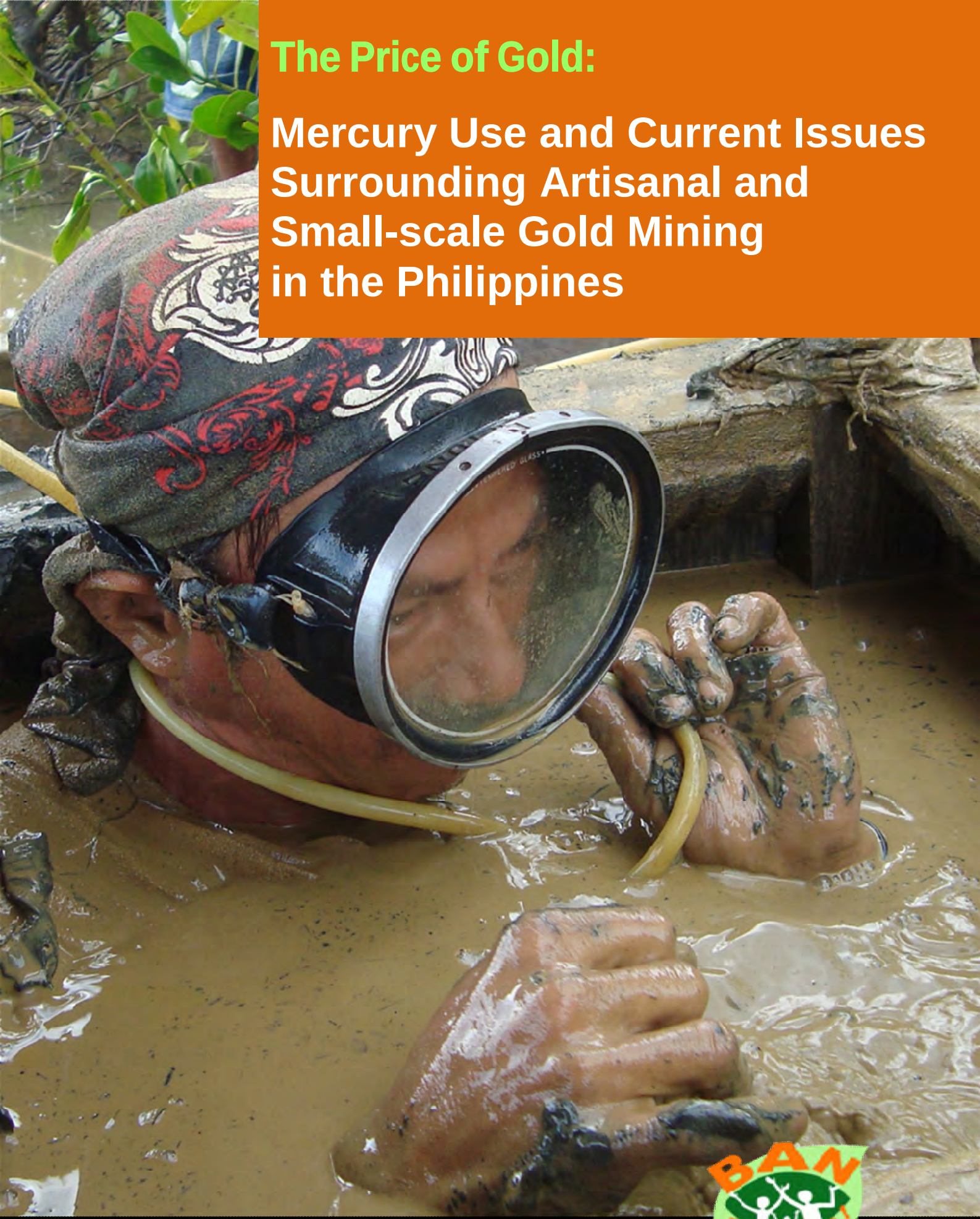
The Price of Gold:

Mercury Use and Current Issues Surrounding Artisanal and Small-scale Gold Mining in the Philippines



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By

Ban Toxics!

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Acknowledgments

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May this humble work help us better understand the complex issues surrounding artisanal and small-scale gold mining (ASGM) and contribute in bringing to fruition our vision for a mercury-free ASGM in the Philippines.

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Executive Summary

Artisanal and Small-scale Gold Mining (ASGM) presents a complex development issue. While it provides livelihood to a significant number of people worldwide and accounts for a sizeable volume of annual gold production, it is also confronted with various environmental, social and health concerns. The sector is also known as the largest emitter of mercury. The global mercury treaty which is currently prepared through series of intergovernmental negotiating committee meetings seeks to incorporate ASGM elements to reduce, and if feasible, eliminate mercury use in the sector and to protect human health and the environment. While the terms of the global pact are being considered, parallel efforts are underway to encourage migration of miners to mercury-free gold liberation techniques.

The Philippines is in the process of formulating its National Strategic Plan on ASGM with support from the United Nations Environment Programme (UNEP). To supplement this initiative, Ban Toxics conducted a study on the inner workings of ASGM focusing, among others, on the trading, use and emission of mercury, gold mining and production methods, and the human health and environmental impacts of mercury pollution. Ban Toxics found out that the problem of mercury pollution in the Philippines is widespread and that unless and until urgent and drastic steps are carried out to contain its further discharge into the environment, the effects will be disastrous. It also noted frequent shifts from mercury to cyanide and attempts to move to mercury-free gold production technologies.

Gold and Mercury Trading

Bangko Sentral ng Pilipinas has established five (5) gold buying stations nationwide to purchase gold at London-price. However, due to the distance of these buying stations to most mining communities and the difficulty of miners to meet certain criteria set by the bank, a significant portion of their production ends up in the black market.

Mercury supply for ASGM relies primarily on imported mercury which enters the Philippines either legally or illegally. The known sources of mercury for gold mining in the Philippines are the United States, European Union, Algeria, Saudi Arabia, Italy and Kyrgyzstan. The exemption of dental amalgamation in the application of the requirements for Chemical Control Order for mercury has resulted in the importation of much greater quantities than is actually needed for dental uses and the proliferation of dental clinics that supply mercury for gold mining. In some mining areas, mercury is available in retail stores from P4 to P10 per gram.

Mercury Use in ASGM

Mercury use in ASGM in the Philippines is said to commence from 70s to 80s. At present, ASGM accounts for the annual discharge of 70 metric tons of mercury into the atmosphere. The amount of mercury used by miners to produce a unit of gold varies depending on the stage when amalgamation is practiced. Whole ore amalgamation utilizes 10 to 25 grams of mercury to produce a gram of gold. Amalgamation of retrieved concentrates, on the other hand, uses about one to three grams of mercury per gram of gold. ASGM activities utilizing mercury has been reported in about 20 provinces in the country.

Since ASGM is a poverty-driven activity, the desire of miners to immediately produce income to bring food on the table has been identified as the main reason why mercury use has become widespread in the sector.

Environmental and health impacts of mercury pollution from ASGM

Several studies have been carried out in the Philippines to probe the effects of mercury pollution from ASGM. Results of these investigations reveal that drinking waters and river systems have exceeded recommended water quality criteria due to mercury contamination, marine species such as mollusks and fishes have mercury levels that are more than the allowable limit, while people that were examined, mostly children, miners and their families exhibited symptoms of mercury intoxication.

ASGM Legal and institutional framework

Artisanal and Small-scale Gold Mining is principally governed by Presidential Decree 1899 and Republic Act 7076, also known as the People's Small-scale Mining Act. Other laws such as Republic Act 7942 or the Philippine Mining Act of 1995, however, carry provisions that have relevance to ASGM.

ASGM has been devolved to provincial and city local governments by virtue of Republic Act 7076 and the Local Government Code of 1991. Under Republic Act 7076, issuance of mining permits and licenses and the establishment of minahang bayan shall be the responsibility of the Provincial or City Mining Regulatory Board, a multi-sectoral body which shall be under the supervision and control of the Secretary of the DENR.

While most sectors decry the non-implementation of the important provisions of Republic Act 7076, others complain about the statute's irresponsive and antiquated provisions, which accordingly discourage them to formalize their operations. A review of the extant laws governing ASGM, plugging of the perceived legal loopholes and harmonization of conflicting provisions must therefore be undertaken to strengthen the legal regime for ASGM in the Philippines and encourage miners to legalize their operations. Formalization of miners facilitates monitoring of ASGM activities, better enforcement of ASGM laws and eventually, improved practices in the sector.

Recommendations

There is no silver bullet that can adequately address the complex issues surrounding ASGM in the Philippines. Care should be taken to understand the specific ASGM areas and the needs of the community for any effective intervention can take place.

Considering these constraints, to rationalize ASGM activities and improve governance of ASGM operations, these broad strategies, mechanisms and potential solutions to various ASGM concerns may be considered:

1. Stop the global supply flow of mercury by putting an end to primary mining of mercury and imposing mercury import ban
2. Provide technical support to ASGM in:
   a. exploration and delineation of mineral deposits;
   b. mineral inventory for extraction at the small-scale level;
   c. identifying areas that can be set aside by the provincial or city mining regulatory boards as People's Small Scale Mining Area; and
   d. studying gold ores properties to determine mercury-free gold liberation techniques
3. Provide needed working capital, credit facilities and suitable mining equipment to ASGM;
4. Organize and strengthen ASGM formal groups to reduce and eventually eliminate exploitation of miners
5. Develop coherent national policy on mining and streamline regulatory and administrative procedures to remove barriers for formalization.
6. Strengthen local mining regulatory boards
7. Increase awareness on mercury's toxic effects to miners, theirs families and affected communities

Ban Toxics also recommends for the government and civil society to initiate a dialogue to find out how and where does ASGM fit into national development. Oftentimes, ASGM is linked with sustainable development, but no concrete consultation with mining and other stakeholders have taken place. It is important to have a national process to determine the true place of ASGM in national development. The social, health and environmental costs that small-scale gold mining brings to society must likewise be weighed and efforts towards minimizing these external costs of gold production must be carried out before we seriously consider mainstreaming ASGM into the national development agenda.

Acronyms & Abbreviations

ASGM	-	Artisanal and Small-scale Gold Mining
BOE	-	Bank of England
BSP	-	Bangko Sentral ng Pilipinas
CMRB	-	City Mining Regulatory Board
CCO	-	Chemical Control Order
CIL	-	Carbon-in-Leach
CIP	-	Carbon-in-Pulp
DAO	-	Department Administrative Order
DENR	-	Department of Environment and Natural Resources
DMC	-	Department Memorandum Circular
DOH	-	Department of Health
DOLE	-	Department of Labor and Employment
DOST	-	Department of Science and Technology
DTI	-	Department of Trade and Industry
EMB	-	Environmental Management Bureau
EO	-	Executive Order
EU	-	European Union
GDP	-	Gross Domestic Product
GEUS	-	Geological Survey of Denmark and Greenland
IEC	-	Information, Education, Communication
INC	-	Intergovernmental Negotiating Committee
LGU	-	Local Government Unit
LSGM	-	Large Scale Gold Mining
MGB	-	Mines and Geosciences Bureau
MROD	-	Mint and Refinery Operations Department (MROD)
NCIP	-	National Commission on Indigenous Peoples
NIPAS	-	National Integrated Protected Area System Act
PCU	-	Project Coordination Unit
PD	-	Presidential Decree
PLGU	-	Provincial Local Government Unit
PMRB	-	Provincial Mining Regulatory Board
PSSMA		People's Small-scale Mining Area
QSP	-	Quick Start Program
RA	-	Republic Act
SAICM	-	Strategic Approach to International Chemicals Management
SSMC	-	Small-Scale Mining Contract
SSMP	-	Small-Scale Mining Permit

TWG	-	Technical Working Group
UN	-	United Nations
UNEP	-	United Nations Environment Program
UNIDO	-	United Nations Industrial Development Organization
WB	-	World Bank
WHO	-	World Health Organization

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Introduction

Constant surge in the price of gold and lack of livelihood opportunities especially in rural areas make artisanal and small-scale gold mining (ASGM) an attractive enterprise for a large number of people especially the poor who often embrace the risks associated with the trade in the hope of escaping from poverty. ASGM, which occurs in more than 70 countries, provides income to an estimated 10 - 15 million miners including 4.5 million women and 1 million children[1].The sector produces about 500 to 800 tonnes of gold per annum, which accounts for about 20 to 30 percent of the world's gold supply[2]. This production however comes with great cost to both the environment and human health. Behind these lofty figures are tales and trails of razed mountains, distorted landscapes, contaminated water bodies and miners exploited and exposed to occupational and health hazards. ASGM is also closely linked with the global emission of mercury. The sector is known to discharge at least 1000[3] tonnes of mercury per year, including 400 tonnes directly to the atmosphere[4]. Among the various regions, Asia has become the largest contributor of anthropogenic atmospheric mercury, accounting for over half of the global emission[5]. The unabated mercury release in ASGM as a consequence of poor practices poses serious long-term health and environmental hazards not only within the mining communities but also in adjacent regions.

The fact that mercury is one of the most dangerous health and environmental pollutants cannot be disputed. It is a potent neurotoxin that impairs brain function. Pregnant women, babies and young children are most susceptible to mercury's toxic effects. High levels of mercury exposure have been correlated to loss of coordination and memory, lower intelligence and hearing loss. It has also been linked to miscarriages and birth defects.

Artisanal and small scale gold mining thus presents a complex development issue fraught with intertwining challenges and opportunities. If conducted properly and with due regard to health, social and environmental considerations, the sector can generate significant economic benefits and in the process help ease or transform the negative impressions linked with it.

The international community has been taking notice of the problems wrought by global mercury pollution. World leaders have been training their sights towards fostering concerted international actions to deal with mercury's worldwide use, emissions and discharges. Hence, during the 25th UNEP Governing Council Meeting in February 2009, the participating governments agreed to form an international negotiating committee which effectively launched negotiations on a legally-binding international mercury treaty. The treaty is expected to be completed at the fall of 2013.

While negotiations on the details of the mercury treaty are initiated, parallel steps to restrict and reduce mercury use are carried out. The United Nations Environment Programme (UNEP), for instance, has embarked on activities towards building and strengthening ASGM partnerships and has initiated measures to help control mercury use and emissions. It has established regional projects in South East Asia, particularly Philippines and Cambodia under the Quick Start Programme (QSP) of the Strategic Approach to International Chemicals Management in cooperation with a number of interested partners. One of the projects under the QSP is the development of country strategic plans for ASGM which is designed to help improve practices and working conditions in the sector and enhance the quality of life of ASGM communities.

Photo: Luis Liwanag/SSNC

Objectives, context and methodologies

1. Objectives

The research aims to supplement the SAICM initiative in the development of a National Strategic Plan for Artisanal and Small Scale Gold Mining in the Philippines. The study will focus on investigating and uncovering the inner workings of ASGM in an attempt to provide a contemporary picture of the state of small-scale gold mining in the Philippines.

