UN environment

Environmental assessment of mercury pollution in two artisanal gold mining sites in eastern Democratic Republic of the Congo

BUTUZI, SOUTH KIVU
SOME, ITURI

TECHNICAL REPORT FOR PARTNERSHIP AFRICA CANADA'S JUST GOLD PROJECT

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Cover Image: A piece of 'sponge' gold produced on burning of mercury-gold amalgam

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All the photos in this report were taken in Butuzi, South Kivu and Some, Ituri, except for photos 14 and 19 which were taken in Mongbwalu, Ituri.

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Artisanal gold mining is degrading landscapes in eastern Democratic Republic of Congo

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Summary

This report is an environmental assessment of mercury pollution in two artisanal gold mining (AGM) sites in the eastern Democratic Republic of the Congo (DRC). It was conducted by the United Nations Environment Programme (UNEP) based on fieldwork in Butuzi, South Kivu and Some, Ituri. The purpose of this assessment is to provide technical advice to Partnership Africa Canada's (PAC) pioneering 'Just Gold' project, which aims to bring legal, conflict-free, and traceable gold from the two aforementioned artisanal mine sites to international markets. In this respect, technical assistance on mercury reduction resulting in increased gold production is also an integral component of the incentive-based model that PAC's project aims to develop to encourage artisanal producers to sell their gold through legal channels.

This study represents the first field assessment of mercury use, emissions and releases to the environment by the artisanal gold mining sector in the DRC. The methodology for preparing the inventory of emissions and releases at the two artisanal gold mining sites complies with guidance developed by the UNEP Global Mercury Partnership for the Minamata Convention on Mercury. In particular, the baseline estimates from this study should help inform the preparation of the DRC's Minamata Initial Assessment (MIA) and National Action Plan on Artisanal and Small Scale Gold Mining (NAP)[1]. In addition, the report addresses other environmental problems and associated health and occupational risks at the two aforementioned AGM sites, as well as some of the broader governance challenges facing the artisanal gold mining sector.

In addressing the multiple environmental challenges at the two AGM sites, a progressive strategy taking into account investment costs and the complexity of measures is proposed. It comprises of targeted technical interventions to:

i) reduce mercury use and pollution;
ii) help mitigate slope destabilization, deforestation and biodiversity loss; and
iii) improve occupational safety in the mining sites.

Snapshot of Artisanal Gold Mining in eastern DRC

- 80% of all artisanal miners in eastern DRC dig for gold
- An estimated 160,000-200,000 gold miners
- ~1,000 AGM sites in eastern DRC (IPIS: 857; BGR: 1305)
- AGM production estimated at 8-10 tonnes per annum
- Official exports around ~200 Kgs (i.e. 98% smuggled)
- Gold is the main resource financing armed and criminal groups in eastern DRC, accounting for 50% of profits

Source: *IPIS (2015): Mapping Conflict Minerals in Eastern DRC; UNEP-MONUSCO-OSESG (2015); Experts' background report on illegal exploitation and trade in natural resources*

[1] The DRC MIA-NAP will be implemented with technical assistance from UNEP and UNITAR, and financial support from the Global Environment Facility. Project activities are planned to start in end 2016.

Mercury pollution

Mercury use by artisanal gold miners is widespread in eastern DRC, and there is little knowledge among users about the toxicity and environmental hazards it can produce. Extensive use of mercury stems from its quick, easy and effective separation of gold from the ore. Significant mercury concentrations can be found in soil and rivers near mine sites, as well as inside homes and businesses where mercury is burned. The greatest health risk for miners, women, and children is from open amalgam burning in small communities and kitchens, as well as in urban centres.

Few of those encountered during the field assessment (miners, government officials, gold buyers) seemed to have previous awareness of the health dangers of mercury. Moreover, no one was aware that gold buyers in cities release mercury when smelting and purifying the gold. Mercury is likely evaporated when the sponge gold is melted into ingots.

