Fact finding mission in Mauritania

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Peter W. U. Appel

appelglobal@gmail.com
www.appelglobal.com

Introduction

Small-scale gold mining is fairly new in Mauritania, but has quickly gained momentum and many thousands of miners are now digging for gold. Being new in that branch the miners did not know all the facets of recovering gold from their ore. However, an influx of miners from Sudan quickly taught the local miners to use mercury for recovering gold. The wave of small-scale gold miners using mercury prompted the Ministry of Mines to establish government controlled sites where the miners should process their ore. The miners were forced to transport their ore for long distances in order to get their ore processed. The idea of concentrating processing gold ore was that the government could monitor the processing allowing better control and better risk management as well as giving operators access to several services (water, electricity).

However, the Sudanese miners were used to extract gold with mercury and an army of mercury dealers developed quickly. The use of mercury escalated, and prompted the government to look for ways to introduce mercury-free gold extraction. Dr. Helmut Burmeister, Deutsche Gesellshaft für Internationale Zusammenarbejd (GIZ) GmbH, Nouakchott, Mauritania contacted Appelglobal. It was decided to carry out a fact finding mission.

Appelglobal has over the last ten years successfully introduced mercury-free gold extraction in several countries in Africa, South America and SE Asia (se website www.appelglobal.com).

Objective of the mission

The objective of the mission was to make a map of the present procedures of gold extraction by small-scale gold miners and suggest ways to to introduce free mercury gold processing technology, which can be tailored to the local conditions. The suggested avenue towards mercury-free methods has been discussed with government officials as well as small-scale gold miners.

Dual advantages of abandoning mercury in small-scale gold extraction

It has obvious health advantages to stop using mercury, but there is another advantage which should convince small-scale gold miners to stop using mercury. In order to liberate the small gold grains, the ore has to be crushed and subsequently milled down to very fine grained powder. When the gold grains free they can be extracted. Often mercury is added to the milling. The reason is that mercury amalgamates with gold which facilitate capturing the small gold grains. The majority of small-scale gold miners therefor use mercury to capture their gold.

There is unfortunately one serious problem with using mercury, apart from the health issue. It is that a large part of mercury during milling is milled into tiny drops called mercury flour (see Photo). These drops can unfortunately not be captured after milling, but are lost to the tailings. That pollutes the environment, but another problem is that each little droplet of mercury contains gold. The gold is lost for the miners. And that is the reason that mercury-free gold processing gives higher yield.

Millimetre sized mercury droplets called mercury flour in tailings

Meeting with Mohamed Lemine Moustapha, Director of Ministry of Petroleum, Energy and Mines in Ministry of Petroleum, Energy and Mines

A meeting was held with the Director and some of his colleagues. At the meeting the Philippine mercury-free gold extraction method was described in detail. The method was invented by a Philippine small-scale gold miner more than thirty years ago and it quickly gained momentum among his ca. 30,000 colleagues. They still use that method. The method has several advantages compared with amalgamation (using mercury). The miners do not need to buy expensive mercury. They will recover significantly more gold and the processing will not jeopardise the health of them and their families. The extra bonus is of course that it will reduce mercury pollution on Planet Earth. It was agreed that funding shall be raised to establish mercury-free processing stations at two governmental processing sites and teach the local miners and mill owners how to use them. However, it is necessary to convince the miners that modified processing station easily can compete with using mercury to recover gold. This shall be done before the miners will stop adding mercury to their gold extraction.

Government processing station at Chima

Three hour drive north of Nouakchott is a government controlled gold processing station with around 700 milling stations using the so-called Chinese mills. The average daily input of sacs with crushed gold ore (each weighing about 50 kg) is 4000 with a monthly average of 130.000 sacs. The ore is milled by the respective mill owners. The average load per run in the mills is about one ton crushed ore. The charge for milling is decided after negotiations between the miner who own the ore and the mill owner. During milling mercury is add in the order of 150 gram per load. If the ore is expected to be high grade more mercury is added. After milling the material is processed and the amalgam is extracted and burned. The burning is carried out in open air with no means of recovering the mercury. After processing a sum of money is paid by the gold owner to the government for use of the facility and in addition a sum per gram gold extracted.

The tailings from processing have been dumped outside the fence surrounding the processing station. Recently a company (Kenzie) has obtained a deal with the government

whereby the company remove all talings to a place away from town. The company plans to extract mercury thereby recovering the gold which is left in the mercury. Which technique the company plan to use is unknown to me. It is important to know how the company will deal with the mercury they recover.

