

Artisanal Mining: Environmental and Cultural Rights in Cabo Delgado, Mozambique

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Report on February 2018 mission to Cabo Delgado, Northern Mozambique

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Dialogos

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Abstract

Teaching and training of small-scale gold miners in using mercury-free gold extraction instead of using mercury, has been carried out in Cabo Delgado, Northern Mozambique. Two mining sites hosted the training, those being Wacueia and Nanlia. Miners from a number of other places also attended the training. Comparison between the two methods was carried out. In Wacueia the miners extracted 78% more gold when using the mercury-free method than when they used mercury during the extraction. In Nanlia the miners extracted the same amount of gold with both methods. The comparison showed that miners in Wacueia lose about 2 kg gold per year together with large amounts of mercury. Most of the invited miners obtained good skills in the mercury-free method. Most of the miners that attended claimed that they would like to use mercury-free gold extraction method in the future. Of paramount importance to keep momentum achieved by the teaching and training is to make the necessary equipment available very fast such as borax, small air pumps, clay bowls and concentration equipment. Borax and small air pumps have to be imported, whereas clay bowls can be produced locally. Supporting and guiding mining associations to unite under an umbrella federation will facilitate reduction/stop use of mercury by small-scale gold miners.

Introduction

Small-scale gold mining is a large contributor to global mercury pollution. The miners use mercury to capture the small gold grains by forming a gold amalgam, which subsequently is burned off to liberate the gold. Several methods to reduce release of mercury have during the last decades been tested to replace or minimise the use of mercury in gold extraction. Most of those failed to gain momentum. However, about thirty years ago a mercury-free gold extraction method was invented in Northern Luzon, Philippines. Small-scale gold miners in that area soon adopted that method. Unfortunately, the use of the method did not spread further in the Philippines or elsewhere until about ten years ago (References). The Philippine method was subsequently named *mercury-free gold extraction method for small-scale gold miners (?)* and has successfully been introduced in other parts of the Philippines, Bolivia, Peru and Sudan. The present report describes implementation of that method in two mining sites in Cabo Delgado region of Mozambique

in February 2018. In 2017 a fact finding mission was carried out in that region in order to establish which gold extraction method was commonly used by the small-scale gold miners in that region. It was established that the so-called whole ore amalgamation had fortunately not yet gained foothold, but that the miners “only” used mercury in the final step of the process. The ground was then regarded as fertile for introducing mercury-free gold extraction.

Brief outline of field work

Field work was carried out in the Cabo Delgado region of Northern Mozambique in an area well over hundred kilometres West of the coastal town of Pemba. The team, which was based in the small town of Namuno, consisted of Peter W. U. Appel, Birgitte Stoffersen Leoncio D. Na-Oy, Sergio F. Baquete and Jofa Falume. Two sites were chosen as teaching and training sites: Nanlia and Wacueia. In Wacueia 6 local miners and 4 miners from other mining areas located in Cabo Delgado were participating in the program. In Nanlia 6 local miners and 5 miners from other mining areas in Cabo Delgado were participating.

Field team: From right to left: Leoncio Na-Oy, Birgitte Stoffersen, Sergio Baquete, Jofa Falume Peter Appel



The first day Nanlia and Wacueia were visited. The local associations were informed how the milling and processing stations should be built and organised. They also got brief information on the programme and of the outline of introducing mercury-free gold extraction. Three days’ work was carried out in Wacueia followed by three days field work in Nanlia. Afterwards both sites were revisited for one day to follow up on our work.

A detailed description of field work can be seen in the Appendix 2.

Present way of extracting mercury

Our fieldwork revealed that miners in Cabo Delgado generally extract gold using the same method, but there are significant differences from one site to the other in how they use the method. The basic principle is that milled ore is lead down a ramp (launder) from a box (sluice). The ramp is covered with a material, which is supposed to capture the gold when the milled ore is flushed down the ramp.

In Wacueia they place a coarse fabric (old sacks) on the ramp. The sacks have been used again and again and have thus been worn. They are full of big holes where no gold can be captured, so the gold grains escapes. In order to get the milled gold ore down the launder from the sluice box the miners pour buckets of water in the sluice box, whereby the water flow down the launder rushes too fast and carry many of the gold particles past the launder back to nature. When their processing is finished they vigorously shake the sack in a tub with water so the captured gold falls into the tub.

