

Final Report*

**Mitigating Mercury Emissions from Artisanal and
Small Scale Gold Mining in Indonesia**

August 2013

*Please note, as this is an externally published report produced by the Blacksmith Institute and the Yayasan Tambuhak Sintia, the designations employed in this material do not imply the expression of any opinion of the United Nations Environmental Programme concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Moreover, the views expressed do not necessarily represent the decision or the stated policy of the United Nations Environmental Programme, nor does citing of trade names or commercial processes constitute endorsement.

Contents

1. Acknowledgements
2. Background
3. Project Implementation
 - 3.1. Baseline Data Gathering
 - 3.2. Multi-Stakeholder Meetings
 - 3.2.a. Small Group Discussion on Progress of Development of National Action Plan for Artisanal and Small-Scale Gold Mining in Indonesia
 - 3.2.b. National Workshop on Project Completion and Efforts in Mitigating Mercury Emission from Artisanal and Small-Scale Gold Mining in Indonesia
 - 3.2.c. Hearing Session with Commission VII of People's Representative Council for Proposal to Ratify the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
 - 3.3. Action Research
 - 3.3.a. Technical Interventions
 - 3.3.b. Communication and Awareness Raising
 - 3.3.c. Seminars and Training Events
4. Efforts on Artisanal and Small-Scale Gold Mining in Indonesia: Moving Forward and Challenges
5. Responsible parties

1. Acknowledgements

This project is made possible through the funding and support of the following agencies:

United States Environmental Protection Agency, Office of Children's Health Protection, and
Office of International and Tribal Affairs

United Nations Environment Programme, Chemicals Branch

Ministry of Environment, Office of the Hazardous Substances, Hazardous Waste, and Solid
Waste Management

Geological Survey of Denmark and Greenland (GEUS) Denmark

Mt. Emerald Workers Cooperative of the Philippines

Agency for the Assessment and Application of Technology (BPPT)

International Research Center for Management of Degraded and Mining Lands (IRC-
MEDMIND)

2. Background

Artisanal and Small-Scale Gold Mining

Artisanal and small-scale gold mining refers to informal or small-batch mining activities that use basic methods to extract gold from ore. The United Nations Industrial Development Organization (UNIDO) estimates that artisanal and small scale mining is responsible for nearly 20% of global gold production, and employs between 10 and 15 million people – including 4 to 5 million women and children.

Most artisanal and small-scale gold miners come from socially and economically marginalized communities and turn to mining as a primary income activity. They are forced to risk not only persecution by governments (if their activities are unauthorized) but also mine shaft collapses, and toxic poisoning from a variety of chemicals used unsafely in processing the ore. Despite its many dangers, artisanal and small-scale gold mining operations continue to spread because the demand for the metal is increasing and other livelihoods, such as farming, are becoming less and less economically viable. Indeed, with gold prices skyrocketing, artisanal mining will likely expand even more rapidly than before.

Mercury amalgamation is a very common form of gold extraction. Artisanal and small-scale gold miners combine mercury with gold-bearing ore to form a hardened amalgam that contains most of the gold metal from the silt. This amalgam is then heated with blowtorches or over an open flame to evaporate the mercury, leaving gold behind. This burning process releases mercury vapors into the surrounding air. The gaseous mercury is inhaled by the miners, and often by their immediate family as well. Mercury that is not burned settles into the surrounding environment or is washed away with unwanted tailings or sediments into local water bodies. It also circulates globally for future deposition far from the site and is absorbed by a variety of living organisms.

UNIDO estimates that 95 percent of all mercury used in artisanal mining is released into the environment. Miners and their families who inhale mercury vapors can suffer permanent damage to the brain and kidneys, and, in the case of pregnant women, to the development of the fetus. They are also exposed through contact with the skin as they knead mercury into sediments to amalgamate the gold.

Bio-accumulation of mercury in rivers poses an additional health risk. Once mercury enters the food chain, it is transformed from elemental mercury to methyl mercury, a dangerous neuro-toxin. Methyl mercury accumulates in the fatty tissues of fish, often a vital source of protein. Exposure to methyl mercury causes arthritis, miscarriages, psychotic reactions, respiratory failure, neurological damage and even death.

The different transmission paths that mercury exposure can take are:

- Inhalation of toxic vapors during combustion;
- Ingestion of contaminated fish, rice and other foods;

- skin contact , since miners rarely use protective gloves while preparing the amalgam; and
- Water contamination due to mercury leaching into rivers and ground water.

Artisanal and Small Scale Gold Mining in Indonesia

Gold mining and processing is a significant source of income for as many as 300,000 small - scale miners in Indonesia¹. As the price of gold has steadily increased, gold mining and processing has become more popular both in the artisanal and large-scale sectors. Historically, artisanal and small-scale miners have used basic technology such as panning and sluice-box concentration. In the past 15-20 years, the use of mercury - especially in a process known as “whole-ore amalgamation” has gained in popularity. Capturing gold using mercury amalgamation is preferred among gold processors as the technique is relatively easy and can generate fast cash to cover miners’ daily expenses. Big mining companies do not use mercury, and use the cyanidation process instead, as it is more effective for industrial-scale processing. This technique has been adapted so that artisanal and small-scale gold miners can capture gold using cyanide tanks. However, many obstacles exist to the environmentally sound implementation of this process including: challenges accessing capital; the need to amass large quantities of finely ground ore and a longer timeframe from milling to gold recovery.

These obstacles have led to a dangerous hybrid processing technique that uses mercury and cyanide. The improper use of both methods together causes greater environmental damage and health risks than either process alone.

Even though the use of mercury is widely practiced by gold miners and processors, awareness of the health impacts caused by mercury is still very low among the miners and the general public. The negative impacts of mercury poisoning (noted above) take up to 50 years to show after exposure, but can appear much more rapidly depending on factors such as dose, pathway of exposure, individual immune system and nutritional consumption. The negative impacts are more immediately severe for children. Mothers, especially pregnant and breastfeeding women, are also highly vulnerable to negative health effects. Mining and processing areas are often indistinguishable from residential areas. Families live in houses that also function as gold shops where amalgam is burned. Children freely play in the gold processing areas.

All project partners working in the ASGM sector in Indonesia must take into account that the use of mercury is the most cost-effective option for these miners, despite its technically illegal status. However, recently, the rising cost of mercury has pushed miners to look for mercury-free techniques. Aggressive growth in the ASGM sector has created new hotspots in Halmahera and East Java, which has increased the scope of the problem. Further, regulators should be encouraged to not view artisanal mining as a problem, but rather as a viable economic development opportunity, if given the right institutional support. Ultimately potential tax revenues lost to the informal gold economy are a missed opportunity

¹ Estimate based on composite data from Artisanal Gold Council, Yayasan Tambuhak Sinta, and Yayasan BaliFokus

for the federal government. For these reasons, USEPA/UNEP/Global Mercury Partnership is supporting Blacksmith Institute, in collaboration with the Ministry of Environment and Yayasan Tambuhak Sinta implemented a project entitled “Mitigating Mercury Emissions from Artisanal and Small-Scale Gold Mining in Indonesia.” This project focused on three project areas:

1. Baseline data gathering: collected information on the current state of artisanal and small-scale mining and to generate an estimate of mercury emissions for Indonesia;
2. Multi-stakeholder workshops: Two national workshops and a series of small group discussion, which raised stakeholder awareness toward the project, built stronger partnerships among relevant stakeholders, and developed a National Strategic Plan for the benefit of artisanal and small-scale gold mining communities in Indonesia; and
3. Action research that combined development of mercury emissions reduction and elimination techniques, health education, training, and media production.

