

**Training of Small Scale Miners and their Families in  
Safe Handling of Mercury During Extraction of Gold in  
the Philippines. Improving Access to Social  
Services: health services and income  
opportunities for Small Scale  
Miners and Their Families**

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Young boy about to dive into a narrow shaft filled with muddy water. He has a plastic hose in his mouth for air supply. He will be digging gold ore 6.5 metres below the surface for the next 4 hours. Camarines Norte on Southeast Luzon

## Summary and recommendations

Two small-scale mining districts were investigated: Sibutad in Zamboanga del Norte on Mindanao, and several villages in Camarines Norte: Barangay Casalugan, Paracale; Barangay Luklukan, Jose Panganiban and Barangay Gumaus, Paracale on southern Luzon. A brief visit was also paid to milling stations for small-scale miners in Benguet North of Manila.

The main finding of the project was that the small-scale miners in the investigated communities release excessive amounts of mercury. They use in the order of 10 to 25 grams of mercury to recover one gram of gold, whereas small-scale miners in other parts of the World use about one gram of mercury to recover one gram of gold. The small-scale miners visited in this project in the two areas release approximately 5 tonne of mercury every year. This result is in good agreement with previous investigations. A report by the Department of Health submitted to UNEP in 2001 concludes that some 140 tons of mercury is released annually to the environment from small-scale mining in Northern Mindanao<sup>1</sup>. These figures show that the gold extraction methods presently used by small-scale miners in large parts of the Philippines create a ticking bomb for the environment and for the health of the people of the Philippines. This ticking bomb can, however, with inexpensive means, mainly education, be disarmed.

Mercury is released partly as metallic mercury and partly as a mercury cyanide compound, both of which are exceedingly toxic and will over time end in the mangrove swamps along the coast line and from there enter the food chain. Numerous fish and shellfish hatch in the mangrove swamps. The population of the Philippines consumes fish almost every day and many of them have fish three times a day. Fish concentrate mercury as methylated mercury which directly enters the human body during consumption of the fish.

There is fortunately an easy, inexpensive way out, an easy way to stop release of mercury to the environment. This will not require advanced techniques or purchase of expensive equipment. All that is needed is to teach the small-scale miners a technique, which has been used for more than a decade by small-scale miners in the Benguet area North of Manila. The solution may prevent further pollution with mercury of the environment, but cannot clean the mercury that has already been released over the years.

Teaching and training courses for small-scale miners and health providers (medical doctors, nurses and midwives) were held at Sibutad in Zamboanga and at three barangays in Camarines. The courses were well attended. In all about two hundred small-scale miners and health providers attended. Short lectures on dangers of mercury were also conducted for elementary school and high school classes in both areas. In total about 600 school children were told about the dangers of mercury. The small-scale miners and especially the children were alarmed by the news that so much mercury is released and they all seemed very willing to adopt new techniques.

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<sup>1</sup> Mercury assessment in the Philippines by Department of Health. Report submitted to UNEP June 2001 by Samuel T. Ramel Philippine Ambassador to Schweiz

Child labour was not encountered in Zamboanga del Norte, but was frequently met in Camarines Norte. Many children worked in small-scale mining. Some of them only worked during week-ends, whereas others worked seven days a week and for that reason did not attend school. Many of the children working with gold extraction use mercury.

A forum that was convened in Manila to report the initial findings and activities and to heighten the awareness of representatives of the NGO community, academia, national funding institutions, and government agencies such as the Department of Environment and Natural Resources (DENR).

A hand out for small-scale miners and medical personnel was produced and distributed in the investigated areas. The hand out describes paths of mercury transport in the environment and the most obvious symptoms of mercury poisoning of humans, see Appendix E.

The following initiatives are recommended:

- Initiation of a 'school' for small-scale miners. The school should provide short courses for small-scale miners from the different small-scale mining communities of the Philippines. The school could be located in the Benguet area, where the local small-scale miners do not use mercury for extraction of gold.
- Establishment of an exchange programme with groups of small-scale miners from one area exchanging work areas with small-scale miners from other areas. Hands-on training sessions will ensure that the best available techniques from the different small-scale mining areas of the Philippines will be known all over the country.
- An immediate nationwide information campaign and training of health care personnel in toxicity of mercury and symptoms of mercury poisoning.
- Creation of multi-sectoral monitoring teams (including medical personnel, school officials and youth leaders, small scale miner-leaders), which will monitor use of devices and techniques that will reduce the use and release of mercury.
- Setting up a mechanism for recognition and reward for milling stations applying gold extraction methods using no or minimal amounts of mercury.
- Raising of funds for financing of school-fees for children working as small-scale miners.

In June 2007 a small group of small-scale miners from Zamboanga and Camarines will attend a teaching and training course in Benguet.

# Background

In early 2006, a call for project proposals for the Panibagong Paraan in Manila 2006 was announced. Maximo T. Kalaw Institute for Sustainable Development in cooperation with Geological Survey of Denmark and Greenland, and Zamboanga del Norte Center for Social Concerns and Development (CESCOD) and the Cordillera News Agency Foundation submitted a proposal entitled: *Training of Small Scale Miners and their Families in Safe Handling of Mercury During Extraction of Gold. Improving Access to Social Services: Health Services and Income Opportunities for Small Scale Miners and Their Families.*

The project proposal was short-listed and at the exhibition in May 2006 the project was awarded by World Bank, Philippines and was financed jointly by World Bank Manila and GEUS.



Location map. Zamboanga area in the south and Camarines in the north

The first phases of the project were carried out in late 2006. This involved selection of small scale mining communities using mercury in their activities, and coordination with local organizations that would work closely with stakeholders in the areas. CESCOD and the Pook Mirasol Center for Appropriate Technology (POMCAT) in Camarines Norte were chosen to be the partners in Zamboanga del Norte and Camarines Norte, respectively. Both organizations initiated activities that socially would prepare the communities for the teaching and training component and the monitoring of appropriate activities and measures that would be agreed on. In March 2007, a fact finding mission was carried out by Peter W. U. Appel (Senior research scientist, from Denmark) and Rasmus Koester-Rasmussen (medical doctor, from Denmark) simultaneously with teaching and training courses for small-scale miners and health personnel and for school children in selected communities in Zamboanga del Norte and Camarines Norte.

# **Field investigations**

## **Initial investigations**

Prior to the teaching and training programme for small-scale miners and medical doctors in safe handling of mercury in Zamboanga del Norte in Mindanao, CESCOD (Centre for Social Concerns and Development) carried out a Baseline Survey on Small-scale Mining in Sibutad and a seminar on Philippine Agenda 21: Training Accomplishment Report (March 6, 2007). Both documents are attached as Appendix B and C. No initial investigations have been carried out in the Camarines Norte area.

The baseline survey showed that the small-scale miners are keen to learn methods for the reduction in release of mercury. The medical doctors, nurses and midwives (health providers) have taken no specific action regarding possible health hazards caused by mercury, but the medical doctors expressed interest in the project. The baseline survey revealed that the small-scale miners are organised in co-operatives.

One of the outcomes from the Philippine 21 Agenda Seminar was the wish from a number of small-scale miners to be taught how their consumption of mercury could be reduced by means of using a retort. The small-scale miners appeared to have little knowledge of mercury paths in nature and the associated health hazards for people.

## **Fact finding mission**

The teaching and training was preceded by visits to mining and processing sites in Zamboanga del Norte and Camarines Norte by the project participants. The findings of these visits are as follows:

A few underground mining sites were visited. There are tunnels extending up to 60 metres in the mountains and from the tunnels a number of shafts down to 100 meter have been sunk. In some of the mines ore was hoisted manually, whereas other mines had electric winches. In one mine tunnel small push carts running on wooden rails was seen. The deeper mines had compressors for fresh air supply. From the mines the ore was carried or trucked to processing plants. The tunnels seemed well supported by timber.

At the processing plants the ore was crushed manually to smaller size. The crushed ore was then added to a rod mill holding up to about 20 kg of ore. The ore was milled for about two hours after which 0.5 to 1 kg of mercury was added. The purpose of adding mercury is that gold “dissolves” in mercury and can then be retrieved. This process is called amalgamation. The ore-mercury mix was ground for another thirty minutes. The mercury-ore mix was extracted from the drum into a large plastic tub. The tub was vigorously shaken and the light material on top was transferred into a tailings basin. This was repeated until only mercury was left in the tub. This procedure was used in Zamboanga, whereas the small-scale miners in Camarines used a gold diggers washing pan to concentrate the mercury

from the tailings. The mercury was then squeezed in a piece of cloth and the amalgam (mercury with dissolved gold) was subsequently heated under a propane blow torch. The burning of the amalgam took place in the open or in small huts sometimes equipped with a chimney. The chimney was meant to prevent the worker from inhaling mercury vapours. Some of the workers use a piece of cloth as a mask believing that it prevents inhalation of the mercury vapour. They were told that such a mask does not prevent mercury vapour from getting into the lungs.

After the ore has been treated with mercury, the tailings are trucked to nearby cyanide plants. The tailings contain high amounts of mercury. In the cyanide plant some of the remaining gold is extracted and the remaining material is discarded in tailings. The tailings from the cyanide plants contain appreciable amounts of mercury and cyanide as well as the extremely toxic mercury cyanide compounds. Some of the tailing ponds are up to three meter deep and with a size of several football plains. They are kept in place by plastic sacks filled with tailings. Many of the plastic sacks were deteriorating and thus provide poor protection for villages situated down hill from the tailing ponds. These tailing ponds constitute a ticking bomb. In case of heavy rain, flooding may occur. This will wash the tailings with the mercury and cyanide further downstream and finally into the sea. The mercury will end in the mangrove swamps along the coast. These swamps provide hatching grounds for fish and shellfish, which is the main source of proteins for the population of the Philippines.

The main reason for the extremely high consumption of mercury with subsequent pollution of the environment is that mercury is added to the rod mills. Adding mercury at this stage of the process is highly inappropriate for three reasons:

1. It requires large amounts of mercury to extract gold straight from 20 kg of crushed and ground ore. About 95 percent of the ore consist of barren quartz which can easily be separated by purely mechanical means from the remaining heavy minerals which include gold. This separation of heavy minerals from light minerals must be carried out before mercury is added. If this is done, only a few grams of mercury are needed in order to extract the total amount of gold.
2. Mercury in the rod mills is beaten into very small "pearls" by the rods and the repeated beating will eventually prevent coalescing of some of the mercury "pearls". These small pearls, many of which may contain gold, will then not be collected for amalgamation, but will end in the tailings, which are transported for further refining at cyanide plants. The cyanide dissolves free gold and presumably extracts gold out of the mercury pearls. However, cyanide will bring the metallic mercury in solution as a cyanide complex. These mercury cyanide complexes, as well as the metallic mercury, will be dumped in the tailing ponds at the cyanide plants.
3. Much of the gold in the gold ore is not recovered by small-scale miners or through the further processing at the cyanide plants. Preliminary sampling in Zamboanga del Norte and Camarines Norte of tailings prior to and after cyanide treatment, gave the results seen below. This proves that lots of mercury is lost to the environment, but also that high amounts of gold are not recovered. 16 gram of gold per ton is high grade gold ore.

