# Occupational Health & Safety Situational Analysis & Training Needs Assessment for Unconventional (Artisanal) Miners in Bangka Belitung, Indonesia






**By Ruby Stocklin-Weinberg, Dr. Marcello M. Veiga, Cristina Villegas, Rini Sulaiman and Kristina Michaux**

April 23, 2017, **Final report**

Pact is a promise of a better tomorrow for all those who are poor and marginalized. Working in partnership to develop local solutions that enable people to own their own future, Pact helps people and communities build their own capacity to generate income, improve access to quality health services, and gain lasting benefit from the sustainable use of the natural resources around them. At work in more than 30 countries, Pact is building local promise with an integrated, adaptive approach that is shaping the future of international development. Visit us at www.pactworld.org.

**Recommended citation:**

Stocklin-Weinberg, R., Veiga, M.M., Villegas, C.M., Sulaiman, R., Michaux, K. Jan 2017. *Occupational Health & Safety Situational Analysis & Training Needs Assessment for Unconventional (Artisanal) Miners in Bangka Belitung, Indonesia*. Washington, D.C., U.S.: Pact.

**Contact:**

Cristina M. Villegas, Project Chief of Party
International Technical Program Manager
Mines to Markets (M2M) Program, Pact
cvillegas@pactworld.org
www.pactworld.org/mining

# Table of Contents

**Abbreviations and Acronyms** ..... i

**Acknowledgements** ..... iii

**Executive Summary** ..... iv

**Introduction** ..... 1

Purpose ..... 1

Project objectives, methodology, schedule, and limitations ..... 1

**Part A: Occupational Health & Safety Situational Analysis** ..... 2

1.1 Context ..... 2

1.2 Description of artisanal (unconventional) mining ..... 3

1.3 The mine sites ..... 5

**2. Occupational Health & Safety in mining regulation** ..... 10

2.1 Context of regulation ..... 10

2.2 Quantifying most grave injuries & fatalities ..... 13

2.3 Key hazards: Gravity, frequency & impacts ..... 14

2.4 Access & barriers to health care ..... 15

**3. Bioavailability of heavy metals in Bangka Belitung** ..... 16

3.1 Brief Geology of Bangka-Belitung Tin Deposit ..... 16

3.2 Effects versus impacts: Definitions ..... 17

3.3 Heavy metals & radioactive elements in Bangka Belitung ..... 18

**Part B: Training Needs Assessment** ..... 20

**Introduction** ..... 20

1.1 Notable recent changes of practices ..... 20

**2. Key similarities & differences between mine sites** ..... 20

**3. Short and long-term health & safety impacts** ..... 21

3.1 Mining-related diseases ..... 21

3.2 Mining-related hazards and other safety issues ..... 21

3.3 The efficiency of unconventional mining activities ..... 22

**4. Training needs** ..... 22

4.1 Prospecting ..... 23

4.2 Mining ..... 23

4.3 Processing for increased wealth ..... 24

**5. Champions: Influence, skills, capacity, commitment** ..... 25

**Part C: Recommendations** ..... 27

**1 Preliminary implementation plan** ..... 27

1.1 Provide training on mine safety & efficiency ..... 29

**2. Preliminary gap assessment & indicators for best practice ASM** ..... 34

**3 Recommended timeline** ..... **44**
3.1 Anticipated challenges ..... 44
**4 Summary of potential training program add-on** ..... **46**
4.1 Mine site reclamation ..... 46
**5 Recommendations for a future formal study** ..... **47**
**References** ..... **49**
**Appendix 1: Responsible Supplier OHS Guide in Mid-Stream Supply Chain** ..... **53**
**Appendix 2: Regulation of OHS in the mining sector** ..... **74**
**Appendix 3: Optional add-on modules for the Training Program** ..... **77**

# Abbreviations and Acronyms

| | |
|---|---|
| AETI | Association of Indonesian Tin Exporters |
| AIDS | acquired immune deficiency syndrome |
| ASM | artisanal and small-scale miners / mining |
| BaBel | Bangka and Belitung |
| Bappeda | Planning & Development Agency |
| BATAN | National Nuclear Energy Agency |
| BLKI | Balai Latihan Kerja Industri (Industrial Training Center of the Province of Bangka & Belitung) |
| Cm | centimeter(s) |
| COP | Chief of Party |
| dBA | decibel level |
| Distamben | *(Dinas Pertambangan dan Energi)* Provincial mining and energy agency |
| EGPAF | Elizabeth Glaser Pediatric AIDS Foundation |
| ESDM | *(Kementerian Energi dan Sumber Daya Mineral)* Ministry of energy, mining and mineral resources |
| HIV | human immunodeficiency virus |
| HP | Horsepower |
| ICP-OES | Inductively coupled plasma atomic emission spectroscopy |
| IDH | IDH, The Sustainable Trade Initiative |
| ILO | International Labour Organization |
| IPR | *(Ijin Pertambangan Rakyat)* People's mining permit |
| ITRI | International Tin Research Institute |
| IUP | (*Ijin Usaha Pertambang)* Mining business license |
| Kg | kilogram(s) |
| km | kilometer(s) |
| L | Liter(s) |
| M | meter(s) |
| M&E | monitoring and evaluation |
| M2M | Pact's Mines to Markets program |
| mg | milligram(s) |
| MOH | Ministry of Health |
| NGO | nongovernmental organization |
| NRM | natural resource management |
| OHS | Occupational Health & Safety |
| OSHA | United States Occupational Health & Safety Administration |
| PPE | personal protective equipment |
| PT | *(Perseroan Terbatas)* Limited Liability Company |
| PVC | Polyvinyl chloride |
| REE | Rare earth elements |
| Rp | Indonesian Rupiah |
| Sn | tin |
| $SnO_2$ | cassiterite |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TI | unconventional tin mining/ miners |
| TNA | Training Needs Assessment |
| TWG | Tin Working Group |
| U.N. | United Nations |
| U.S. | United States |
| USD | United States dollar |
| USAID | U.S. Agency for International Development |

| | |
|---|---|
| USGS | United States Geological Survey |
| µg | microgram(s) |
| WASH | Water, sanitation and hygiene |
| WPR | *Wilayah Pertambangan Rakyat)* People's Mining Area |
| W/W | Weight per weight |

# Acknowledgements

The team would like to thank the Government of Indonesia, officials of the province of Bangka Belitung, village leaders, clinic staffs, and other officials who generously shared their time to help us gain a better understanding of the health and safety issues in Indonesia's unconventional cassiterite sector.

Special thanks to the staff and advisors of Telapak, Pure Earth Indonesia, the Sustainable Trade Initiative (IDH), and the members of the Tin Working Group for their extra efforts and leadership on these critical issues. Mr. Nickolaus Hariohati of Pure Earth deserves special thanks and credit for his field assistance, Mr. Ary Irawan of Telapak for his excellent local engagement, field planning and local insights, and Fabricio Maia, Caetano Constanzo, and Bruce Marshall for their support from Canada. A special thanks to Dr. Adrian Edgar for sharing his knowledge on common presentations of lung cancer. Graphic art presented in this report is courtesy of Maggie Dougherty of Pact.

# Executive Summary

Indonesia is the second largest producer of cassiterite (the mineral that contains tin metal ore) in the world. Almost 90% of tin (Sn) production in Indonesia occurs on the two islands of Bangka and Belitung, locally called “BaBel”.

In October 2016, the Tin Working Group (TWG) of the Sustainable Trade Initiative (IDH) commissioned Pact to complete a two-part assessment, an Occupational Health & Safety Situational Analysis and Training Needs Assessment, which is summarized in the figure below.

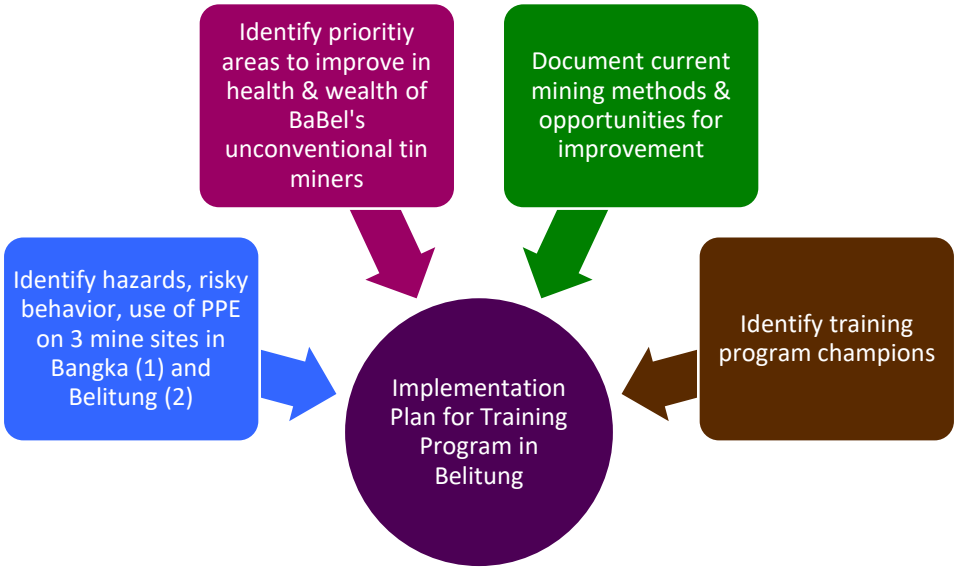
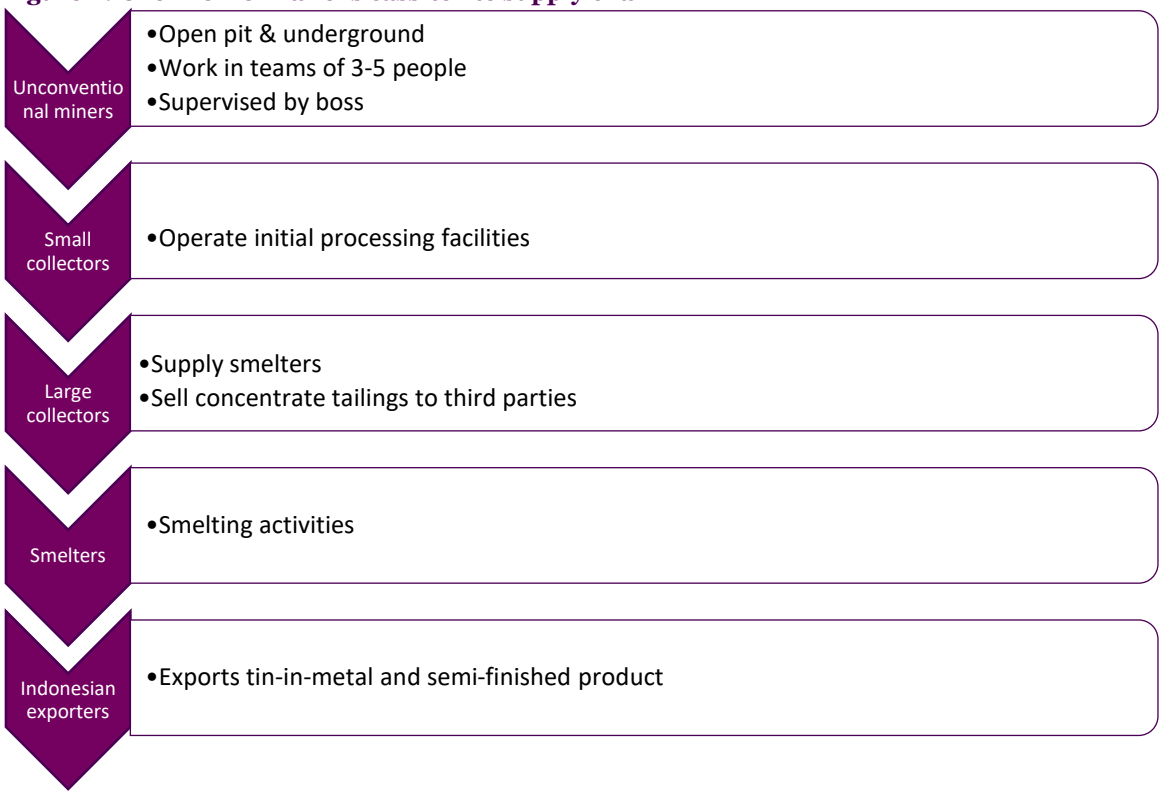



**Figure 1: OHS Situational Analysis & Training Needs Assessment overview**

The assessment took place in November and December 2016 utilizing experienced Indonesian and international expertise.

The figure below describes BaBel’s cassiterite supply chain at a high level.

**Figure 2: Overview of BaBel's cassiterite supply chain[1]**




Following this assessment, the project team recommends a 3-4-year training program in close collaboration with the Government of Indonesia with deep focus on the Bangka and Belitung province. A training program can be developed that could include mine bosses, lead mine workers/supervisors, province-level mining authorities and regulators (e.g. the Provincial Distamben's office), and others, with the following aims:

[1] Adapted from Stocklin-Weinberg, et al, 2013.

| Goal | Delivery mechanism & venue | Topics | Partners | Recipients | Modality | Location |
|---|---|---|---|---|---|---|
| *Improve the health and wealth of Indonesia's unconventional cassiterite miners* through engagement, education, and capacity building on the following priority areas:<br>• Efficient prospecting, mining & processing<br>• Mine site hazards awareness<br>• Prevention of landslides<br>• Water, Sanitation, Hygiene (WASH)<br>• Safe equipment use<br>• Safe processing (collectors only)<br>• Improved understanding of what the law requires of mining actors in terms of mine site OHS (mine bosses, IUP and IPR holders only)<br>• Pollution | Town Hall<br><br>Local coffee shops<br><br>Learning-by-doing demonstration onsite<br><br>Ongoing capacity support visits by vetted local engineer(s), in close partnership with the Provincial Distamben's office and Indonesian education institutions | Personal Protective Equipment (PPE) | Provincial Distamben<br><br>Provincial Secretary<br><br>Bupati<br><br>Independent smelters | Bosses, Lead miners/supervisors<br><br>Collectors<br><br>Independent smelters<br><br>Any other influential champions | Training of Trainers combining theoretical and onsite demonstrations | Sukamandi & Mengkubang sites, WPR, East Belitung |
| | | Mine site safety | | | | |
| | | Slope stability | | | | |
| | | Safe equipment use | | | | |
| | | Simple measures to improve hygiene & sanitation | | | | |
| | | Attaining and maintaining legal status | | | | |
| | | Introduction of wet shaking tables (processing)<br><br>OHS requirements vs. accountability: Filling the present gaps | | | | |

**Table 1. Training Program implementation plan overview**

A Training Program need not be a stationary building; in fact, as will be detailed in Section C, the training sessions could be housed at a town hall or coffee shop and at mine sites.

In addition to the mining training program as suggested above, it is strongly recommended that an engagement program be developed with the Government of Indonesia, particularly at the provincial level where mining decisions have been devolved, to emphasize making unconventional mining legal status easier versus harder, and attractive in practice. Currently onshore unconventional cassiterite miners in Indonesia cannot operate fully-legally anywhere in Bangka, and only in one People's Mining Area (WPR) in Belitung. It is challenging to focus on OHS or invest in professionalizing operations if miners are on the run and evading detection. Insufficient legal status, including security of tenure, is one of many issues that will continue to hobble the sector and prevent full potential benefits if it is unaddressed in a bigger program.

| No. | Task | 2017 | | | | 2018 | | | | 2019 & beyond | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q3 | | | | |
| 1 | Contracting of OHS (and possibly formalization) implementing partner | | | | | | | | | | | | |
| 2 | Develop MoU with partners (independent smelters, Provincial Government, Distamben, other academic or nonprofit collaborators) (6 months) | | | | | | | | | | | | |
| 3 | Recruit trainers (Concurrently with the above) | | | | | | | | | | | | |
| 4 | Further development of curriculum topics (1 month, alongside trainers, Distamben, other stakeholders). | | | | | | | | | | | | |
| 5 | Elaborate a **business plan** with partners, including capital and operating costs, number of students, equipment procurement process, teachers, transportation of students to the field, accommodation of students, etc. The elaboration of a business plan includes considering **capital and operating costs** for required equipment for efficient mining technical curriculum. | | | | | | | | | | | | |
| 6 | Conduct training (6 week sessions over 6 months to a year, depending on how long trainers can be absent from work) | | | | | | | | | | | | |
| 7 | Monitoring and coaching visits with Distamben | | | | | | | | | | | | |
| 8 | Evaluation to document impacts, adjust curriculum if needed, identify further supports/add-ons if needed (such as environmental rehabilitation training) | | | | | | | | | | | | |

**Table 2. Recommended (high level) timeline for OHS training rollout**

---

# Introduction

Indonesia is the second largest producer of cassiterite (the mineral that contains tin metal ore) in the world. According to the 2016 United States Geological Survey (USGS)[2], of 4.8 million metric tonnes of tin available worldwide, China has 31% of the known world tin reserves followed by Indonesia at 17 per cent. The industry association, International Tin Research Institute (ITRI),[3] estimates that 47.4% of tin in the market in 2009 was for electronic solder, followed by tinplate (coating) with 16.8%, tin chemical reagents with 13.3%, industrial solder with 6.3%, brass and bronze with 5.3%, manufacture of floating glasses with 2.7%, and other uses with 8.2%.

Almost 90% of tin (Sn) production in Indonesia occurs on the two islands of Bangka and Belitung, locally called "BaBel". According to the Association of Indonesian Tin Exporters (AETI), the estimated 2016 production of tin in the country is around 60,000 tons. This is consistent with the preliminary data released by Ministry of Trade,[4] which estimates that tin exports in 2016 totaled 63,559 tons.[5] PT Timah, the largest company, produced around 24,000 tons of Sn ingots.[6] Of these, approximately 60% was produced from its offshore operations and 40% onshore. AETI estimates that the remaining 35,000 tons, or 60%, of Sn comes from the country's artisanal and small-scale mining (ASM) producers.[7] This population is referred to locally as 'unconventional miners' or *Tambang Inkonvensional*. Unconventional miners are generally described as "formal or informal mining operations with predominantly simplified forms of exploration, extraction, processing, and transportation…ASM can include men and women working on an individual basis as well as those working in family groups". Unconventional tin miners in Indonesia legally should operate only in designated areas (WPR – People's Mining Area). However unconventional miners also operate in the concessions of permit holding companies, under their supervision and illegally in other areas.[8]

## Purpose

In October 2016 the Tin Working Group (TWG) of the Sustainable Trade Initiative (IDH) commissioned Pact to complete a two-part assessment focused on the following: 1) A Situational Analysis of the existing occupational health & safety (OHS) practices in the *legal, onshore* unconventional cassiterite mining sector in Belitung Island, Indonesia; and 2) A Training Needs Assessment (TNA) to identify priority areas to improve miners' health and wealth by way of a planned training program in the BaBel province. The assessment took place in November and December 2016 utilizing experienced Indonesian and international expertise.

## Project objectives, methodology, schedule, and limitations

The OHS Situational Analysis observed key hazards of unconventional tin miners, existing practices bringing injury, risk awareness of miners and mine bosses, current use of personal protective equipment (PPE). The aim of the Training Needs Assessment was to document current mining methods, opportunities for improvement in the unconventional tin mining sector in BaBel, and make recommendations for a future training program. The team met with the head of the Provincial Planning Agency (*Bappeda*) and the Provincial Mines Inspector (*Distamben*) Sub-district heads in Bangka and East Belitung Regencies, the head of the Social Village Development Department for East Belitung and the

[2] USGS, 2016. Tin. Available at https://minerals.usgs.gov/minerals/pubs/commodity/tin/mcs-2016-tin.pdf
[3] International Tin Research Institute (ITRI) https://www.itri.co.uk/sustainability/material-flow-and-recycling/tin-use
[4] ITRI, 2017. "Indonesian tin exports rise in December." Available at https://www.itri.co.uk/market-analysis/news-2/indonesian-tin-exports-rise-in-december.
[5] According to a reliable source, independent smelters generally source 95% of their cassiterite from unconventional miners. Pers. comm, Feb. 2017.
[6] MetalBulletin, 2016. "PT Timah will lift 2017 tin output by a third on higher prices." Available at https://www.metalbulletin.com/Article/3599281/PT-Timah-will-lift-2017-tin-output-by-a-third-on-higher-prices.html.
[7] Indeed, that figure may be more like 95%, depending on the tin price and the independent smelters' appetite for mining.
[8] This information is based on ESDM Regulation No. 24/2012.

Department of Health in both Bangka and Belitung. These discussions helped the team better understand the scope of the OHS situation in Bangka Belitung's unconventional mine sites.

# Part A: Occupational Health & Safety Situational Analysis

## 1.1 Context

### 1.1.1 Bangka

Bangka Island has hosted industrial-scale mining since the Dutch colonial era. Unconventional mining has been taking place on the island since the late 1990s. Prior to this time, Suharto's government strictly forbid unconventional mining. On Bangka Island, unconventional miners operate in a legal grey area because the government has yet to allocate any Peoples' Mining Areas.[9] Unconventional miners are permitted to operate in some areas of the island, such as Desa Mapur in Bangka Regency. This means that the site is semi-legal: The site is not located in a People's Mining Area, which, according to the law, are the only zones where unconventional mining should take place. On the other hand, the mine bosses have written permission from PT Timah to mine on this portion of the company's concession.

### 1.1.2 East Belitung

Belitung Island is a domestic tourist destination. Promoting domestic and international tourism is a priority of the local government, which is vying for more funding from the central government to promote the sector. Many of the communities of the Belitung Regency[10] see the short and long term economic appeal of tourism and have joined the local government in banning offshore mining, as well as much of the unconventional onshore mining.[11] In general, people from other districts in Belitung are opposed to all forms of unconventional miners.[12] That stated, all the community leaders in East Belitung consulted acknowledge that unconventional mining continues to provide a viable livelihood for those who continue to mine.

[9] WPR – is designated people's mining area identified by the local government based on potential mineral deposit but approved by the National Planning Agency, Ministry of Home Affairs as well as ESDM. It is developed as a part of National Spatial Plan, along with industrial scale mining area. Because of the tedious and the long processing time, most small-scale mining sites in Indonesia occur outside WPR.

[10] A Regency *(Kabupaten)* is a local level government with its own legislative body under the provincial level. BaBel has six Regencies and one Municipality. Following the decentralization in 1998, regencies have enjoyed greater autonomy.