During this project implementation period, September 2011 to September 2013, Yayasan Tambuhak Sinta and Blacksmith Institute have conducted the following activities:

1. Baseline data gathering began with a desk study, analyzing data collected by Blacksmith Institute from the Global Inventory Project, June 2008 – November 2011. The data then was combined with information obtained from other institutions including: Artisanal Gold Council, Ministry of Energy and Mineral Resources and Yayasan BaliFokus.
2. A comprehensive, joint site assessment was done in the areas of Purwokerto, West Java, Gorontalo, and West Nusa. The baseline survey of these sites measured the mercury concentration in tailings. A laboratory analysis was done in partnership with BPPT, GEUS, and Leoncio Van-Oy of Emerald Mountain, Phillipines.
3. The first National Workshop was held December 13, 2011, in Jakarta and attended by 32 participants from the relevant stakeholder agencies.
4. The second small-group discussion was held in Jakarta on December 4, 2012 with participants from the Ministry of Environment, Ministry of Energy and Mineral Resources, and Blacksmith Institute.
5. Action research began in Mt Muro, Central Kalimantan. Technical interventions were prioritized to continue to promote mercury reduction through the distribution of mercury-recycling equipment, i.e. retorts, water-box condensers, and mercury-recharging kits. YTS also introduced sluice boxes to capture free gold and residual mercury before sending tailings to cyanide tanks. In addition, a mercury free technique referred to as gold smelting, or the borax method was tested, and demonstrated for miners in Mt. Muro. (note: USEPA funding has not been used to support borax-related activities. Those funds have been provided by Blacksmith independently of this project)
6. New technologies were distributed among mining communities, including retorts, water-box condensers, and sluices. These technologies reduced the mercury emissions in tailings and during the burning process.
7. Field demonstrations and miner trainings to teach miners mercury-free techniques including concentration and gravity separation.

3. Project Implementation

3.1. Baseline Data Gathering

Beginning in 2008 and continuing until November 2011, Blacksmith Institute with the support from the Asian Development Bank, the European Union, Green Cross Switzerland, and the United Nations of Industrial Development Organization implemented the **Global Inventory Project** to develop an online database of toxic polluted hotspots all over the world. The project commenced in June 2008 in Indonesia at a training workshop for Blacksmith's Initial Site Assessment protocol. The team consisted of 10 "investigators" from the Department of Environmental Health, Faculty of Public Health, the University of Indonesia; Indonesian Lead Information Center/Komite Penghapusan Bensin Bertimbel (KPBB); and Blacksmith Institute.

Preliminary information was collected from previous studies, Central and Local Governments, NGOs, articles in the mass media, and complaints from public. Special attention was paid to the inclusion of data from an Artisanal Gold Council report commissioned by Yayasan Tambuhak Sinta, Artisanal Gold Council and Blacksmith Institute in 2009, entitled "Report on Gold Mining at Indo Muro, Puruk Cahu, Kalimantan."

Investigators were then sent to collect a variety of parameters from the field, including site descriptions, stakeholders, GPS coordinates, suspected key pollutant, estimated population at risk, and media sampling. Up to 10 samples per site were sent to the laboratory for analysis, with all data uploaded and recorded to an online database.

In Indonesia, mercury has been identified as the key pollutant and is mostly due to artisanal and small-scale gold mining activities. Through its fieldwork, YTS has conducted a number of studies on whole-ore amalgamation sites in Indonesia. Most recently, YTS visited Lombok and observed similar mercury usage and noted that the process of whole ore amalgamation had spread to the neighboring island of Sumbawa.

In Palu and Lombok there is no observable technology being used to recover mercury in amalgamation or burning. Simple technology such as retorts and sluices can have a major impact on reducing these emissions.

The artisanal and small-scale gold mining activities in Indonesia are estimated to impact 300,000 to 500,000 people. Mostly these are non-registered, informal operations, located in remote areas.

In the second half of the project, Blacksmith Institute collaborated with institutions such as Agency for the Assessment and Application of Technology (BPPT) to conduct site assessments based on request from the Local Government in their effort to establish programs in dealing with artisanal and small-scale gold mining. In addition, Blacksmith Institute provided assistance to International Research Center for Management of Degraded and Mining Lands (IRC-MEDMIND) to measure the mercury concentration in tailings.

In June 2012, a joint site assessment with Agency for the Assessment and Application of Technology (BPPT) was done in Conservation Forest of Nantu based on the request from a local non-government organization. Gorontalo Regency is also supported by the Office of Mining, which estimates that there are 50 ASGM sites in Gorontalo regency that use approximately 10,100 ball mills. In Conservation Forest of Nantu, gold mining is done by spraying high-pressure water to soil. Then, the slurry is streamed through a sluice box.

In July 2012, Blacksmith conducted a joint site assessment with the Agency for the Assessment and Application of Technology (BPPT), which received a request from the Office of Mining of the Banyumas Regency. The agency had already done an initial site assessment in May 2012 but wanted to do a more comprehensive survey of the area. The activities in Banyumas Regency started in 2008. The community formed a cooperative in 2009 to obtain a mining permit. Due to a change in regulation, the cooperative, named “Sumber Rejeki”, could not obtain a permit, so their activities were still categorized as illegal. The mining locations are concentrated mainly in Paningkaban Village and Cihonje Village in Gumelar Sub-District. There are some smaller operations going on in Dermaji Village and Lumbir Village in Lumbir Sub-District, and Karangtengah Village in Cilongok Sub-District.

Mining activities in Banyumas Regency are done by digging shafts with a depth up to 50 meters. In each shaft, a group of five to ten people work at once. At the end of the day, the revenue is distributed to three parties: one part to land owner, one part to the capital investor, and one part is shared among workers.

Ore is crushed manually before it is processed in ball mills for four to eight hours. It is during this process that the gold processors will also add mercury, with 100 grams of mercury added per ball mill. Then, the slurry is streamed into a sluice box with a towel or carpet underneath. Mercury that is impregnated with gold will be trapped in the towel or carpet while the remainder will flow to a waste pond. At the end of the day, the towel or carpet is washed to get amalgam, which then will be burned in open air. Tailings at the pond will be processed with cyanide to extract any gold that escaped.

In 2012, the Office of Mining in Banyumas Regency estimated there are 418 shafts; 2,110 ball mills; 23 cyanidation tanks; and 5,766 workers. Assuming each ball mill uses 100 grams of mercury on a given day, there are approximately 21.1 kilograms of mercury used each day. These activities also involve women and children who pick up side ore, which is not processed by the gold processors.

During the site assessment, the team also took water samples from tailings. These samples were found to have a mercury concentration of 138 ppm. Water residue from processing is often discharged, untreated, into local rivers. Measurements using XRF portable equipment also showed that ore in this area is highly polluted with lead (Pb). For instance, a measurement taken from one tailing reached 1,774 ppm of lead concentration. Therefore, there is a concern that gold processors and community are not only exposed to mercury but also to lead.

In October 2012, Blacksmith Institute assisted International Research Center for Management of Mining and Degraded Lands (IRC-MEDMIND) to do site assessments in Prabu Village and other locations spread throughout Central Lombok and South Lombok.

South Lombok is famous for its beach tourism and Prabu Village is one gold mining site that is close to the beach. This is a concern for the area, as tourism provides an essential economic sector. In Mengalo Village, Kuta, the measurement using XRF portable equipment showed a mercury concentration of 249 ppm in the tailings.

Central Lombok is well known as a fertile area for agriculture with water overflow. Gold mining and processing poses a threat to the agriculture activities, especially since many of the ball mills and cyanidation tanks are located near rice paddies. A measurement using the XRF portable equipment showed a 57ppm of mercury concentration in tailings from cyanidation tank.

In November 2012, a site assessment was conducted in West Nusa Tenggara Regency, Sumbawa. There, the team identified 4,123 ball mills and 78 cyanidation tanks. In order to find out distribution of mercury use, measurements were done around areas used for amalgam burning, such as kitchens and yards inside family compounds. One such measurement done in a kitchen reached 101ppm of mercury. Another sample taken in a local rice paddy in Batu Putih showed a mercury concentration of 14ppm.



Figure 1. Map of Artisanal and Small Scale Gold Mining in Indonesia



A set of ball mills in Bajuin, Tanah Laut, South Kalimantan.



Tailings being processed by cyanidation in Lombok.



Processors crushing ore using ball mills in Geumpang, Pidie Jaya, Nanggroe Aceh Darussalam.



Mercury-laden tailings from artisanal ball mills in Pancer, Jember, East Java.



Demonstrating the new height charts for children in Lombok. These charts are easily read and can be hung throughout the community to explain the impacts of mercury exposure on children's development.



A trainer demonstrates a retort and water-box condenser to a group of local miners. These technologies can be made locally and are inexpensive to purchase. The miners were extremely receptive to using these technologies.



A miner uses mercury to create a gold amalgam. If gold is present, he will then burn the amalgam to release the gold. The burning will be done out in the open near his family's concession.

