Verification and Capacity Building Consultancy Field Report

Prepared for: El Dorado Project, Conservation International- Guyana

May 2022

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Preamble

Guyana adopted the Minamata Convention on Mercury in 2013 and has established that “artisanal and small-scale gold mining and processing in its territory is more than insignificant”, in accordance with Article 7 of the Convention. Guyana completed development of National Action Plan and developed relevant strategies. The El Dorado Project is part of the GEF-funded planetGOLD program to assist Guyana to meet its commitment under the Minamata Convention. It involves business enterprises with a profit motive for leading the shift in the development of a mercury-free ASGM supply chain and downstream El Dorado Gold branded jewelry.

This Report is prepared in accordance with the Terms of Reference for the Consultancy Agreement between Conservation International Foundation (Guyana) Inc. and Patience Singo Service Agreement Number: 6008030. This Field Report presents findings and recommendations based on observations and stakeholder inputs during the field trip to Guyana from 16th – 31st May 2022.
Acronyms

AMP  Artisanal Mining Producer
ASGM  Artisanal and Small-Scale Gold Mining
ASM  Artisanal-Small Scale Miner
ARM  Alliance for Responsible Mining
BGR  Bundesanstalt für Geowissenschaften und Rohstoffe / [Federal Institute for Geosciences and Natural Resources]
CAHRA  Conflict-Affected and High Risky Area
CBRMT  Capacity Building for Responsible Mineral trades Project
CC  Concentration Criteria, a measure of the difference in density between value and waste minerals
CEEC  Centre d’expertise et d’évaluation et de certification
CI  Conservation International
CoC  Chain of Custody
Con  Concentrate
CSF  Corey Shape Factor, measures how flat a particle is
CRAFT  Code of Risk-mitigation for ASM engaging in Formal Trade
DD  Due Diligence
DRC  Democratic Republic of Congo
DMCC  Dubai Multi Commodities Centre Authority
EITI  Extractive Industry Transparency Initiative

EPA  Environmental Protection Agency
EPRM  European Partnership for Responsible Minerals
ESG  Environment Social Governance
GEF  Global Environment Facility
G Force  Gravitational Forces equivalence generated by rotating centrifugal concentrators
GGB  Guyana Gold Board
GGDMA  Guyana Gold and Diamond Miners Association
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<tr>
<th>Acronym</th>
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<tr>
<td>GGMC</td>
<td>Guyana Geology and Mines Commission</td>
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<td>Guyana Geology and Mines Commission Environmental Division</td>
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<td>GGMC MPU</td>
<td>Guyana Geology and Mines Commission Mineral Processing Unit</td>
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<td>GoG</td>
<td>Government of Guyana</td>
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<td>GPS</td>
<td>Global Positioning System</td>
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<td>GRG</td>
<td>Gravity recoverable gold, a lab testing procedure for predicting gold recoverable</td>
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<td>GWMO</td>
<td>Guyana Women Miners Organisation</td>
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<td>Guyana Dollars</td>
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<td>HSE</td>
<td>Hygiene security Environment</td>
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<td>ID</td>
<td>Identification</td>
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<td>International Institute for Environment and Development</td>
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<td>ILO</td>
<td>International Labour Organisation</td>
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<td>ITOA</td>
<td>Initiative pour la traçabilité de l’or de production Artisanal</td>
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<td>Knelson MD3</td>
<td>Lab Scale Knelson Concentrator</td>
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<td>Know Your Customer</td>
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<td>LBMA</td>
<td>London Billions Market Association</td>
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<td>London Metal Exchange</td>
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<td>Large scale Mining</td>
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<td>MD</td>
<td>Mining District</td>
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<td>ME</td>
<td>Mining Entity</td>
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<td>Mining Medium Scale</td>
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<td>Memorandum of Understanding</td>
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<td>National Action Plan</td>
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<td>Non-Governmental Organisation</td>
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<td>OECD</td>
<td>Organisation for Economic Cooperation and Development</td>
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<td>OECD Due Diligence Guideline</td>
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1. Introduction

Guyana’s ASGM sector which has existed for over ten decades is formalised and supported by a legal framework unlike many other countries. This includes the use of various existing policies which are implemented through the Guyana Geology and Mines Commission as the regulatory body for the extractive industry. These very policies once actualised and enforced have the potential to improve the mining sector.

In Guyana, small and medium scale (SMS) gold mining accounts for over seventy percent of the gold produced by the sector, and as the primary consumers of mercury are responsible for 94% of Hg emissions (Ministry of Natural Resources, 2017). However, as the sector is a key player in Guyana’s economy for decades, it is imperative that the livelihood of the miners and all employed within the industry remain protected while the country moves towards mining in an environmentally responsible manner. To achieve this, the industry must be examined, and recommendations made in a holistic manner which includes education and awareness, technical assistance, access to finance and efficient mining methods or technologies, occupational safety and health, opportunities to diversify, the economic impact, and the social impact of the sector, among others.

The El Dorado project has therefore adopted an all-inclusive approach which fosters the involvement of all key stakeholders and players such as the miners, traders and dealers, the Guyana Gold Board, Guyana Geology and Mines Commission, and the jewellers, the mining organisations, and the indigenous communities. This is necessary to ensure that all the following components can be explored and developed:

1. Identification and trials of Hg free technologies appropriate for Guyana’s ASGM sector by demonstration of a circuit which shows the possibilities of Hg free while establishing the possibilities and opportunities for technology transfer
2. Mechanisms for financing capital
3. Establishing markets for branded Hg free gold from Guyana by identifying and improving the chain of custody process, and a verification mechanism for Hg free gold
4. Monitoring and evaluation
5. Development of communication materials

Research proves that the miners and key stakeholders of the extractive sector are propelled by business gain, and as such, the miners will consider and conform to what makes sense to them from a business perspective.

The El Dorado Gold Verification consultancy and intervention focuses on the various aspects and stages of Hg free gold production such as:

1. Mineral processing
2. Mining standards
3. Chain of custody, and
4. El Dorado Branding and Marketing

The objective is to ensure that the SMS miners can envision and eventually realise operating with higher productivity and recovery rates while meeting social and environmental safeguards, and actively decreasing mercury emissions and pollution.
For the project objectives to be met realistically, it is imperative that the stakeholders and players within the SMS can identify opportunities to grow, improve and benefit while the sector transitions to mercury-free mining.

1.1 Background

Under the consultancy a field visit was undertaken by the consultants. The purpose of the field visit was to understand the context, contextualise the consultancy on El Dorado Gold Verification and capacity building, and develop a road map on mineral processing, responsible mining standards, chain of custody, and El Dorado Branding and Marketing. The expected activities of the field trip included:

- Stakeholder engagements and consultations
- Review mineral processing process flowsheet
- Assessment of gold circuits and site observations; rehabilitation practices
- Demonstration of mercury free technology
- Mine standard baseline assessment
- Supply chain and mine practice risk assessment
- Understanding the structure of the supply chain and the dynamics of the chain of custody
- Initial training to stakeholders at mine level

Field work was conducted in Georgetown, Mahdia and Bartica as shown below
The field mission was conducted from 16 to 31 May 2022 by a team of four consultants focusing on mercury-free technology, responsible mining standards, the chain of custody, and branding. Field trip activities focused on understanding the specifics of the Guyanese mining context to define a pathway for the Guyanese SMS gold sector to produce verifiable El Dorado Gold. The majority of the actors including mining operators, indigenous mining communities, traders, GGB, and jewellers as well as the institutions responsible for the governance of the mining sector, GGMC, were consulted. The consultations also included actors with an impact on the supply chain, such as the mining organisations (GGDMA) and the environmental protection agency (EPA). Demonstrations, interviews, focus group discussions, observations and site assessments were conducted during the field trip. The details of the field trip are presented in Annexes 1 and 4.

Findings

2.1 Mineral Processing Summary: Meetings, activities and key observations

The mineral processing segment of the Consultancy targeted increasing gold processing efficiency and advancing mercury-free technology adoption as a mechanism for capacity building and supporting stakeholders to progress achieving mercury free gold that can be branded with access to local, regional and international markets. In order to achieve this objective, we focused on identifying the main challenges for mercury free technology adoption by information gathering through interactions with miners, GGMC officials, equipment suppliers and gold traders. Based on the interviews, it was clear that the challenges for adoption of mercury free technologies included high equipment cost and process bottlenecks (technology viewed as either slow or throughput limited). In order to clarify the problem, we focused assessment on the Mahdia Demonstration site to distinguish Mercury and Mercury Free Technology.

One of the main observations from the field visit was clarification of the main distinction between mercury and mercury free technologies. The main distinction for the current flowsheet is the use of a gold cube and shaking table to clean the concentrate (black sands) rather than using amalgamation. The flowsheets are shown below in Figure 2.1 for comparison. Figure 2.1a shows the mercury technology whilst Figure 2.1b shows the mercury free flowsheet.

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1 glsc.gov.gy

Mercury flowsheet (Figure 2.1a) consists of gold concentration using a sluice box followed by concentrated cleaning using amalgamation (addition of mercury to capture the gold), once the gold is captured using mercury, the amalgamated gold is separated from the rest of the solids. Mercury is then recovered from the amalgam by heating in a retort to form sponge gold. The last step is smelting of the sponge gold to produce a gold doré. Figure 2.1b, which shows the simplified mercury free technology flowsheet consists of gold concentration using a sluice box and instead of amalgamation concentrate cleaning is achieved by using a gold cube and a shaking table to produce a clean gold concentrate (with sand rejected to the waste), the concentrate is then smelted to produce a gold doré using appropriate fluxes.