Sample no.	Location	before cyanide	after cyanide	Au g/ton	Hg g/ton
494855	Sibutad	x		16.5	250
494856	Sibutad		x	13.6	200
494857	Casalugan	x		14.00	120
494858	Casalugan	x		1310	73
494859	Luklukan	x		1.23	110

In Camarines Norte a very special type of small-scale mining was observed. This is called *Compressor mining*. Small-scale miners in Gumaus and Casalugan barangays have discovered gold-bearing alluvial deposits under rice paddies. The gold ore is found 6 to 35 metres below the surface. The miners dig holes with a cross section of about one square metre and down to where they meet the gold bearing layer consisting of boulders, gravel, sand and some clay. The layer has a varying thickness, but reportedly is rarely more than a few metres thick. There is some confusion as to the actual depth of the holes. We measured one hole in Luklukan, which was 6.5 meters deep. We were, however, told that holes could be as deep as 35 meters. Sometime the miners dig tunnels from the bottom of the holes in order to follow the gold-bearing layer. During this process they frequently dig into a neighbouring hole mined by another group of miners. The hole is filled with water in order to prevent the walls from caving in.



Children concentrating gold from compressor mining

The mining process is as follows. One of the miners dive into the muddy water. He has a plastic hose in his mouth for air supply. The hose is connected to a compressor. A bucket tied with a rope is lowered into the hole, and when the miner has filled the bucket, he signals with the rope and the bucket is hoisted to the surface. The miner stays down the hole for up to 4 hours at a time. The water is very muddy so the miner cannot see anything during mining at the bottom of the hole.

The miners diving into the holes are typically male teenagers, but the miners treating the ore at the surface are often younger children. We saw a mining operation, where five children estimated to be below ten years of age were working. Some of them work on Sundays only and can thus attend school, whereas many of them work every day. The ore from the hole is panned and the heavy mineral concentrates are amalgamated in nearby huts.

When the miners have worked at the bottom of the holes, they often surface very quickly. This causes divers syndrome and some of the miners also suffered from sore joints. Diver's syndrome also affects the brain, but the small-scale miners were not aware of this risk.

## **Borax method**

In the Benguet area North of Manila small-scale miners have for more than a decade evolved and used a safe method of extracting gold. Instead of using mercury they use the harmless and inexpensive borax. The basic principle is very simple. Borax reduces the melting temperature of gold. Borax is added to the heavy mineral concentrate, which contain gold. During heating with borax gold melts and the other heavy minerals separate from gold. A small gold pellet can thus be recovered. In Appendix G is a detailed description of the method. This description can also be viewed on the internet at: [www.geus.dk](http://www.geus.dk)

The borax method ought to be employed not only in the rest of the Philippines, but also in the thousands of other small-scale mining communities in Africa, South-east Asia and South America.

# Teaching and training courses

## Teaching and training of small-scale miners

In Zamboanga the teaching and training course took place in a large community hall in the town of Sibutad. The course was attended by about 45 small-scale miners and health personnel from a local hospital. In Camarines, the first course for small-scale miners was held in the elementary school of Luklukan. Approximately 70 people participated including some children. Several of the children worked in small-scale mining. The second training course was held at Mayor's Hotel Paracale, for 53 small-scale miners including about 10 child labourers from three different barangays, Gumaus, Tawig and Casalugan. The following day, 16 small-scale miners from Gumaus and nearby places came to the hotel and we gave one more training session. A detailed account of the different teaching and training courses is provided in Appendix A.

The first part of the teaching and training courses was a detailed description of the dangers of mercury, how it travels in the environment and how it is digested/entering into the human body. This was followed by a medical description of mercury hazards to human health. People were very concerned and there were many questions.

A session describing alternative processing methods was held after lunch,. This described retorting and alternative methods not using mercury. A retort is a mercury recycling devise invented in South America for small-scale miners and gradually spreading to other continents. The retort was demonstrated and it was shown that mercury was indeed recycled. The small-scale miners were very keen to obtain retorts and a small number was given to them.

Another way could also be suggested. In the Benguet area the so-called borax technique is widely used. This technique does not imply use of toxic chemicals such as mercury or cyanide, but exclusively borax, which is a non toxic and cheap compound. It would not be very expensive to get small-scale miners from the Benguet area to Zamboanga del Norte to introduce the Mindanao small-scale miners to this technique. The borax method is described in detail in Appendix G.

At one of the training sessions it was suggested to initiate a system of rewards to milling stations, which had abandoned the method of adding mercury to the rod mill. It was suggested that this would be good way to put pressure on milling stations that did not change their gold extraction methods.



Rod mills for grinding gold ore. Each mill contain about 30 kg of ore which is ground for 2 to 3 hours. Then 1 kg of mercury is added and grinding continues for about 30 minutes

### **Teaching and training of medical doctors, nurses and midwives**

In Zamboanga, a total of 35 nurses, midwives and other municipal health workers were trained in mercury toxicology for some hours. In Camarines, some 85 municipal health workers, midwives were trained in mercury toxicology. The pre-training awareness was almost non-existing. The participants were extremely positive towards the training and promised to advocate the new technique in their villages.

## Outline of the Medical Training Program

### *A. History of mercury*

After the teaching sessions a “mercury pollution awareness test” was carried out. The test can be seen in Appendix F. The cases of Iraq and Minamata

### *B. Effects of mercury poisoning on nature / environment*

“No visible damage to fish and seaweed”

Circulation of mercury in the nature

Food chain

### *C. Absorption of mercury in the human body*

\*Inhalation “Masks are inefficient“

\*Ingestion (fish) “organic, invisible mercury”

\*Crosses placental barrier

Bioaccumulation

Mercury deposits in the brain and concentrate in the foetus

### *D. Symptoms*

Mercury does not kill you

It may damage your brain

Acute poisoning: Heart beating, gingivitis, tremor, irritation

Chronic poisoning: Developmental delay and reduced intellectual performance. Memory loss, sensory and visionary disturbances, motor function disturbances, balance, tremor, numbness around the mouth. Sleep disturbance, aggressive personality changes, anxiety.

Faroe Islands study from 1998. Reduced motor function, language and memory. “Safe” levels were not safe.

Mother with no signs of poisoning can have affected child

It can be concluded that the training sessions of SSM and hospital personnel were eye openers for all, and the audience was generally alarmed by the information and had many relevant questions.

The local doctors had a very limited awareness of the local mining techniques and had probably no concerns, prior to the medical visit, of local mercury pollution. Monitoring techniques and further information was shared with the medical personnel. A detailed description of the medical teaching and training courses can be seen in Appendix A.

Prior to the training sessions a hand out was produced. It gave short description on the paths of mercury in the environment and described some of the symptoms of mercury poisoning of humans. The handout can be seen in Appendix E.



Teaching small-scale miners and health personnel

### **Teaching of school children**

Child labour does not seem to be widespread in the Zamboanga area, whereas it is frequently met in Camarines. Whether the children work as small-scale miners or not, they still are affected by the release of mercury to the environment by small-scale mining. It was therefore decided to carry out an information campaign in the local schools. After negotiations with the head masters of the local schools, we were allowed to teach primary and secondary school classes. About 15 minutes were spent in each class telling about the paths of mercury in the environment and the health hazards caused by mercury released by small-scale mining. Many of the children had family members or relatives working in small-scale mining, and most of them knew about the use of mercury. None of them, however, had any idea of the toxicity of mercury. Many of the children admitted that they had played with mercury at home.

We were told afterwards that the children kept asking their teacher questions to clarify some of the information, they had been given by us. Many of them also emphasized that they were keen on conveying the messages they had received in school to their parents, when they returned to their homes.



Two school children 10 and 11 years old, working as small-scale miners in the week-ends. They were anxious to know whether they had high contents of mercury in their bodies.



Barangay Luklukan

## **Forum on Small Scale Mining in the Philippines March 26, 2007**

After field work and teaching and training courses, a forum that was convened to report the initial findings and activities significantly heightened the awareness of representatives of the NGO community, academe, national funding institutions, and government agencies such as the Department of Environment and Natural Resources (DENR).

Gathered in the forum were some fifty representatives from various sectors, including the academia, government agencies, the non-government organizations and advocates, local funding organisations, and the small scale mining communities. The objective of the forum was to report what had initially been accomplished by the project, and to steer discussions onto the possible next steps of the project. The discussions heightened awareness on the practice of small scale miners, the effects of mercury, and how organizations and concerned government agencies can help address the issues raised from the field work and teaching/training sessions. Participating small scale miners likewise took this opportunity to share amongst themselves techniques and tools in processing gold, with less harm to themselves and to the environment. List of Philippine participants is seen in Appendix D.

# **Appendix A: Detailed account of the field work with fact finding missions and teaching programme for small-scale miners and health workers (medical doctors, nurses and midwives)**

## **Zamboanga del Norte**

### **Technical session**

#### **Summary and recommendations**

Small-scale gold miners in Zamboanga del Norte use approximately ten times more mercury than small-scale miners working with the same type of gold ore in other parts of the World. In the Sibutad area, about five hundred (500) small-scale miners release an estimated 120 to 360 kg of mercury into the environment every year. A minor part is released from burning amalgam, whereas the main part is released into tailing ponds, as metallic mercury and as mercury cyanide complexes.

The project revealed that the small-scale miners in Zamboanga del Norte do not know about the gold panning method. This method, which is widespread on most other parts of the Philippines, is used for separating heavy minerals including gold from barren light minerals. By learning to use this pan the small-scale miners will be able to reduce their consumption of mercury with more than 95%.

The small-scale miners are interested in obtaining retorts for recycling of mercury during burning of amalgam. Considering the excessive use of mercury it is urgently needed to introduce new beneficiation techniques and convince the small-scale miners to use new techniques. This could be done by an exchange program whereby small-scale miners from Zamboanga would go to Benguet area and vice versa in order to hear about and get accustomed to other small-scale mining techniques. By implementing new techniques together with the retort, mercury release to the environment may be reduced by more than 99%. Alternatively, mercury-free gold extraction techniques, as the borax method used in the Benguet area could be implemented in Zamboanga at minimal costs to an exchange programme.

Child labour has not been encountered in this area. Many children admitted that they play with mercury in their homes. They were not aware of the toxicity of mercury, but were keen, after obtaining the news of the toxicity of mercury, to inform their parents.

### **Initial investigations**

Prior to the teaching and training programme for small-scale miners and medical doctors in safe handling of mercury in Zamboanga del Norte in Mindanao, CESCOD (Centre for Social Concerns and Development) carried out a Baseline Survey on Small-scale Mining in Sibutad and a seminar on Philippine Agenda 21: Training Accomplishment Report (March 6, 2007). Both documents are attached as Appendix A and B.

The main discovery of the baseline survey was that small-scale miners in Sibutad use an excessive amount of mercury to recover gold. An estimated amount of ½-1 kg of mercury is used to extract about 100 g of gold, which is equivalent to 5-10 g of mercury for 1 g of gold. This is in contrast to the rule of thumb in other small-scale mining districts in other countries where ~1 g of mercury is used to extract ~1 g of gold. There are about 20-30 mining and milling sites in the area serving small-scale mining co-operatives with a total of about 500 small-scale miners. A conservative estimate shows that these sites release in the order of 120 to 360 kg of mercury per year to the environment.

The baseline survey furthermore showed that the small-scale miners are keen to learn methods for the reduction in release of mercury. The health providers (medical doctors, nurses and midwives) have taken no specific action regarding possible health hazards caused by mercury, but the medical doctors expressed interest in the project.