3.2. National Workshop for the Development of a National Strategic Plan on Artisanal and Small-Scale Gold Mining in Indonesia

The First national workshop was held in Jakarta on December 13, 2011 and aimed to disseminate progress to date on improving the condition of the artisanal and small-scale gold mining communities in Indonesia. The event informed relevant stakeholders on the successes and constraints the Blacksmith Institute-Yayasan Tambuhak Sinta partnership has encountered in its 3 year working history. The continuation of this work, now supported by USEPA/UNEP/Global Mercury Partnership is taking the necessary steps to develop a National Strategic Plan to enable the Ministry of Environment and Ministry of Energy and Natural Resources to better regulate artisanal and small-scale gold mining activities. The one day workshop was attended by 32 participants:

No	Name	Institution
1	Dra. Halimah Syafrul	Ministry of Environment
2	Syaiful Bahri	Ministry of Environment
3	Yuning K. Purwandari	Ministry of Environment
	Amrizal	Ministry of Environment
4	Dr. Lana Saria	Ministry of Energy and Mineral Resources
5	Cucu Cakrawati	Ministry of Health
6	Heri Nugroho	Ministry of Health
7	Muhammad Hardi	Office of Mining, Province of Nanggroe Aceh Darussalam
8	Syahrizan Lubis	Office for Environmental Impacts Control, Province of Nanggroe Aceh Darussalam
9	Mulyadi	Office for Environmental Impacts Control, District of West Aceh
10	Maryanuddin Mukid	Office of Energy and Mineral Resources, Province of Bengkulu
11	Lusiani	Office of Environment, Province of Bengkulu
12	Novarita	Agency for Environmental Impacts Control, Province of West Sumatra
13	Danaswir	Office of Environment, District of Dharmasraya
14	Laode Muh. Nasihu	Office of Mining, Province of Southeast Sulawesi
15	Retno D.	Center for Research and Development of Technology for Mineral and Coal, Ministry of Energy and Mineral Resources
16	Muchtar Aziz	Center for Research and Development of Technology for Mineral and Coal, Ministry of Energy and Mineral Resources
17	Yayan Surya	Center for Research and Development of Technology for Mineral and Coal, Ministry of Energy and Mineral Resources
18	Mary Jean Brown	US-Centers for Disease Control
19	Tim Dignam	US-Centers for Disease Control
20	Peter Appel	Geological Survey of Denmark
21	Ladjiman Damanik	Association of Indonesia Mining Professional
22	Leoncio D. Na-Oy	ASGM Miner of the Philippines
23	Resa Raditio	Indonesian Center for Environmental Law
24	Ahmad Safrudin	Indonesian Lead Information Center/KPBB
25	Alfred Sitorus	Indonesian Lead Information Center/KPBB
26	Armyrn Gita	Yayasan BaliFokus
27	Andita P.	Yayasan BaliFokus
28	Bardolf Paul	Yayasan Tambuhak Sinta
29	Sumali Agrawal	Yayasan Tambuhak Sinta
30	Dino Mika	Yayasan Tambuhak Sinta
31	Budi Susilorini	Blacksmith Institute
32	Hendra M. Aquan	Blacksmith Institute

The workshop discussed topics that included policy, fieldwork and keywords that must be considered in developing National Strategic Plan:

No	Name & Speaker	Highlights
1	<p>Opening Speech Dra. Halimah Syafrul – Assistant Deputy Minister for Hazardous and Toxic Substances On behalf of Deputy Minister for Deputy Minister for Hazardous and Toxic Substances and Waste Management Ministry of Environment</p>	<ul style="list-style-type: none"> • Artisanal and small-scale gold mining operations in Indonesia still use mercury, while community awareness toward the danger mercury is still low.
2	<p>ASGM Profile in Indonesia : Preliminary Result on ASGM Database and Discussion for development Budi Susilorini, Indonesia Country Coordinator, Blacksmith Institute</p>	<ul style="list-style-type: none"> • The creation of a map of ASGM and mercury hotspots which utilized existing data from Ministry of Energy and Mineral Resources, Yayasan BaliFokus and Blacksmith Institute. The profile also included information on numbers of hotspots and operation units, amount of mercury used and gold yield, source of mercury, and mercury trade in Indonesia.
3	<p>National Regulation on Management of Hazardous and Toxic Substances, and International Cooperation Dra. Halimah Syafrul – Assistant Deputy Minister for Hazardous and Toxic Substances, Ministry of Environment</p>	<ul style="list-style-type: none"> • The amount of mercury that is illegally imported to Indonesia is far more than the legally and registered imported mercury. • National regulation on management of hazardous and toxic substances: Government Regulation Number 74/2001 (Peraturan Pemerintah No. 74 Tahun 2001), but the enforcement is weak. • Indonesia is committed to legally bind instruments on mercury, and has taken steps to control mercury use, including forming a mercury technical group that consists of representatives from relevant government institutions.
4	<p>National Regulation on ASGM Operation in Indonesia Dr. Lana Saria, Ministry of Energy and Mineral Resources</p>	<ul style="list-style-type: none"> • The Government has regulated permits for artisanal mining in Government Regulation Number 78/2010 (Peraturan Pemerintah No. 78 Tahun 2010). • As for ASGM issue, Ministry of Energy and Mineral Resources encourages efforts to reduce mercury use and to shift to environmental-friendly techniques as well as building center for amalgamation and cyanidation to minimize and to control the impacts from both process and tailings.
5	<p>Major Mercury Disaster Threatening Indonesia : Borax Method as Mercury Free Alternative Technique Peter Appel, Geological Survey of Denmark</p>	<ul style="list-style-type: none"> • Mercury is dangerous for human health and it will impact for generations. Staple foods, i.e. rice and fish, are also contaminated with mercury. • The Philippines and Indonesia are noted as the biggest contributors of mercury emission from ASGM due to whole ore amalgamation process. • Borax method has been successfully implemented in part of the Philippines as mercury-free solution, but not yet applicable in Central Kalimantan due to low gold concentration in ore. Further geological assessment is necessary.
6	<p>Fieldwork Progress Report : Preventing Mercury Emission from Traditional Mining Activities Sumali Agrawal, Yayasan Tambuhak Sinta</p>	<ul style="list-style-type: none"> • On the whole ore amalgamation process, 2-4 kilos of mercury are added to each ball mill and it will be turned into a fine powder. The tailings are then sent to cyanide tank will form cyanide and mercury complex that is suspected for negative impacts.

		<ul style="list-style-type: none"> • Mercury that is discharged to bodies of water will get into food chain and turned into methyl mercury accumulated in fish with health risk potential for humans. • Interventions have considered many factors, including types of ore, types of existing techniques, and capital availability. • YTS has successfully promoted retorts, water box condensers and mercury recharging method. Recently, YTS promoted the sluice box to capture mercury from concentrate before it is sent to the cyanide tank.
7	<p>Discussion : Action Plan for Initiating National Strategic Plan for ASGM in Indonesia Ahmad Safrudin, Indonesian Lead Information Center/KPBB</p>	<ul style="list-style-type: none"> • Technology transfer (best applicable technology/best environmental practice); • Identification of relevant stakeholders and responsibilities of each stakeholder – allies and enemies); • Social and economic issues; • National Action Plan; • Source and suppliers of mercury; • Goals; • Mining with minimum environment destruction; • Formulation of the right approaches; • Tribal approach which is identical to mining activities; • Integrated regulation; • To reduce mercury demand; • Involvement of NGOs and collaboration with local NGOs; • Education to mining community is important; • Law enforcement; • Area controlling (to reduce numbers of illegal miners); • Sustainable community empowerment; • Eco-labeling; • Impact assessment – using bio marker and comparison with non mercury location; • Effective communication strategy (need for network formation?); • Economical benefit; • Permit; • Special regulation on ASGM; • Miners to miners communication; • Involvement of community leaders; • Development in international issues; • Change on consumptive mind set; • Community as the subject and to be involved for problems identification; • Local champions; • Cutting mercury trade to ASGM; and • Technical team in provincial level is directed to applications in the field.



Dr. Lana Saria from the Ministry of Energy and Mineral Resources delivering her presentation titled “National Regulation on ASGM Operations in Indonesia”



Alfred Sitorus from the Indonesian Lead Information Center/KPBB suggesting the importance of investigating the source and lifecycle of mercury in Indonesia

The second multi-stakeholder meeting took place in Jakarta on December 4, 2012, with participants from the Ministry of Environment, Ministry of Energy and Mineral Resources, and Blacksmith Institute. The Ministry of Environment and Ministry of Energy and Mineral Resources provided a progress update concerning the development of a National Action Plan for artisanal and small-scale gold mining in Indonesia.