[11] Weinberg, Haris & Mitchell, 2013. *Situational Analysis and Sustainability Assessment of Tin Production in Bangka-Belitung, Indonesia.* Commissioned by the Tin Working Group and written by Estelle Levin, Ltd.

[12] Erwana, F., et al, 2015. Study of socio-economic and environmental impacts of unconventional tin mining (A case study: Bangka Barat District of Bangka Belitung Province. Conference paper for the Third Joint Seminar of Japan and Indonesia Environmental Sustainability and Disaster Prevention (3rd ESDP-2015), at the Institut Teknologi Bandung, Indonesia- November 25, 2015.

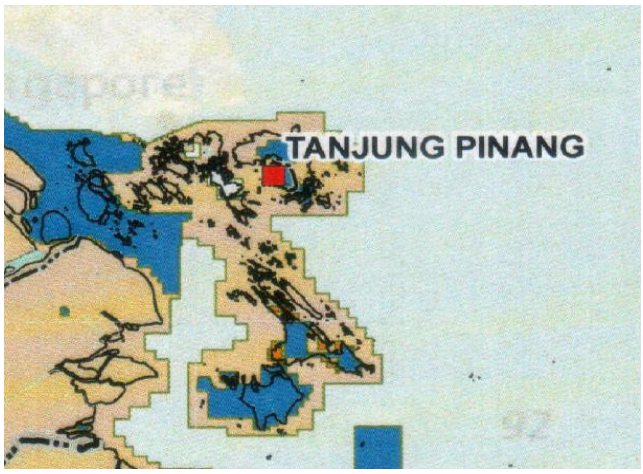



***Figure 1. Determination of mining areas for Sumatra Island.*** *The blue areas indicate the mining zones for metallic minerals, including cassiterite.*[13]

Part of the East Belitung Regency has been zoned as a mining area, with PT Timah allotted 60% of the area and the rest zoned for *Ijin Usaha Pertambangan* -- "Mining business licenses" (IUPs) and "People's Mining Areas" (WPRs).[14] However, since the recent handover of administration of the mining sector from the district to provincial level, the precise area for the WPR has not been finalized.[15]

There are four *Ijin Pertambangan Rakyat* – People's Mining Permit (IPR) holders, but only one company is actively subcontracting activities to unconventional miners.

## 1.2 Description of artisanal (unconventional) mining

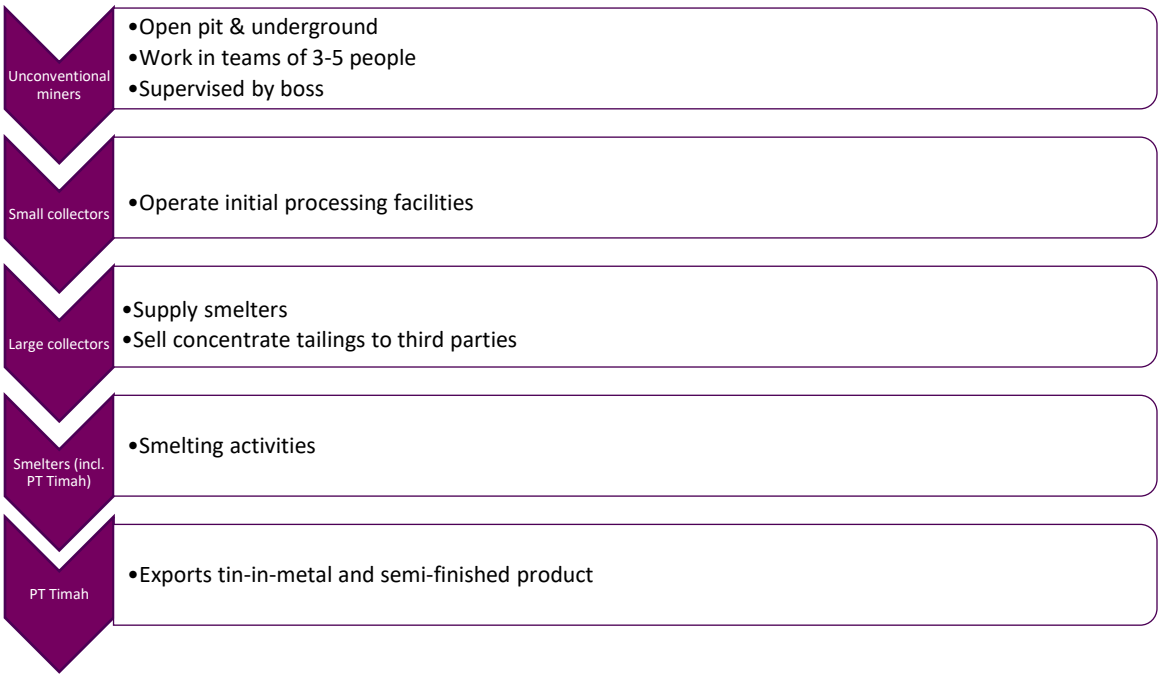
Legislation in many developing countries related to artisanal mining is fraught with confusing definitions. Artisanal mining refers to a rudimentary type of mining and processing used to extract minerals from secondary or primary ores, whereas small mining refers only to the size of the operation.[16] The opposite of the term *artisanal mining* is not necessarily *large-scale mining*, but *conventional* mining, i.e. mining that follows the traditional geological and mining engineering procedures. The main differences between conventional and artisanal activities lie in the technologies applied at site and in the processing of ore. The way of working makes a difference. For example, typically, the artisanal miner works based on instinct, and the need to feed his family and pay bills. There is no previous "classical" engineering and geological exploration, no drilling, proven reserves, ore tonnage establishment, mine and plant designs or engineering studies undertaken. The concept of survival is constantly the driving force for unconventional miners.

### 1.2.1 Legal and semi-legal unconventional mining

The figure below describes BaBel's cassiterite supply chain at a high level.

[13] Ministry for Energy and Mineral Resources decree no. 1095 K30/MEM/2014, determination of mining areas for Sumatra Island.
[14] According to the Planning Agency of East Belitung, pers comm, Dec. 2016.
[15] See section 2.1 for more details. East Belitung's Planning Agency has proposed 5730.95 ha, comprised of 67 blocks of 27 ha each.
[16] Veiga, M.M., 1997. Introducing New Technologies for Abatement of Global Mercury Pollution in Latin America. Published by UNIDO/UBC/CETEM.

**Figure 2: Overview of BaBel's cassiterite supply chain[17]**




In Indonesia, the term *artisanal mining* is widely referred in the field as *unconventional* mining. The unconventional tin mining active in Indonesia, particularly the islands of Bangka and Belitung, extract cassiterite from alluvial deposits. The authors visited legal and semi-legal miners in Belitung and Bangka Islands. The former group is considered legal because they are working within a government-designated Peoples' Mining Area in Sukamandi and Mengkubang, whereas the latter group is considered semi-legal because, while the miners do not have a permit, they have received written permission from PT Timah to mine within a specific area of Desa Mapur.

It is virtually impossible for independent smelters and to establish chain of custody of tin ore once it reaches collectors because the ore from legal and illegal sources is generally mixed at this level, despite the fact that miners working on a WPR and PT Timah's concession are obliged to sell their production to either the IPR or IUP holder.

### 1.2.2 Illegal unconventional mining

There are few differences in the practices of legal versus illegal unconventional miners. Indeed, some mining laborers move quite freely between legal and illegal mine sites. The primary difference between legal and illegal mining is location, not method.

### 1.2.3 Demographics of miners

The table below presents the National Statistic Agency's most recent human development indicators for Indonesia. The HDI's for two mining regencies and BaBel as a whole are slightly higher than the national average. All the unconventional miners consulted are literate with at least an elementary school level of education (typically at least sixth grade schooling). Bahasa Indonesia is the preferred language for training.

[17] Adapted from Stocklin-Weinberg, et al, 2013.

| | Kabupaten Beltim | Kabupaten Bangka | Babel Province | Indonesia |
|---|---|---|---|---|
| Life expectancy (years) | 71,23 | 70,48 | 69,88 | 70,78 |
| School Expectancy (year)<br><br>Average years of Education (year) | 11,28<br><br>7,91 | 12,36<br><br>7,94 | 11,60<br><br>7,46 | 12,55<br><br>7,84 |
| Spending capacity (per capita, year) Rupiah | 10,523,000 | 10,904,000 | 11,781,000 | 10,150,000 |
| Total HDI | 68,83 | 70,03 | 69,05 | 69,55 |

**Table 3: Human Development Indicators for BaBel [18]**

## 1.3 The mine sites

### 1.3.1 Desa Mapur site, PT Timah subcontractor, Bangka

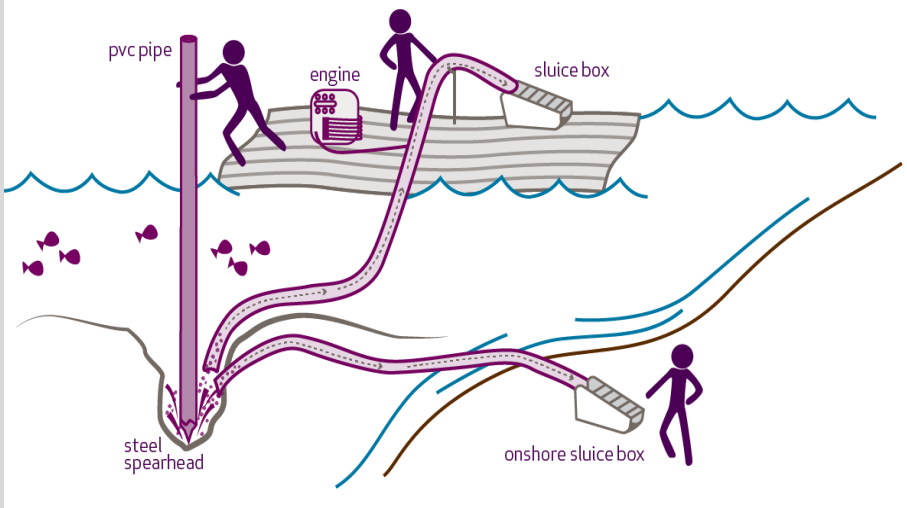
| Mine type | Concession status | Number of miners | Location |
|---|---|---|---|
| Onshore pontoons | PT Timah's IUP- semi-legal | ~100 | Bangka Regency |

**Table 4. Desa Mapur at a glance**

Desa Mapur is an unconventional mining area located inside a PT Timah license and with PT Timah's written permission. The Desa Mapur site is managed by one boss, who oversees operations alongside three other bosses, each of whom run a pontoon with three workers each.

During the rainy season, people cannot mine as often due to slipping and lightning hazards.

***Figure 2. Mining process at Desa Mapur, Bangka Island.*** *The diagram depicts the mining process in Desa Mapur.*




[18] Badan Pusat Statistik, 2015. *Indeks pembangunan manusia, 2015.*

*Unique site hazards*

Risks of hearing loss, drowning, heat stroke, dehydration and poor water, sanitation and hygiene (WASH) practices were the biggest OHS risks exist at Desa Mapur. No miner on the site wears PPE, including goggles, boots, earplugs, respirators, gloves or coveralls. There were no reports of problems with drug or alcohol abuse, neither off site nor of unconventional miners coming to work intoxicated, although smoking cigarettes while working a sluice and on breaks was very common.

**Noise:** The pontoons face the biggest OHS risk due to the loud dredge engine that powers the pump to facilitate the slurry. There are decibel levels between 100-105 decibels from 10 feet away. For reference, the US Occupational Safety and Health Administration's (OSHA's) noise standard states that 100 decibels (dBA) is permissible for no more than one hour. The exposure for pontoon workers at 100 dBA or more typically lasts at least six hours. Further, for noise levels at 85 dBA or above over an 8-hour shift,[19] OSHA requires a hearing conservation program to be implemented. Indeed, Indonesia's Labor and Migration Agency's guideline for 100 dBA is 15 minutes per day.[20] There is no testing of any kind as a precaution against hearing loss.

**WASH practices**: The lake created by the water table flooding the open pit is used by miners to bathe, urinate and defecate. The garbage accumulation and lack of sanitation at the Desa Mapur have obvious environmental and health impacts, such as water borne diseases and parasites.

**Engine vapors and operation injuries:** One of the main obvious problems was the large amount of fuel combustion smoke coming from the dredge engine. The miners were also handling various types of fuel (gasoline and diesel) and lubricants without any gloves or protective gear. Many miners stayed immersed in the lake forcing the tube-spear into the alluvial material at the bottom of the lake. Most of the accidents happen by dilacerations on the hands when miners deal with cables or motors with bare hands.

**Sun exposure:** There are no trees and very little shade at Desa Mapur. In these conditions, daytime temperatures of 24◦ Celsius increase risks of sun exposure problems such as heat stroke, dehydration and sun burns. About half the women miners at Desa Mapur wear full-coverage hats, in addition to frequently worn headscarves; whereas, but male miners do not tend to wear sun protection of any kind.

**Drowning:** The pontoon workers face some risk of drowning given their long days of work on the watercraft.

*Potential mitigation measures are discussed in Section 3 of the Training Needs Assessment.*

[19] USDOL OSHA, n.d. "Regulations (Standards - 29 CFR). Available at https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9735. OSHA uses a time-weighted average (TWA) for the requirement.

[20] Ministry of Labour and Transmigration, 2011. *Peraturan Menteri Tenaga Kerja dan Transmigrasi Nomor per.13/MEN/X/2011 tentang Nilai Ambang Batas Faktor Fisikia dan Faktor Kimia di Tempat Kerja.*

## Images from the Bangka Island Desa Mapur site:

*Above: Pontoon (raft used for mining) crew use the PVC tube with a steel spearhead to pierce the bottom of the pit. The ore is then suctioned up and concentrated using the sluice onboard and onshore.*

*This sluice processes the cassiterite ore from the pontoon raft.*

*Individuals collecting and panning tailings.*

*Women tend to cluster at larger unconventional mines and pan the tailings of the pontoon rafts.*

*Above: These are the only types of gloves available for unconventional miners in immediate area-shops. They are thin, cotton material and would tear easily (as confirmed by miners interviewed).*

*Above: Visible pontoon engine fuel combustion smoke shown.*

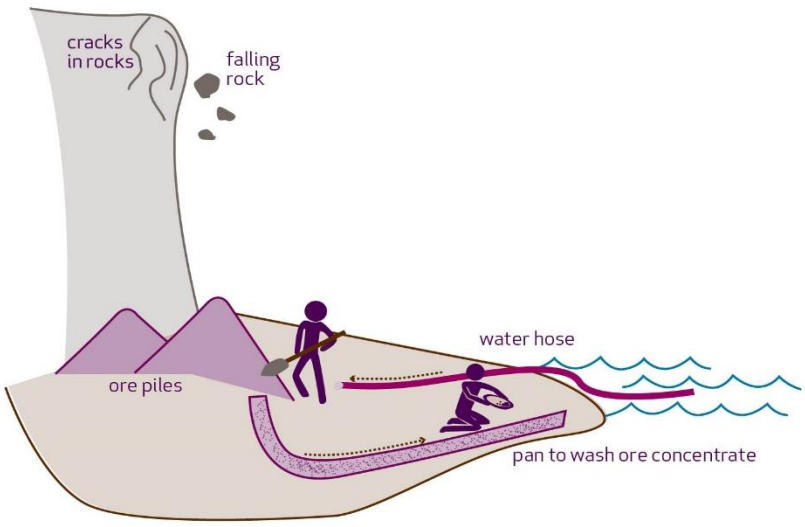
### 1.3.2 Sukamandi site, WPR in East Belitung, Belitung Island

| Mine type | Concession status | Number of miners | Location |
|---|---|---|---|
| Onshore pontoons and panning | Legal, in a People's Mining Area | ~100 | East Belitung Regency |

**Table 5. Sukamandi at a glance**

Unconventional mining has been taking place in two neighboring sites in East Belitung called Sukamandi and Mengkubang since 1993. PT Timah permitted the mining starting in 1997, when the company decided to pull out of the area due to its low production potential.

***Figure 3: Mining process at Sukamandi, Belitung Island***
*The diagram depicts the mining process in Sukamandi in East Belitung.*



**Images from the Belitung Island Sukamandi site:**

*Above: Earthen sluice is used to process ore.*

*Steep cliff walls with active mining pits directly beneath make rockfall hazards and landslides almost inevitable.*

*Unique site hazards*

Like Desa Mapur, risks at the Sukamandi site include hearing loss, drowning, heat stroke and dehydration. In addition, the area is at risk for landslides and potentially for lightning strikes, which happen often. Finally, like Desa Mapur, no PPE, such as hardhats (for miners working near cliff edges), including goggles, boots, earplugs, respirators, gloves or coveralls are worn.

**Noise exposure:** Decibel levels reach 100 dBA at the location where workers are active. There is also no testing of any kind as a precaution against hearing loss.

**Landslides and cave-ins:** To reach the sites, workers must descend a steep trail where men work below. Due to the loose rock, removal of trees and brush, steep incline, and haphazard pitting, landslides and pit-wall cave-ins are extremely likely.

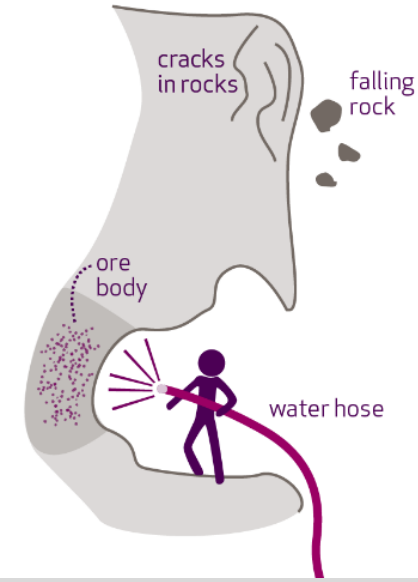
### 1.3.3 Mengkubang site, WPR in East Belitung

| Mine type | Concession status | Number of miners | Location |
|---|---|---|---|
| Onshore, using hydraulic monitors | Legal, in a People's Mining Area | Information unavailable | East Belitung Regency |

**Table 6. Mengkubang at a glance**

***Figure 4: Mining process at Mengkubang, Belitung Island***

*The diagram depicts the processes and obvious safety hazards observed in Mengkubang in East Belitung.*




*Unique site hazards*

Risks of pit wall collapse or slip/fall from atop the pit ledge were the biggest observed hazards. None of the miners use PPE such as boots, eye protection and hardhats.

**Images from the Mengkubang site.**

*Above: Burrowing into the side of pit walls dramatically raises the likelihood of cave-in.*

*Above: Slip and fall hazards like this were observed. It would be approximately a 10-foot fall.*

# 2. Occupational Health & Safety in mining regulation

## 2.1 Context of regulation

Occupational Health & Safety in the Indonesian unconventional tin mining sector is not regulated by one government ministry. In fact, there is no one piece of legislation specifically aimed at OHS of the unconventional mining sector in Indonesia. The primary government agency tasked with overseeing *legal* unconventional mining operations is the Provincial Mines and Energy Agency -- *Dinas Pertambangan dan Energi (Distamben),* but due to understaffing and lack of clarity in the law, in practice the mining unit leaders (called bosses), essentially rely on their own experience of safety, hygiene and accident prevention.

### 2.1.1 OHS responsibilities of the mines inspector

There are 11 inspectors[21] assigned to the Bangka-Belitung province. Mines Inspectors are responsible for over 100 unconventional mine sites, which seems to be an unmanageable scope. According to law 4/1999, the job of the mines inspector (*Provincial Distamben*) is to inspect mine sites, train workers on accident prevention and mine site sanitation accidents. The *Distamben* should inspect mine sites once a year at minimum, but inspectors can also make unannounced mine site inspections at any time.[22] If there are accidents, fatalities, near misses or other environmental or safety-related incidents, the *Distamben* will make recommendations for how the IUP or IPR holder must ratify the situation.

Each company appoints a Chief of Technical Mining and a Technical Mines Supervisor, which the office of the *Distamben* then approves, based on the individual's professional qualifications.[23] Individual inspectors and the Technical Mines Supervisor collaborate on inspections using a blank logbook. In the absence of Technical Mines Supervisor, the team leader or bosses are responsible for miners' safety and compliance with OHS regulations.

***OHS training for unconventional miners provided by the Provincial Distamben:*** For unconventional independent IPR holders, Law 4/2009 and Belitung Timur Regency's regulation 23/2011 stipulates it is the responsibility of Mining Inspectors to provide technical support, including OHS training, mining techniques, mine operational mine safety, environmental management, and reclamation. There is, however, no detailed OHS training material available online. If a company requests the provincial office of the *Distamben*'s assistance, individual inspectors will provide training on proper PPE, slope stability and other topics. Training can take place at the mine site or at the *Distamben's* office. However, there is no required schedule or content for OHS training that the *Distamben* needs to provide to unconventional miners.[24,25] Therefore, this is an opportunity for programmatic collaboration with the provincial inspectorate as the unit has expressed high interest in a MoU with the implementing organization when a ToT program is developed.

### 2.1.3 OHS responsibilities of companies sub-contracting unconventional miners

While bosses of each unconventional mining team are responsible for the day to day activities of their workers, the company (IUP holder) is ultimately responsible if there is an accident or fatality involving their workers, including unconventional miners if they are working on the IUP holder's concession with written agreement by the company.[26,27] The permit holder makes reports to the Mines Inspector one to three times per year on incidents and accidents, land use, production, fuel usage and the number of miners. While it is permitted by law for all IUP holders—not just PT Timah—to sub-contract part of their license to unconventional mining units PT Timah is the only company that does so at present.