The research specifically seeks to:

a. Generate relevant data and information from previous studies and modestly attempt to establish the current state of ASGM in the Philippines;
b. Review existing laws on ASGM and mercury management, assess the extent of their implementation and determine gaps for policy formulation or reform;
c. Examine current mining practices and evaluate their viability taking into account economic, health and environmental concerns;
d. Determine facilitating as well as hindering factors for small-scale miners to adopt recommended alternatives;
e. Follow the trail of mercury in ASGM by investigating its source and its disposal;
f. Establish new data on health impacts of mercury pollution as well as the extent of mercury contamination in fishes and in determined critical sites through fish, air, and sediment sampling; and
g. Identify key players and their roles in the ASGM sector

Results of the study will also be used in developing information and training manuals and as basis for Ban Toxics to determine critical points of intervention to hasten migration towards reduced or mercury-free gold liberation techniques.

The research also attempts to verify extent of mercury pollution in 3 small-scale mining areas around the Philippines, focusing on water, soil, fish, and mercury vapor.

2. Context

ASGM in the Philippines employs a large number of people in the countryside with low level of incomes. Some mining operations are family enterprises, where women and children are actively involved in certain stages of gold production. Most small scale gold miners operate informally and often outside the reach of government rules and regulations. With the increase in gold prices and discovery of new gold rush areas, more people are lured into gold mining; hence, the number of miners may continue to increase in the coming years.

Most small-scale miners in the Philippines are operating without legal mining titles and often in areas where there are apparent conflicts with other resource competitors. Most mining communities also have either no or little access to clean water or basic health care services and are susceptible to break out of diseases.

Mercury use in ASGM remains widespread although cyanide is an emerging alternative. Small scale gold miners usually work with minimum and often completely without safety protection and pollution control measures. Most tailings ponds are discharged directly in rivers and streams. Lack of capital also force most mine workers to deal with local financers under terms dictated by the latter, often placing the workers on the losing end of the bargain.

The Philippines is replete with laws and regulations governing small scale gold mining. However, the seeming culture of tolerance and hands-off policy adopted by both the national and local governments has rendered ineffectual the enforcement of these laws and regulations.

Despite its many dangers, and notwithstanding the apparent lack or absence of an established and sustained support programs from the government, the lure of gold and the lack of economically viable alternatives for small-scale gold miners will allow the industry to thrive, and so with the problems associated with it.

3. Methodologies

Field research was undertaken in selected ASGM sites to gather information on the current gold

extraction and processing techniques, the socio-economic conditions of small-scale miners, mercury and gold trading mechanisms, ASGM structures, and local perceptions on the impacts of mercury use as well as other information necessary towards building a better understanding of the ASGM situation on the ground.

Samples of fish, sediments and water were likewise collected for laboratory examination following recommended protocols to determine extent of mercury contamination especially in critical areas.

The research also analyzed mercury vapor in certain ASGM sites utilizing a Lumex mercury vapor spectrometer to create a broader picture in terms of mercury contamination in the ASGM site.

Prior to actual fieldwork, a review of related literature and other materials culled from primary and secondary sources, e.g. web research, newspaper accounts and interview with officials from several agencies and other key stakeholders was done. The process has generated a comprehensive background information and fair understanding of the complex issues surrounding the industry.

ASGM Overview

Background

The Philippines is endowed with rich mineral resources. About 30 percent of its territory has been identified to have high potential of mineral deposits. Gold is one of the most important. Based on density of deposits per one-square-kilometer land area, the country is ranked third in the world. In 2009, the Mines and Geosciences Bureau (MGB) of the Department of Environment and Natural Resources (DENR) estimated the country's gold reserves at 5,080,785,289 tons[6], based accordingly on the bureau's consolidation of resource inventory data supplied by mining companies. Gold deposits have been reported in about 40 provinces[7].

Table 1. Philippine Gold Resource/Reserve Inventory, 2009

Region	Tonnage	Ave. Grade (g/t)
I	861,000	0.46
II	33,236,000	1.88
III	34,820	1.92
IVA	6,551,280	1.93
IVB	*NDA	*NDA
V	271,016,095	1.45
VI	338,400,000	2.53
VII	*NDA	*NDA
VIII	132,800	11.40
IX	30,660,304	0.96
X	1,073,000	5.28
XI	898,122,300	1.23
XII	2,180,000,000	0.24
XIII	327,707,085	1.04
CAR	992,990,605	3.30
TOTAL	**5,080,785,289**	**1.353**

**NDA – No Data Available*

Source: *Mines and Geosciences Bureau*

Gold mining is said to be an ancient industry in the Philippines. Even before and during the Spanish colonization, gold used to be an important barter and trade commodity. Gold mining in the Philippines can be traced back in the 3rd century when Chinese traders referred to Luzon as the Isles of Gold[8]. During this period, communities in Cordillera, Masbate, and Camarines Norte dig for gold and trade the precious metal for their household needs with Chinese merchants[9].

Spanish explorers have also chronicled conventional mining methods among small miners in some parts of the country. In Northern Luzon, it was reported that traditional miners use wooden pickaxes tipped with iron in chipping the ore in the tunnels. The ores are manually crushed until it is reduced to powder, then washed into the streams where the gold dust or grains were recognized by their gleam in the sunlight[10]. In Camarines Norte, nineteenth century mines were described to be consisting of shafts or wells dug to depths of 120 feet or more with the use of pickaxes and shovels, wooden wedges and bamboo scaffolding. Coconut oil lamps were used as lights while baskets were used in bringing up quartz ore. The ores are crushed in a wooden pestle or between rolled logs. Crushed ores are washed in shallow sluices or pans using a fixer, and then smelted with lime made from seashells[11]. In Mindanao, small miners recover gold from river beds by using wooden gold pans[12].

It is said that modern mining commenced in the country during the early part of the 20th century with the introduction of American technology and capital. From the American period to the 80s, gold production steadily increased, although it experienced sharp decline during the Second World War. The mining industry struggled from the mid 80s to the 90s although it experienced a brief boom in the late 80s when small scale mining and gold panning activities escalated in various regions of the country.

At the height of gold rushes from the late 80s to the 90s, mercury amalgamation was widely practiced. Mine tailings laden with mercury were indiscriminately discharged to the environment. In recent years, however, the advent of cyanidation and the increasing cost of mercury have reduced, albeit insignificantly, mercury releases from the sector. The growing demand for gold which lured small-scale miners to produce more gold within the fastest time possible still presents mercury amalgamation as an attractive option, especially for those engaged in subsistence mining.

The amount of mercury used by miners varies depending on when it is applied during the gold production process. For every gram of gold produced, miners practicing whole ore amalgamation utilize about 10 to 25 grams of mercury while those who practice amalgamation after grinding use about one (1) to three (3) grams.

There is yet no authoritative estimate as to the actual number of people engaged in small-scale gold mining in the Philippines. Studies however suggest that there are about 200,000[13] to 300,000[14] small-scale gold miners nationwide,

which includes close to 18,000 women and children[15]. ASGM also supports directly and indirectly the livelihood of about two million people.

ASGM Definition

The definition of artisanal or small scale mining varies from country to country because of the different set of criteria or parameters used. For decades, experts worked to devise universal definitions of "artisanal" and "small-scale" mining but were unable to reach a consensus[16]. Artisanal and small-scale gold mining (ASGM) is however popularly referred to as mining activities that use rudimentary techniques in extracting minerals, most commonly gold, by miners working in small-sized operations.

In many countries, artisanal mining and small-scale mining are often used interchangeably. However, the two are not without distinction. The former has often been regarded as purely manual and on a very small scale while the latter has some mechanization and is on a larger scale.

This distinction is not relevant in the Philippines in view of the legal definition given by Republic Act 7076, also known as the People's Small-scale Mining Act of 1991. The law describes small-scale mining as mining activities which rely heavily on manual labor using simple implement and methods and do not use explosives or heavy mining equipment[17]. Section 1 of PD 1899 specifically defines the limits of ASGM operation by allowing small-scale contractees to mine up to 20 hectares per permit and extract up to 50,000 metric tons of ore per year.

Nonetheless, the current legal definition of small-scale mining in the Philippines has been the subject of criticism by various sectors, claiming it to be outdated, irresponsive and unduly depriving the small miners the opportunity to expand their productive capacity. There is now a growing clamor for the review and updating of the small-scale mining laws, citing the need to allow subsistence miners to use power tools in order to beef up their gold-digging capacity and improve their income[18].

Classification of ASGM miners

Republic Act 7076 defines small-scale miners as Filipinos who voluntarily form a cooperative duly licensed by the Department of Environment and Natural Resources to engage in the extraction or removal of minerals or ore-bearing materials from the ground[19]. Under its implementing rules and regulations, however, small-scale gold miners in the Philippines may be classified as traditional and gold rush miners.

Traditional gold mining employs indigenous methods and is carried out by communities or tribes for collective benefit and somewhat self-regulated by social norms and ritual while gold rush mining attracts poor migrants and others who work at site until it is exhausted then move on to other gold rush area[20]. Some authors however try to distinguish the two types of miners by asserting that gold rush miners use chemicals such as mercury and cyanide while traditional miners do not.

The requirement for small miners to secure permit or license before they operate has practically rendered most small-scale mining operations in the Philippines illegal. The prohibitive cost and the demanding procedures to gain formal operation have dissuaded small-scale gold miners to apply for permits. Other miners are not simply aware of existing laws governing small-scale mining. Data obtained from the MGB shows that as of December 2007, there were only about 33 permits issued to small-scale gold miners covering more than 400 hectares gold mining areas[21].

ASGM Gold production

ASGM activities currently take place in more than 30 provinces. For the past 10 years, the Philippines' average annual gold production was reported at 36,457 kilos, putting the country consistently in the list of top twenty gold producing countries in the world. About 28 tonnes or close to 80 percent of the country's annual gold supply comes from the artisanal and small-scale gold mining sector. In 2009, Philippine ASGM

comprises about 10 percent of ASGM global production. The volume could be higher but since most of small-scale gold mining is operated without license, some of their production is unreported or unofficially accounted.

Large-scale mining companies on the other hand, are given the right to sell gold directly onto the international market without intervention from the Bangko Sentral ng Pilipinas[22], hence total production from the sector cannot likewise be accurately ascertained.

Table 2. Philippine Annual Gold Production (kilograms)

Year	Total	Small-Scale	Large-Scale
1997	31,199	14,062	17,137
1998	34,038	19,859	14,179
1999	31,050	17,045	14,005
2000	36,540	21,193	15,347
2001	33,841	22,656	11,185
2002	35,848	27,993	7,855
2003	37,843	31,473	6,370
2004	35,464	29,473	5,991
2005	37,488	32,117	5,371
2006	36,141	29,361	6,780
2007	38,792	31,193	7,599
2008	35,568	28,198	7,370
2009	37,047	26,112	10,935

Sources: *U.S. Geological Survey Minerals Yearbook; Mines and Geosciences Bureau; Bangko Sentral ng Pilipinas*

Gold trading structure

Pursuant to RA 7076, the Bangko Sentral ng Pilipinas has established gold buying stations. Although gold is purchased in Philippine pesos, the prices are competitive with those prevailing in the world. Gold sold to BSP must however conform to certain conditions set by the bank as to physical form, maximum dimension, weight and minimum assay. It bears noting, however, that Republic Act 7076 provides that BSP buys gold from ASGM regardless of volume or weight. BSP's current gold buying stations include the Mint and Refinery Operations Department (MROD) in Quezon City and its offices in the cities of Baguio, Naga, Davao and Zamboanga.

Gold produced by small-scale miners which meet the criteria are sold directly at the MROD or at BSP's buying stations which in turn bring them to MROD for refinement and conversion into London gold delivery bars. Some of the gold may also be manufactured into semi-finished material in the form of grains and sheets for re-sale to local jewelers and industrial users. The BSP may enter into a location swap transaction so that bars held in the bullion vault may be mobilized and made readily available for gold-related transactions in the international market[23].

Due to the difficulty of small scale gold miners to meet the standards set by the bank, and their distance to the gold buying centers, they sell their gold to independent gold buyers and jewelers at a lower price.

In Compostella Valley province for instance, about 60 percent of ASGM production is believed to be diverted into the black market[24]. In Benguet province, it is said that at least 40 percent are traded outside BSP. Accordingly, they are either sold to jewelers or illegally transported out of the country, hence, not included in the production report.

In determining the price of gold, the miners merely rely on the information supplied by local gold dealers. They first ask at least three local gold dealers to know the prevailing gold price. Others use cellular phones while others watch Bloomberg Channel to determine latest gold price. In the international market, gold units are mostly reflected in troy ounce. In the Philippines, troy ounce is converted into grams. Price of gold per gram depends on gold grade or "carat". The term "carat" is used to describe the purity of gold and is based on a total of 24 parts, where pure gold is known as 24 carat and those with lower carats have other metal components like copper or silver[25].

In the Philippines, gold carat is determined by using a weighing scale where the gold's weight in air and weight in water are first determined. The gold's weight in air is then subtracted with its weight in water. The difference is divided with weight in air. The quotient will be the specific gravity. The specific gravity indicates gold carat the value of which is specified in a chart provided by BSP to accredited gold traders. In some parts of the country, local gold dealers use an ordinary

stone where gold is rubbed after which nitric acid is poured on the scratched area. If no mark is seen or is hardly recognizable, the gold is of low carat but if the mark is very visible, the gold is of high quality. Their indigenous appraisal system has accordingly been proven accurate when tested with weighing scales.

Guidelines on BSP's Gold Buying Program

1. **Physical Form**
   a. Bar or disc (grains, powder, nuggets and flakes are not accepted)
   b. Should not contain mercury or amalgam in any quantity
   c. Should be free of slags and other foreign matters
   d. Should not bear any sign of metallic segregation or poured shortness
2. **Maximum Dimension**
   a. Bar Form: 9 inches long, 4 inches wide and 2 inches thick
   b. Disc Form: 4 inches in diameter and 2 inches thick
3. **Weight**
   a. Minimum weight of 200 grams per piece
   b. Maximum of approximately 300 troy ounce or 9.3 kilograms per lot
   c. Maximum weight of bar/disc shall be 64.30 troy ounce or 2 kilograms.
4. **Minimum Assay:** 30% per lot

Source: *Bangko Sentral ng Pilipinas*

Mercury use in ASGM

One of the earliest accounts of mercury use in the mining industry was recorded in 2700 B.C.E in Spain where the substance was used to amalgamate and concentrate precious metals. Mercury amalgamation became widespread by the Romans in 50 C.E. In 177 C.E., however, the use of elemental mercury for gold recovery was banned in mainland Italy, possibly in response to health problems caused by this activity.

Gold extraction using mercury was widespread until the end of the first millennium. From 1860 to 1925, amalgamation was the main technique for gold recovery worldwide, and it was common in the United States until the 1940s[26]. With the development of the cyanide leaching process for gold extraction, most miners abandoned mercury amalgamation.

Small-scale mine operators in South America, Asia and Africa, however, still resorted to amalgamation because they lack affordable alternative technologies. Widespread use of mercury in the Philippines is reported to have occurred from 70s to 80s.