The baseline survey revealed that the small-scale miners are organised in co-operatives.

One of the outcomes from the Philippine 21 Agenda Seminar was the wish from a number of small-scale miners to be taught how their consumption of mercury could be reduced by means of using a retort. The small-scale miners appeared to have little knowledge of mercury paths in nature and the associated health hazards for people.

### **Fact finding mission**

The actual teaching and training was preceded by visits to mining and processing sites in the Sibutad area by the project participants. The findings of these visits are as follows:

One mining site was visited. This is a tunnel, which reportedly stretches about 40 meters into the mountain. There were 12 miners working in the tunnel and the ore was carried out by a small push cart running on rails made of wood. The ore was carried by hand to a nearby processing plant. The operation had unfortunately recently run out of ore. They were now desperately searching for a continuation of the ore body.

At the processing plant the ore was crushed to smaller size by hand. The crushed ore was then added to a rod mill holding up to about 20 kg of ore. The ore was milled for about two hours after which 0.5 to 1 kg of mercury was added. Mercury is added in order to extract gold. The gold “dissolves” in mercury making a so-called amalgam. In this way gold can be extracted from the gold ore. The ore-mercury mix was then ground for another ten minutes. The mercury-ore mix was extracted from the drum into a large plastic tub. The tub was vigorously shaken and the light material on top was transferred into a basin for later treatment. This was repeated until only mercury was left in the tub. The mercury was then squeezed in a piece of cloth and the amalgam was subsequently heated under a propane blow torch.

The burning of the amalgam took place in the open or in small huts sometimes equipped with a chimney. The chimney was meant to prevent the worker from inhaling mercury vapours. Some of the workers use a piece of cloth as a mask believing that it will prevent the mercury vapour to be inhaled. They were told that such a mask does not prevent mercury vapour to get into the lungs.

After the ore has been treated with mercury, the tailings are trucked to a nearby cyanide plant. These tailings contain high amounts of mercury. In the cyanide plant the remaining gold is extracted. The tailings from the cyanide plant containing appreciable amounts of mercury and cyanide are dumped in a tailing pond. This tailing pond constitutes a ticking bomb. In case of heavy rain flooding may occur. This will wash the tailings with the mercury and cyanide further downstream and finally into the sea.

The main reason for the extremely high consumption of mercury is that it is added to the rod mills. Adding mercury at this stage of the process is highly inappropriate for three reasons:

1. Adding mercury to the rod mills is inappropriate since it requires large amounts of mercury to extract gold straight from 20 kg of crushed and ground ore. About 95 percent of the ore consist of barren quartz which can easily be separated by purely mechanical means from the remaining heavy minerals which include gold. This separation of heavy minerals from light minerals must be carried out before mercury is added. If this is done, only a few grams of mercury are needed in order to extract the total amount of gold.
2. Second reason is that mercury in the rod mills is beaten into very small “pearls” by the rods and the repeated beating will eventually prevent coalescing of some of the mercury “pearls”. These small pearls, many of which may contain gold, will then not be collected for amalgamation, but will end in the tailings, which are transported for further refining at cyanide plants. The cyanide dissolves free gold and presumably extracts gold out of the mercury pearls. However, cyanide will bring the metallic mercury in solution as a cyanide complex. These mercury cyanide complexes, as well as the metallic mercury, will be dumped in the tailing ponds at the cyanide plants.
3. Much of the gold in the gold ore is not recovered by small-scale miners nor through the further processing at the cyanide plants. Preliminary sampling in Zamboanga del Norte and Camarines Norte of tailings prior to and after cyanide treatment, gave the results seen below. This proves that lots of mercury is lost to the environment, but also that high amounts of gold are not recovered. 16 gram of gold per ton is high grade gold ore.

Sample no.	Location	before cyanide	after cyanide	Au g/ton	Hg g/ton
494855	Sibutad	x		16.5	250
494856	Sibutad		x	13.6	200
494857	Casalugan	x		14.00	120
494858	Casalugan	x		1310	73
494859	Luklukan	x		1.23	110

## **Teaching and training course**

The teaching and training course took place in a large community hall in the town of Sibutad. The course was attended by about 45 small-scale miners and health personnel from a local hospital.

First part of the course consisted of lectures on general problems for small-scale miners, followed by a detailed description of the paths that metallic and methylated mercury uses in nature. Secondly, a detailed account of health issues comprising symptoms of mercury poisoning for the different mercury compounds was given. A detailed account of the teaching of health issues is presented in a separate chapter below.

The small-scale miners were very eager to obtain information on the health - and environmental hazards caused by mercury, and they were also keen on learning about methods of reducing release of mercury to the environment. They were particularly interested in learning about the so-called retort. A retort is a mercury recycling device, which originally was invented in South America. It is presently used by hundreds of thousands of small-scale miners' world wide.

These sessions continued until lunch. After lunch, a demonstration of the retort took place. Two retorts were used for demonstration. One retort was of the type purchased by the project, which is a copy of the model used in South America with minor modifications. The other retort was locally manufactured and was slightly different. This retort belonged to a local small-scale miner and seemed to have been extensively used. Both retorts functioned perfectly and two pellets of amalgam were retorted. The final result was satisfactory and mercury with a value in the order of about 20\$US was recovered. This amount would have been released to the environment during normal burning.

The demonstration proved beyond doubt that the retort was efficient and the small-scale miners thus also lined up for obtaining retorts. The project handed out 20 retorts of two different sizes. One of the leaders of the small-scale miners assured us that in case more retorts were needed they could probably produce them locally from scrap for about 100 pesos (~2\$US) each.

The fact finding mission, however, clearly showed that the dominating mercury release to the environment resulted from the addition of mercury to the rod mills. During the training session alternative technical methods not involving addition of mercury during the crushing process, were explained to the small-scale miners. Although they realised that the process they used was not appropriate, most of them were slightly reluctant to change to other techniques, the main reason being that they were afraid of not recovering all the gold in the ore. One of their leaders, Mr. Eddie Cayabyab was, however, keen to learn other techniques. It was decided to get him to join a teaching and training session in Benguet. The techniques he could learn there would make the method of adding mercury to the rod mills redundant.

Another way could also be suggested. In the Benguet area the so-called borax technique is widely used. This technique does not imply use of toxic chemicals such as mercury or cyanide, but luvishly borax, which is a non toxic and cheap compound. It would not be very

expensive to get small-scale miners from the Benguet area to Zamboanga del Norte to introduce the Mindanao small-scale miners to this technique.

### **Teaching of school children**

Child labour does not seem to be widespread in the Sibutad area. Children are, however, affected by the release of mercury to the environment by small-scale mining. It was therefore decided to carry out an information campaign in one of the local schools. After negotiations with the head master of one of the local schools, we were allowed to teach all eight classes in the school. About 15 minutes were spent in each class telling about the paths of mercury in the environment and the health hazards caused by mercury released by small-scale mining. Many of the children had family members or relatives working in small-scale mining, and most of them knew about mercury. None of them, however, had any idea of the toxicity of mercury. Many of the children admitted that they had played with mercury at home.

We were told afterwards that the children kept asking their teacher questions to order to clarify some of the information, they had been given by us. Many of them also emphasized that they were keen on conveying the messages they had received in school to their parents when they returned to their homes.

### **Medical session**

#### **Summary and recommendations**

A disastrous release of mercury is taking place in the village of Sibutad, Zamboanga del Norte. Mercury was in all rod mills added to the drums and a conservative estimate on the mercury consumption was 9 kg/year/rod mill, sum up to approximately 120 to 360 kg/year. This is 10 times worse than we expected and this degree of spill has been going on for about a decade. 10-20% evaporated in the amalgamation process and 80-90% went out into the tailing ponds. What was not washed out from there or disseminated in the village ended up in the tailing ponds of the 2 cyanide plants, which could be a reason to fear that they are heavily exposed to methylated mercury because they eat fish every day. A considerable exposure of metallic mercury was estimated to take place and the population might be heavily exposed to organic mercury compounds as they eat fish every day.

Little or no precautions were taken when burning amalgam and many were exposed to moderate metallic mercury vapour concentrations.

The level of awareness on mercury toxicity was very low among small-scale miners, health care personnel and children. Doctors and medical staff had a very limited awareness of the use of mercury in gold mining.

In Zamboanga del Norte and Camarines Norte we found that the small-scale miners use the same highly polluting method for gold extraction and this indicates that this disastrous method might be widespread throughout the archipelago. As such, a national mercury catastrophe is in the brew right now, and only a few people recognize it. Small-scale mining

is a sector in growth, with a resulting pollution that is not only extremely large but also increasing.

Mercury may give permanent brain damage and may reduce the intellectual performance of people exposed (locally and globally!) for generations after generations. Immediate action is recommended.

Recommendations:

1. Launch an immediate nationwide information campaign and training of small-scale miners, school children and health care personnel.
2. The formation of "small-scale mining school" to be based in Benguet, to undertake teaching the borax method combined with an exchange program for small-scale miners, among other techniques.

### **Inspection of Rod mills with focus on mercury toxicology**

We inspected two rod mills in Sibutad. There were reportedly 20-30 similar units in the area. The mills had been there for approximately 10 years. We asked 5-6 rod mill operators about their mercury consumption. They bought approximately ½ - 1 kg of mercury a month and produced approximately 100 grams of gold each.

We observed that exposure to metallic mercury was most evident for the miner performing the amalgamation process. No means of protection was used in the first mill. The miners were in danger of inhaling concentrated mercury vapour. In the second mill, the amalgamation was carried out in a chimney, with less concentrated exposure to the miner. All workers had skin contact with mercury and were exposed to a moderate concentration of vapour in the squeezing process. Waste products containing mercury were intensively handled manually without any protection. The tailing ponds in both localities were full and were leaking several L/min of waste water to nearby creeks. Without doubt the ponds were very sensitive to further overflow by heavy rain. Pigs and chicken were in close contact with the mercury containing waste.

### **Inspection of cyanide plant**

We inspected one cyanide plant in Sibutad. There was one other cyanide plant in the area. The cyanide plants have only been in the area for two years. The operator was not present during our inspection.

We observed a large volume of tailing pond with a large spare volume. We estimated it to be relatively safe so far in regards the onset of heavy rain.

### **Evaluation of inspection**

Of the consumed mercury 10 - 20 % was estimated to vaporize during the amalgamation process and 80 – 90 % was washed out into the tailing ponds. An estimated release of metallic mercury is 120 - 360 kg / year. Thus, the major part was released into leaking tailing ponds. The nearby bay is the main source of fish for the inhabitants of Sibutad; fish is a daily food fare. Only a few miners were exposed to concentrated mercury fumes, but many

miners, children and women were chronically exposed to low concentrations of mercury vapour.

A large spill of mercury was taking place in Sibutad. This degree of pollution has been going on for a decade. The bay may be heavily polluted and the population was probably heavily exposed to organic and metallic mercury compounds.

This pollution might have a whole range of severe health consequences locally and globally. Amongst others negative effect on the intellectual performance of adults and the intellectual development of the children.

### **Training of SSM, school children and hospital staff in mercury toxicology**

The health concerns were tackled via the conduct of training for school children, the physicians, nurses and midwives in the Libay, a community of the town of Sibutad.

10-minute lectures on mercury were given to 8 school classes of 25 pupils in one primary school in the Libay community. Also engaged in a discussion were 2 doctors in the municipal hospital and a visiting doctor from another area who was also entrusted with relevant review articles and folders on mercury toxicology which would be at his disposal to the members of the nearby communities.