Atmospheric mercury emissions make up 29% of total releases from both AGM sites. Most of the mercury used is lost in the mine wastes (71%), and potentially up to half of that may be carried by run-off with the suspended sediments. The resulting mercury contamination may negatively impact fluvial biota for many kilometres downstream of sites where waste discharges into streams.

Laboratory analysis confirmed the presence of mercury in every context in which it was expected, though concentrations are relatively low compared to artisanal mining communities in other countries in Asia and South America. This reflects the fact that local miners do not burn amalgam indoors, nor use mercury in excessive amounts of the gold they can recover. Artisanal mining in eastern Congo creates a vast, dispersed, low grade web of mercury contamination and methylation hot spots. This can impact the long term health of ecosystems and people across broad swathes of poor, rural areas. In addition, arsenic concentrations 10 to 20 fold above recommended standards were detected downstream of the Butuzi mining sites, which can cause serious health problems.

Table 1: Average values for mercury inventory measurements in Butuzi and Some.

Inventory measurement	Average N=11	Standard deviation
Mercury applied	4.09 g	3.98
Amalgam	0.50 g	0.42
Recovered Mercury	3.62 g	3.73
Gold sponge	0.23 g	0.19
Mercury lost	1.00 g	1.14
Mercury:Gold	4.3:1	2.74
% lost to air	29	0.10
% lost to land	71	0.10

A positive finding is that some miners produce relatively modest and confined mercury releases by concentrating the gold in their ore using simple sluices before applying mercury. This relatively good practice, however, is typically offset by the large quantities of tailings and primary material processed using whole ore amalgamation (in which mercury is applied to all of the primary ore). Preliminary mercury inventories of the sites suggest that the ratio of mercury losses to gold produced lies in the range between 2:1 and 7:1 (averaging 4.5:1), which is consistent with assessments of other African artisanal mining sites with similar work practices. This ratio of mercury

to gold use is high and inefficient by international standards but low in comparison with more mechanized practices in the Americas and Asia.

Action plan for reducing mercury emissions

Artisanal mining sites should be organized so that all mineral processing, mercury use and tailings storage occur 1km (or at least 500 m) away from all natural water sources, villages, markets, and restaurants. The site must be on high ground to prevent inundation and all drainage from the area must go through settling ponds to reduce suspended sediment emissions. The process of amalgamation of reprocessed tailings must be replaced by better primary processing of ore so that all recoverable gold that can be concentrated or amalgamated is extracted in the first pass. Further recommendations for testing include using a blue bowl gold concentrator to process tailings and recover mercury and gold, and varying the sluice water flow rate, among others.

Mercury use can be greatly reduced or eliminated completely by changing how the ore is processed. The strategy should be to prioritize increasing pre-concentration before amalgamating. Efficient pre-concentration incurs gold losses, so processing in all parts of the chain needs to be improved, from exploration and planning of deposit extraction and mine workings, choice and pre-processing of ore, efficient grinding for gold liberation, as well as concentration and monitoring of gold in ore and waste. Overall, higher gold recovery can be achieved without mercury. Technology and training are the solution, assuming not only formality but access to investment and services.

A progressive plan of action to reduce mercury use and pollution is proposed below. The plan starts with changes requiring the least investment and training, followed by progressively costlier and more complex changes that can be added when the miners are ready to take the next step[2]. Consultations with miners and local communities will need to be organized to obtain their views and buy-in on the proposed plan.

Immediate action:

1. Promote use of retorts or fume hoods to recover mercury and reduce exposure and inhalation of toxic mercury vapours. Miners must stop using leaves as a retort.
2. Promote concentration and direct smelting as an alternative to whole ore amalgamation.
3. Improve water supply and waste management using impermeable reservoirs, refilling old mine pits, and reorganization of processing activities. This will isolate mercury releases and reduce infiltration of water into landslide initiation zones.

Medium term objectives: