The State of Artisanal Mining in Myanmar

Including field study and Human Centred Design (HCD) workshops with gold mining communities in Homalin Township, Sagaing Region

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Executive Summary

Artisanal and small-scale mining (ASM) in Myanmar provides a livelihood for a minimum of 500,000 ASM workers who are directly employed in the sector, and this economic activity supports an estimated 3-5 million people. In 2018, with funding from the Trafigura Foundation, Pact conducted a study of ASM in Myanmar to investigate conditions and challenges in the sector, and to determine opportunities to support development in the sector. This included inquiry into the use of mercury in artisanal and small-scale gold mining (ASGM), which is widespread in Myanmar, in order to determine how Pact could support safer mining practices in the ASGM sub-sector. The study was undertaken using multiple quantitative and qualitative research methods including field visits (to Homalin Township in Sagaing Region), key informant interviews, focus group discussions, a livelihood survey, and thorough desk-based literature review.

Pact is an international NGO that works in many countries on ASM formalization through the *Mines to Market* program, which works with governments, and directly with ASM communities and businesses, and downstream mineral sector partners, to support formalization and development of the mining and mineral sector - which-in-turn results in improved working and living conditions for communities that rely on mining for their livelihoods. Pact is one of the longest-serving international NGOs in Myanmar, since 1997. Our work focuses on Myanmar-owned solutions and work closely with citizens, local government and civil society. With partners that have included USAID, UNDP, The Rockefeller Foundation, Chevron, Coca-Cola, and Shell, Pact implements projects that maximize local ownership - covering a wide spectrum of intervention themes including health, livelihoods, local governance, civil society strengthening, renewable energy, and water and sanitation (WASH). Pact's Global Microfinance Fund (PGMF) is (by far) Myanmar's largest microfinance institution: in 2018, PGMF disbursed more than 1.3 million loans worth $408 million, with a repayment rate of 99.4%. Our most recent development platform, Smart Power Myanmar (SPM) revolves around the use of renewable energy in rural communities, through the facilitation of public/private partnerships for the development of mini-grids in communities not reached by the national grid. This new platform is a compliment to our existing solar systems in place for household and small business usage.

Results of Pact's study indicate that the ASM production of minerals is estimated to exceed $1 billion USD per annum, primarily from extraction of jade, gold, gemstones, and tin. Other mineral resources are also mined but with lesser economic impact. Efforts by government to formalize ASM are ongoing, but to date have yet to engage significantly with market incentives. This report supports previous efforts by civil society, government and other stakeholders towards a safer, cleaner, more productive and responsible ASM sector in Myanmar.

Regarding ASGM, Pact's study confirmed that mercury use for processing gold is widespread, open-burning amalgamation is common, and mercury poisoning disproportionately affects women and children. Awareness of mercury's toxicity (especially understanding mercury's exposure pathways) is weak, and health systems are unable to address the multiple health threats. Recommendations are provided to strengthen health systems and develop market-incentivized approaches to reducing mercury use and empowering miners, especially women and children.

1. Introduction

Despite improvements since joining the Extractive Industries Transparency Initiative (EITI) in 2014, Myanmar's mining sector remains opaque. Recent analysis of mineral governance challenges were undertaken by Natural Resource Governance Institute (NRGI, 2018) and the Myanmar Centre for Responsible Business (MCRB, 2018). These reports focus on jade and rubies, for which Myanmar is responsible for as much as 90% and 85% of global production, respectively (EITI, 2016) (Global Witness, 2015). However, reliable data on the ASM sector is lacking. To address this, Pact engaged the government's Mining Enterprise 2 (ME2) within the Ministry of Natural Resources and Environmental Conservation (MONREC), who accompanied Pact during field study visits, participated during interviews and discussions.

Multiple quantitative and qualitative data collection methods were used, including field visits, key informant interviews, focus group discussions, etc. These are summarized in Table 1 below.

Table 1. Methodologies used in Pact's ASM study in Myanmar

Literature survey	Official government/trade data (ex: Myanmar Central Statistics Organization), public/private sector reports, academic publications, etc.
Remote sensing	USGS Landsat observations, Google Earth, and (Connette, et al., 2016).
Household survey	50 responses from Homalin mining community on 100+ questions covering livelihoods, gender, health & safety, disease, food security.
Interviews & discussions	90+ interviewed including local women & men, miners & owners, local & federal government, community leaders, police, and health providers.
Field visits	Technical data collected from 10 mines & 3 gold shops in June 2018; HCD exploration & mercury trials in August. 2018

During interviews and focus group discussions with miners in Homalin, Pact employed the human-centred design (HCD) methodology. HCD is a phased qualitative approach to explore social behavioural, understand community challenges, and co-innovate end-users. It includes (1) interviews and observation to discover needs and community values, (2) brainstorming, design and building of solutions, and (3) testing and learning about those solutions from end-users. HCD is guided by what communities perceives as valuable, rather than the external designer 'expert'.

The study provides a robust estimate of Myanmar's ASM population. However, the estimates of ASM population and production are indicative only, and further ASM data is warranted. Primary field data was collected only on one commodity (gold) and in only one region of the country. ASM population and production estimates used a triangulation approach that considered new primary data, a range of official and unofficial data sources, and cross-checking with previous analysis.

This condensed version of Pact's report (for public release) is intended to contribute to a general understanding of ASM in Myanmar, and to share Pact's approach and perspective on supporting development in the mineral sector. This version of the report begins with a brief summary of mining governance in Myanmar followed by national ASM estimates. Next the ASGM sector is described, including results from sites visited in Homalin Township. The report concludes with a summary of recommendations as well as plans underway by Pact to support these recommendations. Significant detail (from original full report) has been left out of this condensed report in favour of providing a readily digestible resource. Parties seeking additional information are welcome to reach out to Pact Myanmar with specific inquiries.

2. ASM governance in Myanmar

The Ministry of Natural Resources and Environmental Conservation (MONREC), is responsible for mineral sector governance. There are four state-owned mining 'enterprises' engaged in governance of key commodities indicated in Figure 1. ME2 regulates ASGM.

ME1 Mining Enterprise No. 1	• Lead, Zinc, Silver, Copper, Iron, Nickel, Chromite, Antimony, Arsenic, Aluminium, Cobalt ; Limestone, Stone, Clay, Coal, etc
ME2 Mining Enterprise No. 2	• Gold, Platinum • Tin, Tungsten, Rare Earths, Titanium
MGE Myanmar Gems Enterprise	• Gems, Jade and Jewellery
MPE Myanmar Pearls Enterprise	• Pearl breeding and cultivation

Figure 1. State-Owned Mining Enterprises of Myanmar

Although mining in Myanmar is dominated by ASM, mineral policy has been focused on promoting large-scale mining and criminalizing informal production. For example, an effect of the 2008 US-led ban on Burmese jade and ruby was increased Chinese investment and mechanisation, which further marginalized artisanal producers. ASM has been portrayed as a scourge; many Burmese people feel strongly that ASM is damaging to the environment, illegal, and associated with ills including drugs, prostitution, child-labour, and criminality.

Following pressure from labour activists and NGOs, ASM was recognized in 2015 mining code revisions, though legislation remains poorly developed and unenforced. For example, only 37 subsistence mining permits were registered in 2018. In the code, ASM is classified into two categories: *small-scale mining* ("commercial production with limited investment, expenditure, or technical know-how") and *subsistence mining*, that which uses "ordinary hand tools". In the case of *'small-scale mining permits':* in the 2015 mining law, small-scale mining plots were reduced in size from 20 acres to 4 acres. In the past, small-scale permits had to be approved at central government level, however they can now be sanctioned by ME2 regional offices. While 4-acre plots better reflect the reality of ASM operations and local permitting processes reduce the barriers to applying for mining permits, high taxes (formal and informal) imposed for small-scale plots may still represent a significant barrier for most miners.