A total of 35 nurses, midwives and other municipal health workers and 35 miners were trained in mercury toxicology for some hours. The training program was adjusted to the local mining techniques and the local awareness level presented in the baseline report by CESCOD.

## Outline of the Medical Training Program

### *A. History of mercury*

The cases of Iraq and Minamata

### *B. Effects of mercury poisoning on nature / environment*

"No visible damage to fish and seaweed"

Circulation of mercury in the nature

Food chain

### *C. Absorption of mercury in the human body*

\*Inhalation "Masks are inefficient"

\*Ingestion (fish) "organic, invisible mercury"

\*Crosses placental barrier

Bioaccumulation

Mercury deposits in the brain and concentrate in the foetus

### *D. Symptoms*

Mercury does not kill you

It may damage your brain

Acute poisoning: Heart beating, gingivitis, tremor, irritation

Chronic poisoning: Developmental delay and reduced intellectual performance. Memory loss, sensory and visionary disturbances, motor function disturbances, balance, tremor, numbness around the mouth. Sleep disturbance, aggressive personality changes, anxiety.

Faroe Islands study from 98. Reduced motor function, language and memory. "Safe" levels were not safe.

Mother with no signs of poisoning can have affected child

## **Evaluation of training**

The baseline report stated a minimal awareness of mercury toxicology, as was indicated by statements from the miners and members of their families:

*“No damage on seaweed, fish or other marine life”, “Mercury is not dangerous even when swallowed”, “...no bad effects caused by mercury...”, “no cases of disease or death caused by mercury”.*

Further, the CESCOD baseline report stated, *“The observations of the miners are shared by the local medical doctors and midwives as well as hospital personnel”.*

The awareness level, according to the baseline report was *limited*, and thus meted out ‘limited’ responses: *“They tried to manage safety ... but could not control the overflow of waste” (from tailing ponds), “trying to put tailing ponds in the most safe location”, “use of masks”, “aware of the bad effect of the smoke”.* The baseline report concluded that the awareness level among SSM, doctors and health personnel was minimal prior to our intervention.

After the teaching sessions a “mercury pollution awareness test” was carried out. The test can be seen in Appendix E.

It can be deduced that the training sessions of SSM and hospital personnel were an eye opener for all, and the audience was generally alarmed by the information and had many relevant questions.

The local doctors had a very limited awareness of the local mining techniques and had probably no concerns, prior to the medical visit, of local mercury pollution. Monitoring techniques and further information were shared with the medical personnel.

The teaching off school classes probably had an impact too and an awareness that mercury is dangerous was probably induced.

## **Camarines Norte**

### **Technical session**

#### **Summary and recommendations**

Small-scale gold miners in Camarines Norte use approximately 10 to 25 times as much mercury as small-scale miners (SSM) working with the same type of gold ore in other parts of the World. They release in the order of 4500 kg of mercury into the environment every year. A minor part is released from burning amalgam, whereas the main part is released into tailing ponds, as metallic mercury and as mercury cyanide complexes. The small-scale miners must be taught to change their method of adding mercury to their rod mills and use panning followed by retorting or borax instead. That will decrease the release of mercury to the environment to almost nil.

The small-scale miners expressed genuine interest in obtaining retorts for recycling of mercury during burning of amalgam. After demonstration of the borax method they were also positive of implementing this method. It was suggested to establish an exchange program whereby small-scale miners from Camarines travel to Benguet to learn the borax method on first hand. Then these small-scale miners could act as trainers for other small-scale miners in Camarines.

A recognition and reward to milling stations using only minimal or no mercury should be established. This would put pressure on other milling stations to be more concerned about environmental and health issues. The reward could be a small metal plate with a catchy text stating '*that this milling station works with environmental clean methods and thus not spoiling the future for the children*', could both be inspiring and compelling.

Child labour has been observed to be prevailing in several villages and funds should be raised to cover school fees for these children so they can attend secondary school. Many children admitted that they play with mercury in their homes. They were not aware of the toxicity of mercury, but were keen, after obtaining the information of the toxicity of mercury, to inform their parents. Two little girls who were engaged in mining contacted us after the session in their class. They feared to have high contents of mercury in their bodies.

### **Initial investigations**

No initial investigations were documented by the partner organization, Pook Mirasol Center for Appropriate Technology. POMCAT, however, has had initial work with the small scale mining communities, and in partnership with a few funding agencies, have embarked on projects and activities that would help address social issues that emerge from and are related to mining activities. Among others, a training program for women and children on alternative livelihood activities, information campaign to send children back to school, etc.

### **Fact finding mission Camarines**

The teaching and training was preceded by visits to mining and processing sites by the project participants in Barangay Casalugan, Paracale; Barangay Luklukan, Jose Pangani-ban and Barangay Gumaus, Paracale. The findings of these visits are as follows:

*Barangay Casalugan, Paracale.* A small-scale mining site with several holes dug into rice paddies was visited. This type of mining is called *Compressor mining*. The miners dig holes with a cross section of about one square metre and down to where they meet a gold bearing layer consisting of boulders, gravel, sand and some clay (conglomerate). The layer has a varying thickness, but reportedly is rarely more than a few metres thick. There is some confusion as to the actual depth of the holes. We measured one hole in Luklukan which was 6.5 meters deep. We were, however, told that holes could be as deep as 35 meters. The holes rarely last more than four days before they run out of ore. Sometime the miners dig tunnels from the bottom of the hole in order to follow the gold-bearing conglomerate. During this process they frequently dig into a neighbouring hole mined by another group of miners. The hole is filled with water in order to prevent the walls from caving in. One of the miners dive into the muddy water. He has a plastic hose in his mouth for air supply. The hose is connected to a compressor. A bucket tied with a rope is lowered into the hole, and

when the miner has filled the bucket, he signals with the rope and the bucket is hoisted to the surface. The miner stays down the hole for up to 4 hours at a time. The water is very muddy so the miner cannot see anything during mining at the bottom of the hole.

The miners diving into the hole are typically male teenagers, but the miners treating the ore at the surface are often younger children. We saw a mining operation where five children estimated to be below ten years of age were working. Some of them work on Sundays only and can thus attend school, whereas many of them work every day. The ore from the hole is panned and the heavy mineral concentrates are amalgamated in nearby huts.

We visited two milling plants. The ore is crushed in a rod mill for up to two hours. Then about 0.5 kg of mercury is added to the drum and milling continues for another 30 minutes. The ground mercury-rich ore is then panned in large wooden pans thereby concentrating the mercury. The mercury is squeezed and amalgamated. The tailings are sold to a cyanide plant. The main difference between extraction techniques here and in Zamboanga is that panning is used here, whereas panning is totally unknown in Zamboanga.

There are about 10 milling stations in the village and surroundings. One mill owner claimed to buy about 1 kg of mercury per month and another said that he buys 0.5 kg per week. An average could be in the order of 1 kg per month. This gives a consumption of about 120 kg of mercury per year from those 10 milling stations. Most of the 120 kg mercury ends in the tailings and are transported to the cyanide plants. These plants have been in operation for about 15 years. During that period they have thus released 1.8 tonnes of mercury to the environment.

We visited one of the cyanide plants in the area. That was a frightening experience. The tailings from those plants are not safe at all. They are situated topographically immediately above a village. Two large tailing dams are placed uphill from the village. The uppermost one is the size of a football playing field and several meters deep. It is only secured by plastic sacks filled with soil or tailings. Immediately below this tailing dam, is a slightly smaller dam, which also is secured by plastic sacks only. Immediately below the lower dam is the village. In case of prolonged heavy rains or a minor earth quake, the whole load from the two tailing dams will slide down, through the village and continue further down the river to the mangrove forest and end in the ocean. Tailings in those dams contain tons and tons of mercury.

*Barangay Luklukan.* This is a village totally dominated by small-scale mining. There are between 30 and 40 milling plants in the village serving several hard rock mining sites. These are in the form of tunnels or shafts with a network of underground workings.

We visited two mine entrances. One was a drive into the mountain about fifty metres long and followed a fairly steep decline. We were not allowed to decent the decline. The ceiling and walls of the drive were well supported with timber. The other mine was a reportedly 130 m deep shaft with a cross section of about 1.5 square metres. Miners had to crawl down and up of vertical ladders. The ore is hoisted up.

The '30 plus' milling stations use an estimated 5 kg of mercury per month. This yields between 1800 kg – 2400 kg of mercury released to the environment per year. The techniques is similar to the one described from Casalugan.

*Barangay Gumaus.* There are about 50 milling sites with an average of two drums each. The mill we visited had 2 drums and the owner told us that he buys 0.25 to 0.5 kg of mercury per week and recover in the order of 20 grams of gold per week. This shows that the small-scale miners use 12 to 25 grams of mercury to recover 1 gram of gold. All in all, they release between 750 and 1500 kg mercury per year. We were informed that there were in the order of 100 small-scale miners in the area and about 50 children working in small-scale mining.

Right in the centre of the village there is also a single example of *compressor mining*. The mine is an about 6.5 m deep hole. They pan the ore and amalgamate the gold. The amalgam is burned in a hut nearby. This mining team is very cautious about mercury and just add sufficient mercury to amalgamate with the gold.

### **Teaching and training course**

The first course for small-scale miners was held in the elementary school of Luklukan. Approximately 70 people participated including some children. Several of the children worked in small-scale mining. The first part of the course was a description of the dangers of mercury, how it travels in the environment and how it is digested/entered into the human body. This was followed by a medical description of mercury hazards to human health. People were very interested and there were many questions. We were later told that a good deal of the female participants had been told by their children about the information, we had given in their classes a few days earlier when we also had advised them to ask their parents to participate in the training session. It should be mentioned that two small-scale miners had come all the way from Gumaus in order to attend the training course. One of them, Abner Magtangob later turned up at the next training sessions.

After lunch a session describing alternative processing methods was held. This described retorting and alternative methods not using mercury. The retort was demonstrated and it was shown that mercury was recycled. After the training session we drove to a milling station and demonstrated the borax method with great success.

During our visit, I questioned the chief again about his use of mercury. He stated that he bought about 5 kg of mercury per month. He also said that there were 30 plus milling stations in the area and that they also bought in the order of 5 kg per month. This yields 1800 kg of mercury released to the environment per year.

The second training course was held at Mayor's Hotel Paracale, for 53 small-scale miners including about 10 child labourers from three different barangays, Gumaus, Tawig and Casalugan. Included in the training were a very successful demonstration of the retort and a good demonstration of the borax method. This practical demonstration was carried out by small-scale miner Abner Magtangob from Gumaus. He was invited to participate in the forum in Manila Monday 26 ????. After the training there were a lot of very relevant questions;

it is obvious that the people here are very concerned about the high mercury contents in the region.

The following day Abner Magtangob had asked 16 small-scale miners from Gumaus and nearby places to come to the hotel and we gave one more training session. There was a lively discussion in the group about the new methods suggested.

An interesting idea was discussed. Would it be possible to initiate and run a system of re-wards to milling stations, which had abandoned the method of adding mercury to the rod mill. It was decided that this would be good way to put pressure on milling stations that did not change their gold extraction methods. The idea was further discussed later at the forum on Monday 26 March in Manila.