Blacksmith Institute also provided a progress update on the baseline data and project implementation, with participation from field partners. Blacksmith also presented the next action plan with regard to ASGM sector development and borax pilot technologies. This prompted a discussion on development, dissemination, and application of mercury-free techniques throughout the mining community as part of the National Action Plan, as well as the direction for program planning and development in the future.

The outputs of this discussion was further clarification of the development of the National Action Plan for artisanal and small-scale gold mining in Indonesia. Additionally, baseline data was shared and the next steps were outlined for going forward with mercury-free trainings. During the discussion, Blacksmith Institute presented progress updates and next steps:

No	Activity	Highlights
1	Presentation by Blacksmith Institute	<ul style="list-style-type: none"> • Action Research was conducted in Central Kalimantan in partnership with Yayasan Tambuhak Sinta. • Activities included: <ol style="list-style-type: none"> 1. Technology intervention, in which 90 retorts were distributed and 50 water-box condensers were installed. It was estimated 3,588 kg of mercury was captured using the new retorts and water-box condensers equipment during project implementation from September 2011 to June 2012.

		<ol style="list-style-type: none"> 2. Other equipment included 10 sluices which were distributed to capture mercury from tailing and electrolysis kit to re-activate used mercury. 3. The project also completed field trials and field demonstration of mercury-free techniques using concentration and gravity separation, i.e. borax, sluice box and shaking table. 4. Health education to raise awareness and encourage women to be more pro-active. 5. Main health messages focused on: <ol style="list-style-type: none"> a. Babies and pregnant women are the most vulnerable target of mercury poisoning; b. Amalgam and mercury should not be burned inside; and c. Mercury that is discharged to the environment will turn into health threat to children growth. <ul style="list-style-type: none"> • Both activities were addressed to miners and processors, gold buyers and their families, and most importantly women and children. • Various media were used to deliver health messages, including height charts, brochures, stickers and direct consultations. • Moreover, YTS conducted seminars and trainings to disseminate information about the project, especially technical interventions and health education that had been done. Also, trainings-of-trainers were conducted for local capacity building. • For discussion on development of the National Action Plan, Blacksmith Institute referred to the National Action Plan that has been successfully developed by the Government of the Philippines, which comprises background and national situation, problem statement, goal, objectives, implementation strategies, activities and timeframe matrix, budget, evaluation and monitoring, and communication plan. • Site and laboratory assessments were conducted by Blacksmith Institute in collaboration with several institutions, including: <ol style="list-style-type: none"> 1. Agency for the Assessment and Application of Technology (BPPT); 2. Office of Energy and Mineral Resources of Gorontalo Regency and Banyumas Regency; 3. International Research Center for Management of Degraded and Mining Lands (IRC-MEDMIND); 4. Geological Survey of Denmark and Greenland (GEUS); and 5. Mt. Emerald Workers Cooperative of the Philippines. • Plan for 2013 – 2015: With fund from Global Alliance for Health and Pollution (GAHP) amounted to US\$ 250,000, Blacksmith Institute in partnership with GEUS, Mt. Emerald, YTS and BPPT will implement a project that is aimed to reduce mercury emission and its impacts to environment and health of community of artisanal and small-scale gold mining in
--	--	--

		<p>Indonesia by adopting South-South technology transfer method in grass root level.</p> <ul style="list-style-type: none"> • Activities are divided into two parts: <ol style="list-style-type: none"> 1. Technical investigations of gold ores being utilized by small-scale gold miners in Indonesia, including field investigations at sites using whole ore amalgamation, test mercury free process and laboratory investigation. 2. Teaching and training artisanal and small-scale gold miners in the environmentally benign borax gold extraction method. • Trainings are planned in 4 locations: Central Kalimantan, Central Java, Gorontalo, and Sumbawa. • Final National Workshop is scheduled for February 2013.
2	Discussion	<ul style="list-style-type: none"> • Ministry of Energy and Mineral Resources, as the leader of the National Action Plan development team, announced that the document is underway. It has been intensively discussed with the Government's relevant ministries, but it is not ready to share yet with institution other than the team. • They also informed the group that the document is developed by adopting UNEP guideline with reference from the National Strategic Plan that has been developed by the Government of the Philippines and Cambodia. • Both Ministry of Environment and Ministry of Energy and Mineral Resources positively responded to initiatives in promoting mercury-free techniques. However, they emphasized the importance of knowing the health impact of any technique or chemical substances that will be introduced. Environmental and health damages as caused by mercury must be avoided.

The third national workshop was held in Palangka Raya from February 28th to March 1, 2013. This workshop was to conclude the project. This national workshop disseminated the results of the site assessment and borax training work that had been completed. Blacksmith Institute and partners reported back on the conclusion of the project. Additionally, information was disseminated on the results of the action research component, "Preventing Mercury Emissions from Traditional Mining Activities". The workshop was attended by 43 participants from a variety of institutions:

No	Name	Institution
1	Fery Huston	Min. of Environment
2	Yunik Kuncaraning	Min. of Environment
3	Lana Saria	Min. of Energy and Mineral Resources
4	Jajat S.	Min. of Energy and Mineral Resources
5	Ifan Nefawan	Min. of Health
6	Y. Yudi Prabangkara	Agency for the Assessment and Application of Technology (BPPT)
7	Abdul Haris	Agency for the Assessment and Application of Technology (BPPT)
8	Elizabeth Ardan	Indonesia Center for Environmental Law (ICEL)

9	Antonius Adi Wahyono	Office of Mining and Energy, Banyumas Regency, Province of Central Java
10	Junaidi	Office of Mining and Energy, Banyumas Regency, Province of Central Java
11	Sugiswo	Office of Mining, Province of Gorontalo
12	Dewi Krisnayanti	International Research Center for Management of Degraded and Mining Lands (IRC-MEDMIND)/University of Mataram
13	Rahmawaty	Office of Environment, Sumbawa Regency
14	Agus Salim Nur	Expert to Regional Parliament, Sumbawa Regency
15	Novarita	Office of Environmental Impact Control (Bapedalda), Province of West Sumatra
16	Armyn Gita	BaliFokus Foundation
17	Aseani Ariesta Widya Iswara	Center of Education and Training for Technology of Mineral and Coal (Pusdiklat Tekmira), Min. of Energy and Mineral Resources
18	Wahyu Agus S., ST	Center of Research and Development for Technolgy of Mineral and Coal (Puslitbang Tekmira), Min. of Energy and Mineral Resources
19	Noviany Sintha, ST	Office of Environment Control, Province of Central Kalimantan
20	Ir. Annediyenie Balantek	Office of Environment Control, Province of Central Kalimantan
21	Ina Arieny	Office of Environment Control, Province of Central Kalimantan
22	Jani Priambodo, ST	Office of Mining, Province of Central Kalimantan
23	Syahrizan Idris	Office of Environmental Impact Control, Province of Nanggroe Aceh Darussalam
24	Margareta Asi, SE	Office of Health, Province of Central Kalimantan
25	Feriso, SE	Office of Environment, Katingan Regency
26	Beben Agusthe, S.Hut.	Office of Environment, Katingan Regency
27	Bonapartei	Office of Mining, Katingan Regency
28	Doni Yossa	Office of Mining, Katingan Regency
29	Achmad Fauzi	Gols shop owner/Fauzi retort
30	Dina Berina	Center for International Forestry Research (CIFOR)
31	David Gottlieb	AusAID
32	Usman Tariq	United Nations Environmental Programme (UNEP)
33	Cynthia Indriani	Basel Convention Regional Center for South East Asia (BCRC-SEA)
34	Trina Ayuni	Basel Convention Regional Center for South East Asia (BCRC-SEA)
35	Sumali Agrawal	Yayasan Tambuhak Sinta (YTS)
36	Kulansi Konolius	Yayasan Tambuhak Sinta (YTS)
37	Dinomika	Yayasan Tambuhak Sinta (YTS)
38	Rut Dini PH	Yayasan Tambuhak Sinta (YTS)
39	Kartie Vitamerry	Yayasan Tambuhak Sinta (YTS)
40	Horma	Yayasan Tambuhak Sinta (YTS)
41	Franata	Yayasan Tambuhak Sinta (YTS)
42	Hendra M. Aquan	Blacksmith Institute
43	Budi Susilorini	Blacksmith Institute

The workshop included a field trip to the mining location in Galangan, Katingan regency, and Province of Central Kalimantan. The trip illustrated the technical intervention, which had been completed, as well as the work to reduce mercury emissions from gold processing in gold shops. The first stop on the trip was to gold shops along the main road in Kereng

Pangi. Participants were divided into five groups to interview the gold shop owners and fill out a questionnaire. Participants had a chance to see the water box condensers, which were installed in the shops to capture mercury vapor. The participants were then taken to Galangan to see the rain forest that has now been turned into a large desert as a result of artisanal and small-scale gold mining activities in the area.