The Ministry of Energy, Mining and Mineral Resources' (ESDM) regulation 38/2014 requires a company to develop a safety management system, prevent accidents and work-related illness, and for safe mining operation. The Technical Mines Supervisor is responsible for OHS training and reviewing and evaluating general OHS training for each miner and technical supervisor. The Mines Inspectors working for the Provincial *Distamben* approves the mining safety education and training program. When the permit

[21] As of December 2016.
[22] Government of Indonesia, Law No. 4/ 1999.
[23] For instance, usually this position calls for a mining engineers.
[24] The regulation is not specific about the training curriculum.
[25] For industrial scale miners, the training covers rescue plan/safety in the emergency situation, health and safety for particular job, first aid in accidents and protection from high noise level.
[26] If the latter group is working on their concession with written permission.
[27] BaBel provincial regulation 7/2014 affirms that the companies are responsible for OHS of the contractors.

holder sub-contracts its mining area to unconventional miners, it is responsible for the OHS of unconventional miners working under its business license.[28]

***OHS training for unconventional miners provided by IUP holders:*** According to the Provincial *Distamben*, IUP holders should oversee its workers[29] and, where needed, provide them with training on OHS and use of PPE. However, according to Law 23/2014, it is the responsibility of the Provincial *Distamben* to provide training and supervision on operational safety issues at mine sites. This disconnect may be a product of the recent publication of this law, but it could be explored further as part of the Training Cent capacity building partnership with the *Distamben*.[30]

### 2.1.4 WPR block holders

Each WPR is divided into blocks of land, which are then managed in three ways: 1) Local government provides instructions to cooperatives made up of unconventional miners; 2) Government delegates the management of the WPR to a block holder, a company of a required size and designation; and 3) Government urges unconventional miners to form a cooperative and find an investor to apply for a permit on their behalf.

In the case of Bangka-Belitung, there is only one block that is being actively managed by a company which holds the permit (called an IPR). The unconventional miners are supposed to sell exclusively to company and in return, the company should provide miners with OHS and efficiency training.[31]

### 2.1.5 Responsibilities of mine team leaders (mine 'bosses')

The responsibilities of mine team leaders include:

- Providing warnings to workers who are not following safety guidelines, safe use of machines;
- Select workers who have several years of work experience;
- Providing first aid for minor injuries and pay for medical expenses if a miner must go to hospital or a clinic;
- Supervising mining activities and actively observe for potential accident-causing behavior; provide instruction if that behavior occurs; and
- Acting as a worker safety point of contact.[32]

When workers are seriously injured[33], the boss will cover their costs to visit a local clinic or hospital. In the case of minor injuries, the boss provides a first aid kit. When someone dies in a workplace accident, the three mine bosses consulted stated that the body is taken to the family home. The boss is supposed to report any fatalities to the Mines Inspector.

[28] According to the law 4/2009 and ESDM ministerial regulation 38/2014.
[29] The law does not state specifically whether 'workers' also apply to unconventional miners, but this seems to be the way PT Timah is interpreting the law.
[30] See Section C, Recommendations, for more information.
[31] East Belitung Planning Agency, pers comm, Dec. 2016. There is no explicit statement in the regulation to this effect, however, but that regulation is still under development.
[32] In the case of Desa Mapur.
[33] Such as a bone fracture or deep laceration.

## 2.2 Quantifying most grave injuries & fatalities

The Provincial *Distamben* tracks of numbers of serious accidents and fatalities at every mining operation[34] in the province on an annual basis. While the *Distamben* did not permit the authors to publish precise numbers of fatalities and serious accidents in the past several years, those numbers are **lower** than the six fatalities reported in the primary local newspaper for 2015.[35] In 2014, the Bangka Post reported one landslide fatality in East Belitung;[36] and in 2013 three miners were reported killed in a landslide on PT Timah's concession in Selinsing (East Belitung).[37] It should be noted, however, that published and official numbers of fatalities are likely fewer than the real incidents because illegal unconventional miners tend to keep deaths in their community quiet so as not to draw attention to their already frowned-upon activities.

The official numbers of miner fatalities and the tally from Indonesian newspapers is far lower than the numbers that have been reported by WALHI –the Indonesian chapter of Friends of the Earth—and international media publications. The table below presents a running tally of unconventional miner fatalities since 2012. Identifying the accuracy of these number is difficult because miners may not be reporting fatalities as often as they occur; moreover, there may be other reasons why fatalities are being under or over-reported.

[34] Including conventional and unconventional mining.
[35] Bangka Pos, 2015. "Megi Terkubur Hidup-hidup di Tambang Lintas Timur." Accessed from http://bangka.tribunnews.com/2015/06/23/megi-terkubur-hidup-hidup-di-tambang-lintas-timur; Bangka Pos, 2015. "Dua Pekerja TI Terkubur, Satu Selamant." Accessed from http://bangka.tribunnews.com/2015/11/06/dua-pekerja-ti-terkubur-satu-selamat; Bangka Pos, 2015. "Breaking news: Ini dia saksi terasnya caca. Accessed from http://bangka.tribunnews.com/2015/06/22/breaking-news-ini-dia-saksi-tewasnya-caca; Bangka Pos, 2015. "Breaking news: Dedy Ditemukan posisi terduduk di lubang tambang. Accessed from http://bangka.tribunnews.com/2015/06/12/breaking-news-deddy-ditemukan-posisi-terduduk-di-lubang-tambang.
[36] Bangka Pos, 2014. "Penambang timah tewas tertimbun longsor." Accessed from http://bangka.tribunnews.com/2014/04/24/penambang-timah-tewas-tertimbun-longsor.
[37] Bangka Pos, 2013. "Polres Beltim sidik laka di tambang maut Selingsing. Accessed from http://bangka.tribunnews.com/2013/11/25/polres-beltim-sidik-laka-di-tambang-maut-selingsing.

| Date/ year | Number | Cause | Location | Source |
|---|---|---|---|---|
| 2010 | 21 | Not mentioned | Bangka | Bangka police, cited in The Guardian[38] |
| 2011 | 44 | Not mentioned | Bangka | Bangka police, cited in The Guardian[39] |
| Spring, 2012 | 7 | Landslide | Bangka | Bloomberg[40] |
| November, 2012 | 3 | Landslide | Bangka | The Guardian |
| 2012 | 78 (legal and illegal) | Not mentioned | Bangka (and Belitung?) | The Guardian[41] |
| 2015 | 2 | Landslide | Bukit Intan, Bangka | Village secretary[42] |
| 2015 | 1 | Landslide | Pemali, Bangka | Bloomberg [43] |
| 2016 | 2 | Landslide | Bangka | WALHI[44] |

**Table 7. Miner fatalities reported in the international media**

## 2.3 Key hazards: Gravity, frequency & impacts

### 2.3.1 Common diseases in the mining areas

According to the health agencies for Bangka and East Belitung sub-districts, the most common diseases and their occurrences in 2015 were as follows:

[38] The Guardian, 2012. "Death metal: Tin mining in Indonesia." Retrieved from https://www.theguardian.com/environment/2012/nov/23/tin-mining-indonesia-bangka.
[39] The Guardian, 2012. "Death metal: Tin mining in Indonesia." Retrieved from https://www.theguardian.com/environment/2012/nov/23/tin-mining-indonesia-bangka.
[40] Bloomberg, 2012. "The deadly tin inside your smartphone." Retrieved from https://www.bloomberg.com/news/articles/2012-08-23/the-deadly-tin-inside-your-smartphone.
[41] The Guardian, 2012. "Death metal: Tin mining in Indonesia." Retrieved from https://www.theguardian.com/environment/2012/nov/23/tin-mining-indonesia-bangka.
[42] Bloomberg, 2012. "The deadly tin inside your smartphone." Retrieved from https://www.bloomberg.com/news/articles/2012-08-23/the-deadly-tin-inside-your-smartphone.
[43]Bloomberg, 2012. "The deadly tin inside your smartphone." Retrieved from https://www.bloomberg.com/news/articles/2012-08-23/the-deadly-tin-inside-your-smartphone.
[44] Agence France Presse, 2017. "Indonesian islands pay price for smartphone rush." Retrieved from https://phys.org/news/2017-01-indonesian-islands-price-global-smartphone.html.

| | Health Affliction | East Belitung (# of patients) | Bangka (# of patients) |
|---|---|---|---|
| 1 | Acute Upper Respiratory Infection | 9,684 | 27,105 |
| 2 | Other upper respiratory diseases | 11,599 * | 2,117 |
| 3 | Hypertension | 5,847 | 10,987 |
| 4 | Gingivitis & Periodontal Disease | No data | 14,510 |
| 5 | Dental pulp infection and dental apex decay | 4,747 | 7,598 |
| 6 | Infectious Skin Diseases | 2,963 | 10,019 |
| 7 | Muscular and tendon diseases | 5,318 | 9,878 |
| 8 | Intestinal infection and gastritis | 4,828 | 7,618 |
| 9 | Dental pulp infection and dental apex decay | 4,747 | 7,598 |
| 10 | Diarrhea | 1,895 | 7,218 |

**Table 8. Common regional diseases**

## 2.4 Access & barriers to health care

### 2.4.1 Services provided by healthcare facilities

The hospital in Belitung Timur's services to unconventional miners include recommending traditional health practices like herbs to patients for minor ailments and providing emergency procedures for broken bones and other serious injuries resulting from mining accidents. The Puskesmas[45] serving Desa Mapur provides miners with minor procedures like stitches and treatment for small ailments.

### 2.4.2 Gaps in services provided by healthcare facilities

***Identifying unconventional miner patients:*** The two community health centers the team visited have difficulty identifying unconventional miner patients. This is significant because much of the workforce in BaBel is involved in mining, so local health centers are not necessarily equipped to respond to or anticipate their health needs .

***Radiation and heavy-metal related diseases detection:*** Local clinics and hospitals visited by the team do not have the training or facilities to detect or treat diseases that could be caused by radiation or heavy metals.[46]

***Cancer:*** The hospital in East Belitung can perform some early screening measures for the common types of cancer, but cancer patients must be sent to Jakarta for treatment. The authors are unaware of any

[45] Community health center.
[46] The hospital in East Belitung could be consulted about what types of facilities and technology might be needed to improve detection and how much that technology might cost in a future study. the need for and potential costs of purchasing

studies to date on the causes of the most common types of cancer in Bangka-Belitung.[47] Cancer is difficult to detect early because people believe that cancer cannot be cured, so they do not seek treatment.

***Serious accidents and injuries:*** Clinics near to the mining sites are unable to provide care for miners who have been in a serious accident (e.g. any incident that requires more than stitches). Injured miners are sent directly to the hospital, which is generally in a nearby city and a longer drive from the mine site.

***OHS training for unconventional miners:*** It is difficult for local health centers to provide unconventional miners with OHS training or sensitization on common mining diseases because they are a highly transient group.

# 3. Bioavailability of heavy metals in Bangka Belitung

## 3.1 Brief Geology of Bangka-Belitung Tin Deposit

The Indonesian tin deposit belongs to a large mineralization group in Southeast Asia called the Pemali Group,[48] which was likely deposited in a deep marine environment in the Upper Triassic period (237 Ma and 201.3 Ma (million years ago). The alluvial deposit in Bangka, according to Sumaryanto (2013)[49], has approximately 400,000 hectares, with average thickness of 12 m, and U grade of 100 ppm, Th grades of 500 ppm and 3 % of REE (Rare Earth Elements). This author pointed to monazite as the U, Th, and REE bearing mineral. According to Ikuno et al. (2010)[50] the concentration of REE in the Bangka and Belitung alluvial deposits ranges from 30 to 400 ppm. Overstreet (1967)[51] mentions that various amounts of monazite were produced in Bangka since the 1930s to the beginning of the 1960s. This author states that the source of cassiterite and monazite in Belitung might be granite or a Sn-greissen and cassiterite-quartz veins. The USGS[52] describes a list of ore-minerals, i.e. minerals with economic value, in the Bangka-Belitung alluvial deposit, which is summarized in the table below.

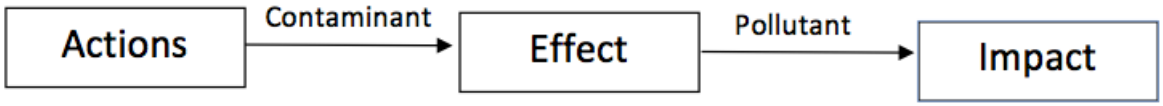
[47] Academics and healthcare workers were unaware of any research of this nature.
[48] KoKo, U., 1986. Preliminary synthesis of the geology of Bangka Island, Indonesia.
[49] Sumaryanto, A. (2013). Uranium and Thorium Exploration and their Processing Research Activities in Indonesia. Interregional IAEA-CYTED-UNECE Workshop, Santiago, Chile. July 9-12, 2013. Retrieved from https://www.unece.org/fileadmin/DAM/energy/se/pp/unfc_egrc/unfc_ws_IAEA_CYTED_UNECE_Santiago_July2013/12_July/3_Sumaryanto_Indonesian_CRt.pdf.
[50] Ikuno, T. et al, 2010. Concentration and Geochemical behavior of REE in Hydrothermally Altered and Weathered Granitic Rocks in Southern Thailand and Bangka Island, Indonesia. Proceedings of the Int. Symp. Earth Science and Technology, p. 269-273.
[51] Overstreet, W.C., 1967. Geological Occurrence of Monazite. US Geological Survey Professional Paper 550. Washington, DC. 591p. https://play.google.com/books/reader?id=DUZSAQAAMAAJ&printsec=frontcover&output=reader&hl=en&pg=GBS.PR1
[52] USGS, 2017. Mineral Resources Data. Bangka Island. Retrieved from https://mrdata.usgs.gov/ree/show-ree.php?rec_id=364.

| Mineral | Common formula |
|---|---|
| Allanite[53] | $(Ca, Ce, La, Y)_2(Al, Fe)_3(SiO_4)_3(OH)$ |
| Cassiterite | $SnO_2$ |
| Hematite | $Fe_2O_3$ |
| Ilmenite | $FeTiO_3$ |
| Marcasite | $FeS_2$ |
| Monazite[54] | $(Ce,La,Nd,Th)PO_4$ |
| Pyrite | $FeS_2$ |
| Rutile | $TiO_2$ |
| Tourmaline[55] | $(Na,Ca)(Mg,Li,Al,Fe^{2+})_3Al_6(BO_3)_3Si_6O_{18}(OH)_4$ |
| Xenotime | $YPO_4$ |
| Zirconite (or zircon) | $ZrSiO_4$ |

**Table 9: Ore minerals in the Bangka-Belitung deposits (USG, 2017)**

## 3.2 Effects versus impacts: Definitions

It is important to highlight that mining activities generate **effects** on the environment but not necessarily **impacts**. Mining effects such as surface disturbance, release of residuals (chemical or physical effects), dispersion of residuals from the source that can have regional effects, spread of chemically reactive particulate matter to the atmosphere and hydrosphere, etc. can lead to impacts. In general, the term **impact** implies that an action generates a toxic situation, or pollution. The establishment of a contamination situation is not sufficient to characterize pollution. **Pollution** is defined as a situation in which "*a substance present in greater than natural concentration because of human activity and having a net detrimental effect upon its environment or upon something of value in that environment*". Therefore, **contaminants**, which are not classified as pollutants unless "*they have some detrimental effect, cause deviation from the normal composition of an environment*".[56]




The type, magnitude and duration of a mining activity associated with the environmental conditions provide parameters about the possibilities of a contaminant being bio-accumulated and then transformed into a pollutant.

[53] Gallery.com., nd. Allanite. Retrieved from http://www.galleries.com/Allanite.
[54] Mineral Data, nd., Monazite. Retrieved from http://webmineral.com/data/Monazite-(Ce).shtml#.WIUuWfkrJRY.
[55] Minerals.net, nd. Tourmaline. Retrieved from http://www.minerals.net/tourmaline_chemical_formula.aspx.
[56] Manahan, S.E., 2005. Environmental Chemistry. 8th edition. CRC Press. ISBN: 1-566706335

In the case of the Bangka and Belitung operations, the safety risks for the operators are much more important than the possible risks of pollution. However, the risk of pollution caused by heavy metals and organics was also investigated.

### 3.2.1 Receptors of concern & pathways for human intoxication

Receptors of concern comprise any living organism that can be adversely impacted by environmental pollution resulting by undue release. The pathway in which a contaminant reaches the receptor is the main issue of concern. In the case of the Indonesian sites, the main receptors were humans and birds, since no aquatic life was observed in the open pits. The main pathways observed were through water (drinking and bath) and air (dust).

***Dust.*** Radioactivity was detected, as the presence of Rare Earth Element (REE) mineral, such as monazite, is abundant in the alluvial material accompanying the cassiterite. However the levels of radioactivity were very low in the field. The harms of radioactive elements are more critical for people inhaling dust in the collectors' processing centers.

***Water.*** Drinking water is of minor importance since all miners and locals drink bottled water, but this must be further investigated in the villages. Bath and epidermal absorption of pollutants is usually a pathway of less importance when dealing with heavy metals but this can be significant in terms of organic matter since the natural water of the mining lakes is not only used for bathing but also to defecation and urination as well.

***Food.*** Usually food is the main pathway for human contamination with metals. However, intoxication via drinking water can occur, especially in the case of arsenic. The miners and locals said they use bottled water for cooking, but this deserves further attention.

***Rare earth elements.*** The human toxicology of monazite sands has been target of many studies over the years. It is difficult to obtain a conclusive idea about the toxic effects of this REE mineral since the level of radioactivity exposure and the frequency are very variable. It is well known than REE are highly cytotoxic (toxic to cells) and can affect various organs (e.g. the liver) also it can cause pneumoconiosis.[57] However, studies in Kerala, India, on the impacts of natural radiation from the monazite-rich sands on population could not prove statistically that cancer was significantly related to cumulative radiation dose.[58]

## 3.3 Heavy metals & radioactive elements in Bangka Belitung

Tin mining and processing of by-products such as monazite, ilmenite, slag, tailings and heavy mineral sands in Bangka Belitung have contributed to an increased level of radioactive elements in the environment. In general, tin mining exposed some naturally occurring radionuclide elements in the deposit that can be easily disperse to surface soil, from a mine site to its surrounding environment.[59]

In 2001, the Ministry of Health, in cooperation with the World Health Organization, funded a preliminary assessment of Thorium, Radon and Potassium (Th-228, Ra-228, Ra-226 and K-40) concentration in soil, water and gas. The collection of soil, water and gas was carried out by the provincial and regency health agencies as well as the National Nuclear Energy Agency (BATAN) in four sub-regencies of Belinyu,

[57] Katsnelson, B.A. et al., 2009. Toxicity of monazite particulate and its attenuation with a complex of bio-protectors. *Medicina del Lavoro* 100(6): 455-470.
[58] Nair, R.R.K. et al., 2009. Background Radiation and Cancer Incidence in Kerala, India—Karanagappally Cohort Study. *Health Physics*96 (1): 55-66.
[59] Arogunjo *et al*, 2009. Uranium and Thorium in soils, mineral sands, water and food Samples in a Tin Mining Area in Nigeria with Elevated Activity, J. Environmental Radioactivity, 100: 232-240.

Pemali, Koba and Mentok on Bangka Island.[60] Concentrations of all four heavy metals were found in monazite.

From urban sampling sites located adjacent to the mining companies, the highest concentrations of Th-228 and R-226 were in the sand washing (washray) facility in Belinyu (448 Bq/kg and 256 Bq/kg subsequently). The concentration of radionuclides in water was below the standard value. The total gamma radiation exposure for the studied population is 33 μR/h (micro Roentgen per hour)—10 times the safe amount of exposure.[61] The authors concluded that the inhalation exposure from Radon gas is the highest concern for communities living adjacent to mine sites. At that time, the public awareness of radiation exposure was very low.

In 2015, Syarbaini from BATAN conducted a baseline assessment of the concentration of radionuclides and calculated the external exposure to the public in Bangka and Belitung islands.[62] The average activity concentrations of Th-232 and Ra 226 are higher in Bangka than in Belitung due to different mineralization patterns of the islands and the greater mining activities in Bangka. BATAN found that Th-232 is a potential contaminant of concern. The calculated outdoor annual effective dose equivalent from all radionuclides is 1.17 $mSvy^{-1}$. It is higher than the global average of 0.07 $mSvy^{-1}$ and slightly higher than the recommended value of 1mSvy.[63]

### 3.2.1 Bioavailability: Direct and indirect methods to access

The bioavailability[64] of the heavy metals associated with alluvial ore can be identified by direct or indirect methods. The most effective way is the direct method in which terrestrial or aquatic biota is sampled and analyzed. The accumulation of the metals in the muscles is an indication of the bioavailability of the pollutant. It is important to highlight that the concentration of the metal is the soil and sediment infrequently correlates with the bioavailability. The main reason is the type of substance that the pollutant forms in the soil and sediments that can be very bioavailable

In the alluvial mining sites in Bangka and Belitung, the team did not collect biota to be sampled. As such, one recommended future area of study would be to collect samples and use a bioassay to establish the bioaccumulation. This is typically done with trout, earthworms, algae, etc.[65]

[60] Please note that these are not the regencies we visited on this site visit.
[61] Roentgen is a unit of measurement that is no longer used. The International Commission on Radiological Protection limits 0.3 roentgen per day.
[62] Syarbaini, Kusdiana and Dadong Iskandar (2015) Concentration of Natural Radionuclides in Soil and Assessment of External Radiation Exposure to the Public in Bangka-Belitung Islands, Indonesia. International Journal of Sustainable Energy and Environment (3) 1: 1-11
[63] UNSCEAR, 2000. Sources and Effects of Ionizing Radiation, United Nations Scientific Committee on the Effects of Atomic Radiation, United Nations publication, New York.
[64] The degree and rate at which a substance is absorbed into a living system. Merriam-Webster, 2017. "Definition of bioavailability." Available from https://www.merriam-webster.com/dictionary/bioavailability. Bioavailability is pollution.
[65] Hinton, J.J. and Veiga, M.M., 2002. Earthworms as Bioindicators of Mercury Pollution from Mining and other Industrial Activities. *Geochemistry: Exploration, Environment, Analysis*, v. 2, n. 3, p. 269-274. Geological Society of London

# Part B: Training Needs Assessment

## Introduction

This Training Needs Assessment contains technical information on the priority OHS issues in BaBel's unconventional mining sector and suggestions for training in those areas.