Simplifying the flowsheet this way allows for comparison to be made on mercury vs. mercury free technologies without incorporating the recovery improvement segments of the flowsheet. This approach helps to address the equipment cost and throughput issues. Miners adopting mercury free technology would need to replace amalgamation with a gold cube and shaking table for concentrate cleaning. One advantage of using the shaking table over other technology is the ability of the miner to see the gold during separation (see Figure 2.2 below), which can help address the “trust” issues when operating a centralised concentrate cleaning centre. This significantly reduces the required capital investment for transitioning to mercury free technology. For smaller operators with limited capital, transitioning to mercury free would require use of either the Gold Cube and or the Warrior with better matting or panning. Two follow up issues to be addressed for the Simplified Mercury Free Flowsheet are recovery and time taken to process the black sands (mostly smelting time). Unlike amalgamated gold which can easily be converted to sponge gold by mercury removal though heating, the product from the shaking table needs to be smelted to remove the impurities from the gold. This process

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2 The term gold doré is an embellishment of the French “doré” which literally translates as golden, gilt or gilded. Gold doré bars commonly come from two sources; mines or reclamation scrap. Mines almost never excavate pure gold ore. Most ores contain a mixture of gold and other useful base and/or precious metals. www.bullionbypost.co.uk/index/gold/gold-dore/
requires the right type of flux and a good heat source for smelting. The presence of residual sand in the concentrate makes the smelting process more challenging and longer. Selection of a suitable heat source and flux will help resolve this challenge.

Figure 2.2: Shaking Table gold separation

The rest of the flowsheet, including: the crusher, Trommel screen, Gold Kachas and Mastas are aimed at improving recovery. Ideally, a cost benefit analysis is required to justify the increased capital expenditure compared with the conventional mercury flowsheet. Preliminary analysis of the performance of the sluice box only vs. the extended flowsheet (including crusher, Trommel, Gold Kachas, Mastas) showed that recovery more than doubles with the extended flowsheet. Miners would require training on basic economics including the benefits of increasing recovery vs. throughput to help justify an investment in additional equipment.

Figure 2.3 below shows the main process flowsheet at the Mahdia Demo site indicating the Mercury Free components vs. recovery improvement components of the flowsheet. The flowsheet consists of the conventional Small-scale gold flowsheet consisting of the slurry preparation process (ore, water source, dredge and sluice box) followed by the Recovery improvement segment of the flowsheet (Trommel screen, Crusher, Gold Kachas and Gold Mastas) and the mercury free segment of the flowsheet (shaking table). It is worth noting that whilst the recovery improvement segment of the flowsheet is not critical for mercury transition, the inclusion of this segment is required for improving recovery. The characterization (both size by assay and GRG) tests indicate the recovery improvement segment is critical for maximising gold recovery from the ore.

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3 https://peacockesimpson.com/portfolio/gravity/

The initial focus at the Mahdia Demonstration site was to help with process Debottlenecking. Discussions with the technical team on site regarding the Trommel screen bottleneck on plant throughput indicated that a reasonable solution to the bottleneck had been identified which included upsizing the Trommel feed pipe. Based on initial assessment of the Trommel screen and discussions with Technical person on site it is evident that minor debottlenecking can be achieved by increasing the 4” feed pipe sections to 6”. Implementation of the solution was pending authorization from GGMC. It is however understood that this will result in a temporal solution to the capacity limitation. Since miners are interested in higher throughput, it is necessary to evaluate alternative configurations to the flowsheet. Suggestions include but are not limited to:

- Complete bypass of the Trommel screen, such that sluice box tails goes straight to the crusher as a slurry and the crushed product directly feeds the Gold Kacha concentrators. Depending on the debris content of the stream it may be necessary to add a wet screening step before the Gold Kacha concentrators.
- Alternatively, a screen can be added upstream of the sluice box, rejecting the coarse solids and debris prior to feeding the sluice box.

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• Evaluation of the potential for early rejection of large lumps in the process in order to unlock the Trommel Screen capacity including the use of a grizzly screen upstream of the sluice box is currently ongoing. The characterization of Trommel Screen rejects to determine gold content found the rejects were barren. For the currently analysed ore, there is therefore no need for crushing the Trommel rejects to increase recovery, this fraction can therefore be rejected earlier in the process as waste. It is to be noted that this early rejection step may not be practical due to the presence of clays which potentially are gold bearing and would need scrubbing. If the clay lumps are found to be gold bearing, oversizing the Trommel screen maybe the only cost-efficient option for small scale mining operations.

The second objective was to complete a Process Audit which included developing and collecting process data on each process stream and performing data analysis aimed at assessing process performance and evaluating equipment utilisation and identification of improvement opportunities for both the Mahdia and Puruni Demonstration sites. It is worth noting that no analysis was done for the Puruni Demonstration site due to challenges with the site beyond the scope of this consultancy. For the Mahdia Demonstration site, size by assay ore characterization was completed by the Sample Collection team and the data was provided to us for review, the data analysis is still under review and findings will be provided in a separate report. High level analysis showed gold is in the fine size fraction between (74-149 μm). High level evaluation of performance of the flowsheet showed good recovery but a more thorough assessment is still to be completed. A unique opportunity exists at the Mahdia Demo site to complete an apple to apple comparison of Mercury free vs. Amalgamation technologies. Operating experience for the mercury free flowsheet is being utilised to evaluate performance of the technology. A qualitative comparison of the mercury free vs. amalgamation sluice box concentrate cleaning technologies showed comparable performance for the two technologies, showing no gold losses from the table recoverable by amalgamation and no gold loss from amalgamation recoverable by a combination of gold cube + shaking table. Follow up testing including assaying of the tailings from the cleaning processes is recommended as a follow up so as to generate quantitative data. A mass balance worksheet has been generated by CI Technical Officer and will be shared with us once data from the sampling program has been received. This analysis will augment existing data for process auditing.

The next focus was evaluation of the suitability of processing approach used at the Demonstration site. A qualitative assessment of the flowsheet is still pending receiving the results from the sampling effort. It is worth noting the limitations of the current data based on a single sample with detectable gold by particle size. Ideally more samples are required to determine the gold particle size distribution than just depending on 1 sample.
Figure 2.4: Graph showing suitable Gravity recovery technologies for Gold based on Particle size

The current results from gold assay by particle size shows gold is in the fine particle size fraction (between 74 – 149 microns), which would benefit from centrifugal concentration (Gold Kachas) in addition to just using a sluice box. Figure 2.4 plots the obtained particle size range observed in a sample collected from the Demo site (in green) on the chart that shows the capability of each concentrator to recover gold by particle size. The results show only partial recovery of the gold by sluices (<50%), whilst centrifugal concentrators can fully recover the proportion above 105 microns (which accounts to 70% of the gold) and partially recover the fraction between 74 - 105 microns. It is worth noting that the Demo site has observed more coarser gold particle sizes with depth and follow up sampling with depth and particle size assaying is recommended to better inform suitable concentration technologies.

The standard approach for determining gold recovery by gravity and specifically by centrifugal concentration is using the Gravity Recoverable Gold (GRG) approach developed by the late Dr. André Laplante to assess the recoverable gold/ gold amenable to gravity concentration (liberated or unliberated) using a laboratory centrifuge. The procedure is shown below in Figure 2.5 and it consists of sequential grinding and processing steps for a 30 to 150 kg sample (depending on the grade) in a 3 in 1, laboratory Knelson centrifuge. This procedure can be modified to study gravity recovery from alluvial ores which do not require grinding. The

5 https://minerals.seprosystems.com/knowledge/
https://www.flsmidth.com/en-gb/products/knelson-semi-continuous-gravity-concentrator?gclid=CjwKCAjwu_mSBhAYEiwA5BBmfy2Y_0hJNbHMkWskc4tShurR9g8ZmvXyk1ENEbakA7BQfa1WI0GxBoC9eYQAvD_BwE#key-benefits

results can also be used to select the combination of gold recovery technologies and guide the selection of cycle times for different ore types using centrifugal concentration.

![Diagram of Gravity Recovery Gold Procedure](image)

**Figure 2.5**: Gravity Recoverable Gold (GRG) procedure for centrifugal concentrator application

Gravity Recoverable Gold or amenability testing was completed with the help of the GGMC. The results show that most (77 – 94%) of the gold is amenable to gravity concentration. There was therefore no need to establish a framework/test protocol for evaluating amenability testing during the field visit since this service is already being offered for free to miners by the GGMC. Based on gold assay by particle size data in combination with the GRG results, it is evident that the Mercury free flowsheet at the Mahdia site should be capable of recovering most of the gold in the ore. There are however opportunities for improving the operation and performance of the flowsheet in order to address the challenges miners have for adopting mercury free technologies.

We assisted the operators to complete process troubleshooting at the Mahdia site, the main challenge was with setting the shaking table to be able to obtain a clean separation of gold from sand. We trained the operators to tune the process variables in order to get a good separation between gold and sand particles prior to the smelting stage. The table was tested on a real concentrate and good performance was observed. During the test, the table filter plugged and we showed the operators how to clean the filter. It may be necessary to have spare filters at site given the quality of waters used for processing.

