NATIONAL ACTION PLAN FOR ARTISANAL AND SMALL-SCALE GOLD MINING SECTOR IN ZIMBABWE

In accordance with the Minamata Convention on Mercury



UN environment

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FOREWORD



The environment cuts across all sectors of the economy, and society at large, directly or indirectly affecting by providing a range of goods and services. The use of natural resources and environment in general should not unduly impair the productive and assimilative or regenerative capacities of the environment. The Government is aware of socioeconomic benefits of ASGM activities and the associated impacts on the environment. ASGM.

The need for development of a National Action Plan (NAP) for ASGM is a requirement under the Minamata Convention. It is designed to protect human health and the environment from anthropogenic emissions and/or releases of mercury and mercury compounds. The NAP allows the Government to be practical in dealing with mercury emissions while guided by baseline information of Mercury use practices in the ASGM Sector. The NAP development started in October 2016. Baseline information on mercury use practices was sought through field measurements and consultations with stakeholders and the public. Consultations were meant to canvas people's perceptions on key issues to be addressed by the NAP and highlight what the Government should adopt. The NAP document fully and accurately reflects the interests, concerns and preferences of all key stakeholders on the issue of Mercury use, environmental degradation, and social vices associated with ASGM activities. It also recognises the pivotal role played by ASGM Sector in the economy.

The overall thrust of NAP is to *"reduce, where possible eliminate the use of mercury in the ASGM Sector".* The document places human health at the centre of economic activities in the ASGM sector. The document has six key objectives and their associated implementation strategies with the main thrust being to ensure sustainable use of environment and maintain the environmental integrity as well as allowing equitable access and public participation in the ASGM activities.

The formulation and adoption of this policy has created appropriate conditions for long term programmes that integrate sustainable resource utilisation with the country's social and economic development and rehabilitate resources that are already degraded. My Ministry is consistent with, and will continuously promote the national agenda sustainable development. With this in mind, l am convinced that the implementation of this NAP for ASGM will not only enhance environmental management but will, to a larger extent improve economic development.

On behalf of the Government, I wish to express sincere gratitude to the Global Environment Facility (GEF), United Nations Environment Programme and Africa Institute, for financing and implementing this project. I also wish to thank the stakeholders who participated in the production of the NAP, either through participating on the National Steering Committee, or carrying out various activities related to the NAP development, or participating in NAP-related workshops. I look forward to continued cooperation in implementing the NAP.

M. MUNODAWAFA
SECRETARY FOR ENVIRONMENT, CLIMATE CHANGE, TOURISM AND HOPITALITY INDUSTRY

EXECUTIVE SUMMARY

Zimbabwe reports its National Action Plan (NAP) to reduce and, where feasible, eliminate the use of mercury in the Artisanal and Small-scale Gold Mining (ASGM) sector. This is in accordance with Article 7 of the Minamata Convention to which the country has been signatory since October 2013. The NAP development procedure followed a series of activities, starting with capacity building for the implementing members, including the national consultant, through a regional programme facilitated by the Africa Institute on behalf of the UN Environment. A coordination mechanism was put in place through the establishment of National Steering Committee. The national overview of the ASGM sector was conducted through desk studies and field data collection via interviews with the mining communities, observations and some physical measurements. A nationwide project sensitisation was conducted through electronic and print media complemented by sensitisation meetings in the ASGM hotspot provinces. The NAP document was then prepared by the National Steering Committee based on the findings from this baseline study and subsequent consultations with relevant stakeholders, including assessment of past experiences addressing ASGM challenges. The baseline analysis revealed that out of the eight mining provinces in Zimbabwe, Midlands, Mashonaland West, Matabeleland South, and Mashonaland Central were the hotspots of ASGM activities in terms of the number of gold processing sites and population of miners. There were considerable mercury emissions largely through open burning of amalgam during gold processing. Mercury volatilised and emitted into the air at national level were estimated in the range of 7,729 to 83,765 kg (average: 24,285 kg) for the base year 2018, using three methods. The emissions had been increasing gradually since 2012. Underground and open-pit gold mining were more dominant than alluvial gold mining along rivers in the ASGM hotspots. Gold extraction from ore using the mercury amalgamation process was predominantly done on concentrates after milling and gravity separation. The majority of the ASGM hotspots used stamp mills for own or custom milling, although increasing prevalence of hammer mills and ball mills was noted in some areas. The baseline did not fully establish the legality of the people involved in ASGM activities following the decriminalisation of such activities in the country. It was however established that the poor extent of formalisation of the ASGM sector is one of the key challenges that has given rise to non-compliance of ASGM players to the existing legal provisions that could considerably

reduce mercury emissions. Lack of effective organisational structures that efficiently represent the needs of miners in the ASGM sector was found to have paralysed previous Government efforts to address the sector. The formalisation efforts by Government were found to be through setting up gold milling and buying centres and registering of the ASGM players. The ASGM sector has been contributing over 40% of mineral exports in Zimbabwe, and employed over 25% of formal employment with more than 300,000 people being involved in ASGM. There has been a gradual increase in gold production from the formal and semi-formalised gold miners in the small-scale mining sector. The survey established the need to raise awareness on the dangers and proper use of mercury, and to address identified myths that endanger the miners and mining community health care systems. The ASGM sector were found to be poorly responsive to the manifesting health and safety challenges arising from exposure to mercury. In response to the objectives of the Minamata Convention, the Country has proposed a budget of USD3 328 000.00 to go into: reducing mercury use in the ASGM sector, based on the quantities determined by the baseline data by 20% in 2021 through the elimination of major inefficient and unsafe practices and harmonising policies and regulations those promote sustainable ASGM activities (75%); establishing and strengthening ASGM representative organizational structures to effectively represent the needs of the sector (2%); building and strengthening institutional capacity of regulatory authorities and ASGM support institutions (2%); enhancing cooperation and partnerships at all levels among miners, public authorities, industry, NGOs, academic institutions and other stakeholders (1%); developing and promoting the safe handling, storage and disposal of mercury in the ASGM sector (1%); and strengthening public health interventions on the use of mercury in ASGM (19%). These activities will be achieved through engagement with government Agencies, industry, non-governmental organizations, local leadership, academia and other stakeholders; development of an outreach plan that increases awareness and advocacy on use of local technology and know-how for reduction of mercury use in ASGM; formulating and implementing of fundraising strategies to support the National Action Plan; and increasing collaboration and networks with local, regional and international institutions.

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A. INTRODUCTION

A1 BACKGROUND

Since the signing of the Minamata Convention on Mercury in October 2013, Zimbabwe has put considerable effort towards collecting scientific data and evidence on mercury use in the Artisanal and Small-scale Gold Mining (ASGM) sector (e.g., Chisango, 2017; UNIDO, 2018). Under Article 7 of the Convention, the country is required to produce a National Action Plan (NAP) in fulfilment of its obligations to the Minamata Convention on Mercury. In the NAP, parties are required to come up with strategies to reduce and, where feasible, eliminate the use of mercury in the ASGM sector.

The gold mining sector in Zimbabwe is generally subdivided into: (1) formal large scale, (2) formal small-scale, and (3) informal small-scale and artisanal operators. In Zimbabwe an artisanal miner is officially defined as "a miner who carries out mining activities using approved tools and employs up to 50 people; these include government-registered groups or syndicates or co-operatives" (EMR, 2014). The ASGM sector is characterised by miners who move in and out of the sector and mostly engage in ASGM as part of a diversified livelihood strategy that also includes agriculture and other activities (Mawowa, 2013). In practice there is a strong connection between the formal small-scale miners and informal artisanal operators, because the former usually purchase and process gold from the latter (Mawowa, 2013). Mercury use in gold mining became prominent in Southern Rhodesia (now Zimbabwe) in the 1930s (COWI, 2016a), however, like South Africa, many of the large scale gold miners in Zimbabwe moved to other gold recovery methods that not only have higher recovery efficiency than mercury amalgamation, but also comply with international funding institutions and markets (Ledwaba, 2017). While the global anthropogenic mercury emissions to air from large-scale gold mining was estimated at 5% in 2010 (AMAP/UNEP, 2013), most large scale gold producers in Zimbabwe, who are largely foreign owned generally do not use mercury in refining gold, leaving the ASGM sector as the major source of mercury emissions in gold production.

Zimbabwe was listed among countries where the mercury amalgamation process is used for gold extraction in 2002 during United Nations Environment Programme's first Global Mercury Assessment (UNEP, 2002). This was followed by the Global Mercury Project in 2007 in which Zimbabwe reported mercury emissions from the ASGM sector under the guidance of the United Nations Industrial Development Organisation (UNIDO). This project conducted baseline studies on mercury emissions with particular focus on Kadoma District in the Midlands Province of Zimbabwe, and established among other findings that 1.7 to 3.4 tonnes mercury is lost at milling centres annually in the Kadoma-Chakari area (UNIDO, 2007). In 2011 the UNEP's International Mercury Assessment established that 10-30 tonnes of mercury is released each year from mercury amalgamation in ASGM in Zimbabwe (UNEP, 2011). The ASGM sector involves both reef and alluvial gold mining. There is a general perception that when the gold source is alluvial, miners "do more sieving than digging and do not need to go to the miller" (Pact, 2015). Local studies on the chemical composition of alluvial gold in Zimbabwe have found that alluvial gold grains in Kwekwe District had up to 10% mercury (Styles et al., 1995), and attributed the high mercury in alluvial gold to contamination by mercury from the amalgamation process.

A2 NATIONAL PROFILE OF ZIMBABWE

Zimbabwe is located in southern Africa between 15° 30" and 22° 30" S, and between 25° 00"and 33° 10" E, covering a total land area of approximately 390,757 km^2. The 2012 population census indicated a total population of 13.1 million people with the average household size of 4 persons (ZIMSTAT, 2013), while the 2018 population was projected at 14.5 million (ZIMSTAT, 2015). According to the 2012 population census reports, artisanal miners are largely concentrated in Midlands (19,451), Mashonaland West (13,267), Matabeleland South (12,153) and Mashonaland Central (8,781) provinces. In these provinces 88-92% of the ASGM population is dominated by males, while the age group 20-39 years is the dominant age involved in ASGM activities.

According to COMZ (2018), gold has accounted for 40% of mineral exports in 2017, down from 47% in 2016, and employed over 25% of formal employment with more than 300,000 people being involved in artisanal gold mining. Historically, "as late as 1908, more than 70 % of the country's mines were classified as 'small workings' and most

mining activities were carried out manually or artisanally" (PACT, 2015). When the country was under the Colony of Southern Rhodesia (1923 – 1979) the early small-scale gold prospectors and miners were gradually replaced by foreign owned mining companies constituting the large-scale mining sector (Chachage et al., 1993). Gold production estimates reveal that there has been a gradual increase in gold production from the formal and semi-formalised gold miners in the small-scale mining sector (**Table A1**).

Table A1 *Gold produced and delivered to Fidelity Printers and Refinery*

Year	***Production (kg)***	***Production by SSM (kg)***	***Contribution (%)***
1982[a]	13,367	n/a	n/a
1989[a]	16,003	1920	12
1992[a]	18,278	n/a	n/a
2002[a]	15,469	n/a	n/a
2009[b]	4,966	959	23
2010[b]	9,619	2,093	25
2011[b]	13,001	2,766	24
2012[b]	13,478	2,607	19
2013[c]	14,000	2,426	19
2014[c]	15,386	3,728	28
2015[c]	20,000	7,532	40
2016[d]	21,440	9,680	45
2017[d]	24,842	13,176	53
2018[e]	33,288	21,678	65

n/a = not available*; Sources:* ***a*** = BGS (2018); ***b*** = COMZ (2013)*;* ***c*** = COMZ (2015); ***d*** = COMZ (2018); ***e*** = MoMMD (2019)

According to MoMMD (2018), "there are over 4 000 recorded gold deposits, nearly all of them located on ancient workings, and the country remains under-explored to discover new deposits as well as realising full potential of known deposits". The deposits are largely concentrated in four provinces of Zimbabwe, namely Midlands, Mashonaland

West, Mashonaland Central and Matabeleland South (**Figure A1**). More than 90% of gold deposits in Zimbabwe are associated with the greenstone belts which are some of the richest and comparable to those in some leading gold producing countries in the world like Australia, South Africa and Canada (MoMMD, 2018). The national average gold ore grade is estimated at 3.4 – 3.6 g/t (COMZ, 2015).

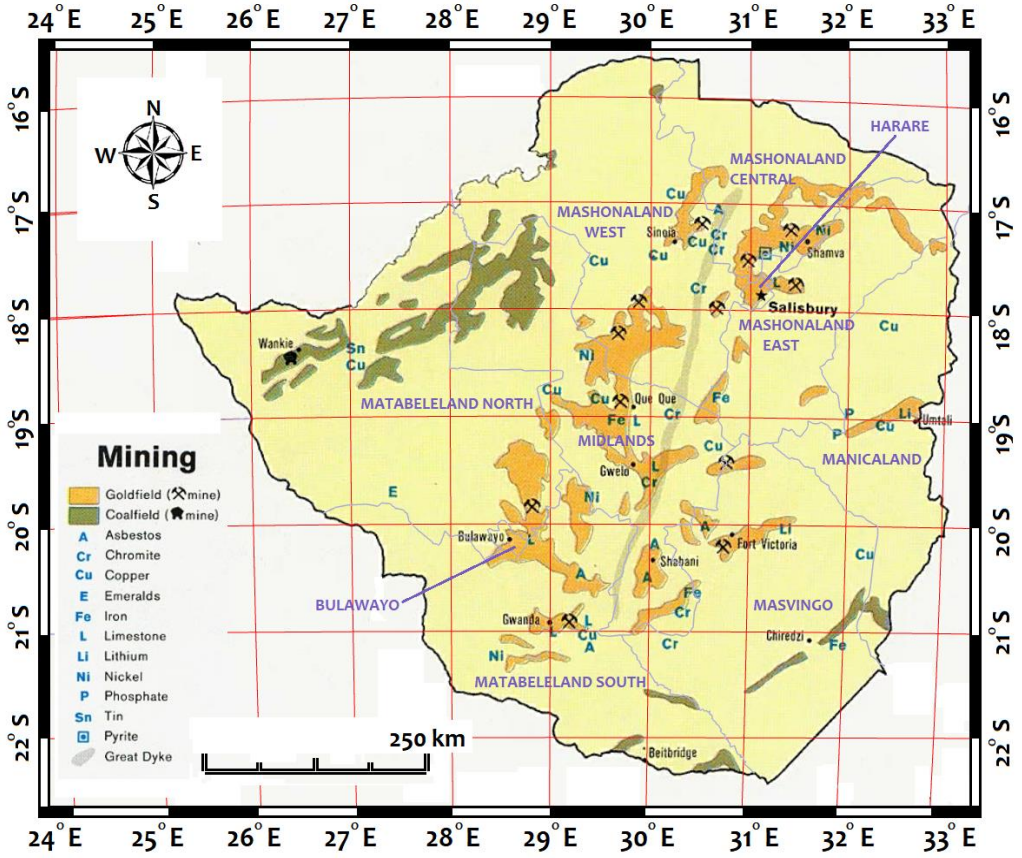


Figure A1 *Distribution of goldfields in Zimbabwe (modified from the Zimbabwe- Rhodesia Geological Survey map of 1979)*

A3 NAP DEVELOPMENT PROCESS

Zimbabwe attended a NAP Regional inception workshop on NAP for Artisanal and Small Scale Gold Mining in South Africa in October 2016. This led to the appointment of two focal points to represent the country throughout the project. At national level, the Country conducted an inception workshop which was attended by various stakeholders in the ASGM sector. A National Steering Committee made up of various experts from

different government ministries and agencies was established. Its terms of reference are mainly focused on overseeing the implementation of the NAP. The workshop also crafted a work plan and assigned tasks and responsibilities to the committee members for execution. The Committee engaged a national consultant to carry out a baseline study on ASGM activities in the Country. The steering committee members and the consultant were oriented on the application of the UN Environment data collection toolkit by international consultants.

A nationwide project sensitisation was conducted through electronic and print media complemented by sensitisation meetings in the hotspot provinces identified for study. The provinces are Mashonaland West, Midland, Mashonaland Central and Matabeleland South. Desk study to gather existing information on ASGM was also done prior to field work. Data collection was done using a standardised Toolkit which was provided by United Nations Environment and key informant interviews were carried out with key stakeholders. After data collection, the consultant presented findings to the steering committee which made some observations and comments for consideration. The issues which arose were addressed by the consultant.

The Steering Committee crafted National Action Plans deriving issues from the baseline study findings, with the assistance of the National Consultant. The draft National Action Plans (NAPs) and baseline report were presented to Environmental Management Agency and Ministry of Environment Tourism and Hospitality Industry directorates who also submitted their input for consideration. The Nation was appraised on the status of NAP through electronic media. The NAP document was send to United Nations Environment and Africa Institute for review. Review comments were addressed by a task team formed from the steering committee to finalise the NAPs. Feedback meetings were held in the study provinces to share the findings of the study. Matters which arose during the feedback meetings were incorporated into the NAP document which was finally submitted to the Ministry of Environment Tourism and Hospitality Industry for endorsement. A regional workshop was convened in Eswatini to share country experiences and lessons learnt by countries that were doing NAPs.

B. NATIONAL OVERVIEW

The ASGM sector is critical in the sustainable development of Zimbabwe despite its contribution towards mercury emissions and other environmental and social concerns. This section provides a summary of the national baseline analysis of the ASGM sector.

B1 NAP AND BASELINE STUDY METHODOLOGY

Zimbabwe attended the ASGM NAP Regional Inception Workshop in South Africa in October 2016 and, following that, a National Inception Workshop attended by various stakeholders in the ASGM sector was held. Capacity building for the implementing members, including the national consultant, was done through workshops facilitated by the Africa Institute on behalf of the UN Environment. A coordination mechanism was put in place through the establishment of multi-sectorial National Steering Committee made up of experts largely from different government ministries and agencies to oversee the development and implementation of the ASGM NAP. The national overview of the ASGM sector was conducted through desk studies and field data collection between via interviews with the mining communities, observations and some physical measurements. Field assessment was undertaken in four provinces identified based on the number of people involved in ASGM activities from previous national census data and a total of 155 mining and gold processing sites were sampled. A nationwide project sensitisation was conducted through electronic and print media complemented by sensitisation meetings in the ASGM hotspot provinces. The NAP document was then prepared by the National Steering Committee based on the findings from this baseline study and subsequent consultations with relevant stakeholders, including assessment of past experiences addressing ASGM challenges.

B2 PREVIOUS EXPERIENCES IN ADDRESSING ASGM CHALLENGES

The ASGM sector has had a gradual increase in the number of alluvial and reef gold miners, most of them using mercury for gold recovery, following the major reforms in Zimbabwe such as the Economic Structural Adjustment Programmes in 1991 and the Fast

Track Land Reform Programme in 2000. The Reserve Bank of Zimbabwe (RBZ) launched the Gold Mining and Minerals Development Trust (GMMDT) in 2001 to improve gold production and stem gold smuggling across the borders. The vision was that the GMMDT would lend to gold miners, promote environmentally friendly mining methods, assist in environmental rehabilitation, advocate for balanced mining legislation, and finance the establishment of milling centres. When regulations on the gold trade (specifically, gold-buying permits for concession areas) were enacted in 2002, GMMDT was granted four gold-buying concession permits in Harare, Bulawayo, Kwekwe, and Mutare mining districts. The GMMDT was abruptly dissolved in 2004 before adequately addressing the environmental issues. This effort need to be revived in the NAP implementation.

Ministry of Mines and Mining Development (MoMMD) has been providing loans fund to small scale miners, particularly for procurement of mining equipment. The ministry also provide free analytical services and carry out pilot test in order to recommend best gold recovery methods. The Ministry is also creating gold buying centres. So far one gold buying centre has been established in Bubi District. The target is to have at least one gold buying centre in each mining province. Miners are required to form groups and bring ore to the centres for processing. The centers also provide technical advice on sustainable mining practices and supply transport. The establishment of Gold Buying Centre is to promote formalization.

The ministry of mines also established Exclusive Prospection Zones. These provide large companies with land to carry out prospecting. They report to the Department of Geological Surveys on their findings. If there are small pockets of mineral deposits which big companies are not interested in, ASGMs are allowed to register claims.

The Shamva Mining Centre (SMC) was developed as an idea by Practical Action, GTZ, and other NGOs in 1989 and was developed further during the early 1990s. Practical Action partnered with the MMMD and the Small-Scale Miners Association of Zimbabwe (SSMAZ) in implementing the project. Supporting donors included GTZ, the UK's DFID, and the European Union (EU). Stichting Nederlandse Vrijwilligers (SNV; Foundation of Netherlands Volunteers) assisted in establishing Shamva Training School for women miners. Project objectives were to: provide a sustainable, commercially viable custom

milling facility for small-scale gold miners in the Shamva area, and improve miners' incomes. A key SMC project concept was that central milling facilities could help bring illegal mining into a legal framework and create a more centralized, organized, and easily regulated way of processing gold. It was believed that this could help control mercury usage and facilitate access to more advanced technology that would raise incomes. Training was provided to small-scale miners to improve their skills in mining methods, geology, mine pegging, environmental management, health and safety, and business planning and management.

The GTZ-funded Rehabilitation Pilot Project, following the enactment of SI 275/1991, equipment manufacturers made several attempts to develop gravity separation equipment that would be more appropriate to gold panning conditions. GTZ funded a project, supervised by the University of Zimbabwe's Department of Mining Engineering, to demonstrate the benefits of using sluice boxes and rehabilitating mined areas in small-scale gold mining regions. The pilot project, under taken at two sites in Zimbabwe along the Manyuchi and Insiza rivers, demonstrated that river bank mining as legislated could be undertaken both economically and in an environmentally sustainable manner. During the project, mined-out material from one section of the river bank was used to backfill another section. The miners removed gold-barren topsoil and subsoil, and then treated the underlying gold-bearing rubble horizon in sluice boxes. The rubble was used to fill the base of the preceding pit and topped by surface tailings, subsoil, and then topsoil. Re-vegetation occurred naturally when the rainy season arrived. Most importantly, the project showed that the cost of repairing the river bank could be covered by the value of the gold that the panners produced. The sluice boxes achieved fairly high productivities, at 4 tonnes (about 4.4 tons) per man-shift. The main drawback was that a minimum ore grade of 0.25 grams per tonne was required to justify the capital investment, which was between US$10,000 and US$15,000 per 20-person panning group. However, leaving behind material with a grade of less than 0.25 grams per tonne would soon attract.

Beginning in late 2006, police began to enforce the country's new environmental legislation, as they tried to control the illegal activities associated with ASGM such as trade in gold on the black market (UNIDO, 2007; PACT, 2015). This suppressed virtually all ASGM operations and led to the arrest of at least 32,000 miners. The approach was

later revoked in December 2013, when the Minister of Finance announced that beginning on January 1, 2014, ASGM would no longer be a criminal activity. In 2014 the Environmental Management (Control of Alluvial Mining) Regulations, Statutory Instrument 92 indicated that "alluvial mining shall not take place on land within 200 m of the naturally defined banks or land within 200 m of the highest flood level of any body of water conserved in natural or artificially constructed water storage work or stream; or any bed or banks or course of any river or stream; or land within 200 m from any wetland" (EMR, 2014). This greatly reduced alluvial mining and reduced the rate of land degradation and water pollution.

B3 GEOGRAPHICAL DISTRIBUTION OF ASGM

The assessment of distribution of ASGM activities in Zimbabwe managed to establish sites with ASGM activities by geographical location and activity density based on the number of gold processing sites per unit area of the district. A total of 155 sites were visited in four provinces that were selected as ASGM hotspots, while an additional 200 sites were identified using satellite images. A site was exclusively for extraction, processing or, in most cases, both. The ASGM activities were found in all provinces, but highly concentrated within the known gold deposits sites that are largely concentrated in four provinces of Zimbabwe, namely Midlands, Mashonaland West, Matabeleland South, and Mashonaland Central (**Figure B1**). Mashonaland West and Midlands Provinces were found to be the dominating province in terms of: (i) the number of miners involved in ASGM; (ii) the activity density in terms of number of gold processing sites per unit area of the province; and (iii) the number of formally registered gold milling sites recognised by the Ministry of Mines and Mining Development.

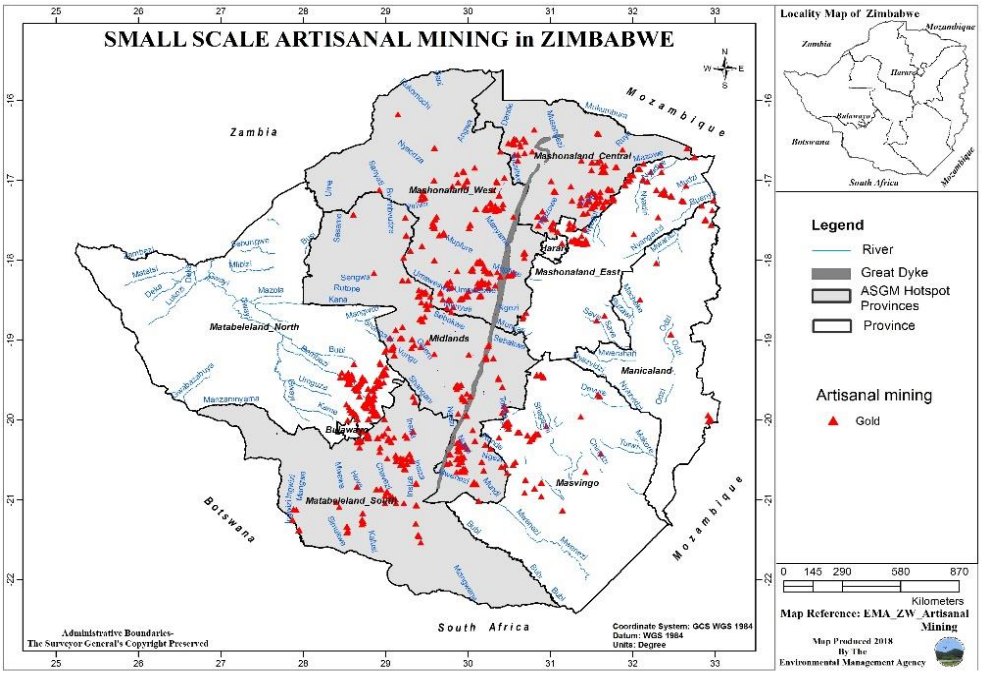
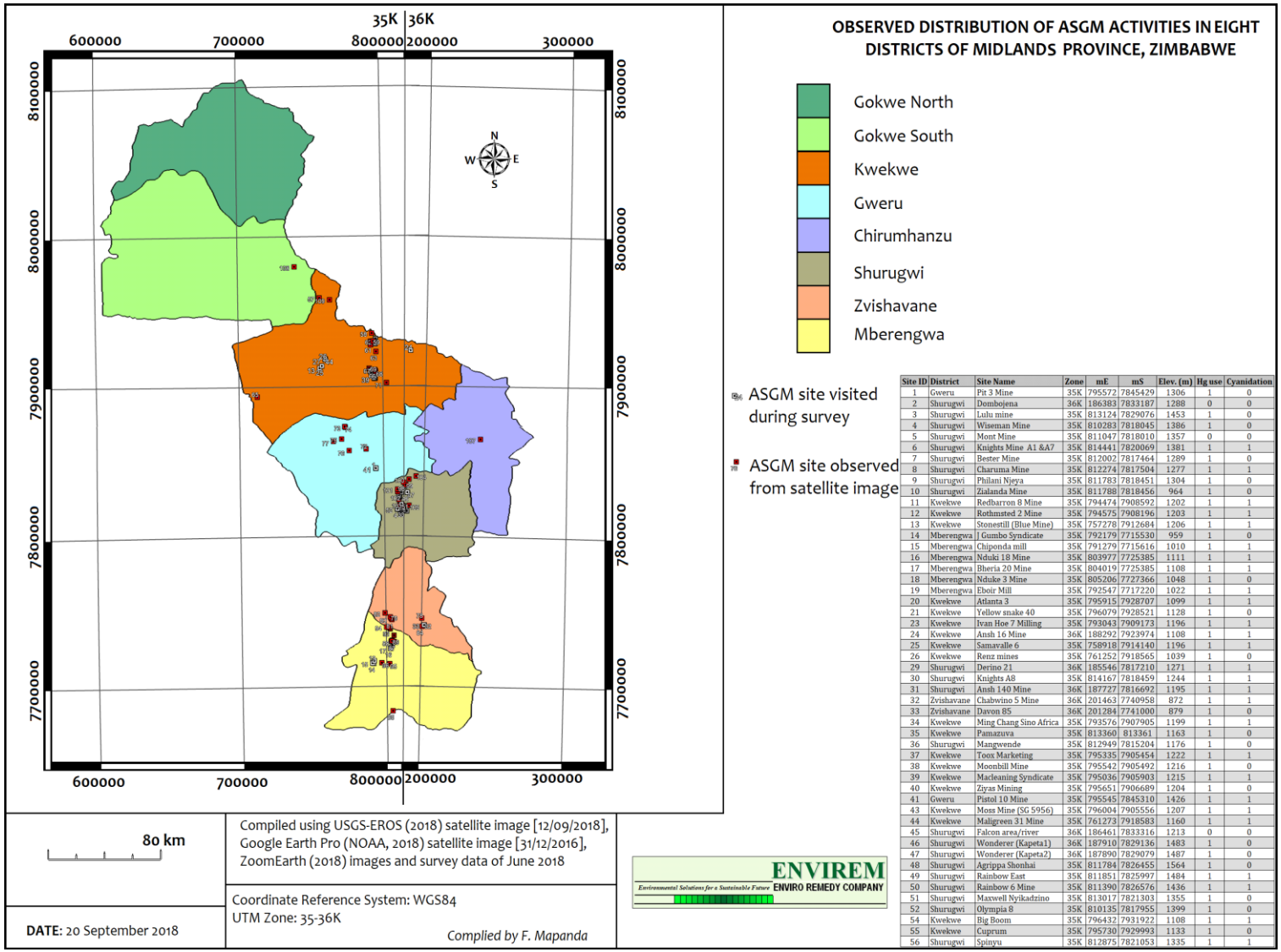


Figure B1: *Distribution of ASGM activities in four provinces of Zimbabwe (EMA, 2014)*

At district level, the study established that the following Districts were in the top ten in order of magnitude: Shurugwi (**Figure B2**), Shamva, Kadoma, Kwekwe, Mberengwa, Mazowe, Umzingwane, Mutasa, Zvishavane and Chegutu. Environmental concerns on the location of ASGM activity and proximity to water courses were noted, particularly in Shurugwi District.



Site ID	District	Site Name	Zone	mE	mS	Elev. (m)	Hg use	Cyanidation
1	Gweru	Pit 3 Mine	35K	795572	7845429	1306	1	0
2	Shurugwi	Dombojena	36K	186383	7833187	1288	0	0
3	Shurugwi	Lulu mine	35K	813124	7829076	1453	1	0
4	Shurugwi	Wiseman Mine	35K	810283	7818045	1386	1	0
5	Shurugwi	Mont Mine	35K	811047	7818010	1357	0	0
6	Shurugwi	Knights Mine A1 &A7	35K	814441	7820069	1381	1	1
7	Shurugwi	Bester Mine	35K	812002	7817464	1289	1	0
8	Shurugwi	Charuma Mine	35K	812274	7817504	1277	1	1
9	Shurugwi	Philani Njeya	35K	811783	7818451	1304	1	0
10	Shurugwi	Zialanda Mine	35K	811788	7818456	964	1	0
11	Kwekwe	Redbarron 8 Mine	35K	794474	7908592	1202	1	1
12	Kwekwe	Rothmsted 2 Mine	35K	794575	7908196	1203	1	1
13	Kwekwe	Stonestill (Blue Mine)	35K	757278	7912684	1206	1	1
14	Mberengwa	Gumbo Syndicate	35K	792179	7715530	959	1	0
15	Mberengwa	Chiponda mill	35K	791279	7715616	1010	1	1
16	Mberengwa	Nduki 18 Mine	35K	803977	7725385	1111	1	1
17	Mberengwa	Bheria 20 Mine	35K	804019	7725385	1108	1	1
18	Mberengwa	Nduke 3 Mine	35K	805206	7727366	1048	1	0
19	Mberengwa	Eboir Mill	35K	792547	7717220	1022	1	1
20	Kwekwe	Atlanta 3	35K	795915	7928707	1099	1	1
21	Kwekwe	Yellow snake 40	35K	796079	7928521	1128	1	0
23	Kwekwe	Ivan Hoe 7 Milling	35K	793043	7909173	1196	1	1
24	Kwekwe	Ansh 16 Mine	36K	188292	7923974	1108	1	1
25	Kwekwe	Samavalle 6	35K	758918	7914140	1196	1	1
26	Kwekwe	Renz mines	35K	761252	7918565	1039	1	0
29	Shurugwi	Derino 21	36K	185546	7817210	1271	1	1
30	Shurugwi	Knights A8	35K	814167	7818459	1244	1	1
31	Shurugwi	Ansh 140 Mine	36K	187727	7816692	1195	1	1
32	Zvishavane	Chabwino 5 Mine	36K	201463	7740958	872	1	1
33	Zvishavane	Davon 85	36K	201284	7741000	879	1	0
34	Kwekwe	Ming Chang Sino Africa	35K	793576	7907905	1199	1	1
35	Kwekwe	Pamazuva	35K	813360	813361	1163	1	0
36	Shurugwi	Mangwende	35K	812949	7815204	1176	1	0
37	Kwekwe	Toox Marketing	35K	795335	7905454	1222	1	1
38	Kwekwe	Moonbill Mine	35K	795542	7905492	1216	1	0
39	Kwekwe	Macleaning Syndicate	35K	795036	7905903	1215	1	1
40	Kwekwe	Ziyas Mining	35K	795651	7906689	1204	1	0
41	Gweru	Pistol 10 Mine	35K	795545	7845310	1426	1	1
43	Kwekwe	Moss Mine (SG 5956)	35K	796004	7905556	1207	1	1
44	Kwekwe	Maligreen 31 Mine	35K	761273	7918583	1160	1	1
45	Shurugwi	Falcon area/river	36K	186461	7833316	1213	0	0
46	Shurugwi	Wonderer (Kapeta1)	36K	187910	7829136	1483	1	0
47	Shurugwi	Wonderer (Kapeta2)	36K	187890	7829079	1487	1	0
48	Shurugwi	Agrippa Shonhai	35K	811784	7826455	1564	1	0
49	Shurugwi	Rainbow East	35K	811851	7825997	1484	1	1
50	Shurugwi	Rainbow 6 Mine	35K	811390	7826576	1436	1	1
51	Shurugwi	Maxwell Nyikadzino	35K	813017	7821303	1355	1	0
52	Shurugwi	Olympia 8	35K	810135	7817955	1399	1	0
54	Kwekwe	Big Boom	35K	796432	7931922	1108	1	1
55	Kwekwe	Cuprum	35K	795730	7929993	1133	1	0
56	Shurugwi	Spinyu	35K	812875	7821053	1335	1	1

Figure B2 *Distribution of ASGM activities in Midlands Province, Zimbabwe*

B4 MINING AND MINERAL PROCESSING IN ASGM

The mining and mineral processing methods used in ASGMs depended on the type of ore deposit, mineral assemblage and the affordability of the technology. The common steps in the case of alluvial and reef gold mining and processing are shown in **Figure B3**, while the milling processes are shown in **Figure B4**. Miners used mercury at all custom-milling sites and all own-millers use mercury (at least on concentrate) before cyanidation for quick petty cash. Overall, an estimated 96% of the gold processing sites use mercury and this mercury is largely emitted into air during the open burning of amalgam.

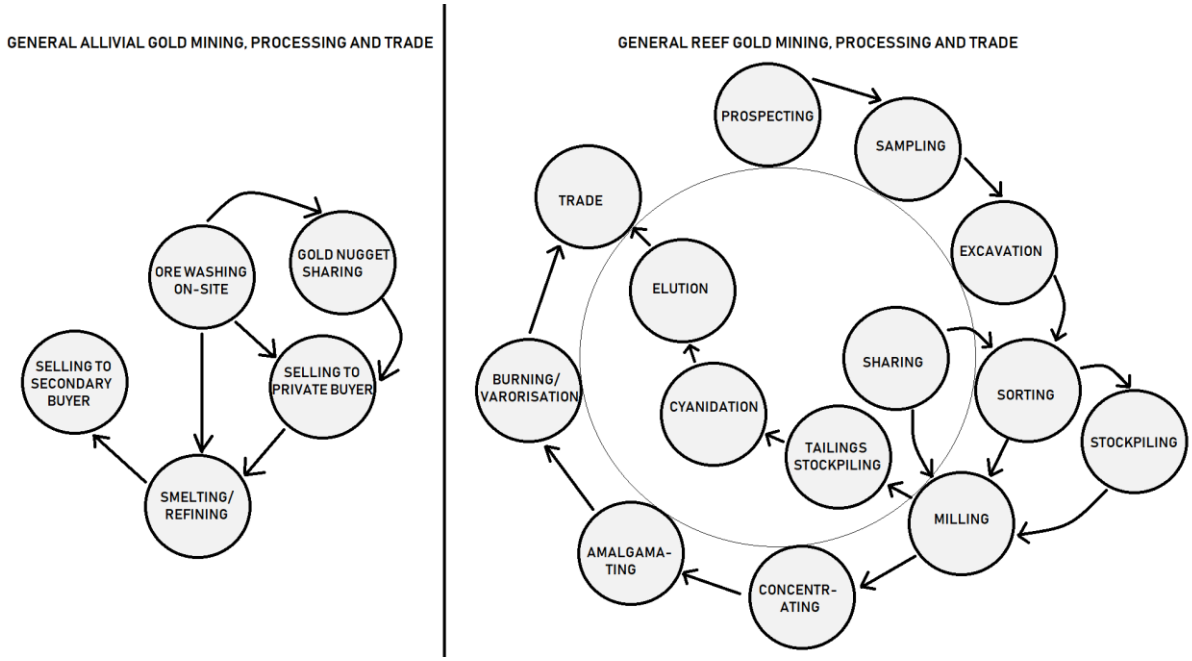


Figure B3 *Common steps in alluvial and reef gold mining and processing*

Gold recovery was estimated to be 40% using mercury amalgamation, and for the 60% of gold remaining in tailings, 90% is recovered by cyanide treatment while the remaining 10% is not recovered, giving an overall Hg-recovered: cyanide- recovered: unrecovered ratio of 40:54:6 (Lucke, 2005; Hylander et al., 2007; Mendoza, 2014). Alluvial gold processing was not done at the mill, and no mercury was used in alluvial gold processing (PACT, 2015). As of year 2017 there were 928 registered gold processing sites in Zimbabwe (Matabeleland South and North, 150; Midlands, 300; Mashionaland Central, 37; Mashonaland East, 27; Mashonaland West, 350; Masvingo, 44; and Manicaland, 20) (MoMMD, 2017). About 52% of the processing sites had 1 shift per day, while 19 and 23% had 2 and 3 shifts per day, respectively. A single shift ranged from 2 to 24 hours (average,

9 hours). The Of all the visited gold processing sites 96% indicated that they do not use retorts or any mercury recovery methods during amalgam burning, 3.2% indicated that they sometimes use retorts, and 0.8% indicated that they always use retorts. Despite the availability of retorts at some gold processing sites some miners indicated that they do not use them because they preferred open burning, perceived that some gold would be left in the equipment, and others believed that for a miner to get more gold they have to do open burning.