### 1.1 Notable recent changes of practices

In the past three years, the unconventional tin mining sector has seen several notable changes:

- There are fewer onshore miners because the resources are becoming depleted. Now unconventional miners must dig to a depth of more than 50 m, which cannot be reached without significant investment. ***Potential implications:*** Consequently, more miners are moving to offshore sites; [66]
- Since President Jokowi visited Bangka Belitung in the spring of 2015, police raids—both on- and offshore—have become more frequent.[67] ***Potential implications:*** It is possible that miners will transition back to onshore mining as a result, which could create a rush-mining situation.
- As noted in Section 2.1 of the Situational Analysis, the legal environment has seen some transitions, most notably, the handover of management of the mining sector by the *Distamben* from the district and sub-district level to the provincial level. There is understandably uncertainty, especially at the sub-district level in East Belitung, as to how this new line of management is going to look procedurally.[68] ***Potential implications:*** An important next step is to ensure that the provincial and local government is closely consulted and included in the design process of the Training Program.[69] This consultative approach will build trust and confidence in the program.

What has not changed is the makeup of the key stakeholders in Bangka's unconventional mining sector. Examples of actors who could be leveraged as champions include tin collectors, investors in the tin sector (Indonesian and non-Indonesian) and independent smelters.[70] Additionally, Indonesia has yet to release clear guidelines for local authorities to follow with respect to unconventional mining. The lack of clear guidelines creates complications for the day-to-day administration of the sector, including how the mines inspector or Technical Mines Supervisor should respond to complaints from workers and, indeed, the extent to which the government can expect unconventional miners to follow the law.

## 2. Key similarities & differences between mine sites

Mining activities at Desa Mapur, Bangka depicts the best observable practices of Bangka's unconventional mining sector. Other reports on Bangka's onshore unconventional mining sector, on the other hand, have depicted a very different situation. According to Stocklin-Weinberg, et al (2013), for example, most unconventional miners in Bangka are migrants from other parts of the country. Mining teams in other

[66] ITRI, 2013. "Tin for tomorrow-Contributing to global sustainable development." Accessed from: https://www.itri.co.uk/information/tinplate/general/tin-for-tomorrow-contributing-to-global-sustainable-development.
[67] ITRI, 2017. "Indonesian tin exports rise in December." Accessed from: https://www.itri.co.uk/market-analysis/news-2/indonesian-tin-exports-rise-in-december.
[68] All the government informants consulted in East Belitung expressed in discussions the need for more clarity on their own roles now that mining would be managed by the provincial level of the Distamben.
[69] See Section C, Recommendations, for more information.
[70] Weinberg, Haris & Mitchell, 2013. *Situational Analysis and Sustainability Assessment of Tin Production in Bangka-Belitung, Indonesia.* Commissioned by the Tin Working Group and written by Estelle Levin, Ltd.

parts of the island are financed by collectors to whom the teams are then obliged to sell, whereas in Desa Mapur, all the financing comes from the mine bosses (who are all friends and or family). Onshore practices also vary between Mapur and other sites in Bangka. For instance, in 2013, Stocklin-Weinberg observed more mine sites working in an open pit using hydraulic monitors, whereas miners in Mapur are extracting ore from pontoons or panning tailings.

This means that Desa Mapur is not representative of typical practices in Bangka—but it is representative of legal mining in the province, meaning practices in Mapur are like those observed in East Belitung's WPR. Whilst offshore mining is more the norm in Bangka, this situation could change if a viable WPR were to be opened in West Bangka, where mining activities would likely be more like Desa Mapur and the WPR in East Belitung.

# 3. Short and long-term health & safety impacts

## 3.1 Mining-related diseases

In terms of mining-related health conditions and diseases, dermatitis, flu and malaria are the greatest short-term health concerns.

## 3.2 Mining-related hazards and other safety issues

Male and female mining actors face different concerns about mine site hazards. As such, for this training program to be inclusive of men and women, it would need to cover different topics. For male miners at Sukamandi and Desa Mapur, the greatest hazard is landslides, and the attendant impacts like broken bones and death, whereas female panners at all three above-ground sites[71] face risks of slips and falls. The health and safety issues for women include slipping and falling, dermatitis and gastritis.

### 3.2.1 Safety gear is not safe

Safety gear can increase the risks of some mining activities. For instance, most people operating a hydraulic monitor work barefoot. In this wet environment, the ground becomes muddy the miner was to wear boots, he could become stuck in the mud, making it difficult to move quickly out of the way if there were a landslide. Likewise, gloves can become stuck in the moving parts of machines. In addition, the gloves on the market are of poor quality and need to be replaced often, which is an unaffordable practice for most miners.

There are three local mining supply shops near legal unconventional mining operations on Bangka and Belitung. In ***Bangka***, there was no nearby place to buy PPE. The closest shops to Desa Mapur were in Pangkal Pinang, which is a two-hour drive away. This shop sells helmets, leather and steel-toed boots, earplugs, glasses, rubber boots, earmuffs, and raincoats and rain-pants. The most common gear sold to unconventional miners is boots, which they buy once or twice a year; helmets came second with miners purchasing one annually. In ***East Belitung***, there is a multi-purpose shop that sells equipment parts and some PPE within two miles of both Mengkubang and Sukamandi. The shop sells different types of gloves and one type of boots. The top seller in this shop for miners was boots.

### 3.2.2 Dry shaking tables are superior to wet

Dry shaking tables are more often in use in Belitung than wet. Collectors in Belitung are not aware that the operator of a dry shaking table is inhaling dusts that contain radioactive elements. Inhaling even low

[71] Desa Mapur, Sukamandi and Mengkubang.

levels of radioactive particles daily over a course of 10+ years could lead to cancer.[72] The particles also spread to the closest houses to the processing facility.

### 3.2.3 Landslides are the greatest safety concern

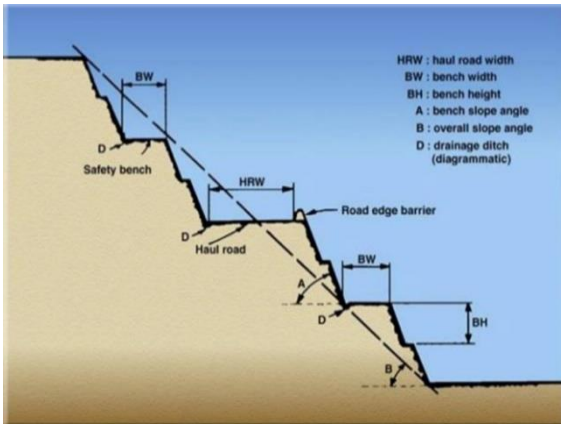



**Figure 9: Components of an open pit with benches**

Landslide prevention training and awareness-raising is a priority in Bangka-Belitung. Unconventional miners do not use benches. They excavate the alluvial material with hydraulic monitors or, in some cases, with mechanical excavators leaving almost a vertical overall slope. This poses a risk for landslides. The introduction of the concepts of benches in the open pit as well as low overall slopes would reduce accidents.[73]

### 3.4.3 Respiratory problems are caused by unconventional mining activities

Upper respiratory tract infections) as one of the chief health issues for unconventional mining actors. Miners' inhaling diesel fumes and collectors inhaling dust could indeed cause the respiratory conditions. However, most of the mining actors are also heavy smokers; this lifestyle choice could also be the cause of such health conditions.

### 3.2.4 Unconventional miners are not the only ones who need safety training

In December 2016, a fatal accident occurred in one of the large mines operated by a smelter. An excavator came down from a face of almost 100 m and the operator who was in the cabin probably was not properly secured in the seat and hit his head in the accident. This illustrates that safety training would benefit smelters as well. Clearly, the risks faced by the conventional mines are also considerable and it is not surprising that accidents of this nature occur.

## 3.3 The efficiency of unconventional mining activities

### 3.3.1 Safety & health are less important than production

For most unconventional miners worldwide, health and safety risks take second tier to the importance of earning an income. Therefore, it is recommended that efficiency training be paired with topics in OHS.

# 4. Training needs

The following sub-section details the priority *safety* and *efficiency* issues to be targeted in a Tin Working Group training program.

[72] WHO, 2016. "Ionizing radiation, health effects and protective measures- Fact sheet." Accessed on 16 Jan. 2017 from http://www.who.int/mediacentre/factsheets/fs371/en/.
[73] See Section the Training Needs Assessment for more information.

## 4.1 Prospecting

***Knowledge gap:*** Prospecting for cassiterite ore. Right now, miners use trial-and-error, excavating everywhere.

***Potential training opportunities:*** A suggested solution could be to use a Geiger counter to detect viable cassiterite areas, since most of the cassiterite is associated with REE minerals such as monazite. The radioactivity of the REE minerals is low but detectable.

Once sites with potential cassiterite mineralization are identified, the miners should make a trench to collect at least 200 kg of sample since the grade of tin is low and the mineralization is not homogeneous. They can pan this sample to provide a preliminary idea about the grade. Trenching is the most common process to evaluate alluvial cassiterite deposits. Drilling is more expensive and usually does not collect large amounts of samples, which provides false information about the grade. A trench of 2m (L) x 1m (W) x 1m (H) is simple and can be made immediately.

## 4.2 Mining

***Knowledge gap:*** Landslides are a major risk at Mengkubang and Sukamandi. The unconventional miners and bosses are unaware of the preventative measures they can take, aside from attempting escape when a landslide begins.

***Potential training opportunity:*** In terms of surface mining safety, the competence of the alluvial deposit determines the safer method to design the pit. The type of equipment used usually determines the bench height and width; bench slope, as well as the overall slope, is defined by the geo-technical conditions.

The introduction of the concepts of benches in the open pit as well as low overall slopes is the main factor to reduce accidents. These simple procedures to work in benches and have a low overall slope angle, for example 30° to 40°, would not involve high costs, but rather planning and management. Any change of the mining methods should be preceded with an intensive education process to convince the bosses that safer methods also bring more productivity.

In the figure below, in Brazil, a cassiterite mine uses a 32° overall slope angle and 45° for each bench. The purpose of the benches is to provide a safe area for the equipment to extract the ore avoiding the material to slide to the bottom.

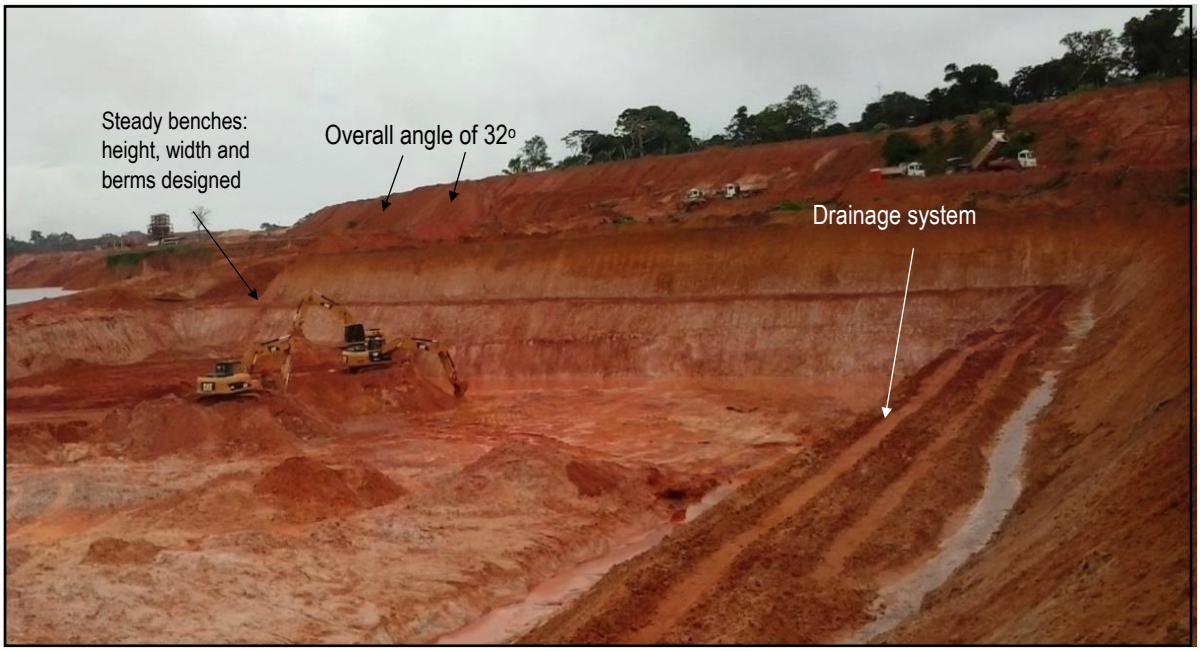



**Figure 10: Alluvial cassiterite mine in the Brazilian Amazon**

## 4.3 Processing for increased wealth

***Knowledge gap:*** A mine cannot be properly planned and designed if the following aspects are not known:

- Geology and location of the mineralized zones;
- Size and shape of the deposit;
- Quantitative data on average and cut-off grades[74];
- Mineralogical and metallurgical characteristics of the ore;
- Physical and chemical characteristics of the waste rocks and tailings; and
- Data on ground conditions, groundwater and other factors that affect mine design and operation.

***Potential training opportunity:*** To suggest methods to improve the mining operations in Bangka and Belitung, it is important to observe how other cassiterite mines work around the world and draw on successful examples to generate suggestions. Most of the alluvial deposit mines in other parts of the world operate either by using excavators and trucks for loading and haulage of the material up to the beneficiation plant, or by using hydraulic monitors and dredges that pump the slurried material directly to the concentration plant. Some mines use both processes.

The size, shape, position, characteristics and grade of the deposit determine the mining process. The grain size and liberation of the tin mineral, cassiterite, define the concentration process, which is usually a gravity separation method such as a jig, spirals, centrifuge and tables. It is difficult to define a processing technique without information about the grain size distribution of the tin mineral and its liberation.

[74] Cutoff grade is the minimum grade one considers for mining. Everything below the 'cut-off' is waste rock.

### 3.2.1 Improve sluicing practices in Bangka

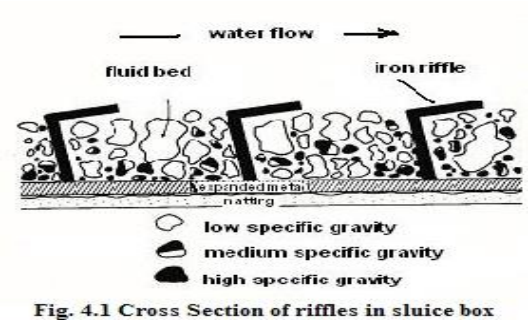


Fig. 4.1 Cross Section of riffles in sluice box

*Figure 11. Example of a riffle*[75]

***Knowledge gap:*** In Desa Mapur, the grade of the tailings, when the concentrate is being washed, reaches 1% Sn. This is an example how the sluicing process, particularly the discharge of the concentrates, is inefficient. The grade of the concentrate Mapur miners produce is usually low—around 65% Sn—because panning does not remove other heavy iron minerals very efficiently.

***Potential training opportunity:*** One way to improve the productivity of their sluice would be to install a riffle, use shorter carpets throughout and pan the *top* (not bottom, as the miners presently do) of the sluice. These measures would slow the flow of water and enable them to mine five times more. Other measures could be explored as part of a curriculum development phase.

### 3.2.2 Essential safety measures for collectors

Collectors are most at risk for developing respiratory diseases, including, but not limited to lung cancer, in large part to their constant inhalation of dust. There are both dry and wet shaking tables in use in East Belitung collector facilities. The use of dry shaking tables is particularly worrying, since they expose the operators to dust, radioactivity from the rare-earth minerals, and spread dust to the houses that surround the collectors. In contrast, wet shaking tables are more efficient at reducing dust.

This is a confusing practice because material is already wet after the pre-concentration in the elutriator and the best procedure would be the use of a wet shaking table. The dry shaking table is rudimentary technology, which uses a brush to make the cut, exacerbating the dust problem. Further, its success depends on the operator's skill to visually monitor separation of tailings from the tin concentrate.

# 5. Champions: Influence, skills, capacity, commitment

Champions are individuals who could be selected for their involvement or partnership in a future training-of-trainers program.[76] Champions will be trained to become trainers for unconventional mining communities. The below section provides a description of each of the types of champions identified during this field mission, as well as suggestions for how they may be included in a training program.[77]

**Bosses (lead miners & bosses)**

Mine bosses demonstrate a clear understanding of mine site hazards and safety issues. This stakeholder group is also well attuned to the needs and motivations of their workers. The authors' experience in training programs for artisanal miners in other countries has shown that bosses are excellent recipients of training because they hold the trust of their workers; they invest in the equipment and they are earning much more than the miners who work for them—as such, they have more to gain by investing in more efficient, if not also safer, equipment.

[75] McCarter, W.A., 1982. "Placer recovery." Presentation for the D.I.A.N.D-K.P.M.A Placer Mining Short Course, Whitehorse, Yukon, April 20-22, 1982. Accessed from http://users.uniserve.com/~mccarter/gold.htm.
[76] Or Training Program. Please see the Recommendations section.
[77] See Section C, Recommendations, for more information about the recommended Training Program.

***Linage to Training Program:*** Bosses would be trained onsite on topics agreed upon during a future curriculum development phase. The trainers for the bosses could be external experts (perhaps initially), a mining engineer or the Mines Inspector, provided the *Distamben* has the capacity and will do provide this training consistently. The purpose of training bosses is to then have them deliver onsite guidance to their mining teams.

**Government**

*Provincial Distamben*

The Provincial Mines Inspectors have experience conducting training for unconventional miners working as subcontractors to PT Timah both onsite, ad-hoc and in the *Distamben's* office. The *Distamben's* office wants to collaborate on a future Tin Working Group training program and would welcome a capacity building effort.

***Linkage to the Training Program:*** An important way to build the *Distamben's* capacity in this area is via theoretical and hands-on training sessions at the *Distamben's* office in Pangkal Pinang. To facilitate this collaboration, an MoU with the Provincial Secretary and then the *Distamben* should be sought as a next step.

*Secretary of the Province*

The team met with the Provincial Secretary in Pangkal Pinang. The Provincial Secretary expressed willingness to help make a training program a reality, but he requested that Pact operate in tandem with and not duplicate the scope of other international programs, particularly the German Federal Institute for Geosciences and Natural Resources (BGR).

***Linkage to the Training Program:*** The Planning Office is a champion in the sense of playing a key advocacy and facilitation role for this program. Thus, members of this office need not participate in any training sessions—though they would be very welcome to—but rather they need to be kept abreast on and coordinated with on matter related to the program's progression.

*Social Village Development Department of East Belitung Regency*

An official whom the team met at the regency level in East Belitung was extremely knowledgeable, charismatic and possesses a wide network in both government and in the tin mining sector. This official would make an excellent champion for the program- to act as a key advisor and to ensure that the appropriate stakeholders are consulted moving forward.

**Traditional authorities**

The village heads of Desa Mapur, Sukamandi and Mengkubang and their village committees and empowerment officers are essential allies for a training program, particularly because they can spread the word about upcoming trainings or demonstrations with miners and their families. The office of the village head plays an important role for mining communities by bringing people together to share important announcements, receive complaints and resolve local disputes.

***Linkage to the Training Program:*** Village heads can provide a venue for a Training Program; they can make recommendations on whom to invite and even assist with some of the organizational logistics.

**Academics**

Education and proven experience is highly respected and viewed as an asset by mining actors—particularly if the educator is more senior than the miners themselves. When it comes to recruiting potential trainers, it would be advisable to see out professors, senior community leaders, current and former PT Timah employee and teachers who have ties with the mining community and can demonstrate to them onsite some of their problematic practices.

***Linkage to the Training Program:*** The University of Bangka Belitung and/ or the Bandung Institute of Technology should be engaged as a research partner for any future phases of this program. Potential areas of collaboration between the Training Program and university partners could include: lecturers acting as trainers; university students gathering data and receiving guidance and mentoring from mining engineers from the University of British Columbia; joint publications and conferences; and professional development for Indonesian academics who want to expand their knowledge of unconventional mining.[78]

**Private sector**

AETI's president is a key champion for this program because of his knowledge of the sector and his can-do attitude about bringing about change in the sector. Whilst he does not always represent the views of his diverse membership, he will be a helpful advocate for mediating the needs of unconventional miners and smelters.

***Linkage to the Training Program:*** An MoU with AETI would be advantageous at this stage so that members can help lobby for the Training Program with the local government. Smelter owners could also participate in the training sessions so that they can be exposed to the challenges and opportunities facing the unconventional mining sector—this could be a way to turn more smelters into champions and support their own responsible sourcing activities from unconventional mining suppliers.

# Part C: Recommendations

A future training curriculum for unconventional tin miners in Bangka Belitung should be both in line with the expert model of priorities *and* the needs and priorities of the unconventional mining actors themselves. As the former group highlighted health and safety issues and the latter group highlighted their desire to improve production and therefore profits, the training program itself has to target both visions. The proposed implementation plan below provides recommendations on how to design a training program that focuses on OHS *and* mining efficiency at the same time.

## 1 Preliminary implementation plan

Any educational program for unconventional miners must be flexible, suitable for their working conditions and respectful of their level of knowledge. In other parts of the world, when a training program comprised only a short period of demonstrations on safer and cleaner techniques, the results were unsustainable.[79] This happens in any technical assistance program, since unconventional miners need ongoing consultation with their instructors to learn and implement the new techniques in their own work. A successful training program must incorporate technical subjects, in addition to business, environmental, social and legal aspects of a mining operation. That said, there is a consensus between the

[78] These scenarios are based on the outcomes of a meeting with the Mining Engineering department at the University of Bangka-Belitung. Feb. 2017.

