Occupational and environmental health assessment of indigenous small-scale mining in Lacub, Abra

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Abstract:

The study looks into the occupational health and safety (OHS) status of indigenous SSM in Lacub, Abra; their disease/ symptom prevalence rates; and their OHS knowledge, attitudes and practices. It sets off by documenting the process of small-scale mining as practiced in Lacub, Abra in order to provide a glimpse on the work and environmental contexts. Relying on on-site observations, focus group discussions and questionaire-guided interviews of individual SSM, the study shows that the occupational, health and environmental issues faced by SSM in Lacub, Abra find resonance in other SSM sites elsewhere. This is especially true with occupational health and safety concerns but only to some extent in terms of environmental issues. The article ends with several recommendations addressed to the SSM and concerned agencies.

Keywords: *Small-scale mining, mining issues, indigenous mining practices*

Small-scale or artisanal mining refers to mining done by individuals, groups, families or cooperatives with minimal or no mechanization, often in the informal (illegal) sector of the market (Hentschel, Hruschka and Priester, 2003). Worldwide, small-scale mining (SSM) provides employment to about 13 million people and affects the livelihood of 80-100 million (Jennings, 1999). In the Philippines there are about 185,000 SSM (Hentschel et al., 2003). They generate or support at least 20,000 formal and informal enterprises and businesses. The small-scale mining sector is known to have contributed 40–50 per cent of the country's total gold production from 1990 to 1999. This percentage is believed to

have been a major factor in recent closures of large gold-mining operations (Bugnosen, 2001).

SSM has recently received a boost in the country as the Philippine government is pushing for the revitalization of the mining industry. As a way of maximizing rewards, small-scale miners are to be tapped as significant extractors of minerals for revenue. As the role of small scale mining increases, it is therefore important to consider the occupational and environmental issues relative to this industry.

Along occupational health concerns, the International Labor Organization (n.d.) has noted that "non-fatal accident rates among the SSM are routinely six or seven times higher than in larger operations, even in industrialized countries". As for environmental impact, SSM have largely been accused as environmental polluters due to their use of dangerous chemicals like mercury and cyanide.

Several studies were done on these both at the local (e.g., Bugnosen, n.d.) and international level (e.g., Hentschel et al, 2003; IIED, 2001), but more data is yet needed (see Jennings, 2001 on health; Bugnosen, 2001). This is especially true with regards the issue of environmental pollution because in the indigenous SSM tradition, the use of chemicals is prohibited, as the SSM practices are regulated collectively by the community. In this regard, there may be lessons to learn from indigenous occupational health and safety practices.

This research focuses on the Cordillera Administrative Region, home to various indigenous groups, where SSM has been and is still widely practiced (for a historical background on the SSM in the Cordilleras, see APITTAKO, 2005). In particular, it takes as research site the municipality of Lacub, Abra Province, an area where SSM has been carried out for about the past hundred years. Lacub is a 5th-class municipality with a total population of 2,782 in 509 households[1] residing in six barangays. Currently, many residents particularly from the Barangays of Talampac (and its sub-sitio Pacoc), Buneg, Balawang, Guinguinabang and Poblacion are engaged in small-scale mining for gold at least part of the year. Majority of residents are farmers belonging to the Binongan and Mabaca tribes. Lacub, just like most other communities in Northern Cordillera, largely depends on agriculture, such that the imperative to care for the environment and protect their agricultural lands remains.

The study aims to describe and expound on the (1) occupational health and safety (OHS) status of indigenous SSM in Lacub, Abra, (2) their disease/ symptom prevalence rates, and (3) their OHS knowledge, attitudes and practices. To set the stage for the discussion of these, the research likewise intends to document the process of small-scale mining as practiced in Lacub. In the end, it hopes to come up with recommendations for the benefit of the SMM as well as for policies that can be enacted by concerned agencies.