After the field trip, the group exchanged information on the problems and obstacles that the project has faced. The discussion led to a larger discussion on the international attitudes and regulations concerning the ASGM sector. Participants had a classroom workshop that combined presentations, information exchange, and discussions:

No	Presentation/Speaker	Highlights
1	Final Report on “Indonesia Training and Technology Transfer on Reducing Mercury Use in Artisanal and Small-Scale Gold Mining”: Budi Susilorini/Blacksmith Institute	<ul style="list-style-type: none"> • During the project implementation, Blacksmith Institute continued collecting data from ASGM sectors in collaboration with local Agency for the Assessment and Application of Technology (BPPT) and IRC-MEDMIND (International Research Center for Management of Degraded and Mining Lands. • Data from site assessments include: <ul style="list-style-type: none"> ○ Estimated 250 ASGM hotspots in Indonesia ○ Estimated 300,000 of miners in Indonesia • Use of Data: <ol style="list-style-type: none"> 1. Information sharing during multi-stakeholders meetings; 2. To provide input to the Government on the importance to manage toxic and hazardous substances; 3. As a reference for future programs. • Multi-stakeholder Meetings <ol style="list-style-type: none"> 1. National Workshop 1: Jakarta, December 13, 2011 2. Small group discussions: <ul style="list-style-type: none"> ○ Small Group Discussion 1 : Jakarta, March 28, 2012, with Min. of Environment, Min. of Energy and Mineral Resources, and Min. of Health ○ Small Group Discussion 2: Jakarta, December 4, 2012, with Min. of Environment, and Min. of Energy and Mineral Resources 3. National Workshop 2: Palangka Raya, February 28 – March 1, 2013 • Action Research in Central Kalimantan in partnership with Yayasan Tambuhak Sinta.
2	Final Report on Action Research “Preventing Mercury Emission from Traditional Mining Activities”: Sumali Agrawal/Yayasan Tambuhak Sinta	<ul style="list-style-type: none"> • Project was implemented in 6 regencies (i.e. Kotawaringin Barat, Murung Raya, Katingan, Gunung Mas, Kapuas, and Pulang Pisau) and 1 municipality (i.e. Palangka Raya) in Central Kalimantan Province. • Actions research combined technology intervention to reduce mercury emissions (i.e. retort and water box condenser), to reduce demand for fresh mercury (i.e. electrolysis kit and gravity separation using sluice box), and to do experiments on non-mercury techniques; and health awareness campaign. • 90 retorts were distributed and 50 water box condensers were installed: 3,588 kg of Hg were recovered during

		September 2011 to June 2012.
3	Highlights from the INC 5 in Geneva and Its Impacts to ASGM Sector in Indonesia: Yunik Kuncaraning/Min. of Environment	<ul style="list-style-type: none"> • Minamata Convention on Mercury was agreed in Geneva on January 19, 2013, that includes ASGM; emission to the air, and mercury discharge to soil and water; and development of the national implementation plan. • Benefits: to increase the environmental quality, to protect human health, and to encourage the development of environmental friendly materials and processes. • Government next action: intensive coordination with relevant stakeholders, communication forum, monitoring of mercury supply and use, and banning amalgamation in gold processing.
4	Progress on Development of the National Action Plan for ASGM in Indonesia: Lana Saria/Min. of Energy and Mineral Resources	<ul style="list-style-type: none"> • What has been done: the establishment of Technical Team for developing the National Action Plan, joint site assessments, and developing the draft of National Action Plan which is addressed to eliminate mercury in ASGM. • Outlines: background, national summary, priority of targets and objectives, methodology, national action plan, budget, evaluation and monitoring, and international support. • More detail in below paragraph.
5	Information Sharing on ASGM Project in Province of West Nusa Tenggara: Dewi Krisnayanti/IRC-MEDMIND/Univ. of Mataram	<ul style="list-style-type: none"> • Cyanidation (<i>tong</i>) has replaced Hg amalgamation as the primary gold processing technology in Lombok. Ballmills are now used to grind rock for <i>tong</i>. • Impacts of ASGM in Lombok: positive (incl. hajj, clean water, festival, and social status) and negative (incl. conflict of interest, social jealousy, and weakening of social welfare). • IRC-MEDMIND has also been doing research on phytomining and phytoremediation.
6	BPPT Standing Position in ASGM Program in Indonesia: Y. Yudi Prabangkara/BPPT	<ul style="list-style-type: none"> • Objectives: to refine ASGM management in Indonesia, especially by reducing the use to hazardous substances (mercury, cyanide, etc.), turning the institution into a technology clearing house, disseminating environmental friendly techniques, and building local capacity. • Program was initiation in 2012 and targets in 2013 incl. to collect data from all sites in Indonesia, to collect experiences from worldwide, to identify and to build partnership with potential institutions, to coordinate technology assessment and application, and to define “action plan” synergy.

Ministry of Environment facilitated the establishment of Mercury Technical Working Group that consists of relevant stakeholders in the government institutions. Indonesia has been very active in Intergovernmental Negotiation Committee (INC), initiated by UNEP, to prepare Legally Binding Instrument on Mercury (LBI) to regulate mercury trade globally. As a result, the Government of Indonesia has agreed to the following:

- a. Restriction on mercury import for gold mining,
- b. To prepare national action plan for mercury elimination,
- c. To prepare national regulations to ban mercury use in gold mining, and
- d. To prepare alternative technology for mercury-free gold processing.

Ministry of Energy and Mineral Resources was appointed to lead the team for developing the National Action Plan that consists of Ministry of Energy and Mineral Resources, Ministry of Environment, Ministry of Home Affairs, Ministry of Health, the Indonesia Institute of Science (LIPI), and University of Indonesia. The National Action Plan is scheduled for implementation throughout 2014 to 2015 when mercury will be banned completely in artisanal and small-scale gold mining activities. Outline of the National Action Plan consists of:

1. Introduction;
2. National Summary;
3. Goal and Prioritized Objectives;
4. Methodology;
5. National Action Plan;
6. Budgeting and Funding;
7. Monitoring and Evaluation; and
8. International Support.

The National Action Plan drafting is also supported by progress in national regulations:

1. Mercury is toxic and hazardous substance (Government Regulation No. 18/2009 and No. 74/2001);
2. Limitation on mercury trade and distribution (Regulation of Min. of Trade No. 44/M-DAG/PER/2009 and No. 23/M-DAG/PER/9/2011); and
3. Establishment of a technical team on mercury management (Min. of Environment Decree No. 141/2011).

In summary, artisanal and small-scale gold mining in Indonesia is described as mostly illegal where environmental and safety aspects are ignored. Additionally, the activities cause economic, social-culture, and environment loss. There is deviation between normative and reality in mercury supply. Mercury can only be imported by particular parties and entered through particular ports, but there is intensive mercury trade in ASGM locations. 582 kg were registered as the amount of mercury imported in 2011, but mercury trade in just one ASGM mining location can achieve tens of ton per year. This means illegal mercury importation is still happening. Gold production from artisanal and small-scale mining sector is estimated 65 – 130 tons per year, while concession and mining license holders produced 111 tons in 2010. This means a big potential loss for state income.

The goal of the National Action Plan is to protect human health and environment from the negative impacts of mercury through the introduction of responsible ASGM practices with a focus on elimination of mercury use, adoption of safer and non-toxic gold processing techniques, while solving existing social, institutional, financial, and regulation issues. The four major objectives are:

1. Implementation of regulations,
2. Implementation of results from research and development of alternative gold processing,
3. Increasing level of awareness from stakeholders toward mercury danger, and
4. Accomplishment of elimination of mercury use.

The National Action Plan will be implemented using a methodology that combines development and implementation of national regulation; to strengthen institutional capacity; to encourage collaboration and partnership, research and development, and development of

a formal education curriculum. The National Action Plan itself is comprised of three components:

- Component 1 – legal framework and institutional strengthening;
- Component 2 – research and development;
- Component 3 – awareness raising and communication.