In 2002, small-scale gold mining activities utilizing mercury have been recorded in at least ten provinces namely: Benguet, Camarines Norte, Negros Occidental, Zamboanga del Norte, Zamboanga del Sur, Bukidnon, Agusan del Norte, Agusan del Sur, Surigao del Norte and Davao del Norte[27]. There are also recent accounts of mercury use among the small-scale miners in Abra, Kalinga, Apayao, Oriental Mindoro, Compostella Valley, Isabela, Nueva Vizcaya and South Cotabato.

Why miners use mercury

There are plenty of reasons why mercury use is widespread in ASGM. One of the principal reasons cited by miners is that mercury produces quick money for their family's daily subsistence, after

which, they can still bring their mine tailings to cyanide processing plants for further recovery of gold. Another reason mentioned is that mercury is easy to use and is highly effective at capturing gold under field conditions. It is also very accessible and cheap. They can either buy mercury at retail stores or source it out from gold dealers. Apparently, the input cost for mercury is minuscule considering that it costs only P4 to P10 per gram while gold prices can be as high as P1,800 a gram. Other reasons cited are lack of awareness of the risks of mercury use and lack of knowledge of mercury-free gold production alternatives.

Mercury trade structure

Because of its unique properties, mercury is used in a wide range of products and processes. The identified sources of mercury include residual mercury from decommissioned chlor-alkali facilities, recycled or recovered mercury from wastes and mercury products, primary mercury from mercury mines and by-product mercury from

other resource extraction operations.[28] Most of these substances are mined in Algeria, China, Spain, Kyrgyzstan and Ukraine. Spain, once a leading producer of mercury from its centuries-old Almaden Mine, stopped mining in 2003, and production is from stockpiled material. In the United States, there are mercury occurrences in Alaska, Arkansas, California, Nevada, and Texas; however, mercury has not been mined as a primary metal commodity since 1992 hence mercury originating from the country comes from leftover stockpiles. The United States is the leading exporter of mercury[29].

In the Philippines, mercury mining also occurred in the province of Palawan from 1955 to 1976 producing 140 tons annually. Since its closure, however, the country's mercury supply relies primarily on imported mercury.

Most of the mercury flask reaching the miners do not reveal their sources, raising suspicion that they may have been shipped into the country illegally, more so that mercury trade for gold mining has accordingly gone underground in the last five to 10 years and is very secretive[30]. The known sources of mercury for gold mining in the Philippines are the United States, Italy, Saudi Arabia, European Union, Algeria, and Kyrgyzstan.

According to reports, most countries import much greater quantities of mercury than is actually needed for legal uses. The excess amount is sold to unsustainable practices such as ASGM through the black market. As the liquid metal passes through brokers on its way to a gold mine, it becomes very difficult to track. A flask of mercury can originate in Spain, make its way to major trade hubs like Singapore or Hong Kong and then get dumped in Indonesia or Philippines. Mercury also enters in the country legally, usually for dental use.

Local trading of mercury

Based on local interviews with mercury traders and miners, Manila is the main source of mercury for gold mining while Baguio City, Bacolod City, Davao City, Zamboanga City and Paracale, Camarines Norte are the secondary sources.

The exemption of dental amalgamation in the application of the requirements for Chemical Control Order for Mercury has resulted in the proliferation of dental clinics that supply mercury for gold mining. In fact, interviews with local miners revealed that mercury is sourced out mostly from dental clinics, which aside from supplying the substance, also operate as gold buyers. In some mining areas, mercury is available in retail stores from P4 to P10 per gram.

Photo: Luis Liwanag/SSNC

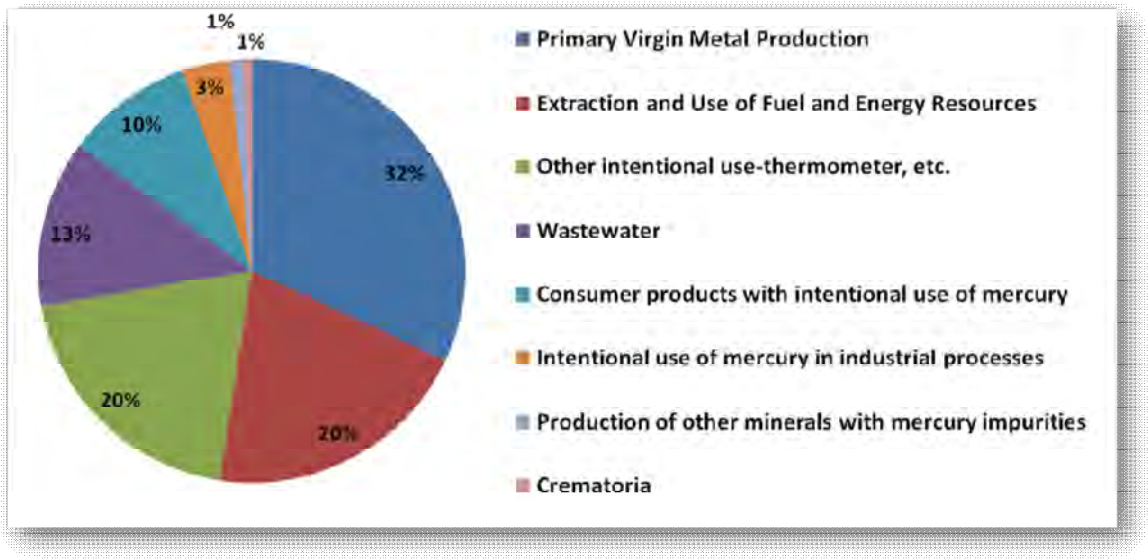
Estimated amount of mercury use and release from ASGM

Several attempts have been made to estimate annual mercury release from the industry. In 2008, a mercury inventory assessment conducted for the Philippines revealed that one of the principal sources of mercury emissions come from primary virgin metal production, primarily from small scale mining of gold and silver[31].

Table 3. Total Mercury Output or Emissions per Category (kg Hg/year)

Category	Mercury Emissions (kg/yr)	%
Primary Virgin Metal Production	74,769	31.95
Extraction and Use of Fuel and Energy Resources	47,862	20.45
Other intentional use-thermometer, etc.	46,653	19.93
Wastewater	29,685	12.68
Consumer products with intentional use of mercury	22,717	9.71
Intentional use of mercury in industrial processes	8,400	3.59
Production of other minerals with mercury impurities	2,415	1.03
Crematoria	1,530	0.65
Total	**234,031**	**100**

In 2007, an investigation made by the Geological Survey of Denmark and Greenland (GEUS) and the Maximo T. Kalaw Institute for Sustainable Development approximates five (5) tons of annual mercury emission from small-scale mining communities in Zamboanga del Norte and Camarines Norte. According to the assessment made by the Department of Health that was submitted to the UNEP in 2001, small-scale gold mining in Northern Mindanao alone emits 140 tons of mercury annually. Studies also show that in the early 90s, the small-scale gold mining sector accounts for 25 tons of mercury release annually[32] while another study reveals that between 1986 to 1988, about 140 tons of mercury was released into the environment from 53 mining communities[33].



Source: *Associated Mercury Plan of the Philippines; DENR-EMB, August 2008*

Gold extraction and processing

Artisanal and small-scale gold mining in the Philippines takes several forms: surface, underground and underwater. Surface mining is done along river beds and streams while underground mining requires digging up of tunnels to extract gold-bearing ores. In some mining districts in Camarines Norte, gold-bearing alluvial deposits are extracted through compressor mining where the miners descend in mucky waters using a plastic hose attached to a compressor and tucked inside their mouth for artificial air.

There are also notable shifts both in the source of gold ores and the technology employed to extract them. In the early 70s, the primary target of small scale miners was alluvial placer gold. Recovery was mainly through direct panning or by crude sluice boxes. In the 80s, high grade veins were discovered triggering series of gold rushes. Miners then shifted from surface mining to underground mining where vein ores are accessed through timbered adits, tunnels or stopes. The use of mechanized rod mills or ball mills, mechanical crushers, electric drills and cyanide processing plants became prevalent[34]. It is also said that miners use explosives inside the tunnels.

1. Gravity concentration

One of the gold processing techniques frequently employed by traditional miners is the use of sluice box. This method uses gravitation by letting the ore pass through a sluice, made of wood or concrete which is covered with materials, such as jute, carpet or corduroy cloth, which captures the gold grains when the ore and water mixture passes the sluice. The cloth is subsequently washed in a basin to recover the gold and other grain particles collected, which afterwards are panned to separate the gold from other particles.

2. Amalgamation

Amalgamation which involves the use of mercury is practiced in several ways. Miners who practice whole ore amalgamation feed mercury in the ballmills/rodmills immediately after the ores have been reduced into fine particles. The rod mill is then turned on again for about an hour where mercury accordingly “captures” the gold. The mercury-ore mix are then removed from the drum and placed on a large basin, then transferred to a washing pan where water is added to retrieve the mercury that is believed to be loaded with gold. Some miners, on the other hand, first segregate the concentrates either by panning or gravity concentration before applying mercury.

Mercury retrieved is squeezed using a piece of cloth to separate it from the gold. The remaining amalgam is blowtorched in a clay pot.

3. Cyanidation

Another method of recovering gold is through the carbon-in-leach, carbon-in pulp and heap leach systems where the cyanide solution dissolves the gold from the host rock. Carbon in leach method takes place for over 15 days after which the ore is run through a zinc oxidation process to extract the

gold. This method is predominantly practiced in Benguet.

Carbon-in-pulp technique is much faster in the sense that gold can be recovered within 72 hours by strongly agitating the mixed concentrates. Under this method, after the gold ore has been grounded into fine particles, lime and water are fed into the cyanide tank. After agitating the feed for about eight (8) hours, cyanide is added. After another eight (8) hours, activated carbon is applied. About 20 hours later, carbon is said to have captured the gold. It is then harvested through airlift using an air compressor.

Heap leaching is one of the methods widely used to process recovered mine tailings in Benguet. After gold is initially retrieved using gravitational method, mine tailings are further processed using heap leaching. Under this method, lime and tailings are placed in a tub with a filter at the bottom made up of small pebbles and sacks. Water with cyanide is added and after two (2) days, the tub is drained. The solution is then treated with zinc, then with nitric acid.

Refining

Most of the gold initially produced by artisanal miners is considered raw or impure. Hence, they employ various techniques including the use of chemicals to purify them. A great number of miners in Quezon, Nueva Vizcaya and in Itogon, Benguet use borax while burning the recovered gold particles to remove impurities. If the desired gold quality is not attained, gold is treated with a nitric acid. Most miners in Paracale and Jose Panganiban in Camarines, Norte use nitric acid to upgrade gold quality.

Environmental and health impacts of mercury pollution from gold mining

Mercury's toxic threats

Mercury is one of the most toxic metals known to man. It bio-accumulates in the food chain, and becomes increasingly concentrated at higher levels. Mercury poisoning can lead to skin irritation, fever, headaches, nausea, irritability, fatigue, loss of speech and memory, decline in sensory ability blindness, depression, kidney disease, tremors, brain damage, serious birth defects and even death.

The most popular case of widespread methylmercury poisoning occurred in Minamata, Japan in 1956[35]. For about thirty years, a local industry had dumped around 75 to 150 tonnes of mercury into Minamata Bay poisoning fish and thousands of people. Hundreds of people died and many more were crippled for life. It was reported that an abnormally high number of children experienced symptoms similar to cerebral palsy and autopsies of the developing brains of those affected in the mercury tragedy show widespread damage to all areas of the brain. In the mid-60s, methyl mercury poisoning also occurred in Niigata, Japan with 47 cases and 6 deaths reported[36].

During the 1970s, about 500 Iraqis died while thousands were disabled for life after eating bread made from mercury-treated grain seeds. Offspring of pregnant women who ate contaminated bread during pregnancy exhibited symptoms ranging from delays in speech and motor development to mental retardation, reflex abnormalities and seizures[37]. Guatemala and Pakistan have experienced similar poisonings.

In the Philippines, a number of students who were exposed to elemental mercury after a mercury spill allegedly occurred in their class experienced fever, itchy rashes, difficulty in breathing, chest pain and body malaise[38]. . One student succumbed to ravages of mercury poisoning and has exhibited Parkinsonism and nerve damage. There are also documented cases of mercury poisoning in some ASGM sites.

Philippine studies on mercury and its effects

Several studies have been conducted to probe the effects and impacts of mercury pollution due to small-scale gold mining in the Philippines.

In 2008, a report which summarizes more than 30 years of fish mercury research in Davao gulf, showed that mercury lowers children's IQ levels for life. The report also demonstrated that fetuses and babies are particularly harmed by mercury in fish[39].

In 2007, a paper presented during a scientific conference in Davao City revealed that mercury-tainted water from Diwalwal mining site which drains into the Agusan River poses a serious threat to the inhabitants. It was also reported that tests made on weekly diets of rice, fish and mussels of people in mining areas revealed the presence of mercury three times over the permissible levels[40].

In September 2006, the Department of Health presented in the conference on Chemical Safety for Sustainable Development in Budapest, Hungary the health and environmental risk assessment made among communities near an abandoned mercury mine especially those whose diet includes consumption of marine or aquatic products[41]. The study was carried out in Honda Bay and Palawan Bay and in villages near an abandoned mine that was in operation for more than 20 years. The assessment unveiled the following:

a. Four (4) fish species[42] had exceeded the recommended total mercury and methylmercury levels in fish while two (2) fish species namely saging and kanuping had exceeded the permissible levels for methylmercury.
b. While total and methylmercury in canned fish, total mercury in rice, ambient air and drinking water were within the recommended levels, additional mercury load from these sources may contribute to the over-all body burden of mercury among residents in the area.
c. Surface water quality at the mining area, Honda Bay and Palawan Bay exceeded

total mercury standards at NV>0.002 ng/ml.

d. Soil samples in Tagburos village and Honda Bay exceeded the EPA Region 9 Primary Remediation Goal recommended values for total mercury for residential purposes at NV>23 mg/kg.
e. Statistically significant results were obtained for infants when comparing the methylmercury levels in hair for both exposed and control sub-groups. Likewise, comparing the initial and final hair methylmercury levels among pregnant women/mothers in the exposed group showed statistically significant ($p<0.05$) results. Comparing the exposed and control sub-groups' mercury hair levels per sub-group showed statistically significant results among the following; (a) initial and final total mercury hair levels among children, (b) initial and final methylmercury hair levels among children, (c) final total mercury hair levels among pregnant women, (d) initial and final total mercury hair levels among mothers, and (e) initial and final methyl hair levels among mothers.

A 2005 study made by the Davao Regional Office of the Department of Health (DOH) estimated that 13.5 metric tons of toxic mercury from ASGM flow annually thru rivers into the Davao Gulf. Examination of fish samples from Davao Oriental, Davao del Sur and Davao City markets also revealed that they have mercury contents higher than the allowable limit of 0.3 microgram per gram.