In the case of '*subsistence mining':* these permits can be granted for 0.5-acre plots for year-long periods according to the new law. These permits, rather than being granted by the mining department, are granted by Regional Government through a bureaucratic process which includes an investigation and agreement between 4 government departments for each plot. This elongated process consolidated by a lack of capacity at regional government level means that it is unlikely that significant roll out of subsistence mining permits will take place. Miners who obtain a small-scale permits, report that it takes up to six months, although ME2 Homalin regional office states it can take as little as one week. Most mine managers described the need to fly to Naypyidaw and have political connections in order to have a permit processed in a timely fashion. For informal operators, they simply need to pay the informal security fees and start mining. Small-scale permit holders spend on average 15 lakh ($1,000 USD) on an EIA and are required to pay a very high tax of 30 tical gold per year (498 grams, approximately $19,500 USD) regardless of how much gold they produce. This is for a 1-year license only.

Numerous ASM miners that Pact engaged in Homalin Township complained of expensive and complex permitting processes. Other NGOs corroborate these regulatory challenges (NRGI, 2018) (MCRB, 2018). Recent government policies to de-regulate the gold market and de-centralise mining regulation are steps in the right direction. For more detailed analysis of Myanmar's mineral regulation, readers are recommended to MCRB (2018), or contact Pact.

3. National ASM Estimates: Employment, Production and Revenue

Available ASM data in Myanmar is inconsistent and unreliable. For example, official government (Ministry of Mines) estimates have ranged between 3,000 – 71,000 miners between 1990 – 2018, however other government sources have stated 83,000 – 132,000 during 1992 – 1999 (see USGS). However, the data points in international reports range from 14,000 (ILO, 1999) to 50,000 (IISD, 2017), and for the jade sector alone range from 150,000 to 400,000 (Global Witness, 2015) (IGC, 2018) (Beech, 2017) (CESD, 2018).

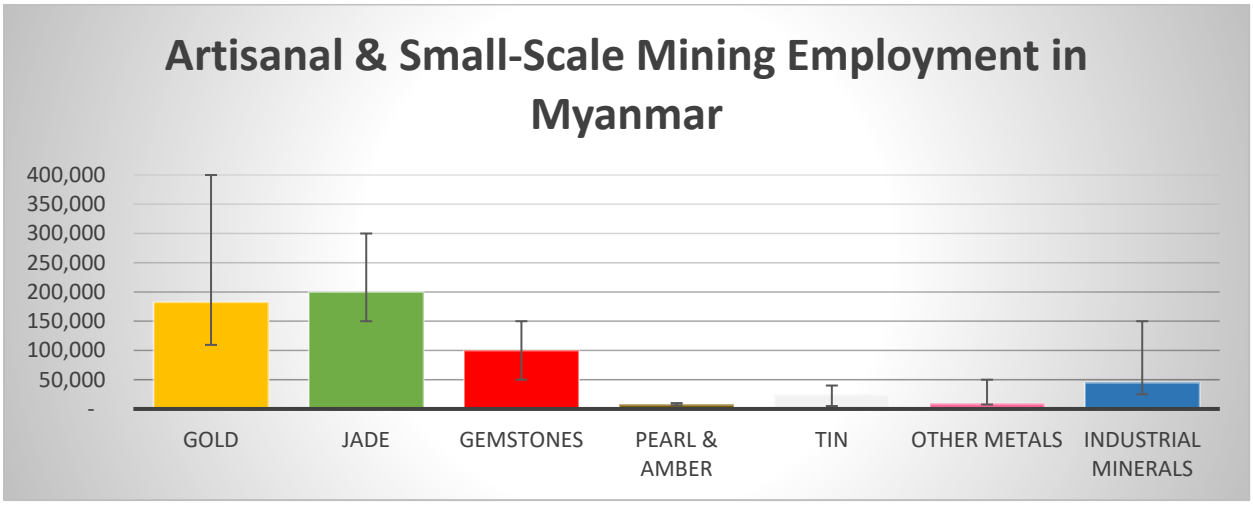

Figure 2. ASM employment in Myanmar, by commodity. Various data sources.

Mineral production data is also inconsistent. For example, the International Council of Mining and Metals stated that the mining sector was worth $62 million USD in 2010 (ICMM, 2012), yet base metal exports have averaged ~$100 million USD (CSO annual trade data) in recent years, and officially reported precious stone sales from bi-annual Emporiums vary from $300 million to over $3 billion per annum (Pala Gems, 2017) - and still, this does not include informal unreported sales. The EITI is improving mineral trade data disclosure. According to their recent estimates, mineral production is approximately $2.2 billion USD per annum. Including oil and gas, extractives contribute 6% to GDP, 24% of state revenue, 39% of total exports, and 0.2% of total employment; oil and gas contribute 72% of overall production value, (EITI, 2015). Conservative estimates triangulated by Pact from a variety of sources (mainly secondary, except for gold) for ASM employment, production and revenue are summarized in Table 2. Further data collection is required to strengthen these estimates and reduce uncertainty.

Pact has estimated 520,000 people directly employed in ASM, with a range between 270,000 and 1,200,000. Production value is estimated to be more than $1.2 billion USD, ($540 million - $14

billion[1]). These are conservative estimates: for example, for jade alone, MONREC estimates that 400,000 people are employed (CESD, 2018) and the sector produces $31 billion USD annually (Global Witness, 2015), of which up to 80% are unreported sales. Please contact Pact for further sector-specific analysis.

Table 2. Summary of ASM employment and production value estimates. Various sources - see note.[2]

Commodity	Employment Estimates			Production Value Estimates ($ USD)		
	High	Low	Median	High	Low	Median
GOLD						
Mandalay	140,000	21,000	35,000	$79,800,000	$13,300,000	$26,600,000
Kachin	220,000	33,000	55,000	$68,400,000	$11,400,000	$22,800,000
Homalin (Sagaing)	200,000	30,000	50,000	$57,000,000	$9,500,000	$19,000,000
Shan	160,000	24,000	40,000	$45,600,000	$7,600,000	$15,200,000
Other Districts	10,000	1,500	2,500	$2,850,000	$475,000	$950,000
sub-total	730,000	109,500	182,500	$253,650,000	$42,275,000	$84,550,000
	ASM Share (Employment):		95%	ASM Share (Production):		90%
ASM sub-total	*693,500*	*104,025*	*173,375*	*$228,285,000*	*$38,047,500*	*$76,095,000*
PRECIOUS STONES						
JADE	300,000	150,000	200,000	$31,000,000,000	$500,000,000	$1,000,000,000
GEMSTONES	150000	15000	100,000	$300,000,000	$50,000,000	$130,000,000
PEARL	10000	2000	5,000			$4,600,000
AMBER	10000	1000	2,500	$1,000,000,000	$2,000	$1,000,000
sub-total	470,000	168,000	307,500	$32,300,000,000	$550,002,000	$1,135,600,000
	ASM Share (Employment):		90%	ASM Share (Production):		40%
ASM sub-total	*423,000*	*151,200*	*276,750*	*$12,920,000,000*	*$220,000,800*	*$454,240,000*
TIN						
	40000	5000	25,000	$800,000,000	$75,000,000	$675,000,000
	ASM Share (Employment):		80%	ASM Share (Production):		60%
ASM sub-total	*32,000*	*4,000*	*20,000*	*$480,000,000*	*$45,000,000*	*$405,000,000*
OTHER METALS (Copper, Nickel, Lead, Zinc, etc.)						
	20000	5000	10,000	$800,000,000	$200,000,000	$630,000,000
	ASM Share (Employment):		60%	ASM Share (Production):		20%
ASM sub-total	*12,000*	*3,000*	*6,000*	*$480,000,000*	*$120,000,000*	*$126,000,000*
INDUSTRIAL MINERALS (Cement, Limestone, Clay, Salt, etc.)						
	75000	10000	50,000	$600,000,000	$200,000,000	$274,500,000
	ASM Share (Employment):		90%	ASM Share (Production):		60%
ASM sub-total	*67,500*	*9,000*	*45,000*	*$360,000,000*	*$120,000,000*	*$164,700,000*
GRAND TOTAL	1,228,000	271,000	521,000	$14,468,285,000	$543,048,000	**$1,226,035,000**

[1] The high variance in production estimates is due to the uncertainty of the jade sector. Official export figures (~ $1 billion per annum) clash with widely cited estimate from (Global Witness, 2015) of $31 billion. Up to 80% of jade sales are unrecorded, and using more liberal estimates, the sector could be worth $170 billion, although this is unlikely.

