Gold Mining Activities and Its Impacts on Land Degradation in Central Sulawesi Indonesia

BASIR-CYIO Muhammad †*, HASANAH Uswah*, NUR Isrun*, and SERIKAWA Yuka**

*Department of Agrotechnology, Agricultural Faculty of Tadulako University
Kampus Bumi Tadulako Tondo, Jalan Soekarno-Hatta KM 09 Palu 94118, Central Sulawesi, Indonesia
** Toyama prefectural University, 5180 Kurokawa Imizu-shi, Toyama, 939-0398, Japan

(Received January 6, 2011, Accepted October 14, 2011)

Central Sulawesi has a large amount of gold deposits unevenly extended in a number of regencies and cities. Some companies with concession land have already held contract of work and mining concession but yet to exploit the land. Most mining activities existed are traditionally conducted in the concession land. The inability of the local government to control the activities has led encroachment to protected forest and agricultural land. The consumption of mercury in gold processing could reach 34,000 kg mercury day⁻¹ with gold production approximately 22.5-45 kg day⁻¹. The improper use of mercury has caused chemical, biological and physical soil degradation.

Key Words: Poboya, Palu, artisanal and small-scale gold mining, mercury, land degradation

1. Introduction

Central Sulawesi Province covers an area of 68,033 km² with about 2,630,000 populations [1]. The population density is 39 people km⁻² in where Palu city is the highest density area with 849 people km⁻² and the lowest density is Morowali regency with 13 people km⁻² [1]. The second largest population is Parigi Moutong regency with about 413,000 population or 15.7% of the total Central Sulawesi’s population [1]. Three other low population regencies are Buol, Tojo Una-Una and Banggai Island with population of 132,000 (5.03 %), 138,000 (5.24 %) and 172,000 (6.52 %), respectively [1].

The ten regencies and city of Central Sulawesi have potential mineral resources including gold. Gold mine operation should consider policy, socio-cultural, economic, legal, environmental, and public health aspects. Environmental degradation threats due to gold mining activities in Central Sulawesi has become crucial and complex problems, particularly when there is no regulation as guidance for any parties to conduct its mining activities.

Natural resources conservation and environmental pollution are overlooked by various parties due to the strong economic thrust obtained from gold mining activities. Although some regulations are existed [3-5], the local government has yet taken part in controlling the mining impacts on environment in the form of air and water pollution, and land degradation...
concession area (MCA) in Central Sulawesi (Fig. 1). Citra Palu Mineral (CPM) Company, a branch of Bumi Resources Company (Bakrie Groups), holds gold mining concession in Poboya Palu.

Gorontalo Sejahtera Mining (GSM) Company operates in Buol Regency (at the boundary between Central Sulawesi and Gorontalo).

Kemilau Nusantara Khatulistiwa (KNK) Company is in Parigi Moutong regency.

a) CPM

CPM Company is the sixth generation of mining Contract Company located in Palu, Central Sulawesi. The relinquishment of six blocks of the Company’s Contract of Work (“COW”) includes Block I located in Poboya (Fig. 2). CPM Company has controlled six blocks covering an area of 138,900 ha since 1997 in the Poboya region in Palu and of which approximately 37,020 ha is at the exploration stage. In 2005, Bumi Resources (Bakrie Groups) bought 99.99% CPM Company’s shares of Newcrest Mining Group/Newcrest Mining Ltd, and Rio Tinto Company shares as well.

The Block I is at the most advanced stage of exploration and already finished its first drilling. This survey has identified 200 tonnes gold content of this block5). Holders of COW and mining authorization (MA) has yet to exploit the block but people surround the area have already exploited the area without legal permit from the COW and MA holder. The location of this illegal mining covers a wide area with the permission from the regional government. This mining area has become income sources for the government budget revenue. It brought many people from outside of Palu to do mining activities in Poboya. 762 gold mining and processing entrepreneurs are estimated to exist in Poboya. The number of people involve in the mining area is about 8000 as miners (diggers) and 4500 as labours in the processing area2).

