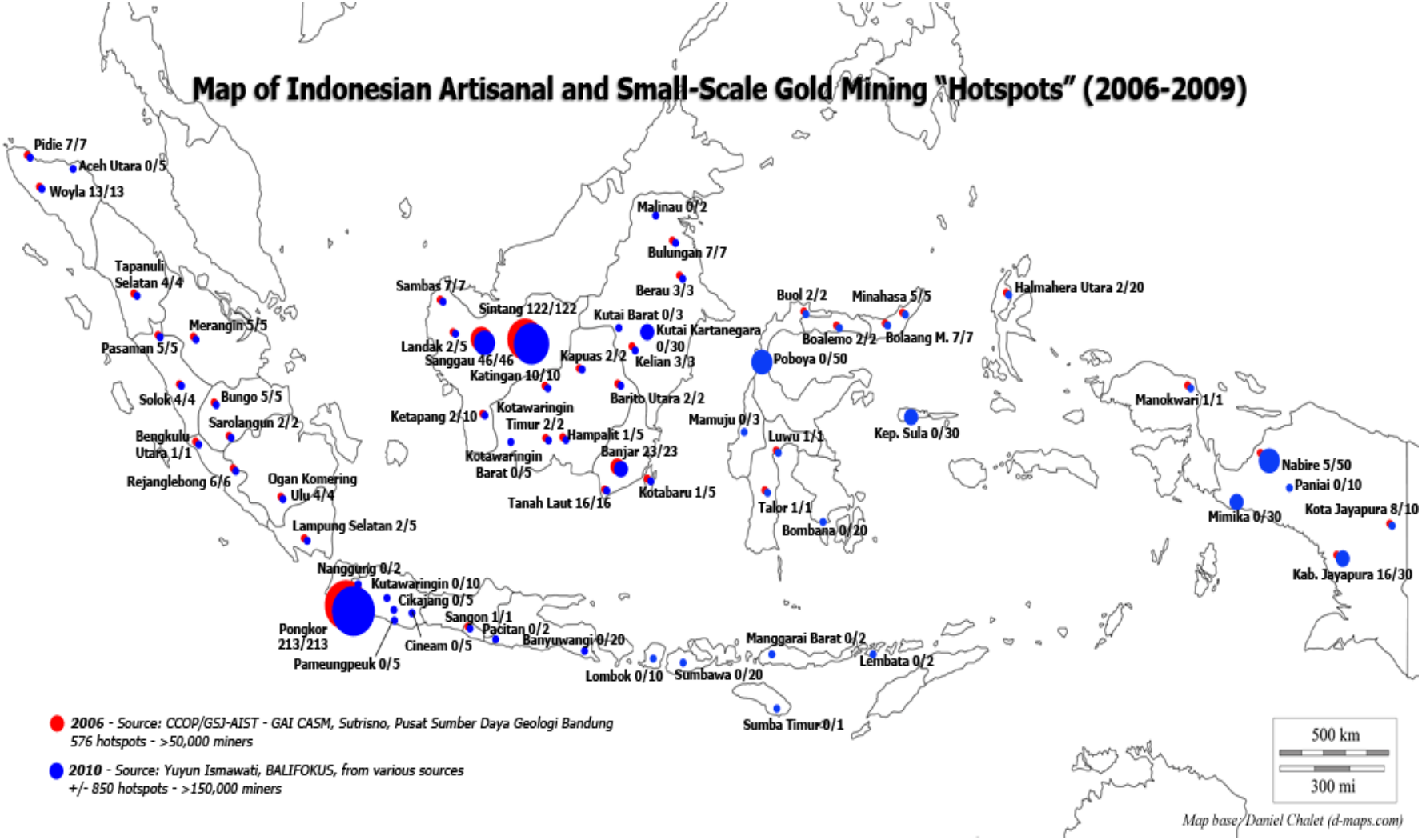

Figure 1. ASGM hotspots in Indonesia 2006-2010. Source: (Ismawati 2010).