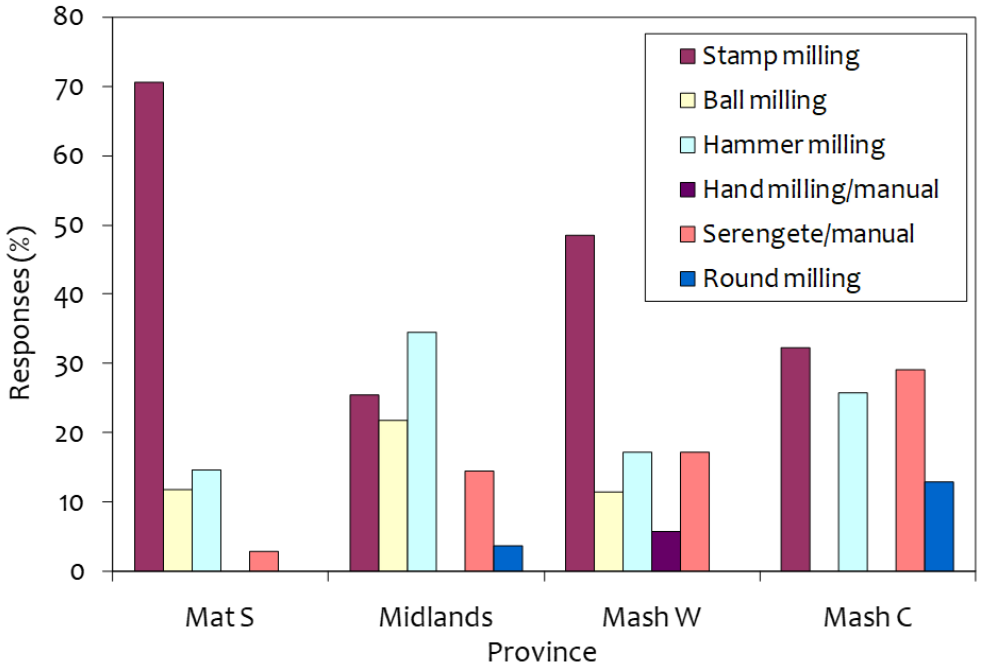


Figure B4: *Milling processes common in the four provinces of Zimbabwe*

The tailings in stockpiles were processed through chemical leaching using cyanide. The survey revealed four major worst practices and open burning of amalgam was the most practised worst practice in all the four provinces (**Figure B5**). This was followed by whole cyanidation of mercury rich tailings which was common in Mashonaland West, Midlands and Matabeleland South.

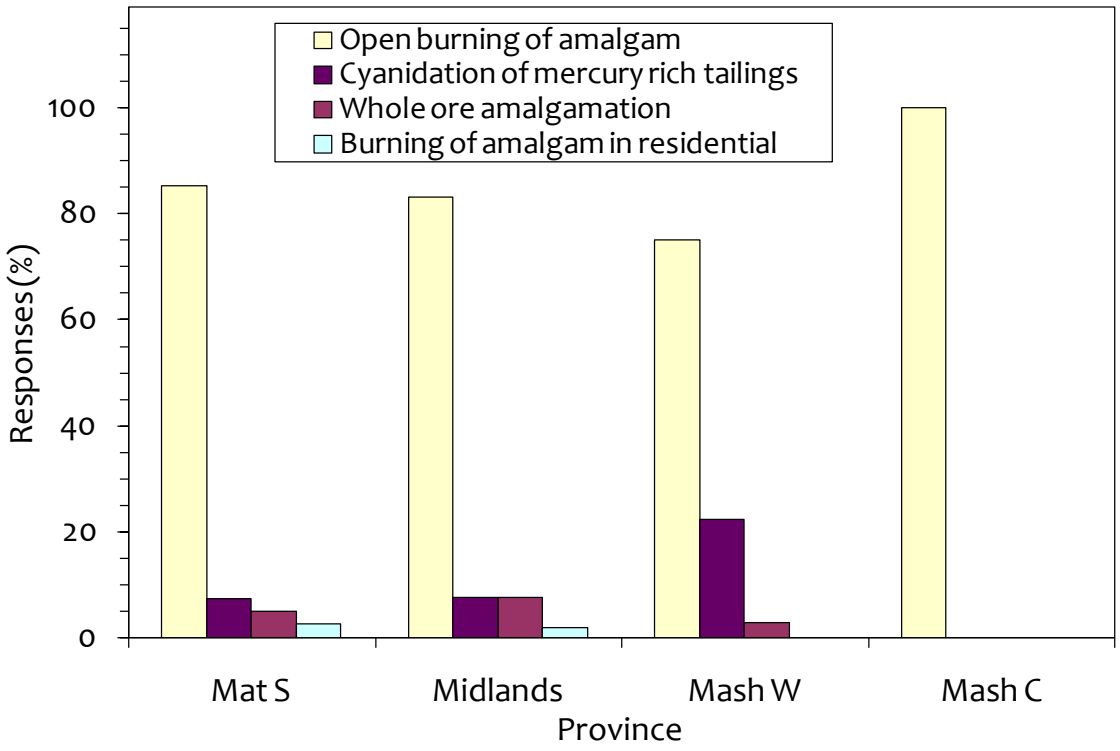


Figure B5: *Common worst practices identified in the four provinces of Zimbabwe*

The number of shafts per site was found to range from 1 to 400 (average, 6), with the highest numbers of 400 at Wonderer (Kapeta camp2, 36K 187890 mE 7829079 mS) in Shurungwi District, and 100 at Caltinia Claim (Gadzena area, 36K 197246 mE 8004207 mS) in Chegutu District. Ore production per site ranged from 0.04 to 60 t/day (average 6.1 t/day), and the ore grade ranged from 0.2 to 100 g/t (average 5.4 g/t). The miners worked between 156 and 365 days per year (average, 310 days). Alluvial gold contribution to the total gold became negligible as from 2014 following a ban of alluvial gold panning.

B5 BASELINE ESTIMATES OF MERCURY USED IN ASGM

Mercury lost was determined using Microsoft Excel spreadsheets with formulae extracted from the National Action Plan Starter Kit (UNEP, 2018) and the Standardised Toolkit for Identification and Quantification of Mercury Sources (UN Environment, 2017a). The estimates followed extraction-based, process-based and revenue based methods (UN Environment, 2017b), that are underpin by estimations of the mercury-to-

gold ratios derived from field assessment. A participatory method was used to determine the mercury-to-gold ratio, involving verbal narration by respondents, and in few cases demonstration of the amalgamation and burning processes. The mercury to gold ratio was calculated as total mass of mercury added (less excess mercury mass), divided by the sponge gold mass. In the Extraction-Based Method of estimating mercury emissions, data on ore extracted per shaft per day, number of shafts per site, ore grade, working days per year, and number of miners per site or shaft, was used to estimate mercury emissions per miner per annum. The number of miners per province was then used to estimate national mercury emissions using 2017 as the baseline year. In the Process-Based Method of estimating mercury emissions, throughput per mill per day, ore grade, working days per year, was used to estimate mercury emissions per site per annum. The number of gold processing sites in 2017 was then used to estimate national mercury emissions per annum. Lastly, in the Revenue-Based Method of estimating mercury emissions, data on gold delivered from small-scale miners to Fidelity Printers and Refinery was used together with the mercury-to-gold ratio. This was a major variance from the Standardised Toolkit procedure that is based on the revenue of an individual miner in the ASGM sector.

Although technically one portion of mercury would extract one equivalent portion of gold, survey results showed that the mercury-to-gold ratio of the amalgam before burning was ranging from 0.5 to 4 (Overall mean: 1.17). In the few cases where the ratio was less than 1 (0.5 to 0.96, average 0.7) there is a possibility that a significant amount of residual mercury would have remained in the spongy gold, that is later emitted during smelting. This was however not captured during the survey. The ratios above 3 obtained in few cases from three provinces were close to the lower limit of the range commonly found under whole ore amalgamation practices (UN Environment, 2017b). There were minor differences in this ratio among the four assessed provinces, Matabeleland South (1.18), Midlands (1.22), Mashonaland West (1.24) and Mashonaland Central (1.05). The national Hg emissions in the 2018 base year, estimated using the revenue-based, process-based and extraction based methods (according to the Toolkit for Identification and Quantification of Mercury Sources (UN Environment (2017a) are given in **Table B1**. The survey revealed that overall the highest annual mercury emissions at gold processing sites is about 6.74 kg/mill (overall mean: 4.6 kg/mill). A single miner emitted mercury into air in the range of 0.22 to 0.47 kg (overall mean: 0.35 kg/miner/yr).

Table B1 *Summary of mercury emissions in 2012 and 2018*

Year	***Estimation method***	***Mercury emissions (kg/year)***		
		Minimum	***Maximum***	***Mean***
2012	Revenue-based	1,303	10,426	3,088
	Process-based	1,439	19,420	2,782
	Extraction-based	1,619	33,322	6,280
	Combined (St.dev. %)	**1,454 (11)**	**21,056 (55)**	**4,050 (48)**
2018	Revenue-based	10,839	86,712	25,709
	Process-based	5,881	74,884	22,060
	Extraction-based	6,467	89,700	25,087
	Combined (St.dev. %)	**7,729 (35)**	**83,765 (9)**	**24,285 (8)**

B6 LEGAL AND REGULATORY STATUS

Zimbabwe currently does not have a national ASGM policy, and measures to reduce or avoid exposure to mercury have not adequately involved many arms of government, including occupational health and restrictions on mercury use under the National Social Security Act CAP 17:04 and Public Health Act CAP 15:09. In line with the national circumstances the legality of the people involved in ASGM activities was not queried during the survey. In December 2013, the Minister of Finance announced that beginning on January 1, 2014, ASGM would no longer be a criminal activity (PACT, 2015). The issue of formalisation of the ASGM sector was the one of major concern as the survey noted that the ASGM sector largely operates at varying levels including formal, semi-formal, unregistered and unauthorised status. There were concerns raised over the way unregistered gold miners and processors are viewed by the government and other stakeholders, particularly with respect to poor representation during conflict resolution and poor progress in their formalisation. The enforcement of regulations alone did not provide adequate cooperation of ASGM players in resolving the challenges in the sector. It was also noted that the Exclusive Prospection Zones established by the MoMMD, which

provides the Large Scale Mining sector with relatively large pieces of land to carry out prospecting and removed access to this land by the ASGM sector, may have increased ASGM informality. A need to revive formalisation efforts that include tribute arrangements, registration of gold claims and partnerships with claim holders was noted as part of the strategies to be included in the NAP.

All minerals, land rights and mining powers are controlled and belong to the Government of Zimbabwe. The relevant legal and regulatory instruments currently governing ASGM activities in Zimbabwe (and related challenges that need to be addressed in the NAP) include: The Constitution of Zimbabwe (GOZ, 2013); Children's Act Chapter 5:06 (that needs to define explicitly the hazardous substances, including mercury fumes and liquid, which children should be restricted from); Elution Plants Control Regulations, SI 63 of 2006, under the Gold Trade Act Chapter 21.03 (GOZ, 2006) (many milling plants use mercury and the gold processed at elution plants may contain some mercury, and therefore these regulations should be aligned with the Environmental Management Regulations on air pollution); Environmental Management Act CAP 20:27 as read with its ancillary legislation (GOZ, 2003); Environmental Management (Effluent and Solid Waste Disposal) Regulations, SI 6 of 2007 (GOZ, 2007a) (noted need to prevent the exposure of vulnerable populations to mercury used in ASGM by strengthen enforcement and monitoring mechanisms on all unlined tailings dumps, processing plants located closer to ecologically sensitive areas, and environmental rehabilitation); Environmental Management (EIA and Ecosystems Protection) Regulations, SI 7 of 2007 (GOZ, 2007b); Environmental Management (Hazardous Waste Management) Regulations, SI 10 of 2007 (GOZ, 2007c); Environmental Management (Hazardous Substances, Pesticides and Other Toxic Substances) Regulations, SI 12 of 2007 (GOZ, 2007d); Mines and Minerals Act CAP 21:05 (GOZ, 1961); Mines and Minerals Amendment Bill (GOZ, 2015); Mines & Minerals (Custom Milling Plants) Regulations, SI 329 of 2002 (GOZ, 2002); Gold Trade Act Chapter 21:03; Mining Management and Safety Regulations, SI 109 of 1990; Mines Minerals (Custom Milling Plants) (amendment) Regulations, SI 178 of 2005; Explosives Regulations, SI 72 of 1989; and the Mining (General) (Amendment) Regulations, SI 10 of 2016 (No. 19).

B7 LEADERSHIP AND ORGANISATION OF ASGM IN ZIMBABWE

The established Zimbabwe Miners Federation (ZMF) is an umbrella board made up of miners (small scale licence holders), millers and different regional Associations, and represents ASGMs at national level it is also recognised by the MoMMD, the Chamber of Mines, RBZ, Fidelity Printers and several mining equipment suppliers. This federation board liaise with all ASGMs country wide and has a database of the majority of the ASGM activities. The board was formed as a way to try to persuade the government to recognise the ASGMs but nothing is working and visible practically. The ZMF has played a significant role in advocacy and trying to shape policy in the ASGM sector, including efforts to formalise the typical gold panner with projects in Mazowe, Silobela and many others. The membership however does not include mine workers of whom about 75% are given partially binding contracts which are not involving the actual claim owner, according to the baseline survey. The NAP should therefore revisit this area in addressing exposure to mercury.

The survey established that most ASGMs do not have a proper universal organizational setup although their setup varies from site to site, pit to pit, shaft to shaft and from region to region. About 2% of the interviewed miners were organised into the so called cooperatives, however the cooperatives were not properly constituted because they do not operate with constitutions guiding their operations. It is more of mutual trust that guides their operations. How can a cooperative be recognized if they do not hold the mining permit or mining claim? They use the principal or philosophy that they can pressurize the government to regularize their mining rights or claims while they are already on the ground like the situation on housing setups. The majority of the ASGMs expressed a lot of concern and disappointment in the way they are viewed by the government and other stakeholders. Although they feel that they are being used there are still very eager and they remain optimistic that the government will put a legislative act or law that will recognize them as legal ASGMs which is not the situation on the ground now. It is therefore necessary for the government to set a legislature which directly acknowledges the ASGMs through regulatory measures.

B8 MERCURY TRADE AND DEMAND

The majority of mercury users in ASGM responded that they were getting their mercury from the shops in the nearby townships (**Figure B6**). The second major source of mercury was the custom mills who supplied customers bringing the ore for milling. A relatively low proportion of the mercury users indicated that they received the mercury from private buyers who were said to be agents of Fidelity Printers and Refineries. There was also a low proportion of miners that was getting mercury from other miners. The survey could not establish the primary source of mercury sold in the shops and identified this as a potential area for future studies.

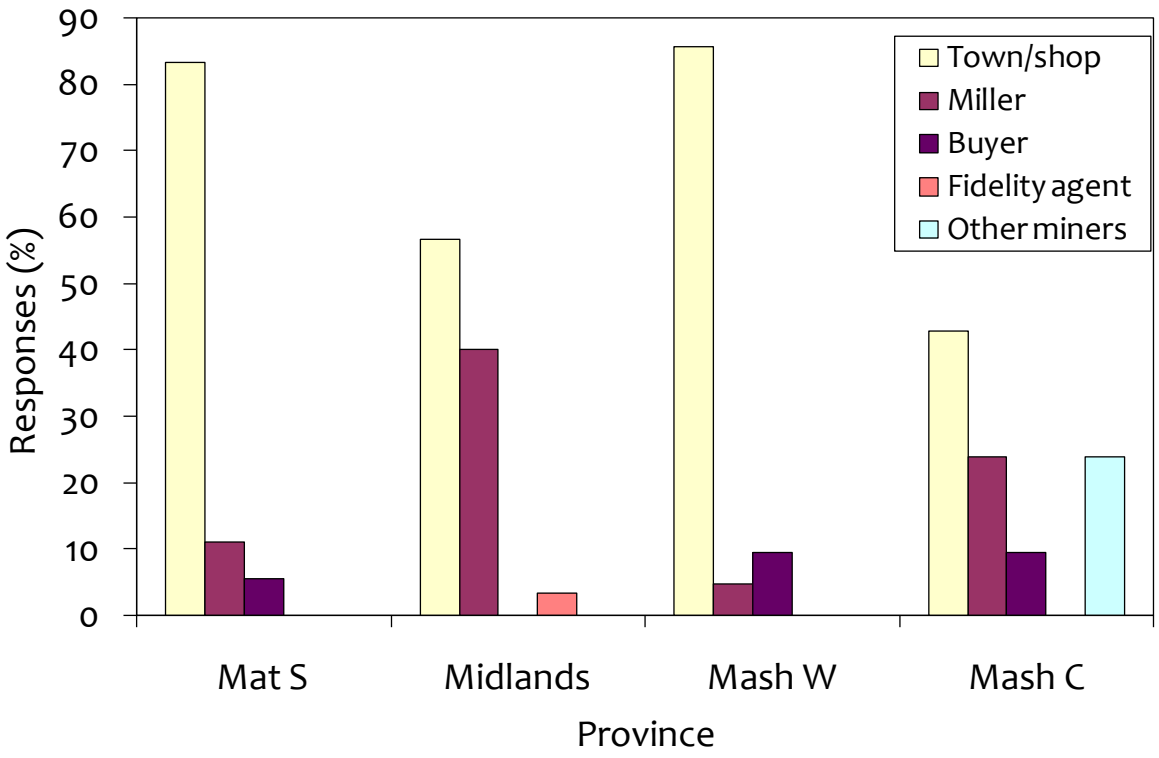


Figure B6 *Identified sources of mercury used in the ASGM sector*

Increasing smuggling of mercury and increasing Chinese mercury traders were noted indicating that mercury importation controls by regulatory authorities require improvements. Gold produced by the ASGM sector, as reported by RBZ, constitutes 40% of the total production from this sector, the remaining 60% being gold traded on black market and smuggled out of the country as from around 2003 (IMF, 2006; UNIDO, 2007; Makochekanwa, 2007; Mutero, 2016; Gutu, 2017; UNIDO, 2018). Similarly, data from

Comtrade showed an increase in mercury importation from China, Hong Kong, India, Italy, South Africa, Switzerland, United Arab, Emirates and United Kingdom through the official route up to 2012 (17,917 kg), and an abrupt decrease thereafter. This was largely due to the EU mercury export ban in 2013. The average mercury importation for the period 2010 to 2012, approximately 12 t/year, was however low compared with the Global Mercury Inventory estimate on mercury use in Zimbabwe for ASGM of 12.5 - 37.5 t/year in the same period (COWI, 2016a). The restriction of mercury sales to one company may have resulted in increased smuggling of the substance into Zimbabwe, as buyers have fewer outlets in which they can formally buy mercury. This restriction explains the apparent decrease in the formal import of mercury.

The price of mercury was on average ranging from about USD249 to USD279 per kilogram, with the highest prices in Midlands and Mashonaland West provinces (**Figure B7**). The highest mercury prices were associated with cases where mercury was sold in smaller quantities such as a tea-spoon (50 g). While mercury import was previously conducted by a number of formal companies dealing with import of mining equipment and chemicals (cyanide, carbon, acids etc.), such as Curechem, Chemplex and Mining Axis House, some years back this was restricted by Environmental Management Agency (EMA), which has cancelled the licenses of these companies and presently licenses only one company based in Bulawayo, namely K. B. Davies. As a regulatory requirement, this formal supplier is obligated to submit quarterly reports on imported quantities and record which buyers it sells to. The company has been visited by the local expert and the reports on imported quantities have been requested from the authorities, but no actual data on quantities imported and sold and information on customers have been obtained.

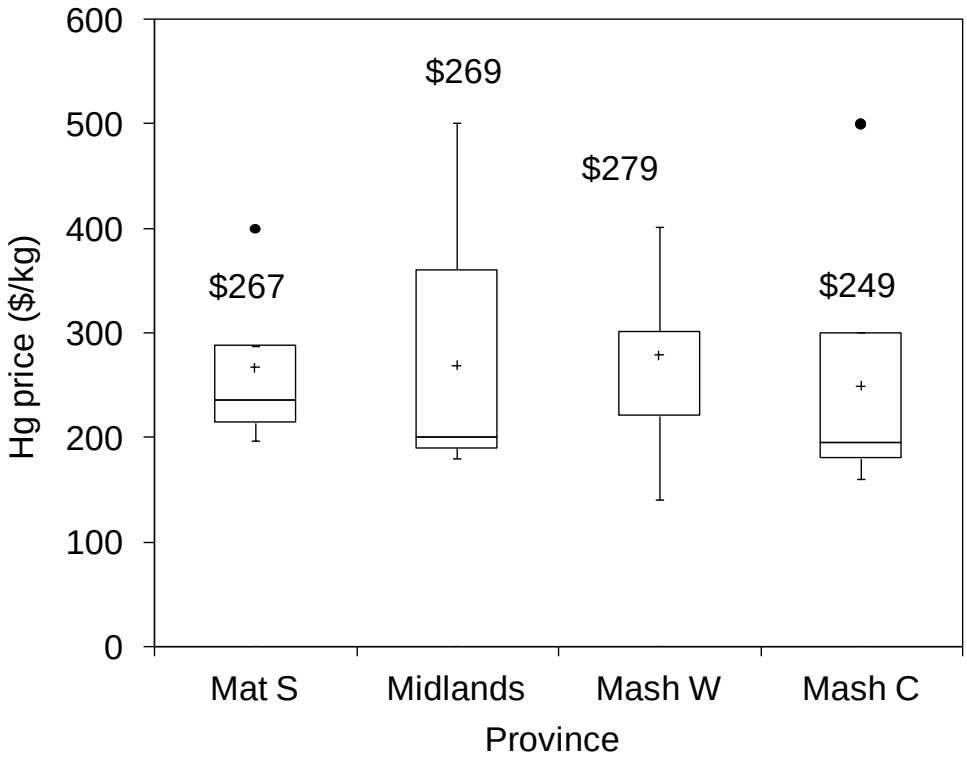


Figure B7 *Mercury prices at the point of sale to the miners in the ASGM sector*

B9 ECONOMIC ASPECTS IN ASGM

Zimbabwe's ASGM sector has been rising in prominence since the 1990s as a result of the deteriorating economy, characterized by hyperinflation and rising unemployment rates (Pact, 2017; Metcalf, 2008). The sector produced about 1,500 kg/year of gold in the early 1990s', which was roughly 10% of the country's total gold output and an approximate value of US $63.3 million (Mujere and Isidro, 2016). In 2017 gold from the ASGM sector (13,176 kg) has accounted for 40% of mineral exports, down from 47% in 2016 (CMZ, 2018). Pact (2015) estimates that the ASGM sector has directly created 35,000 formal jobs and an estimated 500,000 informal ones, which is approximately 7% of Zimbabwe's labour force (COMZ, 2018). The ASGM accounted for over 50% of the national foreign currency earnings in past decade (Gutu, 2017; COMZ, 2018). Zimbabwe aligned the operations of small-scale gold miners with its development growth targets set at 12.6% by 2018 for the mining sector, as stipulated in the Zimbabwe Agenda for Sustainable Socio-Economic Transformation (GoZ, 2013) .

The majority of the miners are driven by poverty and the general lack of employment opportunities in the country, following the shutdown of large-scale mines and the continued layoff of public sector workers with the worsening macroeconomic situation. Throughout the visited sites, it was evident that mining will continue to be an important means of survival and a catalyst for small business growth in the local communities. The miners in visited provinces operated mostly on 50-50% revenue distribution with the Pit Owners, after expenses are accounted for. However, some sites reported that miners are on a fixed monthly salary within the range of $182-$270 per month. The miners work 6 days per work with an average of 12 working hours per shift. The miners highlighted the socio-economic significance of ASGM activities to local development, rural livelihoods and generation of household incomes. It was also observed that ASGM was also an integrated economic system to compliment agriculture, as supplementary incomes generated from ASGM activities were used to support agricultural activities.

Mechanism to foster synergies between the mining sector and small to medium sized enterprises can further strengthen the sustainability of ASGM activities as a positive coping strategy for rural households. Furthermore, policies that create incentives for selling gold through the formal markets are likely to generate more positive multiplier effects and macroeconomic level.

B10 DEMOGRAPHIC AND SOCIAL INFORMATION

The significance of the ASGM sector as a source of livelihoods in rural communities and in the socio-economic development of Zimbabwe is well recognized, despite the related social, environmental and human health challenges. There are social concerns over the escalating cases of child labour, poor occupational health and general lack of social security (PACT, 2017). There are also concerns that ASGM activities create disincentives for schooling, especially during the episodes of 'gold rush' (Metcalf, 2008). The baseline survey established that ASGM activities were generally adult male-dominated, with males performing most of the tasks that require considerable strength, including ore extraction, stockpiling, transportation, refinement and cyanide tank feeding. Women are mostly limited to complimentary activities such as panning, office work and security. However, these kinds of activities carry with them high risks of mercury exposure and potential

poisoning. Although some women actually owned mining claims, the common problem was lack of financing, technical skills and unequal power relations. Interventions and policies to enhance women's equitable participation in the ASGM sector need to be carefully considered.

The majority of responses indicated that children participated under very exceptional cases, particularly in gold panning where children assisted their parents. However, in operations such as shaft mining and gold processing using mercury no children were reported to be involved. The number of miners per site ranged from 2 to 2000 (average, 37) with the highest number of miners at Wonderer site in Midlands and Mashonaland Central provinces. In the Midlands Province, the team observed that women were mostly involved in panning, which relatively requires less labour but, unfortunately, involves direct contact with mercury. In many of the ASGM sites visited, women tend to perform the most toxic jobs in as far as mercury use is concerned. They principal role involves panning, locally known as "serengeto", whereby mercury is poured in small dishes with alluvial. Throughout the sites visited, this process was done with bare hands and no protective gloves were used. The women were evidently oblivious of the human health risk of mercury contamination and poisoning. At this level of engagement, women are generally not involved in decision making concerning the mining activities. They are just contracted to do the panning and are paid the agreed rates.

B11 ENVIRONMENTAL INFORMATION

The majority of the ASGM activity sites had environmental challenges associated with destruction of landscapes and vegetation, close proximity to sensitive areas such as wetlands and rivers and improper management of tailings. The survey established that at all visited gold processing sites the tailings from milling equipment and cyanidation ponds were not lines and in some cases close to rivers and dams (**Plate B1**). Local studies on mercury contamination from the ASGM sector have shown that about 70-80% of mercury used is lost into the river sediment, tailing, and ground (Mudyazhezha and Kanhukamwe, 2014). Some members of the community in the ASGM areas indicated challenges with water quality, which they explained in terms of increased turbidity and in some cases, smell of cyanide in nearby river water.



Plate B1 *Location of gold processing sites near water courses in Zvishavane and Shurugwi. Aerial photographs from ZoomEarth (2018); Image dates: 16 June 2018.*

In few visited areas where alluvial gold mining is taking place challenges of destruction of landscapes, vegetation and water pollution were noted. Alluvial gold mining involves more of sieving than digging, and since alluvial gold is largely considered to be pure the refining process is generally not subject to use of mercury (Pact, 2015). However studies on the chemical composition of alluvial gold in Zimbabwe have found traces of mercury and attributed this to contamination by mercury from the amalgamation processes upstream of mined rivers. Studies have also shown an increase in the concentration of mercury, copper and iron at an alluvial gold mining area along the *Runde* River and downstream, and attributed this to direct deposition of the heavy metal into the river by miners during the separation of gold from the soil (Makonese, 2016). These levels were higher than the maximum permissible WHO standards for drink9ing water. The existence of mercury in alluvial gold was also confirmed during an interview with an alluvial gold miner in Shurugwi District, Dombojena area (**Plate B2**).



Plate B2 *Alluvial gold mining in Shurugwi District, Dombojena area resulting in severe silting*

According to studies in Mzingwane District (Ncube-Phiri et al. (2015) and Mashonaland Central province (Chandiwana, 2016), "ASGM activities could lead to the extinction of plant and animal species, resulting in the disruption of the ecosystem and causing an imbalance in beneficial macro- and microorganisms". In addition, the loss of habitat (drying up of rivers and surface waters; degraded land) has negatively affected aquatic life, terrestrial biodiversity and productivity of both livestock and crops in the district. Lack of employment, drought and limited livelihood options in the district and the country as a whole were identified as the major drivers of unsustainable ASGM activities.

B12 HEALTH INFORMATION

The majority of the miners were ignorant of the dangers of mercury, which underscores the need for raising awareness (**Figure B8**). Health studies in the ASGM sector revealed that: (a) accidents in insecure tunnels and amalgamation plants, acute respiratory tract

infections, malaria, tuberculosis, and sexually transmitted diseases including AIDS are the dominant causes of morbidity and mortality (Boese-O'Reilly et al., 2004); (b) children who handle mercury and miners who burn amalgam have a high incidence of mercury intoxication, based on analysis of hair, urine and blood samples and on neuropsychological tests performed in 2003 and 2004 (Metcalf and Spiegel, 2007). The baseline study revealed that due to weak mercury poisoning diagnosis system in Zimbabwe the number of reported cases could be low. Consultations revealed that currently the country has one poison centre, Drugs and Toxicology Information Services, which is centralised and located in Harare.

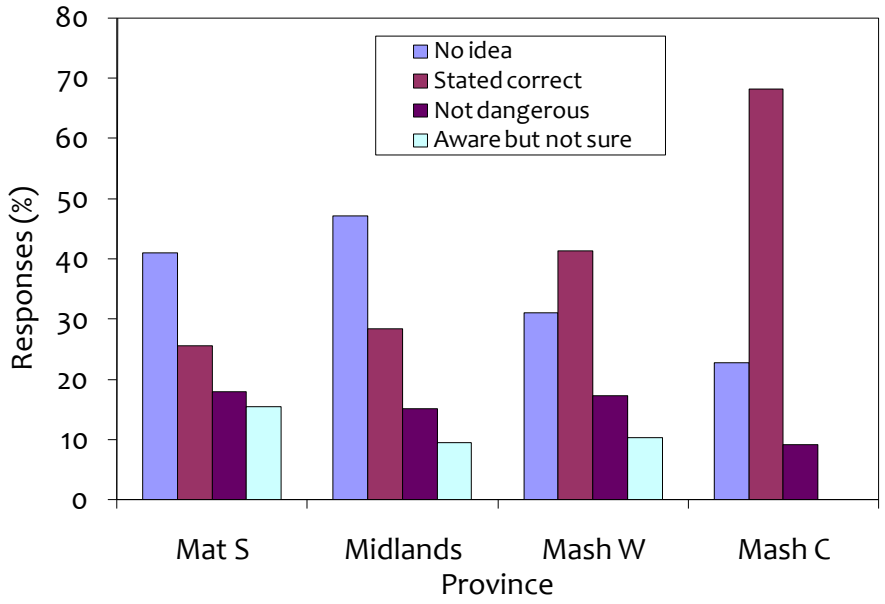


Figure B8 *Responses on awareness of the dangers of mercury in four provinces*

The average distances from the nearest health facilities ranged from 5.8 to 9.7 km (**Figure B9**). Mashonaland West and Mashonaland Central had the shortest distances from the nearest health facilities, while Matabeleland South had the longest distances, with one of the facilities located 45 km away from the mining site. Generally all artisanal small scale gold mining community have very limited access to health facility and information.

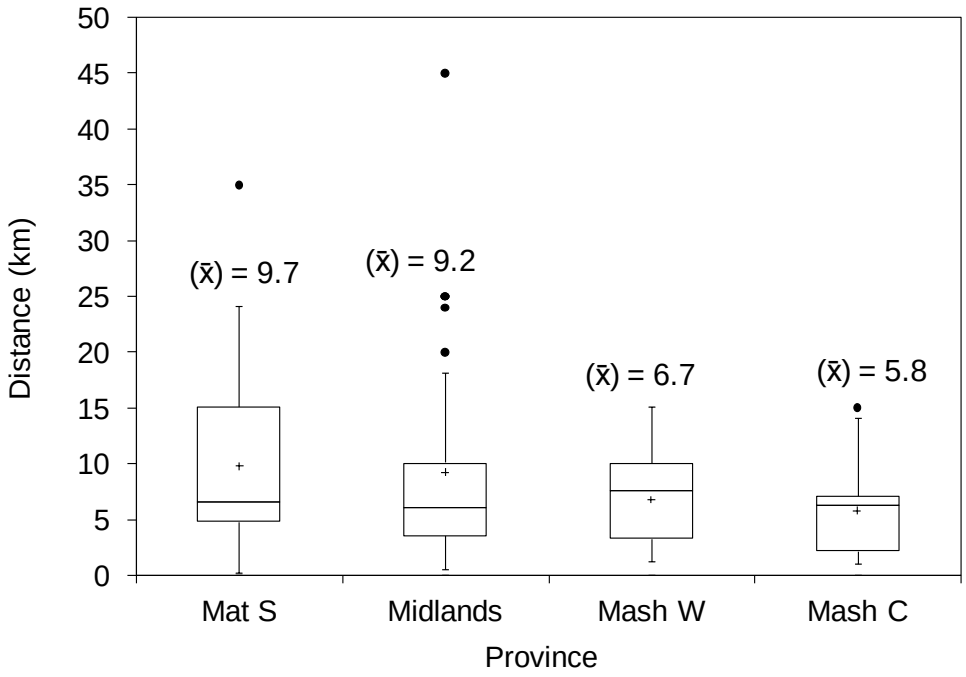


Figure B9 *Distances to the nearest health facility for miners in ASMG sector*

There is need to improve basic infrastructure within the mining community, particularly the sanitary facilities, and to educate them on the dangers associated with mercury use and handling. The occupational related health risk of mining should be assessed in more detail (accidents, drinking water quality, HIV / AIDS, other sexually transmitted diseases, malaria, tuberculosis).

The survey recommended that: (1) the exposure to mercury for the miners and the community has to be drastically decreased. Proper mining techniques to reduce the burden of accidents and mercury exposure are essentially needed; (2) small-scale miners need all possible support to introduce cleaner and safer gold mining and extraction technologies. The exposure with mercury is avoidable with such simple technology as retorts; (3) technical solutions need to go hand in hand with awareness raising campaigns. To improve the social, health and environmental situation of artisanal small-scale gold miners an alliance of local, regional, governmental and intergovernmental bodies is needed; (4) cooperation between health, mining and environmental sectors is needed on local, regional, national and intergovernmental level.

C. NATIONAL OBJECTIVES AND REDUCTION TARGETS

C1 NAP GOALS

The overall goal of the National Action Plan is to protect human health and the environment through the introduction of responsible ASGM practices. These practices will mainly focus on: (a) mercury use reduction and eventual elimination of mercury use and related releases in the environment, (b) adoption of cleaner and mercury free gold production technologies, and (c) legal reforms, as informed by the findings of the baseline survey and stakeholder consultations.

The sub-goals set:

1. Effectively reduce mercury use in the ASGM sector;
2. Develop and implement coherent national policies and regulations that promote the sustainability of ASGM and its allied sectors, as well as environmental and safety measures to protect miners and communities;
3. Establish legal and organized groups of ASGM miners with a national constituency and representing the needs of the ASGM sector;
4. Build and strengthen capacity of ASGM support institutions and regulatory authorities;
5. Enhance cooperation and partnership at all levels among miners, public authorities, industry, civic society, religious groups, academic institutions, local leadership and other stakeholders.

C2 NAP OBJECTIVES AND STRATEGIES

A set of interrelated and mutually supportive actions or strategies are proposed to support the concrete implementation of the identified objectives (**Table C1**).