It was also desirable to develop a framework for a mobile processing plant if feasible, leveraging globally available skid mounted options. The intention was to evaluate the potential for utilising a mobile processing plant to service multiple leases. Discussions with one of the miners suggested this is a potentially feasible option however there was concern for using a generator for the equipment (this may need further evaluation...
based on conversations with CI staff, there is already an existing skid mounted plant designed for the GGDMA project which is going to be tested. According to a media report by Villagevoicenews.com6. The project is jointly funded by the GGDMA and the Government of Guyana and is aimed at deploying the Riven Mineral Recovery System also known as the “Maroker”. The report claims that the system is capable of achieving high recovery of fine gold, reduced physical footprint, and increased profit for the miner. It is recommended that CI obtain the flowsheet from GGDMA for reviewing to better evaluate what is feasible without duplicating the effort. A mobile flowsheet option can help address the equipment cost challenge through shared cost by miners or having it funded by agencies or gold traders and utilised by several miners.

2.1.1 Interview with Key Stakeholders

We had interviews with several stakeholders, this section will capture the main findings from interviews which were relevant to the Mineral processing section of the Consultancy. These include discussions with the GGMC and the equipment vendors. Based on the interview with the Mines and Mineral processing team at GGMC there is a lot of support available to miners through the commission including: technology qualification, training, ore characterization and amenability testing. These services are critical for enabling both efficient gold processing (increasing recovery) and advancing mercury free transitioning for miners. A key highlight is the Mining School initiative aimed at equipping miners which when fully leveraged can provide the basic training required for miners to help them process gold more efficiently and in a safe and more environmentally friendly manner. It was however not clear whether miners were aware of these available services, most of them offered for free by the Commission. More can be done to publicise these services to miners and educate them on how and when they can leverage these free services.

(a) Interviews with the GGMC

It is evident that the Commission has invested a lot to develop a framework for miners to mine more efficiently and in a more environmentally responsible manner, however the degree of adoption for these technologies by miners may still be in its infancy. One initiative that seems to have gained traction is embracing the more efficient Triple Deck Sluice Box for gold processing, the success can be attributed to support from the GGMC to both demonstrate improvement in recovery and assist in the design and the low-cost change (not requiring high capital investment). It is worth noting that this is not a step change from conventional practice but rather an incremental change, which may have helped to make it more palatable for miners. Steps have also been taken to significantly lower mercury emissions, eliminating whole ore amalgamation and use of amalgamation plates and limiting mercury use to only handling concentrates. Use of retorts by miners and proper mercury trapping systems by the gold traders is mandatory. However, discussions with miners showed that long retorting time was a major stumbling block for embracing retorting. This challenge is not only unique to the Guyana market, but has been reported in other jurisdictions. The main causes of long retorting time are the use of thick steel and inadequate heating. This has been resolved in other regions by using bellows to increase the heating temperature or using kerosene cooking stoves. Whilst the efficient use of retorting is a realistic pathway towards meeting the requirements of the Minamata Convention to reduce and eliminate where

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possible the use of mercury, it does not address the mercury free gold agenda, which is the main objective of this consultancy.

Since shaking table technology is the key for transitioning to mercury free gold and it is a significant investment (~$12000 USD) for the miners, it was observed that cost can still be a major hindrance for adoption. Unfortunately, there are no local options for shaking tables in Guyana but discussions with the GGMC experts indicated the potential to develop local solutions based on the current success for developing padding tables for rice. Potential solution to the cost challenge includes the use of a centralised Concentrate (black sand) processing facility, utilised by multiple miners and owned by either the GGB or Gold Traders. The concept of a Custom Concentrate processing facility for mercury free gold requires further exploration to verify feasibility. One of the challenges highlighted by miners for this approach was the issue of security at the custom processing site.

The other relevant meeting with the GGMC was with the Environmental team. Consultation with the Environmental Department of GGMC regarding funding and resourcing of the Reclamation effort was the main target. We also needed to understand the Commission’s expectations for reclamation of mine sites. Based on the interview Mine reclamation is an expectation based on the Code of Practice for Environmental Management and miners are expected to mine with reclamation in mind. The Commission uses a 3-prong approach to ensuring compliance to the Environmental code including: Education, Encouragement and Enforcement. And the emphasis has been on educating the miners. The commission has generated multiple educational tools including posters, pamphlets, a handbook and a checklist for miners outlining the environmental and reclamation expectations. A key highlight is the Reclamation and Closure guidance handbook, which is an easy to read and use summary of the code. Despite all the efforts to educate miners on their reclamation responsibilities there is minimal reclamation effort by small scale miners, in fact besides the 6 Demonstration Reclamation sites run by the commission there is no other reported site reclaimed by small scale miners. This is attributed to the small reclamation bond required compared to high reclamation costs.

A review of the reclamation expectations showed that the requirements were both reasonable and achievable by small scale miners. The simple steps required for miners include:

- Being aware of the regulations and code on mine closure and reclamation
- Preparing and submitting a Reclamation Plan to GGMC prior to commencing mining
- Paying an environmental and reclamation bond
- Storing topsoil separately to reapply after mining
- Practising progressive reclamation during life of mine – implementing plan ensuring physical and chemical stability of site
- Preparing final closure plan with GGMC and community input

Whilst these are all reasonable expectations, miners have an easy way out for just paying the $25000 GYD and walking away and they choose the easier way out. It was not clear from the discussion with GGMC whose responsibility it is to reclaim the land when miners walk away leaving the bond. There is generally consensus even among the miners that the bond is small compared to the reclamation effort. A clarification we obtained from the commission was that the miners were not expected to seed the reclaimed land as the land is expected to revegetate once the topsoil is returned.

(b) Interviews with Equipment Suppliers

We interviewed 2 leading equipment suppliers in Georgetown including Crown Mining Supplies and Johil Commercial. Crown Mining Suppliers did not have any mercury free technologies concentrators (centrifugal concentrator or shaking tables). They used to sell Gold Kachas but they took so long to sell. They are planning to stock the Brazilian ACOMAQUINAS centrifugal concentrators because they are cheaper. They cited several challenges for adopting mercury free technologies especially for small-scale miners. The main challenge being financing. They have no appetite for issuing payment plans for mercury technologies – cash payments are preferred as a form of payment.

Johil Commercial on the other hand mostly carried Brazilian equipment and they had a 5tph Brazilian ACOMAQUINAS centrifugal concentrator (~$ 9 000 USD). They indicated that the concentrator would be better suited for crushed and not dredged ore citing plugging challenges with high clays and organic debris. Same as Crown Mining Supplies, there was an appetite for issuing payment plans for mercury technologies – cash payments are preferred.

2.1.2 Successes, challenges, gaps and lessons learned

One of the greatest achievements for the project is successfully designing and operating a Mercury free plant which actually produces mercury free gold to the satisfaction of the miner operating the plant. The strong partnership with a miner who is willing to test new technology and take the risk is commendable. The process flowsheet in the Mahdia Demo site was designed to maximise gold recovery of gravity recoverable gold and when operated well it should be able to recover most or the gold recoverable by gravity concentration. This is a phenomenal achievement. A process survey conducted in March 2022 on the mercury flowsheet circuit showed overall recovery is >99% compared to 43% for just the sluice box only. The caveat for this result is this is just a single data point and more data needs to be collected to validate the finding.

Whilst the recovery results are good it is unfortunate that miners do not appreciate the value of higher recovery and are more interested in higher throughput. This challenge can be overcome by offering basic training in mining economics to help the miners appreciate the cost benefit for improving recovery performance. It was also observed that whilst the flowsheet shows best practices for maximising recovery, it does not address the miners’ questions regarding amalgamation vs mercury free gold. In fact, the plant seems to be an overkill as a demonstration for transitioning from amalgamation to mercury free gold processing. Instead of showcasing the great recovery benefit derived from the flowsheet, the throughput constraint imposed by the Trommel screen is an Achilles heel to progressing mercury free technology as it seems to confirm the notion that mercury free process is slow compared to Amalgamation. This has many implications to small scale mining operations, which are mostly manual, as it threatens manpower availability - workers tend to run away from mining operations not making enough gold to pay their salaries and news spread easily in the mining communities such that once a miner has a bad production reputation it may be difficult for them to ever find workers to work at their mine.

Secondly the main pushback from miners is that the equipment is capital intensive. Considering the additional equipment: Trommel screen, crusher, gold Kachas and shaking table, this is true and needs to be addressed. Based on these observations it is necessary to clarify the questions that need to be addressed (is it mercury free technology adoption or recovery or both) then simplify the solution (if the focus is on mercury free technology there is no need for a lot of equipment - the shaking table and a gold cube is all that is needed to
demonstrate to miners mercury free technology. CI should then focus efforts on addressing the questions the miners have and ensure they are addressed adequately in order to create buy-in for mercury free technology.

Having simplified what is indeed mercury free technology, the only challenge for adopting mercury free concentrate cleaning is the complexity of the smelting step when the concentrate has residual sand. When operating a shaking table to clean concentrate a trade-off between maximising recovery or concentrate grade has to be done. When the objective is to reject most sand, the challenge is ensuring there is no gold loss especially the fines fraction.

CI was interested to know whether they are using the correct process approach and if there is something that can be done differently. Our assessment during the field visit shows that due process was taken to design the plant and fundamental studies to understand performance of the plant have been undertaken including ore characterisation, particle size distribution of gold, gravity amenability testing of the ore, characterization and assaying of the tailing streams. Our observation is that the flowsheet needs to be simplified in order to help clarify the message and create buy-in for mercury free technology by miners.

