Yayasan Tambuhak Sinta

UNIDO Project No. EG/GLO/01/G34
Contract No. 16001054/ML

Community Awareness on Hazards of Exposure to Mercury and Supply of Equipment for Mercury-cleaner Gold Processing Technologies in Galangan, Central Kalimantan, Indonesia

BASELINE AND COMPARISON STUDY

February 2007

Table of Contents

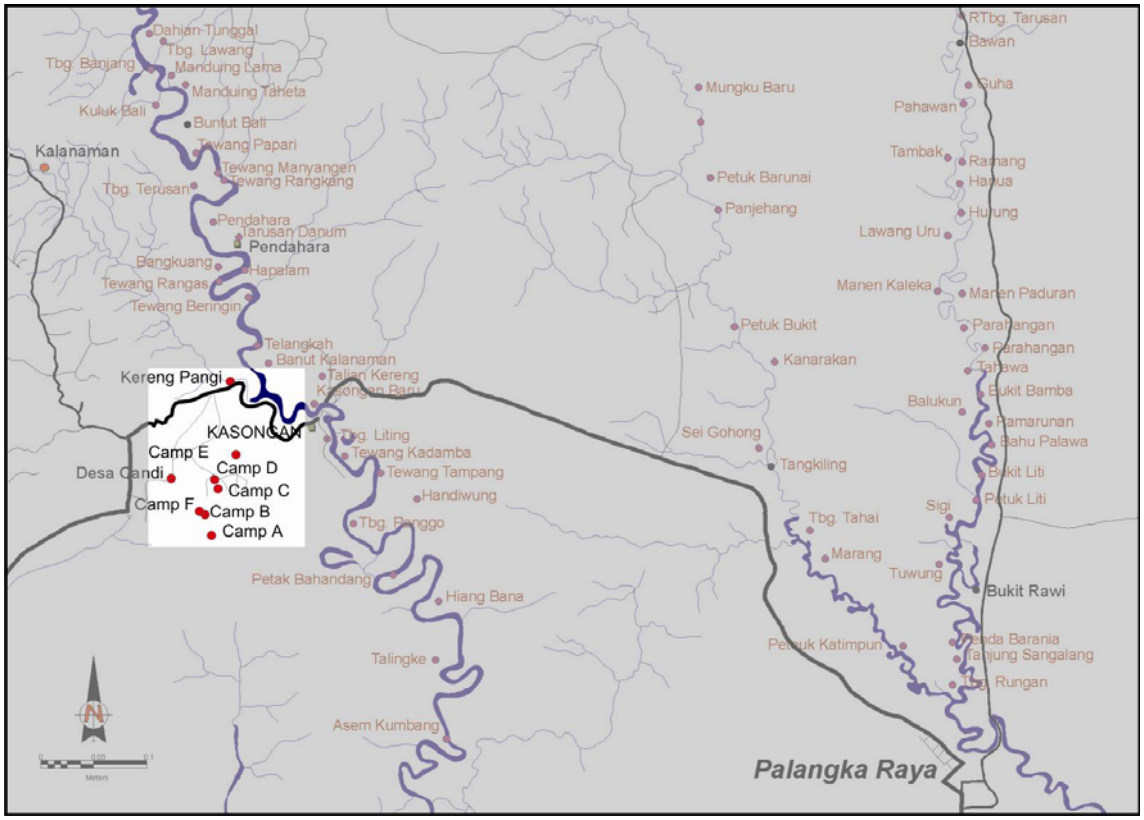
1. Introduction

The purpose of the baseline study was to profile the mining community resident in the study area and identify existing levels of awareness about the mercury health hazard, as well as current behavior regarding mercury use. The study also mapped the access roads by GPS, quantified the numbers of sluices, and defined the target areas for the campaign. The baseline study was conducted one month prior to the campaign in August 2006 to establish a data set on existing attitudes and behavior, and was repeated at the end of the campaign in February 2007 to compare findings and see what changes in attitudes and behavior had taken place as a result of the project activities.

The comparison study examined the population living in the vicinity of the six campsites where fieldwork was concentrated, using a random survey technique. The study included the population living in Kereng Pangi town as well as the transient community living and working in the Galangan gold fields.

The studies attempted to assess changes in both communities' levels of **awareness** about the impacts of mercury on public health, as well as changes in specific **behavior** such as the practice of burning amalgam in the open air.

The Study Area



2. Methods

The Social Baseline Study used a semi-structured interview approach to:

- obtain a socio-economic profile of the community
- identify existing levels of knowledge and awareness regarding mercury
- identify existing practices and behavior

Six sets of questions were devised to obtain information from different target groups among the townspeople and within the community of miners in the field. The primary target comprises people who use mercury directly, either during the amalgamation process or in the subsequent burning process. The secondary target is comprised of the general public including the wives of those primary users.

Six separate sets of question were designed to obtain quantitative data regarding the awareness and behavior of five groups: miners, miner's wives, informal gold shop operators, gold shop operators in the town, and lastly, the town residents affected by the activities of gold shops and other mercury users.

In the Galangan gold fields, separate question sets were used to obtain firsthand data from male miners that relates to their use of mercury in the amalgamation process, as distinct from data that relates to the awareness of women about the health risks of exposure.

Likewise, in the town of Kereng Pangi, one question set focused on the behavior of gold shop operators who burn mercury, and another on the awareness level of the town residents and their perceptions of the health risk of living near the gold shops.

In addition to open-ended questions intended to elicit general information from the different target groups, a series of focus questions were restricted to Yes/No responses for quantitative study. These questions focused on community **awareness** regarding specific hazards, as well as on their specific **behavior** regarding mercury handling.

<u>Baseline Questions to the Town Community</u>

A representative sample of residents living near the gold shop was interviewed.

- Example of an **awareness focus** question:
  Do you think the air in Kereng Pangi is harmful to your health? *Yes / No*

Quantitative analysis was also conducted with gold shop operators who burn amalgam.