In 2000, a study was commissioned by the United Nations Industrial Development Organization (UNIDO) to investigate the effects of mercury contamination in regions affected by the mining operations in Diwalwal, Monkayo, Compostella Valley. Results of said study showed that mercury level from the Naboc River, the major river system draining the operations in the gold rush area exceeds all drinking water quality criteria as well as recommended water quality criteria for the protection of aquatic organisms and their uses. The investigation also reported that mercury concentration in bottom and suspended sediment in the rivers exceeds the Toxic Effects Threshold for the Protection of Aquatic Life by factors of up to 55 and 166, respectively. Mercury levels in rice and other food crops were found to be within appropriate safety standards. Nevertheless, if fish or shellfish from either river are used as part of a staple regular diet, weekly intake levels of mercury (or methylmercury) may exceed WHO guidelines, with possible negative consequences on human health.

Part of the study commissioned by UNIDO was the examination of the mine workers from Diwalwal and in the impact barangays in the lowland area of Monkayo. The miners were found to exhibit severe symptoms of mercury intoxication such as fatigue, tremor, memory problems, restlessness, loss of weight, metallic taste and sleeping disturbances. People from the lowland area of Monkayo and surrounding barangays, on the other hand, complained of headache, vision problems and nausea, other symptoms which could be related to mercury. Of the workers tested, 55 percent of the ball-mill workers and 61 percent of the amalgam smelters were found to have mercury levels above toxicological threshold limits.

The finding of the UNIDO study in the Naboc River Basin was later re-confirmed by the assessment carried out by the Department of Environment and Natural Resources in 2009. According to its report on the geological and bio-physical characteristics of the Naboc River Basin, the water quality of the watershed is categorically critical because of its high mercury content[43].

In February 2000, Dr. Hirokatsu Akagi of the National Institute for Minamata Disease (NIMD) collected blood specimen samples from 49 residents of Aroroy, Masbate to determine mercury levels in their bodies. Results of laboratory examination showed that 35 out of 49 or about 71 percent have elevated mercury level which is beyond the normal level of 6.5µg/l.

In 1999, the Department of Health, in collaboration with the UP-National Poisons Control and Information Service investigated the extent of mercury exposure among schoolchildren in Apokon, Tagum, Davao del Norte, a community whose staple diet includes fish mostly coming from the nearby village in Pantukan which is actively involved in small-scale mining. The investigation found out high levels of mercury among schoolchildren examined, attributed mostly to their simultaneous exposure to inorganic and methyl mercury[44]. Of the fish species collected and examined, three (grunt, gopher and tuna) were also reported to have exceeded the WHO environmental criteria for mercury concentrations in fresh water fish from non-polluted areas. A related study conducted by DOH among gold miners in Kingking, Pantukan, Compostella Valley also revealed that mercury levels in blood samples taken from miners as well as soil and water

samples taken from the river exceeded the existing WHO standards.

The assessment conducted by the Department of Environment and Natural Resources on the impact of gold mining in Murcielagos Bay in Sibutad, Zamboanga del Norte also found out that the bay exceeded the allowable mercury limit for seawater and that stations nearest in proximity to the mining area tend to acquire higher concentrations in water, sediment, suspended particulates and organisms. Four out of 10 marine molluscs examined were also found to have as much as a factor of 5 more than the allowable limit[45].

A study on mercury contamination associated with small-scale mining in Benguet also noted that the seven subbasins of the Upper Ambalanga River and the subbasins immediately downstream are experiencing secondary mercury contamination from the small-scale gold mining and processing plants. The subbasins were found to have sediments containing total mercury concentrations higher than the estimated geogenic concentration of 0.060 µg/g. Results of the study also showed that Acupan, Dalicno and Batuang subbasins are the most contaminated and that the main Ambalanga River downstream from the seven subbasins is more than ten times as contaminated by mercury based on the geogenic estimate[46].

An attempt to quantitatively assess the economic cost of mercury pollution was made by the Philippine Institute for Development Studies in 1999. Site visits and interview with miners were done in Panique, Aroroy in Masbate, Tugos, Paracale in Camarines Norte and Diwalwal, Monkayo in Compostella Valley as study sites. Using the defensive expenditure approach in the economic valuation of mercury, the authors estimated that about PhP933.5M or less than a billion pesos is required annually for the purchase of protective equipment and facility to control the occurrence of future mercury pollution in small-scale mining in the country[47]. The estimate was made on the assumption that there are 250,000 small-scale gold miners in the Philippines, where 215,000 of them are involved in processing.

ASGM and mercury legal and institutional frameworks

The Constitutional mandate for the State to protect and promote the right to health of the people and protect and advance their right to a balanced and healthful ecology has paved the way for the enactment of environmental and health laws and regulations and the involvement of the Philippine government to a number of relevant international agreements.

On top of environmental and health considerations, however, small gold scale miners have to deal with issues pertaining to the ownership, allocation, exploration, development and utilization of natural mineral resources.

There is a growing call for the enactment of new laws to strengthen the legal regime for artisanal and small-scale gold mining in the Philippines in order to plug the perceived gaps of extant laws governing the same and to ensure that the best interests of small-scale gold miners and their families are promoted. The clamor, it is said, was impelled by the popular perception that while the national government seeks to revitalize the mining industry by providing incentives to large-scale mining companies, small-scale gold miners continue to grapple for survival amidst threats of displacement and the persistent issue of environmental and health risks associated with improper mining practices.

A review of the legal and regulatory framework affecting ASGM in the Philippines was undertaken to get a better understanding of the legal and institutional policies governing the sector.

Laws and policies on Small-scale mining

The principal laws governing small-scale mining in the Philippines are Presidential Decree 1899 which established small-scale mining as a new dimension in mineral development, and Republic Act 7076 which aims to promote, develop, protect and rationalize viable small-scale mining activities, generate more employment opportunities and provide an equitable sharing of the nation's wealth and natural resources.

Presidential Decree 1899, the first known law to govern small-scale mining in the Philippines was issued in 1984, prompted by the government's recognition of the increasing economic impact of the small-scale mining sector. The decree was intended to develop small mineral deposits, generate income for the poor and alleviate the living conditions in the rural area. It requires the holders of mining rights to secure small-scale mining permits/licenses which shall be valid for two years and renewable for like period. Holders of permits/licenses are exempt from the payment of all taxes, except income tax. Under PD 1899, applications of small-scale miners are processed with the Director of the Mines and Geo-sciences Bureau.

To further promote, develop, protect and rationalize small-scale mining activities, the Philippine Congress passed in 1991 Republic Act 7076. The law requires, among others, the establishment and implementation of a People's Small-Scale Mining Program to achieve an orderly, systematic and rational scheme for the small-scale development and utilization of mineral resources in certain mineral areas and address the social, economic, technical, and environmental concerns connected with small-scale mining activities. Republic Act 7076 did not repeal PD 1899. It only amended and supplemented certain provisions of the latter.

Republic Act 7076 also recognized the role of Bangko Sentral ng Pilipinas in strengthening the small-scale gold mining industry by mandating it to establish gold buying stations where gold produced by small-scale miners shall be sold at prices competitive with those prevailing in the world market regardless of volume or weight.[48] Other salient features of the law include:

a. Creation of a Provincial/City Mining Regulatory Board which shall be composed of the Department of Environment and Natural Resources representative as Chairman; and the representative of the governor or city mayor, as the representative of the governor or city mayor, as the case may be, one (1) small scale mining representative, one (1) big-scale mining representative, and the representative from a non-government organization who

shall come from an environmental group, as members.

b. Declaration of People's Small-scale Mining Areas and awarding of Small-scale mining contracts by the Board subject to certain criteria and conditions.
c. Registration with the Board of all persons undertaking small-scale mining activities.
d. Securing the consent of the cultural communities concerned and giving priority to cultural communities in the award of small-scale mining contracts.
e. Prohibition on the transfer, subcontracting or assigning of small scale contract
f. Establishment of a small-scale mining protection fund which is equivalent to 15 percent of the national government's share of the internal revenue tax or production share due the government.

While small-scale mining activities continue to be governed by Presidential Decree 1899 and Republic Act 7076, Republic Act 7942, also known as the Philippine Mining Act of 1995 carries provisions which have direct and indirect effect on mercury pollution and on the operations of small-scale miners. Republic Act 7942 exempts from real property tax and other taxes and assessments pollution control devices established by mining contractors while it penalizes firms causing environmental damage through pollution. It also imposes fees for mine wastes and tailings. The law likewise requires small-scale mining permit holders and contractors to secure an environmental impact report, a final mine rehabilitation/decommissioning plan, compliance certificate from the regional offices of the DENR's Environmental Management Bureau and submit a potential environmental and a community development and management programme (CDMP) duly approved by DENR's Mines and Geosciences Bureau.

Republic Act 7942 also lists down areas where mineral agreement or financial or technical assistance agreement applications are not allowed. The areas include, among others, those covered by valid and existing mining rights, old growth or virgin forests, proclaimed watershed forest reserves, wilderness areas, mangrove forests, mossy forests, national parks, provincial/municipal forests, parks, greenbelts, game refuge and bird sanctuaries as defined by law and in areas expressly prohibited under the National Integrated Protected Areas System (NIPAS) under Republic Act No. 7586, Department Administrative Order No. 25, series of 1992 and other laws. Areas already covered by small-scale miners are also closed for mining applications unless prior consent of the small-scale miners is obtained.

Allocation of mineral lands

Mining involves extraction of natural mineral resources. Under the so-called regalian doctrine, all natural resources, including natural mineral resources, are owned by the State[49]. As the owner, the State may pursue full control and supervision in the exploration, development and utilization of the country's natural mineral resources either through direct undertaking or by entering into co-production, joint venture, or production-sharing agreements. The declaration of State ownership over these resources and the different schemes by which they could be managed were designed to guard against (1) alien ownership, (2) control of a large amount of a resource by a few, and (3) regulation of large commercial extractive ventures[50]. The Constitution vests in the Chief Executive the power to enter into agreements with foreign-owned corporations involving either technical or financial assistance for large-scale exploration, development, and utilization of minerals[51]. It also grants Congress the power to allow small-scale utilization of natural resources by Filipino citizens.

The power of Congress to allow small-scale utilization of natural mineral resources has been delegated to the Provincial and City Mining Regulatory Boards (P/CMRB) by virtue of Republic Act 7076. Under this law, only the P/CMRB is with legal authority to issue small-scale mining permits and contracts, thus effectively withdrawing from the Director of Mines and Geosciences Bureau the exercise of said power. RA 7076 is also the governing law pertaining to the procedures and requirements for the processing and issuance of small-scale mining permits.

Republic Act 7942 grants the President the power to establish mineral reservations, when the national interest so requires and upon the recommendation of the Director through the Secretary. In mineral reservation areas, the State, through the DENR may directly undertake exploration, development and utilization or enter into agreements with qualified entities[52]. These entities may include small-scale mining groups.

Republic Act 7942 was the legal anchor used by the national government in issuing Proclamation No. 297 declaring 8,100 hectares located in Monkayo, Compostela Valley as mineral

reservation area to prevent the further degradation of the environment and to resolve the health and peace and order problems spawned by the unregulated mining operations in the area. Pursuant to Proclamation No. 297, the DENR Secretary issued DAO No. 2002-18 declaring an emergency situation in the Diwalwal Gold Rush Area and ordering the stoppage of all mining operations therein. Subsequently, the State, through the DENR, undertook directly the mining operations of the Diwalwal Gold Rush Area and awarded mining contracts to qualified mining entities.

1. Laws and policies on Mercury

Republic Act 6969, also known as the Toxic Substances, Hazardous and Nuclear Wastes Control Act of 1990 provides the legal framework for mercury in the Philippines. The law deals with the regulation, restriction or prohibition of the importation, manufacture, processing, sale, distribution, use and disposal of chemical substances and mixtures that present unreasonable risk and/or injury to health and the environment. DENR Administrative Order 1992-29, the statute's Implementing Rules and Regulations (IRR), include mercury and mercuric compounds (D407) in the table of prescribed hazardous waste. Republic Act 6969 and its IRR prescribe a general regulatory framework as procedures and requirements for hazardous waste management in the Philippines, prohibit the entry, transit and disposal of hazardous wastes into the Philippine territory and encourage proper management of hazardous wastes through minimization, recycling, treatment and landfilling of hazardous waste.

To further control the use and dispersion of mercury and mercury compounds into the environment, the DENR issued Administrative Order No. 97-38 or the Chemical Control Order (CCO) for mercury and mercury compounds. The order provides for additional requirements and procedures in the importation, manufacture, distribution and use of mercury and mercury compounds. It also lays down certain conditions in the treatment, transport, storage and disposal of mercury-bearing or mercury-contaminated wastes in the Philippines.

2. Related laws and regulations

Other laws and regulations that have direct and indirect relevance to small-scale mining and mercury use and emissions are the following:

a. National Integrated Protected Areas System (NIPAS) Act of 1992 (Republic Act 7586)

The law punishes the following acts within the Protected Area: (a) Dumping of any waste products detrimental to the protected area, or to the plants and animals or inhabitants therein; (b) Squatting, mineral locating, or otherwise occupying any land; (c) Constructing or maintaining any kind of structure, fences or enclosures, conducting any business enterprise without a permit; and (d) Leaving in exposed or unsanitary conditions refuse or debris, or depositing in ground or in bodies of water[53].

The establishment, disestablishment or the modification of boundaries of protected areas may only be made pursuant to an act of Congress.

b. Wildlife Resources Conservation and Protection Act (Republic Act 9147)

Republic Act 9147 which took effect in 2001 penalizes the dumping of waste products detrimental to wildlife, mineral exploration and/or extraction in critical areas[54].

c. Indigenous Peoples Rights Act (IPRA) of 1997 (Republic Act 8371)

Republic Act 8371 grants the indigenous peoples/indigenous cultural communities (IPs/ICCs) the right to develop their lands and natural resources, to safe and clean air and water, to regulate the entry of migrants into their domains and to protect their indigenous cultures, traditions and institutions. Unlawful intrusion upon any ancestral lands or domains is punished in accordance with the customary laws of the IPs concerned.

d. Ecological Solid Waste Management Act of 2000 (Republic Act 9003)

Republic Act 9003 includes household hazardous wastes (which include mercury-bearing and mercury-containing waste) within the category of special waste. This type of wastes are required to be segregated at source, properly stored and treated prior to disposal. Republic Act 9003 requires local government units to designate in their sanitary landfills a containment area for special wastes. The law prohibits the open burning of solid wastes.

e. Clean Air Act of 1998 (Republic Act 8749)

Republic Act 8749 provides for a comprehensive air pollution program which includes the implementation of air quality standards. Under the law and its IRR, incineration, or the burning of municipal, biomedical and hazardous wastes, a process which emits poisonous and toxic fumes, is prohibited. The Act likewise mandates the DENR to promote the use of state-of-the-art, environmentally-sound, and safe non-burn technologies for the handling, treatment, thermal destruction, utilization, and disposal of sorted, unrecycled, uncomposed municipal, bio-medical and hazardous wastes.

f. Clean Water Act of 2004 (Republic Act 9275)

Republic Act No. 9275 was enacted to provide for a program and regulations for the abatement and management of water pollution focusing on pollution prevention. The Act designates the DENR as the primary government agency responsible for its enforcement and implementation, more particularly over all aspects of water quality management. It grants the DENR the jurisdiction over all aspects of water pollution, to determine its location, magnitude, extent, severity, causes and effects and other pertinent information on pollution, and take measures, using available methods and technologies, to prevent and abate such pollution.

g. Pollution Control Law of 1976 (Presidential Decree 984)

Presidential Decree 984 prohibits the disposal into the water, air and/or land resources of the Philippines of any liquid, gaseous or solid wastes that will tend to alter their physical, chemical and biological properties or is likely to create or to render such water, air and land resources harmful, detrimental or injurious to public health, safety or welfare or which will adversely affect their utilization for domestic, commercial, industrial, agricultural, recreational or other legitimate purposes.

h. Local Government Code of 2001 (Republic Act 7160)

Enforcement of the provisions of the small-scale mining law as well as the pollution control law has been devolved to provincial LGUs by virtue of Section 17(3)(iii) of Republic Act 7160.