### **Teaching of school children**

Teaching of school children took place in Luklukan and in Gumaus. The teaching was carried out prior to the teaching and training course for the small-scale miners. The children were informed of the toxicity of mercury and the environmental hazards of the metal. They were also made aware that the mercury released today will remain in the environment for a very long time and that this would affect not only their parents and the children themselves, but also generations to come. We advised the children to ask their parents reduce the use of mercury and also ask them to participate in the training course. We were later told that the children had actually told their parents to come to the training course. In Luklukan we taught children in eight classes in the elementary school. In Gumaus were taught 6 classes in elementary school and four classes in secondary school. In Luklukan we had a moving and disturbing experience. Just before we were to leave the school after teaching the children, two little girls aged 10 and 11 told us that they were small-scale miners and that they were very afraid of having mercury in their bodies.

### **Medical session**

### **Summary and recommendations**

An extremely large waste of mercury was taking place in the 3 villages inspected in Camarines Norte. Mercury was in all rod mills added to the drums and a conservative estimate on the mercury consumption was 44 kg/year/rod mill, summed up to more than 4.2 tons/year for the 3 villages. The release of mercury has been going on for decades. A large part of the mercury ends up in the tailing ponds of the cyanide plants. These cyanide tailing ponds were in general in an alarming condition, all leaking and close to the mangrove and sea where all mercury sooner or later will be washed out. The inhabitants eat fish several times a day and it is logical to be alarmed that they were heavily exposed to methylated mercury.

No precautions were taken when blow torching amalgam and many were exposed to moderate metallic mercury vapour concentrations.

The level of awareness on mercury toxicity was non-existing to very low among small-scale miners (SSM), health care personnel and children. Doctors and medical staff had a very limited awareness of the use of mercury in gold mining.

Mercury may give permanent brain damage and may reduce the intellectual performance of people exposed (locally and globally!) for generations after generations. Immediate action is recommended.

**Recommendations:**

- An immediate nationwide information campaign and training of small-scale miners, school children and health care personnel.
- The formation of "Small-scale mining school" based in Benguet teaching the borax method combined with an exchange program for small-scale miners.

**Medical report on inspections and training sessions**

Casalugan; Inspection of "compressor" mine

We inspected on a Sunday a mine in a paddy field in Casalugan. The pit was apparently 5-6 meters deep and full of water from the rice paddy. The miners went down in turns to dig for 3-4 hours in a row. The compressed air was led down to the miner underwater in a plastic tube with no mouth piece. The pits were used for 3-4 four days and the filled up again. Apparently pits in other places were as deep as 30 meters.

We observed 8-10 similar sites within 100 m. Only one was active and run by 5-6 children with estimated ages of 8-15 years. Air was supplied from an ordinary compressor with air intake less than 1 m from the exhaust pipe. No mercury was used on the mining site.

Inspection of rod mills

We inspected 2 rod mills in Casalugan each with one active drum. One mill owner bought ½ kg of mercury every month. The other bought ½ kg every week. Mercury was in both mills put into the drum. There were 10 similar mills in the area.

In both mills we observed blow torching of amalgam without any security precautions. The second mill served also as living room for the whole family. We saw numerous leaking tailing ponds.

Inspection of cyanide plant

We inspected one of several (minimum 3) cyanide plants in the area. The cyanide plant has been processing the tailing from the local rod mills for at least 15 years. The owner was not aware of mercury in the tailings.

We observed 3 large tailing ponds. One completely full, leaking, sized 50 x 30 m and built up by tailing sacks to 1½ m. The last two were each approximately 80 x 80 m situated one over the other in a slope between two hills. The higher one was completely full and separated from the lower one by a 4 m dam build of tailing sacs. The lower one was not entirely full as there were 60 cm from water level to the top of the second dam. The second dam was built of earth and separated the multilevel cyanide-mercury tailing pond from the village

further down the slope. Leaking from the ponds formed a creek running the 100 m through the village and out into the mangrove.

#### Luklukan

We inspected a mining tunnel. The walls and ceiling were well supported and helmets were available. A large compressor supplied air. No mercury was used at the mining site.

Inspection of rod mill. We inspected a 4 drum rod mill in Luklukan. The owner informed us that he bought 4 kg of mercury every week (3000 pesos/kg). He was interested in saving money on mercury. Mercury was put into the rod mills. There were reportedly 30-40 rod mills in the area equivalent to 100 active drums. The same technique was used by all rod mills in the area.

We observed all 4 rod mills in action. Amalgamation took place in a stove with no chimney. We saw numerous overfilled and leaking tailing ponds.

#### Gumaus

We inspected a 2 drum rod mill in Gumaus. The owner told us that he bought  $\frac{1}{4}$ - $\frac{1}{2}$  kg mercury every week. There are 50 rod mills in the area with an average of 2 drums each. An estimated  $\frac{1}{2}$ -1 kg of mercury was put into the drum. Also noted were numerous leaking tailing ponds.

We inspected a "compressor" mine site in Gumaus similar to the compressor mine in Casalugan. The miners stayed down for 3-4 hours in a row. They denied that they suffered from symptoms of decompression disease. A woman later told us that they in fact did suffer from joint pain and numbness of the fingers but would not tell us, or something that is often dismissed as 'fatigue' and tiredness that is normal from the mining activity.

We saw 3-4 young men aged 15-17 years mining. The depth of the hole was measured to 6.5 m. The mud was washed and panned. A few drops of mercury were added to free gold in mineral concentrate and blow torched without any safety precautions.

Inspection of abandoned cyanide plant.

On our way to Gumaus we passed by an abandoned cyanide plant.

We found the tailing pond full, dry and slowly being eroded by a creek running across the plateau.

Teaching in a primary school in 4 classes of 50 children each, and in a secondary school in 2 classes of 25 students each, has drawn a lot of interest and concern from the young population, and including among the teachers.

Training of medical doctors (MD) in Jose Panganiban Cooperative hospital

Under informal conditions the medical doctor was trained in mercury toxicology. The doctor received a review article and information about local mining techniques, the ongoing mercury pollution and alternative techniques. His pre-training awareness of mercury toxicology and the local use was modest. He was very open minded and was alarmed by the information.

Another training session was with the more senior medical doctor in the same Cooperative Hospital.

The senior MD did not consider mercury a relevant problem and was not interested in further information. He thought however that our training program of the miners was a good idea.

#### Training of SSM in Luklukan

Trained 70 SSM and a few healthcare workers in mercury toxicology for 1 hour and gave them a test afterwards with “mercury pollution awareness test”.

#### Training of healthcare personnel in municipal hall in Jose Panganiban

Some 50 municipal health workers, midwives were trained in the municipal hall in Jose Panganiban in mercury toxicology and gave them an orientation of a “new mining technique”. Clarifications and answers to issues were done after the “mercury pollution awareness test” that was conducted.

The pre-training awareness was almost non-existing. The participants were extremely positive to the training and promised to advocate for the new technique in their villages.

Training of trainers. Training of 35 nurses and midwives in mercury toxicology and “new mining techniques” followed the administration and evaluation of the “Mercury pollution awareness test” A training of trainees’ session took place so that the participants were prepared to train miners.

### **Evaluation of inspections in three villages in Camarines Norte**

Mercury was added into the drums in all mills inspected. Based on the amount of gold gained by the miners we estimated that less than 10% of the consumed mercury vaporized during the amalgamation process and > 90 % was estimated to be washed out in the tailing ponds.

There was a large variation in how much mercury the rod mill owners told us that they bought every month. Though, they should know since mercury is rather expensive. The high value from Luklukan was confirmed several times and whether the others underestimated in general or not is uncertain but definitely enormous amounts of mercury was used.

Village	Purchased mercury	Mercury/year
Gumaus	Min: 1,12 kg/month x 50 mills	= 675 kg
	Max: 2,25 kg/ month x 50 mills	= 1350 kg
Luklukan	12,4 kg Hg/month x 35 mills	= 5200 kg
Casalugan	Min: 0.5 kg/month x 10 mills	= 60 kg
	Max: 2,25 kg/month x 10 mills	= 255 kg

The mean mercury consumption of a rod mill was 3,7 kg/month = 44 kg/year

For the 3 villages we estimated the spill to be: 44 kg/year x 95 mills = 4210 kg/year

The mercury in the tailings from the rod mills were disseminated throughout the villages, though the major part ended up in leaking tailing ponds of the cyanide plants. These are

extremely sensitive to heavy rain and the one in Casalugan is estimated to be a ticking bomb in great risk of being turned into a landslide by a minor earthquake or heavy rain.

The distance to the mangrove and the ocean were all short in all three villages and the inhabitants eat fish several times every day. Some miners were daily exposed to concentrated mercury fumes in short periods. Little or no precautions were taken and often there were audience and often the amalgamation took place in the "living room". Thus, a relatively large to moderate exposure of mercury fumes was estimated to take place.

A massive spill of mercury was taking place in the 3 villages. This degree of pollution has been going on for decades. We assume that the whole area and the Gumaus Bay are heavily polluted and that the population may be heavily exposed to organic and metallic mercury compounds.

This pollution will have a whole range of severe health consequences for the inhabitants in the area. Amongst others negative effect on the intellectual performance of adults and the intellectual development of the children.

Training program was the same as in Sibutad.

### **Evaluation of training**

The level of awareness of mercury toxicity prior to the training sessions was estimated to be non-existing to low among all involved groups including the health care personnel. The doctors may have had limited basic knowledge on the subject but did not consider it a problem and had only vague ideas on mining techniques and the amount of mercury used locally.

After the teaching sessions the "mercury pollution awareness test" showed that:

- All understood that a retort would protect from the poisonous mercury vapour
- All identified that mercury may damage the brain and the foetus
- A minority answered (wrong) that a safe position of the tailing pond would reduce mercury pollution.
- All identified smoke as the most toxic. Most checked all 3 answers in question 4

Afterwards all the questions were evaluated and misunderstandings corrected.

It was the impression that the training sessions of SSM and hospital personnel were an eye opener for all. The audience was generally alarmed by the information and had many relevant questions. A training program was developed along the way and the last team of health care personnel was educated in specific mining techniques and trained to train miners.

One local doctor was very interested and said he would follow up on the subject. The other did not consider mercury pollution a problem.

The teaching of school classes definitely had an impact too and we were told that a number of parents came to our training because their children told them to.

# Appendix B Baseline Survey Report

## Background

The small-scale miners (SSM) started to operate in Sibutad mining sites in the year 1986. At present, there are about 500 miners operating in Sibutad. About half of the total numbers of miners are local residents of the municipality of Sibutad and half of them are migrants. Most of the miners reside in the mining sites and some are living in neighboring barangays. Before the coming of the Philex Gold Philippines Incorporated (Philex Mining), some groups of miners were already registered with the Cooperative Development Authority (CDA) as local small-scale miners association. However, upon the entry of the Philex mining, the small scale associations gradually disappeared because large areas of the mine sites were bought by Philex. One of the members of the association that existed before stated that they were able to form a cooperative store with around 700 members. The said store helped uplift their economic status. The funds of the association were used for rallies and meetings against Philex and eventually their store was closed.

## Operations

The types of minerals that are extracted in the site are gold and silver. Only very few miners are extracting silver and most are extracting gold. As small-scale miners, they use manual operations. Some of the operators use heavy equipments to make roads to provide access to their site. The equipments used for extracting minerals are different sizes of hammer, sharp steel (locally known as mowel) also in different sizes, flashlight and blower to produce oxygen.