[2] Data sources include primary data (Homalin gold only), government statistics, personal communication with ASM sector experts, NGO/INGO reports, and extrapolation from similar ASM contexts. Further data needed.

Jade

Jade is Myanmar's most valuable mineral product, and most significant ASM subsector. extracting in excess of $1 billion USD annually[3]. The sector employs a conservatively estimated 200,000 persons, primarily informal 'pickers', as well as large-scale industrial employees working in licenced 'formal sector' mines. Other estimates place employment at 300,000 to 360,000. In addition, ~90,000 jade cutters in China are linked to Myanmar extraction (EITI 2016).

Jade is exported to China, where it is highly prized as a traditional status symbol for wealth and good luck. Large pieces sell for $2 -40 million USD, and small low-quality stones are sold for as little as $1 USD. Most active jade mining takes place in Kachin State, around the town of Hpakant. The KIA/KIO, UMEHL and Myanmar army, and other armed groups are involved in the jade mining sector which has unique governance and security challenges. The region hosts tens of thousands of migrants, in addition to over 100,000 internally displaced persons. In the last twenty years, mechanized Chinese mining equipment has been replacing traditional ASM mining practices, keeping production levels up.

Gemstones

It has been estimated that 80-90% of global ruby production takes place in Myanmar (NRGI, 2018), famous for its 'pigeon blood', deep red colour. ASM has been practiced in the 'Land of Rubies' for over a millennium, but gemstone mining in Myanmar remains forbidden to foreign investors. Gem mining takes place principally in Mogok, Mandalay Division about 200 kilometres north of Mandalay and Mong Hsu, in Shan State. Based on production values and proxies from other countries, the number of miners is expected to be upwards of 100,000. In addition to rubies, sapphires and spinel are also produced. Following a boom during 1995 – 2004, production has fallen to around 10 million carats per year, worth an estimated $130 million USD. According to research by NRGI (2018) it is estimated that 60 – 80% of gems are never formally declared (NRGI, 2018). Almost all gems are sold to Thailand for cutting, hen onwards to global markets. The U.S. sanctions limit but did not stop Burmese gems, as they are marketed as 'Thai' or 'Sri Lankan' gems which don't face import restrictions. Ruby mining has been criticized for supporting the military junta, using forced labour, contributing to systematic rape and ethnic cleansing, and child labour (Haigh, 2008) (HRW, 2008). This study did not include field visits to gem or jade mining sites.

Tin

Artisanal tin mining in Myanmar goes back to the 14th century, first by Burmese and Chinese and later, by British and then Japanese. When mines were nationalized in 1962, many deteriorated and closed shortly thereafter. By the 1990s, only very low levels of alluvial ASM production remained, mainly in the south. Over 1998 – 2006, total tin production averaged just 505 tonnes per year. However, Myanmar surprised many in the tin industry around 2010 when in a matter of a few years Burmese tin production spiked by more than 4,000%, pushing Myanmar to become the third largest producer in the world, supplying over 10% of global tin (Gardiner & Sykes, 2015). By 2011, Myanmar was producing over 10,000 tonnes tin per annum and in 2016 production peaked at over 60,000 tonnes. Most tin mines are in Dawei, Tanintharyi State along the southern coastal stretch of Myanmar, where there are over 50 major primary and secondary deposits. Most of these mines are worked by ASM using basic gravity processing techniques, and limited mechanized equipment. (Gardiner & Sykes, 2015). There are few reliable statistics on Myanmar tin production publicly available, mainly because 95% of current tin production is from the Man

[3] A commonly reported figure for the jade sector is over $30 billion USD (Global Witness, 2015)

Maw mining district, under the control of the UWSA ethnic armed group. The Man Maw mining district began with bonanza grades over 10% (in its first two years of production), but is now down to 2-3% (ITA, 2016). This site is in Wa State, an autonomous, unrecognized state outside of government control, ethnically Chinese, and run by the UWSA. The site is less than 90 kilometres from the Chinese border, which spans over 100 km^2. Production is sold to a subsidiary of Yunnan Tin- the world's largest tin producer, and upstream supplier of many electronics companies including Intel, Apple, etc. Man Maw is a primary deposit mined both by open-pit and underground methods, by both ASM and LSM. (Gardiner & Sykes, 2015). ASM has be assumed to undertake 60% of production, resulting in an ASM tin production worth approximately $405 million USD. Employment numbers are difficult to estimate but based on analogous alluvial sites in Indonesia, a figure of 24,000 ASM tin miners is a starting guess.

Industrial and Other Metals

Myanmar has extensive deposits of industrial minerals and non-metallic raw materials, and most of these are mined by ASM. Limestone quarrying and cement production is a very large industry, and coal and lignite are also produced. In addition, ASM is implicated in many other base metals mined in Myanmar, including significant production of copper and nickel, as well as lead, manganese, antimony, tungsten and zinc, and (previously) iron and silver. Although a detailed review of ASM for industrial and development minerals, and other metals was outside the scope of this study, Pact analysis provides conservative (minimum) estimates of 46,000 ASM workers in ASM of industrial minerals, and 6,000 ASM workers in other metals.

National gold sector

More than 300 gold deposits are officially recorded in Myanmar, in Mandalay and Sagaing in central/northern Myanmar, Kachin and Shan States in the north, and Mon State and Tanintharyi Region in the south. Five formalized gold operations have been in recent operation, including the Monywa/Letpadaung copper-gold mine and Kyaukpahto gold mine in Sagaing Region, and the Phayaung Taung, Lebyin/Shweminbon, and Modi-Momi Taung mines in Mandalay (Zaw, 2017). With the exception of Monywa, these are small to medium size gold mines in international terms. Until January 2018, gold could not be 'officially' exported from Myanmar. Government gold production statistics indicate an increase in production from less than 100 kg in 2008 to around 1.5 tonnes in 2015. Statistics pertaining to historical or current ASGM population or gold production are absent from government sources. At present, the majority of ASM gold production appears to be exported as illicit export (smuggling) to China, India and Thailand (representing a considerable loss of formal government revenue). According to the Myanmar Gold Entrepreneurs Association (MGEA), the country has untapped gold ore resources amounting to 1.3 billion tonnes, of which only ~5% has been exploited (Malerbrugger, 2018).

There are two main ASGM methods used in Myanmar. In Mandalay, most gold mining is in hard-rock deposits, accessed using shafts/adits, and often processed using cyanide. Cyanide (CN) is very effective at dissolving fine gold from crushed rock. Sodium cyanide salt is spread over the sand-sized particles in a vat, water and lime added to regulate acidity. Gold dissolves into the liquid, which is passed through activated carbon or zinc to collect the gold, and then melted into doré bars.

Surface and riverine mining of alluvial and colluvial gold deposits is common in Sagaing, Kachin and Shan States, using suction dredging, riverbank mining, open-pit hydraulic mining, conventional truck-and-shovel open cast mining, and individual sluicing and panning. A large portion of ASGM mining is taking place along waterways, despite a 2012 law forbidding mining

within or within 300 feet of rivers. The Chindwin, Irrawaddy and Tanintharyi rivers (upon which communities depend for primary drinking and household use) are being contaminated by active ASGM dredging activities (Osawa & Hatsukawa, 2015). All miners exploiting alluvial deposits use sluice boxes to separate the heavy gold, from the lighter weight sand particles in a slurry. Mercury is used extensively in the final recovery phase, where gold-rich "black sand" concentrates are panned by hand. Mercury amalgamates with gold particles, enabling miners to recover very fine gold which would otherwise be lost.

