9

Is it possible to integrate health and safety risk management into mechanised gold processing? A methodology for artisanal and small-scale mining communities in the Philippines

Gernelyn Logrosa, Maureen Hassall, David Cliff and Carmel Bofinger

The large number of people involved in artisanal and small-scale mining (ASM) worldwide face significant health and safety issues that have an impact beyond the miners and their communities. In the Philippines alone, ASM sustains more than 500,000 miners and processors (Galvez 2012, cited in Verbrugge 2014). Its immense contribution—supplying 80 per cent of the country's gold supply, which earned PHP48.9 billion in 2010 (Mines and Geosciences Bureau 2016)—proves that ASM is thriving and is worthy of support.

The diversity within artisanal gold-mining is recognised by the Swiss Agency for Development and Cooperation (Hruschka 2011), and can range from formal and responsible ASM communities as pillars of the local economy to chaotic and uncontrollable mining sites, where negative impacts prevail. Four categories of ASM were recognised for purposeful macroeconomic and sectoral approaches by the World Bank (Weber-Fahr 2002): permanent ASM, seasonal ASM, rush-type ASM and shock-push ASM. These categories are in some way reflected in the primary gold-mining provinces in the Philippines—Benguet and Compostela Valley—which are discussed in the following sections.

In Benguet, ASM developed from the previous workings of the indigenous Igorot small-scale miners who originally worked the area. It is a classic example of how ASM in the Philippines had thrived long before the arrival of large-scale mines (Bugnosen 2002). Artisanal mining operations in Benguet are perceived as old and traditional in terms of mode of tunnelling and gold extraction, as compared to other ASM areas of the Philippines. The cyanidation process of gold extraction is used more widely by the small and corporate small-scale mining associations than amalgamation using mercury. In Benguet, the Ibaloi and Kan-kanaey miners are known as *abanteros*. Having inherited their skills from their ancestors, their knowledge of gold-mining has been shaped by years of experience. Some migrant miners from the lowlands have also learned these skills. Altogether, this hierarchy of non-industrialised miners form a community of ASM, without distinction between miners who use the traditional method and miners who employ mechanised and more advanced technologies. The provisions of the Philippine Presidential Decree No. 1899 allow corporations to also engage in small-scale mining (Alternative Forum for Research in Mindanao (AFRIM) 2012).

Traditional mining in Benguet is typically seasonal. The Kan-kanaey tribes in Benguet treat mining as a family-based activity, performed during agricultural off-seasons. The ore-processing stage is performed usually by the women, while the rest of the stages, such as ore extraction, milling, gravitation and panning to separate gold from the ore are performed by the male members of the family. Until 1996, the tools used were simple, such as iron chisels, double-sided iron hammers with a wooden handle, iron crowbars, iron shovels and battery-operated lamps. Initial breakage of the ores is achieved using improvised crushers. After this, grinding proceeds, as the ores are loaded into rod mills or ball mills. This is followed by smelting and processing wherein women do most of the work (Caballero 1996 as cited in Lu 2012). Households are reformed into workplaces as processing of the ore is made to fit into the household responsibilities. Inevitably, of course, the inherent risks from these typical working conditions emerge, as other members of the family are exposed to the hazards of mineral processing (Bugnosen 1998).

A different outlook is provided by the ASM community in Compostela Valley Province, also known as 'ComVal'. ComVal typifies a gold rush–type ASM practice that has sustained itself for more than 30 years. The brief settlement history of the ComVal uplands may offer a useful perspective in understanding its ASM context. Throughout the 1950s and 1960s, expansion of corporate logging and mining brought with it to ComVal the massive influx of migrant workers from Visayas and Luzon, which are located in the central and northern part of the Philippines. The gold rush in the 1970s and 1980s expedited the utilisation of both the migrant workforce and the unskilled 'indigenous labour' in large-scale companies, such as APEX mining in the municipality of Maco, and SABENA mines in New Bataan. However, the gold rush was short-lived. The downturn of large-scale mining in the 1980s forced the impetus towards the expansion and transformation of ASM through the creation of a skilled workforce reserve.

In terms of working practices and degrees of mechanisation and capitalisation, Verbrugge (2014) classified ASM in ComVal into three pertinent categories. The first category is river panning, which is an alluvial mining technique that captures coarse gold, in some cases gold nuggets, using a simple pan or sluice box. The miners rely on natural conditions, such as the passage of heavy rain, which tends to loosen gold-bearing dirt. The second category is self-financed tunnelling operations, in which a 'corpo' is formed by the miners and resources are pooled among themselves. The third category, which is supposedly the defining feature of ASM in ComVal, is the bigger tunnelling operations. Here, the operations are characterised by a much higher degree of mechanisation and the employment of heavy machinery, such as pneumatic drills, excavators, explosives, 2-MW diesel generators, water pumps and mine carts. Consequently, the degree of labour specialisation also increases, providing employment no longer limited to the usual portal guards, carpenters and electricians. Some cases reveal the hiring of chemists and geologists. A fourth category, which is not highlighted in Verbrugge's account but is still worth noting, is the 'banlas' or hydraulic mining, which uses high-pressure jets of water to dislodge rock material or loosen packed gold-bearing sediments.