2.1.3 Recommendations for immediate implementation

The following follow up tests are recommended to address the challenges stated in the section above. These tests are aimed at decoupling the recovery and mercury free aspects of the Mahdia Demo site flowsheet. Whilst conducting these tests, samples of the feed and sluice tailings should be collected at 6- or 12-hours intervals and assayed. Care should be taken to ensure the sample size collected is not only representative but also adequate to ensure statistically meaningful results are obtained. We will be happy to provide guidance on sample collection if required. Below is the proposed test plan:

Test 2.6(a) Run 6” dredge and process the concentrate using mercury free technology as shown in Figure 1a below

![Figure 2.6(a): Test set up for using mercury free technology on 6” dredge concentrates](image)

Test 2.6(b) Run the 4” dredge in parallel with the 6” (processing the same source material) and amalgamate the concentrate as shown in Figure 1b, the tailings can either be run through the gold cube and shaking table or assayed for gold.
Tests 2.3 a & b will address the challenges associated with recovery and throughput for mercury free technology. The objective is to prove that mercury free processing (gold cube + shaking table) is capable of handling 6” dredge concentrate without any production bottleneck. It will also verify that no gold is lost to the mercury free technology that would otherwise have been recoverable by amalgamation. Tests 2.4 a & b are for validating results from Tests 2.3.

**Test 2.7(a)** Run 4” dredge and process the concentrate using mercury free technology as shown in Figure 2.7 (a) below

**Figure 2.7(a):** Test set up for using mercury free technology on 4” dredge concentrates

Test 2.7(b) Run the 6” dredge in parallel with the 4” (processing the same source material) and amalgamate the concentrate as shown in Figure 1b, the tailings can either be run through the gold cube and shaking table or assayed for gold.

**Figure 2.7(b):** Test set up for using amalgamation on 4” dredge concentrates

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Figure 2.7(b): Test set up for using amalgamation on 4” dredge concentrates

These tests will assess if there are any throughput and recovery limitations associated with mercury free concentrate cleaning technologies. They are designed to address the cost and time for processing concentrate questions which were highlighted by miners regarding mercury free technologies. In addition, the tests will address the question whether there is any gold loss to tailings which is otherwise recoverable by amalgamation when using the gold cube and shaking table. Once the Mercury free segment of the flowsheet has been validated, the recovery aspect of the flowsheet can then be focused on. Going forward we will continue to support the site technical team to troubleshoot the process and complete data analysis for process auditing.

The following items outlines plans for the remainder of the consultancy:

- Review the reports submitted to us from the sampling program, complete data analysis and report on findings
- Support the Demo site team to test the suggested flowsheet configurations for mercury free, analysing the data and providing recommendations based on the results
- Assess Alternative Flowsheet configurations if feasible:
  - Test the current flowsheet after Trommel screen debottlenecking to assess the plant capacity
  - Test flowsheet without Trommel screen running the sluice box discharge through the crusher and directing the crusher product to the Gold Kachas
  - Assess the use of a screen/grizzly upstream of the sluice box - ideally a vibrating screen is preferable
  - Process whole feed through the crusher before feeding the sluice box and directing the sluice tailings to the Gold Kachas
  - Evaluate crusher plus centrifugal concentrator options (crusher to Gold Kachas or alternatively crusher to ACOMAQUINAS) bypassing the sluice box - this option may help eliminate re-handling of sluice box tailings in the current flowsheet, however if the crusher can be placed upstream of the sluice box, the preferred configuration would be directly feeding the crusher with slurry from the mine, crusher discharge goes to the sluice box and the tailings from the sluice feeding the centrifugal concentrator
  - Evaluate alternative (ACOMAQUINAS - with higher capacity and higher rotation speed) centrifugal concentrator Centrifugal concentrator on the 6” sluice box tailings without the Trommel screen

Mine Rehabilitation

- Sharing best practices on bench heights and management of waste during mining
- Ideas on replanting after land refilling
- Sharing frugal rehabilitation approaches.

2.1.4 Recommendations for medium term implementation

The following are the recommendations based on the field findings:

(a) Decoupling Mercury Free Technology from Recovery Improvement Technology

This appears to be a low hanging fruit for CI and the test proposed above will help address this issue. A comprehensive solution would include testing Mercury Free Technology and once satisfactory then couple it
with recovery improvement technologies and test the complete circuit (we already have the data for the complete circuit) but mercury free technology by itself has not yet been qualified. If cleaning the concentrate to completely eliminate sand using the shaking table is proved to be challenging, CI should consider investing in more efficient smelting equipment and supplies (Muffle furnace, crucibles and suitable flux).

(b) Debottlenecking the Recovery improvement flowsheet

The Trommel screen is a recognized bottleneck, the initial attempt (upsizing the feed pipe) to debottleneck it should be tested as discussed with the operations team. If it fails to address the problem the following should be tested:

- Elimination of the Trommel screen, complete bypass and just use the crusher to prepare feed for the Gold Kachas
- Moving the crusher upstream of the sluice box and directing the sluice box tailings to an appropriately sized centrifugal concentrator (may need to consider using the ACOMAQUINAS which has higher capacity than the Gold Kachas)
- Use an oversized Trommel screen
- Replace the Trommel screen by a screen upstream of the sluice box (ideally should use a vibrating screen, but a Grizzly screen can also be tested)

(c) Centralised Gold Concentrate Cleaning Centre

Based on the findings of the field visit there is potential for CI to assess the potential for establishing a Centralised Gold Concentrate Cleaning Centre (CGCCC). The facility will only house a Gold Cube and a more robust shaking table than the one currently used at the Demo site. Consideration should be made for using either a larger Gemini table, a James table or Wilfley table. Issues that need to be addressed include, establishing trust, scheduling use of the equipment and security against robbery for the miners. A suggestion was made by one of the Consultant to work with GGB to set up such a plant such that miners producing mercury free gold can either just sell their concentrate to the GGB or would be able to bring their concentrate to the GGB for processing (this may require further exploration). A similar approach is being implemented in Ghana where the government funded purchasing of mercury free equipment for use in community based mining schemes.

(d) Modular Relocatable plants

We recommend assessing the appetite of miners for adopting Modular relocatable plants. These plants present an opportunity to reduce the costs associated with efficient mercury free technologies by either having a centralised processing facility where miners can take their concentrate for processing or having a mobile plant which can be relocated between several miners. The modular plants mostly address increasing recovery performance and do not necessarily address the mercury free transitioning question, but when coupled with the Shaking table (mercury free concentrate cleaning) the result is an efficient mercury free plant with a potential for being more cost efficient. It is worth noting that Ghana is currently deploying a community mining scheme where the government funds purchasing of the mercury free technologies for use by the community and success of this scheme should be monitored by Guyana for potential adoption if it is successful.

There are many options of modular relocatable plants which can be leveraged, these include the Maroker plant, being evaluated by GGDMA, The Icon 150 (2 tph) modular plant shown below costs ~USD$30000, and the RG30
Wash plant shown in Figure 2.8. The Maroker uses a hydrocyclone for fines rejection and the product of the cyclone feeds a centrifugal concentrator, the Icon modular plant uses a vibrating screen to split feed into coarse fraction that goes to a sluice box and the fine fraction goes to the Icon separator whilst the RG30 Wash plant uses a scrubber to prepare feed for the Gold Kacha concentrator. These modular plant options can provide a cost-efficient solution addressing the recovery aspects of the process. Transitioning to mercury free will require addition of a shaking table to the flowsheet or using panning, Gold Cube/Konka or Warrior separator to clean the gold concentrate prior to smelting.

**Figure 2.8a**: Icon 2 tph Modular plant
**Figure 2.8b**: APT 3 tph RG30 Modular plant

Figure 2.8 shows some examples of modular relocatable plants for small scale gold processing worth considering. The Icon modular plant consists of a Grizzly screen, an Icon i150 concentrator and Gold Mastas whilst the APT modular plant consists of a Trommel screen and Gold Kacha concentrator.

### 2.2 Environment and Social Governance (ESG) Criteria.

The user centred approach which incorporated the miners and the key stakeholders (Annex 5 -Figure 1) was used to increase the likelihood of acceptance of responsible mining standards as illustrated below.

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7 [https://www.911metallurgist.com/equipment/i150-icon-concentrator/](https://www.911metallurgist.com/equipment/i150-icon-concentrator/)

8 [https://www.aptprocessing.com/miningnews/2018/05/06/on-a-small-scale-gold-mine-site-apt-rg30-3tph-scrubber-goldilox](https://www.aptprocessing.com/miningnews/2018/05/06/on-a-small-scale-gold-mine-site-apt-rg30-3tph-scrubber-goldilox)
Consultations on Environmental and Social Governance standards were conducted in Georgetown and Mahdia. Activities on ESG criteria involved interviews, informal discussions and focus group discussions as mentioned above. The objectives of the field trip included understanding the context, defining contextualised standards, conducting baseline risk assessment, conducting initial training and collaborating with relevant stakeholders as, Figure 2.9. Findings on ESG criteria are presented below.

2.2.1: Findings and key observations.
The PlanetGold site was located in a mining area outside Mahdia Township in Red Hole district, in Dickman Hill. The mercury-free pilot site was in Potato Mining District #2, Administrative Region #8. The figure below show location of region 8 in the administrative regions in Guyana.