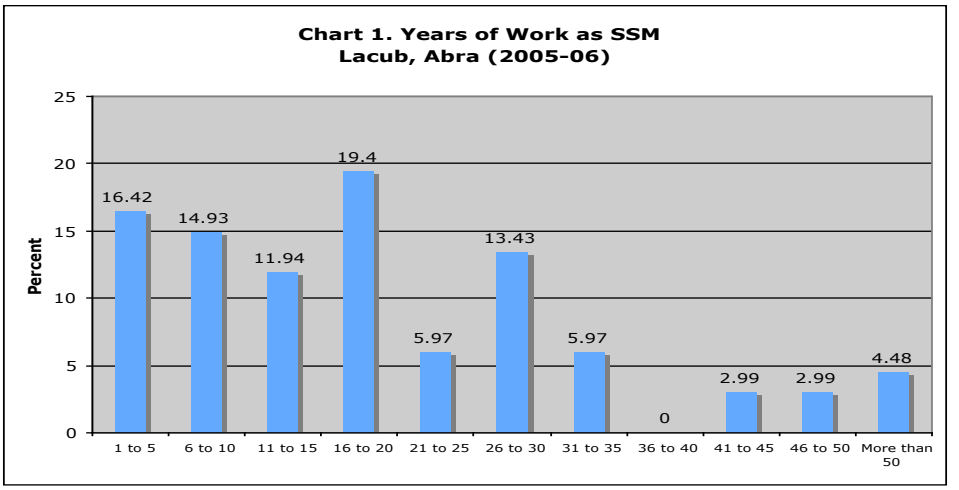
Research design and methods

The study is a descriptive research which employed observation, focus group discussions and questionaire-guided interviews of individual SSM. It was conducted by CHESTCORE staff and medical student volunteers from the Saint Louis University who served as field researchers in this study.[2] Community leaders served as host and guides to the researchers.

Several visits were made to Lacub over the period of one year. These visits ranged anywhere from one to four weeks, mainly in November 2005 and April –May 2006. The team visited four major groups of mine tunnels and interviewed 67 small-scale miners. (The total number of small-scale miners in Lacub is not known. All SSM present at the sites visited who were willing to be interviewed and who fulfilled the inclusion criteria were included in this research.)

The mean age of the mine workers is 41.64 years (standard deviation/ SD=14.01), with the youngest being 18 and the oldest being 81. Fifty-eight percent (58%) were men.

The small-scale miners have been doing this type of work for an average of 20.06 years (SD=14.56). Excluded from this study were SSM who have been working for less than a year at this type of work so the shortest working time as SSM was one year while the longest was 58.



The oldest (81 years old) SSM was a female who had been engaged in mining since she was 23. The youngest SSM (18 years old) had already been mining for the past five years. On the average, the SSM started in this type of job around the age of 21.58 years old (SD=11.53). However, some of them started as early as nine to ten years of age.[3]

SSM work an average of 8.28 hours (SD=1.24) for 6.13 days per week (SD=0.76).

Findings and discussion

The first part of this section describes the process of SSM as practiced in Lacub. This shall set the background for the discussion of the OHS status, knowledge, attitude and practices of SSMs as well as their disease/ symptom prevalence rates.

The process of small-scale mining

Small-scale mining in Lacub is at its peak during the months of September through December. Most mining stops from January to March as harvesting of rice takes precedence. Farming and mining chores are combined from April to May while farming (planting rice) takes precedence again from June to August.

One type of small-scale mining engaged in by miners of Lacub, Abra is placer mining *(panagyakayak/ panaggasagas/ panagbarkis)*. This employs the flow of the river to filter rocks and sandy particles through a series of wooden chutes lined with jute sacks. Others employ panning to directly filter gold from the rocks and sand in the river.

To be discussed in details here is the other type, the one that is most commonly practiced: doghole mining *(panagusok)*. This involves the following steps:

Tunneling. Small-scale miners have their own ways of determining where to dig a tunnel. A tunnel is dug through rock and soil using mallets and chisels. Dynamite is used to blast through solid rock. Timber may be used to support areas in danger of collapsing.

Transporting the ore out of the tunnel. The raw gold ore is gathered into plastic gallon containers and carried out of the tunnel. Older children and young teens (mostly but not exclusively male) are involved in this task. These loads were carried on the backs of the miners.