Basic structures and socio-economic conditions of ASGM study sites

In an attempt to obtain a better understanding of these concerns, aside from book and web researches, Ban Toxics endeavored to pay field visits and interact with ASGM stakeholders in eight (8) mining villages in the country.

1. Profile of ASGM study sites

a. Luklukan Sur, Jose Panganiban, Camarines, Norte

The municipality of Jose Panganiban in the province of Camarines Norte is formerly known as "Mambulao" which was taken from the word "mambulawan" which means bountiful in gold. The municipality is composed of 27 barangays and has a population of 49,028. When the gold industry boomed, other businesses flourished in the municipality, prompting some residents to call it the "Little Manila."

ASGM occurs in eight (8) barangays although mining activities is most active in Luklukan Sur where a new gold rush area was recently discovered. About 800 families in the barangay are involved in small-scale mining. Alternative livelihoods include fishing, farming and operating sari-sari stores. In 1998, the Luklukan Sur Small-Scale Miners Association was formed but was eventually dissolved after four years of existence.

Small-scale gold mining in Luklukan Sur is said to have taken place since the Spanish period, and so with the use of mercury which is popularly known in the area as *asoge*. There are about 150 tunnels and 200 rod mills in the barangay. Tailing ponds maintained by rod mill owners are released in the nearby creeks and eventually end up in the sea. The use of mercury in gold processing has accordingly been minimized with the introduction of leaching or cyanidation process. Even then, the current practice where 10 grams of mercury is utilized to produce one (1) gram of gold is still alarming.

Of the five (5) carbon-in-pulp plants established in Jose Panganiban, three (3) are found in Luklukan Sur.

Gold and mercury trading

Mercury used by miners in Luklukan Sur is supplied by gold dealers and hardware stores located in the poblacion barangays of Paracale and Jose Panganiban. Mercury is believed to be sourced out either directly from a pier in Batangas or in Manila. Cost of mercury ranges from 2,400 to 2,800 a kilo.

Gold produced by miners have purity ranging from 18 to 22 carats. These are sold to independent gold dealers in Jose Panganiban and Paracale and further traded to BSP in Naga City or Quezon City. Jewelry makers from Bulacan also seasonally go to Jose Panganiban to buy gold from the miners. Gold share of mine workers are sold to their financiers at a price dictated by the latter, often below the prevailing market rate. Prices are monitored by the financiers either by watching Bloomberg channel every 6:00 in the morning or by asking the gold dealers in the town center. In December 2009, price of gold ranged from P1,580.00 to P1,842.00 per gram.

b. Gumaus, Paracale, Camarines Norte

More than half of Paracale's 27 barangays are host to small-scale gold mining activities although the bulk of gold production is said to come from barangays Gumaus, Tugos, Palanas and Malagit. Mining boom in Paracale occurred in the 70s with the discovery of rich mineral deposits and high gold quality in Gumaus. Although surface mining which has been practiced since the Spanish period is still utilized, tunnelling has become prevalent, accordingly introduced by large scale mining companies then operating in the area.

Gumaus is situated 22 kilometers from the town proper. It has a land area of 1,320 hectares, where only about four (4) percent is devoted to agriculture. Most residents eke out a living

through fishing, farming and gold panning. Half of its 3,070 population are gold miners. There used to be an association of gold miners known as Samahang Magkakabod ng Gumaus, but this group is no longer active.

Gold-bearing alluvial deposits are also said to be extracted in the barangay through compressor. During the field visit, it was known that compressor mining is still practiced in Gumaus although children are no longer engaged in any mining activity.

There are less than 100 rod mills in barangay Gumaus. Tailing ponds from the rod mills, most of which are overfilled and leaking are discharged directly in nearby creeks and mangrove swamps.

Incidents of child labor used to be common in the barangay but this has been drastically reduced, attributed mainly to the implementation of Education Research Development Assistance (ERDA) Program and the creation of Barangay Council for the Protection of Children (BCPC) which paved the way for the establishment of Barangay Educational Assistance. Through this program, children previously employed in mining are provided with financial and material support for their education, while keeping them preoccupied with other worthwhile activities.

Gold and mercury trading

There is at present only one registered distributor of mercury in Paracale, Camarines Norte. However, mercury can also be sourced out from other non-accredited suppliers including hardware stores and a dental clinic in a nearby town. Mercury can also be bought at P2,400 to P2,800 per kilo. Rod mill owners and processors who also act as local financiers buy mercury at an average of one (1) to two (2) kilos a month. One *korporasyon*[55] in Gumaus can recover up to three (3) kilos of gold annually.
Gold purity in Gumaus also ranges from 18 to 22 carats. These are sold to independent gold dealers in Paracale town proper. Mine workers also sell their share of gold to their financiers. Price of gold is determined by asking the gold dealers in the town center.

c. Tugos, Paracale, Camarines Norte

Barangay Tugos is said to be once covered with vast forest. Mining operations which dates back during the Spanish era has however distorted its once pristine landscape. The use of timber to support mine tunnels has also accelerated deforestation in the area. Unlike Luklukan Sur and Gumaus which can be reached after negotiating with rugged terrains, Tugos is very accessible, only separated by a concrete bridge from Paracale town proper. The main source of livelihood in the barangay is gold panning and rod mill operation.

The barangay LGU generates revenues from small-scale mining operations. Processing plants using cyanide are required to pay P1.00 per sack of sand tails, while rod mill operators which numbers about 200 are obliged to pay P100.00 a month. The fees are based on a local ordinance duly enacted by the barangay council. The discovery of new gold veins in sitio[56] Coloran in 2009 has resulted in the surge of gold rush in the area.

Tugos has a similar gold and mercury trading structure as that of Gumaus.

d. Runruno, Quezon, Nueva Vizcaya

Quezon is a fifth class municipality in the northeastern part of Nueva Vizcaya. It is located 282 kilometers northeast of Manila and 14 kilometers southwest of Bayombong, the provincial capital. Its gateway is through its neighboring town of Solano. Quezon has a total land area of 23,349 hectares with Runruno, its biggest barangay, covering 6,803 hectares or about 30 percent of the town's land area. Quezon is politically subdivided into 12 barangays. Its 17,487 inhabitants is a mixture of different groups - Kalanguyas, Bicolanos, Gaddangs, Ifugaos, Visayans and Ilocanos with the latter comprising the majority.

Barangay Runruno is composed of 12 sitios namely: Dumaliguia, Marangad, Dipilipig, Centro, Kinalabasa, Compound, Tayab, Malilibeg, Cabinuangan, Busat, Atan 1 and Atan 2. Based on the 2007 census, it has a population of 3,110.

The discovery of gold along the rivers of Quezon has triggered a wave of migration into the area in the 60s and 70s. The Igorots from the Cordillera introduced gold panning in Runruno.

In October 2008, it was reported that there are approximately 2 million ounces of gold and 34.4 million pounds of molybdenum in barangay Runruno.

Small-scale miners in the village have organized the Runruno Tribal Tunnel Owners and Gold Panners Association (RTTOGPA) which serves as the umbrella organization of Runruno Landowners Association (RULANAS) and the Bit-ang Residents

Association (BRA). RTTOGPA consists of 33 tunnel owners and small scale workers, 15 ball mill and tunnel owners, 17 gold panners and 95 small scale miners within sitios Bit-ang, Malilibeg, Tayab and Balcony.

Gold and mercury trading

Small-scale miners in Runruno can extract an average of 5 to 50 grams of gold per month. Most of the gold recovered has purity of 17.3 carats. These are sold to local gold dealers at P1,200 to P1,350 per gram. The local gold dealers in turn trade them to gold dealers in Baguio City.

Contrary to newspaper reports[57] small-scale miners in Runruno do not use mercury in the extraction of gold.

e. Acupan Village, Itogon, Benguet

Gold mining in Benguet is said to have commenced even before the arrival of the Spaniards. For more than 400 years, the indigenous people have been practicing traditional small-scale mining. In the 1970s however, mercury use proliferated in the area when miners, then working with large mining companies resorted to high-grading by mixing mercury with concentrates and sneak them out of the tunnels by inserting them inside their anuses[58].

Mining and farming remain to be the main sources of income in the province. About 40 percent of the people rely on gold mining while the other 60 percent are involved in agriculture, tourism and other industries. About 10 percent of the more than 20,000 small scale gold miners in the province have been formalized.
Itogon, Benguet is the center of small-scale gold mining activities in Benguet. It is host to Benguet Mining Corporation, a large mining company which forged a profit sharing arrangement with more than 20 small scale mining contractors.

There are approximately 2,000 miners in the Acupan mining village in Itogon. Most of these miners have contracts with the Benguet Mining Corporation while others operate illegally within the corporation's mining claims.

Gold and mercury trading

Benguet produces three (3) tons of gold annually. Despite the establishment of BSP gold buying station in Baguio City, miners still prefer to sell their gold to local jewellers or gold traders. There are more than 120 gold dealers in the city.

The Benguet Federation of Small-scale Miners has been actively campaigning against the use of mercury among their members. In spite of this, some miners still clandestinely use the substance during gold amalgamation, utilizing about one (1) to two (2) grams for every gram of gold produced. Mercury is mainly sourced out in Baguio City which is about 45 minutes drive from the place. It is also available in local retail stores at P4 - P6 per gram.

f. Aroroy, Masbate

Aroroy, Masbate is comprised of 41 barangays. It has a land area of more than 45,000 hectares and a population of more than 71,000 people. Mining in the municipality dates back during the Spanish period when early Chinese settlers discovered gold nuggets in the river beds. Before the Second World War, a large mining company named Masbate Consolidated Mining operated in Aroroy. After the company ceased operation, Atlas Consolidated Mining and Development Corporation took over and carried out mining activities from 1979 until its closure in 1994. In 2006, Filminera Resources Corporation implemented the Masbate Gold Project and operated in areas previously claimed by Atlas. The Project is said to extract gold and other metals in 443 hectares mining claims covering six (6) barangays: Amoroy, Syndicate, Capsay, Panique, Poro and Bangon. It has an estimated mine life of 9.5 years. Gold reserve in its area operation is estimated at 37.4 million tons.

It is said that small-scale gold mining in Aroroy started in the late 70s. During this period, mining operations were purely manual. Ores are crushed using sledgehammers, then hand milled. Fine particles pass through a sluice and placed on a large basin. Recovered particles are then panned to separate the gold. In the early 80s, miners from Paracale introduced the use of mercury. In 1986, miners began using mechanical ball mills and rod mills. In 1990s, some miners from Diwalwal migrated to Aroroy and introduced cyanidation.

ASGM operations in Aroroy currently take place in 13 barangays namely Tinago, Jaboyoan, Talabaan, Bangon, Poro, Syndicate, Panique, Luy-a, Concepcion, Balete, Pangle, Manamoc and Capsay. It is estimated that the miners produce an aggregate of 2 kilos of gold a day. Small-scale gold mining is the main livelihood of most residents, followed by farming and fishing. Most ball mills/rod mills are set up near the house of the owners. Women and children also help in the operation of mills.

In 2009, a total of 277 rod mill/ball mill owners were identified by the municipal government of Aroroy. Of the 25 cyanide processing plants, 21 have been issued with ECC. The municipality has an ordinance imposing regulatory fees for rod mill/ball mill owners and processing plants.

Gold and mercury trading

There are two ways by which miners recover gold from the ore. First, they employ amalgamation after which they bring the resulting mine tailings to cyanide processing plants for further recovery.

Gold produced from the plant is bought by the plant owner who in turn sells them to local gold dealers. Gold is further traded in Bulacan, Manila or Cebu.

Table 4. Sharing scheme for gold recovered from cyanide plants:

Amount of gold recovered (in grams) per sack	Production Sharing (percent)	
	Owner of mine tails	Owner of processing plants
Less than 0.3	40	60
0.3 to 0.4	50	50
0.5 to 0.8	60	40
0.9 above	70	30

Most of the mercury used by miners in Aroroy is provided by local gold dealers with an agreement that the gold they produce shall be sold to the latter. A kilo of mercury costs P3,000 while a gram of gold is from P1,100 to P1,400.

g. Sitio Libertad, Talacagay, Hinobaan, Negros Occidental

The municipality of Hinobaan is about 200 kilometers south of Bacolod City, the provincial capital. It is made up of 13 barangays with Talacagay and Bacuyangan serving as host to small-scale gold mining activities. It was actually in sitio Sangke, barangay Bacuyangan in Hinobaan where the deposit of placer gold was first discovered in the early 80s, which triggered a gold rush. About 5,000 miners and their families accordingly swarmed this area during the height of the gold rush, where mercury use was widespread. Some areas in Hinobaan also form part of Philex Gold's mining claims.

After more than 20 years of gold extraction in Hinobaan, gold resources have accordingly dwindled and so with the number of miners. DENR-MGB estimates the number of active small scale gold miners in these areas to about one hundred. Local interviews with the miners however suggest that they number about three to five times more. Fishing and farming are the main sources of livelihood in Hinobaan.

Sitio Libertad in barangay Talacagay is about two hours drive from the town proper. There are more than 20 active mine tunnels in the area. Talacagay has more than 200 tunnels, about 100 of which have been abandoned. Some of the active mine tunnels were established in the 80s. They were temporarily abandoned during the surge of insurgency in the area. When peace and order was restored in the late 90s, the miners went back to Hinobaan and continued extracting ores from the old tunnels. There were reports of mine collapse in the area although no miner has been reported to be killed or injured. There are approximately 200 miners in sitio Libertad, mostly migrants.

Mercury amalgamation is the most common method used by miners, although cyanidation is also practiced. Some miners use about 10 grams of mercury to produce about three (3) grams of gold while others utilize only one (1) gram of mercury for every gram of gold. It is said that the gold processing methods were learned from Igorot miners who stayed in Hinobaan during the gold rush area. Others learned their techniques from the miners from Diwalwal.