- Example of a **behavior focus** question:
  Do you save and recycle the mercury you burn? *Yes / No*

<u>Baseline Questions to the Mining Community</u>

Miners were asked a series of questions relating to their use of mercury in field processes.

Informal gold shops that operate in the gold field were also located and interviewed.

- Example of an **awareness focus** question:
  Do you think that using mercury will damage your health? *Yes / No*

- Example of a **behavior focus** question:
  Do you wear gloves when you mix mercury? *Yes / No*

Additional Questions in the Comparison Study

In addition to replicating the baseline question sets, further questions were added:

1. To analyze the relative success of the different presentation media:
   What messages do you recall hearing during our campaign?
   How were you provided with information about the dangers of mercury?
2. To make comparisons regarding changes in behavior:
   What do you do differently now, to avoid mercury contamination?
   Is there anything you have changed to avoid mercury?
   Do you do anything to help your children avoid mercury contamination?
3. To assess if gold shops are willing to promote use of retorts to miners:
   Do you think miners should use retorts?
   Do you prefer to buy pre-burned amalgam?

3. Results of the Baseline Study

3.1. Results from the Town Community

3.1.1 Quantitative Data: Focus on Awareness

Both the operators of gold shops, and the general public living in the immediate vicinity of the gold shops, were asked the following questions:

Do you think that mercury fumes can affect your health?	***Yes / No***
General Public	52% said Yes
Gold Shop Operators	83% said Yes

Do you think that mercury fumes can affect development of children?	***Yes / No***
General Public	55% said Yes
Shop Operators	83% said Yes

Evidently, the operators were more aware of the risks than the general public.

Further questions also focused on the attitudes of the general public in the town:

Do you think the air in the town is bad for your health?	***Yes / No***
General Public	40% said Yes

Do you think it is harmful to live near gold shops?	***Yes / No***
General Public	40% said Yes

The majority of the urban community was unaware of the mercury hazard, however 40% demonstrated a good understanding of the risks. Those who agreed were found to be long term residents, and may have had exposure to information arising as a result of the previous health assessment conducted by UNIDO.

Do you think it is harmful to eat large river fish?	***Yes / No***
General Public	30% said Yes

Likewise, some of the urban community demonstrated an understanding of this issue during the baseline study, and the knowledge is likely to have been derived from previous UNIDO visits.

3.1.2 Quantitative Data: Focus on Behavior

A survey of 16 gold shop operators in the town found that (details in Appendix 2):

1. **None** of the shops used a water filter for the chimney fumes although a few captured some of the mercury using coils of pipe or containers at pipe exits.
2. 87% of shops did **not** use a fan to ventilate the chimney.
3. 87% of operators had **never** used a retort.
4. 80% of shops did **not** reuse and recycle mercury from the chimney
5. 93% of operators did **not** wear any special clothing when burning

3.1.3 Quantitative Data: Mercury Emissions

There are 35 gold shops in Kereng Pangi; they are most active in the afternoon and evening. The amount of amalgam burned in each shop varies according to supply. At

first, gold shops were reluctant to discuss their trade in gold; however a high level of trust was established with many gold shops over the course of the campaign, so that an accurate estimation of the amount of amalgam traded could eventually be made.

Data was collected from one-half of the gold shops in the town to determine the quantity of amalgam vaporized at each establishment on a daily basis (details in Appendix II). There was a wide degree of variation between shops, reflecting the individual relationships each had established with networks of miners, whether they had buyers in the field, and what percentage of the gold was supplied as unburned amalgam. Estimated daily emissions ranged from 17 grams to 488 grams. The average from the total emissions of seventeen shops was 143 grams of mercury per day.

Due to the high degree of variation between each gold shop, each was analyzed individually to assess:

- The number of balls of amalgam burned each day
- The average size of a ball of amalgam received
- The percentage of unburned amalgam received
- The amount of mercury recovered and recycled
- The total emissions in the town
- The total emissions in the field from pre-burned amalgam

It was determined that the annual gold trade to these 16 gold shops resulted in 756 kilograms of mercury vaporized in the town, and a further 356 kilograms of mercury vaporized in the field. As this figure represents one-half of the gold shops, it can be doubled to provide the total amount of mercury released as a result of the gold trade in the town. Total emissions are thus 2,225 kilograms of mercury per year, with over 1.5 Tonnes of mercury emitted in the centre of town.

Atmospheric Mercury Levels in Gold Shops in Kereng Pangi

Gold Shop	**Range of Readings nanograms/meter^3**	
	Street-frontage	Workbench In Shop
Kenangan Baru	10,000	30,000 – 35,000
Mas Swarga	14,000	27,000 – 45,000
Anggun	12,000	14,000 – 17,000
Aulia Indah	14,000	30,000 – 40,000
Anugerah	----	15,000 – 20,000
Famili	11,000	30,000 – 35,000
Sahabat Baru	800	8,000 – 30,000
Haji Sarbani	---	12,000 – 20,000
Average Reading	**10,300**	**20,750 – 30,250**

The above are real time readings taken using a Lumex mercury spectrometer. They were mostly obtained during the early afternoon at times when there was no amalgam burning activity taking place. Higher levels may occur while mercury is combusted in the shop.

A reading of 300 nanograms/meter^3 was also taken on the street-frontage outside a zircon storehouse in the town, named *Toko Purnama*. This reading confirmed that processing points for the zircon buyers in the town are also contaminated sites, due to the residual mercury trapped in the gold tailings purchased by these buyers, and the further sluicing and amalgamation activities that also occur at these locations.

These readings can be compared with baseline readings taken on the street:

- In front of the local health clinic = 85 nanograms/meter^3
- In front of the local doctor's office = 45 nanograms/meter^3
- In front of the high school = 10 nanograms/meter^3

The conclusion is that atmospheric mercury concentrations in ambient air increase by several orders of magnitude with proximity to the gold shops. Ambient air quality readings can be seen to rise from 10 nanograms/meter^3 (in front of school) to 10,000 nanograms/meter^3 (in front of gold shops) over a distance of approximately one kilometer.