b) GSM

In Paleleh sub district, Buol regency, people’s mining have been operated since Dutch colonialism. The mining area is located in Polonggo and Timbulan at the foot hill of Dopalak 7 km to the northwest of Paleleh sub district. The type of gold found in this area is polymetallic veins (Au-Ag-Pb), with the potency of 1,000,000 tonnes gold ore6), or 8.20 tonnes gold7). Newcrest Nusa Sulawesi8) reported that the gold mining operation in Paleleh is possible at a large scale for prospective copper-gold (Cu-Au) ore. Gold resources recorded at 100-200 m depth contain 3.90 tonnes Au with an assumption that average Au content is more than 10 ppm.

c) KNK

In Parigi Moutong (Parimo), two sub districts potential for gold mining areas are Moutong and Taopa. KNK Company plans to explore 4 blocks located about 250 km to the north of Parigi Moutong City with a planned area of approximately 8,522 ha.

d) Others

In Banggai regency, an Australian company has explored the potential area for gold mining since 1997 by after obtaining legal permission from the Department of Energy and Mineral Resources. Currently, there has not yet large investor in Banggai,
and about 8,000 illegal miners from various places in Sulawesi are working in this area. In Tolitoli regency, there has not yet large investor in Tolitoli, and illegal gold mining is located at Dondo sub district with 1000 labors coming from various regions included North Sulawesi and Gorontalo. The mining location covers an area of 20ha including people’s plantation land. Its distance from the capital sub district of Dondo is about 15 km at 300 feet above sea level.

3. Production Potency

The estimated gold deposits in three districts are depicted in Fig. 3. Gold ore reserves/deposits inventoried from several mining location in Central Sulawesi are as follows:

Primary gold (Au) reserves in Parigi Moutong regency at MCA of KNK Company as gold ore in Block I, III and IV are estimated to be 1,357,000 tonnes, 27,000 tonnes and 5,000 tonnes, respectively. Whereas in Artisanal mining area, the gold production ranges from 0.3-1.0 g day\(^{-1}\) person\(^{-1}\).

In Lintidu village, Buol regency, the reserve of gold ore was estimated to be 1,000,000 tonnes containing 51 g gold ton\(^{-1}\) and 125 – 575 g silver ton\(^{-1}\). This area had been mined since 1896 to 1929 with the amount Au and Ag were 8,152 kg and 5,419 kg, respectively. Bunobogu sub distric, Buol regency has recorded 15,000,000 tonnes resources primarily containing 7% Cu and 0.7 Au g ton\(^{-1}\). This area is COW area of New Crest Company. Ampana Tete sub district (Dataran Bulan region) of Tojo Unauna regency (illegal mining area) has yet to be explored. The other unexplored areas (illegal mining) include Toili, Moiling, and West Toili sub districts of Banggai regency, and Dondo sub district of Tolitoli regency.

The amount of gold ore reserve found in Poboya Palu was 2,000,000 tonnes. The estimated production of gold containing 40 - 60% Au from the artisanal and small-scale gold mining in Poboya is estimated to be 0.5-1g trommel\(^{-1}\). According to Balitbangda’s research, there are 762 local entrepreneurs with about 15,000 trommel units in Poboya. Thus the gold generated from them is 7,500g-15,000g in a single processing. The average daily processing is three times, so the gold production of Poboya is 22,500-45,000 g day\(^{-1}\).

4. Processing System and Mercury Uses

Gold ore processing conducted in Poboya is basically similar to that traditionally practiced in other regions.

Fig. 3 Gold ore reserved in the three gold mining areas in Central Sulawesi

The process involves grinding and amalgamation is done simultaneously within trommels. Approximately 20-40 trommels in a processing shed are engine driven at once. The time spent for a single process is about 3-4 hours; therefore 3 processing activities can be run daily. The rotation of the trommel with this technique makes the gold ore breaks down to fine particles to yield gold and silver bullion more effectively than panning system. Gold and silver are purified by vaporizing mercury from the amalgam with a burner (Figs. 5(a)-(b)). Based on the authors’ observation and interview with the miners, they commonly use mercury 500 g trommel\(^{-1}\) per process. At the end of the process, the mercury is reduced to 85% due to leaching, vaporization and carried away in tailing. The tailing is sedimented in three series of sedimentation tanks, and then it is contained in bags (Fig. 5(c)) for sell to the different miners for reprocessing with cyanate. Since cyanate process extracts gold more effectively than amalgamation, they can obtain gold from the tailing of amalgamation with trommels. When the tailing is no longer containing gold after cyanate process, it is discharged into sewage ponds (Fig. 5(d)).