In Nanlia they use the same principle, but much more eloquent. First of all, they are much more particular in their choice of materials to be placed on the launder to capture gold. The launder is covered with a bottom layer of plastic, a second layer of cloth and a top layer of fabric resembling sacks, but much denser. Secondly, they use a hose to slowly flush the ore down the launder with constant water flow. Then they thoroughly clean each layer from the launder one after the other in a tub.



Illustration of the setup used for gold extraction in Wacueia.



Illustration of the launder with the three layers used for gold extraction in Nanlia.

Introducing mercury-free gold extraction

The procedure in both working sites is the same. The local mining associations summoned a group of local miners. Furthermore, Medicus Mundi had summoned small-scale miners from four different mining associations from mining areas as far as 250 km from the Nanlia and Wacueia sites. Details of the involved associations are given in Appendix 3.

First step at each site was an assembly, where we gave a brief description of the background of the project. This was followed by a technical description of why we have come to the mining site and a description of the mercury-free gold extraction method. In Wacueia following representatives from Medicus Mundi gave an introduction to the programme after which they viewed the processing (Margarita S. Camacho, Alima I Lupatta, Jorge Correia, Zamundine A. Cafuro & Renato H. Liane). A brief description with adjoining photos of the mercury-free process as well as the currently used method where mercury is used, is given in Appendix 1.

Comparative study

One way to try to convince miners to change working procedure is to show the advantage of working mercury-free versus using mercury (amalgamation). The following procedure was followed. A sufficient amount of gold ore (150 to 200 kg) was milled and homogenised thoroughly. Then split into two halves.

One half of the milled ore was given to the local miners who process it in their way using mercury. When their processing was finished, the recovered amalgamated gold was weighed and subsequently the mercury was burned off.

The other half of the milled ore was processed mercury-free. During this process the invited miners watched all steps of processing. One of the last steps in this process is to produce a gold concentrate using panning. The concentrate is then mixed with a little borax and a few drops of water and then placed in a small piece of plastic. The concentrate is then placed in a small clay bowl surrounded by charcoal. The charcoal is ignited and strong blowing on the burning charcoal makes the heavy mineral concentrate mixed with a little borax to smelt, whereby the gold grains unite at the bottom and can be recovered when it has cooled down. The recovered gold was weighed.

The following days at each site were devoted to teaching and training of the miners. All miners were actively involved in every step of the mercury-free gold extraction and several of them got the hunch of the technique. Especially the final panning is a challenge for newcomers, but the miners were keen to gain expertise.

Results

At Nanlia ca. 300 kg milled ore was allocated. The lot was split into two lots of ca. 150 kg. The local miners using mercury recovered 4.8 grams of amalgam, which was burned down to 3.6 grams of pure gold. The mercury-free method also recovered 3.6 grams of pure gold. In this case the gold recovery was even, but the mercury-free method has the advantaged that is does not release mercury to the environment. The miners in Nanlia commented that although our method did not prove more economic in respect of gold recovery they could save money on not buying mercury.

The gold grade of the gold ore in Nanlia is about 50 ppm (grams per ton), which is good for a gold ore in a small-scale mine.

At Wacueia 176 kg of milled ore was allocated and was split into two lots of 88 kg.

The local miners using mercury recovered 1.6 gram of amalgam. The amalgam was smelted down to 0.9 gram pure gold. This shows that for each 0.9 gram of gold recovered 0.7 gram of mercury is released to the environment during the burning of the amalgam. This is a yearly release of 1680 gram mercury to the environment from burning the amalgam.

The mercury-free method recovered 1.6 gram pure gold.

The mercury-free mothod thus recovered 78% more gold than the method using mercury.

In Wacueia the Associação Mineira 7 de Abril yearly process in the order of 3600 kg ore and recover 2400 grams of gold when using mercury to extract gold. If they used mercury-free gold extraction they would be able to recover 4270 grams of gold per year ($2400 \times 1.78 = 4270$). Based on this calculation we can conclude that the association lose in the order of 2 kg of gold per year!