[79] McDaniels, J., Chouinard, R., Veiga, M.M., 2010. Appraising the Global Mercury Project: an Adaptive Management Approach to Combating Mercury Pollution in Small-scale Gold Mining. *International Journal of Environment and Pollution*, v. 41, n. 3/4, p. 242-258.

members of the Tin Working Group *and* stakeholders in BaBel that preventing serious injuries and fatalities at the mine site and improving efficiency should be the first order of business for a training program. Therefore, the future training program should have the following theory of change:

**Theory of Change**

Based on the observations from BaBel province, Pact's Theory of Change for improved behavior in the unconventional mining of cassiterite sector is as follows:

· If a politically-aware approach is taken that includes provincial and mayoral-level leadership in a carefully designed technical capacity building and institution building program[80];

AND

· If the envisioned program includes smelters, mine bosses and miners in a training initiative that aims to improve their health and wealth through no-nonsense technical skill-building via both Indonesian academic institutions and an international education partnership and an existing well-suited venue such as a town hall. For improved OHS uptake to be successful, miners must understand the **clear benefits** to their immediate and long-term health and wealth. Through better efficiency gains, wealth will be enhanced. Efficiency training should be paired with key concepts in mine site health and safety.[81]

AND

· If the provincial government participates in reinforcing lessons ***and*** the market rewards safe and responsible mining;

AND

· If parallel efforts are made to enhance legal areas for unconventional miners in the cassiterite mining where it makes business sense to mine legally ***and*** if local authorities allow the project to start with legal miners and, step by step, eventually engage with all onshore miners, regardless of legal status;

THEN

· The occupational health and safety of unconventional cassiterite miners in BaBel province will increase over the long term and produce stronger Indonesian institutions and oversight. The following

[80] Positive change in the everyday occupational health and safety of BaBel's unconventional miners must be a politically aware as well as educational endeavor. Carefully staged partnership discussions are needed at the province level with the following key stakeholders:

- Governor of Bangka Belitung or Secretary of the Province, partnering with this office and launching a pilot program as the Secretary's initiative
- Provincial Mining Inspectorate, developing a MOU emphasizing a practical partnership
- Mayor, planning department and village authorities of the pilot project areas, and ensuring goals align with their targets and key staff are closely involved.
- Village-level chiefs of pilot project areas, to be engaged as key champions of miner health
- PT Timah, if possible, and 2-4 area smelters to be engaged as champions of new Indonesian tin
- Mine bosses, engaged in any technical engagement with mining practice
- Unconventional miners, engaged throughout as key beneficiaries to which a program is ultimately responsible
- Health authorities at provincial and local levels, engaged as data-collectors to track pilot efforts, improve data on sector generally
- International midstream and downstream industry stakeholders

[81] For example, prevention of landslides through benching principles, mine site planning, etc.

sections detail a preliminary implementation plan to bring this Theory of Change for a mine safety-training program to fruition.

## 1.1 Provide training on mine safety & efficiency

The table below provides a summary of the components of this Training Program, including its goal, delivery mechanism & training venue, training topics, partners and training recipients.

| Goal | Delivery mechanism & venue | Topics | Partners | Recipients | Modality | Location |
|---|---|---|---|---|---|---|
| *Improve the health and wealth of Indonesia's unconventional cassiterite miners* through engagement, education, and capacity building on the following priority areas:<br>• Efficient prospecting, mining & processing<br>• Mine site hazards awareness<br>• Prevention of landslides<br>• Water, Sanitation, Hygiene (WASH)<br>• Safe equipment use<br>• Safe processing (collectors only)<br>• Improved understanding of what the law requires of mining actors in terms of mine site OHS (mine bosses, IUP and IPR holders only)<br>• Pollution | Town Hall<br><br>Local coffee shops<br><br>Learning-by-doing demonstration onsite<br><br>Ongoing capacity support visits by vetted local engineer(s), in close partnership with the Provincial Distamben's office and Indonesian education institutions | Personal Protective Equipment (PPE) | Provincial Distamben<br><br>Provincial Secretary<br><br>Bupati<br><br>Independent smelters | Bosses, Lead miners/supervisors<br><br>Collectors<br><br>Independent smelters<br><br>Any other influential champions | Training of Trainers combining theoretical and onsite demonstrations | Sukamandi & Mengkubang sites, WPR, East Belitung |
| | | Mine site safety | | | | |
| | | Slope stability | | | | |
| | | Safe equipment use | | | | |
| | | Simple measures to improve hygiene & sanitation | | | | |
| | | Attaining and maintaining legal status | | | | |
| | | Introduction of wet shaking tables (processing)<br><br>OHS requirements vs. accountability: Filling the present gaps | | | | |

**Table 10. Training Program implementation plan overview**

In addition to the mining training program as suggested above, it is strongly recommended that an engagement program be developed with the Government of Indonesia, particularly at the provincial level where mining decisions have been devolved, to emphasize making unconventional mining legal status easier versus harder, and attractive in practice. Currently onshore unconventional cassiterite miners in Indonesia cannot operate fully-legally anywhere in Bangka, and only in one People's Mining Area (WPRs) in Belitung. It is hard to focus on OHS or invest in professionalizing operations if miners are on the run and evading detection. Legal status, including security of tenure, is one of many issues that will continue to hobble the sector and prevent full potential benefits if it is unaddressed in a bigger program. To be clear: program impact would be limited to current legal miners – which are the clear minority of those unconventional miners in BaBel – unless engagement with the government on formalization is also pursued simultaneously.

That said the provincial government plans to release more land for additional WPRs in West Bangka, made up of 300 blocks. It is unclear, however, how the land was chosen or whether it has been explored and indeed contains a viable cassiterite deposit.

### 1.1.1 Location

Two mine sites in the East Belitung WPR—Sukamandi and Mengkubang—are the proposed pilot areas for the Training Program. The WPR in East Belitung is the only place in BaBel to where people can mine completely legally. Moreover, Belitung itself has a much more receptive operating environment than Bangka. Moreover, the local government has no appetite to allow training of illegal miners—which is the *all* unconventional miners in Bangka, save for the groups mining in PT Timah's concession with the company's permission.

### 1.1.2 Delivery mechanism & venue

Mine bosses cannot take time away from work so the idea is to work around their schedules and bring much of the training to their own sites. The authors' experience working on training programs in other countries has shown that hands-on demonstrations should be accompanied by class sessions on the theoretical underpinnings of the demonstrations. Based on the preferences of the bosses consulted, classes should take place at the town hall or even in a coffee shop near their mine sites. Classes should be brief—one or two hours—and should take place on Sundays when people do not have to be at the mine site. Coupled with the classroom sessions, miners and bosses have expressed a preference for demonstrations at their own mining operations.

### 1.1.3 Partners

There are multiple stakeholder groups who would make instrumental partners for the Training Program. This section details at a high level that the partners are and what kinds of needs and priorities they have expressed. More detail on the next steps for each partnership will be provided in the proposal for future phases of this project.

**Government**

*Provincial Secretary & Bupati*

It is highly advisable for the project to develop an MoU with the office of the Provincial Secretary before continuing with subsequent phases. This MoU should contain the provincial government's support for the

Mining School and any subsequent MoUs with other government agencies. In addition, the Bupati (mayor) of East Belitung should be kept abreast on the progress of the Training Program.

*Provincial Distamben*

A technical partnership with the *Distamben* is an ideal way to advance the *Distamben's* capacity to monitor the health and safety conditions at unconventional mine sites in the province. The dozen mines inspectors consulted also expressed an interest in receiving training on key topics on which they could then train miners.[82]

*Social Village Development Department of East Belitung Regency*

The Social Village Development Department provides a link to the communities and the heads of villages of Mengkubang and Sukamandi. It will be crucial to engage this office early and repeatedly to ensure that the Training Program's targets align with the village constituents. Village heads, who work under the administration of the Social Village Development Department, can help spread the word about the school and provide a venue for classroom training.

*Health authorities at provincial and local levels*

Health authorities can be engaged as data-collectors to track the pilot's efforts on reducing the health and safety impacts of unconventional mining in the East Belitung WPR. This data collection will improve the level of data on the sector more generally, which is unfortunately lacking now.

**Academics**

*University of Bangka Belitung (UBB)*

UBB should be engaged to increase the level of technical expertise on unconventional mining in this province and help secure a longer-term institutional owner for the Training Program.

*Bandung Institute of Technology (IPB)*

IPB has a business arm that has launched international technical partnerships. In the next phase, it would be useful to explore a partnership with the university's mining department.

*University of British Columbia (UBC)*

The University of British Columbia's Norman B. Keevil Institute (NBK) Mining Engineering has provided technical assistance, training and mentorship for emerging training programs for artisanal miners. The Institute could serve as a key academic partner and provide the Training Program with graduate mining engineering students to carry out data collection, produce joint publications with an Indonesian academic counterpart and draw on the artisanal mining experience of several professors in the department to provide raining and other expert input to the Training Program's design and implementation.

**International mid-stream and downstream tin users**

If there is consensus on minimum best practice, then downstream users can band together with their collective buying power and use it as a leverage point with Indonesian authorities and upstream actors. **On that same note, if downstream tin users choose to exit the region, nothing will be likely to change unless there is a plan for re-engagement.** This marks an important moment to band together before any disengagement conversations take place.

[82] Specific topics of interest to the *Distamben* should be explored during a curriculum development phase.

### 1.1.4 Modality

**Miners and bosses want hands-on training on how to improve the efficiency of their practices. This training could take place in the local town hall and at their mine sites.** By making the case to the bosses and miners who participate in the program that there are simple ways to improve their efficiency, the program can build rapport and trust. At this point, it will be easier to introduce concepts of health and safety.

## 2. Preliminary gap assessment & indicators for best practice ASM

The table below extrapolates the findings in the Situational Analysis on the current state of mining practices in the observed sites in Bangka and Belitung and presents minimum and best practices in terms of miner health & safety, efficiency, legal status and monitoring of miner health. The practices described below are based on onshore, above ground, unconventional mining, which would be the most feasible target for a future Training Program.

| Where practice should be at a minimum | What needs to be done and why | What an ideal would look like | What supports are needed to get to the ideal |
|---|---|---|---|
| ***A. Health & safety*** | | | |
| **1. Engineering controls** | | | |
| Benches (to prevent landslides)<br><br>Slope stability: Angles of pits should not be greater than 45 degrees | Mine bosses should be taught about why slope stability and benches are important and how they can be constructed. Slope stability & benches will help prevent landslides. | Miners and bosses are aware of the gravest risks present at the mine site and how to go about preventing them. Proper mine site planning takes place, which is preceded by an intensive educational campaign for mine bosses. | The following activities should take place:<br><br>• Training of trainers<br>• Training of new inspectors<br>• Training of mine bosses, who will then train the miners in their team |
| Drainage of ponds should be improved to prevent proliferation of water-borne diseases and malaria/dengue-bearing mosquitoes | Civil work (e.g. excavation) needed to open channels and drainage, | | Demonstration/ "model mine" with improved drainage systems & signage/ safety rails in place. This would require the agreement of mine bosses and the IPR holder (in the WPR). |
| Slipping & falling hazard areas should be well marked with signage and safety rails should be installed | Install signage and potentially safety rails to prevent falling accidents. | | Mine site planning would need to include: |

| Where practice should be at a minimum | What needs to be done and why | What an ideal would look like | What supports are needed to get to the ideal |
|---|---|---|---|
| | | | • Geology and location of the mineralized zones;<br>• Size and shape of the deposit;<br>• Quantitative data on average and cut-off grades[83];<br>• Mineralogical and metallurgical characteristics of the ore;<br>• Physical and chemical characteristics of the waste rocks and tailings; and<br>• Data on ground conditions, groundwater and other factors that affect mine design and operation.<br>This mine site planning could be incorporated into a study as part of a latter phase of the Training Program (after the ToT campaign is completed) |
| **2. Work practice controls** | | | |
| Only experienced miners (e.g. 3+ years) should be allowed onsite | Training & awareness-raising on PPE use (e.g. hardhats (for | Miners and bosses change their attitudes around PPE; at the same | Tear-resistant gloves should be supplied at nearby shops at an |

[83] Cut-off grade is the minimum grade one considers for mining. Everything below the 'cut-off' is waste rock.

| Where practice should be at a minimum | What needs to be done and why | What an ideal would look like | What supports are needed to get to the ideal |
|---|---|---|---|
| No smoking around engines (e.g. on pontoons) | miners working near cliffs), ear protection, safety goggles, gloves, protective clothing against the sun, and water shoes) and mine site safety so that these minimal risks can be reduced. | time, more appropriate PPE is introduced so that miners' work is risk-free and uninterrupted. | affordable price. Ongoing monitoring & engagement with miners on the importance of site-appropriate PPE and safety measures. This is about changing the "safety culture" so it will take time. |
| Site-appropriate PPE should be worn | | | |
| **3. Safety hazards** | | | |
| People should not be working during rain or thunder storms | This seems to be in practice already. | n/a | Ongoing monitoring to ensure no work takes place during thunderstorms. |
| Miners should drink water regularly, take regular breaks in the shade and wear sun-shielding clothing to protect themselves from sunstroke and dehydration | Training & awareness raising on sun exposure. | Uptake of practices around sun safety, first aid, hygiene and safe maintenance and use of equipment is high. | Health & safety training of bosses needed to then pass on to the miners. |
| No one should be working with open wounds | Training & awareness raising on importance of PPE, basic first aid, how to properly operate machinery and mine site safety more generally so that these minimal risks can be reduced. This will protect miners against accidents, avoid lost time due to injuries and increase production. | | |
| Mining ponds should not be used for defecation. There should be a designated area for the toilet | | | |
| Saf(er) equipment use, e.g. covering moving parts of pontoon engines; floatation devices for pontoons; proper use of hydraulic monitors | | | |
| Face masks should be worn to | | | |

| Where practice should be at a minimum | What needs to be done and why | What an ideal would look like | What supports are needed to get to the ideal |
|---|---|---|---|
| manage exposure to diesel fumes | | | |
| Life jackets should be worn when people are submerged in water or installing Guyanese missiles (make-shift drills) on the pontoons | | | |
| **4. Physical hazards** | | | |
| Mine workers and cassiterite processors should not be exposed to radioactive elements, even at a low level | The Indonesian Nuclear Authority (BATAN) should investigate the gravity of health impacts related to mining, processing, or any other long-term exposure to cassiterite ore and by-products. | Miners and nearby communities are not exposed to unsafe levels of radiation. | This issue should be investigated further. However, given the sensitive nature of this subject—and the fact that it could be considered controversial for an external program to investigate the issue of REE in BaBel—it is recommended that Indonesia's own nuclear agency pursue this further. The TWG could liaise with BATAN at a future date and see if the issue is already on their radar. |
| Noise levels onsite should be reduced to below 100 dBA for 15 minutes per day. [84] | OSHA recommends building sound barriers or replacing the noisy equipment with quieter models. Another suggestion is to install silencers, mufflers or baffles. It might be possible to erect.[85] A hearing conservation | Unconventional miners are more aware of risks to long-term hearing loss. An alternative means of worker communication should be developed so that miners can wear ear protection. | Follow OSHA guidance on how to implement a hearing protection program. Liaise with the regency and provincial health authority to incorporate this issue into a health awareness-raising campaign for |

[84] Ministry of Labour and Transmigration, 2011. *Peraturan Menteri Tenaga Kerja dan Transmigrasi Nomor per.13/MEN/X/2011 tentang Nilai Ambang Batas Faktor Fisikia dan Faktor Kimia di Tempat Kerja.*
[85] OSHA, 1998.

| Where practice should be at a minimum | What needs to be done and why | What an ideal would look like | What supports are needed to get to the ideal |
|---|---|---|---|
| | program should be implemented. | | unconventional miners. The TWG could provide inspiration and support for such a campaign, but it should be led by the Indonesian health authority to ensure it is accepted by people in the region *and* so that the program continues longer term |
| **5. Sanitation** | | | |
| Workers should not eat with their hands or while working. Workers should wash their hands before and after eating. Food should not be prepared onsite. | Awareness-raising campaign, potentially by health center staff on why sanitation issues are important at the mine site and how sanitation can be improved simply and effectively. | Fewer miners contracting communicable diseases and parasites. | It should be noted, however that, whilst not ideal, people make a common practice of eating with their hands. Therefore, it may not be a practice that we can reverse. |
| Workers should not be bathing in the mining pond. | A designated bathing facility should be used onsite or workers should bathe at home. | Fewer miners contracting dermatitis and water-borne diseases. | |
| **6. Waste disposal** | | | |
| Rubbish should be gathered into a central facility | Liaise with mine bosses to see whether miners would accept this waste disposal system. It may take awareness raising and monitoring for this culture change to take place. | Rubbish is gathered into a central facility at the mine site and disposed of at a dump; *not burned*. | Liaison with the relevant government authority and IPR holder to construct the facility and arrange rubbish drop-off at a dump (if it exists).<br><br>It should be noted, however that, whilst not ideal, people make a |

| Where practice should be at a minimum | What needs to be done and why | What an ideal would look like | What supports are needed to get to the ideal |
|---|---|---|---|
| | | | common practice of scattering rubbish around. Therefore, it may not be a practice that we can reverse. |
| ***B. Efficiency*** | | | |
| Dry shaking tables should not be used by collectors. It is harmful for their lungs. If collectors are unwilling to change their technology, then they should wear a facemask and change it daily. | Wet shaking tables should be introduced to reduce radioactive dust exposure of collectors and nearby houses and to improve the process. | Collectors and nearby residents are not exposed to radioactive dust. | Investigate the scenarios under which collectors would agree to use wet shaking tables at a centralized facility. Right now, their quantities of ore are too low for them to each procure their own wet shaking tables. |
| Miners should change their concentration process to apply better and more efficient gravity concentration methods. | Test new types of sluices and centrifuges. | Panners and mine site bosses need to receive awareness-raising to change their perception of vinyl carpets. The most effective way to change hearts and minds of the mine site actors is to demonstrate that different types of processing equipment bring more profits. With repetition, miners will come to weigh cost of the lost time due to cleaning the carpet against the increased income they receive and they will see the benefits. | Engage with local equipment suppliers to see if different carpets and other processing equipment can be procured and available on the market. |
| Prospecting needs to be improved. | Lease-to-own scheme of Geiger counters for mine bosses to | Miners can detect where the cassiterite ore is located. Bosses | Training should be provided to mine bosses on how to conduct |

| Where practice should be at a minimum | What needs to be done and why | What an ideal would look like | What supports are needed to get to the ideal |
|---|---|---|---|
| | detect where the by-products of cassiterite—and therefore cassiterite itself—are located. Mine bosses should construct trenches and take a sample of the ore to provide themselves with a preliminary grade of the cassiterite in the area. | should know how to collect and read ore samples. | on trenching and how to use a Geiger counter. |
| ***C. Legal status*** | | | |
| Miners should be organized and working in designated and *viable* WPRs | Lobby local government, specifically the governor's office and the Mines Inspector to expand legal areas for people to mine. Any additional WPRs should be prospected to ensure there is a viable cassiterite deposit for unconventional miners. | Miners know how to be legal and stay legal. | The Training Program should include an educational component on mining cooperatives—how they have worked in other parts of the world and their potential limitations. Mine bosses and miners should be consulted on whether this is a format that could work in BaBel, and under what conditions it would be a feasible option for unconventional miners working in a WPR. |
| Mines Inspector's mine site monitoring should be increased | Monitoring can be strengthened by showing government agents how monitoring is done in other countries (e.g. DRC) and how governments in other countries have coped with their unconventional mining sectors | Mines inspector presence at WPR increased. Miners have a rapport with the inspectors, who can provide scheduled and ad-hoc safety and efficiency training and address miner questions. | An MoU with the *Distamben* should be explored as an immediate next step. |

| Where practice should be at a minimum | What needs to be done and why | What an ideal would look like | What supports are needed to get to the ideal |
|---|---|---|---|
| | more generally.<br><br>Provide the Mines Inspector with OHS training topics and techniques to embed within their mandate. | | |
| Legal and viable unconventional mining areas should be expanded so that miners have an incentive to mine legally. | The provincial planning agency and Mines Inspector are working on the WPR legislation, which includes additional WPRs in West Bangka. However, it is unclear whether those sites contain a viable deposit for unconventional miners. This issue should be researched further. | Unconventional miners have the chance to work in a legal and well-managed mining area where there is proper mine site planning; accountable mine bosses and IPR holders; regular health & safety training; and a viable deposit. | The government might need financial support to conduct exploration. The precise costs and resources this would require should be explored further as part of the MoU between the Training Program and the government (the governor's office and the *distamben*). |
| ***D. Miner health monitoring*** | | | |
| Data collection techniques of health centers on unconventional miner health issues should be improved | Health centers have accurate and up-to-date data on miner health more generally and the impacts of mining on their health (e.g. common miner diseases & health conditions; # of miners injured per month or year and how; etc.) | There is data available on the following components of miner health:<br><br>• Screening questions[86] asked of *all* patients to determine whether they are miners & what kinds of lifestyle they lead (e.g. are they smokers; | This type of data collection should be within the provenance of the regency and provincial health authority, but the Training Program could provide inspiration and training to health officers on how to collect the data and what kinds of |

[86] Screening questions for lung cancer could include: "Have you had a persistent cough for longer than four weeks? Do you smoke?; Are you losing weight rapidly and with no explanation?; Are you having night sweats that soak your bedding?; Have you coughed up blood?"

| Where practice should be at a minimum | What needs to be done and why | What an ideal would look like | What supports are needed to get to the ideal |
|---|---|---|---|
| | | what their job is at the mine site; etc.) Gather #s of miner patients visiting clinics and hospitals<br>• Occurrences of upper respiratory infections amongst miners<br>• Numbers of miners coming to hospital needing treatment for:<br>  ○ Deep lacerations<br>  ○ Bone fractures | parameters it should include.<br><br>Likewise, the Training Program could provide support to the health authority on an information campaign—an MoU would need to be explored—but it should be led by the local health centers. |

**Table 11. Minimum & best practice unconventional mining in BaBel's cassiterite sector**

Indicators help a program rate its progress toward achieving its goal. For indicators to be achievable, it is helpful for them to be SMART, that is, Specific, Measurable, Attainable and action-oriented, Relevant and Time-bound. If improving the safety and efficiency of Bangka Belitung's unconventional miners is the first priority--and indeed, this is the consensus with experts on the ground--then the following indicators[87] could be measured at regular intervals following the training pilot.

| Risk | Description | Potential indicators |
|---|---|---|
| Preventing landslides & collapses | | |
| Slope stability | Slope angle greater than 45 degrees | % Of pits with slope angle at 45 degrees 6 months after training pilot |
| Sanitation | Defecating in mining ponds<br>Rubbish (incl. sharp objects) | % Of mining population practicing open defecation<br>% Of mines with central rubbish disposal facilities<br>% Of mines with improved gender separated sanitation facility on or near premises |
| WASH | | |
| Hygiene | Preparing food at the mine site<br>Hand-washing avoided before & after meals | % Of miners who practice appropriate hand washing at critical times |
| Health & Safety hazards | | |
| Dermatitis | Miners & panners submerged in dirty water & handling gasoline | % Of miners/panners wearing gloves while working |
| Fumes | Inhalation of fumes from diesel engines | % Of miners wearing protective masks while working |
| Dust (underground) | Inhalation of dust | % Of miners wearing protective masks onsite |
| Collector-specific hazards | | |
| Inhaling radioactive dust | In Inhalation of dust | % Of collectors installing wet shaking tables<br>% Of collectors wearing safety masks |
| Efficiency | | |
| Improving sluices | Installing more productive sluices | % Of sluices with riffles installed 1 year after training pilot |

**Table 12. Potential indicators**

[87] A more detailed log frame would be developed in a later phase.