Components 1 will include evaluation and regulation development; evaluation of import mechanisms, stakeholder communication forums, building official competence, and the evaluation of the initiative role. Component 2 will include a comprehensive database on mercury use, alternative technologies, a health impact assessment, an assessment on the final status of mercury emission and exposure, and an assessment on mercury life cycle. Component 3 will include sensitization, training, and alternative technology demonstrations, media partnerships, training on alternative livelihoods, mercury danger included in the national curriculum of formal education, and the evaluation of change in awareness raising. The National Action Plan was drafted throughout 2012 into 2013. Stakeholders include Ministry of Energy and Mineral Resources, Ministry of Environment, Ministry of Health, Ministry of Trade, Ministry of Communication and Information, Ministry of Education and Culture, Ministry of Home Affairs, Ministry of Religion, Indonesian Institute of Sciences (LIPI), Agency for the Assessment and Application of Technology (BPPT), academic institutions, CSO's, and police. The National Action Plan is scheduled for implementation from 2014 to 2018 when mercury will be completely banned in artisanal and small-scale gold mining sector.

For budgeting and funding, the National Action Plan is expected to be implemented with financial support from national budget (APBN), regional budget (APBD), international and regional donors, and private sectors.

The three components of the National Action Plan will be monitored and evaluated by stakeholders, where evaluation will be done once a year and monitoring will be done twice a year. In the end, Indonesia positively responds to international collaboration, including collaboration to build capacity of stakeholders, technology, and finance for strengthening national capacity in an effort to eliminate mercury use in ASGM.

3.2.c. Hearing Session with Commission VII of People's Representative Council for Proposal to Ratify the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade

The Government of Indonesia signed the Rotterdam Convention in 1998 and in April 11, 2013, the Parliament finally ratified the Draft of Law on Ratification of Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. The Ministry of Environment facilitated the work and Blacksmith Institute was invited by the Parliament in a hearing session with the experts in January 31, 2013, together with representatives from Komite Penghapusan Bensin Bertimbel (KPBB) and Indonesia Center for Environmental Law (ICEL).

There are five main reasons why the Ministry of Environment urged the Parliament for the Government of Indonesia to ratify the Rotterdam Convention:

1. To protect the Indonesian people from negative impacts of certain hazardous chemicals and pesticides in international trade through regulating prior informed consent procedure. This is intended for protecting Indonesia from overuse and dumping, targeting certain hazardous chemicals and pesticides that are already banned in other countries, as it will cause environmental and human health problems;
2. To strengthen regulation and national policy concerning supervision and certain hazardous chemicals and pesticides trade procedures;
3. To obtain easy access for information exchange about certain hazardous chemicals and pesticides that are banned and regulated by common country parties;
4. To obtain opportunities for collaboration in financial and technology transfers to develop infrastructure and capacity; and
5. To build international cooperation to prevent and supervise certain hazardous chemicals and pesticides trade.

Blacksmith Institute was invited jointly with two other NGO's as resource persons to provide inputs and descriptions on the draft law for parliament's reference to discuss the draft with the Government of Indonesia. Blacksmith Institute presented on the dangers of mercury in ASGM citing the following:

1. Mercury is one of the hazardous chemicals that are regulated under the convention.
2. Mercury is extremely toxic and harmful. Mercury contamination can cause nausea, skin irritation, cerebral palsy, kidney/brain/neural system damages, and death.
3. Findings from the field showed that mercury resources in Indonesia are mostly imported.
4. Mercury is no longer used in pesticides in Indonesia, but it is estimated 1,000 tons of mercury is still used in artisanal and small-scale gold mining; the mercury is used in the whole ore amalgamation process and is overwhelmingly obtained from illegal markets.
5. Four most important reasons why the Government of Indonesia must ratify the convention: to support the government's efforts for tighter supervision towards international trade, especially illegal trade; to protect human health and environment; to encourage information exchange among parties for tighter international trade; and to provide accessibility to receive donor for technology and local capacity building.

3.3. Action Research

Research began in September 2011 and was carried out through June 2012. It focused on identifying appropriate mechanisms to reduce and eliminate mercury from gold processing. It included reducing mercury emissions from amalgam burning, reducing mercury from tailings, and eliminating mercury use in ore processing. This is a continuation of work that Yayasan Tambuhak Sinta has been implementing with UNIDO's support from 2006-2007 and Blacksmith Institute's support from 2009. Technical assistance was given by maintaining strong, ongoing relationships with the mining communities. Since 2009, interventions in Mt. Muro have received valuable technical advice from Dr. Kevin Telmer and the Artisanal Gold Council. More recently, Dr. Peter Appel and Geological Survey of Denmark (GEUS) and artisanal miner Leoncio Na-Oy have been invited to demonstrate the use of smelting as a viable mercury-free technique in Central Kalimantan.

3.3.a. Project Sites

Efforts to reduce mercury emissions in Central Kalimantan have been ongoing for about six years. They began in 2006 when the GEF/UNDP/UNIDO – Global Mercury Project in collaboration with Yayasan Tambuhak Sinta (YTS) gave technical assistance to miners in the Katingan District, Central Kalimantan. In 2009, the effort was continued by Blacksmith Institute in collaboration with YTS and has been primarily located in Mt Muro, Murung Raya District and Gunung Mas District. During project implementation, the intervention has been able to grow to include Katingan District, Kapuas District, Pulang Pisau District and Palangka Raya Municipality.

The recent program continued to focus on reducing mercury emissions through the distribution of appropriate technologies. Equipment was distributed in the field in conjunction with ongoing demonstrations that highlighted economic and social benefits of adopting improved technology. Fieldwork was focused in Mt. Muro where the levels of mercury emissions from amalgam-burning activities alone were estimated to be as high as 30 tons per annum in 2009. Hundreds of highly efficient retorts, with capacities ranging from one to fifty kilograms, have been distributed during this project, and have greatly reduced these emissions from amalgam burning. Ore processing in this area is largely conducted using whole-ore amalgamation, which results in the loss of mercury in the tailings up to 60 tons per annum. Efforts were made to replace this practice and find ways to reclaim the mercury or contain and treat the tailings.

3.3.b. Field Activities - Environment

Reducing Emissions from Amalgam Burning

Retorts and water-box condensers are proven technologies that have high adoption rates by miners, processors and gold shops. Sluices are also cost-effective and easy for miners to use, as they do not increase the workload substantially. All of these technologies were initially selected because they do not greatly alter the existing processes, and are, therefore, easy for miners to adopt. At the outset of intervention activities, primary emphasis was placed on building relationships and trust with the miners. Significantly reducing mercury emissions

(particularly from whole-ore amalgamation) requires a total change in processing methodologies for the miners. As a result, the transition to emissions-free from emissions-mitigating technologies is a gradual process. Although the main source of mercury emissions comes from whole-ore amalgamation, promoting the adoption of emissions capture at the burning stage has been an important bridge-building step that will enable project technicians to have deeper influence with these communities.

Steel retorts and water-box condensers were the two main types of equipment that were promoted to reduce emissions from amalgam burning. The project provided one-kilogram amalgam capacity retorts as well as custom-made retorts to meet the needs of various users. Water-box condensers are portable plastic units that are added-on to existing chimneys in gold shops in order to capture the mercury vapor from the amalgam burning process. A third piece of equipment that was given out was the mercury recharger kit, which operates on the principle of electrolysis, to clean mercury for reuse. This increases the effectiveness of mercury at recovering gold from concentrates and allows miners to recycle mercury multiple times.

The average processing shed at Mt. Muro utilizes around 100 kg of mercury for every 1,000 kg of ore that is processed. Prior to project interventions in 2009, miners would use locally made retorts, with 5kg – 30 kg capacities whenever large amounts of amalgam were to be burned. Lesser amounts of amalgam were simply burned in open chimneys with no recapture. The general rate of recovery from the large locally made retorts was less than 70%. By comparison, the large-capacity retorts supplied by the project have proven to be 99% efficient and will recover an additional five kilograms per day, on average. Assuming that the retort is used around 200 days per year, this would result in 1,000 kg of additional mercury captured by each retort over the course of one year.