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9 Singo (Forthcoming) Applying the user centred approach in ASGM
Mahdia is in region 8 which borders with Brazil and is one region away from Venezuela, Figure 2.10. The site was owned by a male concessionaire who was a medium scale miner. The mine site (Mine Entity (ME)) had seventeen employees, sixteen men and one woman. Findings on ESG criteria are given below.

**Observations and findings on ESG Strategy and the Guyanese context**

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10 Administrative Regions, Guyana

Demonstration Strategy

Planet-Gold Guyana applied a comparison of a mercury-free processing unit which was adjacent to a mercury-reduction unit for demonstration purposes. The mercury-free unit had mercury-free technology which was producing mercury-free gold as presented above and illustrated in Annex 2. The mercury reduction unit demonstrated the elimination of the worst practices of whole ore amalgamation and open amalgam burning through concentrate amalgamation and the use of a retort. There was a designated area, away from the camp accommodation or any residential area for amalgam burning for the mercury reduction unit. GGMC expressed that the Mining Regulations were being reviewed and amended to include the obligation for processing sites to own and a certified GGMC retort. Miners were required to use the GGMC certified retort. There was no regulation framework on elimination of mercury in SMS.

Consultations pointed to challenges with mercury-free technology and a significant reduction of mercury use (as presented below) in SMS in Guyana through concentrate amalgamation, and the use of the GGMC certified retort which confirms literature. According to the hierarchy of controls, an elimination strategy can be especially challenging for existing operations since elimination could require major changes or upgrades in equipment and existing procedures\textsuperscript{11}. In addition, the Minamata Convention on Mercury use incorporates reduction of mercury use through elimination of:

- whole ore amalgamation;
- open burning of amalgam or processed amalgam;
- burning of amalgam in residential areas;
- and Cyanide leaching of mercury containing tailings\textsuperscript{12}

The planetGold operation demonstrated mercury elimination. In addition there were ongoing initiatives on the reduction of mercury use in SMS. Consequently, the PlanetGold site adopted the demonstration strategy.

Perceptions on the PlanetGold Criteria

The ME understood the negative impacts of mercury to human health and the environment and expressed commitment to the elimination of mercury use in SMS. However, there was a general perception among the miners that mercury-free technology was slower, and more expensive. According to GGMC processing obstacles to mercury-free technology in SMS included lack of equipment, lack of finance, and the focus on volumes among the miners. The miners had a perception of high volume and more gold with no consideration on better recovery which was achieved by the mercury-free technology. GGMC processing pointed to the need for continual awareness raising on low adverse impacts on the environment and high recovery as miners focused more on earth-moving machines and high throughput. One miner argued that the existing mercury processing units in Guyana could be adapted into mercury-free-technology by eliminating whole amalgamation and replacing the final stage of mercury use with direct smelting with borax flux as shown in Annex 2.

\textsuperscript{11} The National Institute for Occupational Safety and Health (NIOSH). Hierarchy of Controls. 2015. \newline \url{https://www.cdc.gov/niosh/topics/hierarchy/}

\textsuperscript{12} Ibid

Interviewed miners appreciated the need to eliminate mercury despite the challenges, which is an opportunity for approaches such as the processing centres and mobile technology as indicated in the above section.

Social Responsibility

Consultations revealed no Corporate Social Responsibility Requirements for SMS. The pilot site was located in a designated mining area, with no interaction with communities. Consultations with the Campbelltown Toshao showed that there were no adverse social impacts on Indigenous Peoples from the ME mining activities. CI-Guyana had conducted a Rapid Assessment during project planning and no social impacts from mining activities from the ME were found. To fulfill the PlanetGold criteria the results of the rapid assessment should be documented as evidence of compliance to social responsibility requirements of the PlanetGold criteria. The ME should also develop a statement on social responsibility as explained further in the submitted baseline risk assessment report that has been submitted to CI-Guyana.

Environmental Responsibility and Land Reclamation

Concessionaires were expected to acquire environmental permits (involved payment of Reclamation bonds) from the GGMC, and the GGMC Environmental Division was responsible for making routine inspections on environmental issues. SMS were paying a rehabilitation bond of 25,000 (125 USD equivalent) Guyanese dollars. There was a perception among the SMS miners that rehabilitation was optional and could be neglected and transferred to GGMC because of the rehabilitation bond. Discussions with the GGMC revealed that rehabilitation was intended to be an ongoing process throughout the mining cycle and the miners had an active role to play in rehabilitation in addition to the rehabilitation bond. GGMC ED indicated that the regulations on land reclamation were being reviewed to improve compliance. GGMC ED was conducting a project on land reclamation which consisted of Education, Encouragement, and Enforcement. Furthermore, GGMC had established Rehabilitation Demonstration sites for education. Posters, pamphlets and talks on land reclamation in SSM had started from various organisations including GGMC ED. The ME had posters on land reclamation which were displayed on site; see Annex 3A. In addition, the ME was preserving the top soil for land reclamation; see Annex 3A. Consultations with GGMC ED, EPA, miners and CI project staff confirmed that miners were required to backfill and rehabilitate the top soil to allow the natural process of regeneration hence the relevance of the Frugal rehabilitation method which proved simple and applicable in Mongolia. The Frugal rehabilitation method constitutes backfilling of mining pits (technical rehabilitation), rehabilitation of top soil and biological rehabilitation. For the Guyanese context the Frugal Rehabilitation method could be contextualised to backfilling of mining pits and rehabilitation of the top soil which is followed by natural regeneration as discussed above. In addition, there is need for planning (by ME) and monitoring (GGME ED). The ME owned an excavator (the excavator is critical for back filling), had preserved the top soil and was committed to rehabilitation. In Guyana, Environmental assessment for SMS was conducted by GGMC through environmental checklist. No further assessments, such as Environmental Impact Assessments were required for SMS. The ME was using a closed recycling water system (an old mining pit) with no potential contamination.

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13Panorama Environmental rehabilitation: Learnings from Artisanal Miner

of sources of drinking water. Monitoring water quality for safe human consumption was therefore not a priority. The ME was harvesting, storing, and purifying rainwater for site consumption; see Annex 3A.

There was a need for safe management of mercury tailings since there was a mercury reduction unit adjacent to the mercury-free unit as presented above. In addition the ME was required to rehabilitate the land to a physically and chemically stable state. Unfilled shallow old mining pits which had the potential of storing stagnant water were found around the mine water source which could pose the risk of mosquito breeding areas. GGMC environment was committed to working with the ME together with GGMC processing to develop the environmental management plan and fulfill the environmental requirements of the planetGold criteria. GGMC processing requested for the document on the planetGold criteria to facilitate implementation of standards. The PlanetGold Criteria document was sent to CI- Guyana for sharing with GGMC processing. Interaction with animals such as the wild cats (the jaguars) and snakes was reported. Snakes such as the bushmaster were identified as a potential hazard and there were no known attacks from jaguars. Fencing of the mining area and consistent backfilling of used mining pits should therefore be considered to protect wildlife. Compliance to environmental requirements is further discussed in the submitted baseline risk assessment report that has been submitted to CI-Guyana.
Accidents and Injuries

The Occupational Safety and Health (OSH) Department Ministry of Labour, was responsible for accident investigations in the event of an accident. Training on OSH was conducted by the mining school. The challenges associated with training on OSH were high staff turnover and the migratory nature of SMS. The OSH department was responsible for routine inspections and there was reference to temporary mine closure by the OSH department as a penalty for non-compliance to safety regulations. Malaria, dengue and fever were reported as the most common diseases in SMS. Wall collapses and drowning were the most common accidents which were associated with injuries and fatalities in SM in general. There were no reports of near-miss incidents, accidents or injuries at the ME site. Safe practices included benching, use of gumboots with a grip and stripping weak walls were found. There was no risk of drowning at the ME site since mining activities were conducted in a shallow pit, and not in a river. Slips, trips and falls (STFs) were not reported. The site had significant safety signs and posters; see Annex 3A. A respirator was available and was in use. The hard hat area was well designated. However, there was no First Aid Kit on site. The ME was expected to have a replenished First Aid Kit in use which also required training of at least one person (preferably the manager) given the high staff turnover) on how to use the First Aid kit. In addition, workers should also be aware of the location of the First Aid Kit and must have the contact of the person responsible for First Aid. Training on First Aid could be done at a minimal fee at the Mining School or other relevant organisations. A fire extinguisher was not required for SMS; however having a fire extinguisher on site is a good practice. Further details on health and safety management are given in the submitted baseline risk assessment report that has been submitted to CI-Guyana.

Worker welfare and health

The cook, who was the only lady on site (out of 17 workers) and was happily employed, with private and comfortable accommodation, and had worked with the ME for more than 3 years. An additional casual cook was hired when there were more workers on site. The kitchen was well equipped and well-stocked with food; see Annex 3A. The miners were employed on a 10% share of profits and were happily employed. The workers had accommodation with beds and mosquito nets; see Annex 3A. The workers had clean running water and male and female toilets; see Annex 3A. There was a television set for entertainment for the workers. The ME had an approved rapid malaria testing kit, malaria medication and a register of malaria cases on site (accessible for miners from surrounding sites). A malaria poster was also displayed on site; see Annex 3A. A rapid COVID-19 testing kit was available on site. The site owner explained that the workers were allowed to rest when they were sick. Sick miners presenting malaria symptoms were tested for malaria. Workers who were sick and who presented other symptoms (symptoms and signs of dengue) were taken to the nearest public health center which had free health care services. The ME expressed that employees were voluntarily employed. Discussions indicated that the site workers could use the CI-Guyana online grievance mechanism for reporting complaints and grievances. However, the interviewed site workers were not aware of the CI-grievance mechanism and expressed that they were not used to online systems. No cases on violence including violence against women were reported. Management of risks related to worker welfare and health is given in the risk assessment report that has been submitted to CI-Guyana.