# 3 Recommended timeline

Below is the recommended high-level timeline for the next phases of the TWG's training program rollout.

| No. | Task | 2017 | | | | 2018 | | | | 2019 & beyond | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q3 | | | | |
| 1 | Contracting of OHS (and possibly formalization) implementing partner | | | | | | | | | | | | |
| 2 | Develop MoU with partners (independent smelters, Provincial Government, Distamben, other academic or nonprofit collaborators) (6 months) | | | | | | | | | | | | |
| 3 | Recruit trainers (Concurrently with the above) | | | | | | | | | | | | |
| 4 | Further development of curriculum topics (1 month, alongside trainers, Distamben, other stakeholders). | | | | | | | | | | | | |
| 5 | Elaborate a **business plan** with partners, including capital and operating costs, number of students, equipment procurement process, teachers, transportation of students to the field, accommodation of students, etc. The elaboration of a business plan includes considering **capital and operating costs** for required equipment for efficient mining technical curriculum. | | | | | | | | | | | | |
| 6 | Conduct training (6 week sessions over 6 months to a year, depending on how long trainers can be absent from work) | | | | | | | | | | | | |
| 7 | Monitoring and coaching visits with Distamben | | | | | | | | | | | | |
| 8 | Evaluation to document impacts, adjust curriculum if needed, identify further supports/add-ons if needed (such as environmental rehabilitation training) | | | | | | | | | | | | |

**Table 13. Recommended timeline**

## 3.1 Anticipated challenges

Any lasting change in Bangka-Belitung's unconventional mining sector is not going to come quickly or without challenges. These challenges do not mean that the Tin Working Group should not attempt to launch a training program, but they are worth bearing in mind. At a high level, the main challenges, risk, and proposed mitigation strategy are summed up in the table below.

| Challenge | Description | Risk level (Low, Medium, High) | Proposed mitigation strategy | Impact (Low, Medium, High) |
|---|---|---|---|---|
| Capacity | Apparent lack of government capacity to give instructions for OHS of mining activities in the WPR | Medium | Provide capacity building through refresher courses for Mines Inspectors | Medium impact if Mines Inspectors spend more time at unconventional mine sites |
| Demand | Miners have not asked for OHS training | High | Provide efficiency training alongside topics in OHS | Medium |
| Regulations | There are too many regulations but not the right ones | High | Provincial Government is developing regulation for management of WPRs at present. | High impact, if enforced. |
| Time | Miners, mine bosses and collectors cannot leave work to participate in extensive training sessions. | High | Provide training on weekends<br><br>Keep training sessions brief (<2 hours) | High |
| Mind-set | Miners have preconceived ideas about PPE; think they know what they are doing (re: efficiency) | Medium | Safety risks at onshore mine sites are low, and most PPE is inessential. However, changing mindsets about dangerous mining practices is going to be an uphill battle. | Low |
| Mining areas | Zonation of BaBel mining areas is low. It be difficult to find viable land for any additional WPRs without obtaining exploration data | High | Engage PT Timah to understand whether the proposed WPRs in West Bangka contain viable deposits for unconventional miners | Low |

**Table 14. Anticipated challenges**

# 4 Summary of potential training program add-on

## 4.1 Mine site reclamation

The environmental impacts of legal and illegal unconventional surface mining are grim. Impacts range from the mining of protected mangroves, habitat destruction, deforestation and more. The team saw no evidence of land rehabilitation being done by unconventional miners. Most notable in the case of onshore mining, many of the environmental impacts of the mining activities go hand in and with health and safety of miners and nearby community. There is a clear case to marry an OHS curriculum with key concepts in frugal rehabilitation, slope stability, tailings containment, etc. Some of the top issues that could be explored as part of the next curriculum development phase for the Training Program could include:

*Non-rehabilitated sites in Belitung Island, Indonesia. (© Cristina Villegas, 2016).*

1. **Changing miner attitudes around importance of reclamation:** There is a legacy of challenges regarding responsible and sustainable rehabilitation of mine sites in Bangka-Belitung. In a scoping trip to meet with Indonesian reclamation, rehabilitation and reclamation experts in 2015, Stocklin-Weinberg learned that where rehabilitation was attempted by PT Timah and experts from the University of Bangka-Belitung in areas of the company's concession, miners would just return to the site later and disturb the reclaimed land. As such, an **awareness-building and sensitization campaign with unconventional mining leaders** would need to be an integral part of this complimentary component of the Training Program.

2. **Providing incentives for environmental responsibility:** Another challenge the authors have encountered in the most recent validation mission (February 2017) is related to the cost of proposed reclamation efforts. The key stakeholders who would need to be involved in any sustained reclamation program—e.g. the local government, PT Timah, independent smelters and unconventional mining leaders & champions—need **the program to be affordable** (for the government and PT Timah and/or independent smelters— **and directly tied to an economic return**—for the unconventional miners.

3. **Prospecting and exploration:** Coupled with the health and safety risks associated with the unconventional mining activities observed, the authors noted that unconventional miners in the WPR areas have no prospecting knowledge. As a result, they are mining blind and often re-mining areas that have already been picked over numerous times. This is also a problem from the environmental side because it ties into the issue of reclamation efforts being thwarted by miners returning to the sites repeatedly. Coupled to this issue is the lack of viable and legal mining areas for unconventional miners. As noted earlier in the report, the government is allocating a new WPR in West Bangka soon, but it is unclear how much prospecting or exploration has taken place.

Likewise, local government says it cannot afford to carry out exploration; smelters do not seem to want to because they are not guaranteed the mining area; and miners do not have the know-how. While this is a challenging issue from several fronts, the idea of collective prospecting[88] could be explored in more detail in the next phase of the anticipated Training Program.

Based on interest of the provincial government authorities, the TWG, and other key stakeholders, a curriculum and field-based support program can be developed focused on environmental rehabilitation, environmental risk reduction and long term sustainability planning for miners, mining community leaders, government policymakers and other interested parties. The curricula can build on the work of TWG projects focused on rehabilitation, Pact's experience with ASM site reclamation support programs in other countries and input of local and international experts who can share Indonesian best practice and knowledge and the rich experiences of other countries that host large ASM populations.

# 5 Recommendations for a future formal study

The authors focused on delivering the content outlined in the Terms of Reference. If additional resources are available, the table below summarizes potential priority areas to explore:

[88] Collective prospecting is a scenario in which teams of unconventional miners working in a block of a WPR could pool their resources to carry out their own prospecting.

| Priority area | Key issues | Importance |
|---|---|---|
| Socio-economic contextual analysis | A dynamic and changing political environment in BaBel as of late has some of the key stakeholders carrying a different set of motivations, influence and spoiler potential than in 2013. | The Training Program needs to be launched in a politically skilled manner. Socio-economic Contextual Analysis would greatly assist with planning and to ensure that the correct procedures are followed. |
| Improving collection of health data & awareness-raising around miner health | Identification of ways miner health data should be quantified and collected | Local health centers do not collect data specifically on mining related injuries and illnesses. If a training program wants to target the improved health and safety of unconventional miners in Bangka Belitung, it will be essential for monitoring to be done. An MoU could be sought with the health authority in the regency of the training program to assist clinic staff to collect this data. |
| Exploration in future WPRs | Ensuring that future WPRs contain a viable deposit | It will be difficult to make the case to unconventional miners that mining on a WPR is more profitable for them if there is very little cassiterite to be found. The Planning Agency should work with accurate exploration data as it plans for the new WPRs in West Bangka. It is possible that PT Timah holds this data, but if they do not, exploration activities would likely be too costly for the government. |
| Smelter OHS | Smelting facilities likely release radioactive dusts | An OHS needs assessment should be conducted in and around independent smelting facilities, where cassiterite ore (and by-products) are processed. In addition to the health risks to the smelters' employees, team observed that there are houses nearby that could also be exposed. |
| OHS of offshore unconventional miners | OHS issues are more severe in offshore mining | Whilst not in the scope of this scoping visit, offshore unconventional mining is an important sector to explore in a future study. Most of the notable changes since the TWG's 2013 scoping mission have occurred with offshore mining and there are serious OHS risks associated with these activities, so a need for training in this area is likely greater than onshore mining activities. Unfortunately, offshore unconventional mining is illegal, which makes it difficult to include these mining actors in a training program and maintain the government's endorsement. |

**Table 15. Recommended additional research**

# References


Agence France Presse, 2017. "Indonesian islands pay price for smartphone rush." Retrieved from https://phys.org/news/2017-01-indonesian-islands-price-global-smartphone.html.

Agency for Toxic Substances and Disease Registry (ATSDR), n.d. Public Health Statement Thorium CAS#: 7440-29-1. Available at https://www.atsdr.cdc.gov/ToxProfiles/tp147-c1-b.pdf.

Agency for Toxic Substances and Disease Registry (ATSDR), 2015. Public Health Statement Uranium. Available at https://www.atsdr.cdc.gov/phs/phs.asp?id=438&tid=77.

Agency for Toxic Substances and Disease Registry (ATSDR), 2015. Toxicology of Tin and Compounds Available at https://www.atsdr.cdc.gov/PHS/PHS.asp?id=541&tid=98.

Agency for Toxic Substances and Disease Registry (ATSDR), 2004. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Copper. 314 p. Available at https://www.atsdr.cdc.gov/toxprofiles/tp132.pdf.

ALS, 2016. USEPA Method 1311- Toxicity Characteristic Leaching Procedure.

Arogunjo, A. M., V. Hollriegl, A. Giussani, K. Leopad, U.Gerstmann, I. Veronese, U.Oeh, 2009. Uranium and Thorium in soils, mineral sands, water and food Samples in a Tin Mining Area in Nigeria with Elevated Activity, J. Environmental Radioactivity, 100: 232-240.

Badan Pusat Statistik, 2015. *Indeks pembangunan manusia: 2015.*

Bangka Pos, 2015. "Megi Terkubur Hidup-hidup di Tambang Lintas Timur." Accessed from http://bangka.tribunnews.com/2015/06/23/megi-terkubur-hidup-hidup-di-tambang-lintas-timur.

Bangka Pos, 2015. "Dua Pekerja TI Terkubur, Satu Selamant." Accessed from http://bangka.tribunnews.com/2015/11/06/dua-pekerja-ti-terkubur-satu-selamat; Bangka Pos, 2015.

Bangka Pos, 2015. "Breaking news: Ini dia saksi terasnya caca. Accessed from http://bangka.tribunnews.com/2015/06/22/breaking-news-ini-dia-saksi-tewasnya-caca.

Bangka Pos, 2015. "Breaking news: Dedy Ditemukan posisi terduduk di lubang tambang. Accessed from http://bangka.tribunnews.com/2015/06/12/breaking-news-deddy-ditemukan-posisi-terduduk-di-lubang-tambang.

Bangka Pos, 2014. "Penambang timah tewas tertimbun longsor." Accessed from http://bangka.tribunnews.com/2014/04/24/penambang-timah-tewas-tertimbun-longsor.

Bangka Pos, 2013. "Polres Beltim sidik laka di tambang maut Selingsing. Accessed from http://bangka.tribunnews.com/2013/11/25/polres-beltim-sidik-laka-di-tambang-maut-selingsing.

Better Evaluation, n.d. "Equal access participatory monitoring and evaluation toolkit." Available at:http://betterevaluation.org/sites/default/files/EA_PM%26E_toolkit_module_2_objectives%26indicators_for_publication.pdf.

Bloomberg, 2012. "The deadly tin inside your smartphone." Retrieved from https://www.bloomberg.com/news/articles/2012-08-23/the-deadly-tin-inside-your-smartphone.

Bloomberg, 2015. "Corruption, death and tin mining." Retrieved from https://www.bloomberg.com/news/articles/2015-08-25/-vampire-miners-risk-death-to-swell-global-glut-of-tin.

Bupati Belitung Timur Regulation 23/2014 Guidelines for Managing People's Mining *(Peraturan Bupati Belitung Timur Nomor 23 Tahun 2014 - Pedoman Pengelolaan Pertambangan Rakyat).*

Canadian Council of Ministers of the Environment, 1999. Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health. Summary of a Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. Available at http://ceqg-rcqe.ccme.ca/download/en/143.

Canadian Council of Ministers of the Environment, 1998. Canadian Water and Sediment Quality Guidelines for the Protection of Aquatic Life. Winnipeg, Canada. Available at: http://ceqg-rcqe.ccme.ca/download/en/143.

Canadian Council of Ministers of the Environment, 1988. Canadian Water Quality Guidelines for the Protection of Aquatic Life. Winnipeg, Canada.

Erwana, F., et al, 2015. *Study of socio-economic and environmental impacts of unconventional tin mining (A case study: Bangka Barat District of Bangka Belitung Province*. Conference paper for the Third Joint Seminar of Japan and Indonesia Environmental Sustainability and Disaster Prevention (3rd ESDP-2015), at the Institut Teknologi Bandung, Indonesia- November 25, 2015.

Fosmire, G.J., 1990. Zinc toxicity. *American Journal for Clinical Nutrition* 51(2): 225-227.

Goldstein, G.W. 1992. Neurological concepts of lead poisoning in children. *Pediatric Annals* 21(6): 384–388.

Hinton, J.J. and Veiga, M.M. 2009. Using Earthworms to Assess Hg Distribution and Bioavailability in Gold Mining Soils. *Soil and Sediment Contamination*: *an International Journal*, v.18, n.4, p.512-524.

Hinton, J.J. and Veiga, M.M. (2002). Earthworms as Bio indicators of Mercury Pollution from Mining and other Industrial Activities. *Geochemistry: Exploration, Environment, Analysis*, v. 2, n. 3, p. 269-274. Geological Society of London

IDEO 2015. The Field Guide to Human-Centered Design. Available at http://www.designkit.org//resources/1.

Indonesian Ministry of Energy and Mineral Resources (ESDM) Ministerial Decree – No 555 K/26/MPE/1995 - Health and Occupational Safety for General Mining (*Keputusan Menteri Pertambangan dan Energi Nomor: 555.K/26/M.PE/1995 Keselamatan dan Kesehatan Kerja Pertambangan Umum)*

Indonesian Ministry of Energy and Mineral Resources - ESDM Ministerial Regulation 38/2014 Implementation of Safety Management System for Mineral and Coal Mining *(Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 38 Tahun 2014 - Penerapan Sistem Manajemen Keselamatan Pertambangan Mineral dan Batubara)*

Indonesian Ministry of Health (2001). *Laporan Hasil Kajian Kesehatan Masyarakat di daerah tambang timah, Kabupaten Bangka, Kepulauan Bangka-Belitung, 2000-2001*. Assessment Report of the Public Health in tin mining area of Bangka Regency, Bangka-Belitung Island 2000-2001.

International Tin Research Institute (ITRI), n.d. "Tin use." Available at: https://www.itri.co.uk/sustainability/material-flow-and-recycling/tin-use

ITRI, 2017. “Indonesian tin exports rise in December.” Available at https://www.itri.co.uk/market-analysis/news-2/indonesian-tin-exports-rise-in-december.

ITRI, 2013. *Tin for tomorrow-Contributing to global sustainable development*. Available from https://www.itri.co.uk/information/tinplate/general/tin-for-tomorrow-contributing-to-global-sustainable-development.

Katsnelson, B.A. et al., 2009. Toxicity of monazite particulate and its attenuation with a complex of bio-protectors. *Medicina del Lavoro* 100(6): 455-470.

Manahan, S.E. 2005. Environmental Chemistry. 8th edition. CRC Press. ISBN: 1-566706335.

McCarter, W.A., 1982. “Placer recovery.” Presentation for the D.I.A.N.D-K.P.M.A Placer Mining Short Course, Whitehorse, Yukon, April 20-22, 1982. Accessed from http://users.uniserve.com/~mccarter/gold.htm.

MetalBulletin, 2016. “PT Timah will lift 2017 tin output by a third on higher prices.” Available at https://www.metalbulletin.com/Article/3599281/PT-Timah-will-lift-2017-tin-output-by-a-third-on-higher-prices.html.

Ministry for Energy and Mineral Resources decree no. 1095 K30/MEM/2014, determination of mining areas for Sumatra Island.

Multiqui, 2011. Pump Selection Handbook. Available from http://www.multiquip.com/multiquip/pdfs/Pump_Selection_Handbook_DataId_24686_Version_1.pdf.

Nair, R.R.K. et al., 2009. Background Radiation and Cancer Incidence in Kerala, India—Karanagappally Cohort Study. *Health Physics*96 (1): 55-66.

National Institute for Occupational Safety and Health (NIOSH), 2016. Inorganic Tin. Available at https://www.cdc.gov/niosh/npg/npgd0613.html.

OECD, 2016. *OECD Due diligence guidance for responsible supply chains of minerals from conflict-affected and high-risk areas. 3. Edition*. Paris (FR): OECD. ISBN: 978-92-64-25247-9. Available at http://www.oecd.org/daf/inv/mne/OECD-Due-Diligence-Guidance-Minerals-Edition3.pdf

Post Magazine, 2014. “Casualties of ore: tin mining is devastating the Indonesian island of Bangka. Retrieved from http://www.scmp.com/magazines/post-magazine/article/1473532/casualties-ore-tin-mining-devastating-indonesian-island.

Republic of Indonesia Law 4/2009 - Mineral and Coal Mining *(Undang-undang Republik Indonesia Nomor 4 Tahun 2009 - Pertambangan Mineral dan Batubara)*

Republic of Indonesia Law 23/2014 - Regional Governance *(Undang-undang Republik Indonesia Nomor 23 Tahun 2014 - Pemerintahan Daerah)*

Syarbaini, Kusdiana and Dadong Iskandar (2015) Concentration of Natural Radionuclides in Soil and Assessment of External Radiation Exposure to the Public in Bangka-Belitung Islands, Indonesia. International Journal of Sustainable Energy and Environment (3) 1: 1-11

TechnoMine, 2012. Pits & Quarries. Available at http://technology.infomine.com/reviews/pitsandquarries/welcome.asp?view=full.

Telapak, 2015. Profiting fairly together: Reorganizing the tin supply chain from the community up. Confidential report for Apple, Inc.

The Guardian, 2012. "Death metal: Tin mining in Indonesia." Retrieved from https://www.theguardian.com/environment/2012/nov/23/tin-mining-indonesia-bangka.

UNICEF, 2015. "Post-2015 WASH targets and indicators." Available at https://www.unicef.org/wash/files/4_WSSCC_JMP_Fact_Sheets_4_UK_LoRes.pdf.

UNSCEAR, 2000. Sources and Effects of Ionizing Radiation, United Nations Scientific Committee on the Effects of Atomic Radiation, United Nations publication, New York

USDOL OSHA, n.d. "Regulations (Standards - 29 CFR). Available at https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9735.

USEPA, n.d. SW-846 Test Method 1311: Toxicity Characteristic Leaching Procedure. Available at https://www.epa.gov/hw-sw846/sw-846-test-method-1311-toxicity-characteristic-leaching-procedure.

Veiga, M.M., 1997. Introducing New Technologies for Abatement of Global Mercury Pollution in Latin America. Published by UNIDO/UBC/CETE

Webster, 2017. "Definition of bioavailability." Available from https://www.merriam-webster.com/dictionary/bioavailability.

Weinberg, Haris & Mitchell, 2013. *Situational Analysis and Sustainability Assessment of Tin Production in Bangka-Belitung, Indonesia*. Commissioned by the Tin Working Group and written by Estelle Levin, Ltd.

WHO, 2016. "Ionizing radiation, health effects and protective measures- Fact sheet." Available at http://www.who.int/mediacentre/factsheets/fs371/en/.

WHO, 2012. Arsenic. Available at http://www.who.int/mediacentre/factsheets/fs372/en/.

WHO, 2008. Guidelines for drinking-water quality [electronic resource]: incorporating 1st and 2nd agenda, Vol.1, Recommendations. – 3rd ed. WHO chronicles 38: 1–668.

WHO, n.d. Lead poisoning and health. Available at http://www.who.int/mediacentre/factsheets/fs379/en/

# Appendix 1: Responsible Supplier OHS Guide in Mid-Stream Supply Chain

## Abbreviations and Acronyms

| | |
|---|---|
| ASM | artisanal and small-scale mining |
| CPE | Collective Protective Equipment |
| dBA | a weighted decibel |
| DRC | Democratic Republic of Congo |
| Hg | mercury |
| IDH | the Sustainable Trade Initiative |
| ILO | International Labour Office |
| M&E | monitoring and evaluation |
| M2M | Pact's Mines to Markets program |
| NGO | nongovernmental organization |
| OHS | Occupational Health and Safety |
| PFD | Personal Floatation Device |
| PPE | Personal Protective Equipment |
| SDD | Safety Daily Dialogue |
| SGBV | sexual and gender-based violence |
| SME | surface mobile equipment |
| STDs | sexually transmitted diseases |
| TB | tuberculosis |
| TH | Thorium |
| TWG | Tin Working Group of IDH |
| U | Uranium |
| µg | microgram(s) |
| UNEP | United Nations Environmental Programme |

# Glossary

**Bench:** "A ledge that forms a single level of operation above which mineral or waste materials are mined back to a bench face. The mineral or waste is removed in successive layers, each of which is a bench. Several benches may be in operation simultaneously in different parts of, and at different elevations in the open pit mine."[89]

**Biological hazards:** Exposure to bacteria, viruses, fungi, and other living organisms that can cause acute and chronic infections by entering the body either directly or through breaks in the skin.[90]

**Chemical hazards:** Exposure to gas or vapor contaminants.

**Ergonomic hazards:** Excessive vibration and noise, eye strain, repetitive motion, and heavy lifting problems. Improperly designed tools or work areas also can be ergonomic hazards. Repetitive motions or repeated shocks over prolonged periods of time as in jobs involving sorting, assembling, and data entry can often cause irritation and inflammation of the tendon sheath of the hands and arms, a condition known as carpal tunnel syndrome.[91]

**Silicosis:** Lung fibrosis caused by inhaling dust containing silica.

**Slag:** Waste material left over when a metal goes through a smelting process.

**Slipping hazards:** At an artisanal mine site, slipping hazards could include muddy or wet ledges, ridges, narrow pathways or loose gravel.