3.2 Results from the Field Community

3.2.1 Background Data

A. Men

Baseline data confirmed over 1,000 miners remained in the Galangan area during 2006. The majority of miners are in their twenties, and a substantial proportion are teenagers. Forty percent (40%) of the total of miners interviewed were bachelors without children.

B. Women

Women in the gold fields are usually married with two children (mean = 1.94). Married women often accompany miners into the field, cook for their husbands and take care of small children. Others are engaged in running supply stores and food stalls.

C. Income

Earnings for gold miners average around Rp 90,000 a day (US$10). Miners at high yielding locations typically receive around Rp 3 million per month (US$330). However, incomes from gold mining do fluctuate widely from week to week and month to month, thus many miners feel it is an unreliable source of income.

D. Focus Groups

Work gangs interviewed did not think it was possible to eliminate mercury from the separation process, with the exception of one group that said it was possible, yet quite difficult to do so. When asked for how long they mixed the mercury and the concentrate, answers ranged from 5 to 15 minutes. Field observation suggests this is true, as the mercury is mixed not only in the bucket but also in the gold pan. Although hundreds of grams of mercury are utilized for each amalgamation, care is taken to retain the excess mercury, which is returned to the supplier. The supplier often oversees the process, as it is in his interests that all the mercury be returned, as it carries fine gold.

3.2.2 Level of Awareness in Mining Community

An open introductory question was asked to elicit what respondents knew about mercury.

It was found during the baseline study that many town residents already knew mercury to be dangerous and would offer this knowledge without prompting. In contrast, only 3% of respondents in the gold fields offered the same information prior to the campaign.

On average, respondents had lived in the town for ten years. In contrast, mean residence time for miners in the field was six months. The conclusion drawn is that long term residents in the town had a much better understanding of the issue than new immigrants.

What do you know about mercury?	***July 06***
Town respondents who perceived it as a hazardous substance prior to campaign	39%
Field respondents who perceived it as a hazardous substance prior to campaign	3%

The following questions focused on mercury use in the amalgamation process:

Do you want to use less mercury in the process?	***Yes / No***
Miners	66% Yes

Do you get more gold if you use more mercury?	***Yes / No***
Miners	63% No

Miners are generally aware of the need to use appropriate amounts of mercury in relationship to the anticipated yield of gold. Miners prefer not to waste mercury and do not believe that excessive use will bring about a greater yield in gold.

Do you use the same mercury again, a second time?	***Yes / No***
Miners	92% said Yes

Almost all miners recycle or save excess mercury to some extent. However, the degree of wastage and overuse is difficult to quantify as it varies on an individual basis.

Do you squeeze the mercury amalgam in a pond?	***Yes / No***
Miners	74% said Yes

Most miners express mercury in amalgamation ponds. A few miners had built small plastic-lined ponds, used specifically for amalgamation and not for other uses.

Do you wear gloves when you mix mercury?	***Yes / No***
Miners	84% said No

Do you mix the concentrate and mercury in a closed drum?	***Yes / No***
Miners	87% said No

Do you concentrate it in a gold-pan before you add mercury?	***Yes / No***
Miners	82% said No

None of these practices were observed in the field.

4. Results of the Comparison Study

4.1 Results from the Town

4.1.1 Adoption of Intermediate Technology by Gold Shops

A total of 17 gold shops had installed filtration systems in their shops by the close of the project activity in February 2007. One was outside the study area, in another centre for gold shops 30 kilometer North of Kereng Pangi.

A. Quantitative Data: Focus on Awareness

The general public was asked if health impacts resulted from emissions in the town:

Is the air in town harmful to your health?	***July 06***	***Jan 07***
General Public	41% Yes	51%
Is it dangerous to live near a gold shop?	***July 06***	***Jan 07***
General Public	41% Yes	51%
Do mercury fumes from gold shops harm your health?	***July 06***	***Jan 07***
General Public	52% Yes	64%
Can mercury damage the health of growing children?	***July 06***	***Jan 07***
General Public	56% Yes	45%
Do you think it is dangerous to eat large river fish?	***July 06***	***Jan 07***
General Public	30% Yes	34%

These random samples of the urban community, demonstrate a further increase in awareness, building on the high levels of awareness already determined during the baseline survey. As demonstrated by January 2007, half of the town community believed that mercury emissions from gold shops were damaging to their health.

Questions about the health impacts of mercury were also asked of gold shop operators:

Do you think that mercury is bad for your health?	***July 06***	***Jan 07***
Gold Shop Operators	83% Yes	100%
Do you think that mercury is bad for children's health?	***July 06***	***Jan 07***
Gold Shop Operators	83% Yes	100%

There was a high level of awareness prior to the campaign, and by the close, operators were unanimously agreed on the issue.

B. Quantitative Data: Focus on Behavior

Changing the behavior of gold shop operators was one of the main aims of the program, the following questions were asked to assess whether this goal was accomplished:

Does the fumehood have a ventilation fan?	***July 06***	***Jan 07***
Gold Shop Operators	13% Yes	50%
Does the fumehood have a water filter?	***July 06***	***Jan 07***

Gold Shop Operators	0% Yes	55%

Have you ever tried burning mercury in a retort?	***July 06***	***Jan 07***
Gold Shop Operators	14% Yes	20%

Do you save and recycle reclaimed mercury?	***July 06***	***Jan 07***
Gold Shop Operators	20% Yes	75%

Do you wear any special clothes when burning?	***July 06***	***Jan 07***
Gold Shop Operators	7% Yes	0%

Significant changes in behavior are apparent from these results, in accordance with the direct interventions made during the urban activities of the TDU.

Gold shop operators were also asked if they knew how to improve their fumehoods:

Do you know how to improve your burning equipment?	***July 06***	***Jan 07***
Gold Shop Operators	36% Yes	75% Yes

Most operators showed a high level of interest in ways to adapt their existing fumehoods by adding a simple filter system such as a blower and a water trap.