Based on Pact's research, it is estimated that a minimum of 2.2 tonnes gold was produced by ASGM in 2018 (with value of 76 million USD), although this could be as low as 1.1 tonnes or as high as 6.7 tonnes. Refer back to Table 2 for Pact's estimates of the ASGM population by region, which total ~175,000 mine workers, representing ~95% of gold sector employment in the country.

Mercury and the Minamata Convention

Mercury is widely used around the world as a cheap and quick way to extract gold, but the metallic element is highly toxic and can have gave health impacts on miners and their families, including downstream communities. The ASGM sector, worldwide (in more than 70 countries) is presently the largest source of mercury to the global environment, and this issue is being addressed around the world through an international UN treaty called the Minamata Convention - aimed at controlling and reducing mercury use and emissions in various industries including gold mining. Although Myanmar is currently not signatory to the Convention, the government submitted interest in adopting the treaty in 2015 and received $700,000 USD in available funds from the UN Environmental Program (UNEP) in 2017 to conduct an initial assessment and National Action Plan (NAP) for ASGM. Efforts to begin the process began in 2018, with support from the Artisanal Gold Council (AGC) and UNIDO, however implementation of the planned ASGM assessment appears to be stalled, at the time this report was written.

4. ASM gold mining in Homalin Township, Sagaing Region

Pact selected Homalin Township in Sagaing Region as the focal point for in-depth study, based on recent growth and intensity in the region. Field studies to visit mine sites, interview miners, and household surveys were undertaken by Pact during June and August of 2018. Homalin Township is arguably the most heavily disturbed landscape by ASM, in recent years. Over 35,000 hectares were affected in 2015, representing 39% of mine-impacted land in Myanmar (Connette, et al., 2016). More than two-thirds of this mining disturbance seems to have occurred during 2002 – 2015, demonstrating the recent increase in mining activities. Homalin lies along the Chindwin River, which contains gold deposits for over 200 kilometres of its length (Zaw, 2017). The Chindwin river basin, together with the Irrawaddy River to the east, constitute over 95% of Homalin's gold mining-affected land. These rivers flow through the central 'dry zone' lowlands of Myanmar, also known as the 'rice basket' so-named for its' significant agricultural production. The most intensive gold mining occurs along the Uyu River, a large tributary of the Chindwin.

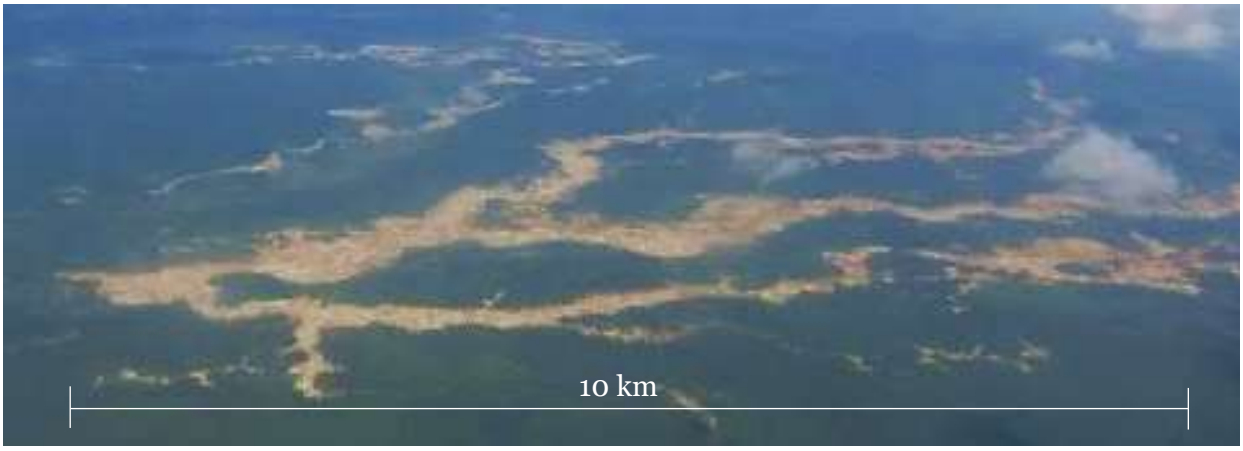

Figure 3. Oblique aerial view of approach to Homalin: gold mining impacts along a tributary of the Uyu River

Mining started in Homalin about 1992 but was limited until the early 2000's when the international gold price began to rise. The first suction pump was reportedly installed in 1996, but only in the early 2000's did production ramp up: satellite imagery highlights this growth effectively. Currently there are approximately 70 – 120 legal, registered mines, owned by 49 companies, and employing 1,000 – 5,000 workers directly. An average registered gold mine in Homalin has 20 employees, although this varies depending on the orebody and mining methods used. During the peak rush of 2003, there were 711 mines and an estimated 75,000 – 200,000 miners. Presently, the estimated number of active gold miners in Homalin is estimated to be around 50,000 (range between 30,000 and 200,00). However, no census or survey has been completed with a high level of certainty. There are several hundred unlicensed mines, which can host from 20 up to 1,000 miners each, often working in cooperative structures, and contributing positively to local development. Mercury pollution by the ASGM sector in Homalin is extensive, although difficult to characterize with certainty: two studies have documented high levels of mercury in the environment, as well as in hair samples of miners, and non-miners (Osawa & Hatsukawa, 2015) (SEI, 2017).

Due to very limited information available on Homalin gold mining prior to the study, the objective of Pact's first visit in June 2018 was to characterize the mining environment, describe g operations, and identify critical issues facing the mining community. A team of 5 Pact staff members visited with gold mines, accompanied by 2 officials of ME2. Eight legal small-scale mines were visited along the Uyu River, as well as gold shops, town administrators and a health official. During field observations and interviews with miners, data was collected on the technical, financial, and operational components, as well as on social and environmental issues.

The gold mining region of Homalin is a large low-land region of dense forest, cut by the Uyu River, where most mining takes place, before it empties into the Chindwin. Low hills less than 100 metres dot the landscape, and 10 km to the north begin large, rugged hills/mountains; 20 km to the west is India. Before mining accelerated, forests were harvested for their valuable timber; it is likely that mining replaced forestry livelihoods for many people. Regionally, farming is the main livelihood alongside mining. The Uyu River is wide (up to 1 km in places), silty, and fast moving. It is not a safe river to travel on with abundant debris flowing past. Elephants use to roam the area, some residents recall, but no longer presumably as a result of numerous factors including deforestation, mining disturbance, and habitat fragmentation. Geologically, the mineral deposits are secondary/alluvial, formed by the erosion of 'hard-rock' deposits in the distant geologic past

high above the river plains. The gold is extracted from loose sands along the Uyu River and its tributaries, as well as the Chindwin, for several hundred kilometres. The gold is deposited in 'paystreaks' or concentrated layers which can be shaped like shoelaces winding down the paths of ancient streams, wide, humped lenses, or broad, flat expanses of low-value, gold-bearing sand. The latter two formations characterize Homalin. Mining occurs primarily along tributaries of the Uyu River, and within 200 metres to 10 km from the riverbank. Predicting the location of deposits is challenging, and according to conversations with miners very rarely is exploration drilling used to evaluate mineral potential. Instead, experienced miners look at the geomorphology (shape) of the landscape and river channels, and orient efforts based on previous successes. Most of the remaining deposits are underneath water level, and therefore require suction-pumping to extract. Further from rivers, however, where gold paystreak lenses are still found, high-pressure water jets are used to extract gold bearing sands. In this way, hills up to 100 meters tall can be reduced to beach sand. The miners look for certain characteristics in the sand and gravel, including colour (darker colours indicate more heavy minerals, and likely gold), consistency (a complex matrix of silt, clay, along with coarse sandy gravel indicates a more favourable environment) and they avoid layers that have only clay and silt – they often contain little or no gold. Generally, coarser gravel indicates higher gold grade. A rough estimate is 0.1 – 0.5 grams per cubic metre (0.2 – 0.9 grams per tonne) however systematic measurements weren't taken. Sand is loose and unconsolidated which results in unstable highwalls, and landslides are common, and sometimes fatal.