[89] Mining Engineer, n.d. "Basics of an open pit mine." Retrieved from http://www.mine-engineer.com/mining/open_pit.htm.

[90] OSHA 3143 1998 (Revised): Industrial Hygiene." Occupational Safety and Health Administration, US Department of Labor. Available online. https://www.osha.gov/Publications/OSHA3143/OSHA3143.htm.

[91] OSHA 3143 1998 (Revised): Industrial Hygiene." Occupational Safety and Health Administration, US Department of Labor. Available online. https://www.osha.gov/Publications/OSHA3143/OSHA3143.htm.

# Introduction

Artisanal and small-scale mining (ASM) is a critical livelihood for more than 30 million people globally. Some 90% of the sector operates outside of the formal sphere and therefore many of the activities are detrimental to the health, safety and long-term economic security of artisanal miners and their families. The sector's informality should not, however, be a justification for supply chain actors to disengage. Rather, progressive improvement should be sought from artisanal mining producers.

## Intended audience

The purpose of this guide is to help *mid-tier supply chain actors*[92] who source from artisanal miners recognize and respond to the occupational health and safety (OHS) risks involved in many artisanal mining operations worldwide.

***Recognizing and attending to the health and safety hazards at artisanal mine sites is a critical first step to protect supply chain integrity.***

## Description of this guide

The guide is structured as follows:[93]

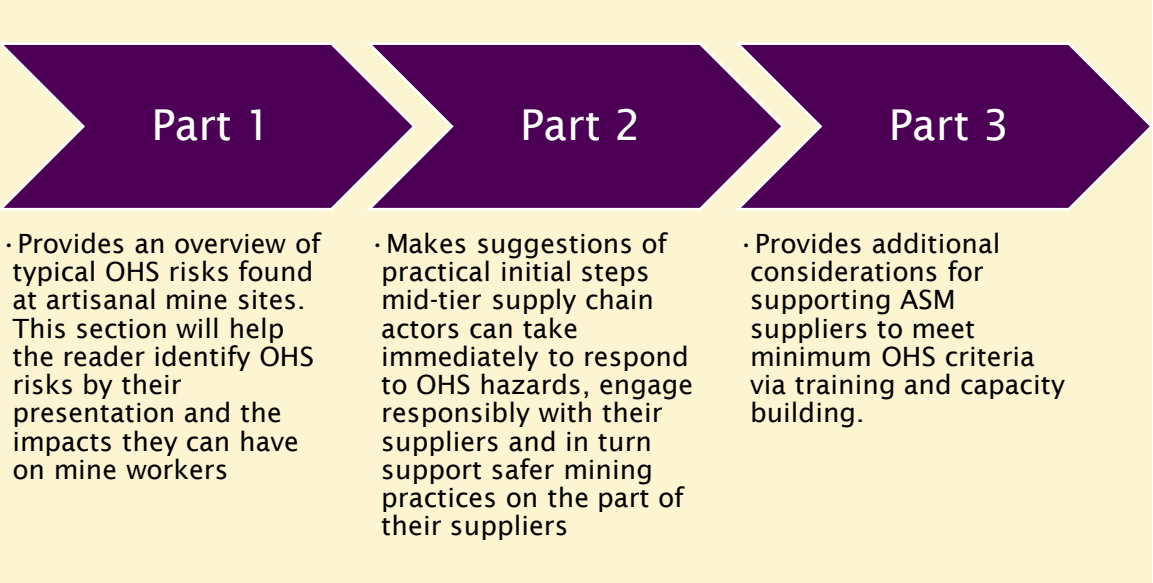



**Figure 3. Overview of this guide**

[92] Including small to medium-scale mining companies and integrated and independent smelters.

[93] Many of these suggestions could be expanded into checklists and other tools if the Tin Working Group decides to commission such an activity.

# Part One: Typical ASM risks

Mine site hazards are highly correlated with a lack of safety management and leadership by mine owners or bosses. Risks vary from site to site based on geological features, the physical profiles of the individuals working the sites, types of equipment in use, level of care in equipment maintenance, local attitudes about risks, among many other considerations. More extreme situations exist (such as compressor mining in Philippine gold mining), but responses to those rarer situations require highly specialized engagement.

According to the International Labour Office (ILO-2001), typical site hazards for ASM fall into seven categories:

1. **High-level hazards** (e.g. engineering and work practice controls);
2. **Potential safety hazards** (e.g. chemical or biological hazards and alcohol or narcotics use);
3. **Ergonomic hazards** (e.g. excessive eye strain; repetitive movements and/or heavy lifting; working long hours without breaks);
4. **Physical hazards** (e.g. excessive noise; exposure to ionizing radiation and intense heat)
5. **Psychological/ social hazards** (e.g. long separation from family; irregular and long working hours; drug or alcohol use onsite);
6. **Sanitation** (e.g. availability of clean drinking and bathing water; and hand washing practices); and
7. **Waste disposal** (e.g. burning rubbish while workers are present)

**Box 1. OHS hazards present at ASM sites**

In Indonesia,[94] and other locations, artisanal miners in surface and sub-surface conditions, face the following major OHS hazards in the table below. These risks are designated according to their severity: Level 1 risks must be eliminated for artisanal mining producers to be deemed acceptable to mid-stream buyers; Level 2 risks may be unavoidable at present, but the company should work with its supplier on a plan to mitigate these risks in the future; and Level 3 risks are not ideal, but they are not a reason to stop sourcing from artisanal mining suppliers.

[94] This guide is based on a training needs assessment and situational analysis of Indonesia artisanal cassiterite mining sector, but it has been adapted so that it can apply to other country mining sectors like Myanmar and the Democratic Republic of Congo, (DRC).

**Table 1. Common major OHS risks found in ASM sites**

| PROBLEM | TYPICAL PRESENTATION | RISK | RISK SEVERITY |
|---|---|---|---|
| **High level hazards: Engineering & work practice controls** | | | |
| Structural Integrity | Landslides<br>Tunnel or shaft collapse<br>Rock falls<br>Flooding of tunnels<br>Equipment failure of winches and other items on which security depends<br>Unsecured waste facilities such as slag heaps or tailings dams<br>Abandoned pits or shafts are not clearly signed, present hazards if overgrown with vegetation or at night, etc. | Severe injury (e.g. bone fractures; brain injuries)<br>Death | 1 |
| Ventilation | No fan-system or ventilation openings in a tunnel or shaft<br>Incorrect use of sub-standard ventilation equipment<br>Ill-positioned ventilation intakes resulting in blockages or pumping fuel/exhaust fumes into the mines | Chronic bronchitis<br>Fatal issues, including heart failure and suffocation | 1 |
| Insufficient, incorrect, inappropriate, inconsistent or no use of Personal Protective Equipment (PPE) to protect against physical and chemical hazards of mining; PPE is ill-adapted for women miners or diverse physical sizes | Dust<br>Noise<br>Heat stress<br>Flying rock fragments<br>Exposure to gold processing chemicals such as mercury or cyanide<br>Without helmets, underground workers risk head injury<br>Without safety-boots, workers risk foot injuries<br>Without clean face masks, mercury, cyanide, uranium (U) and thorium (Th) silica dust and diesel fumes are inhaled by miners<br>Without eye protectors, workers risk eye injuries<br>Without ear protectors, workers risk damage to hearing | Vision loss & eye injuries risks exacerbated<br>Minor to severe head and foot wounds<br>Acute or chronic eye injury | 2 |

| PROBLEM | TYPICAL PRESENTATION | RISK | RISK SEVERITY |
|---|---|---|---|
| Physical hazards | Exposure to excessive noise<br>Exposure to intense heat<br>Excessive sun exposure | Vision and hearing loss risks exacerbated<br>Sunstroke & dehydration | 2 |
| Drug or alcohol use | Use of alcohol or drugs on site leading to dangerous or erratic behaviors | Minor to severe injuries for intoxicated miner and team members | 1 |
| **Potential safety hazards: Chemical & biological hazards** | | | |
| Chemical hazards | Exposure to dust, fumes, vapors & gases | Minor to severe respiratory conditions<br>Minor to severe skin conditions<br>Silicosis<br>Lung cancer (if dust contains radioactive elements) a potential risk for anyone exposed over the long term | 2 |
| Biological hazards | No toilets/pit latrines on site<br>Where there are toilets/latrines, no segregation by gender | Disease outbreaks which may not be limited to the mine but impact on all surrounding and downstream communities<br>Lack of dedicated facilities for women miners or service providers can create security risks. | 2 |
| Working with open wounds | Miners working with open cuts & wounds | Minor to severe infections | 2 |
| Environmental risks | Standing water<br>Charcoal or other fuel burning near extraction or processing sites<br>Fire<br>Transmission of disease by animals entering the mines (e.g. bats as possible source of Ebola infection in DRC) | Water/mosquito borne illnesses, such as malaria or dengue for the miners & the wider population<br>Burn injuries<br>Death by suffocation or smoke inhalation<br>Zoonotic disease transmission for anyone present at the site, as well as surrounding populations | 1 |

| PROBLEM | TYPICAL PRESENTATION | RISK | RISK SEVERITY |
|---|---|---|---|
| **Ergonomic hazards: Excessive eye strain; repetitive movements and/or heavy lifting; working long hours without breaks** | | | |
| Ergonomic risk | Repetitive actions or poor working positions without rest breaks | Muscle-skeletal problems in acute or chronic forms<br>Severe injury in upper body, back, arms and legs<br>Severe risk of exhaustion, inattentiveness, human error | 2 |
| **Psychological & social hazards** | | | |
| Smoking underground | Smoking underground or in proximity to flammable materials or ventilation intake | If an explosion occurs, death or dismemberment | 1 |
| Social | Sex workers operating in mines<br>Migratory workers spread transmissible disease beyond the mine (e.g. STDs, TB, etc.)<br>Children access the mine to work or play, facing same hazards as adult miners<br>Heightened risks to pregnant women associated with some tasks and materials | Spread of communicable and/or sexually-transmitted diseases<br>Minor to severe physical or psychological injuries<br>Miscarriage, fetal deformity | 1 |
| **Sanitation** | | | |
| Lack of clean drinking / washing water<br>Groundwater contamination | No clean water available to drink or use as wash water<br>No protection of downstream water sources | Minor to severe gastritis or other bacterial infections<br>Skin infections<br>Health impacts not limited to mine workers but wider population | 3 |
| **Waste disposal** | | | |
| Rubbish is left untreated | Rubbish scattered around the mine site<br>Rubbish burnt while people are at work | Smoke inhalation<br>Sharp objects on the ground can cause minor lacerations | 3 |

**A note on mercury and cyanide:** Gold and silver mining tend to present additional and more complicated OHS impacts than ASM of other materials due to the common practice of ASM producers using mercury (Hg) and/or cyanide in processing. Refer to Telmer and Veiga's work on this issue[1] as well as Article 7 of the United Nations Environmental Programme's (UNEP) Minamata Convention on Mercury (2013), which pertains to mercury emissions from artisanal gold mining and the most detrimental practices to human and environmental health, including whole ore amalgamation, amalgamation in a public area, open burning of amalgam and leaching amalgamated ore with cyanide.

**Box 2. A note on mercury and cyanide**

# Part Two: Working towards better practices

Each company in the supply chain must determine its own minimal acceptable criteria for the types of conditions and mining practices it will allow in its supply chains. Mid-stream companies like smelters and traders face different challenges than downstream users because their relationship with artisanal mine workers is more direct. The guidance below describes steps for mid-tier companies to consider as they build a responsible partnership with artisanal mining producers. It is essential to work with minimal acceptance criteria based on a larger vision of best practice in OHS for artisanal mining actors.

## 2.1 Addressing common hazards

Each mid-tier supply chain holder has a legal and moral responsibility to take meaningful steps to improve occupational health and safety of the mineworkers from whom they supply. Indicative actions can be summarized in five practical steps.

**Step 1:** Develop and disseminate a policy and establish company management systems

**Step 2:** Know your supplier

- **Step 2a** - Carry out a mine site baseline and risk assessment

**Step 3** - Establish minimal and progressive acceptance criteria

- **Step 3a** - Establish progressive acceptance criteria
- **Step 3b** - Ask mine bosses for a statement of commitment
- **Step 3c** - Carry out training and education programs

**Step 4 – Monitor progress**

- **Step 4a** - Establish an incident reporting mechanism
- **Step 4b** - Commission independent audits at regular intervals

**Step 5** – Report on progress

**Box 3. Step-by-step guide on responsible OHS engagement with ASM suppliers**

## Step 1 – Develop and disseminate a policy and establish company management systems

Management systems should be centered around internal company processes and responsibilities for identifying and mitigating OHS hazards at the mine site. The policy articulates penalties and potential disengagement with suppliers.

## Step 2 -Know your supplier

Carry out a supply chain analysis to know the exact source of the minerals entering your supply chain.[1]

### Step 2a - Carry out a mine site baseline and risk assessment

Each artisanal mining sector is different so it is important to get to know the mine sites material is sourced from and the OHS risks and hazards that miners face.[1]

## Step 3 - Establish minimal and progressive acceptance criteria

Local companies should decide which types of minimally acceptable site-level OHS criteria are appropriate for their suppliers. Examples of minimal acceptance criteria could include structural stability; the prohibition of drug or alcohol use onsite and proper ventilation. Companies should decide for themselves which criteria are a priority based on their own suppliers' context and then communicate these criteria with mine site bosses.

### Step 3a - Establish progressive acceptance criteria

Local companies should establish progressive criteria—e.g. over set time intervals—to achieve the larger vision of safe and responsible ASM suppliers. Progressive criteria can be set to a timeframe, for instance, suppliers have specific OHS targets they agree meet by a deadline, such as six months or a year later. Categories of progressive criteria could include the implementation of a garbage disposal system or site-wide sanitation policy.

### Step 3b - Ask mine bosses[1] for a statement of commitment

The company should ask for a letter of commitment or a policy from mine bosses regarding the minimal and progressive criteria.[1]

## *OTHER IMPORTANT ACTORS*

**Country governments:** The country government may not provide sufficient OHS- related support to ASM actors for many reasons due to staffing, professional capacity, local political will, knowledge, etc. Specific inclusion of government actors such as mine inspectors, environmental officers, etc., is important even if there are capacity and logistical challenges.

**Miners:** Miners themselves may not prioritize these issues due to lack of knowledge on better practices, lack of understanding of the hidden risks, precarious legal status, lack of organization, cost of participation, etc. Training, education, government lobbying and long-term presence and monitoring at the site level are key building blocks for behavior change in this area. Due consideration must be given to gender to ensure that women miners are not being excluded for practical, cultural or discriminatory reasons. Trainings and other engagement opportunities should be designed such that access is inclusive. Measuring gender participation is essential to mitigate discrimination.

**Downstream supply chain actors:** Supply chain stakeholders may need to intervene for a myriad of reasons to ensure ASM suppliers meet minimum safety standards[1] and are improving over time. Downstream supply chain actors can follow the progress on the ground via their mid-tier suppliers' reporting mechanism.

### Step 3c - Carry out training and education programs

Training and education programs for suppliers will help build their capacity & support them to meet the minimal and progressive acceptance criteria.[1]

## Step 4 – Monitor progress

Put systems in place to monitor the progress of your suppliers.

### Step 4a - Establish an incident reporting mechanism

Accidents, fatalities and near misses should be reported using an intuitive reporting mechanism (e.g. being cognizant of the fact that the internet is unreliable in many remote mining areas). Bosses and mine owners are best placed to fill out incident reports. Local companies and the mining authority need to work together to ensure that incidents reported are followed by a remediation plan.

### Step 4b - Commission independent audits at regular intervals

It is important to monitor whether suppliers are adhering to the commitments they have made. One way to monitor their progress is through audits and spot checks at regular (e.g. annual) intervals.

## Step 5 – Report on progress

Compile a public report on progress on a regular (e.g. annual) basis.

*Any miner or mining unit can improve their practices using basic and low-cost steps, and local or international companies can be partners in this.*

## 2.2 Specific technical responses available

For the seven common OHS risks outlined in Table 1, potential responses are listed below. Please note that **OHS-responses cannot be a 'cut and paste' exercise**. Precise responses must factor in context-specific variables such as the geological features of the deposit itself and the immediate surroundings, precise mining equipment in use, local attitudes about risks, levels of education and literacy, social acceptance and so on. The table below is based on key OHS issues observed at hard rock and alluvial tin mines in Bangka Belitung, Indonesia. Many of these problems would likely be applicable at both open pit and underground artisanal mines in Myanmar[95] and the DRC

**Table 2. Technical responses available for common OHS site issues**

| PROBLEM | RESPONSE OPTIONS | IMPLEMENTATION SUGGESTIONS |
|---|---|---|
| **High level hazards: Engineering and work practice controls** | | |
| Structural Integrity* | Benches (to prevent landslides, which are a chief safety concern and the largest cause of miner fatalities onshore in Indonesia and, most likely, Myanmar). Steep areas that are not benched are generally at higher risk of collapse after heavy rains. | Mine bosses should be taught about why slope stability and benches are important and how they can be constructed and maintained. Slope stability and benches will help prevent landslides.<br><br>The following steps should be taken:<br>1) Implementation of operational benches check list, which consists of simple questions and/or drawings that may indicate the hazard of slippage in advance when fulfilled in the field by the operators.<br><br>2) Replace the dredge for SME (surface mobile equipment), such as shovels, trucks and tractors. |

[95] Gardiner, et al., 2015. The metallogenic provinces of Myanmar. *Applied Earth Science IMM Transactions Section B.* March 2014.

| PROBLEM | RESPONSE OPTIONS | IMPLEMENTATION SUGGESTIONS |
|---|---|---|
| **High level hazards: Engineering and work practice controls** | | |
| Structural Integrity* (continued) | Slope stability: Angles of pits should not be greater than 45 degrees.<br><br>Slipping and falling hazard areas should be well marked with signage and safety rails should be installed.<br><br>Noise levels onsite should be reduced to below 100 dBA16 for 15 minutes per day. Alternatively, ear plugs or earmuffs should be worn to preserve hearing. OSHA recommends building sound barriers or replacing the noisy equipment with quieter models. Another suggestion is to install silencers, mufflers or baffles.<br><br>Slipping and falling hazard areas should be well marked with signage and safety rails should be installed.<br><br>If underground mining is legal, teach proper timbering (or other structural support methods) and the importance of not undercutting rocks.<br><br>Implement operational procedures and check-list practices before the beginning of the working hours. | Long-term planning and investment will be required for these measures.<br><br>Raise awareness with miners and bosses on the gravest risks present at the mine site and how to go about preventing them. Proper mine site planning takes place, which is preceded by an intensive educational campaign for mine bosses.<br><br>Implement a "Safety Daily Dialogue" (SDD) routine, wherein at the beginning of each workday, the boss and/or a selected team member gathers the mining team to go over the day's work in a five or ten-minute meeting; attend to safety concerns and remind the team of measures they need to take to prevent site-specific accidents.<br><br>A hearing conservation program should be implemented. Mine bosses should be enlisted to measure noise levels throughout the workday. |
| Ventilation | Utilize fans and dig ventilation shafts to promote safe air flow. Create entry and escape points. This will also assist with ventilation.<br>Place generators in open areas where exhaust from machines are directed outside the tunnel or enclosed area. | Intensive training is advised for all underground operations due to the myriad hazards present. Unventilated areas should be blocked and affixed with appropriate signage. |
| Insufficient or no use of Personal Protective Equipment (PPE) to protect against Physical and chemical hazards of mining | Site and gender-appropriate PPE should be worn, such as well-fitting overalls, tear-resistant gloves, eye protection, ear protection, boots, helmets, life jackets, etc. | Awareness-raising campaign in local languages, sensitive to literature levels and involving imagery, targeting miners, mine bosses and financiers should be undertaken to assist in understanding of the purpose of PPE that is deemed essential for that |

| PROBLEM | RESPONSE OPTIONS | IMPLEMENTATION SUGGESTIONS |
|---|---|---|
| **High level hazards: Engineering and work practice controls** | | |
| Insufficient or no use of Personal Protective Equipment (PPE) to protect against Physical and chemical hazards of mining | Training and awareness-raising on PPE use (e.g. hardhats (for miners working near cliffs), ear protection, safety goggles, gloves, protective clothing against the sun, and water shoes) and mine site safety so that these minimal risks can be reduced. | context. If miners refuse to wear PPE, it is essential to understand why. It could be an easily-solvable design challenge or a matter of helping the person to understand about the real dangers lack of PPE has on him/her and the subsequent impacts on their family if they are injured in the short or long term and cannot work.<br>Mine bosses should act as a safety point of contact and ensure that PPE is being worn consistently and correctly. Failure to wear PPE could result in a suspension of work.<br>Ensure site- and gender- appropriate PPE is available at local shops. If not available, the shop owners should be engaged in outreach activities. They can be recruited to post educational posters, provide information on safety equipment/ site-appropriate PPE, to help improve the "safety culture" and improve PPE demand signal with supply over time.<br><br>Life jackets should be provided by bosses free of charge to miners who will be submerging. Monitoring of safe and consistent use of PFDs should be under mine bosses' purview. |
| | | Training and awareness raising on importance of PPE, basic first aid, how to properly operate machinery and general mine site safety so that these minimal risks can be reduced. This will protect miners against accidents, avoid lost time due to injuries and increase production. |
| | Uptake of practices around sun safety, provision of first aid and training of first-aid providers, hygiene and safe maintenance and use of equipment is high. | Training and awareness raising on sun exposure. First-aid training should be given to mine site safety points of contact at regular intervals, as recommended by the Red Cross. |