The economic benefit to the miners through the reclamation of mercury has been a significant aspect in promoting more efficient retorts. The price of mercury has doubled from 2009 when mercury cost around US \$60 per kg if bought locally, and around US \$1,600 per drum (34.5 kg) if purchased in bulk. The water-box condensers, alone, which are popular in the gold shops, can recapture 80-90% of mercury. The average gold shop accumulates around one kg of mercury per month inside the water-box. The small retorts (1kg capacity) are factory-made and purchased in bulk from the supplier. YTS resells them at the same cost; therefore, the project subsidized the costs of distribution to the field. The larger retorts (10kg - 50kg) are manufactured by students at a local technical school and sold at a low cost to YTS, who then distributes them at-cost. Selling them guarantees that they are being adopted for general use. The smaller retorts are in demand by both individual miners and by processors; whereas, only processors adopt the large-capacity retorts as they accumulate very large quantities of amalgam that they burn at one time. Processors can choose to use small retorts often, or use a large retort less frequently. A small retort costs around \$35 and the largest retort, which includes a condenser, costs up to \$150. This is affordable for miners, as they recoup the costs within weeks by recovering mercury.

Water-box condensers are fixed installations that are suitable for gold shops or processor huts that already have chimneys installed in them. The cost of a water-box and blower set is around \$65 plus the additional PVC piping and is typically less than \$100 to install. YTS has evaluated the EPA mercury capture system but has opted to continue to promote the water-

box condenser instead, as it is preferable both for users and for the field staff for the following reasons:

- a. The blower provides ventilation and better worker safety as it draws the vapor away from the user. It requires electricity, but this is generally available.
- b. In hot countries, mercury evaporates off surfaces very quickly. Drawing the mercury into water prevents this and stores the mercury very effectively in a sealed plastic container.
- c. It is much safer and easier to recover the mercury from this plastic water-box than to scrape it off the impact plates located inside the chimney.
- d. The water-box condenser is easy to install, as it is only an add-on to the existing chimney pipe.
- e. It is cheaper to buy the materials, easier to transport and faster to install.
- f. Recovery is equivalent to the USEPA equipment.

There is great confidence that the mercury re-capture systems will continue to spread amongst miners. This is a major success in mitigating the amount of mercury vapor that miners and their families are exposed to. However, the greatest challenge will be in reducing the prevalence of whole ore amalgamation, which results in the greatest mercury losses to the environment through the release of untreated tailings.

Reducing Emissions from Whole Ore Amalgamation

It is critical that mercury emissions from whole ore amalgamation are significantly reduced. Initially, the project considered introducing sluices as the entry-point for interventions on the tailings emissions as they are simple to operate and cheap to manufacture. As their use was experimental, YTS did not charge processors for this equipment but have made and distributed 10 wooden sluices to different operators to see the rate at which miners would adopt this technology. By testing them together with the processors, a great deal has been learned about the characteristics of the residual mercury flour and the limitations on recovery. Blacksmith also manufactured a large steel sluice box and chute for testing the borax/smelting method. The processors are now using the sluices whenever they pump out their slurry, and they are able to recover some of the mercury and some additional gold.

The project promoted better techniques for gold concentration by introducing gravity separation amongst other methods. Various systems for obtaining a better quality concentrate were added to the fieldwork program beginning in September 2011. The intervention, which was originally aimed to examine the ability of simple sluice-boxes to recover gold, was slightly modified to capture mercury particles from the tailings piles. Sluices will capture much of the lost mercury and allow it to be recycled. The concentrate from the sluices can either be panned, or it can simply be returned to the tumbler in the next batch of processing. The project tested sluices in several locations to recover the residual mercury from the secondary ore (around 10 – 15 grams from each sack of ground ore before

cyanidation). This amounts to 200 – 300 grams of mercury per ton of secondary ore. Using sluices gives processors an immediate source of income. Additionally, the sluices clean the tailings before they are sent on to the cyanide vats. This is critical, as it will prevent much of the effluent currently escaping from the cyanide vats as soluble mercury-cyanide complexes. This effluent was originally being directly released into the headwaters of the Upper Barito River.



A modified large-capacity retort that is shorter than the original design, so it will fit into the stove and quicken the “cooking” time.



A small-retort designed and marketed by the local entrepreneur Pak Fauzi is effective for amalgam burning up to 1 kg.



A miner-to-miner demonstration, conducted in December 2011, that involved Leoncio Na-Oy of the Philippines (red shirt), Pak Fauzi (sitting) and local miners on using a sluice box to obtain a better gold concentrate, without the use of mercury.



Leoncio Na-Oy demonstrating the effectiveness of panning

3.3.c. Field Activities - Health

Beside technical interventions, the fieldwork incorporated health education, as the current level of awareness about mercury hazards is very low in most of the artisanal and small-scale gold mining communities in Central Kalimantan. The project promoted health awareness through direct counseling to miners and processors, gold buyers and their families.

YTS led an extensive Health Awareness Campaign for the Global Mercury Project in 2006. A lot was learned about how to deliver messages to different audiences at that time. At this stage, the project decided to separate the audiences and created an entirely new set of media materials. YTS worked with miners and processors, with gold buyers and their families, with women, and with children, as well as local agencies that provide social services. The brochure handouts that were developed targeted mercury users, in particular, but also provided a health warning to the community at large. Blacksmith distributed these materials primarily to families that operate gold shops and to ore-processors, taking the time to discuss and clarify the contents. These materials are suitable for use in ASM communities across Indonesia, so can continue to be distributed. There is one brochure that is specifically aimed at miners and processors (the users), which warns people of the dangers of using mercury. YTS has also finished creating new media specifically targeting women and children in affected areas.

YTS Field Program Officer Kulansi, explaining the content of “Save Yourself from Mercury Poisoning” brochure to a families in Mangkahui village



A height chart for measuring the growth of children was also created, as it was deemed it would be the most effective method to convey potential risks of mercury exposure on children. This was chosen, in part, because families can hang them in their homes, and it provides an easy to understand, visual picture. These were also put on the walls of health clinics and schools, as well as individual family houses. This has been very effective in aiding with the other education campaigns, and they have remained in situ for 5 years or more. The height charts also include stickers for children, as well as badges and bags. These were distributed directly to affected communities and also throughout two Health Awareness Events, at which time YTS invited health professionals, schoolteachers and NGO's to attend. They were also given media packets and instructed on how to deliver appropriate messages to communities affected by mercury.

Local health clinics are briefed on the signs and symptoms of mercury poisoning.



3.3.d. Technical Interventions

Technical interventions were performed in the city of Palangka Raya, in six major towns, and eight remote field sites. YTS has distributed ninety retorts and installed fifty water-box condenser systems to capture 3,588 kg of mercury during project implementation. Thus, the project has been successful to bring about significant reduction in mercury emission in Central Kalimantan. Additionally, ten sluices were distributed to ore-processors at Mt. Muro, which are now being used for recovering waste mercury from tailings. This recycling equipment not only has been providing economic and health benefits for the mercury users themselves, but also to surrounding communities.

Whole ore amalgamation has been the main issue that causes excessive use of mercury in gold processing, and Blacksmith also did work to reduce and eliminate mercury through the introduction of advanced gravity concentration techniques and technologies. The work first selected an appropriate design that would work for the local miners. Once the design was selected, several sluices were built from locally available materials. Two models of sluices were tested in the field in October and November 2011, but the whole ore amalgamation itself made it difficult for sluices to recover free gold due to the release of embedded mercury from the trommels. However, the sluices were reasonably effective at recovering the fine particles of floured mercury from the tailings; although, it remained difficult to consolidate these particles and extract them from the concentrates obtained. One shed was especially successful, having recovered six kilograms of mercury in two days, simply by using a sluice when relocating a tailings storage area.

Other techniques that were also tested by YTS and Blacksmith to replace whole ore amalgamation are the Borax Method and a Gold Wave shaking table. These activities were not funded by UNEP. The Borax Method was demonstrated at Mt. Muro with the assistance of two international experts: Peter W. Appel from the Geological Survey of Denmark and

Greenland (GEUS), and Leoncio Na-oy of the Benguet Federation of Small-Scale Miners in the Philippines (now Mt. Emerald Working Cooperative). This mercury-free method is used by over 15,000 small-scale miners in the northern Philippines. Since the cost of mercury has soared to over US \$160 per kilogram in Indonesia, this method provides important incentives for miners through reduced costs. This method was demonstrated in three separate locations in Mt. Muro.

