

**TRAINING OF TRAINERS ON ALTERNATIVES OF MERCURY
AND BEST AVAILABLE TECHNIQUES (BATs) AND BEST
ENVIRONMENTAL PRACTICES (BEPs) IN ARTISANAL AND
SMALL SCALE MINING IN TANZANIA (PHASE III)**



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In collaboration with

European Environmental Bureau (aisbl)

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- Government of Tanzania and her departments (Ministry of Health and Social Welfare [Government Chemist Laboratory Agency]; Ministry of Energy and Minerals, Ministry of Industry; Vice President’s Office, Ministry of Environment, Division of Environment; National Environment Management Council; University of Dar es Salaam, Geology Department, for logistical support and information;
- Mwanza Region Small Scale Miners Association (MWAREMA); Shinyanga Region Small scale Miners Association (SHIREMA); and Singida Region Small scale Miners Association (SIREMA) for their support and collaboration before and during field work;
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Chapter 1: Introduction

Artisanal and small-scale gold mining (ASGM) is a worldwide phenomenon, which directly and indirectly supports large number of families. Small-scale mining provides jobs in remote villages, reduces migration of able-bodied people to urban areas, and helps fight poverty. However, small-scale mining may also involve considerable risks for the environment and people's health due to its significant source of mercury releases. In the gold mining process, mercury is used to amalgamate with gold ore. After the amalgamation process, the mercury is often evaporated in an open burner, mostly without the recapture of mercury vapour.

Small-scale mining and mineral processing operations is mostly carried out by non-educated people with little knowledge of the environmental and health hazards related to small-scale mining in general and mercury hazards in particular. However, lack of information and alternative technologies had been the main reason for extensive continued use of mercury in ASGM activities in Tanzania.

AGENDA for Environment and Responsible Development (AGENDA) has recently completed implementing a project "Training of Trainers on Alternatives of Mercury and Best Available Techniques (BATs) and Best Environmental Practices (BEPs) in Artisanal and Small Scale Mining in Tanzania" which based on awareness raising on alternative technologies on recovering gold in central and lake zone due to the fact that similar project had been recently implemented in Lupa gold field in southern part of Tanzania by the ministry of Energy and Minerals.

Chapter 2: Literature Review and Stakeholder Consultations

Literature review covered relevant available literature in both print and/or electronic form. The documentary review was carried out to identify the Best Environmental Practices and Best Available Techniques in Artisanal and Small Scale Mining.

Further, it involved consultations with wide range of stakeholder in the field of ASGM in Tanzania such as government agencies and institutions, research institutions, private sector and civil society. In particular, consultation involved Ministry of Health and Social Welfare [Government Chemist Laboratory Agency]; Ministry of Energy and Minerals, Ministry of Industry; Vice President's Office, Ministry of Environment, Division of Environment; National Environment Management Council; University of Dar es Salaam, Geology Department, for logistical support and information. Furthermore, the review also identified potential stakeholders for the training such as artisanal and small scale miners, private sector and civil society organizations as well as relevant stakeholders in small scale mining activities.

Chapter 3: Methodology

This section covers the methodology used in conducting the demonstration. It explains what the training entailed and methods used, training execution plan and includes the names and affiliation of stakeholders trained.

Identification of Potential Trainees

Identification of the stakeholders that will be provide trainees for the training was conducted basing on the roles and responsibilities of the groups of stakeholders with relevance to artisanal and small scale mining activities in central and lake zone of mainland Tanzania. This was done in consultation with Ministry of Energy and minerals, regional small scale miners associations of the central and lake zones of Tanzania.

Borax User Guide, Brochure and Poster

Borax user guide, Borax User Brochure and Borax user Poster were developed, printed and distributed to each participant (see attached Borax user guide, Borax User Brochure and Borax user Poster) during the training and others were provided to regional small scale miners associations for wider circulation in their constituencies (members) and other important stakeholders.

Demonstration Training Conduction

Demonstration Training and Promotion of Best Available Techniques (BATs) and Best Environmental Practices (BEPs) applications and Training of alternative technologies for recovering gold in small scale mining were leaders and representatives of small scale miners from different areas within central and lake zone areas who will serve as trainers at their areas of work. Participants were mostly small scale miners, private sector and civil society organizations. The trainings were conducted in the mining centre of Nyarugusu, Geita District, Mwanza region in order to cover more stakeholders and employ the materials and equipments that are mainly used by miners themselves.