Table C1 *NAP objectives, strategies and targets*

OBJECTIVE 1 To reduce mercury emissions in the ASGM sector by 20% in 2022	
Problem statement: Baseline study and stakeholder consultations revealed that 96% of the gold processing sites use mercury and open burning of amalgam is the dominant worst practice in the ASMG hotspots; lack of a policy that directly relates to ASGM has paralysed previous Government efforts to reduce mercury emissions particularly using retorts; There is need to prevent the exposure of vulnerable populations to mercury used in ASGM; Current perceptions in the ASGM sector is that there is no cheaper alternative to mercury use during gold recovery	
Action/Strategy	***Target***
1.1 Review the legal framework affecting ASGM activities including management of hazardous substances, trade of gold, mercury, health and safety	Mines and Minerals Act, Environmental Management Act, Children's Act, Gold Trade Act and corresponding regulations reviewed by 2020
1.2 Develop the ASGM Policy and new regulations for ASGM activities consistent with national circumstances and harmonize the existing	ASGM Policy developed by 2022; at least 1 new regulation on ASGM developed by 2022
1.3 Promote mainstreaming of sustainable ASGM activities into national economic blueprints	ASGM in at least one 2021 Pre-Budget Strategy Paper; 2021 Estimates of Expenditure Blue Book and National Budget Statement; At least 1 RBZ supported market-based incentive on Hg-free gold implemented by 2022
1.4 Integrate information management systems for ASGM activities	At least 2 ASGM information access and sharing mechanisms established by 2020; Network database with ASGM priority areas established by 2020
1.5 Promote Hg free technologies	At least 3 tested Hg-free technologies developed/adopted in ASGM hotspot areas by 2021; At least 20% of miners/processors using Hg-free technologies by 2022; Technological needs assessment conducted by 2020; Environmental Management System for ASGM sector established and adopted by 2022
1.6 Minimise worst practices in mercury handling and usage	No whole ore amalgamation, burning of amalgam in residential areas and cyanidation

	of mercury rich tailings by 2022; Cost-benefit analysis of using retorts conducted by 2020; At least 80% using retorts in mercury based gold recovery processes by 2022
1.7 Strengthen enforcement and monitoring mechanisms on environmental rehabilitation.	100% compliance with respect to location of gold mining sites and lining of new tailings dams; At least 20% of tailings dams rehabilitated by 2022
1.8 Conduct regular inspection and monitoring of soil, water and air quality, and human and animal health around ASGM sites for compliance to mine safety rules and regulations	At least 50% of the ASGM sites undergone environmental audits for compliance by 2021; Levels of Hg in water/sediments assessed in ≥20% of ASGM hotspot districts; Extent of Hg contamination of soils measured in ≥20% of ASGM hotspot districts; At least 2 national studies conducted on Hg levels in fish and plants from ASGM hotspot areas
OBJECTIVE 2 To strengthen ASGM representative organizational structures to effectively represent the needs of the sector by 2022.	
Problem statement: ASGMs expressed concern in the way they are viewed by the government and other stakeholders, particularly with respect to poor representation during conflict resolution and poor progress in their formalisation. Effective formalisation depends on the level of representation of miners, including their access to mineral rights and perceived benefits.	
Action/Strategy	***Target***
2.1 Capacitate ASGM associations.	At least 60% of the ASGM represented by associations; At least 1% of the fiscal budget allocated to ASGM activities
2.2 Formalise ASGM activities	All ASGM activities formalised by 2022
OBJECTIVE 3 To strengthen institutional capacity of regulatory authorities and ASGM support institutions by 2022;	
Problem statement: The baseline survey and stakeholder consultations revealed that enforcement of regulations alone does not provide adequate cooperation of ASGM players in resolving the challenges in the sector but a participatory exchange of information. A knowledge sharing platform requires adequate training of regulatory authorities. Increasing smuggling of mercury and	

increasing international mercury traders were noted indicating that mercury importation controls by regulatory authorities require improvements	
Action/Strategy	***Target***
3.1 Capacitate regulatory institutions	All local authorities and other regulatory and administrative authorities in ASGM hotspots trained on participatory approaches and on enforcement of reviewed laws affecting AGSM by 2022
3.2 Strengthen mercury importation control measures at ports of entry	Linkages between national and international regulatory authorities to curb smuggling of mercury developed through MOUs and bilateral agreements by 2020; At least five exchange visits by 2022
OBJECTIVE 4 To enhance cooperation and partnerships at all levels among miners, government departments, government agencies, local authorities, industry, civic societies, academic institutions and other stakeholders by 2022	
Problem statement: Previous efforts to address ASGM sector challenges by civic societies, industries, academic institutions and other organisations have been discontinued prematurely due to lack of effective cooperation with government departments and agencies.	
Action/Strategy	***Target***
4.1 Establishment of operational networks of stakeholders to support environmentally sustainable ASGM	Platform for coordination of ASGM activities set up and functioning by 2020; At least one joint MOU/MOA signed and implemented by 2020
OBJECTIVE 5 To adopt technologies for promoting the safe handling, storage and disposal of mercury in the ASGM sector by 2022	
Problem statement: The baseline survey and stakeholder consultations revealed that disused mercury is dumped in the environment with no proper disposal systems, creating risks of contamination of soil, water and air and human and animal exposure risks. Mercury rich tailings are also disposed of on tailings dams that are not lined	
Action/Strategy	***Target***
5.1 Promote adoption of environmentally sound options for mercury management	Technologies and procedures for storage of mercury and disposal of waste containing mercury identified and tested with miners by 2021; At least 50% of the miners adopt technologies by 2022

OBJECTIVE 6 To improve surveillance systems on health impacts of mercury in Artisanal and Small Scale Gold Mining (ASMG) by 2022.	
Problem statement: Consultations revealed that currently the country has one poison centre, Drugs and Toxicology Information Services, which is centralised and located in Harare; majority of the miners were ignorant of the dangers of mercury, but there were few reported mercury poisoning cases largely due to weak diagnosis system	
Action/Strategy	***Target***
6.1 Capacitate and decentralise poison centres to cover the ASGM hotspots	At least one poison centre introduced and capacitated to analyse for mercury poisoning in each of the 4 ASGM activity hotspot provinces by 2021; At least 2 medical practitioners per ASGM hotspot District trained in identification, screening and management of mercury poisoning by 2020
6.2 Enhance occupational health and safety in use of mercury	Maximum permissible limits for Hg in products/foods introduced and adopted by 2021; Occupational health mandate of NSSA extended to ASGM by 2022;
6.3 Sensitisation of ASGM on public health service provisions	At least 20% of the miners in ASGM on medical aid cover by 2021; At least one health outreach program conducted in each mining district within the ASGM hotspot provinces

C3 OVERALL SCHEDULE OF IMPLEMENTATION

Ministry of Environment, Climate Change, Tourism and Hospitality Industry through the Environmental Management Agency (EMA), will implement the NAP as a multi-sector platform coordinated by the National Steering Committee within a period of 3 years (2020-2022). Six project implementation sub-units will be established to cover the six identified objectives and the lead from each unit will report to the National Steering Committee that will in turn report to EMA Directorate. Specific terms of reference will be given to each unit in line with the expected target, and the Steering Committee will ensure coordination of activities and sharing of information among the units. The multi-sector platform will comprise of members from: Ministry of Mines and Mining Development; Ministry of Health and Child Care; Ministry of Lands, Agriculture, Water and Rural Resettlement; Ministry of Information, Media and Broadcasting Services; Ministry of Justice, Legal and Parliamentary Affairs; Ministry of Local Government, Public Works and

National Housing; Ministry of Higher and Tertiary Education, Science and Technology Development (including state universities); Ministry of Industry and Commerce; Ministry of Finance and Economic Development; Civic Societies; Zimbabwe Miners Federation and other miners representatives; and relevant parastatals aligned to state Ministries.

D. IMPLEMENTATION STRATEGIES

D1 STRATEGIES

The following strategies, as required under Annex C of the Minamata Convention, will be used to achieve Zimbabwe's national objectives and reduction targets:

1. Eliminate worst practices - *as required by point 1(b) of the Annex C of the Minamata Convention*

2. Facilitate formalization or regulation - *as required by point 1(c) of the Annex C of the Minamata Convention*

3. Promoting the reduction of emissions, releases, and risks of exposure to mercury - *as required by point 1(e) of the Annex C of the Minamata Convention*

4. Manage trade and prevent diversion of mercury and mercury compounds - *as required by point 1(f) of the Annex C of the Minamata Convention*

5. Involve stakeholders in the implementation and continuing development of the plan - *as required by point 1(g) of the Annex C of the Minamata Convention*

6. Reduce exposure of artisanal and small-scale gold miners and their communities to mercury - *as required by point 1(h) of the Annex C of the Minamata Convention*

7. Prevent the exposure of vulnerable populations, particularly children and women of child-bearing age, to mercury used in ASGM - *as required by point 1(i) of the Annex C of the Minamata Convention*

8. Provide information to artisanal and small-scale miners and affected communities - *as required by point 1(j) of the Annex C of the Minamata Convention*

9. Include market-based mechanisms to promote mercury free technologies- *as suggested by point 2 of the Annex C of the Minamata Convention*

D1.1 Elimination of worst practices

The NAP proposes to address the open burning of amalgam, cyanidation of mercury rich tailings, whole ore amalgamation, and burning of amalgam in residential areas through the use of legal instruments, research for development, persuasion as well as participatory learning approaches. Worst practices will be eliminated through: (a) the

development of the National ASGM Policy and establishment of regulations for ASGM activities that address the gaps in the current legal framework and that are consistent with national circumstances; (b) testing Hg-free technologies promoting them in ASGM hotspot areas, including promoting the adoption of Environmental Management System for the ASGM sector, (c) improving education and awareness on the dangers of whole ore amalgamation, burning of amalgam in residential areas and cyanidation of mercury rich tailings, and (d) promotion of the use of transparent retorts in mercury based gold recovery processes.

The proposed review of the existing legal framework and establishment of an ASGM National Policy will assist in the elimination of worst practices. This review will be led by the National Steering Committee and will involve the harmonisation of identified regulations directly and indirectly affecting the gold processing activities in the ASGM sector. A series of sensitization/awareness meetings will be held at district, provincial and national levels to address each form of worst practice. Institutions that will be involved in these activities include the departments and government agencies from the Ministry of Mines and Mining Development, Ministry of Environment, Climate Change, Tourism and Hospitality Industry, Ministry of Justice, Ministry of Finance and Ministry of Health and Child Care. The organisations representing the ASGM players and local leadership will also be engaged.

With respect to the open burning of amalgam, the target is to ensure that at least 80% of the gold processors use retorts in mercury-based gold recovery processes by 2022. About 96% of the gold processors were not using retorts and open burning of amalgam was practiced in more than 80% of the visited sites. The challenge of the negative myths around the use of retorts will be addressed through: (1) raising awareness on the dangers of open burning of amalgam, (2) participatory cost-benefit analysis of mercury recycling through the use and non-use of retorts, and (3) the introduction of glass/transparent retorts. The ASGM players will be directly engaged through their representative organisations and through other forms of media that include radio and newsletters in local language by trained facilitators. A national consultant will be engaged to conduct a detailed participatory research on the cost-benefit analysis of using retorts in the four ASGM hotspot provinces and the findings will be communicated to all mining provinces

through meetings and other channels. The Ministry of Mines and Mining Development and the Reserve Bank of Zimbabwe, as part of their market-based incentive will finance the acquisition of transparent retorts and onsite-training in the use of retorts.

The NAP proposed to eliminate all whole ore amalgamation, burning of amalgam in residential areas and cyanidation of mercury-rich tailings by 2021. The baseline study and stakeholder consultations established that these three practices were less common than open burning of amalgam. The elimination of these practices would be through: (1) establishment and enforcement of regulations against such practices, and (2) raising awareness on the need to eliminate such practices, (3) re-introduction of sustainable gold processing technologies, including mercury-free technologies. A team of experts on effective communication and gold processing technologies will be tasked with coming up with comprehensive teaching manuals on sustainable gold processing in the ASGM sector. Other activities related to elimination of worst practices are provided under Sections D1.3 and D1.6.

D1.2 Facilitation of formalization

The formalisation of the ASGM sector is targeted for completion by 2022 through: (a) the capacitating of ASGM associations by promoting membership by ASGM players and lobbying for the allocation of at least 1% of the fiscal budget to ASGM activities, and (b) improving education and awareness on the benefits of formalising the ASGM sector.

The decriminalisation of informal ASGM activities in 2014 has generally provided a platform for positive engagement of the ASGM players in the formalisation process. The NAP proposed to facilitate the formalisation process through: (1) ensuring that the legal framework adequately recognises the ASGM sector in the legal context, (2) developing an ASGM formalisation strategy (UNITAR and UN Environment, 2018), (3) financially and technically capacitating the ASGM associations, and (4) facilitating continuous engagement of stakeholders in the allocation of land for ASGM, licensing of ASGM, organising of supply chain, accessing of financial, technical and market services, and monitoring and enforcement of regulations.

The review of the legal framework governing the ASGM sector was narrated in Section D1.1, and will be conducted against the background that the existing formalisation procedures were viewed as complex, time consuming and unaffordable to most of the ASGM players. A national consultant will be engaged to establish the ASGM Formalisation Strategy using the existing guidelines from the UNITAR and UN Environment (2018). The ASGM players will be mobilised into mining corporative, organisations or association under the direction of the Zimbabwe Miners Federation, Ministry of Mines and Mining Development, and RBZ using at least 1% of the 2021 fiscal budget. The mobilisation process will involve comprehensive raising of awareness on the benefits of belonging to an ASGM association.

Challenges anticipated in the formalisation of the sector may arise from the poor accessibility of some of the miners in the remote parts of the country. It may also be difficult for the ASGM players to access financial resources as the banking sector may not find adequate collateral from the miners in order to lend them money towards better mining practices and other requirements for formalisation. The challenges may be addressed by capacitating the miners associations to educate their members on investing and using other alternative sources of livelihoods to improve their practices.

D1.3 Promotion of reduction of emissions, releases and risks of mercury

The NAP proposes to promote the reduction of mercury emissions to air, releases into the environment and risk of mercury exposure through: (a) promotion of Hg-free technologies, (b) training of local authorities and other regulatory and administrative authorities in the ASGM hotspots on participatory approaches in the enforcement of reviewed laws affecting AGSM, and (c) promoting the adoption of environmentally sound options for mercury management.

The promotion of Hg-free technologies will be initiated by testing local conditions for the introduction of such technologies using the framework developed by Steckling et al. (2014) for Zimbabwe. In this framework the willingness of the miners to change to another gold extraction technology other than mercury amalgamation, the local availability of appropriate materials and equipment, and the suitability of the ore for

applying the borax technology for gold smelting are used as variables to test local conditions for introducing the borax method. A two-day theoretical workshop and a three-day practical demonstration will be conducted in each of the mining provinces of Zimbabwe. The promotion will be spearheaded by the Ministry of Mines and Mining Development officials in collaboration with other government departments and agencies as well as stakeholders from the miners associations and non-governmental organisations. There will be follow up sessions. The target will be to have at least 3 tested Hg-free technologies in the ASGM hotspot areas by 2021, and an adoption rate of a least 20% by 2022.

Local authorities and other regulatory and administrative authorities in the ASGM hotspots will be trained on participatory approaches in enforcing reviewed laws affecting the ASGM sector. The training will take the form of three-day workshops in each mining province and will involve local and international experts to facilitate and deliver the training.

Miners in the ASGM sector will be encouraged to adopt Environmental Management Systems through engagement by the Environmental Management Agency and the Ministry of Mines and Mining Development. This aspect will be included during the routine inspections of the ASGM sites.

D1.4 Management of trade and prevention of diversion of mercury

Linkages between national and international regulatory authorities to curb smuggling of mercury will be developed to strengthen mercury importation control measures at ports of entry. This will involve the signing of MOUs and MOAs with international regulatory authorities on the training of personnel, including exchange visits, and exchange of knowledge, experiences and technologies required to manage trade and prevent diversion of mercury and mercury compounds. Operational networks of stakeholders to support environmentally sustainable ASGM will be used to create a platform for coordinating AGSM activities at international level.

UNIDO (2018) provided a regional framework on curbing illicit mercury and gold flows for West Africa and this framework will also be adopted for the Southern African Region.

Recommendations to be adopted from UNIDO (2018) will include: (1) Improving knowledge and awareness of mercury flows, so that trade regulations and the organizations charged with enforcing them are better informed, (2) Standardization of mercury-specific regulatory trade frameworks to generate a concerted and organized regional response, (3) Improving the engagement with, and capacity of, customs organizations, which are often the first line of defence against illicit mercury flows, (4) Focussing regional efforts on import and export hubs, in particular seaports, which act as a chokepoint in regional supply chains, in order to focus resources more effectively and efficiently, (5) Rewarding miners who extract gold without mercury or make use of more environmentally-friendly technology through tax incentives and other trade benefits in order to reduce mercury demand, (6) Harmonizing gold-export regimes to reduce the drivers of illicit cross-border trade, which creates an obstacle to efforts to formalize the sector, and (7) Strengthening regulatory oversight of gold imports in destination hubs.

The baseline survey showed relatively high levels of uncertainty with respect to mercury flows at regional and international levels. The NAP proposes to engage countries in the southern African region and identified key exporters of mercury to Zimbabwe, notably China, in developing a mercury trade database through international and regional networks such as the SADC and COMESA. There will be MOU/MOAs specifically on improving understanding of mercury flows and revising related regulations.

The rewarding of miners who extract gold without mercury or make use of more environmentally-friendly technology will be done at the port of entry of imported equipment for mercury-free production. This will be through tax incentives and other trade benefits to be identified through Fidelity Printers and Refineries, the sole official buyer of gold. This will be targeted at reducing mercury demand and use by 20% by 2022,

D1.5 Involvement of stakeholders in NAP implementation

The NAP proposes to address the involvement of stakeholders in the NAP implementation through: (1) capacitating ASGM associations to attract more members, and (2) setting up of platforms for coordination of ASGM activities, including the signing of joint MOU/MOA with stakeholders. Multiple-stakeholders to be involved in the NAP

implementation at national level include those from government and non-governmental organisations (**Table D1**).

Table D1 *Stakeholders in NAP implementation (adopted from Wijenayake, 2018)*

Stakeholder	***Type***	***Opportunity***	***Challenges***
Office of the President and Cabinet	Government	Leading role in mainstreaming efforts in all government ministries	May face conflict of interests; Has many priorities to deal with
Political parties	Government	Use the election process to raise awareness of mercury issues; make these issues a theme of political campaigns	May have limited awareness of mercury issues; May face conflict of interests;
Parliament	Government	Leverage its legislative role; foster advocacy roles, especially on national budget	May have limited awareness of mercury issues; Not involved in all stages
Judicial system	Government	Develop synergies with related laws, especially illegal trade	Limited awareness; enforcement of laws may be lacking; May face conflict of interest
Civil society	Non-government	Make use of their expertise including addressing gender issues; bring out voices from community level; information collection, packaging and sharing/awareness raising	Capacities may be weak; Not involved in all stages of planning
Academic and research institutes	Non-government	Make use of their expertise including researching on Hg-free technologies; promote interdisciplinary teams	May be disconnected from national development planning process; capacity to produce policy-relevant information may be weak

Stakeholder	*Type*	*Opportunity*	*Challenges*
Business and industry	Non-government	Reduce mercury influx and trade	May perceive mercury reduction as a barrier to making money

The coordination of the NAP implementation process will be done under the direction of the National Steering Committee for the NAP implementation.

D1.6 Reduction of mercury exposure of ASGM communities

The NAP proposes to reduce mercury exposure of the ASGM community through: (1) capacitating and decentralising poison centres to cover the ASGM hotspots, (2) enhancing occupational health and safety in the use of mercury, (3) sensitisation of the ASGM players on public health service provisions, (4) strengthening enforcement and monitoring mechanisms on environmental rehabilitation and (5) conducting regular inspection and monitoring of soil, water and air quality, and human and animal health around the ASGM sites. These actions will be done principally under the direction of the Ministry of Health and Child Care, and will involve other stakeholders from relevant government departments, agencies and non-governmental organisations, including ASGM player representatives.

The decentralisation of poison centres in hotspot provinces to analyse for mercury poisoning will follow the Guidelines for Poison Control (WHO, 1997). Each of these facilities will provide: (1) information services, (2) clinical services, (3) analytical toxicology services, (4) toxico-vigilance and prevention of poisoning, (5) response to major emergencies involving mercury, (6) standardized formats for the collection and storage of essential data, and (7) documentary and library support for poison information, by 2021. At least 2 medical workers and at least 5 primary healthcare providers per ASGM hotspot District will be trained in identification, screening and management of mercury poisoning by 2020. Primary care providers such as nurses, community health workers and general family physicians may be the first point of contact for workers exposed to health hazards associated with artisanal and small-scale mining IWHO, 2016). In addition to mercury the medical workers will also be trained on hazards

related to cyanide, chemicals contained in the dust and toxic gases as these were identified (WHO, 2016) as common hazards at the ASMG sites.

The ASGM communities will be sensitised on public health services through awareness meetings in their respective districts, involving the Ministry of Health and Child Care, the National Social Security Authority (NSSA). Occupational health mandate of NSSA will be extended to ASGM by 2021, while at least 20% of the miners in ASGM will be expected to be on medical aid cover by 2020. Sensitisation activities will involve conducting free medical examination of the ASGM players and their surrounding community, display of materials showing visible health effects of mercury as part of the communication strategies, showcasing previous studies on mercury poisoning, and awareness raising on the need for personal protective clothing for the ASGM miners.

D1.7 Prevention of mercury exposure of children and women of child-bearing age

The baseline survey indicated that women are directly exposed to mercury as they are involved in the *serengete* system of gold recovery in which they grind mercury added sand to improve gold recovery. Exposure of children was found to be relatively low. Children and pregnant women can have significant exposure: (1) if they consume excessive amounts of fish from mercury contaminated water bodies, (2) if they inhale mercury contaminated air, and if they drink mercury contaminated water (WHO, 2008). The NAP proposed to address the prevention of mercury exposure of children and women of child bearing age by engaging a consultant to investigate and gather information on the levels of mercury contamination in water/sediments and fish from the ASGM hotspots and recommend the consumption patterns for children and women according to the WHO (2008) guidelines. Other activities related to prevention of mercury exposure are provided under Sections D1.3, D1.5 and D1.6.

D1.8 Provision of information to ASGM and affected communities

The NAP proposes to establish operational networks of stakeholders to support environmentally friendly and sustainable ASGM, and integrate information management systems for ASGM activities. The Geological and Mineral Information Systems (GMIS) Strategy proposed by the African Minerals Development Centre (AMDC) (UNECA, 2016)

to facilitate the strengthening of the African production, management and dissemination of geological and mineral information will be adopted. Inclusion of the ASGM and affected community will be directed through the Environmental Management Agency. The GMIS strategy consists of Geological Survey Organizations, universities, national and sub-national agencies with geological functions, the private sector and civil society groups that generate, hold or use geological information, along with Regional Economic Communities, centres of excellence and other international institutions and initiatives that undertake or support the generation, management or sharing of geological information.

The GMIS strategy will be used to address the identified myths, beliefs and ignorance about mercury which endangers the miners. Participatory approaches will be used to engage miners in awareness raising, including use of sign methods that will embed knowledge and transfer to locals for future knowledge transfer and sustainability. Strategies on sharing information on implementation of existing policies will be developed.

Part of the information sharing will be the documentation of existing good practices that are easier to upscale already in Zimbabwe. The GMIS Strategy represents a shift from geological information just for mining development to geological information, which supports broad-based sustainable growth and socio-economic development. The Strategy covers a five years period, which will start in the context of the AMDC operating as a project hosted by UNECA, continue over a transition phase and set the bases for the future work of the AMDC as the new semi-autonomous Specialized Agency. Other activities related to information provision are provided under Section D1.6.

D1.9 Inclusion of market-based mechanisms

The NAP proposes to promote the mainstreaming of sustainable ASGM activities into the national economic blue print by ensuring that ASGM activities are covered in the 2020 National Budget. The RBZ through Fidelity Printers and Refineries will be engaged on incentivising mercury free gold.

D2 WORKPLAN & BUDGET

Strategy	Actions	Priority	Activity lead	Timeline			Funding source	Budget notes	Activity cost (USD)	Expected output	Indicator
				2020	2021	2022					
1. Elimination of worst practices	1.1. Review the legal framework affecting ASGM activities including management of hazardous substances, trade of gold, mercury, health and safety	1	EMA/ MoMMD, ZMF	X			Dev Partners, MoMMD, EMA, MoHCC, NASSA	Multi stakeholder conference. 60 people at $20.00 per day X 5 days Conference $3000.00 X 5days	$21000.00	Review Reports	Number of reviewed legislation Compiled policies; workshop report
	1.2. Develop the ASGM Policy and new regulations for ASGM activities consistent with national circumstances and harmonize the existing	1	TC/ EMA/ Attorney General / MoMMD, ZMF	X	X		Dev Partners, Min of Finance	Engagement of a national consultant @$20000.00 Multi stakeholder conference @ $21000.00and consultative meetings X 3 @	6000.00	National ASGM Policy; At least 1 new regulations	Workshop reports Progress reports

Strategy	Actions	Priority	Activity lead	Timeline			Funding source	Budget notes	Activity cost (USD)	Expected output	Indicator
				2020	2021	2022					
	1.3. Minimize worst practices in mercury handling and usage	1	NGOs, MoMMD/ EMA, ZMF, LAs		X	X	NGOs and development partners GoZ	Biannual Outreaches per district per year x 40 Districts	210 000.00	No WOA, BARA & CMRT by 2021; by 2020; At least 80% using by 2021	Workshop reports; Retorts cost-benefit report
	1.4. Promote mercury free technologies	1	MoMMD	X	X	X	NGOs and development partners, GoZ	Onsite tests of known technologies, procurement of equipment to support technologies at demonstration sites, surveys on adoption rates.	261000.00	At least 3 tested Hg-free technologies developed/ adopted by 2022;	Technological needs assessment report; Workshops report; Survey reports on adoption rates;
2. Facilitation of formalization	2.1. Review legal framework to adequately recognizes the ASGM sector	1	EMA/ Attorney General	X			See Action 1.2	See Action 1.2	See Action 1.2	Review Report	Review invitations, compiled policies; workshop report
	2.2. Develop an ASGM formalization strategy	1	ZMF/ MoMMD, EMA		X		NGOs and development	Outreaches to ASGM Sites,	50 000.00	ASGM Formalization Strategy	Workshop reports; Consultant report

Strategy	Actions	Priority	Activity lead	Timeline			Funding source	Budget notes	Activity cost (USD)	Expected output	Indicator
				2020	2021	2022					
							partners, GoZ	*Engagement meetings*			
	2.3. *Financially and technically capacitate the ASGM associations*	*1*	*ZMF/ MoF/ MoMMD, EMA*		*X*	*X*	*Development partners MoMMD, MoF*	*Engagement meetings Training workshops*	*15000.00*	*ASGM associations trained by 2021; 1% of fiscal budget allocated by 2022*	*Pre-Budget Strategy Paper; Estimates of Expenditure Blue Book and National Budget Statement*
	2.4. *Facilitate continuous engagement of stakeholders in formalization activities, monitoring and enforcement of regulations*	*2*	*EMA/ MoMMD/ MoHCC/ MECTHI/ ZMF/NASSA*	*X*	*X*	*X*	*Development partners, GoZ*	*Engagement meetings with miners, and authorities.*	*51000.00*	*ASGM formalized*	*Reports on: land allocation for ASGM; licensing of ASGM; Access to finance, technical and market services;*
3. *Promotion of reduction*	3.1. *Promotion of Hg-free technologies (see Action 1.4)*	*1*	*TC*	*X*	*X*	*X*	*see Action 1.4*		*see Action 1.4*	*see Action 1.4*	*see Action 1.4*

Strategy	Actions	Priority	Activity lead	Timeline			Funding source	Budget notes	Activity cost (USD)	Expected output	Indicator
				2020	2021	2022					
of emissions, releases and risks of mercury	*3.2. Train local authorities and other regulatory and administrative authorities in the ASGM hotspots on participatory approaches in the enforcement of reviewed laws*	*1*	*TC/ EMA/ MoMMD*		*X*		*Dev Partners, NGOs GoZ*	Training workshops	108000.00	*Knowledge able LAs*	*Number of LAs Trained*
	3.3. Promote adoption of environmentally sound options for mercury management	*1*	*TC/ MoMMD/EMA/ NGOs*	*X*	*X*	*X*	*Development partners, GoZ*	*Awareness campaigns, demonstrations of the technologies.*	*10000.00*	*miners adopt mercury sound management options*	*Percentage of miners adopting the Hg-management options*

Strategy	Actions	Priority	Activity lead	Timeline			Funding source	Budget notes	Activity cost (USD)	Expected output	Indicator
				2020	2021	2022					
4. Management of trade and prevention of diversion of mercury	4.1. Improve knowledge and awareness of mercury flows	1	ZIMRA TC/ MoMMD/ ZMF/EMA/M of Industry	X	X	X	NGOs/Development partners /GoZ	Training workshops with authorities on mercury inventory	30000.00	Improved inventory of mercury trade	Mercury trade database
	4.2. Standardize mercury-specific regulatory trade frameworks	1	ZIMRA TC/ MoMMD/ ZMF/EMA/M of Industry /MoF	X	X		NGOs/Development partners /GoZ	Exchange visits, International conferences	60 000.00	Revised regulations on Hg trade	Number of standardized regulations
	4.3. Capacitation of, customs organizations, which are often the first line of defense against illicit mercury flows	1	TC/ EMA/ZRP/ZIMRA	X	X	X	NGOs/Development partners /GoZ	Needs assessment Survey, Training workshops, equipment procurement	See Action 4.1	Reduced illicit mercury flow cases	Number of border personnel trained, list of screening equipment procured,

Strategy	Actions	Priority	Activity lead	Timeline			Funding source	Budget notes	Activity cost (USD)	Expected output	Indicator
				2020	2021	2022					
	4.4. Reward miners who extract gold without mercury or make use of more environmentally-friendly technology	1	TC/ MoF/ EMA/MoMM		X	X	Development partners, GoZ	See Action 2.4	Engagement with MoF	Reduced demand for mercury	Tax refunds inventory Duty free inventory
	4.5. Harmonizing gold-export regimes to reduce the drivers of illicit cross-border trade, which creates an obstacle to efforts to formalize the sector	1	ZMF/ MoF/ EMA/ ZRP		X	X	See Action 4.1	See Action 4.1	See Action 4.1	Increased gold deliveries FPR	Established channels for gold trade
5. Involvement of stakeholders in NAP implementation	5.1. Capacitate ASGM associations to attract more members	1	MoF/ ZMF		X		See action 2.3	See action 2.3	See action 2.3	Capacitated miners	Training reports
	5.2. Set up platforms for coordination of ASGM activities, including the signing of joint MOU/MOA with stakeholders.	1	TC/ EMA/MoMMD		X		Dev Partners, GoZ	Quarterly Steering committee meetings	60 000.00	Information sharing centre and data management system	Reports on submitted data, Clearing house mechanism
6. Reduction of mercury exposure	6.1. Decentralize and capacitate poison centers to cover	1	MoHCC		X	X	Dev partners/ GoZ	Procumbent of data computer software	203 000.00	Functional information systems,	Established

Strategy	Actions	Priority	Activity lead	Timeline			Funding source	Budget notes	Activity cost (USD)	Expected output	Indicator
				2020	2021	2022					
of ASGM communities	*the ASGM hotspots*							Establishment of 7 provincial centres, Procure microwave plasma emission spectra (MPAES)		*Functional poison centers* *Functional MPAES*	
	6.2. Enhance occupational health and safety in the use of mercury,	*1*	*NASSA, MoHCC*		*X*	*X*	*Dev partners/ MoHCC/ NASSA*	*Sensitisation meetings with miners and stakeholders, Training of trainers.*	50 000.00	*NASSA mandate extended to ASGM*	*Minutes, reports, Number of trainers trained*
	6.3. Sensitization of the ASGM players on public health service provisions,	*1*	*MoHCC*		*X*	*X*	*See action 6.2*	*See action 6.2*	*See action 6.2*	*See action 6.2*	*See action 6.2*
	6.4. Enforce and monitor mechanisms on environmental rehabilitation	*1*	*EMA/MoMMD/ MoHCC*	*X*	*X*	*X*	*Dev partnersEMA, ZMF, GoZ*	*Selection and rehabilitation of pilot sites, Training on rehabilitation*	21 000.00	*ASGM miners trained on rehabilitation*	*Training manuals, training registers, pilot sites established,*
	6.5. Conduct regular inspection and monitoring of soil, water and air	*1*	*TC/EMA/MoHCC/MoMMD*	*X*	*X*	*X*	*Dev partnersEMA,*	*Health outreaches Procurement of rapid mercury*	2000 000.00	*Water, soil animal and human test results*	*Monitoring reports, test kits*

Strategy	Actions	Priority	Activity lead	Timeline			Funding source	Budget notes	Activity cost (USD)	Expected output	Indicator
				2020	2021	2022					
	quality, and human and animal health around the ASGM sites.						*MoMMD, MoHCC*	*testing kits (one kit per province x 7 provinces @ $3000 per kit Establishment of data collection tool/mechanism, Procurement of 14 vehicles*			
7. Prevention of mercury exposure of children and women of child-bearing age	*7.1. Engage a consultant to investigate and gather information on the levels of mercury contamination in water/sediments/fish from ASGM hotspots*	*1*	*EMA/ MoHCC/Ministry of Agric*		*X*	*X*	*Development partners/ GoZ*	*Consultancy fee*	60 000.00	*Water, soil animal and human test results*	*Monitoring reports*
	7.2. Recommend the consumption patterns for children and women in ASGM communities	*1*	*MoHCC*		*X*	*X*	*Actions 7.1*	*Actions 7.1*	*Actions 7.1*	*Actions 7.1*	*Actions 7.1*
8. Provision of information to ASGM and	*8.1. Establish operational networks for information dissemination*	*1*	*TC/ EMA/ZMF*	*X*	*X*	*X*	*Dev Partners, GoZ*	*Engagement meetings*	*10 000.00*	*Established networks*	*Minutes,*

Strategy	Actions	Priority	Activity lead	Timeline			Funding source	Budget notes	Activity cost (USD)	Expected output	Indicator
				2020	2021	2022					
affected communities	8.2. Produce Information Education and Communication(IEC) Material, Conduct environmental education and awareness campaigns	1	TC/ EMA/ZMF/MoMMD/NASSA	X	X	X	Dev Partners, GoZ	Publicity and promotional materials Media programs, Awareness campaign	100 00.00	Knowledgeable society	Educational material, reports, IEC material,
	8.3. Integrate information management systems for ASGM activities.	1	TC/ EMA		X	X	See Actions 5.2	See Actions 5.2	See Actions 5.2	See Actions 5.2	See Actions 5.2
9. Inclusion of market-based mechanisms	9.1. Lobby for tax free importation of mercury free technologies	1	TC/EMA/MoMMD/Parliament		X	X	Dev partners/ GoZ	Engagement meetings	2000.00	.Tax rebate on Hg free technology	Number of technologies with tax exemption
TOTAL									**3 328 000.00**		

E. EVALUATION MECHANISM

Evaluation activities will be carried out using as basis the benchmarks and targets as outlined in the plan and the criteria and indicators as agreed upon by the stakeholders. It will also cover assessment of the extent of reduction of mercury concentration in mining areas and in areas downstream.

Evaluation will employ a combination of any of the following: (a) formal and informal surveys, (b) semi-structured interviews, (c) key informant interviews, (d) focus group discussions, (e) community meetings, (f) case studies, (g) participatory rural appraisal, (h) direct observation, (i) analysis of written documents, and (j) review of implementation methods.

Monitoring and evaluation for this project will rely on several levels of review, quality control and feedback. The National Steering Committee including the main project stakeholders will meet annually to: (a) review and approve annual work plan, (b) assess progress against monitoring and evaluation targets as indicated in the Project Results Framework, (c) approve interim and final reports, and (d) assess any gaps or weakness and make appropriate adaptive management decisions based on progress and achievements.

Work plan for year two will be based on the results achieved in the first year, including associated budget allocations. International experts will be invited to assist and participate in monitoring and evaluation. The terms of reference for the evaluator will be developed with the support of UN Environment.

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F. ANNEXES

F1. TERMS OF REFERENCE OF THE WORKING GROUP

F1.1 INTRODUCTION

Zimbabwe is among countries that notified the Interim Minamata Secretariat that mercury emission from the ASGM sector is more than significant. The country has developed its NAP to reduce the use and emission of mercury from the ASGM sector in accordance to Annex C of the Minamata Convention. By developing the NAP, Zimbabwe has complied with the text of the Minamata Convention and the country positions itself positions to contribute to the implementation of the Minamata Convention through the reduction of the risks posed by the unsound use, management and release of mercury in the ASGM sector.

F1.2 COMPONENTS OF THE NAP

The NAP had four components, which consisted of the activities indicated in Table F1. Each component includes information on project activities, outcomes and outputs:

Table F1.1 *Components of NAP*

Component	***Description***
1	Regional information exchange, capacity building and knowledge generation
2	Establishment of Coordination Mechanism and organisation of process
3	Develop a national overview of the ASGM sector, including baseline estimates of mercury use and practices
4	Develop, endorse and submit to the Minamata Convention Secretariat a NAP on ASGM

The national baseline analysis was undertaken by the consultant, Enviro-Remedy Company, whose membership includes those shown in Table F1.2.

Table F1.2 *Consultancy team for the baseline survey*

Name	***Area of expertise and role***	***Contact Details***
Farai MAPANDA, PhD, MPhil, BSc (Hon.)	*Team Leader; Environmental Management*	*E-mail: faramaps@yahoo.com; Mobile: +263-772-573-177*
Jameson KUGARA, PhD, PGDEd, BSc (Licentiate)	*Chemistry, Heavy metal pollution; Public Health*	*E-mail: jkugara@yahoo.com; Mobile: +263-772-209-468*

Elijah MWEDZIWENDIRA, BSc (Hon.)	*Environmental Management*	*mwedziwendiraelijah98@gmail.com; Mobile: +263-774-623-961*
Vine MUTYASIRA, PhD, MSc, BSc (Hon.)	*Applied Development and Agric. Economics; Advocacy; Conflict Resolution*	*vinemutyasira@gmail.com; Mobile: +263-773-097-640*
Sinikiwe NCUBE, MSc, BSc (Hon.), BSc (Gen.)	*Petrology; Language proficient)*	*sinikiwencube26@gmail.com; Mobile: +263-776-746-145*

The develop a national overview of the ASGM sector, including baseline estimates of mercury use and practices was guided by the following general terms of reference:

1. Desk study, entailing compilation of all available information on ASGM, and conducting interviews with key stakeholders at national, regional and international levels.
2. Field visits at selected ASGM sites to collect more in-depth information via interviews with the mining community, observations and physical measurements.