Further questions assessed if gold shops are willing to promote use of retorts to miners:

Do you prefer to buy pre-burned amalgam?	***Yes / No***
Gold Shop Operators	95% Yes

Do you think miners should use retorts?	***Yes / No***
Gold Shop Operators	85% Yes

At the end of the campaign, almost all gold shops agreed that miners should use retorts in the field and thus supply the gold shops with pre-burned amalgam.

4.2 Results from the Gold Fields

4.2.1 Quantitative Data: Focus on Awareness

An open introductory question was asked to elicit what respondents knew about mercury. Most replied only that it was used to capture gold, however some would also freely offer that it was a dangerous substance. This knowledge was almost never proffered at the start of the campaign, but was asserted quite frequently by the close of the campaign.

What do you know about mercury?	***July 06***	***Jan 07***
Women who perceived it as a hazardous substance	0%	31%
Men who perceived it as a hazardous substance	5%	23%

To further quantify the increase in understanding that mercury is a hazardous substance the following direct questions were asked:

Do you think that mercury can damage your health?	***July 06***	***Jan 07***
Men	21% Yes	93% Yes

Women	15% Yes	91% Yes
Do you think your drinking water is contaminated by Mercury?	***July 06***	***Jan 07***
Women	8% Yes	29%Yes
Is it safe for pregnant women to eat fish from this area?	***July 06***	***Jan 07***
Women	46% Yes	35% Yes
Do you think mercury is a danger to children's health?	***July 06***	***Jan 07***
Women	23% Yes	91%Yes

On the whole, there was a significant increase in awareness as evidenced by these random samples of the mining community in the study area.

4.2.2 Quantitative Data: Focus on Behavior

Do you eat fish from the ponds in this vicinity?	***July 06***	***Jan 07***
Men	66% Yes	65%Yes
Women	38% Yes	44%Yes
Do you wear gloves when you mix mercury?	***July 06***	***Jan 07***
Men	10% Yes	9%Yes

The above results illustrate that some behavior has remained the same, despite the increased levels of awareness.

4.3 Behavior Change in Gold Shops

4.3.1 Behavior-focus questions:

Do you keep and re-use the reclaimed mercury?

Gold Shop Operators reported:

a. Selling the reclaimed mercury.
b. Cleaning the mercury for re-use.
c. Reclaiming mercury at least once every two months.
d. Keeping the mercury because it is expensive.
e. Sometimes collecting mercury from the fumehood when they clean it.
f. Giving it to other people or to miners.

Do you know how to improve your burning equipment?

Gold Shop Operators suggested:

a. Minimizing the number of holes, so fumes only exit through the exit pipe.
b. Using the filter system that UNIDO has promoted.
c. Using methods shown by trainers from the UNIDO campaign.
d. Using a blower.
e. Making a condenser using an enclosed glass box.

Is there anything you do differently now, to avoid mercury?

Gold Shop Operators reported:

a. Using the new fumehood filter from UNIDO
b. Being more careful.

c. Using a mask to reduce smoke from burning area.
d. Asking miners to burn their gold first.
e. Using the tools that UNIDO promoted.
f. Using the blower from UNIDO.
g. Telling their wives and children to keep away from burning areas.
h. Closing holes to prevent fumes escaping.

Have you made any changes to avoid mercury?

Gold Shop Operators reported:
a. Ensuring fumes vent out from the fumehood and closing up holes.
b. Not getting too close when burning gold and using a mask.
c. Using a blower to make sure the smoke doesn't go everywhere.
d. Using the new fumehood from UNIDO.
e. Being more careful with mercury and keeping the family away from mercury.
f. Using a mask and washing your hands after burning gold.
g. Being more careful when burning gold and using a fan.
h. Not burning gold in the shop anymore.

What do you do to help your children to avoid mercury?

a. Almost all operators said they now keep children away from burning areas.

4.4 Behavior Change in the Town Community

4.4.1 Behavior focus question:

Do you do anything differently now to avoid mercury?

The General Public in town reported:
a. Keeping away from burning areas and amalgamation pools.
b. Being more careful when buying fish.
c. Being more careful.
d. Advising the family not to use mercury.
e. Telling the family about the dangers of mercury.
f. Using a mask.
g. Not bathing in amalgamation pools anymore.

Have you made any changes to avoid mercury?

The General Public in town reported:
a. Keep away from burning area and the amalgamation pool.
b. Being more careful.
c. Being more careful when buying fish.
d. Not touching mercury
e. Not bathing in amalgamation pools.

What do you do to help your children to avoid mercury?

The General Public in town reported:
a. Telling the children to keep away from fumehoods.

b. Telling children about the dangers of mercury for health.
c. Reminding children to avoid and keep away from burning area.
d. Forbidding children to touch mercury.

4.5 Behavior Change in the Gold Fields

4.5.1 Behavior-focus question:

Is there anything you do differently now, to avoid mercury?

Informal Gold Shop Operators reported:
a. Using the new fumehood from UNIDO.
b. Being more careful with mercury.
c. Keeping away from burning areas.

Women reported changing their habits to avoid mercury by:
a. Keeping away from burning area and the amalgamation pool.
b. Not taking water and eating fish from amalgamation pools.
c. Washing their hands after using mercury.
d. Staying out of the amalgamation pool.
e. Not touching mercury.
f. Keeping mercury in a safe place.

Men reported changing their habits to avoid mercury by:
a. Using new retorts.
b. Being more careful when using mercury.
c. Using gloves when working with mercury.
d. Washing their hands after using the mercury.
e. Using as little mercury as possible.
f. Not burning mercury in the house anymore.
g. Looking for new bathing places, because their skin started to feel itchy.
h. Not smoking while working with mercury.
i. Keeping away from burning areas and the amalgamation pool.

4.6 Media Messages Recalled in the Gold Fields

4.6.1 Results For Mining Community

Women recalled these messages from the campaign:
a. Mercury is dangerous for their health, their children's and their family's.
b. Be careful with mercury.
c. Keep away from burning area and to avoid mercury fumes.
d. Keep children and pregnant women far away from burning areas.
e. Do not eat fish from, or bathe in, amalgamation pools
f. Wash your hands after using mercury.