Gender mainstreaming

All workers who were at the ME site were male except for the cook as indicated above. Consultations confirmed that SMS in Guyana was male dominated. Women were mostly involved in mining in community mining or artisanal mining where women could work with their families. The majority of women who were involved in mining were owners of operations who preferred hiring men because of the hazardous nature of...
mining and for cultural reasons. Women were considered unclean especially during the menstrual cycle. Male miners were of the view that it was hard for women to work in the water all day in hydraulic mining. Avoiding participation of women in mining was considered as protection for women in an industry which involved an aggressive management, dangerous working environment as and a violent culture. Unlike in Ecuador where women could reprocess waste without active mining, alluvial mining in Guyana had limited opportunity to reprocess waste. Even gold buying was dominated by men in Guyana. Women were normally employed for cooking and washing which was the case on the pilot site. Alternative livelihood was considered as an option for women. However, the planetGold criteria requires raising awareness and encouraging participation of women which involves bringing women together and providing access to land, access to finances, and access to mercury-free technology. Further details on gender mainstreaming are given in the submitted risk assessment report that has been submitted to CI-Guyana.

**Banks, financial institutions, and private actors**

No banks and financial institutions had expressed interest in working with SMS. Implementation of the ESG criteria could be facilitated through working with support from financial institutions for compliance. There was no premium offered by the GGB for producing mercury-free gold. Incentives for mercury-free gold were better recovery and better health. However, jewellers were prepared to pay a premium of up to 10% for mercury-free gold. There were no banks and nor mobile money facilities in Mahdia which posed the risk of money laundering. However, the ME for the pilot site was selling his gold to GGB in Georgetown which involved payment of taxes and royalties. There was no GGB outlet in Mahdia.

GGB was cashing up to 2,000 USD equivalents in cash for gold, and paying the balance as bank cheque payable up to one week. While pre-financing mercury-free producers could safeguard against money laundering, no financial institutions or private organisations were ready to pre-finance SMS given the high risk nature of the sector. To safeguard against money laundering the ME could establish and conform to anti-money laundering policy as further detailed in the submitted risk assessment report that has been submitted to CI-Guyana.

**OECD Due Diligence**

Discussions with jewellers revealed challenges with the reputational risk associated with Guyanese gold and jewellery resulting from previous reports on contamination by gold from Venezuela and proximity to Brazil, Venezuela\(^{14}\) and Brazil\(^{15}\) were associated with money laundering and illegal gold activities. There is need to develop a transparent supply chain and reliable chain of custody as further illustrated below in section 3. The OECD Annex II risks on money laundering and illegal activities should also be assessed and documented continually. In addition the ME should develop and implement site policies on anti-money laundering and responsible supply chain. Further details are given in the risk assessment report that has been submitted to CI-Guyana.

**Child Labour**

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No children were observed working on site. However, there was a discussion on acceptability of child labor as part of socialization and mentorship. Module 5 of the CRAFT CODE incorporates second criteria on child labor which is progressive in situations where children above 15 are not exposed to ‘worst forms’ of child labor\textsuperscript{16}. However, in gold mining, exposure to mercury is one of the worst forms of child labor.

**Baseline Risk Assessment**

Baseline risk assessment was conducted at the pilot site. The priority risks identified included mercury reduction unit adjacent to the mercury-free unit, environmental responsibility, social responsibility, gender mainstreaming, OECD Annex II risks related to reputation risk and contamination from Venezuela and Brazil. There was potential for the ME to conform to planetGold from level one to level three. However, due to the limited time, implementation of levels one and two could be prioritized. Further details on baseline risk assessment are provided in the baseline risk assessment report that has been submitted to CI-Guyana.

### 2.2.2: Successes, challenges, gaps, lessons learned and opportunities

**Successes**

The field trip was conducted with the following successes

- Consultations on the ESG criteria informed contextualization of the Guyanese ESG criteria.
- Site observations revealed existing good practices on formalization, anti-child labour, worker welfare, health and safety, mercury reduction and elimination, and environmental management.
- Risk assessment was conducted and priority risks were identified.
- Initial training was conducted.
- Material on ESG criteria was shared with the ME.
- Contact and collaboration was made with relevant GGMC officers.
- Relevant materials were shared with the communication consultant who was producing pamphlets on the planetGold Criteria: see Annex 3B.

**Challenges, gaps lessons learnt, and opportunities included:**

- Limited time for training.
- High staff turnover was a common practice, as a result only the ME had initial training on the ESG criteria.
- There was no legal framework against mercury use and any premium or incentives for compliance with the ESG criteria, the motivation in large SMS sector could therefore be low.
- There was reception and goodwill by GGMC to support ME with implementation of ESG criteria.
- Gender mainstreaming was low. However, Some of the women involved in SMS owned dredges, which is an opportunity to include dredge owners who are women in future relevant SMS projects.
- The OSH department is positioned to support implementation of safety and health practices.
- The Mining School is best suited for training on implementation of the ESG criteria.

\footnote{16} CRAFT 2.0. 2020. CRAFT Code of Risk Mitigation for Artisanal and Small-Scale Mining Engaging in Formal Trade. Available online at: https://www.craftmines.org/en/what-is-craft/
The existence of SMS regulations and the SMS regulatory mechanisms for responsible mining an opportunity for implementation of the ESG criteria in the Guyanese context.

SMS in Guyana is conducted by actors with the financial capacity to acquire expensive earth moving machines such as excavators, which is an opportunity for capable miners to acquire mercury-free technology.

GGMC and GGB had comprehensive documentation, an opportunity for documentation of evidence of production, payment of taxes and royalties and anti-money laundering.

2.2.3 Road map

2.2.3.1 Recommendations for immediate implementation; proposed activities and work plan for the remainder of the assignment

Work plan and activities for the remainder of the assignment

- Verification of validity of mining and environmental permits: CI and the ME
- Verification of written ME commitment to comply with planetGold criteria which could already be captured in the MoU between CI-Guyana and the ME: CI-Guyana
- Verification of records on production and payment of taxes and royalties: CI-Guyana
- Review of drafted policies and sharing the policies with the ME: CI-Guyana and ME
- Implementation of environmental standards: CI-Guyana in collaboration with GGMC processing, ME, virtual back-stopping by consultant(s)
- Documentation of compliance to planetGold criteria: CI-Guyana, back stopping by consultant
- Awareness raising and pamphlets on the planetGold criteria: Communication consultant, back stopping by ESG consultant(s)
- Relevant Posters on PlanetGold Criteria: ESG consultant(s)
- Development of relevant implementation material as per expressed needs: back stopping by consultant(s)
- End of term risk assessment: CI-Guyana, ME, back stopping by consultant(s)
- End of project report: consultant(s)

NB* Further details on implementation of the work plan are given in the risk assessment report submitted to CI-Guyana.

2.2.3.2 Recommendations for medium term project intervention beyond current phase and proposed activities.

- Gender mainstreaming through empowering women to access land, finance and mercury-free technology through allocating specific mining site(s) for women through syndicates.
- Demonstration of a simpler and cheaper mercury-free technology as discussed above.
- Strengthening safety and hazard preparedness at the mining site.
- Mercury-free gold could earn up to a 10% premium. Jewellers interviewed, expressed commitment to give a premium for mercury-free gold.
- Consideration to modify the planetGold criteria to include mercury reduction in addition to mercury elimination.
Deliverable 2.3: Chain of custody system

The objective of the field mission was to conduct an assessment of the Guyana gold supply chain to identify existing challenges and opportunities to set up a suitable responsible supply chain for Guyana including: creating a due diligence mechanism as required by the OECD DDG and a practical traceability system that will reassure local and international markets of the authenticity of the Guyanese gold, thus bringing Guyana's gold up to responsible local and international standards. This section outlines findings and conclusions arising from the field visit.

3.1.1 Findings and key observations.

Traceability of the Origin of gold

According to the traders, the origin of the gold could be traced by its purity. In Guyana, each region has its own characteristics of gold purity. So for traders, the origin was only about the region but not the producer, or the exact pit. Gold traders were getting gold from everyone and were not requesting for any documentation. In addition, gold traders were working with small miners who could bring small amounts, ounces, or pennyweight. Sometimes the gold traders requested for some kind of ID but not all the time.

Production and Trade

Interviews with miners revealed that almost all miners used dredges and sluices for their production operations although some (independent and individual miners) could use smaller equipment such as simple jigs. After washing, the gold was collected from the sluice mats and cleaned using a pan dish. Mercury amalgamation was done on the black sand gold concentrate and the amalgam heated in a retort to produce sponge gold. Miners without retorts would sell gold in amalgam form.

Miners' sale of gold to traders is determined by the type of agreement they had with them and accessibility to the traders in terms of location. For pre-financing, miners borrowed from traders on the basis of trust, with lenders prioritised to recover the pre-financing. Lack of formal financing for the sector has led to popularity of this type of financing by traders. As a result most of the miners' production is bought directly by the traders. Miners with capacity to finance their operations would sell their gold directly to GGB.