Crushing the ore by hand. Using heavy mallets, hammers and crudely-made rubber holders, the ore is crushed from large rocks measuring 7-15 cm into smaller pieces about 2-4 cm in diameter. Gold-containing ore is separated from ordinary rock. This task is usually done by the women and child miners.

Transport of the crushed ore to the milling area. The crushed ore is gathered into sacks and carried by both men and women miners to the milling area.

Milling the ore. The ball mill is a metal cylinder varying in capacity from 2 cavans (approximately 100 kg) or more. Metal rods[4] are placed inside this cylinder. The hand-crushed ore and water are added. A diesel-powered generator is then used to turn the ball mill for several hours. The finished product is a fine sandy material, which is then filtered through a series of wooden chutes *(barkis)* lined with jute sacks *(ap-ap)* using water steadily flowing from a hose. The miner also employs both hands and feet to control the flow of the sandy material. This task is done by both men and women. It requires experience to perform this process properly and efficiently.

The heavy particles of gold sink to the bottom and stick to the jute sack lining. The lighter non-gold particles flow out with the water.

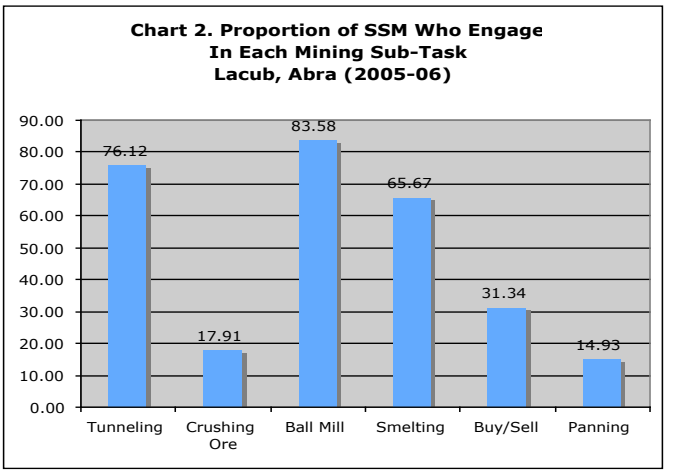
Further gravity concentration by panning. The gold-containing jute sacks are washed in a tub to remove the particles that have stuck to them. Concentration of the gold particles through gravity is then done by rotating them in a round wooden pan. The wooden pan is shaped such that its sides are sloping towards the center, where the gold then concentrates.

Panning may be done at the ball mill area or the sacks of milled ore may be carried home in sacks. Panning will then be done at a later time.

Smelting and purifying the gold. The gold particles are formed into nuggets by heating them in a clay dish *(gangi)*. A blow torch is used for heating. Borax (sodium borate) is mixed with the gold to lower the melting point and reduce viscosity of the mixture. The impurities then separate as a slag while the heavier molten gold (and silver) sink to the bottom (Gold roasting, n.d.).

Selling the gold. SSM sell gold to local resident buyers. Others may choose to travel to Baguio City and sell the gold there themselves, usually at a higher price than that offered by the Lacub gold buyers.

In terms of labor division, the proportion of small-scale miners who are engaged in the tasks enumerated above are as follows:



Miners divide themselves in informal groups of 5-10 members, usually along kinship lines. Division of tasks is informal and may be rotated among the members of the group, except for certain tasks requiring more experience or specialization (e.g. dynamite blasting, running the ball mill engine). Women and younger workers with less experience are usually given the more manual tasks such as chiseling rock or carrying ore. Gold smelting is reserved for the head of the group who is usually older, more experienced and puts in a bigger financial investment in the endeavor.

Major health hazards identified vav disease prevalence

An International Labour Organization survey (ILO, 1999) identified five major health risks in small-scale mining and processing: exposure to dust (silicosis); exposure to mercury and other chemicals; effects of noise and vibration; effects of poor ventilation (heat, humidity, lack of oxygen); and, effects of over-exertion, inadequate work space and inappropriate equipment.