| PROBLEM | RESPONSE OPTIONS | IMPLEMENTATION SUGGESTIONS |
|---|---|---|
| **High level hazards: Engineering and work practice controls** | | |
| Mechanical or electric hazard | Collective Protective Equipment (CPE) (e.g. covering moving parts of pontoon engines; floatation devices for pontoons; proper use of hydraulic monitors). Reducing time using vibrating mechanical devices, or utilizing equipment with anti-vibration handle controls, to prevent White Finger Disease. Working in short shifts with a partner is another way to reduce risk.<br>No smoking around engines (e.g. on pontoons). Smoking should be allowed in designated areas only. | Ensure enforcement of CPE rules.<br>Require regular maintenance of all machinery and ensure casings are put around machinery where possible. Require regular maintenance of all electrical systems on the site, such as replacing worn wires, etc.<br>Use signs to warn people of dangers (see examples below).<br>Keep non-essential workers or observers out of this area. |
| Drug and alcohol use | A culture of safety at all costs needs to be cultivated through training by bosses and other trusted advisors to the miners. Miners who seem intoxicated should not be permitted to work. | Prohibit the use of drugs or alcohol while on sites, particularly those with mechanical, electric equipment, or with pools of standing water.<br><br>Context- appropriate training & awareness campaign on the use of controlled substances & impacts of impaired operation of machinery. |
| **Potential safety hazards: Chemical and biological hazards** | | |
| Chemical hazards | Fresh face masks should be issued free or charge by the site boss and worn when mining or processing ore in dry environments; masks should also be worn to manage exposure to diesel fumes. Stationary diesel-operating machines should not be running in the proximity of workers.<br><br>Note: not all chemicals can be blocked by a simple facemask. Mercury, for example, requires a special protective mask. | Context-appropriate training and awareness campaign on the use of and importance of face masks. |
| Biological hazards | Require permanent, segregated toilets, outhouses, or enclosed pit latrines, be installed at the site that is appropriate to the number of mine workers on the deposit. Require regular maintenance of the facility, such as contracting a caretaker. Workers should not be bathing in the mining pond. A designated bathing facility should be used onsite or workers should bathe at home. | Context-appropriate training and awareness campaign on the health impacts of bathing or defecating in the mining pond. |

| PROBLEM | RESPONSE OPTIONS | IMPLEMENTATION SUGGESTIONS |
|---|---|---|
| **Potential safety hazards: Chemical and biological hazards** | | |
| Environmental risks | Drainage of ponds should be improved to prevent proliferation of water-borne diseases and malaria/dengue-bearing mosquitoes (e.g. by constructing trenches). Excavation may be needed to open channels and facilitate proper drainage of unused ponds.<br><br>People should not be working during rain or thunder storms.<br><br>Miners should drink water regularly, take regular breaks in the shade and wear sun-shielding clothing to protect themselves from sunstroke and dehydration. Drinking water should be provided and foods to restore body salt. Consider construction of sun shades where possible. | Demonstration/ "model mine" with improved drainage systems and signage/ safety rails in place. This activity would require the agreement of mine bosses and land owner. |
| **Ergonomic hazards: Excessive eye strain; repetitive movements and/or heavy lifting; working long hours without breaks** | | |
| Ergonomic risks | Avoid repetitive work. Ensure workers are taking regular breaks. Avoid twisted postures while completing work tasks. Keep tasks an equal level of effort when working with both hands. | Reducing ergonomic risks for ASM miners will take time because it needs to be incorporated into a safety culture that may not yet exist in the sector. Awareness-raising with miners on the importance of regular breaks and using muscle groups most efficiently will be an essential first step, but this will be a long-term process. |
| **Psychological and& social hazards** | | |
| Sexual and gender-based violence (SGBV) and sexual harassment | Zero-tolerance policy from mine bosses should be sought for SGBV and sexual harassment. | SGBV and sexual harassment training should be provided to all workers and service providers with appropriate signage at latrines and a whistle-blowing or other grievance system available to workers. |

| PROBLEM | RESPONSE OPTIONS | IMPLEMENTATION SUGGESTIONS |
|---|---|---|
| **Sanitation** | | |
| Sanitation | Require hand-washing stations (with soap) to be installed near food preparation areas or other areas as appropriate. Clean drinking water should be supplied by bosses.<br><br>Workers should not eat with their hands or while working and they should wash their hands before and after eating. Food should not be prepared onsite. | Awareness-raising campaign in local languages, sensitive to literature levels and involving imagery.<br><br>Campaigns could be led by health center staff on why sanitation issues are important at the mine site and how sanitation can be improved simply and effectively. These campaigns should be gender-sensitive.<br><br>All mining activities involving water and sanitation must not impact on downstream water courses. Plans for provision or use of water away from downstream water courses should be made. |
| **Waste disposal** | | |
| Waste disposal | Initiate rubbish management system to keep mine site clear of trash and potential sanitation and tripping hazards. Rubbish is gathered into a central facility at the mine site and disposed of at a dump; *not burned*. | Incorporate a responsible waste management system as part of a 'model' mine to show mining actors how conditions could be improved. |

# Part Three: Building miner capacity

The journey of change with any artisanal or small-scale producers (of almost any commodity) tends to be long due to educational, financing, or other hidden barriers to quick uptake of even conservative standards. In artisanal mining, the current trend is the introduction of 'entry standards' where ASM producers achieve a base standard and progressive improvement is expected year on year. Specific milestones are set for the context or commodity. While gold and precious metals have FairMined and Fairtrade entry standards applicable to ASM, at the time of this writing, other metals do not. It is essential that if such an entry standard is developed for cassiterite, as an example, the standard must be supported via better market opportunities by mid or downstream industry. The standard should be context appropriate in terms of actual safety or environmental performance risks and there must be a focus on progressive improvement for mining units achieving the base level of performance. **Support organizations – those who can provide capacity support locally—are essential partners,** in addition to local authorities, miners, mine bosses, financiers, mining associations, local traders and industry partners.

Training and capacity building are important first steps local companies can take to support their suppliers to meet entry-level standards. This section details some of the considerations companies should take before launching an education—or training of trainers—program.[97]

## 3.1 Follow appropriate legal procedures and keep the government informed

In many artisanal mining countries, Indonesia included, the members of local and national government are important and influential stakeholders in the upstream supply chain. They need to be engaged in a transparent manner on a regular basis. It is important to ensure that proper procedures are followed to engage government, since cultural communication styles and hierarchies vary from place to place. Collaborate and coordinate with government regulatory services, such as the Mining Inspectorate to increase their knowledge and capacity to adequately monitor the mining areas.

[97] See Stocklin-Weinberg, R., Veiga, M.M., Villegas, C.M., Sulaiman, R., Michaux, K., 2017.*Occupation health & safety situational analysis & training needs assessment for unconventional (artisanal) miners in Bangka Belitung, Indonesia.* Washington, D.C.: Pact, for a more detailed depiction of a potential training of trainers program in the Indonesian context.

## 3.2 Select trustworthy program and training partners who hold the trust of the miners

In training-of-trainers sessions, it is important to select—and engage the commitment—of the right people as partners and confirm that key power brokers have been engaged. On artisanal mine sites, it is often the case that the mining boss (i.e., lead miner or person who runs the crew) and the site financier (i.e. the person paying for the equipment, wages, and food) hold significant power regarding who mines, where mining takes place and how it is done. **Simply training workers without these individuals (or local equivalents) may not achieve the types of changes desired**. In fact, the workers may not attend the session at all if their financier and mining boss do not know about and appreciate the goals of the session (and how it may improve their financial 'bottom line').

**Figure 1:** Examples of 'Boite à image' cartoons where a cartoon with safety messages are presented for the audience to discuss.

## 3.3 Put on a gender sensitive lens

It is important to bear in mind that female miners, mineworkers and service providers may play different roles to their male counterparts and may face challenges in terms of access, perceptions and discrimination. Likewise, health and safety impacts can differ between male and female miners so the training curriculum needs to be cognizant of gender dimensions. For example, if training is focusing on mechanization, bear in mind that women are often involved in the crushing of ore; it is important to make sure that the introduction of new practices do not displace workers.[98] Simple steps such as ensuring that PPE fits women (smaller boot sizes, appropriate overalls, etc.) are important. Segregated latrines are essential. Inclusion of women in all aspects of mine operations and management is important, including in security and supervisory posts.

[98] World Bank, 2012. Gender dimensions of artisanal and small-scale mining: A rapid assessment toolkit.

## 3.4 Be creative about how to spread the word about ASM OHS issues

Some suggestions for innovative training and awareness-raising activities include:

- Laminated posters that utilize imagery and the dominant local language(s) to reinforce key OHS messages;
- 'Boite à image' exercises, where a drawing is used as a discussion tool for group discussions. On the back of each drawing are the key discussion points and safety messages to be reviewed;
- Community theatre traditions[99] to discuss issues such as the health risks associated with mercury;
- Mobile-text systems to warn of upcoming rain or lightning storms and send pertinent safety reminders. SMS-enabled mobile phones are commonplace on ASM sites;
- Community radio to discuss issues such as safe mining practice;
- A demonstration/ "model mine" with improved drainage systems and signage/ safety rails in place. Facilitate discussion with the various visiting stakeholder types (e.g. visiting miners, visiting mine bosses, visiting financiers, etc.) is recommended to enhance learning and action.

## 3.5 Maximize uptake by training 'champions' instead of directly training miners

Via stakeholder mapping exercises and extended engagement with mining communities, engage and train mine bosses, who will then train the miners in their team. Once a training-of-trainers session is completed, solicit the help of bosses and other safety 'champions' (both men and women) or safety committees that can monitor the safety at the mine site, discuss incidents and lead corrective action plans to prevent similar issues from happening in the future on that site, and/or neighboring sites.

**Above:** These are types of OHS signs that tend to be universally understood and function as supplemental educational tools (and not tools outright). Local focus groups should be convened to confirm whether mine workers understand what the signs mean; if not, one may need to adjust signage design according to local understandings.

***Monitor progress***

Single, one-off technical trainings on their own are rarely successful. According to adult education principles, reminders, hands-on practice, onsite training, refresher trainings, and further education are also needed for uptake to be successful.[100] It is advisable to hire coaches to monitor uptake of safety messages and course correct as needed.

[99] See, for example, community theatre efforts used for training in the Global Mercury Program's Zimbabwe chapter: 2012. Using street theatre to increase awareness of and reduce mercury pollution in the artisanal gold mining sector: A case from Zimbabwe. *Journal of Cleaner Production, 37:*19-184.

[100] World Bank, 2012. Gender dimensions of artisanal and small-scale mining: A rapid assessment toolkit.

## 3.6 Ensure inclusivity

In all cases, it is important to recognize that artisanal miners are busy people and that mining is a business, not a social project. Presentations should be respectful of their time, snappy and engaging, cognizant of prevailing education levels, on site or close to it or in a village meeting hall and inclusive of fun activities (if possible and appropriate) and food. Consideration must be given to the fact that miners have other responsibilities and calls on their time outside the mine, particularly women. To ensure that women can participate, trainings or other activities may have to be timed to accommodate other household/agricultural/childcare obligations. Training sessions should be no longer than half a day and should be targeted at building miner capacity to meet your minimum and progressive OHS criteria for entrance into your supply chain.

## 3.7 Monitoring

It is suggested to carry out ongoing monitoring activities at the mine site to ensure that training efforts are having the desired effect. Monitoring can take on different forms and it is important to think outside of the box when engaging with artisanal miners. More classical ways of monitoring could include a baseline and endline assessment[101], but other less formal monitoring activities include spot checks and interviews/conversations/ focus groups of men and women mine workers to determine whether efforts are having the desired effect. A key early question to ask in this process is: *what is the current procedure if someone is seriously injured on a mining site? Where do they go, is this recorded and where, who pays for this care, and what data (if any) is collected?* For example, injured mine workers may not choose to go to a health center for myriad reasons, such as doubt in the quality of the treatment, financial considerations, or local beliefs.

If data is not available from a reliable source, there are ways to enlist local support to begin reliably collecting useful data points for this exercise. This can take the form of capacity development and local response strengthening expertise, improving protocols such as tracking certain data points over time.

[101] A baseline assessment is a study that gathers information about the conditions at the site of intervention *before* the intervention begins. And endline assessment gathers the same data points after the intervention ends (or at regular intervals between phases) to monitor any changes at the site level.

# Suggested further reading


Alliance for Responsible Mining, 2014. *Addressing forced labor in artisanal and small-scale mining (ASM): A practitioners' toolkit*. Retrieved from http://www.responsiblejewellery.com/files/ForcedLaborToolkit-Solidaridad-ARM.pdf

International Labour Office, 2001. *Safety & health in small-scale surface mines*. Sectoral Activities Programme Working Paper (WP. 168).

Project (SMMRP). ND. *Small Scale Mining Handbook*. Kampala, Uganda: Ministry of Energy and Mineral Development.

World Bank, 2012. Gender dimensions of artisanal and small-scale mining: A rapid assessment toolkit.

OECD, 2016. *OECD due diligence guidance for responsible supply chains of minerals from conflict-affected and high-risk areas: Third edition*. Retrieved from http://www.keepeek.com/Digital-Asset-Management/oecd/governance/oecd-due-diligence-guidance-for-responsible-supply-chains-of-minerals-from-conflict-affected-and-high-risk-areas_9789264252479-en#.WOZ994jyuM8.

United Nations Environmental Programme, 2013. *Minamata Convention on Mercury: Texts and annexes*. Retrieved from www.mercuryconvention.org.

USDOL OSHA, n.d. "Regulations (Standards - 29 CFR). Available at https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9735.

# Appendix 2: Regulation of OHS in the mining sector

The laws listed below tangentially cover OHS in the mining industry in Indonesia as whole, but unconventional mining is not mentioned specifically.

**ESDM Ministerial Decree 555K/26/MPE/1995**: The Technical Mines Supervisor is approved by Provincial Distamben. This individual spends 80% of their time on site supervising mining activities and reports any safety incidents, fatalities or near misses to the *Distamben*. This law was written for the industrial mining sector and much of its provisions are not applicable to unconventional mining. The Provincial Distamben said that there are revisions taking place to make the regulations reflect the unconventional mining sector, but there is no clarity as to when those revisions will be published or enforced. Companies have to provide PPE appropriate to the miner's job and inherent risk. Compliance is monitored by mining inspectors.

**Law no. 4/1999**: The Mines Inspector from the Provincial Distamben should guide, coach and supervise the health and safety of mines workers and supervise the safety of equipment. The law explains the scope of work for a Mines Inspector, including mining technology, conservation of mineral resources, OHS in mining, mining operational safety, environmental management, reclamation and post-mining land use, and technology implementation. Mines Inspectors are appointed by either the Ministry of mines, energy and mineral resources, the governor, or the mayor. Under the recent Regional Governance Law (see Law 23/2014), management and training of mining inspectors is the sole responsibility of the Ministry.

Under this law, miners with an IPR are obliged to follow regulations pertaining to OHS, environmental management and adhere to the available standards, manage the environment together with the local government, and pay regular dues and production fees. It further states the responsibility of the District Gov./City to provide technical support for OHS, environmental management, and post mining activity. The same authority has to appoint mine inspectors/officers to document the production of all community mining within their jurisdiction and provide periodic reports to the Minister and local Governor.

**Law no. 23/2014**: The mining sector in BaBel, including supervision of the WPR, is now governed at the provincial level, not at the level of the sub-district. This law took effect in September 2016, so this is a period of transition. The Ministry of Energy and Mineral Resources has developed an integrated national system to record all mining licenses, including WPRs.

The national government is responsible for designate the country's mining area based on national land use planning as well as issue special licenses for minerals and coal. This also includes determination of the Mining Operational Areas (WUPs), WPRs, and Special Mining Areas (WUPKs). The Provincial government can issue community mining licenses for metals, non-metals, and coal commodity within the designated WPR, as well as issue a license for special production for processing, condensing for mining commodity from one province.

**ESDM Ministerial Regulation 38/2014**: This regulation is also aimed for the industrial mining sector. It aims to improve an effective safety management system that is proactive and increases work efficiency. The regulation covers planning, measurements to prevent accidents, work related illness and dangerous events and develops safe mining operation, healthy environment and efficiency.

A company has to identify the level of OHS competency needed for operations and requirements to fulfill the OHS law and regulations. A company's Head of Mining Supervisor has to develop mining safety education and training programs approved by the Mines Inspector. A company has to implement, review routinely and evaluate the general OHS training programs targeting each miner, operational supervisor and technical supervisor. Specific training is given to miners with significant health and safety risks. All

training should be documented and records should be kept. The head of mining supervisor has the responsibility to develop a program for new miners, miners with a new job description, emergency events, yearly refresher and other training requested by the Mining Inspector.

A company is responsible for reporting OHS management in the Mining Book (*Buku Tambang),* and in the Mining Accident Logbook (*Buku Daftar Kecelakaan Tambang)*, submitted to the Mining Inspector. The Mining Book is the official document that records the laws, regulations, guidelines and instructions from the head of mining inspector.

Each light, serious, or fatal accident has to be registered in the Mining Accident Logbook, and requires the following information: case number; time and day of the accident; location of the accident; name, sex and age of person in the accident; job description and the duration on the job; type of accident; task when the accident happened; witnesses; detailed information and probable cause signed by the Head of Mine Supervisor and the time of report submission to Head of Mining Inspector. Each accident needs to be investigated by the Head of Mine Inspector or by other appointed personnel within 48 hours and reported in the Logbook.

**Bangka Belitung Provincial regulation 7/2014**: This regulation was issued before the Regional Government Law of 23/2014, so it may no longer be in effect. In summary, this regulation is aimed at the mining business license (IUP). It covers registration, exploration to post mining obligations and sanctions. When a mining service company (contractor) is hired, the IUP licensee is accountable for OHS, mining safety and environmental management, reclamation and post-mining, conservation of mineral resources, and management of mine tailings (solid, liquid or gas). The concentration (of hazardous materials) in the tailings should be within the safe environmental standard prior to discharge. An IUP licensee can use a mining service company to operate alluvial tin mine. The licensee is obliged to set aside 40% from the active operational mining area for the local community and/or local mining service company (not clear if the local community mentioned refers to legal IPR licensees).

**Minister of Labor and Transmigration Regulation 13/MEN/X/2011:** This regulation contains a set of occupational health standards for physical factors as well as chemical factors for the time weighted average exposure (8 hours/ day). These standards are only recommendations to prevent health impacts from exposures and are not enforceable. Upon request, the *Hiperkes (Hygiene dan Kesehatan Kerja*-Hygiene and Occupational Exposure provincial agency) can train workers, conduct investigations for potential hazards including sample collection and analyses using measurement tools. If the values exceed the thresholds, *Hiperkes* submits recommendation to manage the potential hazards to the mining inspector and the company.

Standards are set for physical factors, including temperature, noise, vibration, microwave, ultraviolet light, magnetic field. Noise exposure is set at 85 dBA for 8h/d and 15 min max exposure to 100 dBA noise level, Direct contact with vibration should not exceed 4 m/sec2. Standard values are set for a list of chemical compounds used in the manufacturing and mining sectors, including heavy metals, pesticides, and hazardous materials found in solid, vapor, liquid or dust. Standards for the metals discovered during the field trip are as follows: As is 0.01 mg/$m^3$; Sn is 2 mg/$m^3$; Pb is 0.05mg/m3; Zn is 6 mg/$m^3$; and U is 0.2mg/$m^3$.

**The Belitung Timur Regency (Bupati) Regulation 23/2014** provides guidance on how to manage People's Mining, including the OHS rights and responsibility of miners and Mines Inspectors. Since the authority to manage WPRs has been transferred to the provincial government, this regulation is no longer applicable.[102] However, it is the only known regulation specifically written for unconventional miners. This regulation identifies criteria for WPR determination, including a maximum area of 25 ha for each WPR; however, each IPR is limited to 1 ha for an individual miner, 5 ha for a group and 10 ha for a mining cooperative. The WPR area should not overlap with another mining license and it must be in the mining location according to the national land use spatial plan. The regulation lists the administrative, technical

[102] Law 23/2014; took effect in September 2016.

and financial requirements of an IPR application for individuals, groups, and cooperatives. The max depth of mine pit is not to exceed 25 m, and the miners are not allowed to use machinery or mechanical pump with more than 25 horsepower.

IPR license holders are supposed to obtain guidance and supervision on OHS, environmental management, mining techniques and mining management from the local (regency) government and receive capital support according to the appropriate regulations. IPR license holders should obey OHS mining regulations, environmental management and fulfill environmental criteria.

# Appendix 3: Optional add-on modules for the Training Program

| Goal | Delivery mechanism & venue | Topical modules | Partners & champions | Recipients |
|---|---|---|---|---|
| Improve reliability of reporting on miner diseases & injuries | Classroom training at Ministry of Health office or sub-district agencies | Common ailments of miners<br><br>Screening techniques for serious diseases<br><br>How to recognize an unconventional miner<br><br>Radiation exposure & risks<br><br>Medicines & treatment | Ministry of Health oversees data collection | Hospitals in target areas<br><br>Community health centers<br><br>Sub-district health agencies in target areas<br><br>Mines Inspectors |
| Improve reliability of reporting of injuries & fatalities | Develop an app to report accidents, injuries & fatalities in real-time<br><br>Classroom training<br><br>Onsite sensitization with the hazard, incident and risk checklist | Policy provisions to fill in the 'logbook' of common incidents, hazards, risks at mine sites | Provincial Distamben<br><br>Ministry of Energy and Mineral Resources | Bosses<br><br>Mines Inspectors<br><br>Technical Mines Supervisor<br><br>Head of Village<br><br>Police |
| Improve Provincial mining regulations involving People's mining | Workshop<br>Learn from other Indonesian province with WPR sites | Developing criteria for Best Mining Practice<br><br>How to implement and enforce policy | Provincial Distamben<br><br>Provincial Planning Agency (Bappeda) | Provincial Distamben<br><br>Provincial Planning Agency (Bappeda) |
| Mining efficiency | Training of trainers<br><br>Lease-to-own scheme with equipment providers<br><br>Onsite demonstrations<br><br>Classroom / town hall to learn theory | Safe equipment use<br><br>How to use more efficient equipment<br><br>Improving existing methods inexpensively<br><br>Metallurgical tin recovery<br><br>How to meet production targets more efficiently | Mine bosses<br><br>Provincial Distamben<br><br>Equipment providers | Bosses train miners<br><br>Collectors |

| | | | | |
|---|---|---|---|---|
| Inter-agency coordination | Provincial government<br><br>Organizational skills<br><br>Team building workshop | Data reporting/collection and repository<br><br>Clarify roles and responsibilities<br><br>Improve cooperation | Provincial Distamben<br><br>Provincial and district health agencies, community clinics and<br><br>Head of village on WPR sites | |

**Table 16. Optional add-on modules for the Training Program**