The role of the state

It has been institutionally recognised that there are drivers that push ASM to continue performing their gold-processing techniques, despite the risks that have been largely discussed in literature, in terms of social and regulatory dimensions (Hentschel et al. 2002; Lahiri-Dutt 2004; Buxton 2013; Hilson et al. 2014). The support from government, local and foreign organisations and other institutions has, in part, been directed at finding technological solutions to ASM-related problems (Priester et al. 1993; Mutagwaba et al. 1997; Hentschel et al. 2002; Hruschka 2011). The most common example is the end-of-pipe technology, in forms of retort or improvised filters to address toxic mercury emissions. This initiative of solving ASM problems related to mercury through the use of technology is a model of technical solutions to reduce environmental impacts. There are also other modifications of the mineral-processing circuits to mitigate unwanted social and environmental impacts (Priester et al. 1993).

The mechanisation of gold processing holds promise in its potential to achieve cleaner and toxin-free ASM practices. However, Hruschka (2011) argues that mechanisation does not replace labour in ASM gold processing. The mechanisation today in ASM usually starts at a basic level, and its primary purpose is to ease physical work conditions and to increase productivity. Labour remains the second-most important production factor next to mineral deposits in ASM. As a result, ASM produces 'only' about 15 per cent of the worldwide gold production, but employs more than 80 per cent of the workforce (Hruschka 2011).

Scholars have so far focused on how technology use has an impact on labour, its regulation, on women's rights and informality (for instance, Nuwayhid 2004; Hermanus 2007; Marriott 2008; Lu 2012; Verbrugge and Besmanos 2016). However, there seems to be little discussion about health and safety and, in particular, there is no examination of how health and safety risk management approach could be used to improve ASM methods for processing gold.

Health and safety project

This study aims to investigate the health and safety conditions in ASM, and to integrate health and safety risk management into mechanised gold processing, through a gold-processing plant recently designed for ASM in the Philippines. It was a collaborative effort, initially made by a state university and a government department to improve ASM gold processing in the country. The technology offers the customary set of principles in gold processing. Innovative mechanisation is highlighted by putting in equipment and methods that stand as a contemporary and creative approach to the recent technical demands in ASM gold processing. The project seeks to develop a plant that overcomes the challenges associated with the two primary ASM gold-processing methods—cyanidation and amalgamation—which cause adverse effects on health and the environment. Another consideration is that ASM gold-processing sites may lack adequate facilities for detoxification treatment, thus compounding the health and environmental risks they cause. ASM gold-processing sites often lack adequate facilities for detoxification treatment, thus compounding the health and environmental risks they cause. Another consideration is the inefficiency of separation and recovery of gold using these processes that leads to major inefficiencies in material utilisation. Once this technical challenge is addressed, the economic opportunities can be enhanced.

Technical demands of the small mines industry have been becoming increasingly dynamic and complex. This is mainly due to the varying mineralogy and metallurgical characteristics of gold ore. Thus, mechanisation has been developed over time. The introduction of mechanisation to ASM was not limited to external influence, such as government projects (Mutagwaba et al. 1997) and foreign aid. In order to meet local conditions, artisanal and traditional techniques have been modified, even through unconventional channels (Priester et al. 1993; Hentschel et al. 2002). This modification was a definitive task among ingenious ASM miners or, as Rawls et al. (1999) described it, enterprising amateurs who characterised the gold rush technology.

This contemporary state of ASM working conditions may include more modern occupational health and safety hazards that may arise from the new machinery. Hentschel et al. (2002) discussed how frequently ASM miners try to modify the conventional equipment they have in order to fit their needs. Unfortunately, in many cases, safety features are suppressed; for example, in the water supply for drill hammers. Nevertheless, a surprisingly large variety of technical solutions to gold processing for ASM have been developed for their local activity.

The risks to health and safety from the gold-processing operations can be potentially increased if mechanisation is applied in the absence of complementary safety measures. In order to solve this, projects, machines, and equipment should be designed according to explicit health and safety considerations. Government and donor organisations should serve as a model of safe mechanisation by consciously integrating risk management into their projects. Good designs have provisions to easily identify hazards and risks early on. This can result in reliable predictions and proactive controls of the gold-processing technology, which adds value to the ASM's inherent ingenuity.

The 'risk' framework

Standards Australia/Standards New Zealand Committee (2009) suggests that the risk management model should ensure the integration and sustainability of health and safety. Such integration is prescribed by the international standard for risk, ISO 31000, as shown in Figure 9.1. The complex interactions between different risks, unique workplace conditions and recent evolution of mechanised technology together establish the context: the first step of the risk management process. This complexity requires that a range of different approaches must be employed to identify the risks. The next step is risk identification. In the case study research, the risk identification element involved collecting data in the form of fieldnotes, audio recordings, transcripts and surveys. Another data source included a set of on-site video recordings. From the data, which covered broad to specific issues of concern, risks were identified and categorised. After this, the risk analysis stage proceeded in agreement with the sequence of elements in the process, as shown in Figure 9.1.