Chapter 4: Results and Discussion

4.1. Results of the Demonstration Training

In implementation of the project, demonstration trainings were conducted on 21st July 2010 Nyarugusu mining centre, Geita District, Mwanza Region at Chama cha Mapindunzi (CCM) grounds. The demonstration training drew participants Singida, Shinyanga and Mwanza regions. Training organizers extended invitation to about 40 participants from the three regions while large numbers of local miners were also invited as observers. Invited participants were from the regional small scale miners association representatives and public interest groups attended with local miners as observers.

4.2. Discussions of the Trainings

During the workshop, participants commended AGENDA for its initiative to advocate for alternatives. However, they cautioned that the alternatives advocated for should be selected carefully so that they will not turn out to be banned as hazardous chemicals in near future.

Participants urged the government to take serious measures to help small scale miners in order to obtain financial assistance as well as on hand technical assistance so that to improve efficiency and effectiveness on their mining activities.

Furthermore, participants urged key stakeholders to facilitate easy access to alternative chemicals and equipments of the best available technologies for small scale mining sector. They are happy and ready to participate in the World Bank project whenever it is ready in order to sustain efficient and safe small scale mining activities in Tanzania.

In order to achieve the objective of BATs and BEPs for small scale mining, it was advocated to venture further for locally available equipments such as “Mkuba” for heating which is efficient and affordable as well as it can achieve to heat the materials to high temperature with locally available resources i.e charcoal within shorter time.

Participants were worried about the cost benefit (material and financial wise) of using borax as the amount of chemical used by borax is higher compared to mercury to recover the same amount of gold as well as the need of high heat energy for efficient recovery. Hence they requested for improved search for better alternative that will be much better and safer than mercury for gold recovery in small scale mining. Hence, they are ready to abandon mercury in gold recovery for better and safer alternative and technology if they are affordable and easy to use as most of them know the effects of mercury.

Lastly, participants commented that, poverty had been driving people to use hazardous chemicals without protective gears due to the fact that they cannot afford safer alternatives and protective gears hence through AGENDA initiatives, they will educate other on availability of chemicals and technologies that are better and hence urged the government to subsidize the best available technologies so that they can be affordable and accessible to many miners.

Chapter 5: Conclusions and Recommendations

5.1. Conclusions

From the experiences of conducting the training, it can be concluded as follows:

- Most of the miners who handle the mercury do know the health impacts of mercury but do not know the importance of using of the use of protective gears;
- In most cases mercury is used without following risk minimisation procedures an equipments and hence poses exposure risks to miners and nearby communities; and
- There is the need to conduct awareness on affordable and easy to use alternatives technologies and chemicals to miners and extension officers of the ministry of energy and minerals.

5.2. Recommendations

It can be recommended as follows:

- Awareness enhancement on affordable and easy to use alternative technologies and chemicals to miners communities and the general the public is vital in order to minimise health and environmental hazards from mercury use and final phase out in small scale mining sector in Tanzania;
- Search for more affordable, safe, easy to use and accessible technologies and chemical alternatives and dissemination of the information is vital for final phase out of mercury use in ASGM in Tanzania.

Annexes

Annex 1: Training Participants

**TRAINING OF TRAINERS ON ALTERNATIVE OF MERCURY AND BEST AVAILABLE TECHNIQUES (BATs) and BEST ENVIRONMENT PRACTICES (BEPs) IN ARTISANAL AND SMALL SCALE MINING IN TANZANIA
LIST OF PARTICIPANTS – DATE 21/7/2010**

S/N.	NAME	INSTITUTION	ADDRESS	TELEPHONE	E-MAIL
1.	Robert Malando	SIREMA	Box 1625 Singida	0786 659511	marandorbert@yahoo.com
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7.	Grace G. Risso	Mpishi – mgodini	Box 71 Nyarugusu	0787 778117	
8.	Selemani Matias	Secretary	Box 71 Geita	0762 659736	
9.	Joel Matatia	Katibu Umoja Saccos	Box 307 Lwamgasa	0782 272545	
10	Thomas Mlengela	Blastor –blue-leef	Box 369 Lwamgasa	0755 173787	
11	Hemed Salehe	MWAREMA (T) Nyakagwe	Box 1867 Mwanza	0787 802972	
12	Masumbuko Lubimbi	MWARO Nyakagwe	Box 1867 Mwanza	-	
13	Malugu Onesmo	Mchimbaji	Box 71 Geita	0785 878518	
14	James Msoga Malco	Mchimbaji	Box 71 Geita	0787 938477	
15	Makoye John	Meneja	Box 71 Geita	0782 200776	
16	Iddy Kessy Tigwela	Mchimbaji	Box 600 SHY	0754 468829	
17	Huruma Njombo	-	Box 71 Geita	0769 553565	
18	Ally Sharifu	Mchimbaji	Box 71 Geita	0785 428888	

