CLINN-GEM para sa Katawhan, Kinaiyahan, ug Kalambuan: A call for support and promotion of the Community-led Integrated Non-Cyanide, Non-Mercury Gold Extraction Method (CLINN-GEM)

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Abstract

This participatory action research describes the status, development, and impacts of Community-led Integrated Non-Mercury, Non-Cyanide Gold Extraction Method (CLINN-GEM) and the operations of the Integrated Gold-Copper Mineral Processing Pilot Plants (IGCMPPPs) in Barangay Del Pilar, Cabadbaran Caraga and Barangay Katipunan, Nabunturan Davao De Oro, Davao Regions. A multiple case study approach was adopted and mixed-methods were used in data gathering and analysis.

The results revealed that both IGCMPPPs have been turned-over to Department of Science and Technology (DOST) Caraga and Provincial Local Government Unit (PLGU) of Davao de Oro for operation and subsequent operation. Both recipients – DOST Caraga and PLGU Davao de Oro took several initiatives to optimize the technology and the operation of the IGCMPPPs. Further, the results of the field testing show that while CLINN-GEM is cost efficient, both IGCMPPPs have low gold recovery at 16.79% for Katipunan and 20.36% in Del Pilar. Aside from low recovery rate, the problems and challenges of the IGCMPPPs include less to no supply of ore for testing to optimize the technology, lack human and financial resource to fully operationalize the IGCMPPPs and comply with the health and safety standards. Despite all these, the IGCMPPPs can offer laboratory and mineral processing services up to flotation. Also, the field-testing project have contributed social and economic development in the barangays. The establishment of the IGCMPPPs in Davao de Oro and Caraga Regions post no harm in the environment as far as the present vegetation survey is concerned but the construction of the IGCMPPP Katipunan changed the surface topography and the effluent from the processing plant that was discharged to the tailings pond may still contain reagents and harmful substances that may affect the quality of water.

Thus, stakeholders are called to intensify and support efforts for the optimization of the IGCMPPPs while continuously monitoring their impacts. Lastly, stakeholders shall lobby for policies for the promotion and adoption of the technology such as provincial and barangay resolutions encouraging small-scale miners to submit samples for assaying and processing and their corresponding incentives.

Research results

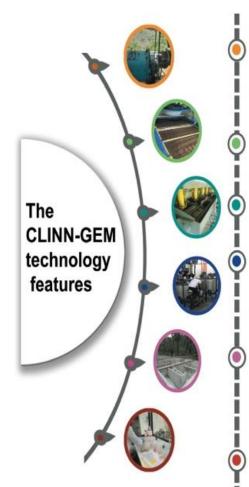
The IGCMPPPs can provide laboratory and limited mineral processing services since CLINN-GEM needs to be optimized. Also, the technology was not yet adopted nor the services of the IGCMPPPs are availed by the small-scale miners but there are efforts for commercialization of its services.

The results of the field-testing show that while CLINN-GEM is cost efficient, both IGCMPPPs have low gold recovery at 16.79% for Katipunan and 20.36% in Del Pilar. However, both recipients took several initiatives to optimize the technology and the operation of the IGCMPPPs.

Table 1. Summary of field-testing result

Indicators	IGCMPPP, Del Pilar	IGCMPPP, Katipunan
Volume (ton)	0.800	4.75
Composite Assay (grams per ton)	10.13	1.12
Processing Time (hours)	26.5	91.78
Processing Cost (power)	6,735.70	6,381.00
Environmental Cost (Php)		
Overall Gold recovery	20.36	16.79%

Figure 1. The CLINN-GEM Technology Features



Size reduction circuit (crushing and grinding)

The crushing circuit consists of a jaw crusher, vibrating screen, double roll crusher, and fine ore bin. Crushing is undertaken to reduce the size of the ores such that grinding can be carried out until the minerals are liberated from the gangue. The grinding circuit consists of a ball mill and a hydrocyclone. With the use of a belt feeder, crushed ore from the fine ore bin is transported to the ball mill spout. Ball mills are used in the grinding of ores and other materials. The ball mill is in a closed circuit with a hydrocyclone, a piece of classification equipment that enables the separation of coarse and fine particles in the slurry. This feature provides mineral processing services at crushing and grinding stages which could cost 1200 to 1700 per dry metric ton.

Enhanced gravity concentration circuit

This circuit is composed of two types of gravity concentrator, the Falcon SB 400 concentrator, and the shaking table. The Falcon SB400 concentrator is used for the recovery of valuable minerals, while the shaking table enables the separation of light and heavy minerals by using a flowing film of water and a table vibrating longitudinally. The mineral processing services up to this stage could cost 2300 per dry metric ton.