In the mine sites of barangays Minlasag and Calube, about 120 hectares are covered for extraction and 21 hectares in barangay Libay. The 21 hectares of barangay Libay is owned and managed by Philex Corporation. It is in this area where miners of barangay Libay extract minerals. The Philex management along with some local financiers formed an association which they call "Minahang Bayan" ("Community Mining" pertaining to a particular site open for mining by the general public) to operate small-scale mining in the area. However, the association does not serve the purpose because it is not the small-scale miners (Bayan) who benefit from the mining site (Minahan). Only the few local financiers and Philex get the big share of the income while the laborers earn very little.

The small-scale miners who once operated in the area lost their livelihood because they are no longer allowed to enter the area covered in the Minahang Bayan. Since the start of the mining operations up to the present, hundreds of "holes" (excavated areas) are present for mineral extraction but now only a few are operational.

Common methods are applied by all miners. At first, they do soil sampling in the portion of the "hole" to determine the presence of gold. After sampling, they gather the soil or stones

and put them on the sacks. After putting all gathered soil into the sack, the miners pull them out the “hole“ and transport them to the mills for processing.

## **Processing**

Rod mill is the most common implement used by most of the small-scale miners. Some of the machines used to run the process of grinding are powered by electricity while some are powered by gasoline. The machine is used with the drums and rods. After the stones and soil are crushed, amalgamation then follows. This is the process when mercury is mixed inside the rod mill for several minutes. Crushed minerals with mercury are then placed in the basin and the waste minerals are slowly taken away, until only the mercury is left. Then, the mercury is placed in a small piece of cloth. The cloth is squeezed until the mercury splits out from the cloth and raw mineral remains ready for the melting process.

The waste ores are drained in the tailing pond. Tailing ponds are of two layers. The first waste from rod mill is drained in the first layer. When the first layer tailing pond is full, another process is applied. It is locally known as “BANLAS”. It is a process when the waste is drained through a rough surface of cloth or other material. In this process, the gold mineral is absorbed by the cloth and the waste is drained to the second layer tailing pond. The cloth that absorbed the minerals is washed and then mixed again with mercury. The process is then repeated. After the process of ‘banlas’, the last and final process for gold extraction is applied. It is when the waste is mixed with cyanide for at least 48 hours. Cyanide processing extracts gold in totality; after which the waste can no longer be used again. The waste after cyanide extractions is transferred to the permanent tailing pond. As for now, there are two cyanide plants operating in Sibutad site. One cyanide plant is willing to be checked and cooperate with the project while the other plant is not open to work with us or any group that will attempt to introduce some measures to regulate pollution etc.

After the gold has been extracted using the above-mentioned processes, it is now ready for melting. The chemicals used for gold melting are mercury, borax, acid, blue torch and clay. Gold is melted inside a structure that looks like an oven with a chimney (exhaust tube) for exhaust made of GI sheets. This kind of structure is not safe to be used because there is a greater tendency for the smoke to escape through the opening of the melting box rather than in the exhaust tube. Chemicals for gold extraction and melting are accessible here in Dipolog or even from local traders. Other operators have these chemicals stocked in large volume in their areas.

## **Economic Impact**

Each operator and financier has his own set of policies with regards to sharing with their workers and laborers. In each operation, the total expenses are subtracted from the total income. The distribution and sharing of the net income from the operation depends on the terms and conditions set by the operators and financiers. Some operators give 70% to the workers; others give 60% and some apply a 50 by 50 sharing. The latter sharing is applied when the net income is very minimal. Operators and financiers express that they are very

flexible when sharing issue is concerned because they are also looking at the welfare of their laborers. Sometimes they divide the ores by sacks and the workers process them individually or they process all the ores and share the net profit in cash.

Normally, vending or trading of gold is not a problem with the miners because the financiers are the ones who buy the gold. This idea helps both the laborers and the owners, in a way, because the former can make advances which may be deducted from his share of the profit.

There is no specific price range of the gold because it depends on the karat of the gold and the prevailing market rate of the gold. The highest karat of gold in Sibutad mining site is 24 and the lowest is 16. As of today, the 24-karat gold is priced as high as Php 800 .00 per gram. As the karat lowers, the price also lowers i.e. a 23 karat gold would cost PhP 780.00. The difference in price according to karat ranges from PhP 20.00-PhP 30.00.

Regarding the production output, no operator and owner can determine the exact volume of gold that they get per week, month or year, although some operators say that they can acquire at least 30-50 grams a week. There are many reasons why they cannot determine the volume of output per week. First of all, there is an irregular operations of workers due to an erratic volume of gold content in the soil and rocks.

The miners in Libay area experience erratic operations because the site of their operation is now owned by Philex and some portions are leased by Philex from private landowners. They operate without a permit from Philex and only when the Minahan Bayan workers are not around. This used to be a common area prior to the entry of Philex. They would only give the owner a share from their operations.

Now, since the area is occupied by the so-called Minahang Bayan, the arrangement about the sharing in the small scale operation within the vicinity of Philex is between the management of Philex and the association. The association is composed of only a few miners which defeats the name 'minahang-bayan'. In this kind of scheme, the small operators in Libay area lost their means of livelihood.

Before the Philex Mining came to operate in Sibutad, the small-scale miners operated in the area. It was during this time that they got the maximum volume of gold output in the area. It was during that time when the people in the community and the miners enjoyed brisk business and economic boom.

When Philex started to operate its large scale and open pit mining in 1997, the small scale miners slowly and gradually lost their source of livelihood and their income declined considerably.

This situation continues to this day. Occasionally, they are able to recover and get back to their operations but they can no longer sustain their operation because of a decline in the volume as compared to before the entry of Philex. This explains the fact that there is also a decline in the economic activity in Sibutad today.

Social and Ecological Impact

Geographically, the mining site in Libay is facing Murcillagos Bay while the other site is in Minlasag, an interior barangay of Sibutad. The Libay miners have their plant just meters away from Murcillagos Bay which spans an area that extends to Baliangao, Misamis Occidental.

During the pre-Philex period, a slight mudslide happened from the plant site to the shore. The mudslide during that time occurred whenever there was a heavy downpour. These mudslides were the waste from the tailing ponds. It's important to note that there were a number of plants in the area and each plant contributed to the volume of waste that flowed to the bay.

The miners said during the FGD that the damage to the bay then was very minimal. They were not able to observe a significant damage on the seaweeds, seashells, fishes and other marine life. They tried to practice safety measures but they said that they could not control and /or manage the overflow of waste all the time.

The worst situation occurred when the open pit operation of Philex started in 1997. Their large tailing ponds mixed with mercury and cyanide overflowed each time it rains all the way down to the bay. Since their operation was open pit and in a large scale manner, more damage occurred. There was a rice field that was damaged and turned into a rocky area. The beautiful blue colored sea of Murcillagos bay turned brownish and murky . Thick volume of mud covered the shore and the seaweeds around it gradually died.

Marine products became the most dangerous food to eat because of the reported observations of mercury contamination. When the operations of Philex stopped the volume of mudslides became minimal. The operations of Philex has not resumed to this day but the intensity of the damage it has done in the area remains as a painful memory to the affected communities in Sibutad.

In the Minlasag mine site, there is no reported damage or pollution since this is an interior barangay and the operation does not directly affect the bay. The plants and operation sites are also far from the farmlands. No farmland has been reported damaged due to mudslide. The bodies of water that may be affected by mercury and cyanide are the creeks and other water sources. No fish kills in creeks in the area due to mercury has been reported. If there is at all, then it is very insignificant. Miners confessed that they are trying to apply preventive measures as much as they can. They are trying to put their tailing ponds in the most safe location. Comparing these two sites, Libay has a greater number of plants and rod millhouses than that of Minlasag.

With all these small and big damages especially from the large scale operations the NGOs and church groups have been active in making studies and conducting awareness campaigns to educate the people of Sibutad. Unfortunately the NGOs do not get the support of the LGU and DENR.

The DENR has not taken action about the problem though the damage brought about by Philex was very obvious. The miners and operators in the area claim that the DENR is trying to favor the large-scale operation over that of the SSM. Presently, there are some DENR officials who visit the area regularly and perform water sampling but no contamination has been reported.

The health issue on miners became a debatable topic during the survey. Almost all of the miners expressed that mercury is not a dangerous chemical. Mercury is not dangerous even if swallowed according to some miners. They even cite examples of some instances where miners swallowed the mercury but are still alive until now. They said that they have been working in the mine sites for many years already but still they feel nothing about the bad effects caused by mercury. There was not a single moment that they lost the confidence to eat marine products from Murcillagos Bay.

As claimed by the miners, they could not find any instance of diseases or deaths caused by mercury to both children and adults. The observations of the miners are shared also by the local medical doctors and midwives as well as the hospital personnel. The reason behind this observation may be due to the lack of facilities in the local hospital and health centers to determine mercury contamination or its effect on people.

According to the midwives interviewed, serious cases of illnesses and diseases are immediately referred to the provincial or private hospitals in the city of Dipolog which also explains the reason why they do not have information about the cause of the illness.

One common observation of both miners and medical personnel is the increase of Tuberculosis and Hepatitis. However, the miners were quick to refuse the probable connection of these diseases to mercury. The medical personnel also have not determined the connections because of the lack of facilities and laboratory materials in the local health units.

The miners and operators expressed confidence in denying the negative effect of mercury because they practice some preventive measures during gold melting. One of these is the use of masks during gold melting. At least they are aware of the bad effects of the smoke that comes out during gold melting. Both the local health centers and medical practitioners have not promoted any measure to prevent health hazards on mercury. Maybe, this could be attributed to the lack of coordination and concern of both the LGU and local medical personnel.

### **Conclusions / Evaluations:**

1. The area being operated by small scale miners since the gold minerals are discovered is now on its twenty years. If the estimated populations of 550 miners have been in the area since the small scale mining begun, so they are already in their twentieth year of using mercury. They are on their twentieth year of using dangerous chemical. If we are to listen to the miners' comments on the span of the time that they have been engaged in using mercury, they will say that mercury is not dangerous for the health because if it were really dangerous they would have been died long before. During baseline survey, I observed that miners prepared food immediately after working from gold processing. During gold processing they do not use hand gloves and touched immediately the foods they are preparing. Worst than this is that they ate their meals by hand without thoroughly washing it. The miners' level of awareness towards health and ecological affects is so vague. This is because the priority concern of the miners is not on how they can safely obtain gold but on how they can easily and

immediately obtain income. Though they have this kind of mentality, still they are open for possible measures for their sake. This project is of great help to enlighten the miners' unawareness on the negative effects of mercury.

2. Local health units in Sibutad have no specific action regarding possible health hazards caused by mercury. The awareness level of the doctors regarding this issue is also very minimal because there is no coordination from the LGU. Doctors do not have any data of poisoning and mercury related disease. Dr. Tapayan the rural health officer of Sibutad does not have the data of the number of miners in his vicinity. Yet he expresses support for the project's success.
3. Sustainability of the project is viable because majority of the miners express their cooperation. During the survey, some expressed that there is no reason for them not to cooperate because they are the ones being helped in this project. They are also willing to learn new technologies especially on the retort as I told them that it could prevent physical poisoning during gold melting. At the same time they are also willing to learn informations and preventive measures regarding environmental handling.