The specific terms of references were to gather national information on:

a) Legal and regulatory status of ASGM;
b) Baseline estimates of mercury emissions and releases from the ASGM sector;
c) Structure of the ASGM sector (i.e., single family miners, community mines, etc.);
d) Policies surrounding ASGM;
e) Geographic distribution of ASGM;
f) Economics, such as earnings per capita, mercury supply, use and demand, information on gold trade and export, cost of living, and access to finance for miners. The project will search for information about gender and children aspects of the ASGM economics;
g) Size of the formal and informal ASGM economy;
h) Information on mining practices, including information on ore bodies exploited, processes used, amount of mercury used, the number of people directly involved in ASGM and indirectly exposed to mercury (disaggregated by gender and age);
i) Information on gold processing practices/burn off of mercury in gold processing shops or community retorts;

j) Known information on overall environmental impacts, contaminated sites, mercury releases in soil, air and water;
k) Studies and other information on mercury exposure, through various media, and studies on impacts in ASGM communities and downstream communities. The project will search for known information desegregated by gender and age;
l) Information about access to basic education, health care (including health effects of mercury exposure) and other services in mining communities;
m) Information about access to technical assistance for miners;
n) Leadership and organization of ASGM at national and local levels.
o) Experiences in addressing ASGM;
p) Information gaps at the local and national scale that can be addressed; and
q) Known information about the influence of ASGM practices and policies in neighbouring countries.

F1.3 STAKEHOLDERS CONSULTED

Table F1.3 gives a summary of the institutions and individuals consulted during the baseline assessment.

Table F1.3 *Stakeholders consultation and literature review*

Name	***Organisation***	***Designation***
Mr. L. Hwengwere	Environmental Management Agency (EMA) New Chinese Complex/Chinhoyi/Box 432, Chinhoyi. Email: lhwengwere@ema.co.zw; Tel: +263-775-553-025; +263-8677006244	Environmental Officer, Applied Environmental Science
Mr. D. Mhizha	Environmental Management Agency (EMA) 685/6 Lorraine/Faber Drive, Bluffhill, Harare Email: dmhizha@ema.co.zw; Tel: +263-773-551-005; +263-8677006244	Environmental Officer, Safety, Health & Environmental Management
Mr. L. Mugadza	Environmental Management Agency (EMA) 685/6 Lorraine/Faber Drive, Bluffhill, Harare	Environmental Officer
Ms. T. Nzenza	Ministry of Health and Child Care	Health Officer
Mr. R. Daison	Ministry of Health and Child Care	Director
Mr. M. Mungoni	PACT	Program Officer
Mr. R. Muchero	Ministry of Mines and Mining Development, Department of Metallurgy, 6th Floor, ZIMRE Centre, Cnr L.Takawira St/ K. Nkrumah Ave. Harare, Email: mmmd@mines.gov.zw; Tel: +263-4-777022	Metallurgist
Mr. T. Chinyowa	Ministry of Mines and Mining Development, Department of Metallurgy	Acting Director
Mr. P. Mbano	Ministry of Mines and Mining Development, Department of Metallurgy	Metallurgist

Name	***Organisation***	***Designation***
Mr. T. Munatsi	Ministry of Mines and Mining Development, Department of Metallurgy	Metallurgist
Mr. T. Matibhini	Ministry of Mines and Mining Development, Mashonaland West Province	Metallurgist
Ms C. Tagwireyi	SIRDC	Research Officer
Mr. A. Matiza	Ministry of Environment, Climate, Tourism and Hospitality Industry	Deputy Director
Ms P Dhlakama	Ministry of Environment, Climate, Tourism and Hospitality Industry	Environment Officer
Mr. W. Takavarasha	Zimbabwe Miners Federation	President
Mr. Ruzvidzo	Mashonaland West ASGM Representative	Chairperson
Mr B. Gada	Environmental Management Agency (EMA) 685/6 Lorraine/Faber Drive, Bluffhill, Harare Email: bgada@ema.co.zw; Tel: +263-717-802-695; +263-8677006244	Environmental Officer
Miners representatives	Several individuals	Miners representatives
Mr K. Ndiweni,	EMA Matabeleland South Province	Provincial Environmental Quality Officer
Mr I. Nyaguwa	EMA Harare	Environmental Technician
Mr M. Ndlovu	EMA Matabeleland South Province	District Environmental Officer
Mr N. Dhlamini,	EMA Matabeleland South Province	District Environmental Officer
Mr A. Rugara,	EMA Midlands	Provincial Environmental Quality Officer
Ms P. Manyatera	EMA Head Office	Environmental Technician
Mr Kangara	EMA Midlands Province	District Environmental Officer
Mr Masendeke,	EMA Midlands Province	District Environmental Officer
Mr Viriri and Mr Muchini,	Zimbabwe National Statistics Agency (ZIMSTAT)	ZIMSTAT Officers
***Reports**	Reserve Bank of Zimbabwe (RBZ).	**Reports**
***Database**	British Geological Survey (BGS).	**Database**
***Database**	Southern African Development Community (SADC)	**Database**
Mr Chiodze A.T	Forestry Commission	Sanyati District Forestry Officer
Mr Matope D	Rural District Council	Sanyati Planning Officer
Mr Mutandiri S	AGRITEX	Mhondorongezi Lands Officer
Dr T Pasi	Veterinary Department	Sanyati Veterinary Officer
Mr Mutambirwa H	DDF	District Co-ordinator

Name	***Organisation***	***Designation***
Mr Hurumende J	Ministry of Youth	Youth Development Officer
Mr Devere C	Sanyati Ministry of Health	District Health Officer
Mr Mudziwa D	Local Government	Sanyati District Administrator
Ms. Sekeso T	Woman Affairs	Women Affairs Centre and Community Development Officer
Mr Chipangura B	Ministery of Information	Herald Reporter
Mr Madawo M	Mhondorongezi Ministry of Health	District Health Officer
Mr Makono J	Kadoma City Council	Environmental Health Officer

F2. DETAILED NATIONAL BASELINE ANALYSIS

F2.1 GEOGRAPHICAL DISTRIBUTION OF ASGM

F2.1.1 INTRODUCTION

The gold mining sector in Zimbabwe is generally subdivided into: (1) formal large scale, (2) formal small-scale, and (3) informal small-scale and artisanal operators. In practice there is a strong connection between the formal small-scale miners and informal artisanal operators, because the former usually purchase and process gold from the latter (Mawowa, 2013). Many towns in Zimbabwe developed in the vicinity of large scale mining areas, the likes of which include Kwekwe, Gweru, Shamva, Shabani and Gwanda (**Figure F2.1.1**), with some founded as far back as 1898 before miners started using amalgam and cyanidation methods of refining gold (Huffman, 1974; Kritzinger, 2017).

Mercury use in gold mining became prominent in Southern Rhodesia (now Zimbabwe) in the 1930s (COWI, 2016a). However, like South Africa, many of the large scale gold miners in Zimbabwe moved to other gold recovery methods that not only have higher recovery efficiency than mercury amalgamation, but also comply with international funding institutions and markets (Ledwaba, 2017). The geographical distribution of large-scale gold miners that include Falcon, Arcturus, Jessie, and Fred mines is shown in **Figure F2.1.1**. While the global anthropogenic mercury emissions to air from large-scale gold mining was estimated at 5% in 2010 (AMAP/UNEP, 2013), most large scale gold producers in Zimbabwe, who are largely foreign owned generally do not use mercury in refining gold, leaving the ASGM sector as the major source of mercury emissions in gold production.

The large-scale gold mines have largely fixed mining premises. However, the ASGM sector is characterised by miners who move in and out of the sector and mostly engage in ASGM as part of a diversified livelihood strategy that also includes agriculture and other activities (Mawowa, 2013). There has therefore been variability in the geographical distribution of ASGM operations, particularly those involved in the gold panning along rivers (PACT, 2015). The objective of this assessment was to establish the geographical distribution of ASGM activities in Zimbabwe. This is particularly important in establishing

the levels of environmental risks from mercury use since mercury behaviour is related to prevailing climate and other environmental conditions.

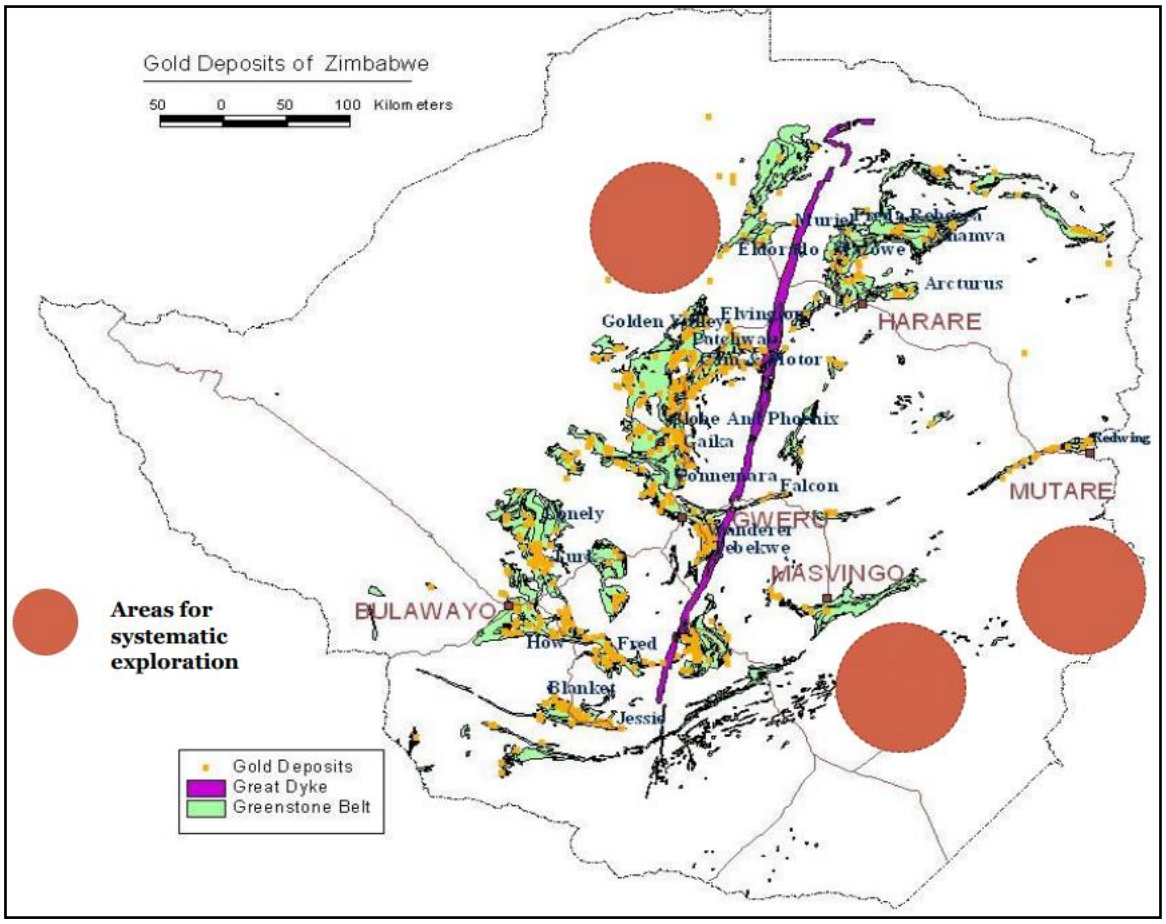


Figure F2.1.1 *Large-scale gold mines and gold deposits in Zimbabwe (after Mugandani, 2017) The keys should be combined into one key; change the symbol for areas for systematic exploration*

F2.1.2 METHODOLOGY

Assessment of the geographical distribution of ASGM in Zimbabwe was initially done through a desk study involving the compilation of available information and maps on the location of ASGM activities. This was followed by field assessment in selected districts under four provinces (**Table F2.1.1**). The provinces were selected on the basis that they have the highest number of people involved in ASGM activities based on previous national census data.

Geo-referenced satellite images were obtained from online sources that include: (i) Sentinel-2B L1C True Colour images from (USGS-EROS, 2018), with images dating as late

as 12 September 2018; (ii) Google Earth Pro (version 7.3.2.5491) images (NOAA, 2018), with the majority of them dating between 5 July 2011 and 18 December 2017(latest 2 July 2018); and (iii) ZoomEarth (2018) with images dating as late as 16 June 2018. The choice between image sources was based on the compromise between image quality and recentness, the latter being first preference to accommodate the nature of ASGM, in particular the dynamics of mobile practices related to 'gold rush'.

Identification of ASMG sites from satellite images was done before and after field visits. Snapshots of identified ASGM sites were created using Microsoft Windows Snipping Tool in rectangular snip mode. The mapping of locations of ASGM sites in each mining province was done using satellite images and field assessment data obtained during the survey. The maps were drawn using a combination of QGIS (version 2.12.3-Lyon) and Google Earth Pro (version 7.3.1.4507), aided by MS Paints (version 6.1).

Table F2.1.1 *Provinces, districts and number of sites assessed during the surveys*

Mining Province	***Visited Districts***	***Number of sites***			***Visit survey dates***
		Visited	***From images***	***Total***	
1. Matabeleland South	Insiza, Gwanda, Matobo, Umzingwane, Mangwe	40	24	64	12-16 Mar. 2018 04-08 Jun. 2018
2. Midlands	Zvishavane, Kwekwe, Gweru, Shurungi, Mberengwa	56	53	109	11-15 Jun. 2018
3. Mashonaland West	Kadoma, Chegutu, Makonde, Hurungwe	34	42	76	25- 30 Jun. 2018
4. Mashonaland Central	Mazowe, Bindura, Shamva, Mt Darwin	25	22	47	19-23 Mar. 2018 02-06 Jul. 2018
5. Manicaland	-	-	21	21	-
6. Masvingo	-	-	11	11	-
7. Matabeleland North	-	-	22	22	-
8. Mashonaland East	-	-	5	5	-
Total		**155**	**200**	**355**	

Coordinates and altitudes of sites were recorded using Global Positioning System (GPS) receivers set to the WGS84 Coordinate Reference System (CRS), while missing altitude

data for some of the points was gap filled using altitudes from the Google Earth Pro satellite images. The areas covered by different administrative boundaries, including districts were estimated using Google Earth Pro utilities from Earth Point Corporation (2018). The horizontal positional accuracy for Google Earth Pro's high resolution imagery was assumed to be ±2 m based on the study by Mohammed et al. (2013), and also supported by Paredes-Hernandez et al. (2013) for all images from 2008 onwards. The vertical positional accuracy for Google Earth Pro's high resolution imagery was assumed to be between 1.3 and 5.4 m based on the study by Sharma and Gupta (2014), and also supported by Rusli et al. (2014).

In order to differentiate ASGM activities from other activities such as alluvial sand mining and soil excavation for brick making (**Plate F2.1.1**), sites search also focused on identification of cyanidation ponds and equipment in the case of a milling plant. Proximity of the site to previously identified ASGM sites was also used as a guiding factor.



Plate F2.1 *Difference between brick making plant (a) and gold ore milling plant (b)*

Small-scale mining of chrome that takes place along the length of the Great Dyke was also differentiated from ASGM activities. It was noted that these workings also stripped off large quantities of soil, leading to piles of overburden material that look like tailings or ore stockpiles. However, the materials from chrome mining were appearing relatively coarser with distinct blue-green colouration in most cases.

F2.1.3 FINDINGS

The distribution of ASGM activities in Zimbabwe based on mapping by the Environmental Management Agency (EMA) is shown in **Figure F2.1.2**. The map includes activities related to both reef and alluvial gold mining. There is a general perception that when the gold source is alluvial, miners "do more sieving than digging and do not need to go to the miller" (Pact, 2015). Alluvial gold mining sites could not be identified from satellite images at the current resolution, and since alluvial gold is largely considered to be pure, the refining process is generally not subject to use of mercury. However studies on the chemical composition of alluvial gold in Zimbabwe have found that alluvial gold grains in Kadoma District, Midlands Province, had up to 0.8% mercury, while in Kwekwe District some samples had up to 10% mercury (Styles et al., 1995). The researchers attributed the high mercury in alluvial gold to contamination by mercury from the amalgamation process. The existence of mercury in alluvial gold was also confirmed during an interview with an alluvial gold miner in Shurugwi District, Dombojena area.

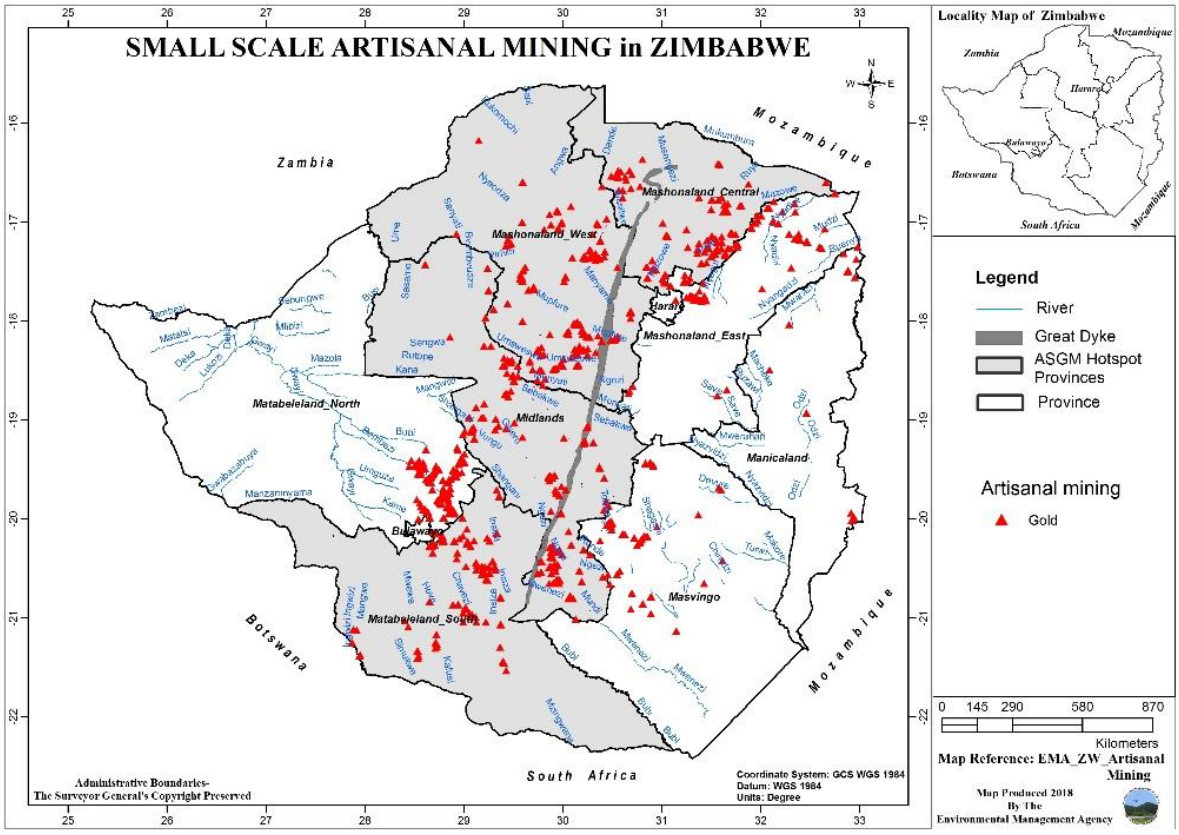


Figure F2.1.2 *Distribution of ASGM activities in Zimbabwe (EMA, 2014)*

With the exception of alluvial gold panning along major rivers such as *Runde, Angwa, Sanyati, Munyati, Msweswe, Sebakwe, Odzi* and *Macheke* (confirmed by Ashton et al., 2001; PACT, 2015), it can confirm that ASGM sites are found within the gold deposits sites that are largely concentrated in four provinces of Zimbabwe, namely Midlands, Mashonaland West, Matabeleland South, and Mashonaland Central (**Figure F2.1.2**).

Based on the national population statistics (ZIMSTAT, 2013) and population projections (ZIMSTAT, 2015), the estimated number of miners in the ASGM activities increased by about 11.4% between 2012 and 2017 (**Table F2.1.2**). The highest proportion of miners in the ASGM sector were found in Midlands (27.3%) followed by Mashonaland West (18.8%), Matabeleland South (16.8%), Mashonaland Central (12.5%), Mashonaland East (12.2%), Manicaland (7.7%), Matabeleland North (2.7%) and Masvingo (1.9%). However, given the dynamics related to 'gold rush' and close down of some sites due to exhaustion or other factors the distribution is expected to be also dynamic.

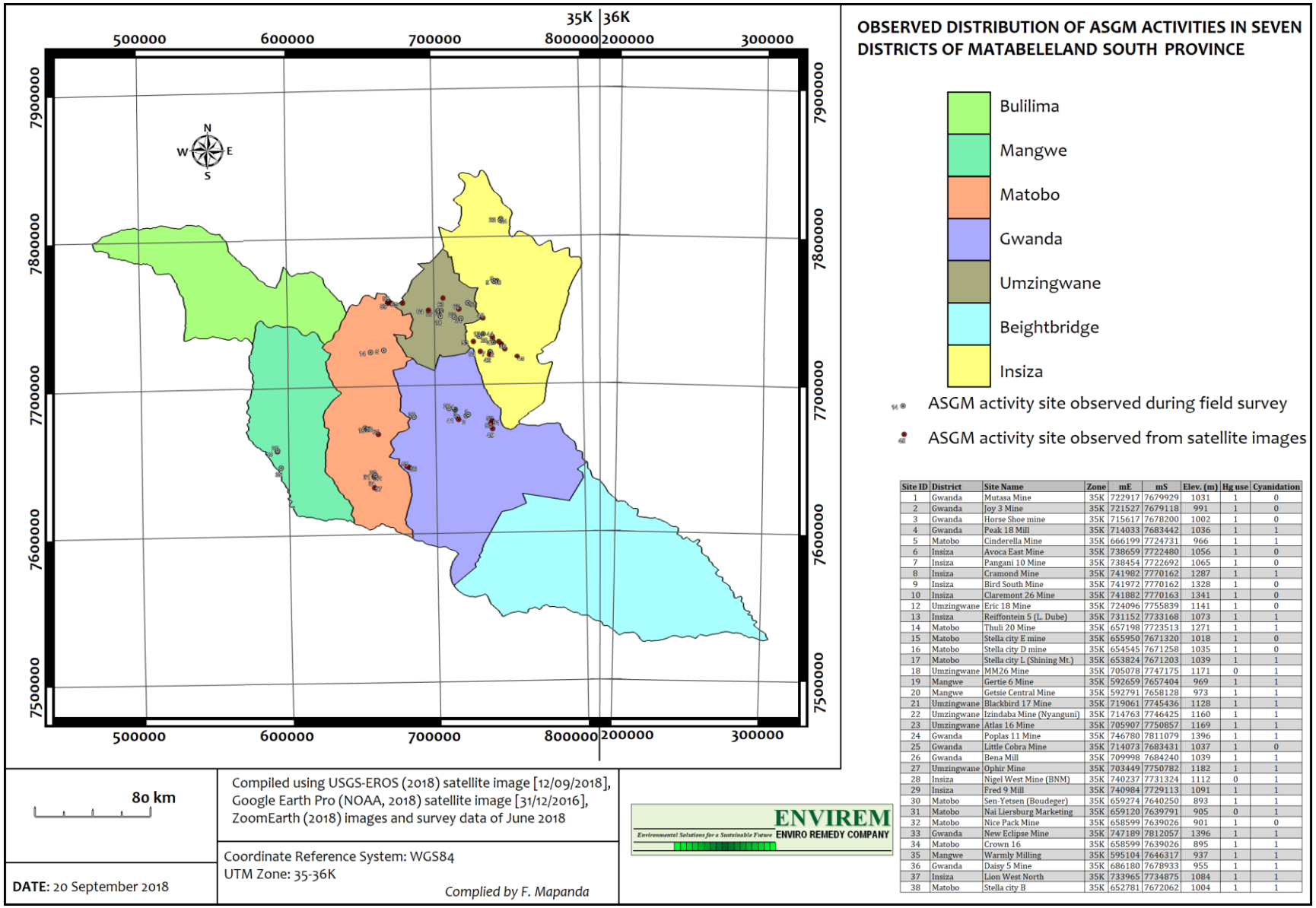
Table F2.1.2 *Estimated number of miners in the ASGM sector*

Year	Mat. S	Mat. N	Mid.	Mash. C	Mash. E	Mash. W	Masv.	Man.	Total
2012	12,153	1,925	19,451	8,781	8,663	13,267	1,381	5,458	71,079
2013	12,838	2,034	20,219	9,274	9,033	13,836	1,435	5,673	74,341
2014	12,965	2,063	20,618	9,447	9,204	14,132	1,460	5,793	75,682
2015	13,123	2,096	21,039	9,633	9,387	14,443	1,486	5,921	77,129
2016	13,303	2,131	21,477	9,829	9,578	14,765	1,487	6,053	78,624
2017	13,499	2,169	21,928	10,033	9,775	15,096	1,544	6,191	80,236

The distribution of ASGM activities in Matabeleland South Province is shown in **Figure F2.1.3**. Based on the number of gold processing sites per unit area of the district the highest ASGM activity density was found in Umzingwane, followed by Insiza, Matobo, Gwanda and Mangwe (**Table F2.1.3**).

Table F2.1.3 *Observed ASGM activity density in Matabeleland South Province and number of registered milling sites according to the Ministry of Mines and Mining Development (MoMMD)*

District	***Approx. district area (km²)***	***Observed mining/ processing sites***	***Activity density (sites/1000 km²)***
Bulilima	6,609	0	0.0
Mangwe	6,050	3	0.5
Matobo	7,242	15	2.1
Gwanda	10,738	16	1.5
Umzingwane	2,773	10	3.6
Beightbridge	12,922	0	0.0
Insiza	8,316	18	2.2
Total	54,650	62	1.1
MoMMD Total		*120*	*2.2*



Site ID	District	Site Name	Zone	mE	mS	Elev. (m)	Hg use	Cyanidation
1	Gwanda	Mutasa Mine	35K	722917	7679929	1031	1	0
2	Gwanda	Joy 3 Mine	35K	721527	7679118	991	1	0
3	Gwanda	Horse Shoe mine	35K	715617	7678200	1002	1	0
4	Gwanda	Peak 18 Mill	35K	714033	7683442	1036	1	1
5	Matobo	Cinderella Mine	35K	666199	7724731	966	1	1
6	Insiza	Avoca East Mine	35K	738659	7722480	1056	1	0
7	Insiza	Pangani 10 Mine	35K	738454	7722692	1065	1	0
8	Insiza	Cramond Mine	35K	741982	7770162	1287	1	1
9	Insiza	Bird South Mine	35K	741972	7770162	1328	1	0
10	Insiza	Claremont 26 Mine	35K	741882	7770163	1341	1	0
12	Umzingwane	Eric 18 Mine	35K	724096	7755839	1141	1	0
13	Insiza	Reiffontein 5 (L. Dube)	35K	731152	7733168	1073	1	1
14	Matobo	Thuli 20 Mine	35K	657198	7723513	1271	1	1
15	Matobo	Stella city E mine	35K	655950	7671320	1018	1	0
16	Matobo	Stella city D mine	35K	654545	7671258	1035	1	0
17	Matobo	Stella city L (Shining Mt.)	35K	653824	7671203	1039	1	1
18	Umzingwane	MM26 Mine	35K	705078	7747175	1171	0	1
19	Mangwe	Gertie 6 Mine	35K	592659	7657404	969	1	1
20	Mangwe	Getsie Central Mine	35K	592791	7658128	973	1	1
21	Umzingwane	Blackbird 17 Mine	35K	719061	7745436	1128	1	1
22	Umzingwane	Izindaba Mine (Nyanguni)	35K	714763	7746425	1160	1	1
23	Umzingwane	Atlas 16 Mine	35K	705907	7750857	1169	1	1
24	Gwanda	Poplas 11 Mine	35K	746780	7811079	1396	1	1
25	Gwanda	Little Cobra Mine	35K	714073	7683431	1037	1	0
26	Gwanda	Bena Mill	35K	709998	7684240	1039	1	1
27	Umzingwane	Ophir Mine	35K	703449	7750782	1182	1	1
28	Insiza	Nigel West Mine (BNM)	35K	740237	7731324	1112	0	1
29	Insiza	Fred 9 Mill	35K	740984	7729113	1091	1	1
30	Matobo	Sen-Yetsen (Boudeger)	35K	659274	7640250	893	1	1
31	Matobo	Nai Liersburg Marketing	35K	659120	7639791	905	0	1
32	Matobo	Nice Pack Mine	35K	658599	7639026	901	1	0
33	Gwanda	New Eclipse Mine	35K	747189	7812057	1396	1	1
34	Matobo	Crown 16	35K	658599	7639026	895	1	1
35	Mangwe	Warmly Milling	35K	595104	7646317	937	1	1
36	Gwanda	Daisy 5 Mine	35K	686180	7678933	955	1	1
37	Insiza	Lion West North	35K	733965	7734875	1084	1	1
38	Matobo	Stella city B	35K	652781	7672062	1004	1	1

Figure F2.1.3 *Distribution of ASGM activities in Matabeleland South Province, Zimbabwe*

The observed ASMG activities in Umzingwane were in Wards 3, 14 and 15. **Plate F2.1.2** shows selected features of visited sites in selected districts of Matabeleland South.



Plate F2.1.2 *Selected features of visited sites in selected districts of Matabeleland South*

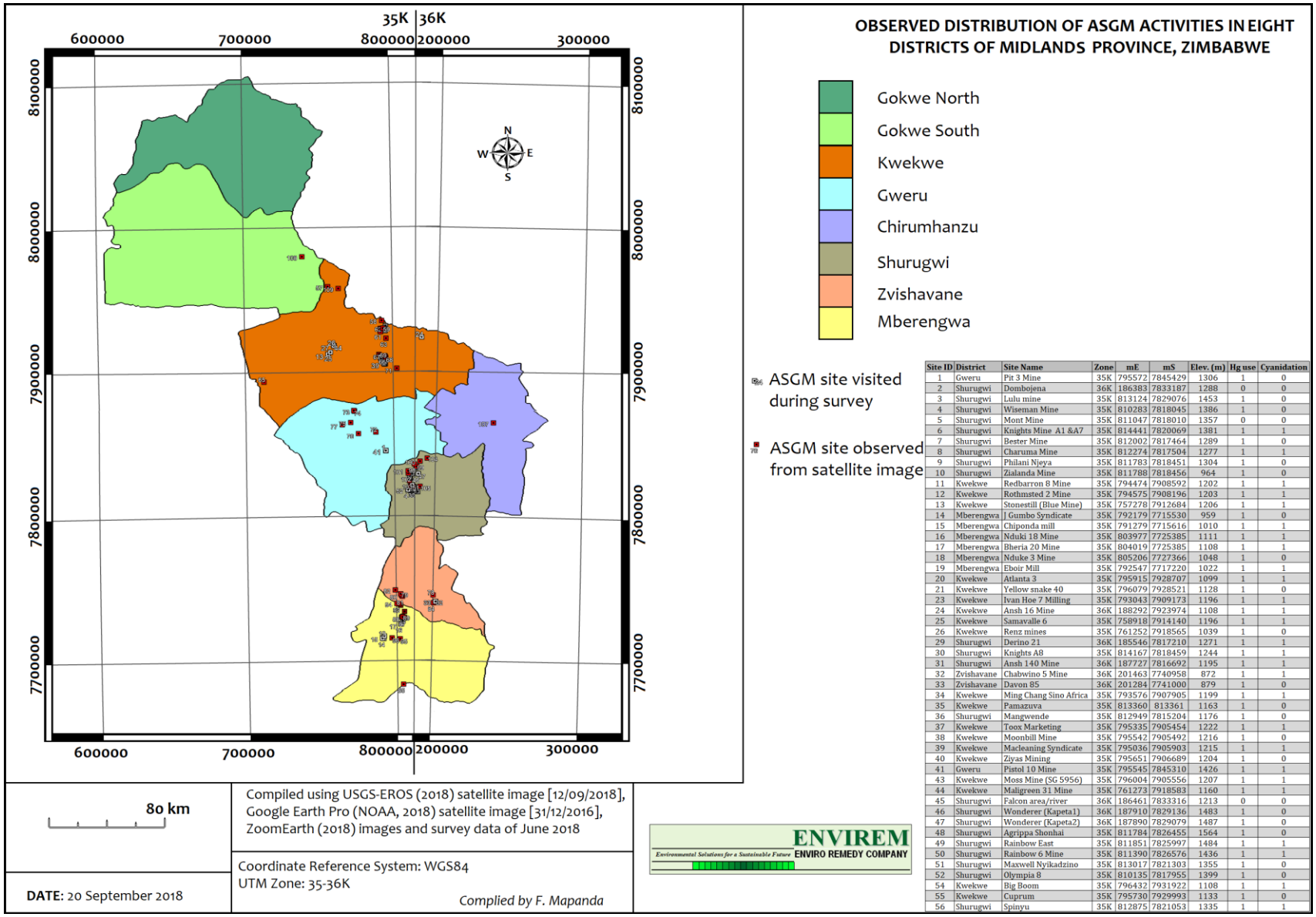
The Midlands Province recorded the highest number of ASGM activities based on the available information and field observation (**Figure F2.1.4**). The highest ASGM activity density was found in Shurugwi District, followed by Kwekwe, Mberengwa, Zvishavane, Gweru, Chirumhanzu and Gokwe South (**Table F2.1.4**). There were considerable environmental issues in Midlands Province relative to all other provinces, and most of these problems were associated with gold mining processes in close proximity to water courses (**Plates F2.1.3** and **F2.1.4**).

Table F2.1.4 *Observed ASGM activity density in Midlands Province and number of registered milling sites according to the Ministry of Mines and Mining Development (MoMMD)*

District	***Approx. district area (km²)***	***Observed mining/ processing sites***	***Activity density (sites/1000 km²)***
Mberengwa	4,985	19	3.8
Zvishavane	2,633	8	3.0
Shurugwi	3,631	32	8.8
Gweru	6,189	8	1.3
Chirumhanzu	4,719	1	0.2
Kwekwe	8,814	35	4.0
Gokwe South	11,088	1	0.1
Gokwe North	7,380	0	0.0
Total	49,439	104	2.1
MoMMD Total		*300*	*6.1*



Plate F2.1.3 *Location of gold processing sites near water courses in Zvishavane and Shurugwi. Aerial photographs from ZoomEarth (2018); Image dates: 16 June 2018.*



Site ID	District	Site Name	Zone	mE	mS	Elev. (m)	Hg use	Cyanidation
1	Gweru	Pit 3 Mine	35K	795572	7845429	1306	1	0
2	Shurugwi	Dombojena	36K	186383	7833187	1288	0	0
3	Shurugwi	Lulu mine	35K	813124	7829076	1453	1	0
4	Shurugwi	Wiseman Mine	35K	810283	7818045	1386	1	0
5	Shurugwi	Mont Mine	35K	811047	7818010	1357	0	0
6	Shurugwi	Knights Mine A1 &A7	35K	814441	7820069	1381	1	1
7	Shurugwi	Bester Mine	35K	812002	7817464	1289	1	0
8	Shurugwi	Charuma Mine	35K	812274	7817504	1277	1	1
9	Shurugwi	Philani Njeya	35K	811783	7818451	1304	1	0
10	Shurugwi	Zialanda Mine	35K	811788	7818456	964	1	0
11	Kwekwe	Redbarron 8 Mine	35K	794474	7908592	1202	1	1
12	Kwekwe	Rothmsted 2 Mine	35K	794575	7908196	1203	1	1
13	Kwekwe	Stonestill (Blue Mine)	35K	757278	7912684	1206	1	1
14	Mberengwa	J Gumbo Syndicate	35K	792179	7715530	959	1	0
15	Mberengwa	Chiponda mill	35K	791279	7715616	1010	1	1
16	Mberengwa	Nduki 18 Mine	35K	803977	7725385	1111	1	1
17	Mberengwa	Bheria 20 Mine	35K	804019	7725385	1108	1	1
18	Mberengwa	Nduke 3 Mine	35K	805206	7727366	1048	1	0
19	Mberengwa	Eboir Mill	35K	792547	7717220	1022	1	1
20	Kwekwe	Atlanta 3	35K	795915	7928707	1099	1	1
21	Kwekwe	Yellow snake 40	35K	796079	7928521	1128	1	0
23	Kwekwe	Ivan Hoe 7 Milling	35K	793043	7909173	1196	1	1
24	Kwekwe	Ansh 16 Mine	36K	188292	7923974	1108	1	1
25	Kwekwe	Samavalle 6	35K	758918	7914140	1196	1	1
26	Kwekwe	Renz mines	35K	761252	7918565	1039	1	0
29	Shurugwi	Derino 21	36K	185546	7817210	1271	1	1
30	Shurugwi	Knights A8	35K	814167	7818459	1244	1	1
31	Shurugwi	Ansh 140 Mine	36K	187727	7816692	1195	1	1
32	Zvishavane	Chabwino 5 Mine	36K	201463	7740958	872	1	1
33	Zvishavane	Davon 85	36K	201284	7741000	879	1	0
34	Kwekwe	Ming Chang Sino Africa	35K	793576	7907905	1199	1	1
35	Kwekwe	Pamazuva	35K	813360	813361	1163	1	0
36	Shurugwi	Mangwende	35K	812949	7815204	1176	1	0
37	Kwekwe	Teox Marketing	35K	795335	7905454	1222	1	1
38	Kwekwe	Moonbill Mine	35K	795542	7905492	1216	1	0
39	Kwekwe	Macleaning Syndicate	35K	795036	7905903	1215	1	1
40	Kwekwe	Ziyas Mining	35K	795651	7906689	1204	1	0
41	Gweru	Pistol 10 Mine	35K	795545	7845310	1426	1	1
43	Kwekwe	Moss Mine (SG 5956)	35K	796004	7905556	1207	1	1
44	Kwekwe	Maligreen 31 Mine	35K	761273	7918583	1160	1	1
45	Shurugwi	Falcon area/river	36K	186461	7833316	1213	0	0
46	Shurugwi	Wonderer (Kapeta1)	36K	187910	7829136	1483	1	0
47	Shurugwi	Wonderer (Kapeta2)	36K	187890	7829079	1487	1	0
48	Shurugwi	Agrippa Shonhai	35K	811784	7826455	1564	1	0
49	Shurugwi	Rainbow East	35K	811851	7825997	1484	1	1
50	Shurugwi	Rainbow 6 Mine	35K	811390	7826576	1436	1	1
51	Shurugwi	Maxwell Nyikadzino	35K	813017	7821303	1355	1	0
52	Shurugwi	Olympia 8	35K	810135	7817955	1399	1	0
54	Kwekwe	Big Boom	35K	796432	7931922	1108	1	1
55	Kwekwe	Cuprum	35K	795730	7929993	1133	1	0
56	Shurugwi	Spinyu	35K	812875	7821053	1335	1	1

Figure F2.1.4 *Distribution of ASGM activities in Midlands Province, Zimbabwe*

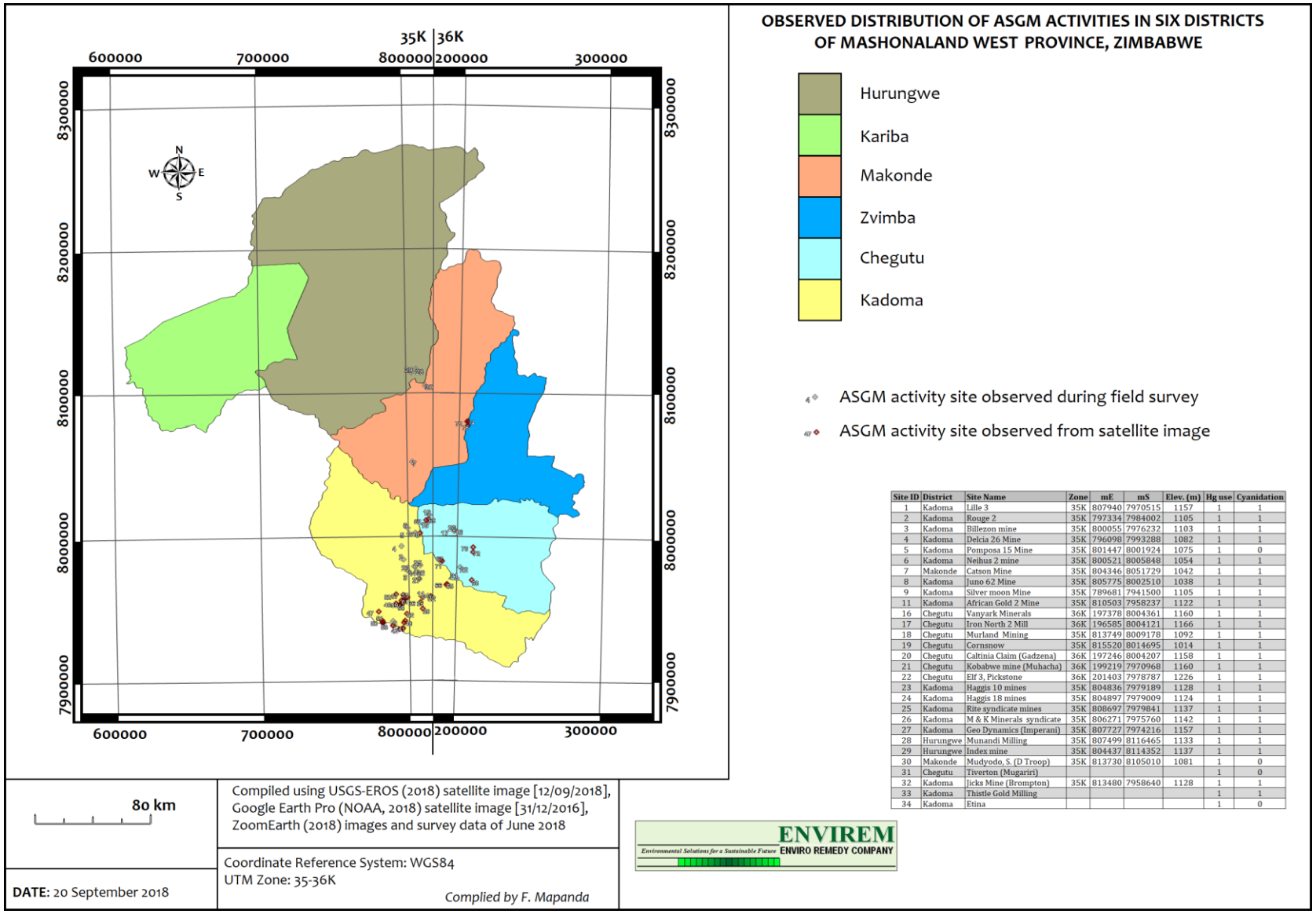


Plate F2.1.4 *Alluvial gold mining in Shurugwi District, Dombojena area resulting in severe silting*

The ASGM activities in Mashonaland West Province were concentrated on the south-central parts of the province with Kadoma dominating in terms of activity density (**Figure F2.1.5** and **Table F2.1.5**).