In spite of its remote location, electric supply in sitio Libertad is uninterrupted. Dynamo is used 24 hours a day to generate electricity for the cyanide plants and to light the tunnels. Fuel consumption which averages 20 gallons or more a week eats up a large portion of the miners' gold production cost.

Most of small-scale gold mining operations are financed by local gold traders from Bacuyangan, Hinobaan. Before dividing the income, 25 percent from the gross sale is first withheld by the tunnel owners, then food and other expenses incurred during extraction and processing are deducted. The remaining amount is divided equally by the

miners. Tunnel owners earn about P10,000 to P30,000 a month while the workers receive about P5,000 to P20,000.

Gold and mercury trading

Miners trade their gold to local dealers in Bacuyangan and Talacagay for P1,300.00 to P1,400.00 per gram. Price of gold is monitored through the Bloomberg Channel or by texting local gold dealers. During the field visit, there are more than 10 gold dealers in Hinobaan, six (6) of whom are from Bacuyangan.

Mercury is either sourced out from local gold dealers in barangay Bacuyangan at P15.00 per gram or bought directly from Bacolod City at P10.00 per gram. Miners interviewed said they utilize about 80 to 100 grams of mercury per month.

h. Mt. Diwata (Diwalwal), Monkayo, Compostella Valley

Barangay Mount Diwata which is popularly known as Diwalwal is located 23 kilometers from Monkayo town proper and about 150 kilometers from Davao City. Mount Diwata's landscape is composed mostly of rolling to moderately steep terrain. Its elevation ranges from 500 meters to 1,200 meters above sea level. The vegetation is dominated by secondary growth forest trees. Mount Diwata is composed of 24 puroks, each of which is monitored and administratively overseen by a particular barangay kagawad or purok chairman.

DENR Administrative Order 66 issued in 1991 has placed 269 hectares of Mount Diwata's 729 hectares land area open for small-scale gold mining. The barangay is part of the 8,100 hectares mineral reservation area that was established by virtue of Presidential Proclamation No. 297 issued in November 2002.

Gold deposit in Diwalwal was first discovered by a native from the Mandaya tribe in September 1983. The discovery set off a gold rush. During the peak of gold mining from the late 80s to early 90s, the barangay's population swelled to more than 100,000. The unregulated entry of migrants in search of gold has led to lawless violence and poor peace and order conditions, making the mountain of gold infamously known as the "wild, wild west." The volatile situation in the gold rush area prompted the national government to declare a state of emergency in Diwalwal. Subsequently, the national government took over in managing the area, granting service contracts to qualified individuals and cooperatives including small-scale miners.

Gold mining and processing is the main source of livelihood for Mount Diwata's close to 50,000 people. There are 320 ball mills and 64 mini-carbon in pulp plants operating in the barangay. Prior to operation, owners of these plants are required to register in the barangay and pay the required license fees. Each ball mill drum is charged with a license fee of P384.16. The rates for CIP tanks vary depending on its size and capacity. CIP tanks with capacity to process 5 – 9 tons of ore are charged with P10,000 license fee. Those with 10 – 15 tons capacity and 15 tons above are required to pay P17,000 and P30,000 respectively.

There are 75 registered tunnel owners in Mount Diwata. The barangay also imposes a fee of P1,500 per tunnel per operation. Newly opened tunnels are initially charged P500 while big tunnels are charged P5,000.00. The Chair of the Committee on Environment is responsible in ensuring the annual registration of tunnel owners.

There is at present a slowdown of mining activities in Mount Diwata. Most of its gold deposits have accordingly been exhausted while extraction of gold ores from the tunnels has become more difficult. Many miners have also moved to a new gold rush area in the municipality of Maragusan.

At the height of the gold rush, as much as 20 grams of gold are extracted for every ton of ore. This has accordingly been reduced to about 3 to 5 grams per ton.

Gold and mercury trading

The purity of gold produced in Mount Diwata is 16 carats or 75 percent raw gold. Local dealers bring the gold in Tagum City for refinement before they are traded either to the Bangko Sentral ng Pilipinas

or to the black market. Unrefined gold is purchased locally at P1,130 to P1,230 per gram. Prices of refined gold fetch up to P1,700 per gram. There are 15 local gold dealers in the barangay. There is no current estimate as to the annual gold production of Mount Diwata. Official estimates however suggest that a total of 2.7 million ounces of gold has been extracted since the commencement of mining operations in the area.

Liquid mercury is openly sold in local stores at P3,000.00 a kilo. These are sourced out either in Tagum City or Davao City at P2,000 per kilo. An inventory made in 2006 reveals that five mercury dealers which were listed either as importer, distributor and end user in Mount Diwata were granted in 2003 and 2004 with permission to sell an aggregate of 367 metric tons of mercury. At present, only two mercury dealers are operating with Chemical Control Order (CCO). The reduction in mercury consumption was attributed to the increasing price of the chemical.

The 2006 mercury inventory[59] also suggests that at least five (5) to 10 tons of mercury is used annually for gold mining in Mount Diwata. A significant portion is said to have originated from the European Union, notably the Spanish state company MAYASA. Based on the containers examined, mercury supply also originates from Algeria.

2. Profile of ASGM miners

Most small-scale gold miners are working casually and informally. They often come from communities that have a long tradition of small-scale mining. Some of them work full-time while others are seasonal. They go into mining to augment the meager income they get from farming or fishing. Most of them are drawn into mining due to economic hardships. They do not have fixed income. The amounts of wages they receive depend purely on luck, or the quantity of gold deposit they are able to extract from the mines. The typical salary of a mine worker ranges from P250 to P500 a day. Local financiers, most of whom are mine owners and processors, on the other hand, earn P15,000 to P100,000 a month.

Some of the mine workers interviewed claim that they have been involved in the trade for more than 30 to 40 years, although they have yet to show substantial or valuable properties they have acquired from more than three to four decades of toil. Some of the miners who are either in their late teens or early twenties and mostly unmarried said they have less than one-year gold mining experience. They admit to have been drawn into mining because of their belief that mining provides them with easy money. Others say the job doesn't require much qualification.

Occupational hazards ranging from electrocution, gas poisoning, and accidents from explosives, shaft collapses, eroding soils and falling rocks, often resulting to injury or sickness and even death among the miners have been reported from the mining areas. Miners however try to contain information about these accidents to avoid further censure from authorities and pressure from those opposed to their activities.

3. System of cooperation

Gold extraction and processing in ASGM sites can be carried out collectively where more than two (2) to ten miners agree to pool their resources together to cover all their expenses during gold mining operation. Once they start producing and selling gold from their mines, they deduct all their expenses and divide the profits in accordance with their pre-arranged scheme. Miners in Runruno, Quezon, Nueva Vizcaya who are party to these arrangements are called *compañeros.* This system of cooperation is also locally known in Camarines Norte as *korporasyon*.

In case the miners are unable to raise the funds needed for their gold mining operations, they look for financiers. The financiers, who are well-off individuals either within or outside the barangay, and mostly local gold dealers and processors themselves, provide the miners with the necessary capital which may be in the form of cash or equipment. Cash advances are also given to the miners for their family's subsistence while the mines are not yet productive. Once gold production starts, expenses of financiers are deducted before profits are divided. Division of income varies. In some *korporasyon*, the financier gets either two or three times more than those received by the miners. Some generous financiers

divide the profits with their "players" equally after deducting the expenses incurred.

In some sites, miners organize themselves into associations or cooperatives. In Mt. Diwata, 53 mining cooperatives have been organized although only 10 is said to be active at present. Miners in the barangay are required to form cooperatives before they can be granted service contracts by the Natural Resources Development Council (NRDC), a government corporation under the DENR tasked to run and manage the operation of the mineral reservation. In Benguet province, a total of 64 associations of small-scale miners have been formed. These associations comprise the Benguet Federation of Small-scale Gold Miners.

One of the small-scale gold mining cooperatives which proved to be beneficial to the member-miners is the Luy-a Balite Concepcion (LUBACON) Agro-Small Scale Miners and Gold Processors Cooperatives in Aroroy, Masbate. LUBACON was organized in 2008 to minimize conflicts arising from overlapping mine claims, which were then prevalent in the area and oftentimes resulted to violent confrontations. Aside from reducing conflicts between and among the miners, the cooperative was accordingly instrumental in the substantial reduction of mercury use among their ranks. The cooperative is composed of about 700 miners from the three mining villages.

The cooperative was also able to acquire 20 hectares small-scale mining area from the mining claims awarded to Filminera Resources Corporation by virtue of a Memorandum of Agreement forged with the large mining company in January 2009. The covenant allows the cooperative to operate in the mining area for two years while obliging them to secure the necessary permits to legalize their operation. The agreement also requires the initiation by the cooperative of measures to stop or eradicate mercury use.

Assessment of the extent of mercury contamination in ASGM sites

Ban Toxics conducted a sampling of soil, water, and fish (when available) as well as mercury vapor analysis in the ASGM sites its team of researchers visited. The goal of conducting the sampling aside from verifying the extent of mercury pollution from the sites was also to introduce these methods to the miners and community, and endeavor to help them understand and possible use these scientific tools for future studies.

Sample collection

Water, soil, fish and shellfish samples were collected from the sites visited, in order to assess the extent of possible contamination due to mercury use in ASGM. Water samples were initially chosen, as wastewater from ore and gold processing procedures is often discharged directly into surface water creeks and rivers. Soil and fish samples were taken to determine whether mercury from such procedures has already made its way into biota through the water sources identified. Later, air sampling was conducted with a portable mercury vapor analyzer, the Lumex RA-915+.

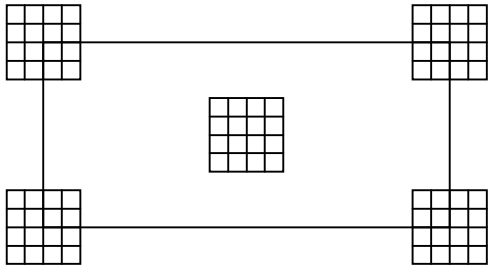
The following protocols for water, soil, fill and shellfish sample collection were adopted from the recommendations of Engr. Ana Rivera of the Environmental and Occupational Health Office of the Philippine Department of Health's National Center for Disease Prevention and Control.

Water

At least three water sources were identified for each ASGM site. Samples were placed in 1-liter polyethylene bottles, tightly sealed, and stored in a cooler equipped with frozen cold packs. Ideally, concentrated nitric acid should have been added for preservation and stabilization of mercury. However, due to the difficulty of obtaining and transporting nitric acid, this step was omitted and precautions were instead taken to bring samples to the testing laboratory within 24 hours.

Soil

Soil samples were collected near riverbeds, and in uncemented areas near schools. A five-point sampling system was used, wherein a sampling debris-free soil were taken from 3-4 random squares within the grid, and homogenized to obtain one sample, weighing 100 grams. Samples were wrapped tightly in aluminium foil, placed individually in sealed zip-top plastic bags, and stored in a cooler equipped with frozen cold packs.



Fish and Shellfish

When available, especially in sites where seafood comprises a major part of the community's diet, locally caught fish and shellfish were collected as well. Whole fish and shellfish samples were wrapped tightly in aluminium foil, placed individually in sealed zip-top plastic bags, and stored in a cooler equipped with frozen cold packs.

Air

Elemental mercury concentration was determined through the use of the Lumex RA-915+ mercury spectrophotometer. This instrument detects and measures the amount of elemental mercury vapor in the air, in terms of nanograms per cubic meter (ng/m^3). The Lumex was brought to various areas within the mining sites, including ball mill plants, panning areas, miners barracks, tunnels, and cyanidization areas, among others.

For each sample, a baseline check test is done to ensure that the machine is working properly, and to bring the machine to a background level of zero, making sure that there are no interferences or background noise. Then, the machine collects and analyzes ambient air for a period of 10 minutes. Data is processed using the accompanying DataLogger software to obtain the minimum, maximum, and average elemental mercury vapor concentrations.

Results

The collected samples were analyzed for total mercury content by two analytical laboratories: *Intertek Testing Services Philippines, Inc.* in Makati City, and *Philippine Institute of Pure and Applied Chemistry* in Quezon City. Results of the cold vapour atomic absorption spectrophotometric analyses are summarized in the table below. Figures in red represent the results of analyses performed by PIPAC.

Site	Water	Soil	Fish	Shellfish
Runruno, Nueva Vizcaya	<0.001	ND	*	*
Paracale, Camarines Norte	<0.001	ND	ND	ND
Jose Panganiban, Camarines Norte	<0.001	ND	*	*
Itogon, Benguet	<0.001	ND	0.02	0.02
Hinobaan, Negros Oriental	*	*	0.05	0.04
Aroroy, Masbate	*	*	0.41	*

Concentration of total mercury (T-Hg), expressed in parts per million (ppm)

ND = none detected
* - no samples obtained

Elemental mercury concentration in air in various locations in Acupan Plant, Camp 5, Itogon, Benguet. Testing was conducted on November 21-22, 2010.

Location	Average reading	Maximum reading
Ball Mill Plant	19.2 ng/m^3	30.4 ng/m^3
Top-Hill Panning Area	92.4 ng/m^3	710.7 ng/m^3
Retail Store	18.1 ng/m^3	33.0 ng/m^3
Miners Barracks	3751.8 ng/m^3	30000.0 ng/m^3
Field Test	6.3 ng/m^3	7.7 ng/m^3
Ball Mill Plant with Women Miners	3.44 ng/m^3	17.3 ng/m^3
Lime Process Area	26.3 ng/m^3	41.0 ng/m^3
Cyanidezation Area	8.9 ng/m^3	10.4 ng/m^3
Carbon and Leach Area	26.5 ng/m^3	64.7 ng/m^3

Elemental mercury concentration in air in various locations in Brgy. Maluguit and Brgy. Tugos Paracale, Camarines Norte. Testing was conducted on November 24-25, 2010.

Location	Average reading	Maximum reading
Brgy. Maluguit Residential Area	266.7 ng/m^3	5516.2 ng/m^3
Mangrove Forest	9.0 ng/m^3	19.7 ng/m^3
Gold processing Area	14275.3 ng/m^3	30000.0 ng/m^3
Compressor mining area	93.2 ng/m^3	96.4 ng/m^3
Actual amalgamation	7548.5 ng/m^3	30000.0 ng/m^3
Brgy. Hall-Tugos, Paracale	78.8 ng/m^3	86.9 ng/m^3
Tunnel area	17.8 ng/m^3	142.7 ng/m^3
Ball Mill and Panning Area	227.0 ng/m^3	620.4 ng/m^3

ASGM issues and concerns

A. Environmental impacts

1. Deforestation and landscape destruction. Considering that small-scale gold mining usually occurs in forestlands where miners and their families clear forests for habitation and other economic activities including the cutting of timbers to support their mine tunnels, the activity has aggravated forest denudation and the distortion of scenic landscapes. Natural forest regeneration is likewise hampered by intensified mining operations in the forestlands. The forest loss in Kias Mine within the Baguio gold mining district for instance, has been attributed to the felling of pine trees that were used as timber supports for underground workings during the early gold-rush stage.