Men recalled these messages from the campaign:
a. Mercury is dangerous for your health.

b. Keep children and women away from burning areas and fumes.
c. Be careful when using mercury.
d. Wash your hands with soap after using mercury.
e. Don't wash inside the amalgamation pool.
f. Use a retort when burning gold amalgam.
g. Don't burn gold at houses near people.
h. Don't take a bath in the amalgamation pool.
i. Use gloves when working with mercury.

Informal Gold Shop Operators recalled these messages from the campaign:
a. Mercury is dangerous for your health.
b. Keep children away from burning areas and the fumes.

4.7 Media Messages Recalled in the Town

4.7.1 Results For Formal Gold Shops in Kereng Pangi

What messages do you remember from our campaign?

The messages they recalled were:
a. Mercury is dangerous for your health, your children's and your family's health.
b. We can reduce mercury pollution by using the fumehood promoted by UNIDO.
c. Keep the community away from the mercury hazard.
d. Wash your hands with soap after burning gold.
e. Keep women, children and pregnant women far away from burning areas.
f. Be careful with mercury.
g. Find ways to avoid the dangers of mercury.
h. Find ways to burn mercury safely.

4.7.2 Results For The General Public in Town

What messages do you remember from our campaign?

The messages they recalled were:
a. Mercury is dangerous for their own, their children's and their family's health.
b. Be careful with mercury.
c. Keep away from burning areas and avoid mercury fumes.
d. Keep women, children and pregnant women far away from burning area.
e. Don't eat fish from amalgamation pools.
f. Burn gold in a safe manner.

4.8. Relative Success of Different Types of Media

4.8.1 Results For Mining Community

How did you get your information about the dangers of mercury?

Women remembered getting information from:
a. Booklets from UNIDO 56%

b. Trainers 29%
c. Mercury Awareness Films from UNIDO 18%
d. Posters 15%
e. Brochures from Health Centre 15%
f. Information from Friends 15%
g. Radio 3%
h. Billboards 3%
i. Information from Dr. Robert 3%

Men remembered getting information from:

a. Booklets from UNIDO 49%
b. Trainers 42%
c. Mercury-Awareness Films from UNIDO 40%
d. Friends 35%
e. Posters 7%
f. Brochures from Health Centre 7%
g. Radio 5%

Informal gold shop operators remembered getting information from:

a. Booklets from UNIDO 57%
b. Trainers 57%
c. Posters 29%
d. Brochures 57%
e. Mercury-Awareness Films from UNIDO 29%

4.8.2 Results For Formal Gold Shops in Kereng Pangi

How did you get your information about the dangers of mercury?

Gold Shop Operators remembered getting information from:

a. Trainers from UNIDO 55%
b. Booklets from UNIDO 30%
c. Information from Friends 25%
d. Watching Mercury-Awareness Films from UNIDO 20%
e. Information from Doctor Robert, and the local health centre 5%
f. Posters 5%

4.8.3 Results For The Town Community

The General Public remembered getting information from:

a. Watching Mercury-Awareness Films from UNIDO 27%
b. Trainers from UNIDO 27%
c. Books from UNIDO 17%
d. Posters 10%
e. Brochures from Health Centre 7%
f. Information from Friends 7%
g. From the UNIDO campaign 7%
h. Billboards 3%
i. From Government Programs on Television 3%

5. Summary

The campaign had a lasting impact on the level of awareness of the community in the town and in the gold fields. This is most strongly reflected in the behavioral changes made by the gold shop operators, who expressed a strong desire to work together with trainers to improve the existing fumehoods in their shops and make their work places safer. This involved some capital expenditure on their behalf, albeit a small sum of money, it signified a genuine wish for ownership of the technology, reinforced by a wish to capture and recycle mercury using the equipment. The adoption of this recycling technology by 16 gold shops in the study area (plus one outside the study area) is a significant step forward towards a massive reduction of mercury emissions in the town of Kereng Pangi.

Awareness levels increased substantially throughout the mining community regarding the fact that mercury is a health hazard. Among gold shop owners, 100% of operators in a sample of 20 gold shops took the view that mercury can damage one's health.

In the field, this increase in awareness was elevated from 21% prior to the campaign to 93% at the close of the campaign among the primary target group of gold miners. The secondary target group of women in the field (not direct users of mercury) rose to a similar level, from 15% to 91% over the course of the six-month campaign. Due to the high turnover of miners towards the end of 2006, much of the community had been replaced by new immigrants by January 2007. Interestingly, new arrivals were also found to be aware of mercury hazards, despite having had no contact with the TDU. This signifies that word-of-mouth may well perpetuate the message within the community despite the high replacement rate of the labour force.

Among the general community in the town of Kereng Pangi, there was a moderate increase in awareness, such that 51% from a representative sample of the community were in agreement that mercury was a health hazard by the close of the project.

Several 'Fauzi' retorts were in use in the field by the end of 2006. The users of these retorts were all rig owners who accumulate substantial quantities of gold from a number of rig operations on a regular basis. The vast majority of the gold produced in Galangan is traded by such rig bosses. These people are therefore the most appropriate users of retorts. By contrast, miners usually handle small balls of only one or two grams of amalgam. The willingness of several rig-bosses to purchase and use these locally made retorts is a positive indicator of changing habits in the field.

Another positive behavioral trend observed to be on the increase over the course of the project, was the practice of retaining waste concentrates inside a small, purpose built amalgamation pond. This practice contains the contaminated concentrates for collection and reduces the level of mercury released on site - shifting the burden to the processing points of the zirconium buyers instead. This creates a new opportunity for intervention at these points, most of which are located within the town, and which can more easily be addressed by local government departments wishing to raise standards within the zircon industry.