Miners paid a tax on their sale of gold at a rate varying between 2% and 3.5% and a royalty of 5%. Financing and taxation are the main problems in the production and trade segment of the ASGM supply chain.

Gold Traders

Gold purity was assessed through Gravimetric/Density method and price agreed with the miners, less 8.5% taxes (inclusive of royalty). Traders mixed the gold regardless of origin. In some cases gold from some regions may be packed differently because of different purity levels. To improve on gold verification, traders could provide a purchase slip to the miner, with name, weight and amount paid (Annex 5 - figure 6-7). This slip could be used at the bank for tax declaration. There was limited compliance in record keeping such as required by GGMC (Annex 5 - figure 2). Gold traders were pre-financed by dealers. Keeping the link from miners, traders and dealers was not always practised, miners were normally not included in the records of the supply chain between traders and dealers.
GGB had a system of paying cash up to 2,000 USD and the rest through the bank. This could take up to a week to access the money and limit both traders and miners liquidity. The main incentive for selling gold to GGB was VAT, tax-free process on mining related equipment. On their assessment of the supply chain, traders consider the process of trade as simple, hence about 90% of Guyanese gold trade is done through traders; making them significant players in the supply chain.

**Taxation**

GGDMA expressed concern about the heavy taxation of gold. In fact, a total of 7 or 8.5% tax is deducted from the miners’ gold sales whether sold through dealers, traders, or the GGB. The Association advocates urgency to resolve this for two main reasons:

- A fixing of the tax between 2 and 3.5% in order to have certainty and not to depend on calculations and determination by traders.
- Reduction of the tax and a better distribution of the tax payment among the actors in the supply chain. Currently, the tax is paid by the miners.

**Mercury-Free Technology**

The mercury-free solution that had been presented to the miners was imported from other countries which required additional investment for the miners. To encourage uptake of technology, establishing a market for mercury-free gold could help. A contract/MOU between the miners and market could incentivize use of technology to achieve mercury-free gold. According to GGDMA, the technologies require adaptation to local context, maintenance and thus additional cost to the miners.

Traders expressed strong support for mercury reduction technologies citing the adverse health effects associated with mercury use. They suggested that miners should have financial support to access these technologies. Miners also needed to be convinced that mercury-free equipment could work better than mercury. The new mercury-free technology imply additional work and time to recover gold compared to amalgamation. Hence the mercury-free technology should be capable of delivering gold at a fast rate. One informant expressed that,

"It will take me 6 hours to process what I can process in one or two hours with other equipment. So why not find a solution where they don’t have to load the material in the machine".

The traders also suggested that communication on mercury-free technology could include the following:

- Support mechanism available for miners- technical and financial
- Guidance on how miners should handle mercury-free technology
- Information on the efficiency of the mercury-free technologies
- Suggested solutions to make miners work easier and time efficient
- A need to have multiple pilot actions which will continue after the project
- Demonstrate success and best practice as more miners adopt the technology

Traders had an interest in supporting the project to establish a mercury-free processing centre in Bartica, focusing on cleaning of the gold concentrate.
Identified Risks

The main risks identified linked to the gold supply chain in Guyana are mostly related to:

- The legality of mining operations (whether the operator has all the legal requirements).
- Health Safety and Environment issues.
- Workers' rights
- Corruption and money laundering which is more of a general problem related to Guyana and its proximity to Venezuela.
- Gold traceability due to mixing of production.

The other risks identified were mercury use. For the international downstream actors, requirements and by extension GGB will need the following to fulfill market demands;

- A strong DD based on the LBMA requirements.
- The GPS location of each site.

GGB expressed the need for external support to implement LBMA DD and establish site location for delivered gold.

Guyana Gold Board (GGB)

Based on the interviews, GGB has not been tracing the origin of the gold purchased, and there was a lack of established processes for verification of gold origin. While GGB has customer records, these do not include the gold origin (annex 5 - Figure13). This data has been transformed into an ID number for each customer. With this information, GGB is able to track gold volumes traded by each customer and helpful for tax purposes.

Figure 2.11: The team visited GGB offices in Georgetown (left) and Bartica (right)

Compliance
Prior to a purchase, GGB performs a compliance check on its customers in line with the GGMC database. Some miners have suggested that the GGMC log sheet was not suitable and GGM is working with GGMC to improve it and gain miners’ interest in filling it. With the compliance check, some actors who were not registered could not directly sell gold to GGB. However, GGB was providing a certificate or permission to temporarily sell of minerals up to a maximum of 3 ounces. This shows that GGM has adapted to meet the needs of the local context. However, the dynamics of the international gold supply chain requires additional inputs from GGB such as verification of gold origin and due diligence on the supply chain.

![Figure 2.12: Post showing some purchase procedures and warning for customers at GGB lab.](image)

The GGB has clear procedures for gold delivery and assessment which include; (1) verification and confirmation of client records (2) smelting, (3) density measurement, (4) pricing & billing (5) invoicing, and (6) payment.

These processes are transparent and steps posted around the building as shown below,
Customers get to see the entire process up to the time the invoice (Annex 5- figure 19) is issued and payment done. To increase sample analysis, GGB plans to acquire an XRF machine.

**Jewellers**

Jewellers indicated that they were buying gold from GGB and it was impossible for them to import gold from elsewhere, according to the law. GGB supplied gold with up to 99.4% gold purity. Jewellers indicated shortage of gold supply through the GGB as there was limited reserve for local supply by the GGB. A jeweller in need of 20 ounces per week had difficulty with reliable supply.

The jewellers indicated an interest to engage in a mercury-free supply chain if it could provide the amount of gold needed and with affordable prices.

### 3.1.2 Successes, challenges, gaps, and lessons learned

The diagram below shows the actors and their role along the supply chain. While the supply chain of the pilot project is simple (see figure below), it is also important to look at the broader supply chain of Guyanese gold.

**Figure 2.14**: Graph showing the CI project Gold supply chain from the Demo site.

Miners produce gold and sell it to GGB who will separately purchase Mercury free Gold for future sale to the Jewellery. Traders are not part of the supply since the ME sales the gold directly to GGB

**PlanetGold Supply Chain:**

The supply chain consists of production; trade; export/processing. The end of the chain could be GGB or a jeweller. It is therefore fairly straightforward to establish procedures to enable a responsible supply chain. This will be discussed in detail in the next Assignment deliverable. The Just Gold model based on recording evidence of sources at each stage of the supply chain could be implemented. The recording can either be manual or phone based along each stage of the supply chain. The principles include registration of the production data by the producer, sales to traders or GGB, and the amount of payment received. Records of workers’ names, dates of transaction related to each gold lot, declaration of mercury free processing, taxes and royalties paid are included in the records accompanying each gold lot. This Just Gold system can provide quick wins as the pilot set up fulfills a majority of its components.

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For the broader supply chain for Guyana, the situation is different and can be described as follows: *Producer (small and large)* - *Informal producers* - *One or more traders* - *Dealers and/or GGB* - *Export and/or Jewellery*.

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**Figure 2.15**: Graph showing the sales relations among actors in the Guyana supply chain from production to export or local consumption

(orange arrows) different Miners produce Gold and sell to different traders with whom they have relations or to the dealers for the same reason. In some cases miners who have enough budget to run his mine sell his production to GGB who propose a better price on gold.

(Yellows Arrows) Traders sell their Gold to Dealers with whom they have a relationship (to whom they borrow money most of the time) or to GGB for the most important Traders. If the amount of Gold is big they usually sell simultaneously to both as GGB provides better price and advantages.

(Green arrows) Dealers are “selling” gold to GGB only or they request export licences and export their gold outside of the country. Dealers are not selling gold to Local Jewelries.

(Black arrows) GGB is buying gold coming from all actors (miners, traders and Dealers). So, GGB receives most of the gold produced in guyana. GGB is either selling refined gold to Local jewelries or they export Gold outside of the country.

(Red square) Local Jewelries are buying Gold exclusively for GGB for their consumption. No import of Gold is allowed and most of the product is sold on the Guyana market.

(Red square) The exporter receiving Gold from GGB is not known but GGB is in process of looking at new partners.
The supply chain for the broader SMS will be more complex involving more actors such as traders and dealers. This is further explored in the next deliverable.

**Successes**

**Production**

The supply chain for the pilot site is relatively simple, with the mine operator committed to mercury free production and implementation of gold verification procedures.

The existence of different tools provided by GGMC, EPA are essential for supporting due diligence monitoring such as on environment, safety and working with local communities. The existing structures including local communities can participate in the monitoring of mining activities.

**Trade**

Majority of the traders expressed their views and perspectives on how to embed mercury free production to the supply chain. They showed willingness to engage and support ideas such as establishment of a mercury free gold recovery unit in Bartica, for cleaning concentrate from the miners/traders.

The GGB structure at the end of the chain is an asset for the establishment of a responsible supply chain. As the last buyer, the GGB could establish the due diligence requirements for the supply chain for actors to comply with.

**Transformation**

The existence of an active local jewellery industry in Guyana is an important part of the supply chain. The industry has a higher demand for gold than what GGM can supply, and has indicated interest in mercury free gold. This allows for piloting mercury free supply to the local jewellery market as a quick win.

**Challenges, gaps, and lessons learned**

**Complex context**

While the supply chain is clear for the pilot area, the situation for Guyana looks complex.