2. Contamination of water bodies due to cyanide and mercury pollution. The excessive use and emission of toxic substances like mercury and cyanide during gold processing has also resulted in the consequent contamination of several water bodies thereby undermining their beneficial use. Overflowing and often leaking mine tailings contaminated with mercury and cyanide are discharged directly in rivers and creeks and in due time end in seas and oceans where it bio-accumulates in fish. In 2006, the Department of Health Region XI found that fish samples from Davao Oriental, Davao del Sur and Davao City markets had mercury content higher than the allowable limit of 0.3 microgram per gram. While the Department accordingly withheld the official release of the results of the study as it cannot pinpoint exactly where these fishes were caught, the findings indicate that mercury pollution in our water bodies have detrimental effects to freshwater and marine life. Investigations on the extent of mercury contamination in the Upper Ambalanga River in Benguet, Kingking and Naboc River in Compostella Valley, Agusan River, Davao Gulf, Murcielagos Bay in Zamboanga del Norte, Honda Bay and Palawan Bay in Palawan, among other water bodies, have also shown mercury levels above existing standards.

3. Soil erosion and siltation. Excessive ore extraction in the uplands and indiscriminate discharge of waste rocks in several water bodies has aggravated soil erosion and siltation which in turn resulted in instant flooding, with consequent damage to crops, properties and even lives. It is estimated that about 40 tons of dry rock is extracted for every kilo of gold produced. In a village in Jose Panganiban, Camarines Norte waste rocks from the mining site find their way to the rivers and streams causing instant flooding during rainy days. In 2006, Runruno, Quezon, Nueva Vizcaya also experienced two flash floods which killed seven people and nearly wiped out one whole village. While the incident may not be attributed solely to small-scale gold mining which has been taking place in the village since the 1960s, the volume of waste rocks deposited in rivers and creeks has aggravated the peoples' misfortune.

4. Biodiversity loss. Contamination of water bodies also resulted in the disappearance of various life forms especially aquatic resources. Local stories are prevalent about how their rivers and streams used to be teeming with abundant fish and other life forms. Now, all that is left are stories and trails of destruction. The near extinction of freshwater fishes in Naboc River in Monkayo, Compostella Valley has been closely linked by residents with the mining activities in the upper Monkayo.

5. Loss of soil productivity. In most mining areas, miners turn to farming to augment their income. However, soil productivity has been reduced by erosion, deforestation and the impairment of water sources. In many mining areas, farmlands are converted as tailings ponds.

B. Social and health problems

Photo: Luis Liwanag/SSNC

1. Unregulated migration in mining areas. Most gold rush miners in the Philippines are migrants who do not have legitimate claim in the areas where they operate. The mass migration of miners in a newly discovered gold rich area has often resulted to the displacement of original inhabitants and the disturbance of local customs and long-established economic activities in the host community.

2. Land tenure and resource use conflicts. The tendency of miners to swarm around a gold deposit area often results in conflicts in mining rights and resource uses, which often lead to violent confrontations between and among them as well as with the local residents. The opening up of mining to large-scale mining companies has also resulted in increasing confrontations between these companies and small-scale miners.

3. Limited access to health and basic services. Most mining communities also have either no or little access to clean water or basic health care services. Break out of diseases like malaria and diarrhea have been documented in several mining areas. Other diseases frequently experienced by miners include tuberculosis, skin diseases, pneumonia, cough and upper respiratory tract infection. There are also reported cases of venereal diseases like gonorrhea.

4. Exposure of miners to occupational health and safety hazards. Basic safety equipment like helmet, safety boots, gloves and dust masks appears to be a low priority among miners, hence their exposure to health risks ranging from the effects of poor ventilation to exposure to dust and toxic chemicals like mercury, cyanide and nitric acids.

5. Exploitation of workers. Lack of capital and formal sources of credit have forced mine workers to deal with local financiers under terms dictated by the latter. This has often put the workers on the losing end of the bargain. Miners, including minors, also work under hazardous environments and receive compensations which are often not commensurate to the strenuous work rendered.

6. Absence of social security benefits for miner-labourers. Notwithstanding the risks encountered by the mine labourers, and the measly income they receive from exposing their life and limbs to the dangers of the trade, they do not have any health or life insurance or any social security benefits, save in the case of some miners in Benguet where contractors are required by the partner corporation to provide labor-mandated benefits to their workers. Absent these security benefits, miners merely cling on to the verbal assurance of financiers and customary practice that in case something untoward happens to them, the latter will be financially responsible.

7. Cases of mercury poisoning and high levels of mercury among miners and their families. As mentioned earlier, investigations on the effects of mercury pollution in certain ASGM sites have shown high mercury levels among miners and their families attributed mostly to their

simultaneous exposure to inorganic and methyl mercury. In 2006, the United Nations reported that miners in the Philippines are found to have mercury levels up to 50 times above World Health Organization limits.

C. Legal, enforcement and institutional problems

1. Weak and non-operational mining regulatory boards. Almost all city and provincial mining regulatory boards in the country have been organized; however, it appears that foremost in their agenda pertains to quarry operations save for the case of PMRBs in some provinces which may be cited for their support for small-scale gold mining. Almost two decades have passed since the enactment of Republic Act 7076 but we have yet to see a People's Small-scale Mining Area declared or established by the body.

2. Costly and difficult permitting and licensing process. The demanding procedures to gain formal operation have likewise dissuaded small-scale gold miners to apply for permits. A checklist for the application of small-scale mining permit under PD 1899 for instance, requires small-scale gold miners to comply, among others, the following requirements:

a. Survey plan with the technical description of the area applied for which must be prepared by a registered geodetic engineer;
b. Barangay and municipal endorsement;
c. Clearance from various government agencies namely, FMS, EMPAS, LMS and MGB;
d. Environmental Compliance Certificate;
e. Surety bond in the amount of Twenty Thousand Pesos (P20,000.00); and
f. Articles of partnership/incorporation/association and by-laws duly registered with concerned government agencies[60]

For a miner to complete the abovementioned requirements, he will have to wait for at least six (6) months and shell out at least P40,000[61]. Application for miner's license under Republic Act 7076 on the other hand requires only P5.00 filing fee and a certificate of barangay residency[62]. Without a designated PSSMA and a mining permit, however, the license is virtually unnecessary.

3. Ineffectual enforcement of small-scale mining and other related laws. In paper, small-scale mining laws appear to be adequate. Realities on the ground would however highlight the impractical application of some of its provisions. This accordingly prompted national and local governments to tolerate illegal gold mining activities. Enforcement of other environmental laws such as those that concern air and water pollution, protected area, wildlife, toxic, hazardous and solid waste which are also wantonly violated in most mining sites is also wanting.

4. Small-scale mining companies undertaking large-scale operations. Under our small-scale mining laws, small-scale mining permittees are allowed to mine up to 20 hectares per permit and extract up to 50,000 dry metric tons of metallic and non-metallic minerals annually. There have been reports, however, that some small-scale mining companies exceed the extraction limits.

5. Need for the strengthening of LGUs for effective local mining governance. While the enforcement of small-scale mining laws have been devolved to the provincial LGUs by virtue of the Local Government Code, we have yet to see the active participation of most provinces with small-scale gold mining activities, let alone smooth coordination in addressing small-scale mining concerns.

6. Uncontrolled ASGM activities in protected and watershed reservation areas. Small-scale mining activities are also reported to have encroached upon ancestral domains of Indigenous Peoples and in established protected areas as well as watershed reservation areas such as in Mount Guiting-Guiting Natural Park in Sibuyan Island, Romblon, the Bugkalots Ancestral Domain in Nueva Vizcaya, and the Mainit Hotspring Protected Landscape in Maragusan, Compostella Valley to name a few.

ASGM stakeholders: Getting their acts together

Given the complexity of issues besetting the sector, enhancing the interaction between and among stakeholders both at the local and national level can facilitate better sharing of information, consensus building and joint ownership of decisions reached. This positive interaction can help the stakeholders reach a common ground, minimize conflicts and move forward.[63] ASGM is characterized by multiple actors with multiple voices, and it is important to recognize these actors and listen to their voices.

The following are some of the known actors in the ASGM industry:

a. Miners, ASGM communities and adjacent villages. These are the sectors that are directly affected by the hazards of mercury. Their meaningful participation in planning and implementing ASGM interventions is thus essential. To facilitate this, continuous capability building and community organizing should be carried out to empower these local communities. The voices of the people in adjacent villages, especially those living downstream or downwind the mining sites should also be heard considering that they both suffer the health and environmental cost and sometimes the economic benefits of the activities upstream.

b. DENR/EMB/MGB. The DENR is the primary agency responsible for the management and enhancement of the quality of the environment as well as the use and management of all natural resources in the Philippines. Within the DENR hierarchy are two bureaus whose functions include those that deals with ASGM and mercury pollution. The Mines and Geosciences Bureau is tasked, among others, to administer the country's mineral lands and mineral resources and provide technical assistance to local government units in the performance of their devolved functions on small-scale mining operations. The Environmental Management Bureau, on the other hand, is mandated to formulate, integrate, coordinate, supervise and implement all policies, plans, programs, projects and activities relative to the prevention and control of pollution as well as the management and enhancement of environment.

c. Local government units. Under the Local Government Code, local governments are empowered to formulate and implement local development plans and programs, oversee the welfare of the communities under their jurisdiction, and share in the revenues of the national government. The decentralization that was brought about by the Code has entrusted local governments with greater responsibility, chief of them is the delivery of basic infrastructure and social services to their localities. It is thus important to strengthen capacity of local governments to enable them to respond to the challenges for better local small-scale mining governance.

d. Department of Health. The Department of Health is one of the government agencies that have been at the forefront in the efforts to minimize and control mercury use and emission in the Philippines. The Department, in collaboration with national and international partners, has undertaken several studies on the extent of mercury contamination in mining areas as well as the health and environmental hazards of mercury pollution. Areas of support which the Department may provide to small-scale gold miners will include the conduct of regular health and safety monitoring and sustained health education programs, in collaboration with local health workers.

e. Bangko Sentral ng Pilipinas. The bank was mandated by the People's Small-scale Mining Law to purchase gold from the small-scale miners at a price competitive with the world market. Pursuant to this, the bank has intensified its campaign to convince small-scale miners to bring their gold to any of its five buying stations. Aside from ensuring ready market for the small-scale miner's gold, the bank also contributes in the efforts to minimize mercury use by not accepting gold containing mercury or amalgam.

f. Department of Trade and Industry. The big number of people engaged in ASGM supports the Department's mandate insofar as employment generation is concerned. The Department can therefore help stimulate the industryby providing technical, financial and marketing support to miners and in helping ensure the efficient collection of government revenues. However, for

the miners to avail of DTI assistance, they have to formalize or legalize their operations.

g. DOLE-Occupational Health and Safety Hazards Division. The high risk faced by miners and the accidents that occur in the mine sites often make ASGM unacceptable for many sectors. The dangers of the trade are also well-recognized by the miners as they often joke with one another after coming out of the tunnel: "You should thank God, you're a person again." The Philippine government has promulgated health and safety regulations for ASGM. DOLE's OSHS Division can therefore help eliminate or minimize safety and health risks in the mines by overseeing enforcement of these regulations.

h. Church and other non-governmental organizations. Although they don't advocate small-scale mining, the Catholic Church and most NGOs are accordingly not per se opposed to it. What they detest is irresponsible small-scale gold mining. These sectors can then be tapped as the watchdogs of the industry, especially in ensuring that small-scale gold mining is responsibly carried out.

i. PMRB. An empowered local mining board is the key towards robust small-scale gold mining governance. The board, once functional can be a good venue for threshing out differences or settling conflicts among key players.

j. Gold and mercury traders. Most miners largely depend from gold and mercury traders for capital. In fact, most of these traders also act as local financiers. Their role can however be changed, in that they can be tapped to invest in financing safety equipment for small-scale miners.

k. Large-scale mining companies. The awarding of most mining tenements to large-scale mining companies and the requirement for small-scale miners to secure first their consent as a condition sine qua non before their application could be granted appear to have widened the gap between the two sectors. However, good stories are emerging about the peaceful co-existence of small and large-scale mining in the Philippines as exemplified by the partnership contracts forged by the Benguet Corporation with the miners in Itogon, Benguet and agreement forged by a mining cooperative with a large-scale mining company in Aroroy, Masbate.

These initiatives may be replicated in other sites by encouraging large scale mines to release areas of their concessions that are not suitable for large-scale mining operations to small-scale gold miners.

Mercury Risk Reduction Efforts

In response to the call to limit the supply and demand of mercury, the Philippine government has issued regulations, policies and guidelines calling for more stringent requirements and procedures pertaining to the importation, manufacture, distribution and use of mercury and mercury compounds as well as the proper transport, storage and disposal of mercury-bearing and mercury-contaminated wastes. These legal and policy measures were instituted purposely to reduce environmental and human health impacts of improper management and disposal of mercury.

In 2008, the Environmental Management Bureau of the Department of Environment and Natural Resources, made an inventory of mercury releases in the country. The results of the study were used as basis in the formulation of an Associated Action Plan for Mercury in the Philippines. One of the action items embodied in the said document is the implementation of the Quick Start Programme for Small Scale and Artisanal Mining in partnership with UNEP.

In July 2008, the Department of Health issued Administrative Order 2008-0021, requiring all hospitals in the country to gradually phase out all mercury-containing devices, to immediately discontinue the distribution of mercury thermometers in the patient's admission/discharge kits and to establish a mercury minimization program. Attached to the order are specific requirements and standards for setting up a temporary mercury storage area.

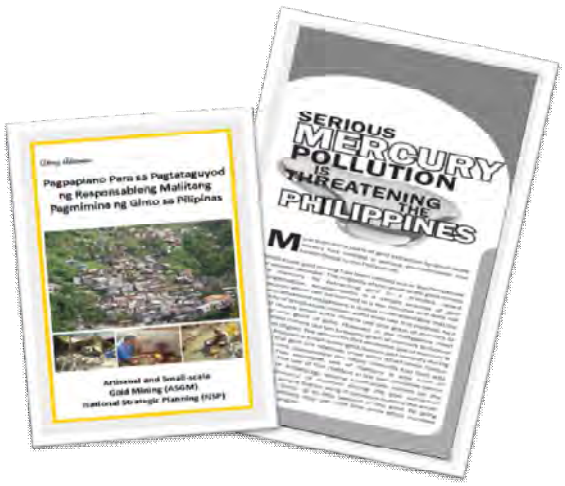
In August 2005, the Department of Environment and Natural Resources and the Department of Health also signed a joint administrative order prescribing the policies and guidelines on effective and proper handling, collection, transport, treatment, storage and disposal of health care wastes, pursuant to existing laws, rules and regulations. The JAO was also intended to clarify the jurisdiction, authority and responsibilities of the two agencies and to harmonize their efforts with regard to health care waste management.