S/N.	NAME	INSTITUTION	ADDRESS	TELEPHONE	E-MAIL
19	Lorivi L. Kivuyo	Mchimbaji	Box 71 Geita	0784 758165	
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21	Jafeth J. Mayige	Mw/kiti L.S. Mine	Box 109 Geita	0786 451037	
22	John J. Medird	Mw/kiti	Box 109 Geita	0783 239936	
23	Amon Kapula	Mjumbe	Box 109 Geita	0786 993247	
24	Ignas Lwamasenga	Mjumbe	Box 307	0787 400194	
25	Thobias M. Masanja	Mjumbe	Box 307	0784 592823	
26	Golden Hainga	MWAREMA	Box Nyarugusu	0764 925653/ 0784 684499	Ghainga2009@yahoo.com
27	Theresia Samwel	MWAREMA	Box Nyarugusu	0787 326571	
28	Cypiriani James	MWAREMA	Box Nyarugusu	-	
29	Pascal M. Fumbuka	Mjumbe	Box Lwamgasa	0782 124577	

Annex 2: Photographs of the Demonstration Trainings



Mwanza Regional Small Scale Miners Chairperson Initiate the opening of the Demonstration Training Workshop



AGENDA staff presenting during demonstrate training



AGENDA staff demonstrate Borax use



Demonstration Training Participants listening attentively during presentations



Shinyanga Regional Small Scale Miners Chairperson stressing a point during the Demonstration Training Workshop



Singida Regional Small Scale Miners representative stressing a point during the Demonstration Training Workshop



Demonstration Training Participants concentrating attentively during presentations



Participants watching closely the demonstration of melting gold by using Borax



Melting of the ore by using kerosene stove which takes longer time



Melting concentrate of ore with Borax by using acetylene gas burner which takes shorter time



Participant melting ore with Borax by using acetylene gas burner while one of the AGENDA staff records the proceedings



Alternative locally made heating equipment used by local iron smiths that could be useful for Borax use called "Mkuba"

Annex 3: Borax User Guide

GOLD RECOVERY BY BORAX METHOD (Borax user Guide)

Introduction

Mercury had been used widely to recover gold by small scale miners. However, the use of mercury to recover gold ore 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.

Borax Method

Borax is one technique among many that may be useful alternatives to mercury for gold recovery including cyanide, chlorine, iodine, bromine, thiocyanate, nitric acid, e.t.c. Borax had been used Philippines for many years as an alternative method for gold extraction and recently introduced in Ghana and shows great acceptance and success. The technique is easily learned, in a matter of hours. The melting point of gold is 1064°C, which is a much higher temperature than can be obtained by inexpensive burners. By adding borax, the melting temperature of all minerals and metals including gold decreases. Borax is virtually non toxic, cheap, readily available in most towns and gives clean gold which will obtain a better price than gold produced by amalgamation which will contain some amount of mercury

Borax likewise mercury works better on mineral ore concentrates particularly free milling gold (ore contains silicate) while it is hindered by presence of sulphur as is the case with refractory gold which require oxidation of the ore prior to recovery process.

PRELIMINARY GOLD RECOVERY PROCESS

Initially the rocks rich in ore are grounded by hand hammers into small sizes which are then dry-fine-grounded by ball mills into fine powdered raw material. Wet mills improves gold extraction without use of sophisticated equipment while are cheap and produces no dust hence no risk of silicosis as well as No noise pollution hence no risk of tinnitus. The obtained fine powder from mill is then put into sluice boxes where water is carefully added using buckets or water pipes. A constant water flow is crucial to high recovery of gold from the ore. The sluice boxes are covered by carpets to capture fine gold as it runs down the sluice boxes. The finer the gold grains are, the less efficient is the sluicing process. After sluicing process, the canvases are washed in large metallic or plastic trays or containers. The obtained mineral ore concentrate will now undergo gold recovery process.

GOLD RECOVERY BY USING BORAX

Necessary Equipments

- | | |
|-----------------|----------------|
| 1. Borax | 4. Plastic bag |
| 2. Ceramic bowl | 5. Blow torch |
| 3. Charcoal | |

Description

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



A pure gold pellet produced without use of mercury



The shining gold pellet in red glowing molten borax

Annex 4: Borax User Poster (A3)

(Swahili Version)

TUMIA BORAKSI: KEMIKALI MBADALA YA ZEBAKI KUCHENJULIA DHAHABU ISİYOKUWA NA MADHARA

BORAKSI NI NINI?