Chinese mills

Meeting with representatives of the stakeholders at Chima

A meeting was held with representatives of miners, of the ministry of mining and of two mining cooperatives (see attached list below of participants). A detailed account of mercury-free gold extraction was presented to the audience. A lively discussion took place where arguments pro and contra the old method versus mercury-free gold extraction were put forward. The discussion boiled down to a very positive attitude from the miners and their representatives from the cooperation. The miners furthermore said that they hoped the ministry would move fast in order to get gold extraction mercury-free.

During the meeting the sale of gold was described. The present system is that each miner take his/her gold and sell it mainly at the black market and a smaller part to the official purchase offices of the national bank at world market prices.

Meeting with representatives of stakeholders at Chima

Tasiast mining site

Visited the Tasiast mining site where reportedly about fifty thousand miners are active. They are spread over a vast area where they dig trenches down to about ten metres depth and about a couple of metres wide. They also sink shafts and work tens of metres underground. However, we did not see that kind of operation. They mine a quartz vein system. They sometimes have really good grade of 40 gr/ton. I talked to some of them and they explained that they were frequently harassed by the local police. The police sometimes visited their diggings and if they got the impression that the miners recover high grade ore then the police chased the miners away and sent some other miners (friends?) to mine the gold. Not much I could do about it apart from suggesting to report the harassment to higher levels.

Small-scale gold miner at his pit

Meeting with the Governor at Chima

The group had a short meeting with the local governor, I explained the idea of introducing a Philippine type mercury-free gold processing station for small-scale gold miners. The governor listened and asked a number of questions. He sincerely hoped that money could be raised either from the government or from GIZ. I invited him for an opening ceremony for the mercury-free processing plant. He accepted the invitation and told that he would bring a his staff along to the opening.

Government processing site at Zouérate

Previously small-scale gold miners extracted their gold in town using mercury. The local government realised that mercury was too dangerous for the population, so the miners were allocated an area a few kilometres away from town. The allocated area is surrounded by a small wall of sand. The government supplied electricity. However, there is not power enough for all the plants so some of them bring in their own power plant. There are in the order of 300 Chines mills. They mill about 1 to 1.5 tons per day. They add mercury to the milling. The amount depends on the expected gold grade of the ore. Very rich ore requires up to 700 grams of mercury per run, but generally around 150 gram is used.

When milling is finished the mill is emptied and the material is concentrated with panning. The amalgam is burned. Tailings are trucked to areas outside the processing area. Both dump areas are bordered by long piles of soil. One area is reserved for tailings for the Kenzie company. That area is presently empty. The other area is partly filled with tailings of all sorts of colours. The idea is that Kenzie and another company will find a way to recover mercury and gold from the tailings. Such a process has been discovered by the author of this report. Information is available on request. See chapter on cleaning tailings below.

We did not see the mining sites. One reason being that they are more than one hundred kilometres away. The other reason being that since it is summertime and the weather is very hot few miners work during this period.

Chinese wheels at Zouérate

Depot of tailings

Meeting with the Governor at Zouérate

Meeting with the governor. I explained the technical details with the Philippine mercury-free gold extraction system. He appeared very interested and much positive for the possibility to get the use of mercury in his area stopped. He promised to support an upcoming project.

Meeting with stakeholders at Zouérate

The meeting went along the lines of the meeting in Chima. The representative of the miners appeared very interested in seeing mercury-free gold extraction in action and indicated that if it is as good as I told them, they would be very supportive in changing their gold extraction procedure. List of attendees in appendix below.

Estimate of mercury release to the environment from Chima and Zouérate

The two government processing sites have in the order of 1000 mills running every day. An average of 150 gram of mercury is added in every run which last a working day. That gives a daily use of mercury in the order of 150 kilogram. This adds up to a monthly consumption of 4.5 tons of mercury per month or about 54 tons of mercury per year! It should also be emphasized that all that mercury contains large amounts of gold.

Brief description of mercury-free gold processing for small-scale gold miners

This can be viewed in an attached annex. The procedure can be seen on educational video the internet in:

English: http://youtu.be/X6Sawj0HyF0.

French:https://www.youtube.com/watch?v=C9VweNJ-Hw4

Suggested project plan

The educational programme shall be carried out at the two sites Chima and Zouérate.