The Department of Health and the UP-National Poisons Management and Control Center have likewise been undertaking health monitoring of mercury contamination in ASGM communities, orientation of rural health units (RHUs) and barangay health workers on the toxic effects of mercury and information, education and communication campaigns on the effects of mercury.

In 2006, Maximo T. Kalaw Institute for Sustainable Development received from World Bank and GEUS funding assistance for the training of small-scale gold miners and their families in the safe handling of mercury during gold extraction focusing on the application of borax technique and mercury recycling using a devise known as retort.

The urgency of tackling mercury scourge in ASGM has likewise been the subject of various conferences, meetings and consultations carried out in many parts of the country. Several studies have likewise been conducted to investigate the extent of mercury use and the degree of its impact among affected communities, the results of which were also discussed in this report. Experiments were likewise conducted to test the efficiency and effectiveness of mercury free alternatives[64].

The Philippine government has likewise commenced with the development of a National Strategic Plan for ASGM in coordination and collaboration with concerned stakeholders. The plan is endeavored to contribute to the efforts to reduce mercury use in the sector and improve the condition of miners.



Alternatives for cleaner gold production

Over the years, the need to reduce mercury use in ASGM has resulted in the introduction of cleaner technology alternatives and the improvement of traditional mining methods.

Retort

The use of retort, which was originally invented in South America[65], is currently promoted not as an alternative but as a method to increase recycling of mercury. While ultimately, mercury free alternatives are undeniably necessary, until they are available, the use of retort can be a good step in reducing the amount of mercury being used in ASGM while minimizing occupational exposure of miners and its release to the environment.

Retorts are inexpensive to manufacture and can be made out of local materials. There are basically two types of retort commonly used by miners: closed retorts and retorts with a pipe or tubing. The latter is more popular in the Philippines. This method is practiced by placing the amalgam in the retort, after which, it is heated over a charcoal burner, wood fire or propane burner. While the amalgam is heated, the mercury evaporates inside the retort, travels through the long cooling pipe and ends in a bowl of water into which it falls in the form of small pearls. The cooling pipe is kept cool by a wet cloth or the like. When the process has been concluded the retort is cooled down after which the gold inside is recovered.

Blacksmith Institute offered the following suggestions for a more efficient use of retort:

- Retorts must be hermetically closed to prevent all mercury vapours from escaping.
- Retorts must be practiced by all miners in the community.
- Retorts should be made with stainless steel and not with thin glass or with copper or iron materials. Amalgamation can happen between mercury/copper and mercury/iron.
- Retorts must be used for burning amalgam only. The items used in making the retort are not to be used in cooking, storage or any other application for health reasons[66].

Some miners in the Philippines have undergone training on the use of retorts; however, advocates of this technology still find hard to convince miners to adopt it.

Centrifugal method

Proponents of the use of centrifugal concentrators claim that this technology is likely to achieve higher recoveries than gravity concentration method. The UNIDO's Global Mercury Project illustrates how the method operates:

> Centrifugal concentrators consist of a vertical rotation bowl with a series of concentric rings that trap the gold. A centrifugal force is applied on the ore particles, in such a way that this force is 60 to 300 times higher than the gravitational force. The rotor is accelerated and feed slurry is introduced to the concentrating cone through a stationary feed tube. Upon reaching the deflector pad at the bottom of the cone, the slurry is driven outward to the cone wall by the centrifugal acceleration. As slurry flows up the cone wall, the solids fill each ring to capacity creating the concentrating bed. The tailings product overflows the bowl and the gold becomes trapped in the rings. Some separators have a smooth wall at the bottom of the bowl where stratification takes place. The high density gold is concentrated at the wall forcing and displacing lower density particles away from the wall. Compaction of the bed in the rings can be prevented by introducing pressurized fluidization water from behind the rings. This helps the high-density gold particles to displace lower density gangue particles causing the gold grade to increase in the concentrating rings with time. After a period of time, the feed is stopped and the rotor is shut off. The concentrate is flushed from the cone into the concentrate launder and can be upgraded further by panning[67].

One of the issues raised with respect to the use of centrifugal concentrators as alternative technology is that they are relatively complex to manufacture.

Magnetic sluice

Magnetic sluice uses magnetism to create riffles for a physical separation of gold from grains with lower density, instead of using mercury or other chemicals for separation via chemical reactions. The only equipment needed under this method is a simple sluice, through which the gold containing ore and a relatively small amount of water is passed by laminar flow. This process is briefly explained by Hylander et al in this wise:

To extract the gold, the ore should either contain magnetically susceptible components, or inexpensive, recyclable, magnetically susceptible material can be added. The gold grains settle in the riffles and then the material attached to the sluice is scraped off into a pan. The final extraction of gold from the gold concentrate in the sluice was done by traditional panning, but can also be done by using strong magnets to remove the magnetically susceptible material from the dry concentrate. The gold grains in the pan can be suctioned up with a small plastic vial or the gold concentrate can be smelted straight away[68].

The use of magnetic sluice has been tested in the Philippines in 2005[69]with varying results. Based on the experiment in five sites namely Acupan & Balatoc in Benguet, Paracale in Camarines Norte and Mainit & Diwalwal in Compostella Valley this technology can have a gold recovery efficiency of up to 73 percent.

Shaking sluice

Another emerging gold liberation technique is the use of shaking sluice or shaking table. Under this method, the sluice is set up diagonally with an inclination of up to 0.7 meters on its highest point and 0.2 meters on its lowest point. The ore sample is first mixed with water to form slurry and then poured into the shaking sluice with the remaining bottom sediment added to the sluice by spooning. After a few minutes, the shaker and the water are turned off simultaneously. Water is then drawn away from the riffles using a piece of paper placed beside the material without touching the ore material, which had been separated into clearly visible fractions along the sluice.

Gravity concentration with borax

Another mercury free-alternative being pushed is the use of borax. This method is widely practiced by the miners in Quezon, Nueva Vizcaya and Itogon, Benguet. The use of borax essentially follows gravity concentration where gold concentrates that were recovered from a sluice are panned. Miners in Quezon use detergent bars in separating the gold from other particles in the pan. Recovered gold concentrates are then heated with a blowtorch where borax is occasionally added.

Removing barriers to cleaner gold production

The basic tenet of technology transfer is that technology does exist, or technology can be readily developed, that is superior to the existing technologies being used by the people in the field. The challenge is how best to inform the end users that this technology exists, or can be developed, and to get them to accept the new technology and successfully implement it in their operations[70].

More than technological issues, however, there are many factors to be considered in promoting the adoption of cleaner gold production alternatives. Even if the miners are aware of the hazards of mercury or other production techniques, they tend to dismiss it because of their need to earn quick income for their daily subsistence. Hence, any gold production technology, no matter how viable they may be, if it requires more labor and a longer period of time before they can produce gold for their daily needs may only be passively received by miners. Organizing the miners, increasing their capital base and providing credit facilities that will address these concerns may however help increase acceptance by the miners of these mercury-free alternatives.

These efforts should be complemented by awareness raising activities, documentation of good mining practices for possible replication and the provision of the needed incentives for migration from mercury use.

Conclusion & Recommendations

Conclusion

Review of related past studies, field investigations, interviews and samples collection and analysis lead to the conclusion that the problem of mercury pollution in the Philippines is widespread and that unless and until urgent and drastic steps are carried out to contain its further discharge into the environment, the effects will be disastrous. While a significant portion of mercury releases are attributed to the ASGM sector, forcing them to shut down their operations would have economic repercussions, as it will surely affect the livelihood of a significant number of people. There have been attempts to move to a mercury-free system but there is no silver bullet or single solution to the problem although there are lots of moving pieces that can be individually tackled leading to significant improvement[71].

Artisanal and small-scale gold mining can be a viable development option provided adequate environmental safeguards are in place and the health socio-economic costs are minimized. If managed appropriately with adequate technical and financial assistance, the industry has the potential to make a significant contribution to rural livelihoods and poverty reduction, without the massive social and environmental disturbances of large-scale mining[72]. But of course it all depends on the sincerity of the government in finding effective solutions to the various problems faced by the industry. Unfortunately, the government provides relatively little assistance to small scale miners, while giving priority to large, foreign-owned firms.

Recommendations

There is no silver bullet that can adequately address the complex issues surrounding ASGM in the Philippines. Care should be taken to understand the specific ASGM areas and the needs of the community for any effective intervention can take place.

Considering these constraints, to rationalize ASGM activities and improve governance of ASGM operations, these broad strategies, mechanisms and potential solutions to various ASGM concerns may be considered:

1. Technical. Due to limited knowledge and resources, small-scale miners cannot conduct scientific and efficient exploration activities. The frequent "wild" searches for gold deposits have often resulted to losses in investment and unnecessary degradation of lands. To eliminate uncertainties in the search for gold deposits and promote sustainability of the industry, it is thus necessary for the Mines and Geosciences Bureau to provide technical support in the exploration and delineation of mineral deposits and come up with mineral inventory of lands available for extraction at the small-scale level. These areas can then be set aside by the provincial or city mining regulatory boards as People's Small Scale Mining Area pursuant to Republic Act 7076.

In determining appropriate gold liberation techniques, the properties of various gold ores should be closely studied. Alternative technologies which are simplified, health friendly and mercury free should be explored while interventions should be introduced to improve traditional mining methods like gravity concentration.

It is also advisable to prioritize efforts at changing the three major environmentally unsound practices in ASGM, in relation to mercury-use:

1. whole-ore amalgamation;
2. open burning;
3. mercury-cyanide mixing

Substantial reduction in mercury emissions from the sector can be substantially achieved if these three priority practices are effectively halted.

Some efforts have been started. In 2007, the Global Mercury Project came out with guidelines on mercury management in ASGM where it laid down, among others, as principal technical measures the use of retort in heating the amalgam and the prohibition of whole ore amalgamation and cyanidation of mercury-rich tailings.

In view of these guidelines, the sector is faced with a stiff challenge in establishing a common service facility or proper storage and disposal system for confiscated mercury and other mercury-containing wastes. The establishment of a central establishment where gravity concentrates is

processed by specialized people using amalgamation or leaching methods in a controlled laboratory environment may likewise be considered.

There is also a need to establish safe storage of excess mercury coming from the sector. If efforts in convincing miners to migrate towards mercury-free processes and technologies are successful, the government will be faced with the prospect of managing mercury coming out of the sector, especially, when mercury from tailings are being recovered. Addressing this need before the excess mercury begins to accumulate would be highly advantageous.

2. Financial. Most ASGM operations are rendered ineffective and unsustainable by lack of working capital and credit facilities and lack of suitable mining equipment. Few miners have access to the necessary capital from financial institutions due to the nature of their activities which is scattered, informal, illegal and rural. This concern can be addressed by encouraging miners to form cooperatives, associations or federations, or strengthen those that are already in existence to increase their capital base and maximize utilization of existing equipment so that other available resources can be channelled into other areas. These organizations can even get easier support from local and national, or even international funding agencies. They can also avail of the benefits of Republic Act R.A. 9178, popularly known as the Barangay Micro Business Enterprises (BMBEs) Act of 2002.

3. Business/Economic. One of the main concerns in the trading of gold is the distance of BSP gold buying centers in ASGM sites which has resulted in the inadequacy in the price of gold and pilferage of a substantial volume of ASGM production into the black market. There is a need to re-evaluate proximity of BSP gold buying centers to ASGM sites and establish, if and when practicable, sub-buying stations. There may also be a need to modify existing gold acceptance criteria to increase incentives for miners to sell their gold to the BSP. Another strategy is to tap mining organizations to serve as local gold dealers.

Strengthening linkage with other sectors of the economy as well as establishing formal marketing systems is also important for the industry's growth. This can be done by the expansion of local jewellery and other related industries.

4. Legal/regulatory. Formalizing the operation of small-scale miners is a good step towards the sustenance of the industry as it allows supervision and control in the activities of miners. Greater intervention can facilitate better enforcement of pertinent laws and regulations and in addressing health, safety and environmental issues. However, present legal and regulatory frameworks for ASGM do not create a condition conducive for formalization. A review of extant small-scale mining laws and policies and effecting appropriate amendments like the streamlining of regulatory and administrative procedures will certainly help eliminate the barriers for formalization. To realize this, the active involvement of the affected sectors, particularly the small-scale miners themselves will be indispensable.

Promotion of educational programs, safer alternatives, and incentives such as tax holidays and access to credit for those who register may, among others, encourage miners to regularize their activities. Large-scale mining companies should also be encouraged to release areas of their concessions that are not suitable for large-scale mining operations for licensing to small-scale miners as already implemented by the Benguet Corporation in Itogon.

At the core of the mercury reduction efforts in the sector would be the imposition and implementation of a stringent prohibition in the entry of mercury into the Philippines. Removing all import exemptions for mercury can further help in controlling the influx of mercury into the country.

5. Institutional. As mentioned earlier, artisanal and small-scale gold mining is a complex development issue which affects a broad range of stakeholders and thus requires organized and rationalized efforts between and among the key

players. To ensure smooth coordination of ASGM initiatives and effective discharge of mandated roles, there is a need to simplify institutional structures and delineate overlapping functions of various institutions; strengthen the provincial and city mining regulatory boards and increase the capacity and capability of LGUs. Municipalities are also encouraged to include small-scale mining development in their local economic development strategies.

6. Health and safety. Small-scale gold miners should be provided with some form of on-site health, environmental and safety training courses. These kinds of training should be made a pre-requisite for acquiring licenses/permits. Health studies and monitoring in affected regions should be maintained and appropriate remediation measures should be carried out to protect the miners and their families from adverse health and environmental impacts of their unsustainable practice.

Fish and shellfish monitoring and advisories in downstream communities is also critical, and must be immediately implemented by the government. This is needed to be done in parallel with efforts at phasing out mercury use in the sector.

7. Education. To eliminate the "silent killer" known as mercury, intensive awareness campaigns should be undertaken.

Focus should be geared to children and their mothers. Tapping community leaders will also be critical in establishing local "expertise" on the environmental and health dangers posed by mercury.

An assessment of the current knowledge, awareness and practices of small-scale miners and their families will help establish a baseline data to determine effectiveness of future IEC interventions. The result of the assessment can also be used as basis in identifying proper IEC interventions.

Ban Toxics also recommends for the government and civil society to initiate a dialogue to find out how and where does ASGM fit into national development. Oftentimes, ASGM is linked with sustainable development, but no concrete consultation with mining and other stakeholders have taken place. It is important to have a national process to determine the true place of ASGM in national development.

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[55] In Camarines Norte, gold extraction and processing from the ASGM sites are carried out by mining groups locally known as *korporasyon*. Each *korporasyon* is usually composed of five (5) to ten miners who either agree to pool their resources or seek financing from local investors. The mine workers or labourers are called *players.*

[56] In the Philippines a barangay is further divided into zones which are locally known as sitios or puroks.

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