Suction-dredging is most common mining method. A suction dredge works like a giant hoover, sucking up gold-bearing sediments underneath the water, pumping them up and across a sluice box. The sluice box (a long wooden channel lined with carpet, to collect gold particles) traps the heavy gold particles along the bottom of the carpet bristles, where they concentrate and build up, while lighter particles wash over the top. After several hours of pumping and sluicing, the carpets are cleaned, and the black sand concentrates are carefully collected, and then transported to panners who pan concentrates with the use of mercury. The total costs of a 6-inch diameter suction-dredge and sluice ranges between $5,000 - $20,000 USD, although these costs tend to vary considerably. In addition to 6 in. diameter pumps, 8 in. and even 10 in. pumps are in use, however these are more expensive and difficult to maintain. The life expectancy of a suction dredge is only 2 – 4 years, as the pumps are pushed to their maximum, the diaphragms are poorly constructed, and maintenance is rarely performed. Production from each pump-sluice varies considerably depending on the operator and the value of the ground being worked. An average figure from mines visited was up to 2 grams per day per pump, but this can vary between 0.5 grams – 10 grams. Often, a bank of 15 -20 pumps will work in unison to excavate and slowly advance underwater mining in this way, in a semi-systematic manner. A bank of 15 - 20 pumps can produce 15 – 25 grams of gold per day, on average. Each pump-sluice has 3 – 5 workers, whose job is to control the pumping rate, ensure the suction intake is optimally placed on the riverbed to maximize production, keep the floating dredge platform solidly in place by driving down the 'spud' or metal anchor buried in the sand, and also monitor the sluice box and pipes. There is a lot of moving around and physical labour involved, especially in driving the pump, which is done manually in most cases, by a trio of miners jumping on top a wooden plank to drive the spud deeper. This all occurs aboard an unsteady platform on water, with unguarded motors spinning: hazards that can maim and injure, not to mention the risk of being knocked off and drowning. Miners often do not sluice the first 20 ft of sand, called overburden, and wait until visual signals indicate gold-bearing horizons have been reached. Approx. 60% of Au production in Homalin is from suction-dredge operations.

Figure 4. A miner clearing the sluice box in preparation for sluicing gold-bearing sands

Figure 5. A row of suction-pump dredges in Homalin

Figure 6. Suction pump dredge mining for gold in Homalin: a miner carefully walks along the 6-inch steel pipe

Figure 7. ASM safe and efficient technological advancement. Miner on the left invested in mechanical spud driver to increase production, improve safety and increase profitability

The second common method of alluvial mining is hydraulicking, where a high-pressure water jet is used to spray and wash down a tall wall of gold-bearing sand and gravel. Between one and three miners hold onto this high-pressure jet, and face considerable risk of landslides from loose, unstable highwalls that can be more than 60 metres tall. When miners see that a collapse is likely, they select one individual to man all the hydraulic jets, so that in case the slope collapses, only one person is at risk, rather than several. Hydraulic operations ('hydraulicking') are suited to gold-bearing sands in higher elevations, and they produce a large volume of tailings that need to be managed carefully. It is a complex method that requires planning. When the material is washed down, a pump is lowered into a sump depression, and the material elevated high to very tall, long sluice boxes up to 200 metres in length. This long length is unnecessary for gold recovery but is used to dispose of tailings, so they don't contaminate the working pit. Hydraulic mining operations cost slightly than suction-dredging, as they often need mechanical excavators and haul trucks to remove some overburden, construct roads, and more laborers to fulfil all the different tasks. However, they can be more selective of mining higher value ground, and can mine with higher throughput rates, recovering more gold. An estimated 30% of the mines in Homalin use hydraulicking techniques.

Figure 8. An artisanal miner in Homalin facing the most common occupational hazard - landslides

Figure 9. Hydraulic-mining in Homalin results in a "moonscape" of degraded land (active worker in centre)

Figure 10. Manager of a small-scale gold mine in Homalin

The third and least common ASGM mining technique in Homalin is conventional truck-and-shovel mining – and this approach occurs in only few scenarios. This is the most costly and complex method, however, there is flexibility in mining using excavators and dump trucks, and the equipment has rental value. Thus, equipment owners also rent their mining equipment out to ancillary construction or other mining tasks. An estimated 8% of Homalin mining is done this way, but this estimate is not well constrained. Backhoes cost around 1,300 lakh ($89,000 USD) and can also be rented. Operating expenses and wages vary between mines, but typical operating expenses for diesel, food, and wages cost between 150,000 – 750,000 kyat/day ($103 - $515 USD/day, although fuel costs can be much higher depending on several mining criteria. Diesel alone can cost up to 1,750,000 kyat/day ($1,200 USD) for the largest mines.

A final category of ASGM miners are individual miners using only sluice boxes and a shovel. They typically set up in the tailing streams of the suction-pumps, or along river banks, and work for 1 – 3 *yway* (0.14 – 0.4 grams) of gold per day (approximately $5 - $16 USD/day).

Mercury use observed in Homalin

Mercury use and pollution were previously reported along the Uyu and Chindwin rivers (Osawa & Hatsukawa, 2015) (SEI, 2017) and Pact's visits observed widespread mercury use during

processing of mineral concentrates. Following a mine shift (8 – 12 hours), mineral concentrates were brought to domestic areas where women took on the panning, mercury amalgamation, mercury burning/cooking, and sale of the sponge gold to shops. Outside miners' homes, 5 x 5 x 1 metre pools were used by women to pan the concentrates, clean with soapy water, and amalgamate with mercury. Excess mercury was squeezed out with a cloth, so the resultant 1 – 2cm ball was 50% gold, 50% mercury. In the final step, women burn the mercury within a paper wrapper on charcoal within 4 x 4 metre, poorly-ventilated huts. Children are often present during open-burning indoors. Money from gold is quickly spent on operational costs (fuel, spare parts, food, wages) few households save money.

The labour roles and norms that mean women are principally responsible for mercury processing of mineral concentrates is highly concerning. Women and children are more susceptible than men to contamination and poisoning from mercury. Generational IQ loss results in communities where children are in close vicinity to open-air burning, and pregnant women can pass contamination to their offspring in-utero, which is known to retard early stage development. When questioned, many women did not understand the risk of inhaling invisible, odourless toxic mercury fumes.

Figure 11. Fine-grained gold and black sands in a wooden panning dish. Gold grains are very fine, in the range of 100 mesh (0.15 mm) to 400 mesh (0.037 mm). Black sands consist of magnetite, ilmenite, goethite, and zircon. Magnetite was about 30% of the black sand, which can be easily removed (although not practiced) using magnets.