Appendices

Appendix I: Baseline Study Sample Size

Survey Sample Sizes: Baseline Study and Comparison Study

Baseline Study	**n = Number of Respondents**
Primary Target Group	
1 Gold Shop Operators	n = 14
2 Informal Gold Shops	n = 3
3 Miners in Field (males)	n = 38
Secondary Target Group	
4 Women in Field	n =15
5 Town Community	n =28
	Total = 98 individuals

Additionally: 7 work gangs of miners were interviewed as Focus Groups (n = 28)

Comparison Study	**n = Number of Respondents**
Primary Target Group	
1 Gold Shop Operators	n = 20
2 Informal Gold Shops	n = 7
3 Miners in Field (males)	n = 43
Secondary Target Group	
4 Women in Field	n = 34
5 Town Community	n = 47
	Total = 151 individuals

Appendix II: Estimates of Amalgam Supply

Emissions in the town resulting from unburned amalgam traded

Burned at Gold Shop	Grams mercury per Day	Kilograms mercury per Year	Estimated Recovery	**Annual Emissions**
Huda	38,9	14.180	7.090	7.090
Delta	488,3	178.211	7.200	171.011
Jonito	328,0	119.720	36.000	83.720
Aulia Indah	74,4	27.156	3.000	24.156
Dua Saudara	26,2	9.578	0	9.578
Karya Famili	204,8	74.752	8.000	66.752
Al Karomah	41,4	15.111	3.600	11.511
Sahabat Baru	33,1	12.089	0	12.089
Maskanah	16,6	6.044	0	6.044
Kenangan Br.	75,6	27.603	400	27.203
Sumber Kayu	132,0	48.180	500	47.680
Noor Yahya	90,8	33.124	4.000	29.124
Pancar Indah	454,1	165.756	4.000	161.756
Sentral	82,5	30.113	0	30.113
Karya Baru	142,4	51.958	3.000	48.958
Swarga	54,1	19.754	0	19.754
Average	**142,7**	**52.083**	**4.799**	**47.284**
TOTAL	**2.283**	**833.328**	**76.790**	**756.538**

Emissions were also calculated for amalgam pre-burned in the field:

Emissions in the gold fields resulting from pre-burned amalgam traded.

Burned before Gold Shop	Grams Mercury per Day	Kilograms Mercury Recovery	Estimated Recovery	**Annual Emissions**
Huda	66,2	0	24.145	24.145
Delta	141,8	0	51.739	51.739
Jonito	72,0	0	26.280	26.280
Aulia Indah	21,6	0	7.884	7.884
Dua Saudara	5,8	0	2.102	2.102
Karya Famili	115,2	0	42.048	42.048
Al Karomah	48,6	0	17.739	17.739
Sahabat Baru	38,9	0	14.191	14.191
Maskanah	19,4	0	7.096	7.096
Kenangan B.	61,9	0	22.584	22.584
Sumber Kayu	108,0	0	39.420	39.420
Noor Yahya	74,3	0	27.101	27.101
Pancar Indah	70,9	0	25.869	25.869
Sentral	67,5	0	24.638	24.638
Karya Baru	52,7	0	19.217	19.217
Swarga	11,9	0	4.336	4.336
Average	**61,0**	**0**	**22.274**	**22.274**
TOTAL	**976**	**0**	**356.390**	**356.390**

Estimates of Unburned and Pre-Burned Amalgam Supply*

Cut-off is 20g Au

SUPPLIED TO GOLDSHOP	Estimated # Balls/Day	Estimated Min Weight Au	Estimated Max Weight Au	Estimated Avg Weight Au	Annual Trade in Kilos of GOLD	QUANTITY OF UNBURNED AMALGAM			Daily gm/Hg in Unburned Balls	QUANTITY OF PRE-BURNED AMALGAM			TOTAL gm/Hg Vaporised Daily	ANNUAL Kg/Hg Vaporised
						Hg x factor	Avg Hg Weight	% is Unburned		Hg x factor	Avg Hg Weight	% is Pre-Burned		
Huda	10	1	20	10.5	38,325	100%	10.5	30%	31.5	10%	1.1	70%	38.9	14,180
Delta	60	1	20	10.5	229,950	100%	10.5	75%	472.5	10%	1.1	25%	488.3	178,211
Jonito	50	1	15	8	146,000	100%	8.0	80%	320.0	10%	0.8	20%	328.0	119,720
Aulia Indah	12	1	15	8	35,040	100%	8.0	75%	72.0	10%	0.8	25%	74.4	27,156
Dua Saudara	4	1	15	8	11,680	100%	8.0	80%	25.6	10%	0.8	20%	26.2	9,578
Karya Famili	40	1	15	8	116,800	100%	8.0	60%	192.0	10%	0.8	40%	204.8	74,752
Al Karomah	20	1	8	4.5	32,850	100%	4.5	40%	36.0	10%	0.5	60%	41.4	15,111
Sahabat Baru	16	1	8	4.5	26,280	100%	4.5	40%	28.8	10%	0.5	60%	33.1	12,089
Maskanah	12	1	5	3	13,140	100%	3.0	40%	14.4	10%	0.3	60%	16.6	6,044
Kenangan Baru	25	1	10	5.5	50,188	100%	5.5	50%	68.8	10%	0.6	50%	75.6	27,603
Sumber Kayu	30	1	15	8	87,600	100%	8.0	50%	120.0	10%	0.8	50%	132.0	48,180
Noor Yahya	30	1	10	5.5	60,225	100%	5.5	50%	82.5	10%	0.6	50%	90.8	33,124
Pancar Indah	50	1	20	10.5	191,625	100%	10.5	85%	446.3	10%	1.1	15%	454.1	165,756
Sentral	30	3	7	5	54,750	100%	5.0	50%	75.0	10%	0.5	50%	82.5	30,113
Karya Baru	30	5	8	6.5	71,175	100%	6.5	70%	136.5	10%	0.7	30%	142.4	51,958
Swarga	12	1	10	5.5	24,090	100%	5.5	80%	52.8	10%	0.6	20%	54.1	19,754
Shop Average	26.9	1.4	12.6	7.0	74,357	100%	7.0	60%		10%	0.7	40%	142.7	52,083
TOTALS	431				1,189,718				2174.6				2,283	833,328