3.3.e. Communication and Awareness Raising

Due to very low awareness about the mercury hazard in most ASGM communities in Central Kalimantan, YTS and Blacksmith set out aggressive health campaigns to deliver messages to all target audiences, including miners, processors, families, government and community-based organizations, particularly those working in health and education. Communication outreach was done by combining public health events, brochure distributions, and direct counseling in the field.

Two printed materials were prepared. One brochure was used to target mercury users, in particular, and also provided a health warning to the community at large. Families of miners and processors are also involved. Another handout was specifically produced for mothers and children who live in target communities with the expectation that they can influence the mindset of the miners. For this audience, Blacksmith and YTS developed a height chart to measure children's growth and complimentary stickers.

At the end of project implementation, Blacksmith and YTS produced a film titled "The Tailings Issue" which summarized what the project has done in reducing mercury emissions as well as efforts to test and demonstrate mercury free techniques. Mangkahui in Mt Muro, Central Kalimantan, was the main target area where whole ore amalgamation is in practice. Before the project inception, gold processors burned the amalgam using homemade retorts with 50% efficiency, but now they have already adopted environmentally safe retorts to reduce mercury contamination.

During whole ore amalgamation process, mercury is poured into the ball mills and gets pulverized and lost to tailings, which are dumped onto local bodies of water. Blacksmith estimated this whole ore amalgamation process in Mangkahui has resulted in 30 tons of mercury per annum used in the amalgam process and 60 tons of mercury per annum lost to tailings. Mercury price has increased, but gold processors are still using mercury because gold grain size is very fine, which is easily captured by mercury. High mercury prices, on the other hand, have encouraged gold miners and processors to recycle more mercury.

In this project, a health campaign was brought with a slogan to grow up healthy (tumbuh sehat) using media that was also specially designed to target women and children as the most vulnerable targets of mercury contamination. The more people become aware and understand about mercury hazards, the more they will be able to influence miners to change behavior. The environmental benefit to prevent mercury contamination downstream is another benefit of these campaigns.

3.3.f. Seminar and Training Events

February 2013, Blacksmith and YTS participated in an international conference in artisanal and small-scale gold mining held by the International Research Center for Management of Degraded and Mining Lands in Malang. During the field visit in Sekotong, Lombok Island, Province of West Nusa Tenggara, Blacksmith received interest from gold miners and processors when YTS and Blacksmith showed and presented equipment that had been promoted in Central Kalimantan to recover mercury and to reduce mercury emission.

Health presentations and awareness-raising were conducted in various events with different audiences, including a health awareness-raising campaign in Palangka Raya to the government and civil society. Moreover, health presentations were made to a respected authority as well as to Japanese researchers. A field trip to the gold mining area in Palangka Raya was included as part of the campaign to bring the spotlight of media attention. In May of 2013, Blacksmith conducted a training-of-trainers for the department of environment at the district level. A number of local non-government organizations also attended, YTS and Blacksmith delivered presentations, discussions and also conducted a field trip. Media materials and a trainer's handbook were provided for participants.

3.3.g. Seminar and Training Events

- International conference on ASGM in Malang
- Health awareness raising event
- Health presentation
- Training of trainers

5. Efforts on Artisanal and Small-Scale Gold Mining in Indonesia: Moving Forward and Challenges

4.a. Finalization of the National Action Plan for Artisanal and Small-Scale Gold Mining in Indonesia

As clearly mentioned by Dr. Lana Saria who represented Ministry of Energy and Mineral Resources in her presentation for the National Workshop 2 in Palangka Raya on March 1, 2013, the Government of Indonesia will finalize the draft for the National Action Plan. The Government of Indonesia will also revisit the Ministry Decree 1211.k/1995 by incorporating a motion to ban whole ore amalgamation.

4.b. Indonesia Center for Artisanal Mining

The initiative for creating a Center for Artisanal Mining came from Agency for the Assessment and Implementation of Technology (BPPT), University of Mataram in Indonesia, University of British Columbia in Canada, Massey University in New Zealand, and Institute of Geochemistry of the Chinese Academy of Science in China. This institution will be incorporating Center for Research Excellence in Artisanal Mining and Indonesia Training Center for Artisanal Miners. The Center will provide training and advanced

technology to ensure that ASGM mining communities and the environment are safe, healthy and prosperous. The Centre of Excellence will support the sustainable development of ASGM throughout Indonesia and will focus on mining practices, technology to recover gold, and the safe management of mining waste. The Centre will be led by Indonesian government and university departments in collaboration with international university experts, and will be supported by international aid programs.

The institution will be established with a vision: *to evolve artisanal miners into successful small-scale mining entrepreneurs that aim to build and respect environmental, social, health, and economic structures in their communities.* A clear mission statement adopted from the International Training Center for Artisanal Miners (ITCAM) in Ecuador, championed by Prof. Marcello Veiga of the University of British Columbia, Vancouver, Canada, which is *to contribute with education and technology to the transformation of artisanal miners into responsible small-scale miners while striving, through a collaborative effort, to help them reduce poverty and improve quality of life for workers and affected communities.* The INCAM mandate is to:

- Promote global, national and local awareness of artisanal mining issues;
- Develop appropriate technological and educational programs to meet local needs;
- Help artisanal mining communities improve their quality of life;
- Create opportunities for alternative livelihoods and enterprise in mining communities;
- Help artisanal miners increase mineral recovery, increasing profit margins;
- Help artisanal miners reduce the environmental, social, and health impacts of their practice;
- Assist governmental agencies in understanding technical issues in artisanal mining; and
- Assist mining companies address regulatory problems related to artisanal mining.

As part of the implementation of the National Action Plan for artisanal and small-scale gold mining, Indonesia led by the Ministry of Environment of Indonesia, has also defined a mercury phase-out strategy. The INCAM initiative will be supporting to identify, develop and implement non-mercury mining technologies throughout Indonesia.

In July 31, 2013, BPPT hosted a workshop to disseminate and obtain support and resources from relevant stakeholders, including Ministry of Environment, Ministry of Energy and Mineral Resources, United Nations Industrial Development Organization (UNIDO), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Canadian Embassy, New Zealand Embassy, Yayasan Tambuhak Sinta (YTS), BaliFokus Foundation, and Blacksmith Institute. The initiative will be divided into two phases; the first phase is to prepare an academic writing, in the form of a business plan, as to how this centre will be established, managed and operated. The first phase is expected to be finished within six months. The second phase will be an implementation phase, which is expected to come into effect in the first quarter of 2015.

4.c. A Knowledge Transfer and Trainings of Mercury Free Technique in Indonesia using Gravity Separation and Borax

Blacksmith Institute, which has been working in artisanal and small-scale gold mining in Indonesia, continues its commitment to combat mercury use in this sector. With financial support from the Global Alliance of Health and Pollution Fund, Blacksmith Institute

collaborated with Geological Survey of Denmark and Greenland (GEUS), Agency for the Assessment and Application of Technology (BPPT), University of Gadjah Mada, Mt. Emerald Workers Cooperative of the Philippines, and Yayasan Tambuhak Sinta (YTS) to implement a project in 2013 and 2014, in conjunction with this project, for a knowledge transfer and trainings of mercury free techniques using gravity separation and borax. 15,000 miners in the Philippines have successfully practiced this technique for years. Not only can it be economically beneficial, but it also minimizes the health and environment risks since there is no mercury usage.

The project was divided into two parts; part one was to conduct technical investigations of gold ores being utilized by small-scale gold miners. The activities included field investigations at sites using whole ore amalgamation, laboratory investigations, and to test the mercury free process. The second part was to teach and train small-scale gold miners the environmentally benign borax gold extraction method. (Note: Funding for borax-related activities has been provided separately by Blacksmith Institute).

5. Responsible Parties

Contact Details

Organization : Blacksmith Institute
Representative : Meredith Block
Title : Program Director
Address : 475 Riverside Drive, New York City, USA 10115
Country : United States of America

Organization : Blacksmith Institute
Representative : Budi Susilorini
Title : Indonesia Country Coordinator
Address : Jakarta
Country : Indonesia

Organization : Yayasan Tambuhak Sinta
Representative : Bardolf Paul
Title : Director
Address : Jl. Badak VII No. 2, Bukit Tunggal, Palangka Raya
Country : Indonesia

Organization : United Nations Environment Programme
Representative : Usman Tariq
Title : Consultant
Address : 11-13 chemin des Anémones
1219 Châtelaine, Genève
Switzerland