Figure 12 Women panners using mercury to recover gold

Figure 13 Female mine owner and gold trader refines gold with blow torch to 95 - 98% purity

Figure 14 Gold-mercury amalgam ready for refining

Figure 15 A women burns mercury amalgam in the open air inside a poorly ventilated house

Most of the 30 gold shops were buying 1.5 – 5 tical (25 – 80 grams) on a good day, but larger shops claimed to purchase up to 25 tical (400 grams) on a busy day. Smaller shops essentially operate as traders, selling product to larger traders - and can profit at around 5,000 kyat/tical trader ($20.70 USD per 100 grams Au), whilst the larger buyers claim to earn 3,000 kyat/tical ($12.40 USD per 100g) for their gold sales. Gold prices[4] were found to track international spot price closely[5]. In remote gold shops near mines, the average gold price was 910,000 kyat/tical ($37.60 per gram). Larger gold buyers and traders in Homalin purchase for 915,000 k/t on

[4] Assumption of July 2018 gold price: $39 USD per gram

[5] The international spot price is set through daily auctions by the London Bullion Metals Association (LBMA), used by traders and miners globally as a standard price.

average ($37.80/gram) and in Mandalay, the main domestic market for Homalin gold, the price is between 900,000 – 944,000 t/k ($37.18 - $39.00). The international spot price at the time was 945,000 t/k ($39.00/g). Based on interviews with miners, panners, and regulators, the ratio of mercury used to recover each gram of gold ranges from 1:1 to 5:1 depending on the operation. Based on these data points collected, Pact has used a conservative Hg:Au ratio of 1.75, to make estimates of mercury consumption. On this basis, Pact estimates approx. 4 tonnes of mercury is being consumed and emitted per year in Myanmar, however this estimate is based on mercury use observations in Homalin only and additional survey work is required to improve this estimate. On the basis of Pact's, observations, there is urgent need for awareness raising, education, health services and technical supports for these mercury dependant ASGM operators. Also worthy of note is a report from 2015 which confirmed that hair samples of miners in Homalin showed mercury levels 2.5 times those of non-miners and the health impacts of mercury remain poorly understood or recognized (Osawa & Hatsukawa, 2015).

Figure 16. Gold shop owner in Homalin Town

Figure 17. A 10 tical gold bar (~163 grams), the first step in the gold refining and trading market.

Homalin Township Livelihood and Health Survey

A total of 50 individuals were surveyed by Pact during June and July 2018. The questionnaire included 120 questions on demographics, mining practices, health and gender, hygiene and sanitation, household income and savings and food security. Respondents came from eight mining sites in Homalin: Hwai Pha Lar (34), Than Shwe Yi Aung (4), Shwe Sin Moe (5), Dakana Ta Khon (3), Ngwe La Won Thar (2), and one each from Nant and Dakan Thiri. Nine women were surveyed, and forty-one men. Key results are summarized below.

Demographics

- Miners surveyed ranged in age from 16 years to 55, with 70%) between 22 and 38 years.
- Working females were in their 30's; males responded as migrants and 'head of household'.
- Most miners achieved between level six and level nine education; 98% declared themselves Buddhists; 60% were married. Each miner had on average 5 – 6 household members.

Livelihoods

- Job roles included general labourer/miner, panner/amalgamator, and mine supervisor. Most younger miners were laborers, and mine supervisors were generally in their late 30's.

- Mining roles were gender-specific: women panners, amalgamators and traders/service providers, whilst men were labourers and managers. This follows cultural beliefs that mining is 'men's work' and corresponds to the fact that women are not allowed in underground mines.
- Only 1 of 50 had received formal mine training. The majority (86%) of miners practiced ASM year-round alongside farming. A few alternated between the two; 20% had no alternative.
- Two-thirds (64%) planned to stay in ASM as long as the mines were producing, 89% of women. Child labour was not reported, but survey methods were insufficient to study this.

Role of women in mining

- Based on interviews, approximately 5 – 20% of the mining workforce in (legal) small-scale mines are women: within the informal sector this figure is estimated to be around 10%.
- Asked about the significance of female roles in the ASM community, 32% stated they were 'essential', 48% stated their role was 'fair', and the remainder didn't know.
- The overwhelming response about the barriers to female integration into mining businesses was that of cultural influence, that 'the place of women is in the house'.
- Women are limited to the roles of panning, mercury amalgamation-burning, and trading. Reasons given for the lack of women involved in mining was the household work load, and a shortage of money. More than three-quarters (78%) stated they were 'comfortable' with females playing a leadership role in ASM activity, which contradicts the current status quo.
- Of the eight mines visited during the June 2018 trip, one was led by a woman, who explained difficulties in the male-dominated business: claimed that very few women sit on management boards; only one of the miners surveyed had ever attended any gender training.

Occupational Health and Safety including Mercury Use

- Asked about mercury, 56% stated that they knew about the health hazards related to using it, but this did not deter them from burning amalgam in their home. Just over 60% said they burnt amalgam inside their homes; none of the 50 miners had ever used a retort.
- 86% of miners admitted to using mercury. Miners purchase their mercury locally in Hwai Pha Lar, where it is sold by numerous gold shops.
- One miner admitted getting help from (his) child to burn mercury amalgam, and another parent admitted children involved in transporting concentrates.
- Parents and children reported that children attend school, and in fact several schools' construction were apparently funded by miners (both legal and informal).
- The most commonly reported mining accidents reported were drowning (46%) and machinery-related accidents (46%)

Sanitation, disease and reproductive health

- Respondents claimed that drinking water is obtained from wells, although significant use is made of river water and abandoned mine ponds water sources.
- Nearly all respondents stated that they wash hands with soap before and after every meal and take daily baths. Waste pits are used to dispose of dry solid waste, and the most common toilet facility used is the fly-proof pipe toilet, which is present at every family's residence.
- The most common disease reported was diarrhoea; most miners reported having malaria or knowing individuals with it. Treatment is available in local clinics.
- All respondents were aware of HIV/AIDS, although only 10% had ever received specific education on the topic. Testing is done at the government hospital. Knowledge about how HIV is transmitted was lacking; nearly 40% had no idea: others recognized that unprotected sex and blood transfusions could transmit HIV.

Income, savings and food security

- Mining was the main income source for 90% of those surveyed, with the remainder mentioning agriculture as their main livelihood. Reported family income ranged quite widely from 100,000 Kyat to over 500,000 ($60 - $310 USD).
- Two-thirds of miners stated that they do not save any income, with 22% reporting 'regular saving' of an average 25,000 Kyat (USD $15) during the past 6 months. No microfinance facilities are available locally; national bank branches are in larger towns such as Homalin.
- Spending on education varied from as little as 10,000 Kyat (USD $6) up to 500,000 Kyat (USD $310). Miners reported that nobody ever dropped out of school, although when pressed, some admitted they were forced to withdraw because they could not afford to pay fees.
- A few respondents claimed to spend money on health (10,000– 500,000 Kyat over past year)
- Eight of fifty miners reported taking out loans during the past year. Only one person stated that food security was a problem. When questioned further, stated being forced to sell household assets, and that some days the family went hungry.
- Wages for migrant men are the lowest, followed by women, and local or experience male miners earn the most, summarized below. Practically all female mine workers surveyed were from local communities (as appose to being immigtant or itinerant workers).

Table 3 Average monthly wages for men (local and migrant) and women in Homalin ASGM.

	Monthly wage range	**Average wage**	**Monthly Wage**
Male (Migrant)	55,000 – 122,000 kyat	94,000 kyat	$65 USD
Female	100,000 – 150,000 kyat	112,000 kyat	$77 USD
Male (Local)	150,000 – 270,000 kyat	175,000 kyat	$120 USD

- Benchmarked to the minimum wage of 3,600 kyat per day, these wages are not as high as in other ASM contexts, perhaps reflecting the labour market conditions in rural Myanmar, and limited income opportunities. Most miners seem satisfied with these wages. Informal miners have a wider reported earning range.

Homalin HCD Workshop & Results

The HCD workshop during August 2018 was focused on understanding health at the village-level within Homalin gold mining communities. To gain an 'end-user' perspective, the team placed the focus of activities at the village level by working with local women and spending time in two small villages: *Khauk Ngoe* and *Naung Khan*. These villages closely neighbour illegal mine sites, with the largest and most well-known illegal mine site in the area being Hway Hpa Lar. While these communities largely perceived themselves to be agricultural-driven, their proximity and involvement in the mining sector place them at high risk for potential mercury poisoning. The team intentionally sought additional perspectives on the issue from clinicians and other informal health professionals, to map out interactions between service providers. Framing Pact's study with a health focus, as opposed to mining legislation or supply chains, allowed the team to move somewhat freely and avoid local politics.