Similar hazards were found in Lacub, Abra:

Dust, fumes and other inhaled particles. Dust must be the most readily evident hazard to which the Lacub SSM are exposed. Similar dusty conditions are described in the Kias gold mines of Benguet (Bugnosen, n.d.).

Generation of dust from mining in Lacub is heaviest during the digging of tunnels and the crushing of ore. The SSM relate how, during the dry summer months, the ore that is left lying around the tunnels (prior to manual crushing and transport) generates much dust. Dust and fumes (heavy enough to obscure visibility for a few meters) is also generated during dynamite blasting. Before the fuse is lit, the tunnel to be blasted and adjacent ones are cleared of workers. However, the dust from blasting extends out of the tunnel entrance. The SSM wait only 10-15 minutes prior to re-entry.

Fumes are also generated from the headlamps used by the SSM which are fueled with carbide. Diesel fumes also emanate from the motor engine that powers the ball mill. Despite all these, the SSM were noted not to resort to any practice that could help reduce their exposure to dust and fumes.

Present evidence now indicates that all dust exposures sufficiently intense to be reported by those exposed should be viewed with suspicion. Not only organic and inorganic dusts have been related to chronic obstructive pulmonary disease (COPD), but poorly characterized dusts (with or without chemicals, fumes and vapors) as well (Rom, 1998).

Given this situation, cough is the third most common symptom reported by the Lacub SSM (see Chart 4). Tuberculosis is reported as a past illness by 11 (20.75%) of them. The incidence of TB among the small-scale miners is 10 times higher than that reported for the general population of Lacub municipality. In 2005, pulmonary tuberculosis was reported as the third leading cause of morbidity in Lacub municipality, affecting 2 percent of the total population (60 cases out of 2,782 total population) (RHU, 2005).

Ergonomic hazards. The work of the SSM is physically intense. Muscles, joints and tendons are strained as they assume and maintain awkward body positions while exerting much force to pound on the rocks using crude heavy tools.

The task of manually crushing the ore is also physically taxing. Women and older children squat for several hours under the sun, repeatedly pounding on the ore with a heavy mallet (approximately 5 kg).

Transporting the ore in sacks or pails is again heavy work. Loads that SSM carry on their backs several times a day weighed 50 kg. These loads were carried at a minimum distance of 10 m (from inside the tunnel to the entrance of the tunnel), to about 50 m – 1 km (to the ball mill area), or to 1-4 km (their home in the village).

Gold panning also involves sitting or squatting for long hours.

Given these conditions, muscle pain is the most common symptom reported by 85.07% of the SSM. Muscles referred to were those of the extremities including the shoulders, upper and lower back. Joint pain is the second most common symptom, reported by 67.16% of the SSM. Almost all those who reported joint pain referred to the knees.

The incidence of muscle pain among the SSM is much greater than that in the general population of Lacub. Musculoskeletal strain is reported

as the 10th leading cause of illness, affecting only 0.3% of the general population (11 out of 2,782) (RHU, 2005). Bugnosen (n.d.) reports that "Backache is also a major problem among the (Kias, Benguet) miners -- largely due to their posture while working."

Noise. Noise comes from pounding of the tools against the rocks and ore, dynamite blasting and ball mill operation. Based on crude estimates using the Arm's Length Rule[5], noise levels approach 85-90 dB while the ball mill is operating. Noise generated from pounding and blasting is more of 'burst' noise.

Deafness or diminished hearing is the tenth most common symptom, reported by 34.33% of the SSM. This condition is probably confounded by the common practice of diving in the river for eels and other marine food sources.