BURNED FOR GOLD SHOP	QUANTITY OF Hg PRE-BURNED IN FIELD			TOTAL gm/Hg Vaporised Daily	ANNUAL Kg Vaporised Hg
	# Balls/Day	Avg Hg Weight	% is Pre-Burned		
Huda	10	9.5	70%	66.2	24,145
Delta	60	9.5	25%	141.8	51,739
Jonito	50	7.2	20%	72.0	26,280
Aulia Indah	12	7.2	25%	21.6	7,884
Dua Saudara	4	7.2	20%	5.8	2,102
Karya Famili	40	7.2	40%	115.2	42,048
Al Karomah	20	4.1	60%	48.6	17,739
Sahabat Baru	16	4.1	60%	38.9	14,191
Maskanah	12	2.7	60%	19.4	7,096
Kenangan Baru	25	5.0	50%	61.9	22,584
Sumber Kayu	30	7.2	50%	108.0	39,420
Noor Yahya	30	5.0	50%	74.3	27,101
Pancar Indah	50	9.5	15%	70.9	25,869
Sentral	30	4.5	50%	67.5	24,638
Karya Baru	30	5.9	30%	52.7	19,217
Swarga	12	5.0	20%	11.9	4,336
Shop Average		6.3	40%	61.0	22,274
TOTALS				976	356,390

Grand Total of kg/Hg release

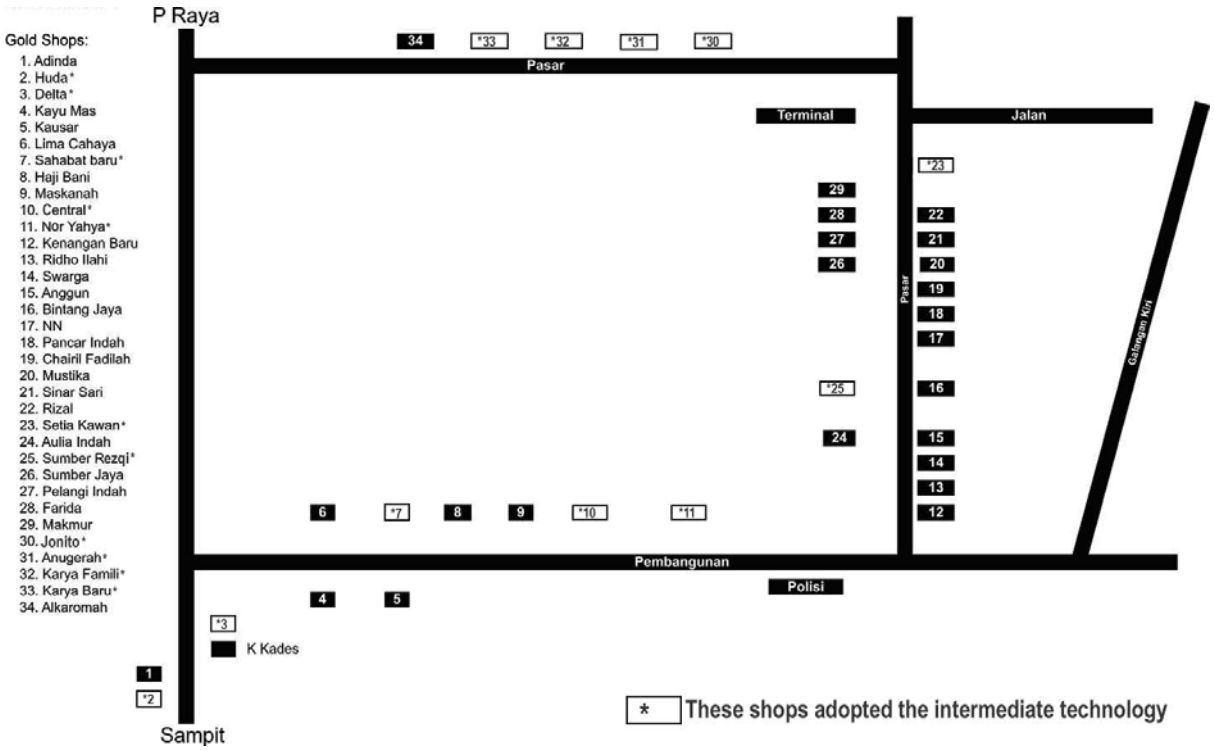
*These estimations by gold shops include 2006 recovery levels

Appendix III: Gold Shops with Fume Hoods

List of Gold Shops with Fume Hoods

No	Date	Gold Shop / Place	Information
1	19-12-2006	Jonito	Fumehood Prototype 1 - GMP
2	22-12-2006	Huda	Filter at base, blower 3”
3	27-12-2006	Central	Filter above (level 2)
4	27-12-2006	Noryahya	Filter above (level 2)
5	27-12-2006	Anum (Galangan)	Filter opposite chimney
6	28-12-2006	Anugerah	Filter above (level 2)
7	28-12-2006	Setia Kawan	Filter above
8	03-01-2007	Delta	Filter above
9	06-01-2006	H. Anwar (km 25)	Filter opposite chimney
10	06-01-2007	H. Barkati (km 25)	Filter at base
11	13-02-2007	Sumber Rezqi	Filter above
12	13-02-2007	Sahabat Baru	Filter opposite chimney
13	14-02-2007	Karya Baru	Filter above (level 3)
14	14-02-2007	Karya Family	Filter above (level 3)
15	17-02-2007	Aria	Materials Supplied
16	17-02-2007	Abdurrahman	Materials Supplied
17	17-02-2007	Desa Kelanaman	Materials Supplied

Map of Gold Shops in Kereng Pangi Town



Appendix IV: Questionnaires

A. Baseline Study Questionnaires

The Primary Target Group use Mercury Directly (Miners/Men)

The GMP aims to raise awareness of mercury as a threat to individuals and families and to reduce usage at source by changing the behavior of miners at the stage of concentration and amalgamation.