# Appendix C Philippine Agenda 21 Seminar

## Training Accomplishment Report

Date: March 06, 2007

Venue: St. Anne Parish Formation Center, Sibutad, Zambo Norte

Resource Persons: Dodo Andog, Reo Mondejar, Patrick Jalapadan, Jojo Leyson

Participants: Small Scale Miners operating in Sibutad

### **Narrative Report:**

The program formally started at around 9 o'clock in the morning. The venue was held at Saint Anne Parish Formation Center. The opening program started with an invocation followed by the singing of the National Anthem. When the participants all sat down, they were recognized and called by area. There were 45 participants who attended the seminar. After the recognition of participants, Dodo Andog gave the overview of the seminar and its goals and objectives. After giving the participants the overview of the seminar, Patrick Jalapadan one of the resource persons from CESCOD gave the first topic about what is PA 21 and its historical background. After the historical background another topic followed.

The next topic was about the Principles of Unity. It focused on the developmental trends: "Where are we now" and the vision "where do we want to go". The topic was discussed by Mr. Reo Mondejar another resource person from CESCOD. The topic on the principles of unity ended until lunch time. Then we took our lunch break and resumed at 1pm. The first topic in the afternoon was "Going Local". The methodology was a workshop. In the workshop the participants made an action plan guided by this question: **What can we (as SSM) do to promote sustainable development?** Jojo Leyson another resource person from CESCOD who gave the instructions and some points to consider about the workshop.

She emphasized that in making an action plan it should be doable and viable. After she gave her instruction Dodo came in to facilitate the process. The participants were divided into four groups according to the area where they are operating. Each group was instructed to discuss their answers to the guide questions. They wrote their action plan and answers on the manila paper.

The following are the results of the workshop. Each group selected a representative to report in front of the participants.

Group I

On Tunnel Operation

- The tunnel should put timber around the hole to avoid soil erosion for the safety of the *abanteros* (local name for group member laborers).
- The *abanteros* should wear boots and skull cap for safety inside the tunnel while in operation.
- The tunnel should have be fenced.
- Avoid smoking inside the tunnel
- Plant trees near and around the tunnel.

#### On Rod Mill Operation

- The flooring of the rod mill area must be concrete;
- There should be enough number of tailing ponds to avoid waste washouts;
- There must be exact positioning of rod mill facilities like the CR, kitchen and the area for melting gold;
- Attached is an illustration of the proper arrangement of the facilities and implements in tunnel and rod mill. They also include in the illustration the view of the area being planted by trees and other plants.

#### Group II

- During milling process, do not keep mercury and ore wastes so that they will not be drained into the seashore.
- Tailing ponds and *dampakan* (local name for big tailing pond) should be well made to avoid soil erosion. If possible, plant trees around the *dampakan* to hold the pressure of water and waste from flowing into the seashore.
- A place to where gold is melted should be in separate area and it is advisable to use retort for the mercury to evaporate. (explanation from the reporter) *The smoke that evaporates during gold melting is in fact the mercury itself. When it evaporates, it sticks in the leaves of the trees. When the rain comes, the mercury mixes with the rain. The rain with mercury falls to the ground and creeks. There is a big possibility that it can touch human skin or be swallowed. It touches the plants and vegetables. So therefore improper practice of gold melting is very dangerous to our health and the health of our families.*
- The tunnel should be reinforced with timber as a safety measure for the *abanteros*.
- Also included is the illustration of the proper placement of facilities and drainage in the mill house.
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#### Group III

- Tunnel should have safety facilities for the *abanteros*. It is suggested that *abanteros* should not drink during operation.
- Rod mill should be constructed in a safe place, far from the creeks; avoid wash outs of wastes; and *dampakans* should be deep enough. In using mercury, a miner should wear mask and hand gloves. Plant trees around the *dampakans* and proper sanitation should be observed.
- Place separate area for gold melting
- Wear mask and gloves
- Also included is an illustration of their proposed tunnels and rod mills with trees and with properly placed facilities ;

#### Group IV

- A tunnel should have timber around the hole.
- *Abanteros* should wear boots and skull guard.
- A rod mill should have deep tailing ponds and *dampakans* far from the creek or seashore.
- Plant trees around the tailing ponds and *dampakans* to avoid land slides
- Included is the illustration of the proper positioning of facilities. Trees are planted around the tunnel and rod mill as shown in the illustration.

After the reporting, the open forum followed. During the open forum, the issue regarding the retort which was mentioned by Group 2 was one of the main topics. Most of the participants raised questions about the retort because they do not have an idea of what it is; how it looks like and how it is being used.

Dodo mentioned a little to them about the form of the retort .One of the participants, Joel Dazo described his version of the retort. He said that he got his idea of the retort from the mining area in Davao. He explained to the participants the usage and importance of the retort. He illustrated the process of gold melting according to the design of his retort. He told the participants about the safe effects if retort is used. All the participants were amazed and willing to learn new means of gold melting.

During the open forum, Miss Jojo Leyson also tackled the issue regarding the controversial 'Minahang Bayan'. She explained the inconsistencies of the so called "Minahang Bayan" where in fact only a few people are able to participate. She added that it should be open to everybody and not only to a select few. She proposed possible action on the controversial site after election to avoid issues and prejudices from the persons concerned on the 'minahang bayan'.

Then the closing program followed after the open forum. During the closing program, we let the participants manifest their commitment to protect their natural resources for sustainable development. Their manifestation of commitment was done in the form of a creed. Each group wrote a creed according to the format we suggested to them.

The format of the creed goes like this: **We will stop...***(improper practices in extracting gold)*, **We will do...***(the right way of extracting gold)*, **We will continue...***(their old practices*

*that are helpful to them), and **We hope...**(their wants and visions for sustainable development). All the participants showed willingness and excitement to participate in the activity.*

As part of the activity, the members of each group stand in front of the rest of the participants and read their creed of commitment. They all placed their signatures below the creed. After all the groups have finished reading their creed of commitments, the training coordinator gave his final words to them. He encouraged them not just to end with the planning but really act on their plans and hopes. After which, he gave the schedules of the forthcoming seminars.

The seminar ended a few minutes before 5 PM.

Prepared by: Dodo Andog  
Project Coordinator

**COMMITMENTS** made by the miners during the PA 21 Training

Date: March 06, 2007

Venue: St. Anne Parish Formation Center, Sibutad, Zambo Norte

Resource Persons: Dodo Andog, Reo Mondejar, Patrick Jalapadan, Jojo Leyson

Participants: Small Scale Miners operating in Sibutad

**Group 1**

**We will STOP**..... doing what is destructive to the nature and to the people.

**We will DO**..... safety measures for sustainable development.

**We will CONTINUE**..... on our effort for sustainable development on our livelihood.

**We PLEDGE / PROMISE** ..... continue doing things for the future of our livelihood and for sustain able development.

**Group 2**

**We will STOP**..... careless practices and make sure that our operations will not cause damage to our environment especially to the bay.

**We will DO**..... safety measures regarding mercury and others.

**We will CONTINUE**..... the good methods in operation to avoid bad effects due to our careless practices and so that we can attain sustainable livelihood.

**We PLEDGE / PROMISE** ..... to do and act on our plan.

**Group 3**

**We will STOP**..... being drunk during operation.

..... operating the tunnel that has no timber.

..... operating without skull guard and boots.

**We will DO**..... safety measures on tunnel operations

**We will CONTINUE**..... reaching the sustainable development.

**We PLEDGE / PROMISE** ... that we will try to attain sustainable development in our livelihood.

**Group 4**

**We will STOP.....** improper processes in gold extraction so that, we ourselves will not become bad influence in the community and at the same time not abusive to the environment.

**We will DO....** ..... safety measures in mining to care the nature.

**We will CONTINUE.....**the proper processes in mining so that our followers may learn the proper ways and so that they will become models to all small scale miners.

**We PLEDGE / PROMISE .....** to avoid mess around the mining area.

## Appendix D List of participants. A Forum on Small Scale Mining in the Philippines

Back from the Field Report:

March 26, 2007

Room 404 Ateneo de Manila School of Government

Rockwell Drive, Makati City

Participants:

Name	Organization	Contact Numbers
Roger Birosel	Earth Savers Movement	
Adel Briones	Ateneo School of Government	
Michael Cabalda	Mines and Geosciences Bureau, Department of Environment and Natural Resources (DENR)	
Roy Calfoforo	Alyansa Tigil Mina	
Fr. Archie Casey	Justice and Peace – Association of Major Religious Superiors of the Philippines	Xaverian Missionaries 14, K-7 <sup>th</sup> St., West Kamias, Quezon City em: <a href="mailto:sxarchie@yahoo.co.uk">sxarchie@yahoo.co.uk</a>
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Leoncio Na-oy	Benguet Federation of Small Scale Miners	
Noel Bilibli	Benguet Federation of Small Scale Miners	
Lomino Kaniteng	Benguet Federation of Small Scale Miners	
Guillermo Padsuyan	Benguet Federation of Small Scale Miners	
Matthew Daping	Benguet Federation of Small Scale Miners	
Abner Mabtangob	Gumaos, Paracale, Camarines Norte	0919-773-1011
Rodrigo Ultra	Luklukan Sur, Jose Panganiban, Camarines Norte	
Maricel M. Jamito	POMCAT, Daet, Camarines	

	Norte	
Erwin Jamito	POMCAT, Daet, Camarines Norte	
Arvin Musca	POMCAT, Daet, Camarines Norte	
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Fer Ramirez	Foundation for the Philippine Environment	922-3022 <a href="mailto:framirez@fpe.ph">framirez@fpe.ph</a>
Sylvia Mesina	Foundation for the Philippine Environment	922-3022
Lazaro Ramos	Mines and Geosciences Bureau, DENR	926-0944
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Elizabeth C. Roxas	Environmental Broadcast Circle	
Vicky Segovia	Miriam PEACE Miriam College	920-5093
Zeny Ugat	Philippine Sustainable Development Network	637-2409 <a href="mailto:info@psdn.org.ph">info@psdn.org.ph</a>
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Ramon Fernan III	Philippine Sustainability Watch Network	706-1166
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Robot Mission	MTKISD	
Joey Imson	MTKISD	
Emy Perez		
Mimi Coloma		
Jared Espi		

**Appendix E. Hand out for small-scale miners and medical personnel.**

## SIGNS AND SYMPTOMS OF MERCURY POISONING

Mercury is extremely dangerous to your health. Mercury is easily absorbed in the body by inhalation of vapour and by eating contaminated fish and other food. The poisoning can damage the kidneys, heart and most important the brain.

### 3) Shaking hands!

Can you draw a circle? When mercury is deposited in the brain it disturbs the control of fine movement. Some will even have problems button up the trousers



Normal



Mercury Poisoned

### 2) Painful mouth!

The mercury causes inflammation of the gingival. Often the nerves of the lips are affected too, which causes numbness around the mouth.



### 3) Mental disorders!

Mercury damages the brain and can make you crazy. Maybe you know someone with psychological problems like these:

Insomnia

Shyness

Irritability

## BIOACCUMULATION

Once the mercury is absorbed in the body it is very difficult to get out again. The older we get the more mercury we store in our body. Pregnant women transfer mercury to their unborn children so that the fetus gets higher concentration than the mother. The fetus is very sensitive to pollution and consequently a healthy appearing mother with mild mercury intoxication can give birth to a poisoned child with permanent brain damage!!! It has been documented that even small concentrations can affect children's ability to learn.