Ni kemikali mojawapo katika kemikali nyingi ambazo zinatumiwa katika uchenjuaaji wa dhahabu ikiijumuisha zebaki, sayanaiidi, klorini, madini joto, bromini, thiosyaneti, asidi ya naitriki, n.k. Zebaki imekuwa ikitumiwa kwa muda mrefu lakini ina madhara makubwa kiasya na kimazingira. Kwani hukaa muda mrefu kwenye mazingira hivyo huwaza kuathiri vizazi vijavyo.



Boraksi

SIFA ZA BORAKSI

- Ni nafuu na upatikanaji wake ni rahisi;
- Hutoa dhahabu safi ambayo ina soko kubwa kuliko dhahabu inayo zalishwa kwa kutumia Zebaki;
- Ni teknolojia rahisi na huchukua muda mfupi kujifunza;
- Hupunguza jotoridi la kuyeyuka dhahabu mbalo kwa kawaida haliwezi kufikiwa kwa vifaa vya kawaida vya kuyeyushia vya majiko ya wahunzi.

ZEBAKI INA MADHARA GANI?

Husababisha madhara kama:

- Mwili kutetemeka, kupungua nguvu za macho na masikio, kiharusi na mabadiliko ya hisia yasiyotengemaa;
- mfumo wa fahamu hasa kwa wanawake walio katika umri wa kubeba mimba;
- Kuharibika kwa vinasaba (DNA na chromosome);
- mzio ambao husababisha vipetele, uchovu na maumivu ya kichwa;
- Athari katika mfumo wa uzazi;
- Kuharibika kwa mbegu za uzazi, ulemavu wa kuzaliwa, matatizo ya kujifungua.

HATUA ZA AWALI ZA UCHENJUAJI

Inashauriwa

- Kutumia Kalasha lenye maji ili kuzuia kelele na vumbi ili kumlinda mtumiaji kuelepeka ugonjwa wa kutosikia kutokana na makelele (tinitusi);
- Kumimina maji kwenye sluisi kwa mtiririko usiobadilika kama bomba la maji ili kukamata dhahabu kwa ufanisi zaidi;

JINSI YA KUTUMIA BORAKSI

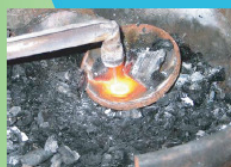
- Kausha mahomeka (mchanga wenye dhahabu nyingi) kabla ya kuichanganya na Boraksi;



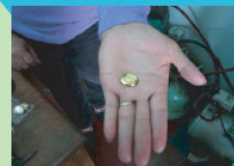
1. Changanya mahomeka (mchanga wenye dhahabu nyingi) yenye ujazo mara tatu ya boraksi na weka kwenye kifuko cha plastiki na kisha ongeza matone machache ya maji



3. Punje ya dhahabu inayong'aa ikiwa imezungukwa na Boraksi iliyoyeyuka yenye kutoa mionzi myekundu



2. Kifuko cha plastiki huwekwa kwenye bakuli la udongo na mkaa kidogo na kuanza kuchomwa na stovu (picha ya upande wa kulia)



4. Punje ya dhahabu safi inayong'aa iliyopatikana bila kutumia zebaki

European
Environmental
Bureau (eisb)



AGENDA
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Annex 5: Borax User Brochure

(Swahili Version)

HATUA ZA UCHENJUAJI KWA KUTUMIA BORAKSI.



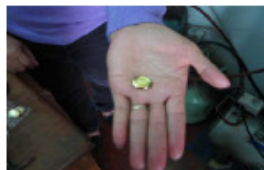
1 Changanya Boraksi na Mahomeka (mchanga wenye dhahabu nyingi) yenye ujazo mara tatu ya Boraksi kwenye kifuko cha plastiki na matone machache ya maji



2 Weka Kifuko cha plastiki kwenye bakuli la udongo na mkaa kidogo na arza kuchomakowa kutumia stovu



3.Punje ya dhahabu inayong'aa ikiwa imezungulwa na Boraksi iliyoyeyuka yenye kutoa mionzi nyekundu



4 Punje ya dhahabu safi inayong'aa iliyoparikana bila kutumia zebaki

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TUMIA BORAKSI KEMIKALI MBADALA YA ZEBAKI KUCHENJUA DHAHABU.