The sites are excellent since there is governmental support and control. There is mechanical back-up available as well as a powerline to run the mills. Most of the materials for the processing stations will be locally available. Well ahead of the arrival of the international team we will submit drawings of the modifications of the processing station(s) and list of equipment to be purchased or made locally. Some of the construction work can be done prior to the arrival of the Philippine miners. Construction of the processing station(s) will take in the order of a few days provided all requested material is at hand.

The processing station for mercury-free gold extraction is essential an addition of some steps to the present Chinese wheels. It is a must that the Chinese wheels are cleaned for mercury. This is done by repeatedly milling of batches of sand in the mills. It is not possible to say how many batches of sand need to be milled. It will be determined during the milling process.

Construction of the first processing plants will be supervised by Philippine small-scale miners. It is suggested to erect six to eight processing stations at Chima processing site as well as at Zouérate. The processing stations shall preferably near or next to each other. They should preferably be placed near the entrance to the processing site so they catch the eyes of the miners.

When the stations are built a number of sacs of crushed gold ore shall be ready for milling. The international team will first test each processing site and when it functions properly demonstrations of the mercury-free method will be carried out. After a few demonstrations

a comparison of the mercury-free gold extraction and the amalgamation method will be carried out as follows:

A number of sacs with crushed gold ore (about 400 kg) will be milled mercury free. The milled material will be piled up and divided into two equal piles. One pile is then re-milled with mercury and subsequently gold is extracted and weighed. The mercury-free material is run through the new process and the recovered gold is weighed. The output from the two methods is evaluated.

The addition to the mercury clean Chinese mills provides a gravitational separation of heavy minerals the so-called Philippine method. The output is a heavy mineral concentrate with high percentage of gold. The output will be placed in a small plastic bag mixed with borax. It will then be placed in a clay bowl with some charcoal. Heating together with blowing will make the heavy minerals melt. Gold sinks to the bottom as a small button whereas the other heavy minerals will be hosted in a borax glass (see attached appendix).

Summary of the advantages of the proposed free mercury processing

1. The two main advantages of introducing mercury-free gold extraction are. **A**: The miners recover much more gold, which will improve the Mauritanian economy. **B**. Mauritania will significantly reduce its contribution to local and global pollution of mercury.
2. Introducing mercury-free gold extraction in Mauritania has some advantages compared to introducing the method in many other countries. The most significant advantage is that the mills used in Mauritania can be used in mercury-free gold processing. The miners or mill owners do not need to invest in new mills which would have been a very costly process, probably prohibitive expensive. The Chinese mills in Mauritania can simply be cleaned for mercury. This is done by milling several batches of sand.
3. Miners can bring small batches say half a ton and up to 1.5 tons of crushed gold ore and the mill owners can mill the ore. This is important since some miners are able to mine much gold ore why others are less lucky.
4. Investment cost. No investment necessary for milling. The few items needed after milling to produce a heavy mineral concentrate will not pose a burden on the economy of the miners.

Possible technical 'bottleneck' factors which could affect the quality of the proposes free mercury processing

1. More water is used during mercury-free gold extraction. However, efficient recycling is possible to organise
2. Use of energy for mercury-free gold processing is the same as the present way of gold recovery

Cleaning mercury polluted tailings

The tailings from the mining produced by small-scale gold miners in Chima and Zouérate will be collected and stored. The plan is to extract the mercury for safe deposition and recover the gold which is in the mercury. It is not an easy task, but very successful cleaning of such tailings has been carried out in Nicaragua and plans are underway to clean mercury polluted river sediments in Philippines. Information on the way to clean the tailings can be found at:
https://www.dropbox.com/s/6sctcwa0hepqqzm/ToS%20Forum%20Special%20Mercury%20pollution%20issue%20FINAL%20June%2011%202019.pdf?dl=0