Fig. 4 Grinding and amalgamation process in trommels. Tailings are ready to sell.
The miners use 1,500g of mercury trommel⁻¹ day⁻¹ as they operate three processes in a day. When 85% of a recovery rate is assumed, combined with the number of the trommels of 15,000, 3,400kg of mercury is consumed every day. This is equivalent to 1200 tonnes of consumption every year. Based on the interview with the owners of the trommels, they admitted that the mercury is illegally obtained from outside (Manado) with either local people or gold buyer as brokers who have been partners with the trommel owners. The price of the mercury ranges between USD 65-70 kg⁻¹. The equivalent quantity to consumed mercury should be released to the water environment as liquid and to the atmosphere as vapor.

5. Impacts on Agricultural Land

Gold mining activities have resulted in land degradation such as decreasing physical soil condition in agricultural land due to flood, erosion and sedimentation, and landscape changes due to excavation. Miners often abandon the former mining area without any land reclamation effort as a part of environmental impact control

Increasing Agricultural land conversion lately has threatened its sustainability. One of the driving forces of the land conversion to mining areas is to get better economic condition. The concept of sustainable agricultural development is overlooked with the existence of mining activities (Fig. 6).

In Central Sulawesi, particularly Poboya, the mining activities has been carried out close to agricultural land including shallot and other vegetable cultivation. The Poboya mining activities has led to disastrous impact indicated by land surface damage at former mining areas due to fertile topsoil loss and tailing pollution affecting chemical soil condition. It has already converted 3,000 ha of agricultural land (mixed and local shallot farming). This is equivalent to 1200 tonnes of consumption every year. Based on the interview with the owners of the trommels, they admitted that the mercury is illegally obtained from outside (Manado) with either local people or gold buyer as brokers who have been partners with the trommel owners. The price of the mercury ranges between USD 65-70 kg⁻¹. The equivalent quantity to consumed mercury should be released to the water environment as liquid and to the atmosphere as vapor.

6. Impact on human health

In Poboya area, 3,400kg of mercury is estimated to be emitted from the gold mining activity to the environment every day, resulting in extremely high concentration of atmospheric mercury exceeded 40,000 ng/m³, which is 40 times of the WHO guideline of 1,000 ng/m³. The mercury emitted to the atmosphere could deposit on the sea surface of the Palu bay and the soils, causing accumulation of mercury in the environment. Though the mercury in fish in the Palu bay was found to be still in a low level, accumulation of mercury in the aquatic fauna through the food chain will be likely.

7. Conclusions

Gold mine potency in Central Sulawesi is large spreading in a number of regencies and cities. Most mining activities are traditionally conducted in concession land belonging to various companies which already hold contract of work and mining concessions. The local government has open the opportunity to traditional miners by allowing them to operate either in land belonging to various companies or in agricultural land and protected forest. Gold processing in Central Sulawesi has been using trommels with 500g mercury trommel⁻¹. Not less than 3,400kg day⁻¹ mercury was used with gold production of approximately 22.5-45 kg day⁻¹. Mining activities has caused land degradation including chemical, biological and physical soil degradation and agricultural land conversion as well as adverse effects on human health.

Acknowledgement

The research was in part supported by Grant-in-Aid for Scientific Research from the Ministry of Education, Culture, Sports, Science and Technology (No.23710016) and by the Environment Research
and Technology Development Fund (B-1008) of the Ministry of the Environment, Japan.

References

1) BPS Sulawesi Tengah, Central Sulawesi in Numbers (2009).
3) Pemkot Palu, Palu Mayor Regulation Number 6 on Controlling and Management of Gold Mining in Palu (2010).
4) Pemkot Palu, Palu Mayor Regulation Number 7 on People’s Mining License of Palu City Kota Palu (2010).