Flotation circuit

This circuit uses self-aerating mechanical flotation cells and reagents such as collectors, frothers, and pH modifiers to separate valuable minerals from unwanted minerals (gangue). The mineral processing services up to this stage could cost 2100 per dry metric ton.

Hypochlorite leaching and staged precipitation circuit

This circuit consists of leaching tanks and precipitation tanks. The leaching tank is used for the chlorination process where sodium chloride, hypochlorite, and hydrochloric acid are added to the concentrate. Gold and silver tanks are connected in a series. In the gold precipitation tank, sodium metabisulfite and ascorbic acid are added to produce a gold precipitate, which is then smelted using a surface with a working temperature of 600-700C. Meanwhile, the silver precipitation tank contains the clear liquid produced in the dewatering of gold and will be added with reagents to form a silver precipitate. No mineral processing service is proposed for this stage since it is on-going optimization.

Tailings disposal and wastewater treatment facility

The tailings disposal and wastewater treatment, also called tailings storage facility (TSF), is an essential feature of the pilot plant to protect the environment because it is where hazardous components from the tailings are removed before being discharged permanently. The TSF includes wastewater treatment with a tailing settling pond. The wastewater treatment compartment is where heavy metals are removed from wastewater generated in the extractive metallurgy area. The removal of heavy metals is by adsorption using coco peat and zecifite. The wastewater treatment compartment is divided into three (3) sub-compartments to allow treatment in 3 stages. The tailings pond allows solids to settle and produce clear water that can be discharged to the nearby river.

Analytical (Fire Assaying) laboratory

The laboratory area contains equipment for analytical tests. The oven, furnace, chipmunk crusher, and disc mill pulverizer are located inside the Fire Assaying room. The proposed laboratory services include Gold Weighing Service, Gold, Silver, Lime, Copper, and Iron Analysis. Also, propose Ore Physical Tests include, Moisture Content, Wet Sieve Analysis and Specific Gravity while Laboratory Flotation Testing will include Bulk Flotation and Differential Flotation. Lastly proposed water testing services will include the following parameters - Temperature, pH, Turbidity, Dissolved Oxygen, Conductivity, Oxidation-Reduction Potential, Salinity, Total Dissolved Solids, and Seawater Specific Gravity.

Figure 2. Social, economic, and environmental impacts of the IGCMPPPs in Barangays Katipunan and Del Pilar

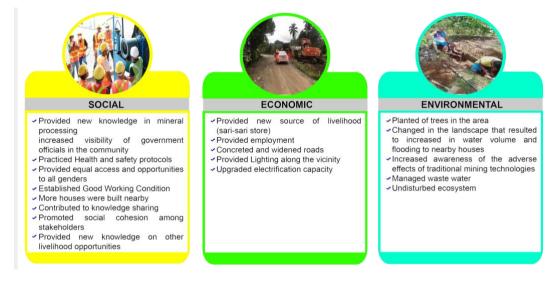
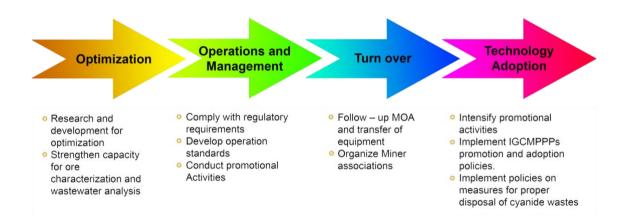


Figure 3. Strategic Actions for the Different Transition Phases



The social, economic, and environmental impacts brought about by the establishment of the IGCMPPPs are contributing to the development of the communities, more direct impacts of CLINN-GEM and the IGCMPPPs have to be known.

Policy recommendations / conclusions

- For the stakeholders to intensify and support efforts for the optimization of the IGCMPPPs specifically, recovery of gold and other minerals, improvement laboratory equipment and procedures. pollution control compliance to and safety standards, and conduct of complete characterization.
- Develop programs and activities for information and education campaign to introduce the services and operations of the IGCMPPP to the small-scale miners and its stakeholders.
- Formulate policies for the promotion and adoption of the technology such as provincial and barangay resolutions encouraging small-scale miners to submit samples for assaying and processing and their corresponding incentives.
- Propose amendment to Sec 3 paragraph (a) of Republic Act 7076 also known as the People Small-Scale mining Act of 1991 on the definition of mineralized areas for the broadening of scope of the mineralized areas and inclusion of other minerals but not limited to lead, copper, iron, and zinc.

Acknowledgments

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