## TREATMENT

There is no treatment of mercury poisoning. Damage to the brain is persistent. The only thing to do is to limit the use of mercury:

## Training of Small Scale Miners and their Families in the Safe Handling of Mercury During the Processing of Gold



**Memory Loss**



**Anxiety**



**Aggressive-  
ness  
Excitability**



- \* NO MERCURY IN THE ROD MILL DRUMS
  - \*AD MERCURY ONLY IN THE MINERAL CONCENTRATE
  - \* USE RETORT
- or
- \* USE BORAX METHOD



Maximo T. Kalaw Institute for Sustainable Development  
Geological Survey of Denmark and Greenland  
With Funding Support from  
the Panibagong Paraan 2006 of the World Bank

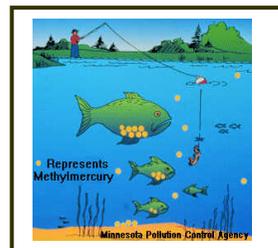
## Safe Handling of Mercury During Extraction of Gold in the Philippines

Mercury is a highly toxic element which is released in large amounts through extraction of gold by use of mercury (amalgamation) and is absorbed in the human body by different ways.

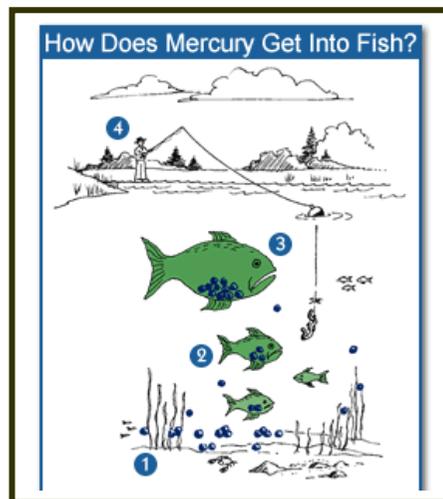
Mercury is directly inhaled by the people

doing the amalgamation, and also by people in the whole village or mining community.

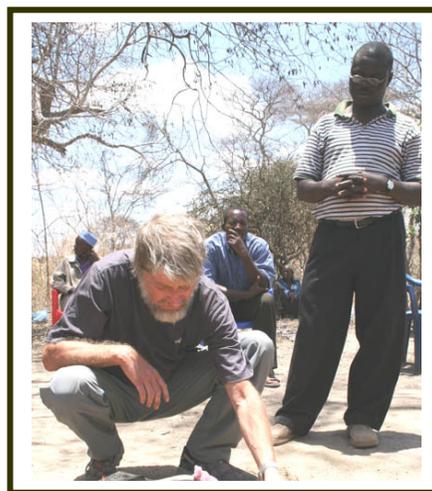
The mercury vapour will gradually condense in the soil. In the soil, part of it will be taken up by plants and crops. The crops and grass is eaten by people and cattle and thus enters the human body. Mercury vapour in the air is also deposited into lakes and rivers. When mercury hits water, some of it changes into another form of mercury, methylated mercury, that is even more dangerous than metallic mercury. The methylated mercury is eaten by small fish and will be concentrated in larger fish which again is eaten by people. By eating fish the local population thus ingests large amounts of methylated mercury.



One of the main problems in mercury pollu-



### Retort in Action



## Retorting

Release of mercury to the environment causes serious health problems for millions of small-scale miners all over the world. This led small-scale miners in Brazil to invent a simple, cheap and robust device to recycle mercury, the so-called retort.

The retort consists of a few pieces of plumbing tubes. These tubes are available at most black smiths all over the Philippines. It is very easy to learn to use the retort and it can recycle 90 to 95 percent of the mercury used for amalgamation. The amalgam is placed in the cup which is then screwed to the retort. The cup part of the retort is placed in a bonfire or charcoal burner. The long tube is covered by a wet cloth and the pipe ends in a cup of water. The mercury will evaporate and condense in the tube. Gentle tapping of the tube will cause droplets of mercury to slide down into the

tion of the environment is that it never disappears. The mercury in either form will remain in the environment. This means that the mercury released to the environment today by amalgamation which is hazardous to the generations to come.

cup of water. The mercury can then be used again. Recently one small-scale miner in Tanzania recycled 750 grams of mercury in one month.

## Appendix F Mercury pollution awareness test

- 1) Inhalation of mercury smoke can be avoided by
  - : Rain
  - : Use of retort
  - : Use of mask
  
- 2) Mercury can damage
  - : The lungs
  - : The foetus
  - : The brain
  
- 3) A safe position of the tailing pond will reduce mercury poisoning?
  - : Yes
  - : No
  
- 4) What is most dangerous?
  - : Drinking a bit of metallic mercury
  - : Inhaling mercury smoke from amalgamation
  - : Eating fish contaminated by mercury
  
- 5) In the body the mercury will deposit in
  - : The arm
  - : The liver
  - : The unborn child
  - : The brain
  
- 6) Heating mercury makes it
  - : Disappear
  - : Evaporate

## Appendix G Borax replacing mercury in small-scale mining



Heavy mineral concentrate with gold

Millions of small-scale miners all over the world use mercury to extract gold. The use of mercury by small-scale miners causes extensive damage to the environment and to the health. The health hazards are not only for the small-scale miners, but also for the communities where gold extraction takes place. A further problem is that mercury released from small-scale mining stays in the environment for a long time and will thus also affect the health of future generations.

In the Benguet area north of Manila in the Philippines an alternative method of gold extraction has been in use for many years. This is the so-called borax method. The method is simple, inexpensive, does not require advanced technical equipment and is non toxic. The basic principle behind the method is that borax reduces the melting point of gold. The melting point of gold is  $1064^{\circ}\text{C}$ , which is a much higher temperature than can be obtained by inexpensive burners. By adding borax the melting temperature decreases. The technique is also easily learned, in a matter of hours.

### **Description**

Gold ore is crushed and ground. If the gold ore is from placer deposit (sand and gravel) then crushing and grinding is of course not necessary. The ground ore is then “washed” in a traditional gold digger’s pan in order to concentrate the heavy minerals including gold. This washing requires skill, but the process can be learned within a few days.

The mineral concentrate is dried and then mixed with three times as much (by volume) of borax powder. The borax - heavy mineral concentrate is thoroughly mixed in a small plastic bag. A few drops of water are added. The plastic bag is placed in a ceramic bowl together with a few pieces of charcoal.



Mineral concentrate in a plastic bag is mixed with borax and a few drops of water.



The plastic bag is placed in a ceramic bowl with a little charcoal and heated by a blow torch.

Then the plastic bag is heated by a so-called blow torch which is gasoline powered. After a few minutes the borax melts and further heating for a few minutes will melt the gold in the heavy mineral concentrate. All the other heavy minerals will separate from the molten gold. Heating is stopped and the shining gold pellet can be removed after a few minutes by the tip of a knife.



The process is finished. The shining gold pellet in red glowing molten borax.



The final result. A pure gold pellet produced without use of mercury.

### **Necessary equipment**

1. Gold digger's washing pan
2. Borax
3. Ceramic bowl
4. Charcoal
5. Plastic bag
6. Blow torch

A gold digger's washing pan is a must for any small-scale miner. Borax is cheap and easily available. Ceramic bowls can be made locally.

The blow torch is the only requirement which has to be manufactured locally. In the Philippines the cost is about 20US\$ everything included. Below is a photo and drawings of the blow torch.

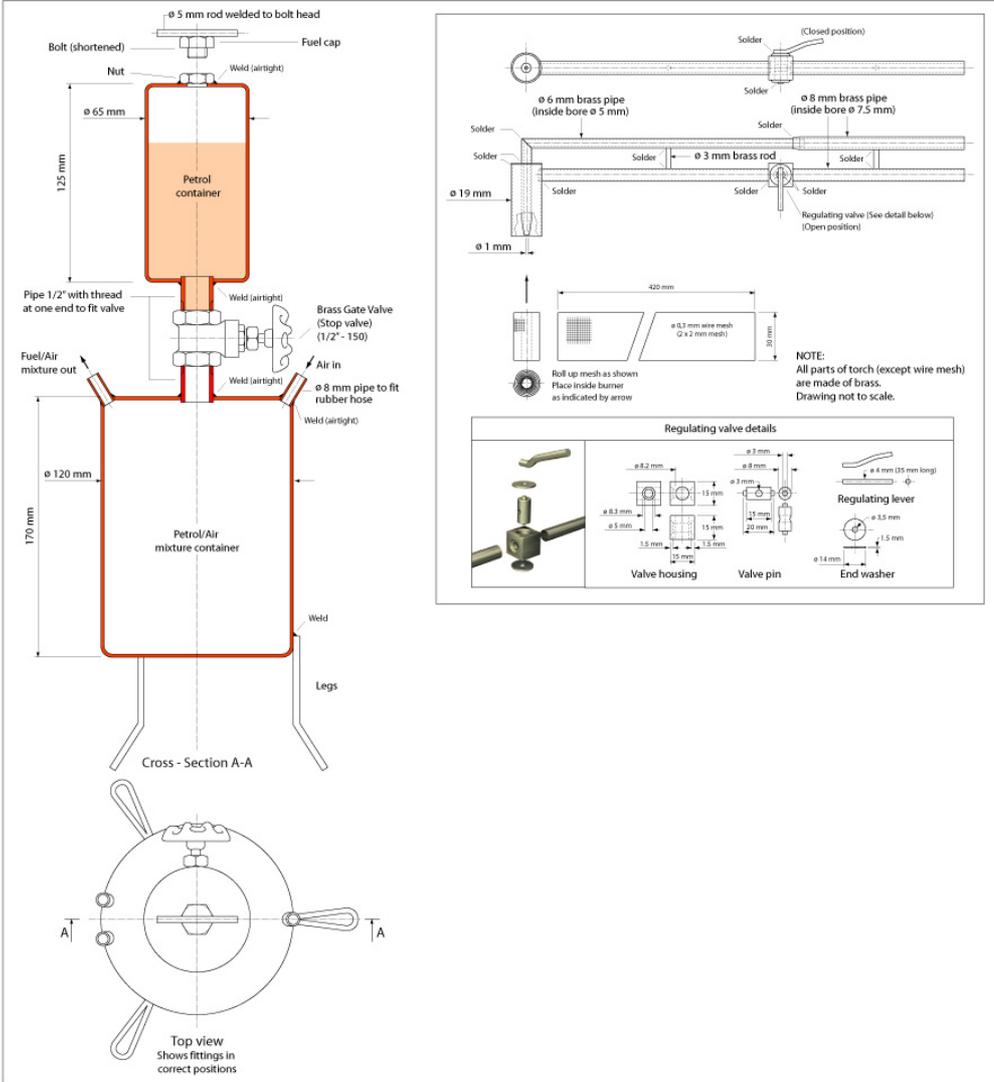
### **Blow torch**

The blow torch is petrol powered. It is very simple to operate and cheap to produce.

The top container is filled with gasoline. A little amount is then released into the lower big container through the valve.

The air pump is operated by the feet, and connected to the lower container through a rubber hose. The burner is a bit complex. It has two rubber hose connections to the lower container, and one of the outlets can be adjusted by a small handle.

Before igniting the burner the lower container is pumped. Then the burner is ignited. After a few minutes the burner is hot enough and the melting of borax and gold can take place.





Further information <http://www.geus.dk/geuspage-uk.htm>