Table F2.1.5 *Observed ASGM activity density in Mashonaland West Province and number of registered milling sites according to the Ministry of Mines and Mining Development (MoMMD)*

District	***Approx. district area (km²)***	***Observed mining/ processing sites***	***Activity density (sites/1000 km²)***
Kariba	8,136	0	0.0
Hurungwe	19,752	2	0.1
Makonde	8,777	2	0.2
Kadoma	9,290	47	5.1
Zvimba	6,082	3	0.5
Chegutu	5,361	14	2.6
Total	57,398	68	1.2
MoMMD Total		*350*	*6.1*



Site ID	District	Site Name	Zone	mE	mS	Elev. (m)	Hg use	Cyanidation
1	Kadoma	Lille 3	35K	807940	7970515	1157	1	1
2	Kadoma	Rouge 2	35K	797334	7984002	1105	1	1
3	Kadoma	Billezon mine	35K	800055	7976232	1103	1	1
4	Kadoma	Delcia 26 Mine	35K	796098	7993288	1082	1	1
5	Kadoma	Pomposa 15 Mine	35K	801447	8001924	1075	1	0
6	Kadoma	Neihus 2 mine	35K	800521	8005848	1054	1	1
7	Makonde	Catson Mine	35K	804346	8051729	1042	1	1
8	Kadoma	Juno 62 Mine	35K	805775	8002510	1038	1	1
9	Kadoma	Silver moon Mine	35K	789681	7941500	1105	1	1
11	Kadoma	African Gold 2 Mine	35K	810503	7958237	1122	1	1
16	Chegutu	Vanyark Minerals	36K	197378	8004361	1160	1	1
17	Chegutu	Iron North 2 Mill	36K	196585	8004121	1166	1	1
18	Chegutu	Murland Mining	35K	813749	8009178	1092	1	1
19	Chegutu	Cornsnow	35K	815520	8014695	1014	1	1
20	Chegutu	Caltinia Claim (Gadzena)	36K	197246	8004207	1158	1	1
21	Chegutu	Kobabwe mine (Muhacha)	36K	199219	7970968	1160	1	1
22	Chegutu	Elf 3, Pickstone	36K	201403	7978787	1226	1	1
23	Kadoma	Haggis 10 mines	35K	804836	7979189	1128	1	1
24	Kadoma	Haggis 18 mines	35K	804897	7979009	1124	1	1
25	Kadoma	Rite syndicate mines	35K	808697	7979841	1137	1	1
26	Kadoma	M & K Minerals syndicate	35K	806271	7975760	1142	1	1
27	Kadoma	Geo Dynamics (Imperani)	35K	807727	7974216	1157	1	1
28	Hurungwe	Munandi Milling	35K	807499	8116465	1133	1	1
29	Hurungwe	Index mine	35K	804437	8114352	1137	1	1
30	Makonde	Mudyodo, S. (D Troop)	35K	813730	8105010	1081	1	0
31	Chegutu	Tiverton (Mugariri)					1	0
32	Kadoma	Jicks Mine (Brompton)	35K	813480	7958640	1128	1	1
33	Kadoma	Thistle Gold Milling					1	1
34	Kadoma	Etina					1	0

Figure F2.1.5 *Distribution of ASGM activities in Mashonaland West Province, Zimbabwe*

The southern parts of the Mashonaland Central Province showed some significant ASGM activities (**Figure F2.1.6**), and the highest activity density was found in Shamva District, followed by Mazowe, Bindura and Mount Darwin (**Table F2.1.6**). Mashonaland had the fourth largest number of miners involved in the ASGM activities and forth largest ASGM activity density, but fifth largest number of registered gold milling sites, trading behind Masvingo Province.

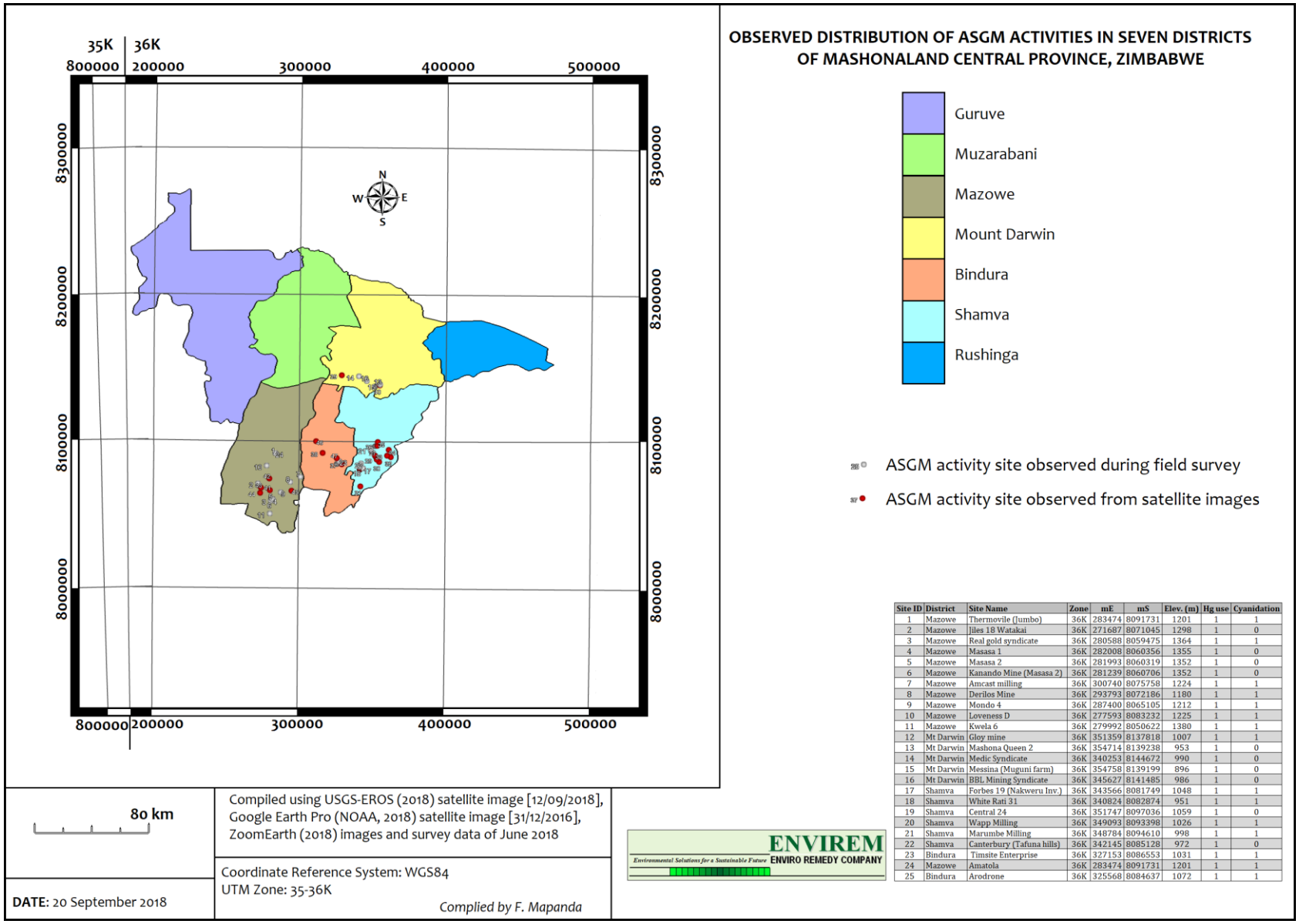
Table F2.1.6 *Observed ASGM activity density in Mashonaland Central Province and number of registered milling sites according to the Ministry of Mines and Mining Development (MoMMD)*

District	***Approx. district area (km²)***	***Observed mining/ processing sites***	***Activity density (sites/1000 km²)***
Guruve	7,753	0	0.0
Mount Darwin	4,500	7	1.6
Mazowe	4,463	17	3.8
Centenary	4,267	0	0.0
Bindura	2,291	6	2.6
Shamva	2,745	17	6.2
Rushinga	2,319	0	0.0
Total	28,338	47	1.7
MoMMD Total		*37*	*1.3*

The major sites of ASGM activities in Manicaland Province were located in Mutasa District, followed by Mutare, Nyanga, Makoni and Buhera (**Figure F2.1.7; Table F2.1.7**).

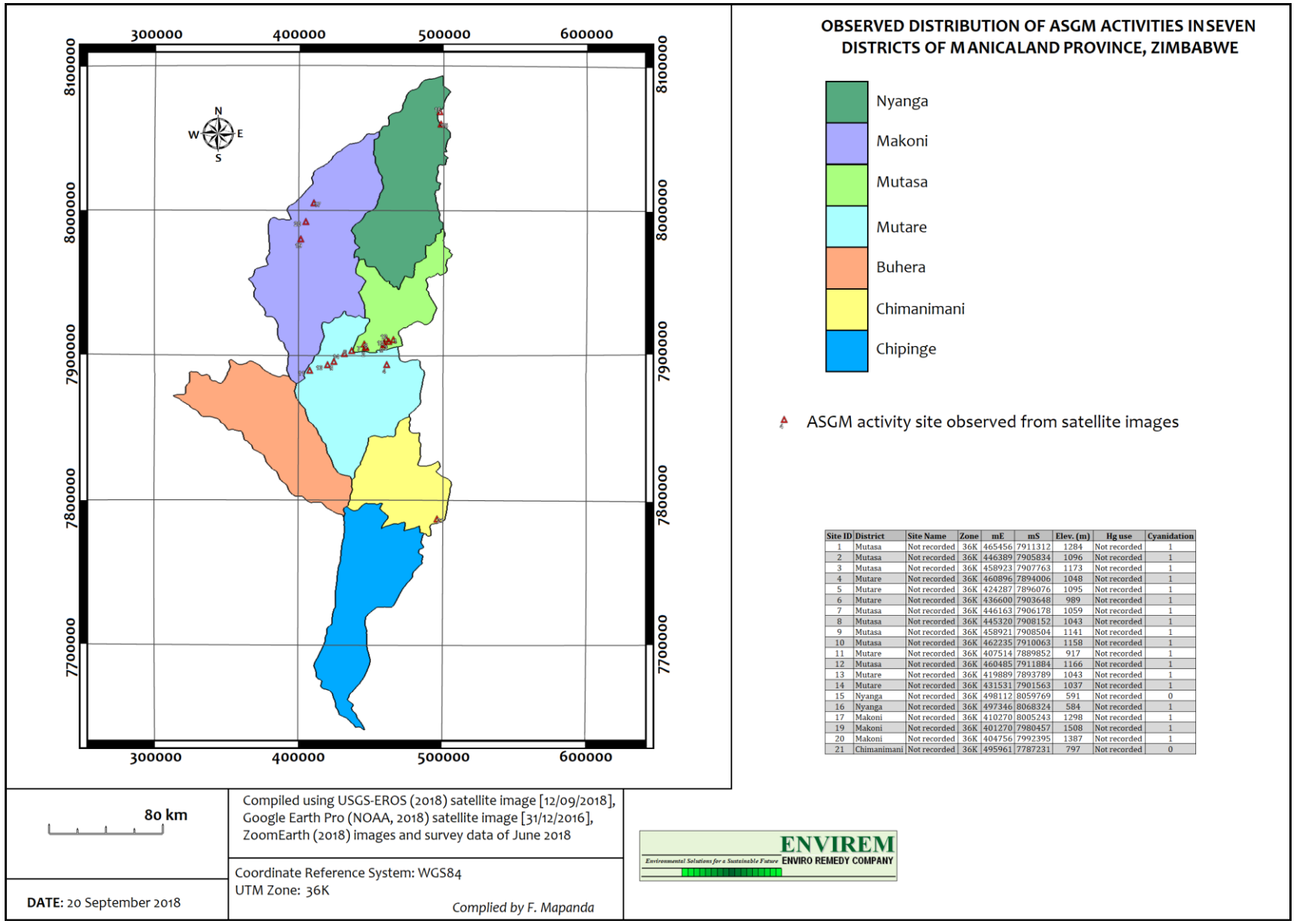
Table F2.1.7 *Observed ASGM activity density in Manicaland Province and number of registered milling sites according to the Ministry of Mines and Mining Development (MoMMD)*

District	***Approx. district area (km²)***	***Observed mining/ processing sites***	***Activity density (sites/1000 km²)***
Nyanga	5,682	2	0.4
Makoni	7,872	3	0.4
Mutasa	2,555	8	3.1
Mutare	5,635	6	1.1
Buhera	5,338	0	0.0
Chimanimani	3,316	1	0.3
Chipinge	5,199	0	0.0
Total	35,597	20	0.6
MoMMD Total		*20*	*0.6*



Site ID	District	Site Name	Zone	mE	mS	Elev. (m)	Hg use	Cyanidation
1	Mazowe	Thermovile (Jumbo)	36K	283474	8091731	1201	1	1
2	Mazowe	Jiles 18 Watakai	36K	271687	8071045	1298	1	0
3	Mazowe	Real gold syndicate	36K	280588	8059475	1364	1	1
4	Mazowe	Masasa 1	36K	282008	8060356	1355	1	0
5	Mazowe	Masasa 2	36K	281993	8060319	1352	1	0
6	Mazowe	Kanando Mine (Masasa 2)	36K	281239	8060706	1352	1	0
7	Mazowe	Amcast milling	36K	300740	8075758	1224	1	1
8	Mazowe	Derilos Mine	36K	293793	8072186	1180	1	1
9	Mazowe	Mondo 4	36K	287400	8065105	1212	1	1
10	Mazowe	Loveness D	36K	277593	8083232	1225	1	1
11	Mazowe	Kwela 6	36K	279992	8050622	1380	1	1
12	Mt Darwin	Gloy mine	36K	351359	8137818	1007	1	1
13	Mt Darwin	Mashona Queen 2	36K	354714	8139238	953	1	0
14	Mt Darwin	Medic Syndicate	36K	340253	8144672	990	1	0
15	Mt Darwin	Messina (Muguni farm)	36K	354758	8139199	896	1	0
16	Mt Darwin	BBL Mining Syndicate	36K	345627	8141485	986	1	0
17	Shamva	Forbes 19 (Nakweru Inv.)	36K	343566	8081749	1048	1	1
18	Shamva	White Rati 31	36K	340824	8082874	951	1	1
19	Shamva	Central 24	36K	351747	8097036	1059	1	0
20	Shamva	Wapp Milling	36K	349093	8093398	1026	1	1
21	Shamva	Marumbe Milling	36K	348784	8094610	998	1	1
22	Shamva	Canterbury (Tafuna hills)	36K	342145	8085128	972	1	0
23	Bindura	Timsite Enterprise	36K	327153	8086553	1031	1	1
24	Mazowe	Amatola	36K	283474	8091731	1201	1	1
25	Bindura	Arodrone	36K	325568	8084637	1072	1	1

Figure F2.1.6 *Distribution of ASGM activities in Mashonaland Central Province, Zimbabwe*



Site ID	District	Site Name	Zone	mE	mS	Elev. (m)	Hg use	Cyanidation
1	Mutasa	Not recorded	36K	465456	7911312	1284	Not recorded	1
2	Mutasa	Not recorded	36K	446389	7905834	1096	Not recorded	1
3	Mutasa	Not recorded	36K	458923	7907763	1173	Not recorded	1
4	Mutare	Not recorded	36K	460896	7894006	1048	Not recorded	1
5	Mutare	Not recorded	36K	424287	7896076	1095	Not recorded	1
6	Mutare	Not recorded	36K	436600	7903648	989	Not recorded	1
7	Mutasa	Not recorded	36K	446163	7906178	1059	Not recorded	1
8	Mutasa	Not recorded	36K	445320	7908152	1043	Not recorded	1
9	Mutasa	Not recorded	36K	458921	7908504	1141	Not recorded	1
10	Mutasa	Not recorded	36K	462235	7910063	1158	Not recorded	1
11	Mutare	Not recorded	36K	407514	7889852	917	Not recorded	1
12	Mutasa	Not recorded	36K	460485	7911884	1166	Not recorded	1
13	Mutare	Not recorded	36K	419889	7893789	1043	Not recorded	1
14	Mutare	Not recorded	36K	431531	7901563	1037	Not recorded	1
15	Nyanga	Not recorded	36K	498112	8059769	591	Not recorded	0
16	Nyanga	Not recorded	36K	497346	8068324	584	Not recorded	1
17	Makoni	Not recorded	36K	410270	8005243	1298	Not recorded	1
19	Makoni	Not recorded	36K	401270	7980457	1508	Not recorded	1
20	Makoni	Not recorded	36K	404756	7992395	1387	Not recorded	1
21	Chimanimani	Not recorded	36K	495961	7787231	797	Not recorded	0

Figure F2.1.7 *Distribution of ASGM activities in Manicaland Province, Zimbabwe*

The observations of ASGM activities in Masvingo Province were relatively few (**Figure F2.1.8; Table F2.1.8**) despite the province having a higher number of registered milling sites (44) than Mashonaland Central (37).

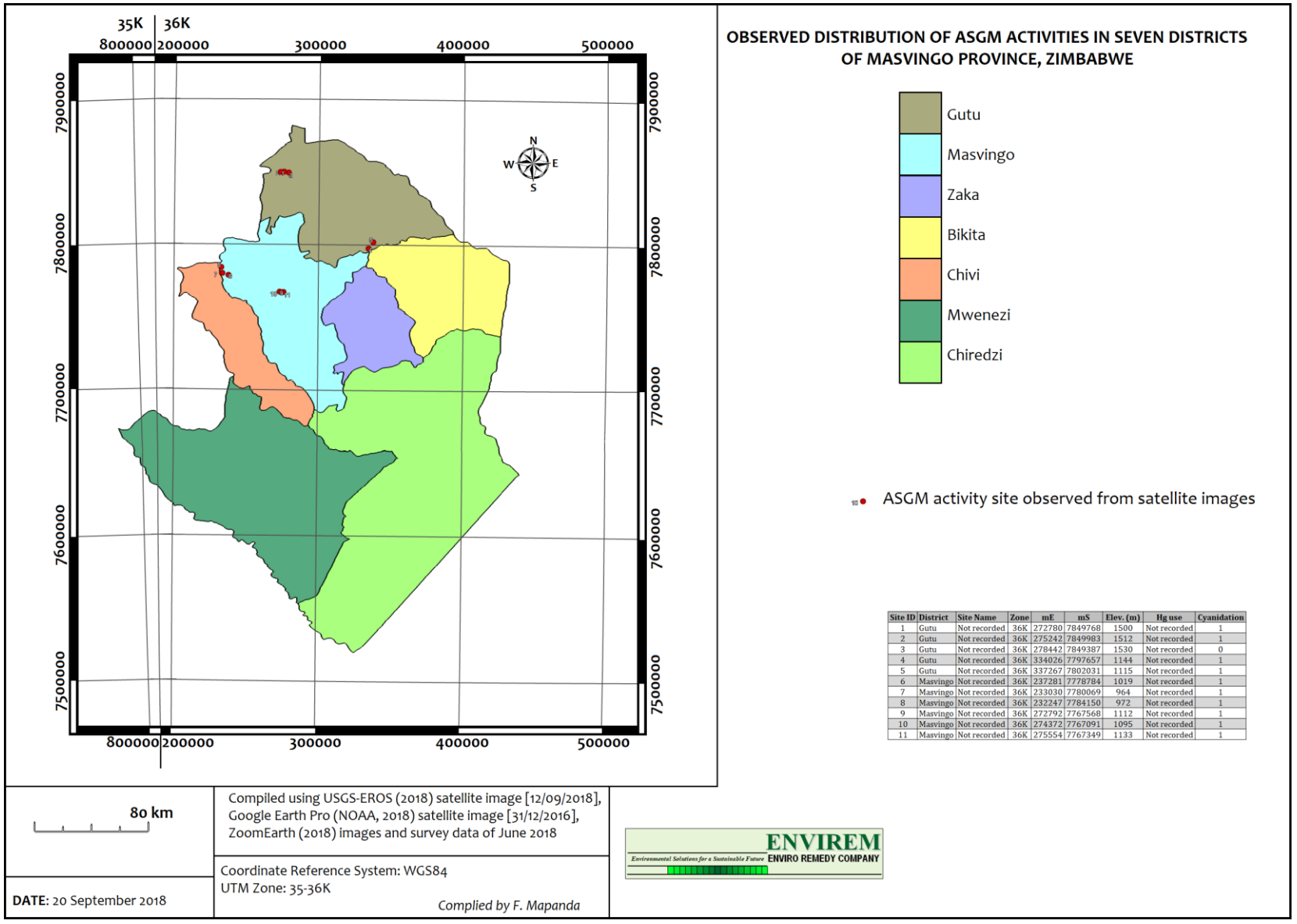
Table F2.1.8 *Observed ASGM activity density in Masvingo Province and number of registered milling sites according to the Ministry of Mines and Mining Development (MoMMD)*

District	***Approx. district area (km²)***	***Observed mining/ processing sites***	***Activity density (sites/1000 km²)***
Gutu	7,107	5	0.7
Masvingo	6,901	6	0.9
Bikita	5,177	0	0.0
Chiredzi	17,566	0	0.0
Zaka	3,104	0	0.0
Chivi	3,560	0	0.0
Mwenezi	12,856	0	0.0
Total	56,271	11	0.2
MoMMD Total		*44*	*0.8*

In Matabeleland North, only Bubi and Umguza showed evidence of significant ASGM activities from the aerial views (**Figure F2.1.9; Table F2.1.9**), however the existence of 30 registered milling site in this province suggests emerging potential of expanding ASGM activities in the past year.

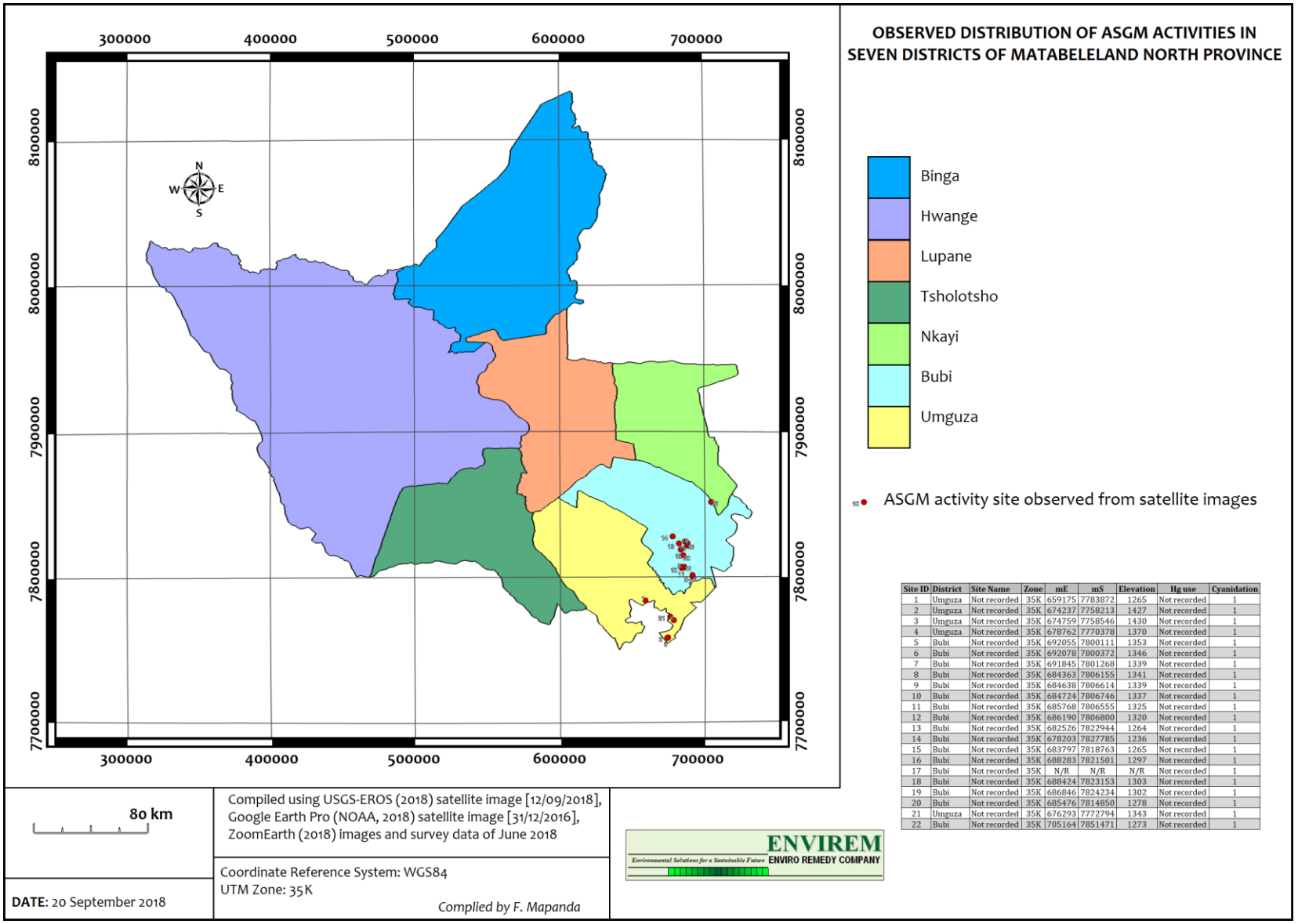
Table F2.1.9 *Observed ASGM activity density in Matabeleland North Province and number of registered milling sites according to the Ministry of Mines and Mining Development (MoMMD)*

District	***Approx. district area (km²)***	***Observed mining/ processing sites***	***Activity density (sites/1000 km²)***
Binga	13,242	0	0.0
Hwange	29,788	0	0.0
Lupane	7,748	0	0.0
Tsholotsho	7,785	0	0.0
Umguza	6,094	4	0.7
Nkayi	5,312	0	0.0
Bubi	5,531	17	3.1
Total	75,500	21	0.3
MoMMD Total		*30*	*0.4*



Site ID	District	Site Name	Zone	mE	mS	Elev. (m)	Hg use	Cyanidation
1	Gutu	Not recorded	36K	272780	7849768	1500	Not recorded	1
2	Gutu	Not recorded	36K	275242	7849983	1512	Not recorded	1
3	Gutu	Not recorded	36K	278442	7849387	1530	Not recorded	0
4	Gutu	Not recorded	36K	334026	7797657	1144	Not recorded	1
5	Gutu	Not recorded	36K	337267	7802031	1115	Not recorded	1
6	Masvingo	Not recorded	36K	237281	7778784	1019	Not recorded	1
7	Masvingo	Not recorded	36K	233030	7780069	964	Not recorded	1
8	Masvingo	Not recorded	36K	232247	7784150	972	Not recorded	1
9	Masvingo	Not recorded	36K	272792	7767568	1112	Not recorded	1
10	Masvingo	Not recorded	36K	274372	7767091	1095	Not recorded	1
11	Masvingo	Not recorded	36K	275554	7767349	1133	Not recorded	1

Figure F2.1.8 *Distribution of ASGM activities in Masvingo Province, Zimbabwe*



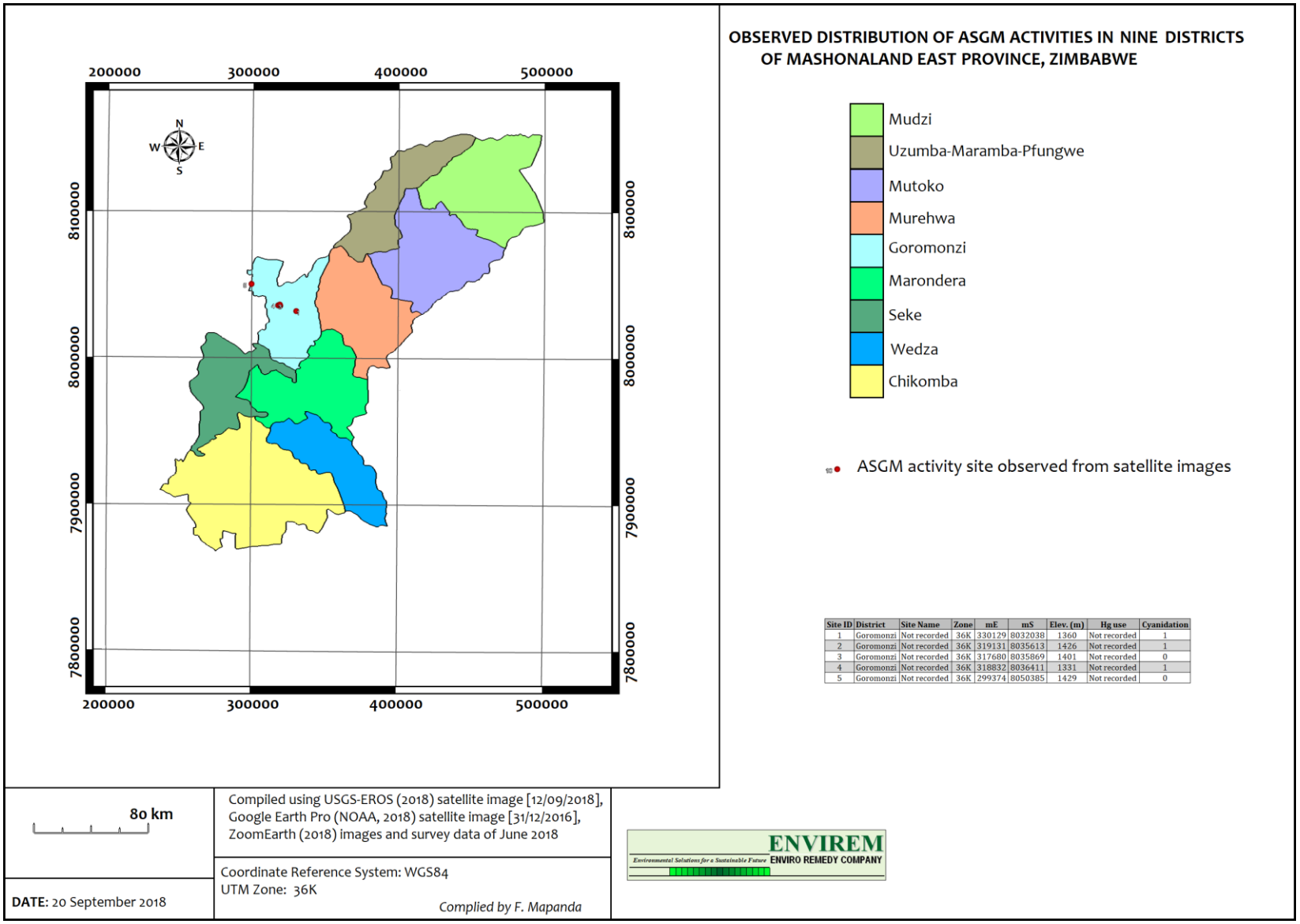
Site ID	District	Site Name	Zone	mE	mS	Elevation	Hg use	Cyanidation
1	Umguza	Not recorded	35K	659175	7783872	1265	Not recorded	1
2	Umguza	Not recorded	35K	674237	7758213	1427	Not recorded	1
3	Umguza	Not recorded	35K	674759	7758546	1430	Not recorded	1
4	Umguza	Not recorded	35K	678762	7770378	1370	Not recorded	1
5	Bubi	Not recorded	35K	692055	7800111	1353	Not recorded	1
6	Bubi	Not recorded	35K	692078	7800372	1346	Not recorded	1
7	Bubi	Not recorded	35K	691845	7801268	1339	Not recorded	1
8	Bubi	Not recorded	35K	684363	7806155	1341	Not recorded	1
9	Bubi	Not recorded	35K	684638	7806614	1339	Not recorded	1
10	Bubi	Not recorded	35K	684724	7806746	1337	Not recorded	1
11	Bubi	Not recorded	35K	685768	7806555	1325	Not recorded	1
12	Bubi	Not recorded	35K	686190	7806800	1320	Not recorded	1
13	Bubi	Not recorded	35K	682526	7822944	1264	Not recorded	1
14	Bubi	Not recorded	35K	678203	7827785	1236	Not recorded	1
15	Bubi	Not recorded	35K	683797	7818763	1265	Not recorded	1
16	Bubi	Not recorded	35K	688283	7821501	1297	Not recorded	1
17	Bubi	Not recorded	35K	N/R	N/R	N/R	Not recorded	1
18	Bubi	Not recorded	35K	688424	7823153	1303	Not recorded	1
19	Bubi	Not recorded	35K	686846	7824234	1302	Not recorded	1
20	Bubi	Not recorded	35K	685476	7814850	1278	Not recorded	1
21	Umguza	Not recorded	35K	676293	7772794	1343	Not recorded	1
22	Bubi	Not recorded	35K	705164	7851471	1273	Not recorded	1

Figure F2.1.9 *Distribution of ASGM activities in Matabeleland North Province, Zimbabwe*

In Mashonaland East Province only Goromonzi District could be identified on the satellite images in terms of ASGM activities (**Figure F2.1.10; Table F2.1.10**). However, there are a total of 27 registered gold milling sites in Mashonaland East.