Demographics:	Questions 1, 2, 3, 4
Attitudes:	Questions 9, 10,
Behavior:	Questions 5, 6, 7, 8,

PRIMARY TARGET: QUESTION SET for GROUPS OF MINERS

1. Do you all come from the same place?

2. How long have you worked here?

3. Are you mining for gold now?

4. How much gold are you getting?

5. Are you using mercury?

6. How much mercury are you using?

7. How do you mix the mercury and concentrate together?

8. How long do you mix it together for?

9. Do you think you can get more gold but use less mercury?

10. Can you obtain the gold without using mercury?

Demographics:	Questions 1 - 9
Attitudes:	Questions 10, 12, 13, 20
Behavior:	Questions 11, 14, 15, 16, 17, 18, 19

PRIMARY TARGET: QUESTIONS for INDIVIDUAL MINERS (men)

1. What is your name?

2. How many children do you have?

3. When did you come here?

4. When do you think you will leave here?

5. Where did you work before you came here?

6. Where will you go at the time of Idul Fitri?

7. Will you return to work immediately after Idul Fitri?

8. What activities do you do to make an income?

9. Is your income enough to cover your living costs?

10. What do you know about mercury?

11. Do you use mercury to capture gold? Yes / No

12. Do you get more gold if you use more mercury? Yes / No

13. Do you want to use less mercury in the process? Yes / No

14. Do you wear gloves when you mix mercury? Yes / No

15. Do you mix the concentrate and mercury in a closed drum? Yes / No

16. Do you concentrate it in a gold-pan before you add mercury? Yes / No

17. Do you use the same mercury again, a second time? Yes / No

18. Do you squeeze the mercury amalgam in a pond? Yes / No

19. Do you eat fish from ponds in this area? Yes / No

20. Do you think that using mercury will damage your health? Yes / No

The Secondary Target Group does not use Mercury Directly (Women and Children)

The GMP aims to raise awareness of mercury contamination in the area and change the general behavior with regard to using water from contaminated amalgamation ponds, and specifically: to educate people NOT to eat fish from the ponds.

Demographics:	Questions 1 - 8
Attitudes:	Questions 9, 11, 13, 14, 15
Behavior:	Questions 10, 12

SECONDARY TARGET: QUESTIONS for INDIVIDUALS (women and children)

1. What is your name?

2. How many children do you have?

3. Do your children go to school?

4. How long do you think you will stay here?

5. Where did you live before you came here?

6. What activities do you do to make an income ?

7. Will you continue to do your usual activity in the month of Ramadan?

8. Does your family make enough income per month?

9. What do you know about mercury?

10. Do you think there is any mercury in your drinking water? Yes / No

11. Do you take a bath in a pond where people use mercury? Yes / No

12. Do you eat fish from ponds in this area? Yes / No

13. Is it healthy for pregnant women to eat fish from this area? Yes / No

14. Do you think mercury can damage your health? Yes / No

15. Do you think mercury can harm your children? Yes / No

The Primary Target Group use Mercury Directly (Men and Women)

The GMP aims to raise awareness of mercury as a threat to individuals and families and change the behavior of people who burn mercury by introducing the use of retorts

Demographics:	Questions 1 - 9
Attitudes:	Questions 10, 16, 17
Behavior:	Questions 11, 12, 13, 14, 15, 18

PRIMARY TARGET QUESTION SET for GOLD AND FUEL SHOPS

1. What is your name?

2. How many children do you have?

3. Where were you born?

4. Where did you work before you came here?

5. How long have you been here?

6. Do the miners take a break during or after the time of Ramadan?

7. How long do mining activities stop for?

8. What activities do you do to make an income?

9. Is your income enough to cover your living costs?

10. What do you know about mercury?

11. Do you burn amalgam to get gold? Yes / No

12. Do you usually burn amalgam outdoors? Yes / No

13. Do you usually burn amalgam indoors? Yes / No

14. Do you wear special clothes when you burn amalgam? Yes / No

15. Do you burn amalgam inside a closed container (retort) ? Yes / No

16. Do you think mercury is bad for your health? Yes / No

17. Do you think mercury is bad for your family's health? Yes / No

18. Do you take the mercury and burn it far away from people? Yes / No

PRIMARY TARGET QUESTION SET FOR GOLD SHOPS IN KERENG PANGI

Demographics: Questions 1, 2, 3, 4
Attitudes: Questions 5, 6, 13, 14, 15,
Behavior: Questions 7, 8, 9, 10, 11, 12,

1. What is your name?

2. How many children do you have?

3. Where were you born?

4. How long have you worked here?

5. What happens to mercury when you burn it?

6. Where do the mercury fumes go after you burn the amalgam?

7. Do you burn amalgam inside a chimney? Yes / No

8. Does the chimney have a fan? Yes / No

9. Does the chimney have a water filter? Yes / No

10. Have you tried burning mercury inside a retort? Yes / No

11. Do you save and recycle the mercury you burn? Yes / No

12. Do you wear special clothes when you burn amalgam? Yes / No

13. Do you think mercury fumes are bad for your health? Yes / No

14. Do you think mercury fumes are bad for children's health? Yes / No

15. Do you know how you to improve your burning equipment? Yes / No

SECONDARY TARGET QUESTION SET FOR COMMUNITY IN KERENG PANGI

Demographics: Questions 1 - 4
Attitudes: Questions 5, 6, 7, 8, 9, 10

1. What is your name?

2. How many children do you have?

3. Where were you born?

4. How long have you been here?

5. What do you know about mercury?

6. Do you think the air in Kereng Pangi is harmful to your health? Yes / No

7. Do you think it is harmful to live in the vicinity of gold Shops? Yes / No

8. Do you think mercury fumes from gold Shops affect your health? Yes / No

9. Do you think mercury can harm the development of children? Yes / No

10.Do you think it is harmful to eat large river fish? Yes / No

B. Comparison Study Questionnaires

Additional Questions:

1. What message do you remember from our campaign?
2. How did you hear about the dangers of mercury?
3. Is there anything you do differently now, to avoid mercury?
4. What changes have you made to avoid mercury?
5. Do you help your children to avoid mercury?