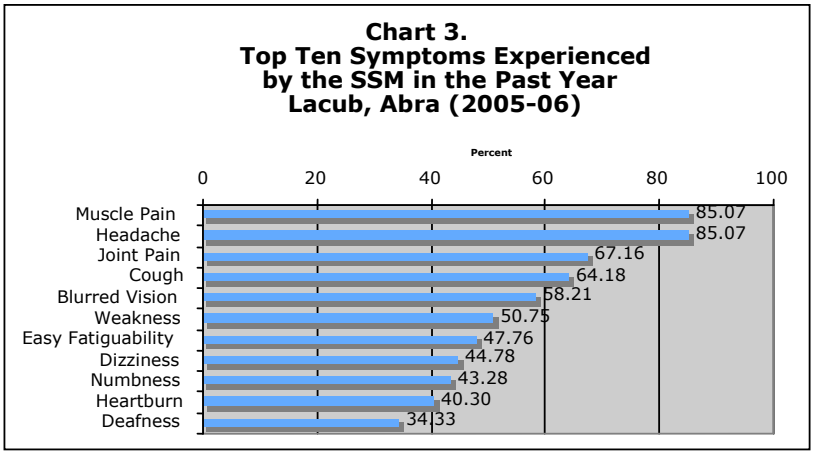
Chemicals. There is a community-enforced taboo against the use of chemicals such as mercury and cyanide in the extraction of gold. However, the use of less toxic chemicals such as those in dynamite, potassium mixed with the dynamite and borax is allowed. These chemicals are handled by hand. At the minimum, they act as skin irritant.

Extreme temperature. Extremes of cold or hot temperature are not prominent in Lacub's tunnels as these are located near the surface. It is the women and children crushing the gold ore outside the tunnels who are exposed to direct sunlight for prolonged periods of time.

There is also some heat and risk of burn present during the smelting process as a blow torch is used. The miner performing the smelting needs to look at the bright flame for prolonged periods of time.

Disease and symptom prevalence

The most common symptoms experienced by the SSM in the past year were:



Among other diseases, ulcer affects 7.5% of SSM. In the general Lacub population, only 0.4% are affected (RHU, 2005).

Past Medical History

The SSM listed the following in their past medical history:

Table 1. Past Medical Illnesses of SSM
Lacub, Abra (2005-06)

Past Medical Illnesses	**Number**	**Frequency n=67**
Hypertension	23	34.33
Asthma	18	33.96
Heart Disease	12	22.64
Kidney Disease	11	20.75
Tuberculosis	11	20.75
Allergy	10	18.87
Goiter	6	11.32
Ulcer	4	7.55
Psychiatric Ds	3	5.66
Anemia	3	5.66
Malaria	2	3.77
Cancer	1	1.89
Diabetes Mellitus	1	1.49
Others	5	9.43

Smoking, Alcohol Drinking and Diet

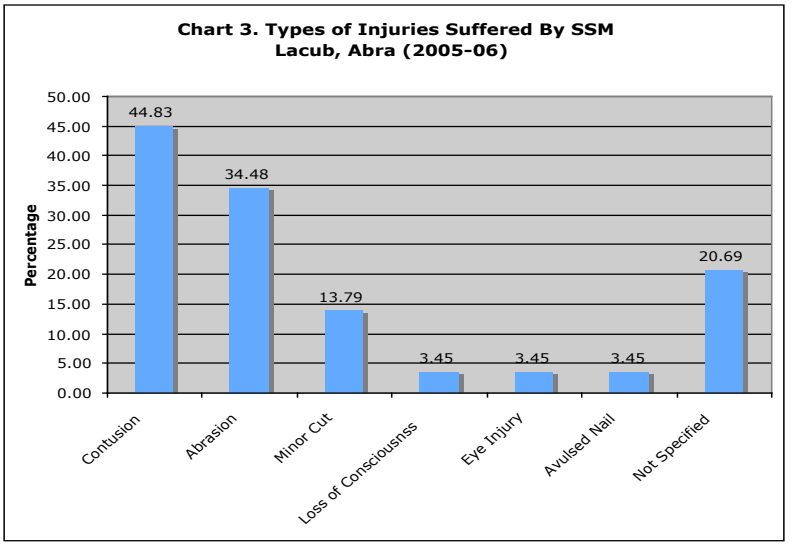
Fifty-four percent (54%) of SSM were smokers. They averaged 15.09 pack years (SD=13.25). Twenty-six percent (26.87%) had quit smoking an average of 12.28 years (SD=9.04). Half of the SSM (52.20%) also chewed betel nut. Eighty-two percent (82.10%) were alcohol drinkers. Gin was the usual alcoholic beverage imbibed, 1-2 times per week.