Table F2.1.10 *Observed ASGM activity density in Mashonaland East Province and number of registered milling sites according to the Ministry of Mines and Mining Development (MoMMD)*

District	***Approx. district area (km²)***	***Observed mining/ processing sites***	***Activity density (sites/1000 km²)***
UMP	2,667	0	0.0
Mudzi	4,127	0	0.0
Mutoko	4,035	0	0.0
Murehwa	3,482	0	0.0
Goromonzi	2,494	5	2.0
Marondera	3,543	0	0.0
Wedza	2,577	0	0.0
Seke	2,562	0	0.0
Chikomba	6,610	0	0.0
Total	32,097	5	0.2
MoMMD Total		*27*	*0.8*



Site ID	District	Site Name	Zone	mE	mS	Elev. (m)	Hg use	Cyanidation
1	Goromonzi	Not recorded	36K	330129	8032038	1360	Not recorded	1
2	Goromonzi	Not recorded	36K	319131	8035613	1426	Not recorded	1
3	Goromonzi	Not recorded	36K	317680	8035869	1401	Not recorded	0
4	Goromonzi	Not recorded	36K	318832	8036411	1331	Not recorded	1
5	Goromonzi	Not recorded	36K	299374	8050385	1429	Not recorded	0

Figure F2.1.10 *Distribution of ASGM activities in Mashonaland East Province, Zimbabwe*

F2.1.4 SUMMARY AND CONCLUSIONS

The assessment of distribution of ASGM activities in Zimbabwe managed to establish sites with ASGM activities by geographical location and activity density based on the number of gold processing sites per unit area of the district. At provincial level, it was noted that ASGM activities are taking place in all mining provinces of Zimbabwe. Midlands and Mashonaland West Provinces were found to be the dominating provinces in terms of: (i) the number of miners involved in ASGM; (ii) the activity density in terms of number of gold processing sites per unit area of the province; and (iii) the number of formally registered gold milling sites recognised by the Ministry of Mines and Mining Development. Matabeleland South and Mashonaland Central also had significant ASGM activities. At district level, the study established that the following Districts were in the top ten in order of magnitude: Shurugwi (8.8 activity sites/1000 km^2), Shamva (6.2), Kadoma (5.1), Kwekwe (4.0), Mberengwa and Mazowe (3.8), Umzingwane (3.6), Mutasa (3.1), Zvishavane (3.0) and Chegutu (2.6). Environmental concerns on the location of ASGM activity and proximity to water courses were noted, particularly in Shurugwi District.

F2.2 MINING AND MINERAL PROCESSING IN ASGM

F2.2.1 INTRODUCTION

Gold extraction and processing methods mainly depend on the type of ore deposit and the mineral assemblage (**Plate 3.1**). Gold ores can be classified as primary ores or secondary ores. The primary ores commonly found in ASGM sites are free milling ores, placers and oxidized ores, while the secondary ores found are gravity concentrates, flotation concentrates and tailings. Each of these classes of gold bearing materials has special mineralogical characteristics which in turn affect their processing. For example, primary ores are processed using mechanical equipment such as stamp mills and hammers mills, while secondary ores are mainly processed by chemical treatment, such as cyanide leaching.



Plate 3.1 *Types of ores in Shamva, Mashonaland Central Province.*

The objective of this assessment was to identify the types of ores found at the ASGM sites and related gold extraction and processing methods to the point of sale. The assessment also attempted to identify and characterise the people involved in ASGM different mining and mineral processing activities, both directly and indirectly.

F2.2.2 METHODOLOGY

Refer to section **F 2.1.2**

F.2.2.3 FINDINGS

3.3.1 Ores found in ASGM sites

Free milling ores

These are defined as those from which cyanidation can extract approximately 95% of the gold when the ore is ground to 80% <75µm. Some of the gold is recovered by gravity concentration and amalgamation and gangue mineral composition does not significantly affect the processing requirements. There are two main classes of free milling ores, paleo-placers and quartz vein gold ores, sometimes referred to as bed rock or hard rock in Zimbabwe.

Paleo-placers consist of lithified (the formation of massive rock from loose sediment) conglomerates which contain small rounded pebbles of quartz in a matrix of pyrite, fine quartz, micaceous material and a small quantity of heavy resistant minerals such as magnetite (Fe_3O_4), uraninite ($UO2/U_3O_8$), PGMs, titanium minerals and gold. An example of a paleo-placer deposit is the Witwatersrand lake bed in South Africa.

Non-placer deposits mainly formed as a result of deposition from hydrothermal solution. These are also termed quartz vein gold ores. The hard rock is shown in Figure 3.1



Plate 3.2 *Quartz vien also known as hard rock to ASGMs*

Placers

Placer deposits are formed by the liberation of gold and hydraulic transport of gold particles away from a primary gold deposit. This is possible because gold is chemically inert and dense, resulting in accumulations of gold at relatively close to primary deposits. The main prerequisites for the formation of placer deposits are the following

1. A primary source of gold, e.g. gold-quartz veins
2. A long period of chemical and physical weathering to release gold grains in the host rock
3. Concentration of gold particles by gravity, almost certainly involve moving water in the transport medium
4. Stable bedrock and surface conditions over a long period, e.g. no glaciation folding, to allow significant concentrations of gold to accumulate.

The placers gold ores mainly contain alluvial, eluvial or colluvial material. Alluvial material. An **eluvial (residual) placer** consists if weathered rock from which some of the finer and lighter material has been washed away, leaving gold at a heavier concentration. Eluvial gold is usually located at or near the parent deposit.

Colluvial (or deluvial) placers consists of gold that has been transported from some distance from the parent deposit, but where the gold is not located in an established stream system e.g. on the slopes surrounding outcropping source rocks.

Fluvial (alluvial) placers are those in which gold occurs in stream or river systems. The gold tends to concentrate upstream of obstructions in areas of lower fluid velocity. The soft rock is shown in Figure 3.2



Plate 3.3 *Alluvial mining in Mashonaland Central*

Oxidized ores

An oxidized ore is defined as one in which the ore material has been oxidized or weathered, possibly in a zone that is typical of the primary sulphide deposit. Oxidation and other hydrothermal alteration lead to the breakdown of the rock structure, resulting in increased permeability. This often allows the leaching extractions to be achieved by heap leaching of run-of-mine ore, even though ore particles size is very coarse.

The gold usually occurs either liberated or in the alteration products of pyrite and sulphidic minerals. The most common of these are the iron oxides, such as hematite, (Fe_2O_3), magnetite (Fe_3O_4), goethite (FeOOH) and limonite ($FeOOH.nH_2O$). The degree of gold liberation is generally increased by oxidation although in some cases protective coating of secondary hydrated oxides on gold are commonly encountered. Under such conditions these grains are unrecoverable by cyanidation, but would be sufficiently coarse to be recoverable by gravity concentration. The oxidized ore is shown in Figure 3.3



3.3.2 Mineral processing

The main method of gold extraction techniques used by ASGMs in Zimbabwe and elsewhere in Africa are comminution (classification), gravity concentration, amalgamation, retorting and cyanide leaching. Gravity concentration is widely used for the recovery of free gold.

Comminution (Classification)

The communition process involves crushing and grinding in order to liberate the gold, and gold bearing minerals from gangue. It can also be described as the mechanical disintegration of a rock. This can be done by crushing (coarse) and grinding (fine) or by simply breaking up clumps of soil or clay materials. The degree of comminution required depends on many factors, including the liberation size of gold, the size and nature of the host minerals and the host minerals and the methods, to be applied for gold recovery. The main ways used in Zimbabwe are the crushers, ball mills, hammer mills, impact mill, size classification and checking gold liberation.

Crusher

Different types of equipment are best for each stage of crushing. Crushing typically occurs through the pinching of a rock between two metal plates or through the impact of a metal surface on a rock. These are the types of common crushers that are used in gold mining

Jaw Crusher

Jaw crushers operate by means of a moving jaw suspended from an eccentric shaft driven by a diesel or electric motor via a large flywheel. Feed size to a jaw crusher can range from 50 - 300mm; discharge sizes are between 10 - 70mm. Jaw crushers are typically sized by the size of the largest feed particle--if the rocks are large, the crusher must be large. Jaw crushers are very common in artisanal gold mines. A small crusher operating in batches of 5 to 10 tonnes of ore and handling 500 kg/h to reduce it to -1/4" (6.5 mm) is suitable for most artisanal mining operations.



Plate 3.5 *A jaw crusher that was found at Monde 4 mine in Mashonaland Central*

Ball Mill

Ball, pebble and rod mills are all cylindrical rotating shells which are mounted on bearings and filled with up to 40% by volume of a grinding medium such as steel balls, rods or hard pebbles. Large models are usually lined with a wear-resistant lining. Mills are typically longer than their diameter, although some ball mills can be shorter in length than diameter. Feed rock size is typically 10-40 mm and Fig 4.3 - An industrial ball mill discharge sizes can be 0.03 - 0.3 mm. Mills operate at an optimum speed which is typically 70% of the critical speed of the mill - the speed at which the contents will stick to the shell of the mill. The critical speed N for a mill is calculated based on the diameter D (in meters)

of the mill: N = 42.3/D0.5. For a small ball mill with internal diameter of 90 cm, the critical speed is around 44 rpm. The suggested speed is 70% of the critical speed or 31 rpm.



Plate 3.6 *Ball Mill used at Horse Shoe Mine in Matabeleland South*

Stamp/Hammer Mill

This is another crusher that has the name of "mill". Stamp mills operate simply by the crushing action of the cast-metal stamp heads as they fall onto the ore at the bottom of the mortar box. "Normal" stamp mills have 3 or 5 stamps. The stamps are lifted via the cast iron collars by cams driven by a pulley and flywheel. Feed is typically -50mm, loaded into the top of the mortar box by shovel, and discharge is typically -0.5 to 1mm via a fixed screen on the back of the box. Stamp mills can be operated either dry or wet, and can be either manually, electrically, or diesel driven.

During operation, the base (die) of the stamps becomes deformed and quite often miners have to stop the crushing process to grind off the lips formed on the steel base.

The crushing capacity of a 3-stamp mill is around 0.3 to 0.5 tonnes/h depending on the hardness of the ore. The cleaning of a stamp mill is easy but not quick, and usually involves manually digging out all the material accumulated in the mortar box between the stamp dies. Gold, as a heavy mineral, can be accumulated in the mortar box.

Manual Crushing and Grinding Methods

Manual methods of crushing and grinding are important in small scale mining. These can be mortar and pestle and sledgehammers.

Crushing and grinding can be achieved in a batch fashion with a mortar and pestle. Pre-sized rocks are placed in a steel bowl with a rounded bottom, or in a short length of wide pipe welded onto a steel plate, and pounded with a steel rod such as an automobile axle.

The sledge hammer is a common method of pre-sizing rocks before grinding in a stamp mill or ball mill is to place oversize rocks (>2") on a large flat rock, inside a Hessian or nylon ring which holds the rocks in place while they are hit with a hammer to produce typically 1 cm rocks. Some miners then use a piece of stone to grind the crushed rocks. In this process, the ground material is screened at 0.5 to 1 mm and the coarse material re-ground.



Plate 3.8 *(a) Miners in Zimbabwe grinding with mortar and pestle, and screening manually (b) Female miner fine grinding ore with a stone*

Hand stamp mill

Hand stamp mills such as the ones made in Bulawayo, Zimbabwe (Matabeleland Engineering), are useful for grinding small quantities of -50 mm ore to 0.5-1 mm. The hand-operated mill is a simple construction of one or two stamps and a camshaft supported on a heavy timber frame.

A small one-stamp mill, the "Katanka", was developed in Zimbabwe by the company Small Mining Supplies to be a portable crusher that can be engine-driven. The mill frame is made of flanged pipe construction rather than wooden beams. The discharge screen size is adjusted easily by changing the mesh in the discharge splash box. Typical product size is below 0.6-0.8 mm.



Plate 3.9 *Hand ball/rod mill made in Zimbabwe. One and two stamp models are available.*

Gravity Concentration

Gravity concentration is a process to concentrate the gold using the difference of specific gravity of gold and gangue minerals. The specific gravity of gold is 19.5 and the specific gravity of quartz (the common gangue mineral associated with gold) is 2.65 (i.e., gravity concentration works because gold is heavy, and quartz is light). Often gravity separation methods are confused with size classification because large particles of light minerals can behave like a small particle of a heavy mineral. The most effective gravity separation processes occur when applied to ore particles of about the same size. The most important factor for a successful gravity separation is liberation of the gold particles from the gangue minerals. It is not easy to establish the degree of liberation of low-grade minerals such as gold.

Classical microscopy of screened fractions to establish mineral liberation is unreliable with gold ores. The most recommended method to establish the optimum gold liberation size is grinding for different times (or grain size distributions) and applying gravity concentration to the ground products. This is a classical and important procedure to recommend any type of gravity concentration process. Because most artisanal miners do not classify (screen) the crushed/ground material (i.e. they work in open circuit), their chances to improve gold recovery are very limited.

The main advantages of gravity concentrators over gold cyanidation are:

- relatively simple pieces of equipment (low capital and operating costs)
- little or no reagent required
- works equally well with relatively coarse particles and fine grained materials

Sluices

Sluices are inclined, flat-bottomed troughs that are lined on the bottom with a trapping mechanism that can capture particles of gold and other heavy minerals. They can be used either for alluvial or for primary ore (sluices are sometimes called "strakes" or "blanket tables"). Ore is mixed with water and the pulp poured down the trough. Sluices work on the principal that heavy particles tend to sink to the bottom of a stream of flowing water while the lighter particles tend to be carried downstream and discharged off the end of the sluice. Sluices are used in various sizes, from small hand-fed sluices to large sluices found on dredges or fed by trucks, front-end loaders or bulldozers, which can process as much as 150m^3 of alluvial ore per hour. Much like in the past, today's hand-fed sluices are usually 1 to 2 meters long, 30 to 50 cm wide, with walls 10 to 30 cm high.

Sluices are usually inclined at a 5 to 15 degree angle. Many miners working with alluvial deposits today use large sluices when sufficient water and operating capital is available. In monitor-gravel pump systems, slurry is pumped through 7.5-15 cm hoses onto 1-1.5 m wide by roughly 5 meter long sluices. Sluices are efficient devices to separate gold from gangue. While sluices are not necessarily more efficient than panning, they do allow miners to increase the amount of ore they process, thus boosting their income considerably.



Plate 3.10 *Example of a sluice in an alluvial site, Bindura Mashonaland Central.*

Gemini Table

A shaking table used to treat high grade concentrates to produce a product to be melted, in the last step. It has been used by large mining companies to treat centrifuge concentrates. The table deck is made of fiberglass supported by a steel frame. It has a longitudinal adjustable tilt and just one-direction shaking movement with variable speed. The gemini table separates particle grains of its feed material based on the differences in their specific gravity, density, size and shape. The mineral rich particles, from light to heavy and fine to coarse will be sorted by net effective weight.

The final concentrate is extremely rich and does not require the use of mercury. The main problem of using Gemini table is the fact that the middling product, which sometimes consists of unliberated gold particles, is not easily visually identified. In this case, the middling must be re-circulated to the table, preferentially after re-grinding.



Plate 3.11 *Example of a Gemini Table in White Rati 31 in Shamva, Mashonaland Central Province.*

Centrifugal Concentrators

Centrifugal concentrators consist of a vertical rotation bowl with a series of concentric rings that trap the gold. A centrifugal force is applied on the ore particles, in such a way that this force is 60 (in the case of Knelson) to 300 (in the case of Falcon) times higher than the gravitational force. The rotor is accelerated and feed slurry is introduced to the concentrating cone through a stationary feed tube. Upon reaching the deflector pad at the bottom of the cone, the slurry is driven outward to the cone wall by the centrifugal acceleration. As slurry flows up the cone wall, the solids fill each ring to capacity creating the concentrating bed. The tailings product overflows the bowl and the gold becomes trapped in the rings. Some centrifuges have a smooth wall at the bottom of the bowl where stratification takes place. The high density gold is concentrated at the wall forcing and displacing lower density particles away from the wall. Compaction of the bed in the rings can be prevented by introducing pressurized fluidization water from behind the rings. This helps the high-density gold particles displace the lower density gangue particles causing the gold grade to increase in the concentrating rings with time. After a

period of time, the feed is stopped and the rotor is shut off. The concentrate is flushed from the cone into the concentrate launder and can be upgraded further by panning.



Plate 3.12 *(a) Centrifugal concentrator found in in Shamva, Mashonaland Central Province.*

Panning

Panning is the most ancient form of gravity concentration. The circular or back-and-forth shaking of ore and water in a pan causes the ore to stratify the heavy minerals settle to the bottom of the pan while the lighter gangue can be washed off the top.

Panning is the basic means of recovering gold from alluvial and high-grade primary ore. In Zimbabwe, for example, miners rarely use the stamp milling plants for their high-grade reef ores. They rely on pounding this ore with mortar and pestle and use pans for concentration. They later wash these panning concentrates through a clay/sand sluice lined with blanket or rubber matting.

Assays of these tailings are always high, suggesting that either gold liberation is poor, or panning efficiency is low. Primary crushing uses a 4-pound hammer to produce affordable sizes for grinding in a mortar using a steel bar pestle. The ground up material is then classified through a sieve to collect the fine undersize material. In most cases in Zimbabwe, the coarser oversize is thrown away and not reground for better liberation. All the undersize are then panned and the gold recovered. A magnet can be used to

remove the black magnetite. The magnet is applied to the bottom side of the pan and moved in a circular motion with the pan slightly tilted. Those rich gold concentrate does not need amalgamation, as it can be smelted directly.



Plate 3.13 *Gold panners in Zimbabwe*

Amalgamation

Zimbabwe is relatively high on technical process expertise, even at ASM level, and appreciation of correct use of mercury is possibly better than a lot of other countries, but mercury is nevertheless a problem as it tends to be overused. In some cases mill owners are persuaded by their customers (miners) to do incorrect things. For example, very often in milling centers, miners add mercury into the ABJ centrifuges or use Cu-amalgamating plates at the discharge of the stamp mills.

Amalgamation of the whole ore is usually the main cause of high mercury losses and the Hg_{lost}:$Au_{production}$ ratio can be higher than 3. Manual amalgamation of concentrates using pans is environmentally better than the amalgamation of the whole ore. Amalgamation barrel is adequate equipment to amalgamate gravity concentrates but the use of many iron balls and long amalgamation time, as seen in Zimbabwe, promotes mercury flouring and consequent loss. As such some re-education of millers and miners is required.

Amalgamation Barrels

An amalgamation barrel is the most efficient amalgamation process. They are used to amalgamate gravity concentrates. Recovery of gold from heavy mineral concentrates can

be higher than 90%. Amalgamation barrels with capacity to amalgamate up to 30 kg of concentrate per batch are adequate to the demonstration units.

In Zimbabwe miners in some places do not like to use the amalgam barrel as they want to see the gold. Amalgamation barrels can also be made of plastic PVC but in some African countries this can be more difficult to find and costly than steel. This is definitely very beneficial as no iron balls can be introduced in the barrels and the mercury flouring is avoided.



Plate 3.14 *An unused amalgamation barrel at a milling site in Bindura, Mashonaland Central Province.*

Retorting

This is a method to separate mercury and gold from amalgams is by heating above 350 °C. Mercury becomes volatile leaving gold behind in solid state. A retort is a container in which the gold-mercury amalgam is placed and heated; volatile mercury travels up through a tube and condenses in an adjacent cooler chamber. With retorts, mercury recovery is usually higher than 95%. Substantial reduction in air pollution is obtained. There are a large variety of retorts. Some of them are made with stainless steel while others use inexpensive cast iron. Mercury losses during retorting are usually less than 5%, but this depends on the type of connections or clamps used. Fig 3.xx displays a retort used in Shamva area in Zimbabwe.



Plate 3.15 *A diagram of a typical mercury retort used in Shamva, Mashonaland Central Zimbabwe.*

Increasing Temperature

Blow torches with gas also known as a cutting torch are commonly used to increase the temperature on the amalgam. These can easily go above 400 °C promoting efficient mercury elimination from amalgam in less than 20 minutes. In a bonfire, more than one hour is needed to remove more than 90% of mercury from a 5 g-amalgam.



Plate 3.16 *Open burning of gold amalgam in Shamva, Mashonaland Central Zimbabwe.*

F2.2.4 SUMMARY AND CONCLUSIONS

ASGMs use mining methods that are cheap methods. The main processes involve the following crushing, grain size control, milling, concentration, mercury amalgamation, mercury vaporisation, smelting. The tailings are later processed through chemical leaching.

F2.3. BASELINE ESTIMATES OF MERCURY USED IN ASGM

F2.3.1 INTRODUCTION

Zimbabwe was listed among countries where the mercury amalgamation process is used for gold extraction in 2002 during United Nations Environment Programme's first Global Mercury Assessment (UNEP, 2002). This was followed by the Global Mercury Project in 2007 in which Zimbabwe reported mercury emissions from the ASGM sector under the guidance of the United Nations Industrial Development Organisation (UNIDO). This project conducted baseline studies on mercury emissions with particular focus on Kadoma District in the Midlands Province of Zimbabwe, and established among other findings that that 1.7 to 3.4 tonnes mercury is lost at milling centres annually in the Kadoma-Chakari area (UNIDO, 2007). In 2011 the UNEP's International Mercury Assessment established that 10-30 tonnes of mercury is released each year from mercury amalgamation in ASGM in Zimbabwe (UNEP, 2011). In view of the increase in ASGM activities and appreciation of mercury dangers, Zimbabwe signed the Minamata Convention on Mercury in October 2013. The country is now required to produce a National Action Plan in fulfilment of its obligations to the Minamata Convention on Mercury.

The objective of the assessment reported in this Section was to establish baseline estimates of mercury emissions and releases from the ASGM sector, including the processes used, amount of mercury used, the number of people directly involved in ASGM and indirectly exposed to mercury.

F2.3.2 METHODOLOGY

Refer to section **F2.1.2**

4.2.1 Sources and nature of data collected

There were seven major sources of data and information, namely: five local and two international organisations. The local sources were: (1) Ministry of Mines and Mining Development (MoMMD), (2) Environmental Management Agency (EMA), (3) Chamber of Mines of Zimbabwe (COMZ), (4) Zimbabwe National Statistics Agency (ZIMSTAT) and (5) Reserve Bank of Zimbabwe (RBZ). The two international organisations were: (6)

Southern African Development Community (SADC) and (7) British Geological Survey (BGS).

The MoMMD provided data on: (i) aggregated gold deliveries from small-scale miners to Fidelity Printers and Refinery from 2009 to 2017, (ii) number of registered gold processing sites by mining province for the year 2017, and (iii) estimates of the proportion of unregistered gold processing sites based on the 2016 surveys. Gold production statistics and analysis of production trends were also obtained from the State of the Mining Industry Survey reports (annual) by COMZ, and Monetary Policy Statements by the RBZ. This information was used, together with other related information, to derive assumptions used in estimating mercury emissions (**Table 4.2**). Information and data obtained from EMA included: (i) location and distribution of ASGM activities in all mining provinces of Zimbabwe, (ii) State of the Environment Reports for Matabeleland South, Midlands, Mashonaland West and Mashonaland Central, disaggregated to district level, and (iii) estimates of the proportion of alluvial gold and gold captured using mercury and cyanidation.

National census data was obtained from ZIMSTAT for the years 1982 (CSO, 1984), 1992 (CSO, 1994), 2002 (CSO, 2004) and 2012 (ZIMSTAT, 2013). ZIMSTAT also supplied data on: (i) total number of miners involved in ASGM by province for the year 2012, (ii) projected national population from year 2013 to 2032, disaggregated by province (ZIMSTAT, 2015), and (iii) Census of Industrial Production (CIP) report that include gold trade. The two international sources of information BGS and SADC were largely online databases with historical gold production statistics under World Mineral Statistics Archive (BGS, 2018) and SADC Statistical Yearbook 2014 (SADC, 2018).

4.2.2 Site selection for field surveys

Four provinces were selected for field assessment on the basis that they have the highest number of people involved in ASGM activities based on previous national census data (ZIMSTAT; **Table 4.1**). From each selected province, 3 to 5 districts were purposively selected based on the State of the Environment Reports from EMA. However, in reality the number of districts per province went up to a minimum of 4, upon noticing that some

sites were outside their perceived district boundaries after mapping the visited sites (**Section 2**).

Table 4.1 *Provinces, districts and number of sites assessed during the surveys*

Mining Province	Visited Districts	Number of sites	District size (km^2)
Matabeleland South	Insiza	10	8,316
	Gwanda	8	10,738
	Matobo	12	7,242
	Umzingwane	7	2,773
	Mangwe	3	6,050
Sub-total		*40*	*35,199*
Midlands	Zvishavane	2	2,633
	Kwekwe	21	8,814
	Gweru	3	6,189
	Shurungi	24	3,631
	Mberengwa	6	4,985
Sub-total		*56*	*26,252*
Mashonaland West	Kadoma	19	9,290
	Chegutu	22	5,361
	Makonde	1	8,777
	Hurungwe	2	19,752
Sub-total		*34*	*43,180*
Mashonaland Central	Mazowe	12	4,463
	Bindura	2	2,291
	Shamva	6	2,745
	Mt Darwin	5	4,500
Sub-total		*25*	*13,999*
Total		***155***	***118,550***

4.2.3 Field survey on ASGM activities

The field survey to establish baseline estimates of mercury emissions from the ASGM sector was conducted between 12 March 2018 and 06 July 2018 and comprised of a team of experts with considerable background in environmental management, heavy metal pollution chemistry, applied development and agricultural economics, petrology, health and safety, industrial ecology and mining engineering. The team was drawn from Enviro Remedy Company, and selected members from EMA and MoMMD who were providing both technical and logistical assistance from their experiences working in the selected areas.

The survey was largely focused on the miners and processors of gold in the ASGM sector and on the communities they operate in. A list of guiding questions was prepared and used during the interviews and visual assessment (**Box 1**). These questions were formulated in line with the Standardised Toolkit for Identification and Quantification of Mercury Sources (UN Environment, 2017a), and the guidance document for developing a national action plan to reduce and, where feasible, eliminate mercury use in artisanal and small-scale gold mining (UN Environment, 2017b).

Box 1 *Questions guide used during interviews with miners and millers*

NAP – QUESTIONS GUIDE

PIT BOSS/MINER

LOCATION PARTICULARS: ALL SITES	**SOCIO-ECONOMIC ISSUES, ALL SITES**
1. Site Name?	21. Ratio of women workers?
2. Location coordinates?	22. Number and role of women?
3. Type of Activity: Mining/Processing/both?	23. Number, age & role of children?
4. Formal/Informal/Registered?	24. Role in community development
5. Informant name and position?	25. Staff accommodation? Toilets?
	26. Sources of entertainment?
TECHICAL ISSUES: EXTRACTION RELATED	27. Risk of HIV/STIs, evidence?
	28. Local perception of Hg use/danger
6. Ore production estimate (t/day /wk /mnth)?	29. Possible solutions on Hg
7. Method of extraction?	30. Au trade/who buys/price?
8. Type of rock – hard/soft/sulphide etc?	31. Hg supply/who sells/price?
9. Ore grade (g/t)?	32. If possible – follow up on Hg suppliers.
10. Workforce/number of workers in company?	
11. Revenue distribution: sharing ratio?	
12. Miners earnings (g/day or $/day)?	**HEALTH ISSUES: ALL SITES**
13. What is the gold purity (% or K)?	
14. Working days per week? Holidays?	33. Health care facilities/distance?
15. Working hours per shift?	34. Common diseases & victims?
16. Number of shifts?	35. Poisoning incidents at site?
17. Total number of active pits?	36. Injury incidents at site?
18. Number of miners per active pit?	37. Fights incidents at site?
19. Total number of pits at the site?	38. Evidence of Hg poisoning?
20. Estimated site population?	

PROCESSOR

TECHICAL ISSUES: PROCESS RELATED

39. Processing systems used? [**draw a flow chat**]
40. Throughput by process (bags/hour or t/hour or per day)?
41. Type, number and size of equipment used?
42. Workforce and earnings distribution?
43. Working days, hours and shifts?
44. Is there evidence of Hg use at the site [take pictures/video later]?
45. How much Hg is added and at what stage?
46. How much Hg is recovered?
47. How much gold produced, by process (g/month)?
48. Rehabilitation plan by processor?

NB: after the questioning pictures/videos are to be taken, record the location

4.2.4 Estimation of mercury emissions

Mercury lost was determined using Microsoft Excel spreadsheets with formulae extracted from the National Action Plan Starter Kit (UNEP, 2018) and the Standardised

Toolkit for Identification and Quantification of Mercury Sources (UN Environment, 2017a). The estimates followed extraction-based, process-based and revenue based methods (UN Environment, 2017b), that are underpin by estimations of the mercury-to-gold ratios derived from field assessment. A participatory method was used to determine the mercury-to-gold ratio, involving verbal narration by respondents, and in few cases demonstration of the amalgamation and burning processes (**Plate 4.1**).



Plate 4.1 *Demonstration of the amalgamation and burning processes in Mashonaland West (a,c) and Mashonaland Central (b, d) Provinces*

In the Extraction-Based Method of estimating mercury emissions, data on ore extracted per shaft per day, number of shafts per site, ore grade, working days per year, and number of miners per site or shaft, was used to estimate mercury emissions per miner per annum. The number of miners per province was then used to estimate national mercury emissions using 2017 as the baseline year. In the Process-Based Method of estimating mercury emissions, throughput per mill per day, ore grade, working days per year, was used to estimate mercury emissions per site per annum. The number of gold processing sites in 2017 was then used to estimate national mercury emissions per annum. Lastly, in the Revenue-Based Method of estimating mercury emissions, data on gold delivered from small-scale miners to Fidelity Printers and Refinery was used together with the mercury-

to-gold ratio. This was a major variance from the Standardised Toolkit procedure that is based on the revenue of an individual miner in the ASGM sector. Statistics on gold delivery by the ASGM sector have received considerable attention amid government efforts to strengthen its indigenisation policies. With the mandatory Custom Milling Plant Registers and other measures, it has generally become less demanding to disaggregate gold production statistics by the mining sub-sectors. The assumptions made in the three methods of estimating mercury emissions are given in **Table 4.2**.

Table 4.2 *Assumptions used during estimation of mercury emissions*

Issue	***Assumption***	***Applicability***	***Assumption basis/Ref***
1. Small scale versus artisanal miner	▪ The official distinction between artisanal miners and small-scale miners in Zimbabwe is based on scale of operations and degree of mechanisation and not on formal registration status	▪ Extraction-based method ▪ Revenue-based method ▪ Process-based method	Bello and Bybee, 2014; MoMMD, 2016
2. Gold trade	▪ Gold produced is sold to the Reserve Bank of Zimbabwe's subsidiary, Fidelity Printers and Refiners, who are the ultimate buyer and sole exporter of gold	▪ Revenue-based method	RBZ, 2016; MoMMD, 2016
3. Illegal gold trade	▪ Gold produced by the ASGM sector, as reported by RBZ, constitutes 40% of the total production from this sector, the remaining 60% being gold traded on black market and smuggled out of the country as from around 2003.	▪ Revenue-based method	IMF, 2006; UNIDO, 2007; Makochekanwa, 2007; Mutero, 2016; Gutu, 2017; UNIDO, 2018
4. Mercury use by ASGM sector	▪ Miners use mercury at all custom-milling sites ▪ All own-millers use mercury (at least on concentrate) before cyanidation – quicker petty cash	▪ Revenue-based method	Current survey
5. Gold recovery ratio X:Y:Z where, X=by Hg Y=by CN^- Z=unrecovered	▪ Gold recovery using mercury amalgamation = 40% ▪ Of the 60% of gold remaining in tailings, 90% is recovered by cyanide treatment ▪ Thus, X:Y:Z = 40:54:6	▪ Revenue-based method	Lucke, 2005; Hylander et al., 2007; Mendoza, 2014

Issue	*Assumption*	*Applicability*	*Assumption basis/Ref*
6. Alluvial gold	▪ Alluvial gold processing is not done at the mill ▪ No mercury is used in alluvial gold processing ▪ Alluvial gold contribution to the total gold became negligible as from 2014 following a ban of alluvial gold panning	▪ Revenue-based method	Pact, 2015; Gada and Hwengwere (EMA), personal communication
7. Unregistered ASGM activities	▪ 62.5% of artisanal and small-scale miners do not have mining licences from the MoMMD, while 37.5 % of sites are licensed	▪ Process-based method	MoMMD, 2016
8. Registered AGSM activities	▪ As of year 2017 there were 928 registered gold processing sites in Zimbabwe (Mat. South and North, 150; Midlands, 300; Mash. Central, 37; Mash. East, 27; Mash. West, 350; Masvingo, 44; Man., 20 ▪ The changes in the number of gold processing sites between 2012 and 2018 is directly proportional to national gold production	▪ Process-based method	MoMMD, 2017
9. Miners in the ASGM sector	▪ Number of miners in ASGM sector has been on increase between 2012 and 2018 at a rate that is proportional to both population and national gold production., due to decline from agriculture employment (32.9 to 29.6%) as wages in agriculture declined ▪ Annual increase in gold production from the ASGM sector attributed to people migrating from agriculture and not to improved mining efficiency by already existing miners ▪ Of the reported number of people involved in ASGM activities in Zimbabwe, only 20% are undertaking the actual extraction of ore	▪ Extraction-based method	ZIMSTAT in LEDRIZ, 2016
10. Mercury emissions at milling sites	▪ Not less than 1 kg of mercury is emitted per mill per year	▪ Process-based method	UNIDO, 2007

Issue	*Assumption*	*Applicability*	*Assumption basis/Ref*
11. Mercury emissions per miner	▪ Not less than 50 g of mercury is emitted per miner per year	▪ Extraction-based method	

4.2.5 Identification of worst practices

The worst practices investigated as part of the initial stages to fulfil *Annex C, Paragraph 1(b)* of the Minamata Convention, which requires inclusion of actions to eliminate four worst practices in ASGM (UN Environment, 2017b), were:

(i) Whole ore amalgamation (WOA);

(ii) Open burning of amalgam or processed amalgam (OBA);

(iii) Burning of amalgam in residential areas (BARA); and

(iv) Cyanidation of mercury rich tailings (CMRT).

F2.3.3 FINDINGS

4.3.1 Mercury use in ASGM

A relatively small proportion of the sites in Matabeleland South and Midlands indicated that they did not use mercury for gold recovery, while all sampled sites in the remaining provinces used mercury (**Figure 4.1**). The gold recovery method used as these sites was cyanidation. One of the sites that did not use mercury was an alluvial gold mining site in the Falcon area of Shurugwi District in Midlands Province. In Matabeleland South the indication from non-mercury users was that they were using borax and were doing own milling. Overall, 96% of the gold processing sites were using mercury.

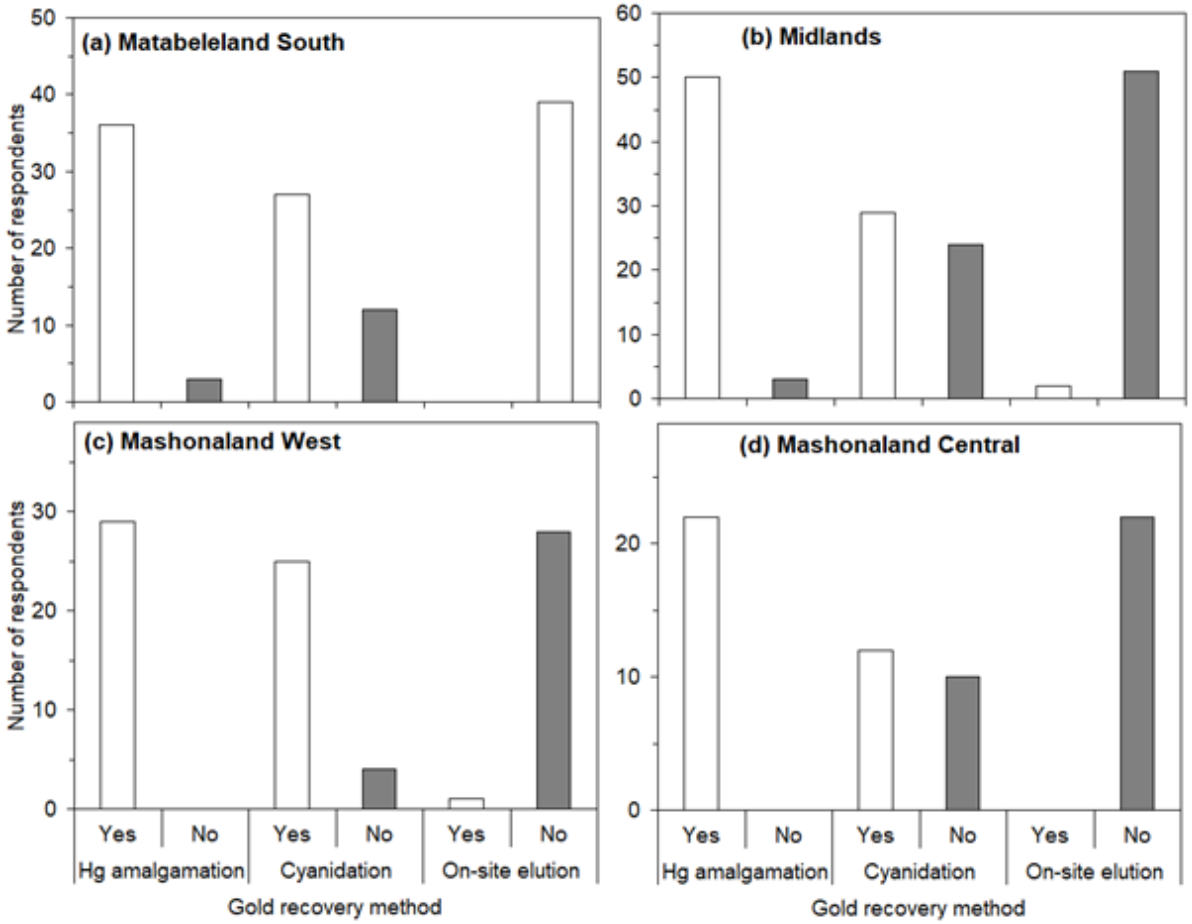


Figure 4.1 *Gold recovery methods in four provinces of Zimbabwe*

4.3.2 Mercury-to-gold ratio and mercury recovery during amalgamation

The average mercury-to-gold ratios were: 1.18 for Matabeleland South, 1.22 for Midlands, 1.24 for Mashonaland West and 1.05 for Mashonaland Central (**Figure 4.2**), giving an overall value of 1.17 for the four provinces. Extreme ratios of between 3 and 4 were found in few cases in all assessed provinces, except Mashonaland Central was relatively more conserving. The extreme ratios obtained in few cases from three provinces were close to the lower limit of the range commonly found under whole ore amalgamation practices (UN Environment, 2017b). Results showed average mercury recovery during amalgamation of 28% (median: 25%) for Matabeleland South, 34% (median: 16%) for Midlands and 43% (median: 20%) for Mashonaland West and 43% (mediam: 23%) for Mashonaland Central (**Figure 4.3**), however the relationship between the mercury-to-gold ratio and mercury recovery during amalgamation was nonexistent.