The Figure 2.15, above shows the complexity of the supply chain.

Some of the issues to be addressed to create a fully functional and traceable supply chain include access to mercury free recruitment, and volume of gold produced. The more the volumes, the less the intermediary actors between the producer and GGB.

**Monitoring production.**

The main challenges are in setting up the right technology and monitoring the activity. Indeed, it was important during the project to ensure a fairly constant mercury-free production and for that, the notion of the efficiency of the equipment and its profitability must be proven to the users. It was not yet clear to the miners that the proposed technology had the same cost-effectiveness as the equipment currently in use.
3.1.3 Road map
The next steps for supply chain development should consider the short term for rapid implementation and a long term option for in-depth work on sustainability and extension of responsible mercury-free supply chains.

3.1.3.1 Recommendations for immediate implementation; proposed activities and work plan for the remainder of the assignment. Chain of custody system
The short-term implementation of traceability in the supply chain will constitute the following elements, in response to the Terms of Reference and expected assignment outputs:

a) Recommend a traceability system for the El Dorado pilot sites. This system will be elaborated in the next deliverable.

b) Piloting of the traceability system supported by the consultants.

c) Integrating the activities of the chain of custody system; standards implementation, mercury free gold production and branding.

d) Developing a narrative on the El Dorado gold based on the implementation of c) above.

To support the implementation of the above activities other elements of the supply chain that are important include:

a) Due Diligence Implementation and Monitoring:

Training of actors and stakeholders on due diligence as part of responsible supply chain implementation. Training will include the OECD due diligence guide and other downstream requirements such as LBMA Requirements for ASGM.

b) Production improvement at the site:

Production at the pilot site should be high enough to generate market interest. There are local jewellers whose demands can be met by current production from the pilot sites. However for international players the production is still limited.

c) Engagement with consumers/market;

It will be critical for engagements with GGM and local jewellers to be facilitated and agreements made on how to rollout a chain of custody system supported by stakeholders. Clearly the CI project can not do this alone. Stakeholders commitment and interests are important to make this work.

3.1.3.2 Recommendations for medium-term project intervention beyond the current phase and proposed activities. OECD and Annex 2 risk issues
At a medium term the project may consider a traceability system for Guyana, based on lessons from the El Dorado implementation. The main issues for consideration include the following:

- A system that is adaptable to the different production sites and allows for a fairly simple implementation.
- Affordability. Cost of traceability and due diligence should be affordable for stakeholders to be part of a chain of custody system.
- There must be Acceptability of the system by stakeholders for ease of upscaling.
The supply chain procedures will be developed in more detail in a separate document.

**Deliverable 2.4: Branding and Marketing of Eldorado Gold**

2.4.1: Findings and key observations.

Discussions with jewellers and stakeholders revealed that mercury-free gold from SMS was the main strategy for branding mercury-free gold. Made in Guyana and El dorado gold are proposed branding options. In addition, the designs which were proposed for jewellery pieces from the mercury-free gold included the national bird (Canje Pheasant or Hoatzin), the national animal (the jaguar), the map of Guyana, and Guyana’s National Flag, figure 2.16. One of the jewellers showed a unique jewellery piece of the Canje Pheasant he was designing on request by one of his clients. However, such a design will be expensive and for a specific niche market because of the amount of material and expertise required.

Discussions with Guyanese jewellers and members of the general populace suggested the following design concepts for El Dorado Hg free gold to be considered:
Key:

**A** - Traditional (birthstones) and patriotic (flags and maps) pieces that are bought by Guyanese, especially those overseas, all year around. These will especially appeal to the overseas Guyanese who are looking for something very meaningful for themselves or as a very meaningful gift.

**B** - Pieces that appeal to nature and animal lovers both locally and overseas. These will appeal to those who genuinely love and care for their environment, flora and fauna, and those who are inclined to animal symbolism.

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18 Source, Raj Jewelry and Amazon.com
C - Religious and sentimental pieces that have deep spiritual meaning and symbolism. Buyers of these may appreciate knowing that the gold used to create these pieces is as clean and sincere as the thought behind purchasing the said pieces.

Further to the above, the following marketing and branding suggestions were made during discussions with stakeholders including jewellers, miners, GGMC staff, and members of the general population:

- Telling a story of exactly how the gold is mined, for example, the hardship and sacrifices of the miners who work in the sun and rain to sustain their families. Marketing the pieces with a postcard or pamphlet reflecting the story of the miners
- Identifying a target market such as the wealthier class of Guyanese both locally and abroad, who would have the resources to pay more for Hg free gold jewellery. In this case, the created pieces should be exquisitely made hand-crafted jewellery; one of its kind on the market
- The target market should include people of high intellectual standards and status since these individuals would most likely appreciate the technical details of what Hg free and responsible mining entails.
- The pieces that are made, branded, and marketed should be unique to the Guyanese culture in every way. They should have Guyanese symbolism and can be specially engraved or marked to reflect that they were made of El Dorado Hg free gold.

Strategies for branding could include:

- Mercury-free gold
- Emphasising that it is Responsibly mined gold. No child labour, and workers are treated fairly
- Emphasising that it is Environmentally responsibly mined and produced gold; complying with responsible mining standards such as CRAFT and PlanetGOLD ESG Criteria.
- Emphasising that the gold is produced in a safe environment where there are no negative impacts to workers or the surrounding communities
- El Dorado gold.

**Mercury-free gold**

The successful demonstration of mercury free gold production should be an important element for branding.

**Environmentally and socially friendly mercury-free gold**

The ME /producer is willing to implement CRAFT Code and the PlanetCriteria. There are existing good practices being implemented such as preservation of top soil. With additional efforts and implementation of the CRAFT the gold can be branded in the context of implementation of responsible mining standards.

**Made in Guyana**

While made in Gayana could be considered for branding, consultations with jewellers revealed that “Made in Guyana” will be in conflict with the Bureau of Standards’ “Made in Guyana” brand which currently distributes a wide variety of locally made products in Guyana and on the overseas markets.

Additionally, the jewellers and co-consultants indicated that there was a negative reputation attached to gold and gold products from Guyana due to the fact that there were previously recorded instances of suppliers cheating on the quality, and the existing concerns of potential contamination or mixing of Venezuela's gold.
which is smuggled into Guyana. A consideration of a name that differentiates the gold such as “Eco-Guyana” or such names could be considered.

**El Dorado Gold**

El dorado could be the preferred brand as it is a globally known term for “City of Gold” or “City of Abundance.” The fact that the name is so well known both locally and abroad, can be considered a marketing advantage since it gives a feeling of familiarity and knowing a brand. However, discussions with co-consultants and a few stakeholders revealed a potential threat. There was an existing gold dealer who was carrying the Eldorado name, with operations in Georgetown. Apparently, the company had a bad reputation on the international market because of the contamination of gold from Venezuela.

2.4.2: Successes, challenges, gaps, and lessons learned

Successes

- Demonstrations provided evidence that miners, and in particular the ME, could produce mercury-free gold through mercury-free equipment and technology. Mercury-free gold could therefore be used for branding and marketing.
- The ME was in the process of complying with the Planet Gold Environmental Criteria. As explained above there are no adverse social impacts from the ME’s mining activities. The gold could therefore be branded as environmentally and socially responsible and friendly.
- The GGB expressed willingness to buy mercury-free gold and treat the process of sale differently.
- Various exquisite designs of jewellery pieces could be produced (incorporating the map of Guyana, Guyana’s national flag, the Canje Pheasant, the jaguar, or any other symbol unique to Guyana’s culture) as determined according to the consumers’ preferences.

Challenges and gaps

- Consultations pointed to a negative reputation of Guyana’s gold and jewellery products on the overseas market. Notably, this is not really a concern for the average Guyanese consumer. International refiners also indicated concerns with Guyana’s proximity to Venezuela.
- Although the GGB is willing to encourage the production and sales of Hg free gold, the institution currently has no policies and systems in place to verify and address the sales of Hg free gold separately.
- There are no extra incentives for miners using mercury-free equipment to produce mercury-free gold except that it is better recovery and better health as presented above. There was no extra motivation for the production of mercury-free gold.
- The lengthy time it takes to produce mercury-free gold could affect output, and the reliable supply of mercury-free gold which would be needed by the jewellers

2.4.3 Road map
2.4.3.1 Recommendations for immediate implementation; proposed activities and work plan for the remainder of the assignment: Local jeweller sourcing from project pilot

- Establishing the amount of mercury-free gold which could be produced per month, cognizant of the fact that a slow production process will affect the supply
- Engagements with the GGB on creating or establishing a system that could separate the stream of mercury-free gold from the gold from SSM sector
- Identifying at least one local jeweller interested in piloting mercury-free gold jewellery, and providing the needed guidance and support
- Implementation of the chain of custody and a responsible supply chain, component 3
- Implementation and documentation of ESG criteria, component, component 2
- Improving production from mercury-free gold, component 1

2.4.3.2 Recommendations for medium term project intervention beyond current phase and proposed activities. International refineries

- Improving production and increasing output from the mercury-free gold site
- Raising awareness and advocating for mercury-free gold, and implementation of ESG standards from the broader SSM
- Identifying a potential buyer of mercury-free gold at the international market

Next Steps

- Implementation of the planetGold standards
- Improving mercury free-technology
- Implementation of the chain of custody
- Second field visit
- Branding and first pilot of marketing of mercury free gold
- End of project assessments and reporting.