In the first two days of the trip, the research team worked at the structural level, spending time in Homalin town to conduct observation and interviews with the local township administrator, ME2 officials, and local clinicians. This reaffirmed understanding of local health issues and system structures gained in previous scoping trips, including the health-related agendas and efforts of varying government bodies (i.e. ME2's latest mercury reduction campaign). The team additionally spent time in the informal settlement of Hway Pha Lar, the largest illegal gold mining site in the area - observing miners, women panning gold (using mercury), and those selling mercury in gold

shops. Questions focused on gauging health practices at the mine site (specifically focusing on women and mercury use), along with perceived health priorities from the community. During these visits, two-part workshops with local women were conducted over four days. These were held in nearby villages, accessible two hours by car from Homalin. The HCD workshops undertaken by Pact's experienced HCD team revealed the highly nuanced character of the health services landscape in rural Myanmar, including a general lack of awareness, and in some cases a disinterest in mercury toxicity and dangers. The detailed results of Pact's HCD workshops are not provided here - but interested parties should contact Pact Myanmar for further information.

5. Conclusions and Opportunities for ASM in Myanmar

ASM provides a livelihood for over 500,000 people in Myanmar. Myanmar produces around 90% of the worlds jade and rubies and is the third largest tin producer. Subsistence gold mining supports rural economies in Sagaing, Mandalay, Kachin and Shan States/Regions, and many other metals and minerals are produced throughout the country. Over $1 billion USD is produced annually by ASM in Myanmar. This report is the first nation-wide estimate of Myanmar's ASM sector, highlighting the significance of ASM livelihoods for millions of Burmese. ASM remains negatively perceived by communities, the media, and government officials. Since the governments ASM formalisation provisions were introduced in 2015, little has changed in practical terms for most ASM miners in Myanmar, although progress continues with 2018 Mining Code revisions. Subsistence miners face threats from unsafe working conditions including health risks associated with mercury use, to legal risks, and in some cases criminality (violence and extortion). Improved collaboration and awareness raising is critical to changing the narrative and building support for ASM livelihoods, which can transform rural communities. Many organizations are active in the natural resources space in Myanmar but most focus on transparency challenges, governance and accountability. Most ASM analysis focuses on negative impacts, and there is no regional or national ASM association to support constructive development of the sector. Through the course of this study, Pact made significant steps to build relationship with MONREC and other NGOs. Further engagement will be critical and should not be delayed – to support ASM operators, improve regulatory and monitoring capacities, and include interventions focusing on health and livelihoods. This report concludes with a list of eight opportunities to support Mynamar's ASM stakeholders in developing the mineral sector. Pact has strong interest in taking these opportunities forward and is actively seeking partnerships in doing so. Immediate next steps are described in the final section.

Health Systems Strengthening

Raising awareness of health issues among ASM mining populations is critical. Broader health awareness raising should be conducted, educating village residents on basic health and safety concerns (e.g. occupational hazards) in addition to specialized and acute care (i.e. HIV). From speaking with 50+ women in focus groups and interviews during the assessment, the lack of maternal and child health education is clearly evident. Midwives and traditional birth attendants serve as very influential points for healthcare but are under-resourced and need additional training. According to communities in Homalin, all training should be made very practical (experiential) and delivered with a high-level of visuals, as opposed to being literature-based. Pact's team recommends that mercury-awareness and reduction programming should be included as a component of wider health interventions including WASH, STD/HIV, and new born and child health. Pact intends to pursue further work with the Ministry of Health due to their broader mandate. Pact already has an MOU with the ministry and furthering this partnership to support focus on mining populations would build upon Pact's history of effective health

programming in Myanmar. To strengthen the township's health system, Pact should work with the Township Health Departments (THD) to advocate for health systems strengthening.

Support for ASM Formalization

Introduction of the new mining law in 2015 and rules and regulations subsequently enacted in 2018 has extended provisions for the formalization of ASM operations under an altered small-scale mining category and a new subsistence mining category. Despite the creation of these provisions, obstacles still stand in the way of artisanal miners obtaining formal recognition, such as expensive and inappropriately onerous environmental impact assessments, and a complex, bureaucratic licensing process. Obstacles and impediments to the formalization of ASM operations means that mining activities will continue to be characterized by high levels of environmental degradation, rent seeking and corruption from local police and administrators, and unsafe, inefficient mining and processing practices. Support should be provided to capacitate government ministry staff in best-practice ASM legislation to improve miners access to legal rights, access geo-data, and remove financial barriers to ASM formalisation (ex: taxation, export restriction, loan availability). ASM regulation should be benchmarked to best-practice standards, which will require revision of EIA requirements to simplify the process and reduce costs. Support for formation and capacity development of ASM mining cooperatives, as well as regional and national ASM associations, is required to ensure the sector has a greater voice and platform.

Mercury Use in Myanmar's ASGM Sector

The National Action Plan (NAP) being developed in response to the Minamata Convention is an important opportunity for Myanmar ASM sector stakeholders, to raise sectoral awareness to the danger of mercury use in ASGM and develop solutions to ensure community safety and reduce mercury emissions.

Awareness raising and education: Based on the low level of awareness of mercury toxicity among affected community members that Pact observed, educational and outreach programs should be among the top priorities for NAP workplans. Basic education and awareness strategies may be able to improve future health outcomes considerably.

Access to mercury-free gold processing technologies: The adoption of alternative equipment and practices at mine sites can support miners to reduce mercury use and avoid acute exposure to harmful mercury fumes. Technical interventions and miner trainings should focus on supporting ASM operators to increase mineral production, but with safer and cleaner outcomes. Demonstrating and assisting them to improve production and efficiency (e.g. income) is the 'hook' which will incentivize behaviour change. Equipment such as retorts or fume-hoods can reduce the level of mercury exposure, while use of magnets, sluices, shaking tables or centrifuges can improve gold concentration and reduce or eliminate the need for excessive quantities of mercury during amalgamation. During Pact's study, two technologies – magnets to clean mineral concentrates, and mercury vapour fumehoods – were trialled with men and women to assess their appropriateness and adoptability in the local context. Both technologies have limitations, however the process of trialling technologies enabled Pact's team to understand the needs of mining communities and identify potential technologies and interventions that may have greater traction. The viability of advanced processing technologies was discussed with mine owners, including the use of improved sluicing, jigs, centrifuges and shaking tables. Of these, shaking tables are the most suitable, being low-cost ($6500 from China or Mandalay), and simple to install and operate. Installing a shaking table to replace panning activities and establishing a women's' processing cooperative would eliminate health hazards associated with mercury (no mercury would be used),

improve livelihood diversification, increase women's empowerment, and recover higher amounts of gold more efficiently. Miners were very interested in better processing technology.

Figure 18. Pact introduced the use of hand magnets to clean mineral concentrates, and co-designed fumehoods with Homalin gold miners.

Mercury health screening: There are currently no known institutes conducting mercury testing, in Myanmar, which accentuates the lack of evidence-base to support mercury interventions. Along with awareness campaigns, miners and community residents should be tested for mercury poisoning. This will build credibility, validating future requests for partnership and resources from the Ministry of Health and other key stakeholders. Mercury screening could be embedded with other health screenings, such as HIV/STDs, for example.

Child Labour

Children are present in mines across Myanmar, but mostly hidden from view. Several miners surveyed admitted to using the help of children both in extraction and panning, amalgamation and burning activities. An honest account of child labour in the sector should be undertaken, followed by interventions which focus on drivers of the issue. Mining work can constitute 'worst forms' of child labour as defined by the ILO, and despite the complexities and sensitivities, effort should be directed to eradicating child labor where its worst forms are evident and supporting social services.

Empower Mining Community Networks and Stakeholders

Throughout the assessment, village leadership were pointed to as those who make decisions at the village level - however, it was apparent that the community lacks formal mechanisms to raise 'grassroots' issues or initiatives to leaders. This has significant impacts for behaviour change, particularly if village leadership do not identify issues community members face (e.g. women's health). In other work, Pact's integrated approach in Myanmar has combined communities' needs with governance through Village Development Committee (VDCs) – a grassroots mechanism for promoting inclusive and participatory village decision-making, supporting transparent and accountable development, and sustainability. Pact could assist in the formation and support of these governance structures, advising on integration of local voice in decision making to ensure

health needs are raised. Similarly, but on a national scale, network strengthening between ASM sector stakeholders could have tangible effects.