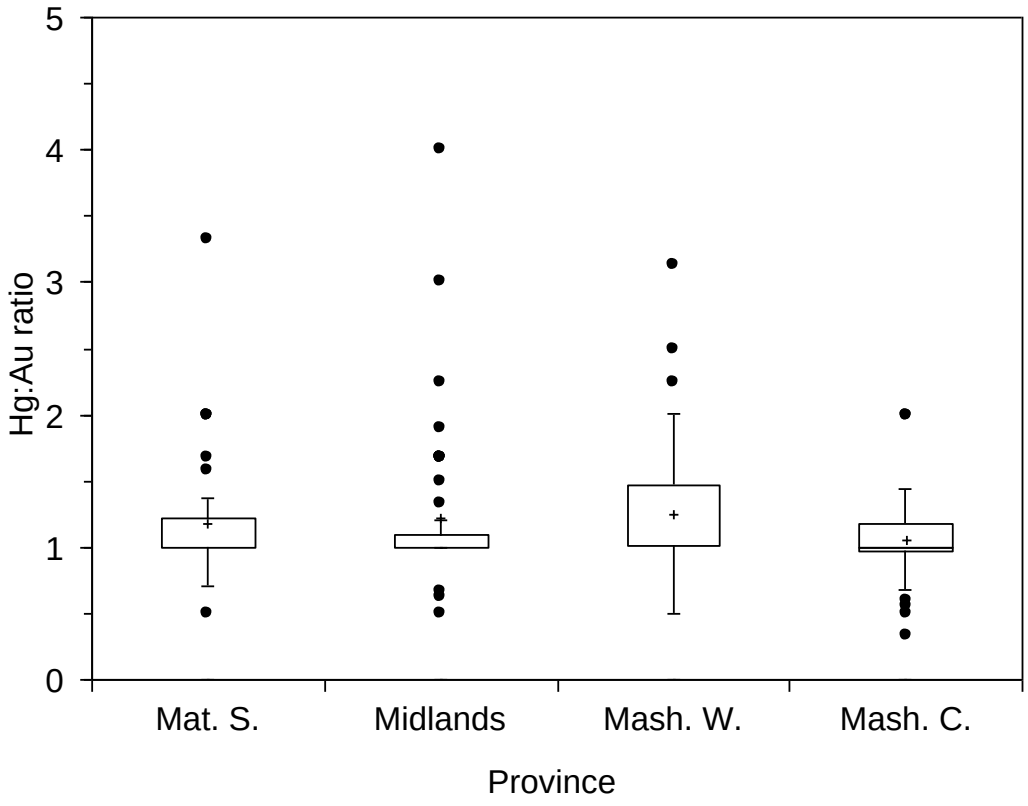


Figure 4.2 *The mercury-to-gold ratios obtained from gold processing sites in four provinces*

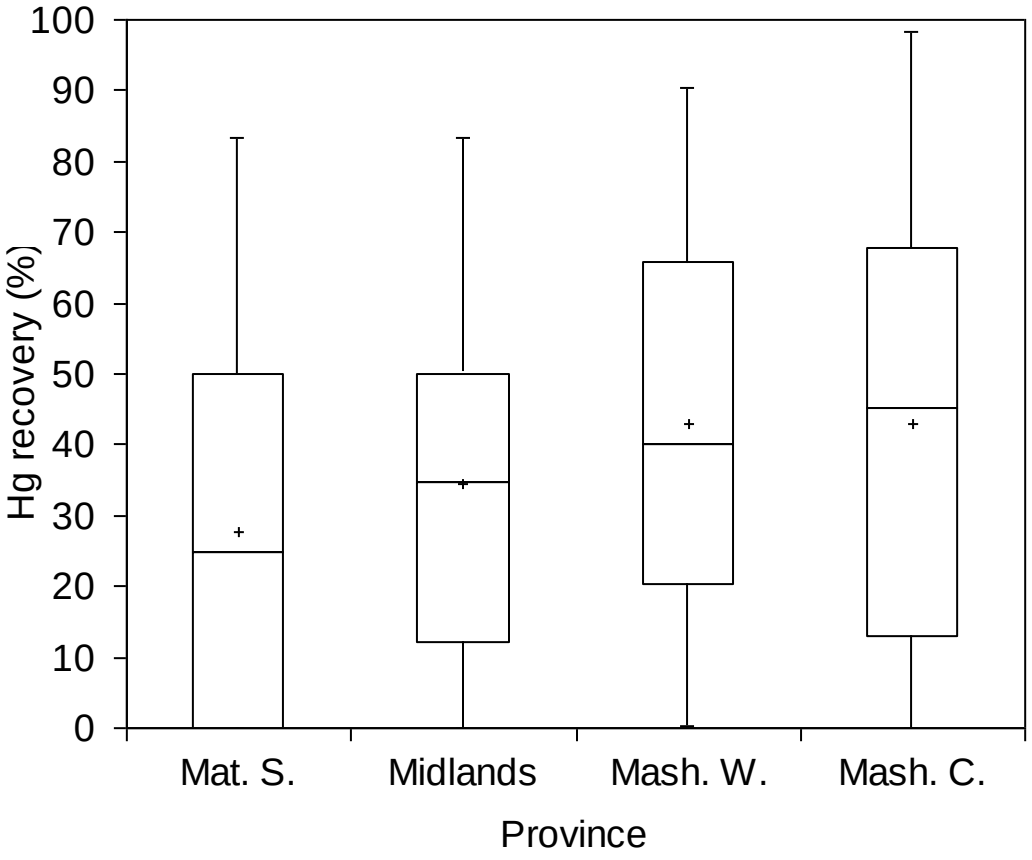


Figure 4.3 *The mercury-to-gold ratios obtained from gold processing sites in four provinces*

The emissions of mercury, using the process-based method showed that mercury emissions per mill ranged on average from 2.2 to 8.9 kg/year, and the highest emissions per mill were found in Matabeleland South province (**Figure 4.4**).

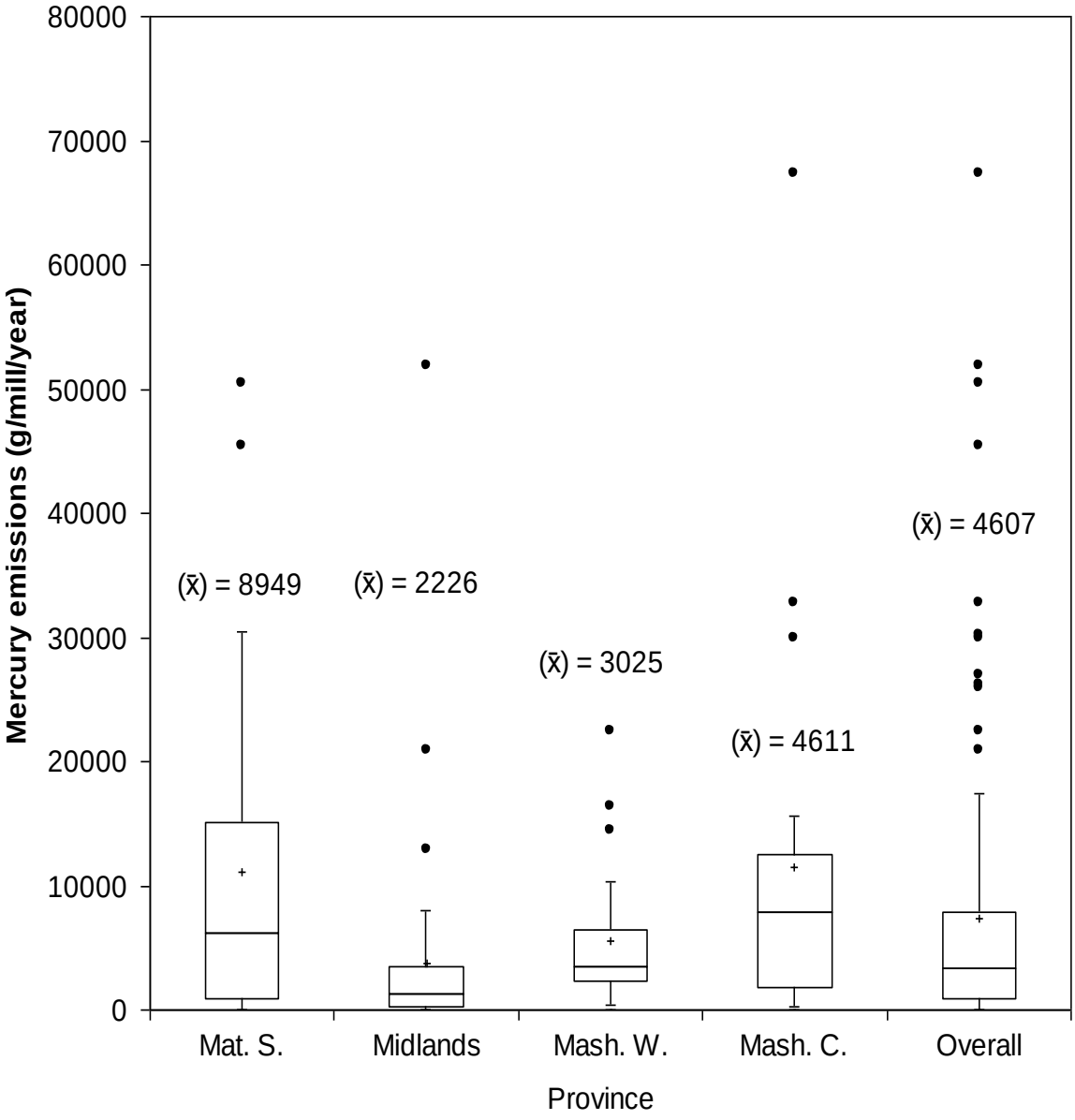


Figure 4.4 *Mercury emissions in ASGM per mill using the process-based method.*

At national level the process-based method revealed that mercury emissions for the base year 2018 was in the range 5,881 to 74,884 kg (average: 22,060 kg) (**Figure 4.5**). There has been a gradual increase in mercury emissions since 2012.

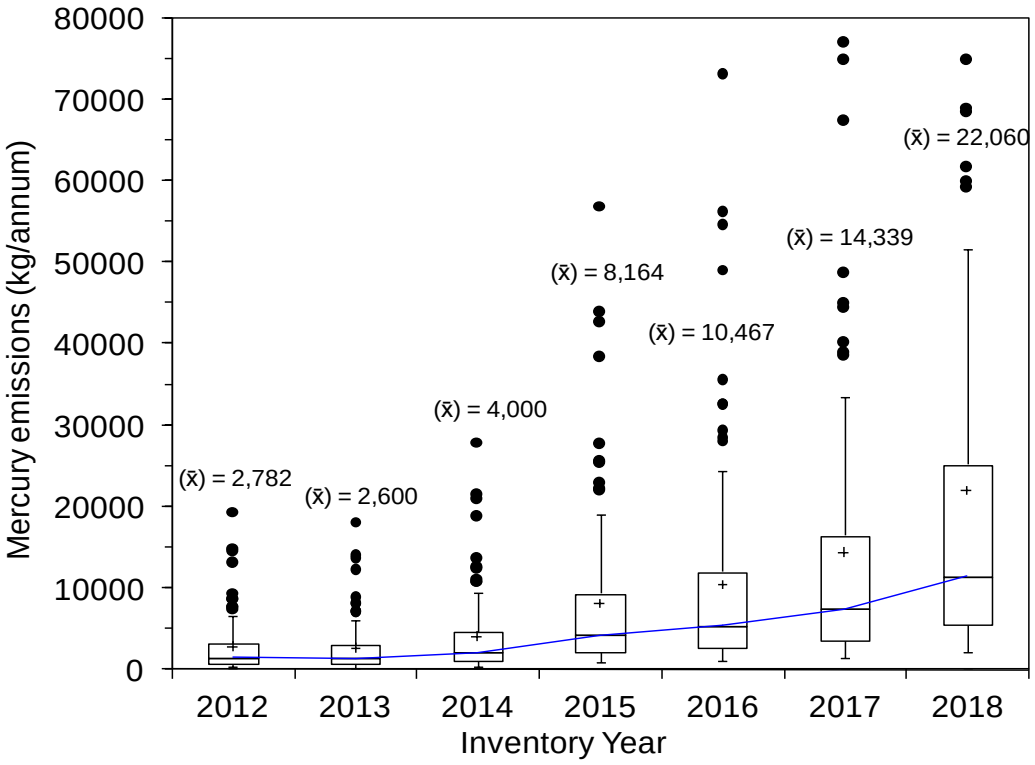


Figure 4.5 *National mercury emissions between 2012 and 2018 according to the process based method*

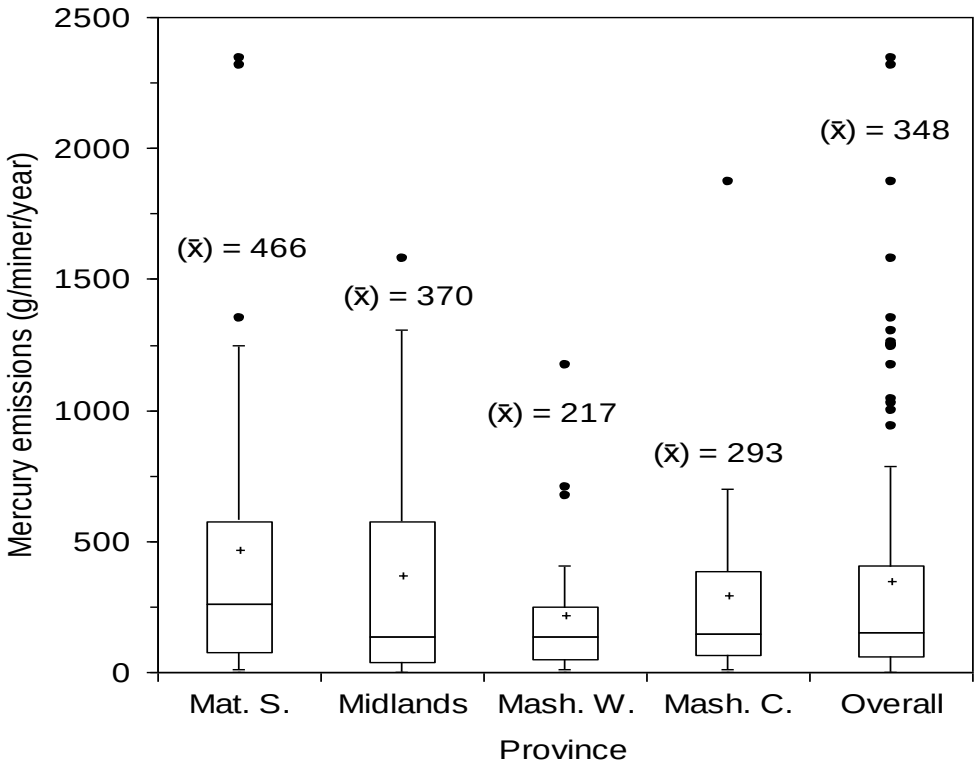


Figure 4.6 *Mercury emissions in ASGM per miner using the extraction-based method.*

At national level the extraction-based method revealed that mercury emissions for the base year 2018 was in the range 6,467 to 89,700 kg (average: 25,087 kg) (**Figure 4.7**). There has been a gradual increase in mercury emissions since 2012.

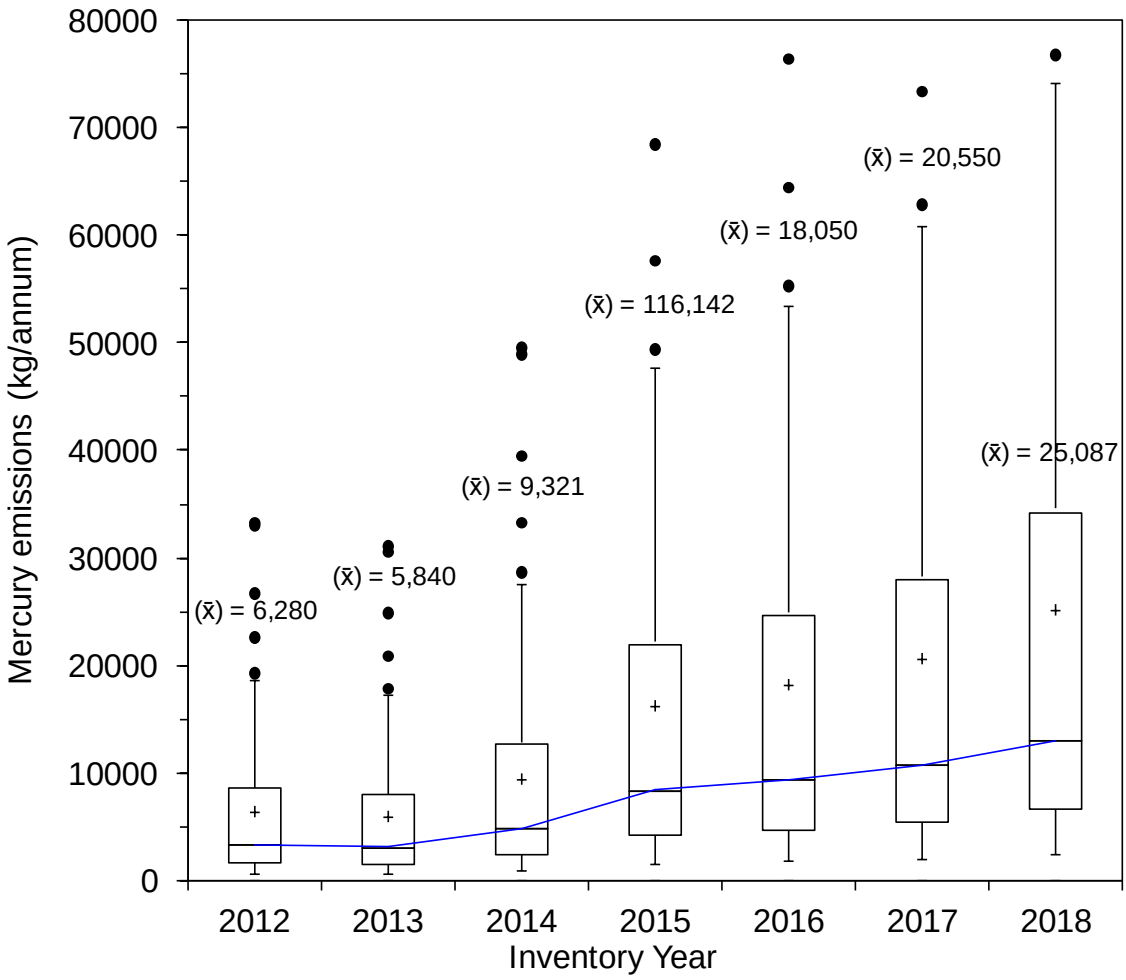


Figure 4.7 *National mercury emissions between 2012 and 2018 according to the extraction-based method*

Using the revenue based method the national mercury emissions were in the range of 10,839 to 86,712 kg (mean: 25,709 kg) for the 2018 base year (**Figure 4.8**). The revenue based method showed a more gradual increase in mercury emissions between 2012 and 2018.

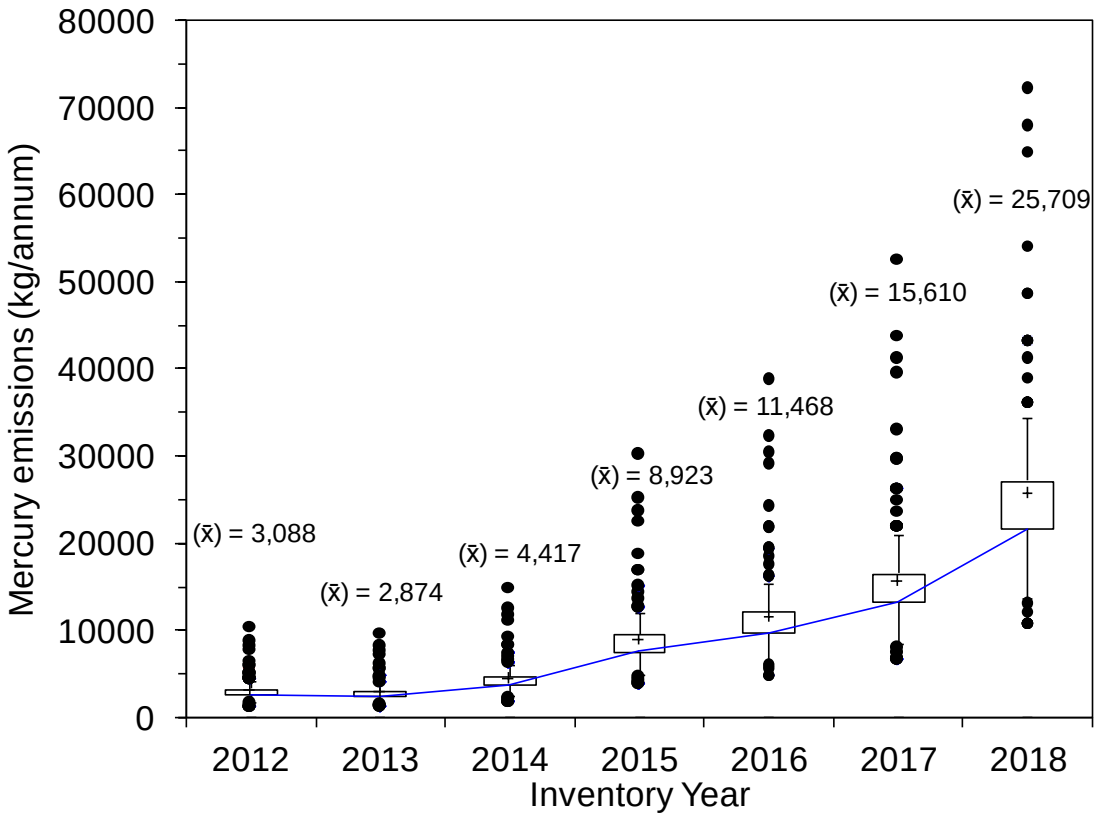


Figure 4.8 *National mercury emissions between 2012 and 2018 according to the revenue-based method*

F2.3.4 SUMMARY AND CONCLUSIONS

Overall, an estimated 96% of the gold processing sites use mercury and this mercury is largely emitted into air during the open burning of amalgam. The mercury-to-gold ratio of the amalgam before burning was estimated to be on average 1.17. There were minor differences in this ratio among the four assessed provinces, Matabeleland South (1.18), Midlands (1.22), Mashonaland West (1.24) and Mashonaland Central (1.05). The national Hg emissions in the 2018 base year, estimated using the revenue-based, process-based and extraction based methods were in the range of 7,729 to 83,765 kg (mean: 24,285 kg). The survey revealed that overall the highest annual mercury emissions at gold processing sites is about 6.74 kg/mill (overall mean: 4.6 kg/mill). A single miner emitted mercury into air in the range of 0.22 to 0.47 kg (overall mean: 0.35 kg/miner/yr).

F2.4. LEGAL AND REGULATORY STATUS

F2.4.1 INTRODUCTION

The issue of formalisation of the ASGM sector is one of the most complicated scenarios in Zimbabwe. Although all minerals, land rights and mining powers are controlled and belong to the Government of Zimbabwe, the ASGM largely operate from semi-formal, unregistered or sometimes unauthorised backgrounds. Currently there is what is known as mining federation, an umbrella board which claim to represent ASGMs nationally. This federation board is supposed to liaise with all ASGMs country wide and carry a database of the majority of the ASGMs. The board was formed as a way to try to persuade the government to recognise the ASGMs but nothing is working and visible practically.

F2.4.2 METHODOLOGY

Refer to section **F2.1.2**

F2.4.3 FINDINGS

Review of Regulatory and Policy Environment for Mercury Management

This section provides an assessment of the relevant legislation in Zimbabwe in relation to the provisions of the Minamata Convention on Mercury. Focus has been put on identifying the provisions of the Minamata Convention that are covered by the existing local legislation, and the identification of gaps.

Relevant legal framework

Table 1 Analysis of the relevant pieces of legislation and identified gaps

Title of legislation	Provisions	Gap(s)
Constitution of Zimbabwe (GOZ, 2013)	This is the supreme law in Zimbabwe which provides an enabling framework for environmental management. The constitution of Zimbabwe provides for environmental rights under section 73 which states that every Zimbabwean has a right to a clean, safe and healthy environment.	-
Children's Act Chapter 5:06	This Act makes provision for the protection, welfare and supervision of children and juveniles in face of hazardous labour. This is complementary to the Labour Relations Act [Chapter 28:01] which stipulates that no parent or guardian of a child or young person shall permit such child or young person to engage in hazardous labour.	The Act does not define explicitly the hazardous substances (which at mine sites commonly include mercury fumes and liquid) which it restricts children/infants from being in contact with.
Elution Plants Control Regulations, SI 63 of 2006 (under the Gold Trade Act Chapter 21.03 (GOZ,2006)	These regulate the operation of elution plants. Elution plants conduct final processing of gold won at custom milling plants using cyanide. However many milling plants use mercury and the gold processed at elution plants may contain some mercury.	The regulations do not refer to the environmental management regulations on air pollution
Environmental Management Act CAP 20:27 as read with its ancillary legislation (GOZ, 2003)	The Act promotes the sustainable utilisation of natural resources, prevention of pollution and land degradation. It provides environmental rights. The regulations under the Act regulate the entire chain of custody of chemicals including mercury.	
Environmental Management (Effluent and Solid Waste Disposal) Regulations, SI 6 of 2007 (GOZ, 2007a)	These provide for all landfills to be lined and require that no-one should continue to use unlined landfills more than 5 years from date of publication of Regulation (2007).	
Environmental Management (EIA and Ecosystems Protection) Regulations, SI 7 of 2007 (GOZ, 2007b)	These provide for the preparation of EIAs for development projects such as mining projects which use the amalgamation process.	`

Title of legislation	Provisions	Gap(s)
Environmental Management (Hazardous Waste Management) Regulations, SI 10 of 2007 (GOZ, 2007c)	The regulations provide for the issuance of licences for the generation, storage, use, recycling, treatment, transportation and disposal of hazardous waste. The regulations also outline the requirements for hazardous waste landfills. The regulations provide a detailed list of hazardous waste, and includes mercury and mercury compounds on the list.	-
Environmental Management (Hazardous Substances, Pesticides and Other Toxic Substances) Regulations, SI 12 of 2007 (GOZ, 2007d)	The regulations outline the requirements regarding sales, handling and transportation of hazardous substances, including mercury.	-
Mines and Minerals Act CAP 21:05 (GOZ, 1961)	The Act has a provision for the assessment, prevention or minimisation of damage to environment by mining operations through the generation of a report on anticipated environmental impact.	The Act does not refer to the Environmental Management Act CAP 20:27 on the management of chemicals.
Mines and Minerals Amendment Bill (GOZ, 2015)	*This bill promotes environmental stewardship by miners and mining companies, and makes adequate reference to the Environmental Management Act.* *The Bill establishes the Safety, Health and Rehabilitation Fund, which shall be used for rehabilitation of the environment with regard to environmental degradation caused by, among other things:* *Tailing and waste dump breaches and contamination* *Chemical spillage or acid mine drainage* *Closed mine risks (chemical leaks, water contamination and collapse)* *Every miner is expected to contribute annually to this Fund.*	*The Bill allows for alluvial mining in river beds, which is prohibited by Environmental Management (Control of Alluvial Mining) Regulations, SI 92 of 2014.* *Chemical contamination arising from active mines does not seem to stand out clearly as being one of the types of degradation that will be rehabilitated from the SHR fund.* *The Bill does not make it clear whether the SHR fund will be used for rehabilitating degradation arising from currently active mines, or whether it will be used for rehabilitating degradation arising from closed, inactive and / or abandoned mines.* *Three years after being drafted, the bill is yet to be passed into law, which means that the*

Title of legislation	Provisions	Gap(s)
		environmentally pertinent issues which are addressed by the bill and which could improve environmental management and mercury management in the mining sector, are still not being implemented.
Mines & Minerals (Custom Milling Plants) Regulations, SI 239 of 2002 (GOZ, 2002)	These regulate the operations of custom milling plants. These plants are the sites where most mercury use by artisanal and small-scale miners is conducted.	The regulations do not address mercury use.
Mining (Health and Sanitation) Regulations SI 182 of 1995 (GOZ, 1995)	Imposes health and safety standards for mining operations.	This regulation does not address mercury impacts on human health.
Mining (Management and Safety) Regulations, SI 109 of 1990	Sections 21 to 24 of the regulations address the management (handling, storage, emissions and availing of antidotes) of toxic substances such as cyanide and arsenic at mining sites.	The sections do not directly address the management of mercury through measures to ensure rehabilitation and monitoring of the mercury contaminated sites
Zimbabwe Mining Development Corporation Act 21:08	This Act allows for the investment in mining through capitalizing the prospecting, exploration, mining and mineral beneficiation programmes.	It does not restrict the use of mercury in beneficiation and does not prohibit the further exploration and exploitation of cinnabar (mercury bearing mineral found in Zimbabwe)
Public Health Act CAP 15:09	This Act makes provision for public health.	The Act currently has no restrictions on the use of mercury in medical practices and processes and storage thereafter of mercury bearing medical waste. The Act does not encourage the raising of public awareness regarding the health risks of exposure to mercury. The Act does not address the protection of public health from cosmetics. The Act does not provide for the registration of food items.

Title of legislation	Provisions	Gap(s)
		The Public Health Bill of 2017, which is meant to replace the current Public Health Act, does not address the identified issues either.
Medicines and Allied Substances Control Act CAP 15:03	This Act provides for the regulation of medicines which may be imported into and sold in Zimbabwe.	The Act does not address non-medical cosmetics, and there is no act which does.
The Health Professions Act CAP 27:19	This Act governs the operations of different health personnel, including dentists.	The Act does not address the management of dental waste.
Control of Goods (Open General Import Licence) (Standards Assessment) Notice SI 132 of 2015	This notice establishes the Consignment Based Conformity Assessment (CBCA) Programme, which is meant to reduce hazardous and substandard imported products. The programme involves shipment inspection, verification of documentation, sample testing and risk assessment of goods to be imported while in the country of origin. This is meant to ensure that counterfeit and sub-standard goods do not come into Zimbabwe.	-
The Consumer Protection Bill	*Provides for the rights of consumers to safe products*	The bill is yet to be enacted.

Legal framework in relation to the Convention

Table 2 Analysis of the existing pieces of legislation in relation to the provisions of the Convention

Convention Obligation	Legal Instrument(s)	Summary of Legal Provisions
Each Party shall Endeavour to identify individual stocks of mercury or mercury compounds exceeding 50 metric tons, as well as sources of mercury supply generating stocks exceeding 10 metric tons per year, that are located within its territory;	Environmental Management Act CAP 20:27 as read with Statutory Instrument 12 0f 2007	All stakeholders that are involved in chain of custody of mercury are licensed by the Environmental Management Agency. During the Mercury Initial Assessment (MIA) project, the quantities of mercury which are currently in Zimbabwe will be declared. Zimbabwe is in the process of promulgating legislation that will specifically govern the importation, storage and use of mercury within the country. Specific legal provisions aimed at control measures such as record keeping and prohibitions on sale to unlicensed persons or unlicensed possession of this product, have been introduced by this draft legislation.
Each Party shall not allow the export of mercury except to a Party that has provided the exporting Party with its written consent, and only for the purpose of: I) A use allowed to the importing Party under this Convention; or ii) Environmentally sound interim storage as set out in Article 10	Environmental Management Act CAP 20:27 as read with Statutory Instrument 12 0f 2007	Currently Zimbabwe has a statutory instrument in place which governs the trans-boundary movement of all hazardous substances including mercury. As part of requirements for movement in and through Zimbabwe, the legislation requires pre-clearance before being allowed entry into or through Zimbabwe. The draft instrument alluded to above, now have a specific focus on mercury and mercury containing products and more stringent restrictions have been put on transboundary movement of mercury.
Each Party shall not allow the export of mercury except to a non-Party that has provided the exporting Party with its written consent, including certification demonstrating that: I) The non-Party has measures in place to ensure the protection of human health and the environment and to ensure its compliance with the provisions of Articles 10 and 11; and ii) Such mercury will be used only for a use allowed to a Party under this Convention or for	Environmental Management Act CAP 20:27 as read with Statutory Instrument 12 0f 2007.	Currently Zimbabwe has a statutory instrument in place which governs the trans-boundary movement of all hazardous substances including mercury. As part of requirements for movement in and through Zimbabwe, the legislation requires pre-clearance before being allowed entry into or through Zimbabwe. The draft instrument alluded to above, now have a specific focus on mercury and mercury containing products and more stringent restrictions have been put on transboundary movement of mercury.

Convention Obligation	Legal Instrument(s)	Summary of Legal Provisions
environmentally sound interim storage as set out in Article 10.		
Each Party shall not allow the import of mercury from a non-Party to whom it will provide its written consent unless the non-Party has provided certification that the mercury is not from sources identified as not allowed under paragraph 3 or paragraph 5 (b).	Environmental Management Act CAP 20:27 as read with Statutory Instrument 12 0f 2007	Currently Zimbabwe has a statutory instrument in place which governs the trans-boundary movement of all hazardous substances including mercury. As part of requirements for movement in and through Zimbabwe, the legislation requires pre-clearance before being allowed entry into or through Zimbabwe. The draft instrument alluded to above, now have a specific focus on mercury and mercury containing products and more stringent restrictions have been put on transboundary movement of mercury.
Each Party shall include in its reports submitted pursuant to Article 21 information showing that the requirements of this Article have been met.	Environmental Management Act CAP 20:27	Reference is made to the proposed legislation for governing the importation, storage and use of mercury. As part of its requirements, all importers, exporters, sellers, users and storage facilities dealing with mercury or mercury containing products shall be obliged by law to keep records of stocks and stock movement including information on whom such stock was sold to or how it was used. It is a collective of this information which will be periodically reviewed by Zimbabwe through its enforcement Agency, the Environmental Management Agency, and used to compile reports as required by Article 21.
Each Party shall not allow, by taking appropriate measures, the manufacture, import or export of mercury-added products listed in Part I of Annex A after the phase-out date specified for those products, except where an exclusion is specified in Annex A or the Party has a registered exemption pursuant to Article 6.	Environmental Management Act CAP 20:27	Reference is made to the proposed new legislation for governing the use of mercury.
Each Party shall take measures for the mercury-added products listed in Part II of Annex A in accordance with the provisions set out therein	-	-
Each Party shall take measures to prevent the incorporation into assembled products		Reference is made to the proposed new mercury legislation. With regards manufacturing, there are currently no manufacturing plants

Convention Obligation	Legal Instrument(s)	Summary of Legal Provisions
of mercury-added products the manufacture, import and export of which are not allowed for it under this Article		in which mercury added products are being produced. Current legislation already controls the importation, storage and use of all hazardous substances including mercury through a licensing system. Such a system ensures that such addition of mercury added products is prevented.
	Environmental Management Act CAP 20:27 as read with Statutory Instrument 12 0f 2007	Current legislation already controls the importation, storage and use of all hazardous substances including mercury through a licensing system. Such a system ensures that such use of mercury or mercury compounds is prevented. The draft legislation specifically dealing with mercury and its derivatives will introduce more strict controls in access to mercury by manufacturers through stringent pre-clearance requirements before sourcing any mercury supplies.
Each Party with one or more facilities that use mercury or mercury compounds in the manufacturing processes listed in Annex B shall: Take measures to address emissions and releases of mercury or mercury compounds from those facilities; Include in its reports submitted pursuant to Article 21 information on the measures taken pursuant to this paragraph; and Endeavour to identify facilities within its territory that use mercury or mercury compounds for processes listed in Annex B and submit to the Secretariat, no later than three years after the date of entry into force of the Convention for it, information on the	Environmental Management Act CAP 20:27 as read with Statutory Instrument 12 0f 2007 National Social Security Act CAP 17:04 (GOZ, 1989)	Zimbabwe currently has legislation and standards governing the release of air pollutants and also point source effluent discharge from industrial activities. These pieces of legislation can be used to address the emissions and releases of mercury or mercury compounds from such facilities. The legislation advocates for quarterly monitoring of emissions and releases thus ensuring consistent management of the operations at such facilities. With the comprehensive coverage and presence of the government of Zimbabwe's enforcement arm, the Environmental Management Agency, information on the number and types of such facilities and the estimated annual amount of mercury or mercury compounds used in those facilities can be compiled easily. The legislation spoken of above also makes it mandatory for any licensed industrial applications to keep records of their activities which can be verified through constant monitoring for compliance.

Convention Obligation	Legal Instrument(s)	Summary of Legal Provisions
number and types of such facilities and the estimated		
Each Party shall not allow the use of mercury or mercury compounds in a facility that did not exist prior to the date of entry into force of the Convention for it using the manufacturing processes listed in Annex B. No exemptions shall apply to such facilities.	Environmental Management Act CAP 20:27 as read with Statutory Instrument 7 0f 2007	The Country has an essential tool with regards management of development which is Environmental Impact Assessment legislation. The legislation gives the government the discretion to control development and gives conditions on how such development shall be carried out in an environmentally friendly manner. In this regard, the country has the ability to control or ban the use of mercury by any new facilities that came into being post coming into force of the Convention.
Each Party shall discourage the development of any facility using any other manufacturing process in which mercury or mercury compounds are intentionally used that did not exist prior to the date of entry into force of the Convention, except where the Party can demonstrate to the satisfaction of the Conference of the Parties that the manufacturing process provides significant environmental and health benefits and that there are no technically and economically feasible mercury-free alternatives available for providing such benefits	Environmental Management Act CAP 20:27 as read with Statutory Instrument 7 0f 2007	As mentioned above, the Environmental Impact Assessment legislation gives the government of Zimbabwe the ability to control any development within the country. Thus it is possible to totally ban the construction of any such facilities through the above mentioned legislation.
Each Party that has artisanal and small-scale gold mining and processing subject to this Article within its territory shall take steps to reduce, and where feasible eliminate, the use of mercury and mercury compounds in, and the emissions and releases to the environment of mercury from, such mining and processing	Environmental Management Act CAP 20:27 as read with Statutory Instrument 7 0f 2007 Mines and Minerals Act CAP 21:05 National Social Security Act CAP 17:04	-

Convention Obligation	Legal Instrument(s)	Summary of Legal Provisions
Each Party shall notify the Secretariat if at any time the Party determines that artisanal and small-scale gold mining and processing in its territory is more than insignificant. If it so determines the Party shall: Develop and implement a national action plan in accordance with Annex C; Submit its national action plan to the Secretariat no later than three years after entry into force of the Convention for it or three years after the notification to the Secretariat, whichever is later; and Thereafter, provide a review every three years of the progress made in meeting its obligations under this Article and include such reviews in its reports submitted pursuant to Article 21.		Zimbabwe submitted a declaration that the country has more than insignificant artisanal and small-scale gold mining and processing. The country is in the process of developing national action plan in accordance with Annex C prior to its implementation.
Each Party shall take measures to ensure that the interim storage of such mercury and mercury compounds intended for a use allowed to a Party under this Convention is undertaken in an environmentally sound manner, taking into account any guidelines, and in accordance with any requirements, adopted pursuant to paragraph 3.	Environmental Management Act CAP 20:27 as read with Statutory Instrument 12 0f 2007	The current legislation provides that storage facilities for mercury should be licensed and conditions be imposed to ensure the sound management of mercury.
Parties shall cooperate, as appropriate, with each other and with relevant intergovernmental organizations and other entities, to enhance capacity-building for the	Environmental Management Act CAP 20:27	Citizens have the right to environmental information which includes knowledge of chemicals management mercury included.