Figure 2. Location of Poboya hot-spot, Palu City, Central Sulawesi

Figure 3. Location of Sekotong hotspot, in West Lombok Regency area, West Nusa Tenggara

Materials and methods

BaliFokus conducted sampling of human hair at both selected ASGM sites using protocols developed by IPEN (2011). Twenty hair samples were taken in total for this study, 10 in Poboya area and 10 in Sekotong. Biodiversity Research Institute (BRI) measured mercury levels (total mercury content = THg) in hair samples in their laboratory in Gorham, Maine, USA. BaliFokus characterized the site and provided information about its history and presumptive mercury sources.

Results and discussion

In Sekotong Village almost every household has their own ball-mills unit, located at the backyard or near the rice field, to process the ore which operates all day long without personal protection equipment. While in Poboya, Palu, the ball-mills plants are concentrated in some clusters and release very high mercury vapor to the air and the environment (Serikawa, Inoue et al. 2011); (Ismawati and Gita 2011). In both hot spots, the mercury-contaminated tailings

are either processed further in the cyanide leaching plant or disposed directly into rivers. More information about both hot spots is summarized in Table 1.

Table 1: Summarized information about size of ASGM activities in Poboya and Sekotong hot spots, Indonesia.

Hot spot	Villages	Miners	Area in hectares	Ball-mills
Poboya	4 (Poboya, Kawatuna, Tanamodindi, Lasoani)	35,000	7,000	20,000
Sekotong	3 (Buwun Mas, Kerato, Pelangan)	5,000	1,200	100

The most heavily polluted sites are in Poboya located in the hilly area. Mercury was introduced here in 2004 by a particular trader who taught the villagers to add three drops of mercury in the final panning process. In 2008, the ball-mill process introduced by miners from North Sulawesi to process the ore in bigger volume which runs for four hours, 3-4 times within 24 hours. About 300g – 500g mercury is added to each unit every 4 hours. Under the assumption that all ball-mills operate at least once a day, and about 20-50 grams of mercury will be released to the environment to produce one gram of gold, at least about 200-500 kg of mercury is released to the environment per day or approximately 73 - 183 tons of mercury per year.[a]

The ASGM activities in Sekotong area, which was started 5 years ago, are less intense compared to the Poboya site. About 100 small ball-mill units are operated by the local villagers in the backyards of their houses and near the rice fields. For more data comparing both hot spots see Table 1.

Table 2 shows the levels of mercury (Hg) in hair samples from both chosen sites and summary of all samples taken in Indonesia for this report.

Table 2: Mercury content in hair samples from Poboya and Sekotong, two sites in Indonesia

	Sample Size	**Hg Average (ppm)**	**St Dev**	**Min Hg (ppm)**	**Max Hg (ppm)**	**Reference dose (ppm)[b]**	**Fraction of samples over Ref. Dose**
All hair samples	20	4.32	3.28	0.82	13.30	1.00	95%
Poboya	10	5.01	4.47	0.82	13.30	1.00	90%
Sekotong	10	3.63	1.28	1.85	6.05	1.00	100%

Abbreviations: Hg, mercury; ppm, parts per million or mg/kg; st dev, std deviation; min, minimum; max, maximum

Results presented in Table 2 show that average mercury level in all 20 hair samples is more than 3-times higher than the US EPA reference dose of 1 ppm. The maximum mercury value observed in the hair samples from Poboya exceeded the US EPA reference dose by more than thirteen-fold. Only one sample among all 20 was below the US EPA reference dose. All 10 samples from Sekotong exceeded the reference dose.

[a] Calculation based on the interview (Ismawati, Y. (2011). Interviews with importers and ASGM workers by Yuyun Ismawati.)

[b] U.S. EPA's RfD is associated with a blood mercury concentration of 4-5 μg/L and a hair mercury concentration of approximately 1μg/g." US EPA (1997). Mercury study report to Congress, Volume IV, An assessment of exposure to mercury in the United States. EPA-452/R-97-006**:** 293.