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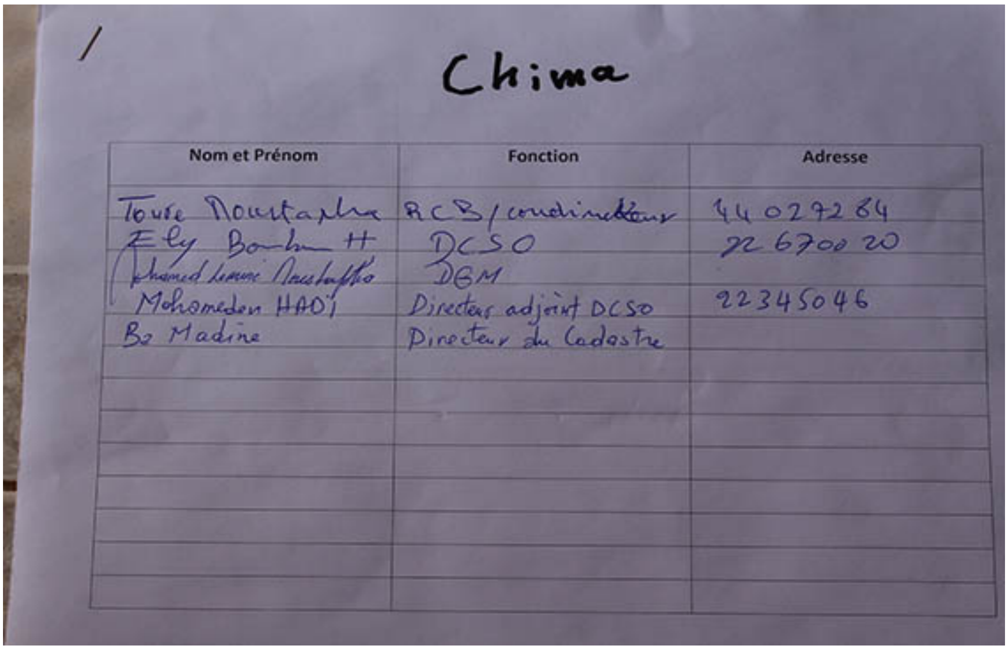
Mr. Mohamad Bouye Sakaly	GIZ
Mr. Mohameden El Hadi	Ministry of Mines
Mr. Hamdi Mohamed El Hacen	Interpreter

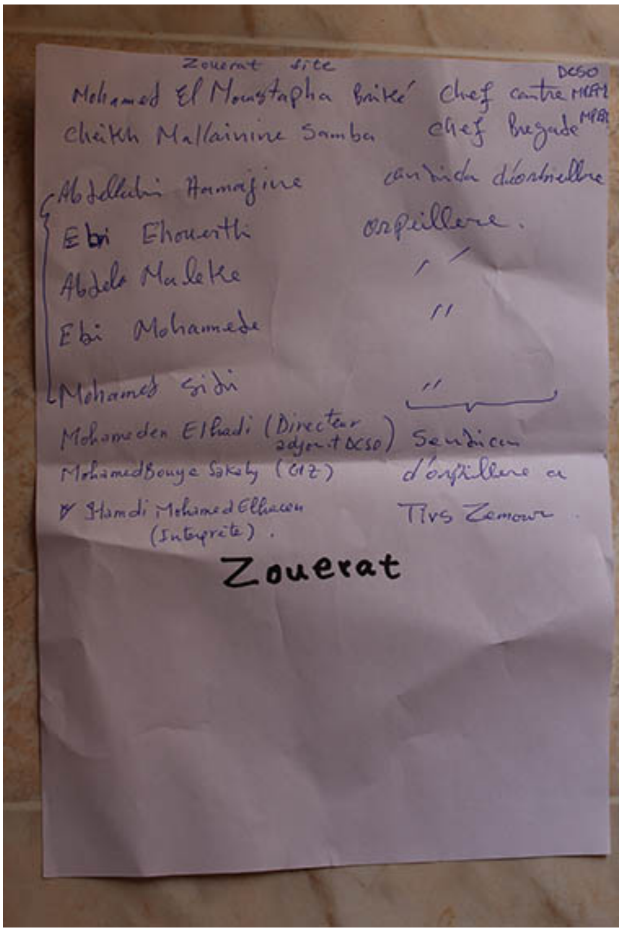
Appendix

List of attendees at meetings in Chima and Zouérate



Chima

Nom et Prénom	Fonction	Adresse
Toure Moustapha	RCB/coordinateur	44 02 72 84
Ely Bouhm H	DCSO	22 67 00 20
Ahmed Lemine Moustapha	DGM	
Mohomeden HADI	Directeur adjoint DCSO	22345046
Bo Madine	Directeur du Cadastre	



Zouerat site

Mohamed El Moustapha Brike' Chef centre MPM DCSO
Cheikh Mallainine Samba chef Brigade MPM
Abdellahi Hamajine candida d'orpaillere
Ebi Ehouerthi orpaillere.
Abdela Maleke "
Ebi Mohamede "
Mohamed Sidi "
Mohameden Elhadi (Directeur adjoint DCSO) Sendicat
MohamedBouye Sakaly (GIZ) d'orpaillere a
Hamdi Mohamed Elhacen (Intéprète). Tirs Zemour

Zouerat