Convention Obligation	Legal Instrument(s)	Summary of Legal Provisions
environmentally sound interim storage of such mercury and mercury compounds.		
Each Party shall take appropriate measures so that mercury waste is: Managed in an environmentally sound manner, taking into account the guidelines developed under the Basel Convention and in accordance with requirements that the Conference of the Parties shall adopt in an additional annex in accordance with Article 27. In developing requirements, the Conference of the Parties shall take into account Parties' waste management regulations and programmes; Only recovered, recycled, reclaimed or directly re-used for a use allowed to a Party under this Convention or for environmentally sound disposal pursuant to paragraph 3 (a); For Parties to the Basel Convention, not transported across international boundaries except for the purpose of environmentally sound disposal in conformity with this Article and with that Convention. In circumstances where the Basel Convention does not apply to transport across international boundaries, a Party shall allow such transport only after taking into account relevant international rules, standards, and guidelines.	Environmental Management Act CAP 20:27 and its ancillary legislation Environmental Management Policy Integrated Solid Waste Management Strategy	The management of waste is guided by the stated legal documents. The legal documents are built on the principles to reduce, reuse and recycle waste. They follow the waste management hierarchy with land filling being the least preferred situation. They state that waste should only be disposed at designated facilities.

Relevant Policies

In addition to legal statutes, there are also a number of policies that can contribute to sound mercury management in Zimbabwe. The main ones are described in Table 3.

Table 3 Policies which are relevant for mercury management

Policy Instrument	Relevant Provisions for Mercury Management
National Environmental Policy	The specific objectives in the Policy include optimising the use of resources and energy, minimizing pollution and waste, supporting environmental education, supporting collation and management of environmental information, and implementing provisions of MEAs. Sources of mercury emissions and releases include poor waste management (use of unlined landfills and lack of waste separation at source), as well as use of fossil fuels for energy provision. Addressing these issues will lead to reduction in mercury releases and emissions. Environmental education, which is mentioned as one of the objectives of the Policy is also fundamental for ensuring that the public play an active role in protecting the environment from mercury emissions and releases.
National Integrated Waste Management Plan	The goals of the Plan include minimizing solid waste generation, separating waste at source, promoting resource recovery, and investing in environmentally sound disposal systems. Other goals include educating all sectors of society to practise integrated waste management, developing a Waste Management Information System, and developing a Solid Waste Management Policy. As mentioned above, poor waste management practices result in significant releases of mercury into the environment. Addressing waste management is therefore key in reducing emissions and releases.
Occupational Health and Safety Policy	The Policy assigns responsibilities for Occupational Safety and Health (OSH) to both employers and employees. It gives workers certain basic rights, including the right to refuse to undertake unsafe work, and the right to know the OSH risks that they are likely to be exposed to, and their effects. Those who work with mercury (e.g. in the ASGM sector, or even in battery or CFL manufacturing) are at risk of exposure to mercury, so application of this policy can lead to reduced exposure for that population group.
National Energy Policy	The Policy Goal is to provide a framework for the exploitation, distribution and utilization of energy resources. Its objectives include the development of energy supply that promotes sustainable development and promotion of investment in and usage of renewable energy. Currently Zimbabwe uses large quantities of fossil fuels for energy provision, which results in emission of mercury into the environment. Promoting renewable energy sources will therefore lead to a reduction in mercury emissions.

The presence of policies which can contribute to improved mercury management is commendable. However, at times there are no implementation mechanisms for the policies, and they end up not being implemented. Also the fact that they have no legal backing often makes it difficult to implement them. In spite of these weaknesses, they act as good starting points for implementing critical activities that can lead to substantial reductions in mercury emissions. It is therefore important that implementation mechanisms for implementing the identified policies should be put in place and applied.

F2.5 LEADERSHIP AND ORGANISATION OF ASGM IN ZIMBABWE

F2.5.1 INTRODUCTION

This issue of formalisation of the ASMG sector is one of the most complicated scenarios in Zimbabwe. Although all minerals, land rights and mining powers are controlled and belong to the Government of Zimbabwe, the ASGM largely operate from semi-formal, unregistered or sometimes unauthorised backgrounds. Currently there is what is known as mining federation, an umbrella board which claim to represent ASGMs nationally. This federation board is supposed to liaise with all ASGMs country wide and carry a database of the majority of the ASGMs. The board is mandated to address the problems faced by ASGM members but because no legislature recognises it, it saves no purpose. The board was formed as a way to try to persuade the government to recognise the ASGMs but nothing is working and visible practically.

The gold sector is governed by the Mines and Minerals Act and the Gold Trade Act. Of grave concern to ASGMs is the non-recognition of its members in the Mines and Minerals Act. The principal Act was first crafted in 1961 and was last reviewed in 19961. In 2016, "a bill was placed before Parliament to re-align the law to best international practices and to address contemporary challenges affecting the mining sector. However, the amending bill to date falls far short of fully recognising ASGMs. The bill simply defines a small-scale miner as a 'holder of a mining location who is not a large-scale miner' and no attempt has been made to define an artisanal miner. During public consultations on the Bill by the parliamentary Committee on Mines and Energy, ASGM associations expressed disappointment over the vague description of its group. It should be noted that defining ASGM has been problematic in many African countries.

The objective of this assessment was to determine the nature and status of existing miner's cooperatives, associations and other initiatives in the ASGM sector. This also entailed assessment of the distribution of power in the ASGM community.

F2.5.2 METHODOLOGY

Refer to section **F2.1.2**

F2.5.3 FINDINGS

Existing cooperatives/associations in ASGM

The majority of the ASGMs are indirectly organized in the sense that they will be mining in regions or places with mining claims which are owned by other people who then find mediators or front runners who then persuade these desperate ordinary people to work under them while they are given partially binding contracts which are not involving the actual claim owner. This scenario is popular in almost 75% of the interviewed ASGMs.

The main reason why the ASGMs are not organized and do not have a proper leadership is that during the black empowerment era no proper policy was introduced to cater for these ASGMs, As it is known that the definition of ASGM is nothing else other than, "the illegal extraction of minerals by people who do not own a mining license, permit or any other form of an official document which substantiate the individual who will be getting the gold". The only reason why these people have been on the ground for so long is the political situation on the ground where the people in power are afraid of losing the votes when they try to harass away the ASGMs. Not long ago the government made a good move of allowing the ASGMs to sell their gold to Fidelity Printers (FP) or their agency.

Now the so called cooperatives are only about 1-2% of the ASGMs. Although they call themselves cooperatives, they are not properly constituted because they do not operate with constitutions guiding their operations. It is more of mutual trust that guides their operations. How can a cooperative be recognized if they do not hold the mining permit or mining claim? They use the principal or philosophy that they can pressurize the government to regularize their mining rights or claims while they are already on the ground like the situation on housing setups. This is impossible since the actual mining rights are owned by big companies which had temporarily seeded unofficially their mining rights by just letting the piece of land to other pending the desperate political situation to evaporate before they can come back to their operations. Although they exist the so called CEO of the ASGMs, the structure does not cascade down to grassroots level due to lack of proper policy by the government which is supposed to be viewed through

the mining act which lie within the ministry of mines. If an ordinary grass root ASGM member is to ask the CEO what are the benefits gained by a paid up member, the CEO will definitely fail to convince this member due to the fact that his position is not even known by the government. It is only now that the government is allowing these unofficially registered miners to sell their gold to Fidelity Printers directly and this might bring some positive feelings which may lead to official recognition of ASGMs.

Officially there exist no legal cooperatives in the ASGMs groups although the word is just being used in order for them to extend their illegal existence in the mining of gold on the ground of other people. The majority of the so called cooperatives do not possess official documents which reflect the official position. They are led by politically connected individuals who give verbal assurances and the situation then remains hanging indefinitely hence confusion prevails.

Organization of ASGMs at local levels

Generally, ASGMs have organizational structures at their different sites where they are made to comply through the small and temporarily binding contracts which are issued by third parties or mediators who give them the areas, pits or shafts to do the gold extraction. This set up varies from site to site and from region to region because it is just a survival set up which bridges the gap between claim owners and the ordinary people.

F2.5.4 SUMMARY AND CONCLUSIONS

From the above submissions the research found out that most ASGMs do not have a proper universal organizational setup although their setup varies from site to site, pit to pit, shaft to shaft and from region to region. The majority of the ASGMs expressed a lot of concern and disappointment in the way there are viewed by the government and other stakeholders. Although they feel that they are being used there are still very eager and they remain optimistic that the government will put a legislative act or law that will recognize them as legal ASGMs which is not the situation on the ground now. It is therefore necessary for the government to set a legislature which directly acknowledges the ASGMs through regulatory measures.

F2.6 MERCURY TRADE AND DEMAND

F2.6.1 INTRODUCTION

In recent years increased attention has been devoted to the environment and health issues related to mercury (Hg) uses and releases worldwide (UNEP, 2008a, 2008b). Mercury is a natural element used in a great variety of applications such as dental amalgam, chlor-alkali production, thermostats and gold amalgamation (UNEP, 2013a, 2013b). It is also unintentionally emitted via industrial activities like coal combustion, cement production and metal smelting (UNEP, 2013b). Due to its high toxicity and hazard to human health and the environment, mercury has increasingly been regulated worldwide in order to reduce its trade, use and releases.

ASGM may be formal or informal and may be carried out by family groups, partnerships, cooperatives or associations, including men, women, seasonal workers and not infrequently, children (e.g., Basu et al., 2015; Ali, 2009; Philippine Government, 2011). ASGM workers typically use simple or rudimentary methods to explore, extract, process and transport minerals (WGC, 2015; OECD, 2012). Mercury is often used in this process because it readily amalgamates with gold particles present in the ore. However, the basic processing techniques generally employed lead to substantial emissions of mercury to the atmosphere and releases to waterways and the soil. ASGM attracts many people who have limited alternative employment opportunities, and many others who find it more profitable than work in agriculture, which is often the only option (Nyame and Blocher, 2010; Bryceson and Jønsson, 2010). It is estimated that up to 15 million people work in this sector in about 70 countries in Asia, Latin America and Africa. The most recent estimates of the Artisanal Gold Council puts ASGM annual gold production in the range of 400 metric tons, or nearly 15 percent of worldwide primary mine production. Larger mining operations employ processes that do not involve mercury.

F2.6.2 METHODOLOGY

Refer to section **F2.1.2**

F2.6.3 FINDINGS

Mercury Trade

Data on import to Zimbabwe and export to Zimbabwe as reported by partner countries from the UN Comtrade database are shown below. There is no reported export. Furthermore, some information was obtained directly from Customs in Zimbabwe. According to information obtained from customs, 94 kg mercury was imported from South Africa in 2014, in accordance with the Comtrade data, while in 2015 the import was only 9 kg (see below Table).

The steep decrease in import from 2012 to 2013 likely does not reflect the actual trend in import, but rather a change from formal to informal import. As shown in *Table below* export from South Africa, reported as export from South Africa to Zimbabwe, continued during 2013 and 2014.

As mentioned in the previous section, the restriction of mercury sales to one company may have resulted in increased smuggling of the substance into Zimbabwe, as buyers have fewer outlets in which they can formally buy mercury. This restriction may explain the apparent decrease in the formal import of mercury. The lack of import from the United Kingdom as of 2013 is a consequence of the EU mercury export ban. The average for the period 2010 to 2012 of approximately 12 t/year is, however, low compared with the Global Mercury Inventory estimate on mercury use in Zimbabwe for ASGM of 12.5 - 37.5 t/year.

Table 7.1 ***Import of mercury in kg to Zimbabwe by country in 2010-2014****

	2010	2011	2012	2013	2014	2015
China	120		865	5		
China, Hong Kong			45			
India				16		
Italy			27			
South Africa	2,659	4,175	4,426	100	94	9
Switzerland	3,450					
United Arab Emirates		1,725	5,278			
United Kingdom	3,732	4,502	7,276			
Total	9,961	10,402	17,917	121	94	9

Source: Comtrade database

Mercury use and trade flow

With the exception of South Africa, all of the export countries for which imports into Zimbabwe have been recorded are non-African, the major exporters being the United Kingdom and the United Arab Emirates. However, formal import of mercury ceased in 2013.The smuggling of mercury into the country's ASGM sector has prevailed following the imposition of mercury trade restrictions upon the majority of pre-existing mercury importers. While mercury import was previously conducted by a number of formal companies dealing with import of mining equipment and chemicals (cyanide, carbon, acids etc.), such as Curechem, Chemplex and Mining

Axis House, some years back this was restricted by Environmental Management Agency (EMA), which has cancelled the licenses of these companies and presently licenses only one company based in Bulawayo, namely K. B. Davies. As a regulatory requirement, this formal supplier is obligated to submit quarterly reports on imported quantities and record which buyers it sells to. The company has been visited by the local expert and the reports on imported quantities have been requested from the authorities, but no actual data on quantities imported and sold and information on customers have been obtained.

Information on Mercury trade routes

A study was conducted in Zimbabwe, the study was based on semi-structured interviews with miners in active ASGM sites within the goldfields of Shurugwi, Gweru and Kwekwe in Mid- lands Province in central Zimbabwe.

Several miners from the active ASGM sites asserted that South Africa is the main trader of mercury in Southern Africa, adding that mercury is smuggled as a result of the restrictions and lengthy import process imposed by the EMA. When enquired about the modality of informal inflows, they revealed that dealers smuggle mercury in 34.5 kg flasks (in haulage trucks) and repackage it into 1 kg syrup bottles that are sold off locally, with the resource ultimately distributed in teaspoon portions. It is believed that Zimbabwean and South African traders participate in the trade. One mine manager of horse shoe mine, following corroboration from an insider in South Africa, was able to confirm that mercury originates from South Africa in large canisters (flasks). He elaborated "In South Africa, these packages are imported from Russia, sold to traders at a price of USD 183 and transported across the border via small hired vans locally known as Malaisha Cars". Further, he disclosed that an associate involved in this trade purchases two to three of the canisters and repackages them into 1 kg bottles for sale.

According to a one-time manager of a custom milling center, who formerly sold mercury to small-scale miners, the resource is smuggled from South Africa in canisters, where from it is repackaged into 30 g, 50 g, 0.5 kg and 1 kg parcels. The now freelance metallurgist also pointed out that Indian mercury is of higher quality than Chinese mercury, which is comparatively impure and costs USD 10 – 20 less per kg. "Indian suppliers have the capacity to furnish up to 150 kg per week, and once offered me a stock at a price of USD 140 per kilo," he narrated. From his account, gold buyers play a notable role in the distribution of mercury to ASG miners as part

of their credit arrangements with them, and similar involvement is demonstrated by gold custom milling centers. One jewellery owner who deals in the legal purchase of gold from small-scale miners divulged to have sold small packages of mercury to ASG operators in the past, maintaining that this business line has been terminated given that the local market was challenging. By the account of the ASM Project Leader of PACT, workers employed in a number of large mercury-reliant mines allegedly steal the resource for clan destine sale, thereby feeding into the black market. "I know of dealers who import mercury in 34.5 kg flasks across the border using public buses," he added. Furthermore, he stated that mercury reaching Zimbabwe originates from the USA, wherefrom it transits through Switzerland before entering South Africa.

A number of informants from the Institute of Mining Research (University of Zimbabwe) noted that, locally, mercury is distributed further downstream by millers and pharmacies situated in ASGM areas. A South African based supplier of small-scale mining equipment was approached for further information on the trading channels in South Africa. It was informed that Protea Chemicals, amongst other suppliers, is known to sell mercury in South Africa. He affirmed that Zimbabwean gold buyers fetch mercury from South Africa and that smuggling out of the country is rampant in the border town of Beitbridge. The smuggled mercury is contained in canisters and is portioned into 1 kilo (or less) packaging, most often into medicine bottles for subsequent distribution further down the supply chain. An employee of a local mining supplies provider that was formerly licensed to import mercury for local distribution revealed that the company sold off an average of 15 flasks (equivalent to 510 kg) per month during its peak period, stating that they were not dealing in mercury any longer.

According to a mine owner, an average of 300 grams of mercury is purchased every month for production at the site. He shared that mercury used at the mine is bought mainly from Chinese suppliers, and from numerous mining chemical stores located in the towns of Kwekwe, Kadoma, or Chegutu. “Aside from mercury, the Chinese sell other chemicals, as well as mining equipment, and have dominated the local supply chain as they are currently the cheapest,” he mentioned. On average, mercury is priced at around USD 100 per kilo (September, 2018), although regular customers can purchase it for as low as USD 75per kg. Smaller portions sell for between USD 8 and USD 10 for 30-50 g. Generally, the larger the quantity purchased, the lower the price. Mercury supplied by the Chinese is sealed in plastic bottles weighing a kilo,

while that from other suppliers is sold out in smaller quantities (e.g. full teaspoons sold in small plastic bags). It is alleged that most mercury suppliers smuggle the resource through Beitbridge, paying off drivers of inter-state buses to ensure their parcels are smoothly transported across the border, in which case the drivers either conceal the stocks or bribe custom officials.

The Mine Manager of a custom mill quoted the price of mercury as USD 150 per kilo and USD 10 per tea- spoon measure (approximately 30 grams). Informants at the custom mill stressed that they have no stake in the supply chain given that mercury is provided entirely by the customers, and claimed to have no further knowledge of it. In one visited mine, "mercury is used in the stamp mill and is ordered through the mine's Bulawayo office," explained the Mine Supervisor. A bottle with an official KB Davies label was produced as evidence of legitimate mercury procurement. As stated by the supervisor, a 30 g teaspoon of mercury costs US$10. He pointed out that the sale of mercury at the site is closely monitored by the mine owners and that around 2 kilos of mercury are consumed each month. Six respondents from an informal Makorokoza site on Wensor Mine acknowledged that mercury is used heavily at the site and that it is purchased in small unlabeled bottles in Gweru at a price of USD 85 – 90 per kilo. It was established that 30 g teaspoon volumes are priced at USD 10, and these can extract up to30 g of gold. Although the monthly consumption of mercury at the site could not be determined, its usage was depicted as significant.

<u>Actors in the mercury value chain</u>

In light of the information provided by the interviewees, the actors comprising the country's mercury supply chains can be categorized as follows:

› K. B. Davies, the country's only formal mercury importer and retail shop located in Bulawayo.
› Small-scale business people, who purchase a few kilos in South Africa or Zimbabwe and sell it on, often in smaller quantities, with a profit.
› Gold buyers, who sell their gold in South Africa and bring back mercury, which they sell to miners, often on credit subject to the miners selling their gold to them at a price where the mercury cost is deducted.
› Large-scale sellers, who import several hundred kilos a month and have their own distribution net- works.

› Sellers of mining chemicals and equipment, who are considered to dominate the supply chain; of these, Chinese traders are the most favourable as they provide the cheapest supplies.

Mercury is readily available throughout the country, especially in towns and settlements close to the mining activities. It is sold in shops selling mining equipment, pharmacies, and by gold buyers and custom millers. It is alleged that mercury is sold in certain pharmacies situated within ASGM areas, particularly in the town of Kadoma.

Mercury pricing

In the first round of consultations (June 2018), the price of mercury was quoted as ranging from USD12l.0/kg to USD 160/kg, with smaller portions (30-50g) selling for roughly USD 10. In the course of subsequent field visits, however, a kilo was reported to cost between USD 70 and USD 110, and 30-50 g portions priced as low as USD 6-15. Mercury from China, claimed by some to be of comparatively low quality, was previously reported to cost between USD 120 and 130/kg, and more recently, USD 70/kg in some areas. Prices higher that USD 300/kg has been noted for the period 2010 to 2011

F2.7 ECONOMIC ASPECTS IN ASGM

F2.7.1 INTRODUCTION

The gold mining sector in Zimbabwe is divided into large-scale gold mining (LSGM) and artisanal and small-scale gold mining (ASGM). The ASGM sector is largely informal, unregulated, unregistered, unlicensed, and generally associated with limited degree of mechanization (Pact, 2017; Mujere and Isidro, 2016). The sector has generally been growing over the past 20 years and remains a significant contributor to economic growth and development in developing countries (Barreto, 2011). For instance, the International Labour Organization (ILO) estimated that about 10 million people were employed and benefit directly from ASGM activities in Southern Africa (ILO, 1999). Zimbabwe's ASGM sector has been rising in prominence since the 1990s as a result of the deteriorating economy, characterized by hyperinflation and rising unemployment rates (Pact, 2017; Metcalf, 2008). The sector produces about 1,500 kilograms of gold a year, which is roughly 10% of the country's total gold output and an approximate value of US $63.3 million (Mujere and Isidro, 2016). Pact (2015) estimates that the ASGM sector has directly created 35,000 formal jobs and an estimated 500,000 informal ones, which is approximately 7% of Zimbabwe's labour force.

Over 50% of the people involved in the sector are women and children (Mudyazhezha and Kanhukamwe, 2014). In contrast, LSGM is estimated to directly contribute around 11,000 jobs, representing just 0.1% of the labour force (Zeparu, 2016). Indirectly, the ASGM sector benefits local micro-economies through multiplier effects such as local procurement of tools and equipment, generating stocks of capital, development of basic socioeconomic infrastructure and services, as well as creating local demand for other consumables (Pact, 2017; Mujere and Isidro, 2016). Furthermore, while ASGM has largely been regarded as a competitor and disincentive for agricultural production, capital generated from mining activities can be reinvested through purchase of farming implements and livestock to compliment farming activities (Pact, 2015; Mungoni, 2008; Metcalf and Spiegel, 2007). Overall, Mujere and Isidro (2016) estimate that about 2 million people in Zimbabwe are directly or indirectly affected by ASGM through ancillary services and secondary economic activities.

F2.7.2 METHODOLOGY

Refer to section **F2.1.2**

F2.7.3 FINDINGS

The team visited a total of 33 sites in Mashonaland West Province, conducting interviews at both extraction and processing sites. The general observation in this Province was that those who are into ASGM activities basically do it on a full-time basis, with limited access to other income-generating activities to sustain their livelihoods. Generally, the miners operate mostly on 50-50% revenue distribution with the Pit Owners, after expenses are accounted for. However, some sites reported that miners are on a fixed monthly salary within the range of $182-$270 per month. The miners work 6 days per work with an average of 12 working hours per shift. The miners highlighted the socio-economic significance of ASGM activities to local development, rural livelihoods and generation of household incomes.

A number of interviewed miners reported that they were able to build houses, purchase cars, send children to school and provide food for their families. ASGM has been a critical source of employment especially at a time when job prospects are limited due to the general economic situation obtaining in the country. The miners also noted that their standards of living have generally improved, and that ASGM activities have stimulated a hive of economic activities in the rural communities. Some miners in Chegutu indicated that they were able to invest the incomes from mining activities through starting up small business to sustain their families. An interesting case is Index Mine in Makonde district. A total of 15 miners operate on the site, on equal revenue sharing basis. The miners reported that they occasionally donate to orphans and have also contributed to the building of a new bridge in the area.

An almost similar trend was observed in the other Provinces visited. In Mashonaland Central, the team visited a total of 25 sites in Mazowe, Mt Darwin and Shamva Districts. ASGM continues to be an important livelihood source for the miners. Some miners interviewed reported that they used mining proceeds to sink boreholes for improved access to safe water supplies for their homesteads. It was also observed that ASGM was also an integrated economic system to compliment agriculture, as supplementary

incomes generated from ASGM activities were used to support agricultural activities. For example, Nyasha, the mine manager at Kanando Mine in Mazowe District, indicated that miners were able to buy farming implements and fertilizers from the incomes generated through ASGM activities. Mining and ASGM activities in general were regarded as the major driver of development in Concession area. The miners on fixed salary earn an average of $200-$260 per month. In Midlands Province, however, most of the miners indicated that their monthly salaries were in line with the National Employment Council (NEC) rates. However, the actual figures varied from one site to another. The highest observed was at Knights Mine in Shurugwi where it was reported that the monthly salaries range from $150 to $600 per month. Miners were able to purchase residential stands, buy livestock and pay school fees to support their children's education. Further contributions of ASGM to community development are observed at Maligreen 31 Mine in Kwekwe, a site that combines own milling and mining. It was reported that they purchased a pump to take water from underground to give the community for irrigation, on top of sponsoring netball sporting events and supporting two orphans.

F2.7.4 SUMMARY AND CONCLUSIONS

ASGM continues to make significant contributions in low-income communities. The majority of the miners are driven by poverty and the general lack of employment opportunities in the country, following the shutdown of large-scale mines and the continued layoff of public sector workers with the worsening macroeconomic situation. Throughout the visited sites, it was evident that mining will continue to be an important means of survival and a catalyst for small business growth in the local communities. There is, however, scope for exploring cost-effective and efficient methods of extraction and processing, probably through appropriate mechanization options for the small-scale miners. This would reduce the overall costs of production and boost net returns from mining activities. Mechanism to foster synergies between the mining sector and small to medium sized enterprises can further strengthen the sustainability of ASGM activities as a positive coping strategy for rural households. Furthermore, policies that create incentives for selling gold through the formal markets are likely to generate more positive multiplier effects and macroeconomic level.

F2.8 DEMOGRAPHIC AND SOCIAL INFORMATION

F2.8.1 INTRODUCTION

The significance of the ASGM sector in the socio-economic development of developing countries is quickly becoming recognized. While the ASGM sector has remained an important source of livelihoods in rural communities, it has also been associated with unwanted social, environmental and human health challenges. There are social concerns over the escalating cases of child labour, poor occupational health and general lack of social security (PACT, 2017). There are also concerns that ASGM activities create disincentives for schooling. For example, Metcalf (2008) observed that children's participation in mining activities often lead to significant absenteeism from school, especially during episodes of 'gold rush'.

Generally, ASGM activities in Africa as associated with steep social costs such as unsafe and economically unstable work conditions, impacts on the health (diseases, accidents), precarious life conditions, complex dependent relationships, use of child labour, violation of the rights of the communities including indigenous communities, change in ethical values and its consequences for the social fabric, as well as the general absence of reliable social security (Baretto, 2011). Direct injuries and deaths also occur in ASGM activities as a result of 'turf wars', shaft collapses and exposures to hazardous chemicals (Mawowa, 2013; Metcalf, 2018). For instance, it was reported that in the Mzingwane District more than 20 people are injured or killed every year as a result of collapse of sidewalls and hanging walls due to lack of proper underground support systems (Dreschler, 2001).

F2.8.2 METHODOLOGY

Refer to section **F2.1.2**

F2.8.3 FINDINGS

Throughout the sites visited, the team found that the key operations were dominated by male miners, probably due to the physical demands of the extraction processes. It was observed that males go into the shafts to extract ore, while their colleagues would pull them out through ropes. Almost all of the interviewed miners said those kinds of tasks were not suitable for women and therefore they wouldn't let them get involved in

activities deemed dangerous. However, it was noted that women still play complimentary roles such as cooking, office work and generally providing catering services. At more formalised mines such as Pin 3 Mine in Shurugwi, Midlands Province, women are employed as security guards on the mine premises, while others do office work. At Evaco East Mine in Insiza, Matabeleland North, it was reported that women are responsible for involved in testing cyanide on cynidation tanks.

In the Midlands Province, the team observed that women were mostly involved in panning, which relatively requires less labour but, unfortunately, involves direct contact with mercury. In many of the ASGM sites visited, women tend to perform the most toxic jobs in as far as mercury use is concerned. Their principal role involves panning, locally known as "serengeto", whereby mercury is poured in small dishes with alluvial. Throughout the sites visited, this process was done with bare hands and no protective gloves were used. The women were evidently oblivious of the human health risk of mercury contamination and poisoning. At this level of engagement, women are generally not involved in decision making concerning the mining activities. They are just contracted to do the panning and are paid the agreed rates.



Plate 9.1 *Women involved in the "serengeto" (panning) at Olympia 18 Mine, Shurugwi, Midlands Province. They are paid $4 per dish, and they average about 15 dishes per day, meaning that they each earn roughly $60 per day on a good day.*

In Mashonaland West Province, the team witnessed a notable number of women who actually owned mining pits. A notable case is Miriam, who owns mining pits at Etna Mining Site in Kadoma. She has employees who do the extraction for her and revenues are shared on a 50-50 percent basis after expenses are accounted for. It was also noted in Mashonaland Central Province that women would either own mining claims or sponsor mining activities. At Pangani 10 Mine in Insiza, Matabeleland North, a woman was hired as involved as the director of the company involved in implementing production strategies. An interesting observation throughout the sites was the limited participation of children, particularly those of school-going age, in the mining activities. The miners reported that they would not allow children to be involved in the mining activities, unless it is limited to basic chores like fetching water. Another interesting observation was at Nakeru Mine in Mashonaland Central, where miners argued that women are generally not allowed at the site because of the belief that they bring bad luck, actually causing gold to disappear.

A variety of social and public health concerns associated with proliferation of ASGM activities were also noted during the filed visits. Notable health concerns were the general lack of protective equipment and exposure to mercury. A case of possible mercury poisoning was observed at Atlanta 3 Mine in Kwekwe, Midlands Province, where one miner came forward and reported that after about 8 years of mercury exposure, he was feeling its impacts on his sexual health, which was threatening to destroy his marriage. The miner experiences chest pains and has low sex drive, which he attributes to prolonged mercury exposure. At Horse Shoe Mine in Gwanda, Matabeleland North, there were also reported cases where miners complained of chest pains and difficulties in breathing, which the manager linked to mercury poisoning. Most of the mining sites visited generally lack proper sanitation facilities and amenities, which could potentially compound health hazards.

Social vices and behavioural challenges were also reported throughout the site visits. At Mashona Queen 2 in Mt Darwin, Mashonaland Central Province, it was reported that the prevalence of Sexually Transmitted Diseases (STIs) was an issue due to the rampant prostitution is the mining communities. The same problems were reported in most of the sites in the Midlands province. This is consistent with the general literature obtaining in

other published studies. Artisanal and small-scale gold mining tends to disrupt the traditional family structure, culminating into social vices such as prostitution and the high prevalence of sexually transmitted diseases. For instance, in Kadoma-Chakari, a hotspot of ASGM activities in the country, the HIV/AIDS prevalence is thought to be considerably higher than the national average (Metcalf, 2008).

F2.8.4 SUMMARY AND CONCLUSIONS

The ASGM activities are generally male-dominated, with males performing most of the tasks that require considerable strength. Women are mostly limited to complimentary activities such as panning. However, these kinds of activities carry with them high risks of mercury exposure and potential poisoning. The majority of the women were evidently ignorant of the dangers of mercury, which underscores the need for raising awareness amongst the women in ASGM sector. Although some women actually owned mining claims, the common problem was lack of financing, technical skills and unequal power relations. Interventions and policies to enhance women's equitable participation in the ASGM sector need to be carefully considered.

F2.9 HEALTH INFORMATION

F2.9.1 INTRODUCTION

Mercury-based artisanal and small-scale gold mining (ASGM) causes more mercury pollution than any other human activity (Lanze, 2014). In this practice, mercury metal is used to extract gold from ore as a stable amalgam. The amalgam is then heated to evaporate the mercury and isolate the gold. While mercury amalgamation has been used for thousands of years to mine gold and silver, it is unfortunately still a widespread technique in present-day artisanal gold mining (Chrevic, 2015). The health effects on the miners are dire, with inhaled mercury leading to neurological damage and other health issues. The communities near these mines are also affected due to mercury contamination of water and soil and subsequent accumulation in food staples (Towen, 2017). The risks to children are also substantial, with mercury emissions from ASGM resulting in both physical and mental disabilities and compromised development. The mercury exposure in the mining areas is mainly due to exposure with elemental mercury and not due to exposure with methyl mercury.

Exposure with elemental mercury could come from handling mercury with bare hands and burning of amalgam (Jeffry, 2016). In Zimbabwe the most common mercury exposure pathway in ASGM areas is during the cynadiation process (Dahlmann, 2004). During this process the tailings are processed in large tanks using cyanide leaching. The cyanide complexes and dissolves the residual gold. The gold is then recovered by the addition of activated carbon, which is, in turn, isolated and burned. As much as 20 g of gold can be isolated for every tonne of tailings(Boes, 2015).Because mercury is also solubilized through cyanide leaching, release of this water into the environment—either through direct release or by way of drainage from unsecured tailing ponds—is a significant source of mercury pollution (Boes, 2015).

The release of mercury from tailings into soil and water is a serious hazard to human health because it can compromise food safety and contaminate drinking water (Ralph, 2016). Mercury contaminated water used for irrigation also leads to contaminated food crops, such as maize (Dahlmann, 2004). Mercury poisoning is a tremendous burden to

human health, especially in ASGM communities (Reilly, 2015). Mercury gas, such as that encountered in ASGM amalgam processing, is readily absorbed in the lungs and then further transported to other organs (Heiss, 2005). Elemental mercury is able to cross membranes including the blood–brain barrier and the blood-placenta barrier, posing a threat to neurological function and foetal development, respectively (Tussel, 2008).

Acute mercury exposure (for instance to mercury vapour produced from heating mercury–gold amalgam) can lead to tremors, memory loss, respiratory distress and even death (Tussel,2008). Chronic exposure to mercury gas may lead to renal failure, tremors, movement disorders, and various psychosis and memory impairment. Inorganic mercury, formed through oxidation of mercury metal lost during ASGM may contaminate water and also lead to kidney damage if consumed (Matip, 2017). Conversion of mercury pollution from ASGM into methyl mercury also poses a tremendous risk as this highly toxic form of mercury accumulates in food supplies, such as fish, crustaceans and mollusks (Matip, 2017). Consumption of methyl mercury is particularly harmful to the central nervous system, causing nerve and brain damage (Heis, 2005).

F2.9.2 METHODOLOGY

Refer to section **F2.1.2**

F2.9.3 FINDINGS

In midlands province a total of 34 sites were visited, for all the visited sites a common practice was noted. In all the mining sites elemental mercury is used to obtain a mercury-gold alloy called an “amalgam” (roughly equal parts mercury and gold). There are two main methods used in ASGM for amalgamation: whole ore amalgamation and concentrate amalgamation. In most sites visited the mostly used method of amalgamation was whole ore amalgamation, only except only for Kwekwe yellow snake where they use concentrate amalgamation. With whole ore amalgamation method elemental mercury is added with little prior comminution and concentration. Large quantities of mercury are often used (3-50 units per unit of gold recovered) and most is released as waste into the mine tailings because of the resulting inefficiency of this process. The whole ore amalgamation was the most commonly practised method in all the four provinces that were visited.

Most of mine workers to all the visited sites especially in Mashonaland West they perceived mercury as a harmless, odourless liquid that they can handle in whatever way they can without fear of any hazard from the chemical. Mr Chitsa of Gumbo mining site in Kadoma even articulated that he has used mercury for more than 5 years without any health problems associated with the use of the chemical. Most of the mine workers are highly exposed to mercury during burning of the amalgam, most of the of mine workers prefer to do open burning since they claim that using retorts requires a lot of firewood and takes long to heat the amalgam. With trust that has been gained by mine workers towards mercury which they refer to as the harmless liquid they even go to the extent of mixing mercury with the concentrate using bare hands. This case was observed at Olympia 8 mine in Shurugwi where women were mixing mercury with the concentrate as shown in Plate 11.2.



Plate 11.1 *Shows Kwekwe Misi mining site where they admitted to use whole ore amalgamation for maximum gold recovery.*



Plate 11.2 *Women mixing mercury and ore concentrate without gloves.*

In all mining sites that were visited in all four provinces, there was very poor sanitation. Most of the mining workers sleep in tents. Within the compounds were no toilets or bathing showers, so all the people in the area has to use the bush as a toilet. Many mining sites are very far from the hospital facility, the closest distance that was recorded from mining site to Hospital was 2km which was long distance considering poor road status within the mining area. Most of the mining sites did not have emergency health response service in case of any accident.



Plate 11.3 *Show a tent for mine worker at Horse shoe mine in Insiza District in Matabeleland North*

F2.9.4 SUMMARY AND CONCLUSIONS

Generally all artisanal small scale gold mining community have very limited access to health facility and information. ASGM community plays a critical role in improving the economy of the country. There is therefore a need to improve basic infrastructure within the mining community and to educate them on the dangers associated with mercury use and handling. The occupational related health risk of mining should be assessed in more detail (accidents, drinking water quality, HIV / AIDS, other sexually transmitted diseases, malaria, tuberculosis). It was recommended that: (1) the exposure to mercury for the miners and the community has to be drastically decreased. Proper mining techniques to reduce the burden of accidents and mercury exposure are essentially needed; (2) small-scale miners need all possible support to introduce cleaner and safer gold mining and extraction technologies. The exposure with mercury is avoidable with such simple technology as retorts; (3) technical solutions need to go hand in hand with awareness raising campaigns. To improve the social, health and environmental situation of artisanal small-scale gold miners an alliance of local, regional, governmental and intergovernmental bodies is needed; (4) cooperation between health, mining and environmental sectors is needed on local, regional, national and intergovernmental level.

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