Levels of mercury in hair observed in this study are within range estimated by Castilhos, Rodrigues-Filho et al. (2006) for hair of inhabitants living in other gold mining areas in Indonesia. In comparison with levels of total mercury observed in hair of group of workers from mining areas in Sekotong and Sekarbela in recently published study (Krisnayanti, Anderson et al. 2012) we observed lower levels. We believe that main reason for this difference is that the group of volunteers in our study represents rather mixed local population and includes by majority other occupations than miners. Krisnayanti, Anderson et al. (2012) found mean level of THg 7.72 ppm and range of 0.805 - 52.500 ppm in hair of mine workers exposed to mercury from Sekotong and Sekarbela. Bose-O'Reilly, Drasch et al. (2010) have observed even higher levels of total mercury in hair of workers exposed to mercury from amalgamation process for North Sulawesi and Central Kalimantan.

Indonesian ASGM sites were found to be most seriously polluted by mercury in study comparing situation in different countries by Baeuml, Bose-O'Reilly et al. (2011). The highest median mercury hair levels were found in Zimbabwe and Indonesia-Sulawesi (3.09 μg/g) in that study, while the highest maximum mercury hair levels were found in Indonesia-Kalimantan (792 μg/g) among 167 samples and Indonesia-Sulawesi (239 μg/g) among 99 samples.

High levels of mercury in the vicinity of ASGM facilities were not only observed in human hair, but also measured in the air. Mercury levels in the outside air near the Poboya ball-mill plants was as high as 45,000 ng/m^3 and around the city of Palu levels were about 1,500-2,300 ng/m^3 (Serikawa et al, 2011; Ismawati and Armyn 2011). Krisnayanti, Anderson et al. (2012) also followed levels of Hg in rice in Sekotong and based on their findings concluded: "The recorded methyl mercury values for Sekotong represent a potential threat to the health of local residents."

ASGM sites and the mercury treaty

The ASGM sites in Indonesia researched in this report as well as in other recent reports showing confirmed levels of mercury in human hair from elevated to extremely high (Castilhos, Rodrigues-Filho et al. 2006); (Bose-O'Reilly, Drasch et al. 2010); (Krisnayanti, Anderson et al. 2012) provoke questions about how the mercury treaty might mandate actions to eliminate mercury pollution of the environment and its harmful effects on human health at ASGM sites.

ASGM is the single largest intentional use of mercury and causes extreme mercury pollution. In areas where ASGM is practiced, it is recognized as a significant source of human exposure to mercury, and contributes to high levels of methyl mercury pollution of fish in waterways nearby and downstream of ASGM sites (Castilhos, Rodrigues-Filho et al. 2006); (Eisler 2004).

Mercury emissions from ASGM are the second largest source of global atmospheric mercury pollution (UNEP Chemicals Branch 2008).However, considering its significance as a source, there are very few mandatory controls on ASGM. For example, currently proposed convention provisions will allow countries to import unlimited quantities of mercury for use

in ASGM with no phase-out date (UNEP (DTIE) 2012). [c] In addition, the current treaty text (UNEP (DTIE) 2012) does not require Parties to even address ASGM if a country does not admit it has ASGM or determines that it is not "more than insignificant". Unfortunately, there are no guidelines to determine "significance". Finally, to address the mercury pollution caused by ASGM in such sites as Poboya or Sekotong, funding and technical assistance will be needed by developing and transition countries, to shift from mercury to non-mercury methods and clean up the contaminated hotspots. However, since the treaty links compliance with funding and action on contaminated sites is not obligatory, it is likely that no funding will be available through the treaty's financial mechanism to address contaminated sites left after the gold mining closed or terminated.

Taken together, the current treaty text raises serious concerns over whether it will reduce mercury emissions from ASGM, or even permit increased emissions after the treaty enters into force. There is a strong need to address the restriction and phase out of mercury trade, supply and distribution in ASGM sector. To prevent continuous mercury pollution caused by using mercury in ASGM and to stop harm to communities settled around ASGM sites like e.g. Poboya it is necessary to prevent further use and releases of mercury from the ASGM. Until this problem is addressed, mercury will continue to harm people and ecosystems at both local and global level.

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[c] UNEP(DTIE)/Hg/INC.5/3; Article 9 para 5 "Each Party that is subject to the provisions of paragraph 3 of this Article and determines that domestic sources of mercury are not available: a. May import mercury for use in artisanal and small-scale mining consistent with its action plan developed in accordance with paragraph 3 of this Article; and"

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