SSM predominantly ate vegetables which came from within Lacub or from Bangued, the capital of Abra.

Accidents at work

The International Labour Organization (1999) identifies three types of accidents in small-scale mining all over the world: trips or falls (at the same level, or from one level to another); being hit by machinery or a moving object (including rocks, stone chips, tools); and, effects of cave-ins or rock falls (e.g. fractures, sprains, contusions) (ibid.).

Fifty-six percent (56.72%) of SSM have not experienced any accidents on the job. Forty-three (43% or 430 per 1,000 workers) of Lacub SSM reported mostly minor injuries, namely contusions (44.83%), abrasions (34.48%) and minor cuts (13.79%). Only 1 miner reported eye injury.



Only 1 death was reported, occurring more than 20 years ago (extrapolated to roughly 0.15 fatal accidents/1,000 workers). South African gold mines reported 1.05-1.57 fatal accidents per 1,000 employed (Loewenson, n.d.).

Bugnosen (n.d.) reported a similarly low incidence of accidents in Kias, Benguet: "The miners state that there were no fatal or serious accidents at the mine site, even during the height of illegal mining activities. Common injuries that occur are mainly cuts and bruises caused by flying objects, rock falls and slipping."

The general consensus is that "Overall health and safety data for ASM (artisanal/ small-scale mining) are sketchy, but the sector appears to experience a significantly higher accident rate than the industry as a whole" (Undermining the Rights, n.d.). This data seems to be skewed by a bigger proportion of accidents in underground coalmines "in view of the risk of fire or explosion arising from the ignition of methane and/or coal dust" (ILO, 1999). However, "A typical gold mine in Zimbabwe is a shallow underground operation in stable rock…. Nonetheless, small-scale mining in Zimbabwe has a well-established reputation for a disproportionately high number of fatalities. These are mainly caused by miners re-entering closed mines illegally to win gold from the pillars, and from alluvial miners burrowing into uncompacted river banks" (ibid.).

The seemingly low accident rate in Lacub mines may be attributed to the small number of workers included in this study and the relatively low scale of operations.

Possible causes of trauma identified by the researchers in the Lacub mines were: rock fall, dynamite blasting, falls, dropping of heavy loads, mishandling of tools and impingement in the ball mill. The frequent and indiscriminate use of dynamite in tunneling has also been identified as a dangerous practice. These are similar to what has been identified by the International Labour Organization (1999) as causes of accidents in small-scale mines all over the world are likewise detected by ILO: rock falls; subsidence; lack of ventilation; misuse of explosives; lack of knowledge; lack of training; violation of regulations; and, obsolete and poorly maintained equipment.

Environmental issues

The environmental issues obtaining in Lacub are similar to those observed by Bugnosen (n.d.) in Kias, Benguet (e.g., deforestation, soil erosion, land slides and siltation). More specifically, the problems identified by the researchers in Lacub are, as follow:

Mine waste disposal. There is no organized manner of mine waste disposal in Lacub. Valleys filled with rocks extracted from the mines were observed. These pose a danger of land or mudslide especially during the rainy season.

Some residents report that slowly the silt from the mines is flowing down the waterways and into their rice fields. Buyatan Creek near Lipit is highlighted by community residents as one of the waterways most affected by sedimentation. Fish and snails can no longer be seen in this creek.

Depletion of water supply. Buyatan Creek is again pinpointed as one of the waterways which has diminished in flow volume. Other waterways have been noted to have less flow, after mining flourished.

The diminished water flow has resulted in the non-usage of approximately two (2) hectares of rice fields for lack of irrigation. (The problem was aggravated by the damage wrought by typhoons on Lacub's irrigation canals.) Some fish ponds have also been abandoned for lack of water supply.