ASM Market Incentives

Increase access and provision of mining and business skills training in ASM communities: Business skills and support for entrepreneurialism are needed to provide ASM operators and miners with the possibility to formalize their businesses and livelihoods. Basic business skills are often lacking in these communities, as well as an understanding of permitting procedures. Skill building workshops with specific formalization focused agendas can be a very useful way to support miners in their interests while also pursuing formalization objectives of the government.

Financial support for ASM business: In many ASM regions, access to finance is a major barrier for miners who wish to develop their businesses. A study should be undertaken to assess and support if and how ASM miners can gain access to bank accounts and small loans, which would enable them to increase production and improve their livelihoods. Financial management skills are often lacking in ASM communities as well, and support systems which assist miners to manage finances better should also be prioritised.

Support for a Myanmar 'Responsible Gold' Initiative: Myanmar recently opened its doors to the international gold trade, providing a new market opportunity for ASM. Many international gold traders wish to purchase responsibly produced gold and in some cases are willing to pay a premium for gold that is responsibly produced. Incentives for clean and safe mineral supplies must be driven by markets, and by engaging traders. Building the case for Myanmar financial lenders to support ASM is necessary in order to unlock capital for miners to invest in cleaner, more efficient technology. This should be started by developing a pilot program with a legal small-scale gold mine or establishing a responsible subsistence-based gold mining cooperative.

Livelihoods Diversification

Over the course of Pact's assessment, most miners and residents surveyed considered their work as 'seasonal'; 47% of community focus group participants mentioned farming as their primary occupation, and 100% of women miners voiced desire for their children to engage in different work. While gold mining is the largest industry in the region, education is limited for those in the sector, and there is strong need for supporting vocational training, especially for youth. In addition, value addition opportunities exist in several ASM mineral supply chains, for example the quality of gold jewellery produced locally could be improved upon.

Gender Equity in the Mining Sector

Women miners in Myanmar suffer from unequal opportunities in the ASM sector work and face disproportionate health and safety hazards. Providing gender training and awareness raising of women's skill sets would help shift the cultural perception that currently limits their vocations. Support to women should be prioritised in technical training programs, as well as in health systems, improving their knowledge and access to services. Business development support should be made available to women-led enterprises.

6. Next Steps

Co-designing a Homalin gold business that is: legal, clean, safe, artisanal, cooperative, and gender-sensitive. This approach would need to look at mercury-free processing, fair prices for ethnically processed gold, and safer working practices that would go a long way to improve health

indicators in the community. Pact plans to deliver the Homalin intervention in three phases, starting with a health intervention.

Phase # 1: Health Intervention: During the scoping visits in late 2018, health concerns were identified as a key concern among community participants and other stakeholders. While many health issues can be directly linked to the use of mercury in artisanal mining, this link was not strongly made by members of the community, including health professionals. With the global disease burden of mercury is 1.2-2.4 million DALYs (Disability Adjusted Life Years), putting this health statistics on par with Hepatitis B and Parkinson's disease, the community does not make this link. There is then a need to educate the community on the hazards of mercury use, especially on women and children. However, there are wider health issues linked to ASM communities including HIV-AIDs, maternal/child health issues, immunization, non-communicable diseases, and health & safety issues. The intervention, therefore, must be a holistic health intervention dealing with overall health issues and more community awareness on the health impacts of mercury usage. This will involve working with local health provider to build their capacity, Pact's approach being capacity-building of local stakeholder and supporting a systems approach to health.

Phase # 2: Introduction of Mercury-Free/Reduced Technologies: All artisanal (and small-scale miners) use mercury in Homalin as a means of extracting gold from ore. As women are the ones burning the gold-mercury amalgam in closed-in spaces, mostly in the homes, they are the ones affected by the toxic vapor as well as their young children who are normally near this activity. Realizing the negative impact on the health of humans, we need to introduce mercury-free/reduced technologies that could be used by artisanal miners. There are many appropriate alternatives technologies used in other ASM operations, many of which have been part of Pact's M2M work in sub-Saharan Africa, Colombia and Indonesia – techniques linked to retorts, shaking tables, pulsating jigs, centrifuges, improved sluicing, and fume hoods. Some of these are more expensive, while others are affordable. These types of technologies can be introduced as individual mining family solutions and some can be developed as communal, cooperative solutions, where women could come together as a social enterprise to operate a higher-level shaking table facility. Vocational training and demonstration modelling would be part of this phase. As well, specific designs would need to be introduced, especially for a cooperative facility.

Phase # 3: Formalization of Artisanal Miners: Sagaing is one of the regions that is introducing a formalization system in place to license artisanal and small-scale miners. This process is currently underway, and it will take some time to see a clear path forward. Under Pact's intervention, we will not be directly engaged in this process as this is something the regional government is undertaking with support from such groups as the Myanmar Centre for Responsible Business (MCRB), the Natural Resource Governance Institute (NRGI) and Oxfam; all three are providing technical support to the Sagaing state level government and the ministry responsible for licensing. We will work directly with these groups to fit our intervention into a formal, licensing process. As we develop our health interventions and introduce new mercury-free/reduced technologies, certain aspects of this intervention can be seen as an incentivization for formal licensing. If we develop a cooperative, social enterprise model for a mercury-free facility (that might be a business initiative run by women), we could say that any ore processed in this facility would have to come from licensed miners. Pact will look at setting up a loan mechanism to help these artisanal miners get proper licensing, so this would be a further incentive to

formalize. Under a formalization/licensing process, an environmental management plan is a requirement. In cooperation with other stakeholders, we would participate in this process.

Our timeline for direct intervention is proposed as follows, depending on funding availability:

- **Phase # 1: Health Intervention** – begin intervention in January 2020, ongoing programming;
- **Phase # 2: Introduction of Mercury-Free/Reduced Technologies** – phased approached starting in May 2020 with demonstration of individual systems, modelling and vocational training. Development of communal, social enterprise model for shaking table or other technology; development of a business model;
- **Phase # 3: Formal Licensing** – January 2021 - engage with regional government actors and INGOs (i.e. NRGI); develop incentivization plans – communal social enterprise facility; revolving loan fund for licensing miners.

Throughout this process Pact will ensure the development of local partners and systems – civil society groups, health care providers, village leadership via Village Development Committee.

Pact can also mobilize other platforms to support this project. Our microfinance operations, PGMF, is interested to explore the feasibility of opening an office in Homalin as we develop this intervention. If they decided to open an office in Homalin, miners may be able to approach PGMF for loans to become licensed. Upstream and downstream businesses linked to the industry, such as local goldsmiths, could also be clients. The development of a mercury-free shaking table facility will require an industrial level of electrification. Our Smart Power Myanmar (SPM) renewable energy platform could look at this if a mini-grid system was feasible. If we are looking at a larger solar panel type requirement, this can be looked at via our in-house solar system connections.

As part of the earlier intervention, we plan a community scoping visit in late June 2019. During this field visit, we would do some health awareness campaign around the ill effects of mercury use and assess other health issues. We would also conduct a meeting of community people/artisanal miners/wives to introduce mercury free/reduced appropriate technologies. A survey with gold buyers to determine their interest in purchasing mercury-free processed gold, will also be done. Turquoise Mountain, an international ethnical buyer of gold and other precious metals would be a potential buyer of mercury-free gold.

Once the technical Concept Note is finalized, we would convene a stakeholder workshop in Yangon, inviting groups such as, NRGI, MCRB, Oxfam, Spectrum, Valentis, Turquoise Mountain and others, to provide additional input.

After the stakeholder workshop, we would finalize our Concept Note for presentation to potential donors, including bilaterals, foundations and private companies.

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