UTANGULIZI

Zebaki hutumika kwa wingi katika uchenjuaji wa dhahabu hasa kwa wachimbaji wadogo wadogo. Matumizi hayo ya zebaki husababisha madhara makubwa kiafya na kimazingira kwa wachimbaji na jamii inayowazunguka, hivyo huweza kuathiri vizazi vijavyo kwani zebaki hukaa kwenye mazingira kwa muda mrefu. Zebaki huingia mwilini kwa njia ya hewa na kwenye ngozi.

MADHARA YA ZEBAKI

Husababisha madhara kama:

- Mwili kutetemeka, kupungua nguvu za macho na masikio, kiharusi na mabadiliko ya hisia yasiyotengemaa;
- mfumo wa fahamu hasa kwa wanawake walio katika umri wa kubeba mimba;
- Kuharibika kwa vinasaba (DNA na chromosome);
- mzio ambao husababisha vipete, uchovu na maumivu ya kichwa;
- Athari katika mfumo wa uzazi;

Kuharibika kwa mbegu za uzazi, ulemavu wa kuzaliwa, matatizo ya kujifungua.

BORAKSI: KEMIKALI MBADALA YA KUCHENJULIA DHAHABU ISİYOKUWA NA MADHARA

Boraksi ni kemikali mojawapo katika kemikali nyingi ambazo zinatumika katika uchenjuaji wa dhahabu ikijumuisha zebaki, sayanidi, klorini, madini joto, bromini, thiosyaneti, asidi ya naitriki n. k. Boraksi ina sifa zifuatazo

- Ni nafuu na upatikanaji wake ni rahisi;
- Hutoa dhahabu safi ambayo ina soko kubwa kuliko dhahabu inayozalishwa kwa kutumia Zebaki;
- Ni teknolojia rahisi na huchukua muda mfupi kujifunza;
- Hupunguza jotoridi la kuyeyuka dhahabu ambalo kwa kawaida haliwezi kufikiwa kwa vifaa vya kawaida vya kuyeyushia vya majiko ya wahunzi.

Kama ilivyo Zebaki, Boraksi:

- Hufanya vyema kwenye mbale yenye madini ya siliketi (free milling gold - ore contains silicate); na
- Haifanyi vizuri kwenye mbale yenye salfa (refractory gold) ambayo huhitaji kuchomwa (oxidation) ili kuweza kuondoa salfa kabla ya uchenjuaji.

HATUA ZA AWALI

Mbale yanye dhahabu hupondwa kwa kutumia nyundo nzito na kisha kuwekwa kwenye kalasha. Ni vyema kutumia Kalasha lenye maji ili kuzuia kelele na vumbi ili kumlinda mtumiaji kuelekea ugonjwa wa kutosikia kutokana na makelele (tinnitus);

- Weka vumbi lililopatikana kwenye makasha ya sluisi yaliyofunikwa kwa kitambaa ambapo maji hupitishwa na kuondoa udongo na kuacha chembe za dhahabu zilizozalishwa kwenye kitambaa kilicholazwa kwenye ubao wa sluisi;
- Ni vyema kumimina maji kwenye sluisi kwa mtririko usiobadilika kama bomba la maji ili kukamata dhahabu kwa ufanisi zaidi;

- Osha kitambaa chenye chembe chembe za dhahabu kwenye makalasha makubwa ya plastiki au chuma chenye maji; na
- Kusanya Mahomeka (mchanga wenye dhahabu nyingi ulisafishwa) na kuikausha ili kutumia njia ya boraksi kupata dhahabu bora.

JINSI YA KUTUMIA BORAKSI:

VIFAA MUHIMU

1. Boraksi
2. Bakuli au chungu cha udongo
3. Mkaa
4. Mfuko wa plastiki
5. Stovu ya mafuta ya taa



Stovu ya Mafuta ya taa

- Kausha mahomeka (mchanga wenye dhahabu nyingi);
- Changanya mahomeka yenye ujazo mara tatu ya boraksi na weka kwenye kifuko cha plastiki na kisha ongeza matone machache ya maji;
- Weka kifuko hicho kwenye chungu au bakuli la udongo pamoja na vipande vichache vya mkaa na kuchoma kwa kutumia stovu ya mafuta ya taa;
- Endelea kuchoma boraksi huku dhahabu ikien-delea kuyeyuka kwenye mchanganyiko wa madini mengine na kujitenga;
- Uchomaji husitishwa na kipande cha dhahabu kinachong'aa huweza kutolewa baada ya dakika chache kwa kutumia neha ya kisu;