Deforestation. The areas of Binangsalan and Lipit are recognized by the community as watershed areas. Mining activities have resulted in the cutting of trees in these areas, although less than one (1) hectare has been denuded at present.

Acid mine drainage. The exposure of soil and rocks to water and air in the process of mining generates acid mine drainage. The acid generated in turn dissolves heavy metals and releases them into waterways. This phenomenon has not been adequately documented in Lacub.

It is good to note, however, that people's organizations exist within the small-scale mining areas of Lacub municipality. It is mainly through these people's organizations that collective control over mining operations is instituted. For instance, disputes among SSM are settled through the people's organizations. Likewise, the ban on the use of mercury and cyanide is enforced through the people's organization. While this research was ongoing, the mine site of Lipit was closed down by the people's organization in recognition of the many environmental hazards that its continued operations was posing.

Conclusion and recommendations

This study has looked at the (1) occupational health and safety (OHS) status of indigenous SSM in Lacub, Abra, (2) their disease/ symptom prevalence rates, and (3) their OHS knowledge, attitudes and practices.

Quite clearly, the issues coming out from this research find resonance in the findings of SSM research done worldwide. In the case of Lacub SSM, the major hazards involve dust and ergonomics. These can be related to the predominance of cough and muscle/ joint pains as leading health complaints of the SSM. The incidence of these health conditions is much higher among the SSM as compared to the general population.

However, in terms of environmental concerns, the use of chemicals such as mercury and cyanide is not as pronounced in Lacub as elsewhere. This most likely stems from the fact that people's organizations abound in the area which play a crucial role in exerting collective control over the mining operations.

To alleviate the occupational, health and environmental hazards identified, the following recommendations are set forth:

1. Conduct health education among the SSM regarding the occupational and environmental hazards especially towards the following interventions –
   a. development of appropriate and more efficient tools to decrease ergonomic hazards;
   b. institution of dust reduction measures;
   c. development of practical and cheap personal protective equipment; and,
   d. organizing of health and safety committees among the SSM.
2. Conduct baseline sampling and periodic monitoring of acid and heavy metal levels along waterways within Lacub.
3. Develop appropriate mine waste disposal systems.
4. Institute a system for disease surveillance among the SSM.

In considering these recommendations to improve the occupational, health and safety profile of the SSM of Lacub, lessons from others who have tackled the problem need to be kept in mind:

> Many environmental and health and safety assistance programmes have demonstrated that interventions should focus on incentives and training rather than on traditional monitoring and enforcement systems. It is important to show how protecting the environment or health can produce more benefits than costs. Solutions have a better chance of success if they can be implemented with readily available material that is familiar to the cultural environment of the miners. Adapting and optimizing existing technology is preferable to introducing new and sophisticated equipment. Due to the differences between mining operations and local contexts, a single generic technical solution is normally inappropriate. Change is most effectively disseminated through pilot operations that are implemented successfully and that serve as models for duplication. Education, training, demonstration and monitoring are the key elements of any programme to improve occupational safety and health in ASM (artisanal and small-scale mining)" (Loewenson, n.d.).

Acknowledgments

This research was made possible through a grant from the UP Medical Foundation, November 2005-2006, in cooperation with Community Health Education, Services and Training In the Cordillera Region (CHESTCORE) and the Department of Family and Community Medicine, Saint Louis University College of Medicine.

Notes

[1] National Statistics Office, 2000, as quoted in the Abra Provincial Profile by the Provincial Government of Abra.

[2] The Community Health Education, Services and Training in the Cordillera Region (CHESTCORE) is a health NGO within the Center for Development Programs in the Cordilleras (CDPC), a network of nongovernment organizations

that has served Lacub Municipality for almost twenty years. CDPC and CHESTCORE have organized people's organizations and trained community health workers among Lacub's barangays.

[3] This was validated by our observation that small-scale mining is a family endeavor in which children are not exempted.

[4] Metal balls were originally used inside the ball mill, thus its name.

[5] Arm's Length Rule – Noise levels reach 85-90dB when two people standing an arm's length apart need to shout at each other in order to be heard.

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