The gold grade at Wacueia is in the order of 20 ppm (grams per ton), considerably less than in Nanlia.

Next steps

There are several obvious next steps to be made in order to increase gold recovery and reduce release of mercury from Cabo Delgado:

- Let educated trainers from Wacueia and Nanlia train miners in other parts of Cabo Delgado
- Improve the technical standard of mineral processing in the region

Train miners

At the two visited mining sites several miners have shown talent for getting expertise in the mercury-free gold extraction method.

In Wacueia two candidates are obvious:

- Bernardo Namuno +258 862 037 565
- Feldon Gabriel Biaque +258 874 453 733

In Nanlia two candidates can be recommended:

- Teodosio Jacinto +258 860 206 713
- Esperanca Jaime Ngulube +258 867 500 422/ +258 847 415 161

These guys should be hired to teach and train fellow miners in other areas.

Improve the technical standard

The present equipment used in extracting gold from the mined ore is of low quality and ought to be improved. An update of machinery will increase productivity significantly.

In order to make the milling of the gold more efficient, they should install more efficient and less energy consuming mills. Local blacksmiths with materials at hand make the drums they use presently. Those drums are very heavy and often leak considerable amounts of partly milled material, which then has to be milled again. A time consuming process. They frequently have to be patched and every patch makes the drum heavier.

We suggest that the miners in the future will use wetmilling instead of dry milling. The main drawbacks of dry milling are:

- Dry milling creates huge amounts of dust which give the miners stone lungs
- Dry milling cause major loss of fine gold
- Dry milling is very noisy and will create hearing problems over time

It is possible to import such drums and present them to the local industry in Mozambique so the drums can be produced locally. See photo below.



Example of a modern processing plant for small-scale miners



Major amounts of dust released from dry milling

Urgent immediate action

Field work at the two sites was successful, but there were some stumble stones. The equipment that had been made locally was fine. We had brought borax, felt, clay bowls and blowers along from Denmark and Philippines, but obviously in limited amount. Not all representatives from different mining associations received the utensils.

The following equipment should be made available better today than tomorrow:

- Blowers
- Borax
- Felt
- Clay bowls
- Sluice and launder

Blowers at a decent price are manufactured in China and can easily be purchased in Philippines where Leoncio can ship them to Pemba. Borax is widely used in welding and should be available from companies supplying blacksmiths, car repair and house building business. Mrs. Joia Alberto Semente who is heading a mining association in Wacueia informed us that clay bowls in the near future might be produced locally. Production of

sluice boxes and launders should be organised urgently. The carpenter can make sluice and launder in Namuno. He already made three sets.

Creation of Federation for small-scale miners

During the project the mercury-free method was taught to a small group of miners. At our final meeting in Nanlia the miners raised the question on how they could disseminate the mercury-free gold extraction method to other groups in Cabo Delgado.

We told them that a single miner or an association cannot easily convince other miners or associations to go mercury-free. It is suggested that the associations team-up and establish an umbrella federation. A federation representing thousands of miners has easier access to the political system and can thus explain to the government which measures should be taken to reduce/stop use of mercury in Mozambique. The federation could organise teaching and training sessions for the miners

With a set-up like the above described a federation will function as

- An advertisement for responsible mining
- Venue for fellowship of small-scale miners and families
- Partner for other agencies implementing responsible small-scale mining
- The voice for small-scale miners to the government and vice versa
- Place for social dialogue of the small scale miners
- Institution for implementation of the mercury-free method in other associations

From earlier experience of making up a federation of small-scale mining association in e.g. the Philippines it is expected that the small-scale miners will realize that it is an advantage to take responsibility for their actions and at the same time get known in the public. It takes time to make up such a federation, but it has from the experience in the Philippines proved to be a very helpful instrument for the small-scale miners.

Conclusion

Timing of the project appeared very appropriate. The government has in line with the signing and ratification of the Minamata convention recently asked the miners to stop using mercury. The small-scale gold miners thus very positively received introduction of mercury-free gold extraction. The miners are really motivated for abandoning mercury. The

momentum gained by the present field campaign should be followed up as soon as possible.

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Appendix 1

Gold extraction with and without using mercury

Appendix 2

Field notes

Appendix 3

List of miners and associations that attended the demonstration and training.