In the risk analysis step, the data collected is analysed to rank the risks based on the severity and frequency of risks. These are prioritised in terms of seriousness and relevance to stakeholders. The risk analysis and evaluation process utilises the risk identification data to holistically inform the introduction and implementation of the proposed gold-processing plant. Risk evaluation is then performed to identify the more serious risks that need risk treatment. Therefore, the output of the risk assessment steps is developed by collating the health, safety and other risks that need to be considered and managed. The risk treatment element of the process determines how these risks might be managed by suggesting controls that can prevent, mitigate or manage the risks. The output from the risk management process can then be incorporated into a project to help ensure successful implementation and sustainable operation of innovative gold-processing plants by the miners in different Philippine contexts. In doing so, the risk-based model should identify how the plant will impact the ASM miners' health and safety, and inform stakeholders how the risks can be reduced and managed accordingly. The model should also highlight if there are risks that the plant may not directly address or may exacerbate, so these can be addressed as well.

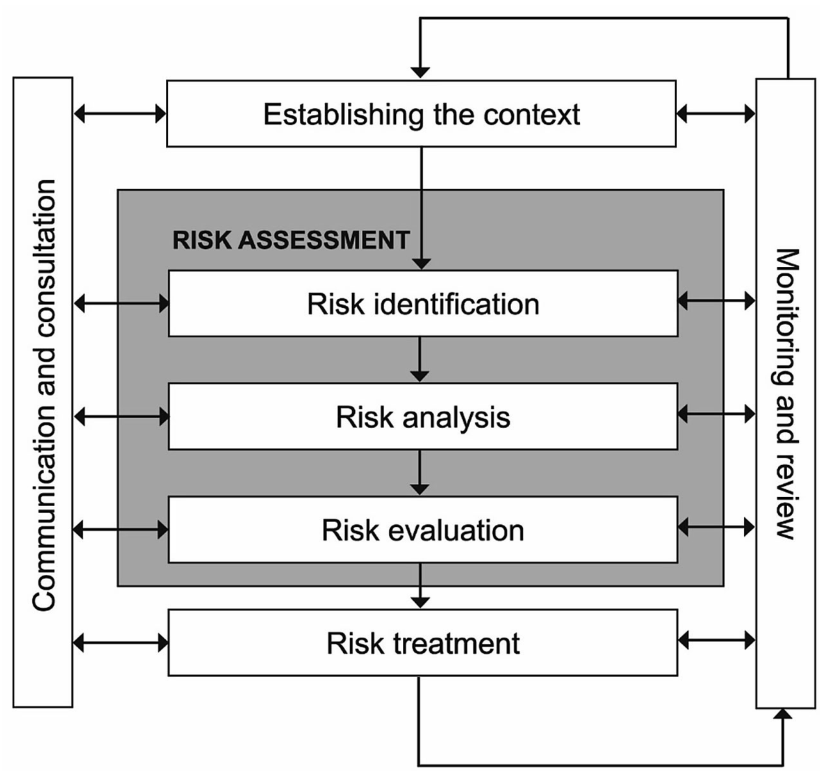

Figure 9.1: The risk management process

Source: AS/NZS ISO 31000:2009.

Methodology trialled

To understand the risks and health and safety considerations associated with introducing mechanisation into ASM, it is necessary to grasp the true ASM context and to understand stakeholders' views about the impacts of the proposed project. In certain cases, it is only through immersion into a community that the full impact and contextual relevance of projects can be understood. This risk-based immersion methodology was used to gain insights into the range of impacts that mechanisation can have on the ASM communities in the Philippines.

Risk identification using field interviews was conducted among representatives from the stakeholder groups. Semi-structured interviews and participant observation were exploratory in nature and aimed to provide baseline information about risks, especially health and safety considerations in gold processing in ASM communities. For the purposes of the case study, semi-structured interviews were conducted in four stakeholder groups, including the technical group (technology providers and other technical experts, external to the processing plant project), the government group (national and local government units), the social group (non-government organisations, civil society organisations, community staff of the processing plant project) and the ASM gold group.

The interview part of the data collection was focused on understanding the Philippine ASM. The interview questions were designed to allow the stakeholders to discuss their work and their perceptions, and to collect information about health and safety. Information was gathered regarding stakeholder perceptions of the impacts that the proposed gold-processing plant might have on the health, safety and other risks associated with ASM activities. These helped reveal the level of acceptance of the proposed technology amongst relevant stakeholders, who will be directly affected by the changes brought about by its actual implementation. The interview questions focused not just on health and safety issues, but also on the equally important dimensions of environment, social and institutional policy and regulation, and governance.

Another important aspect of the risk-based immersion methodology were the insights that resulted from the on-site field observations of the current system of gold processing in different Philippine contexts, which included the two major ASM provinces of the country—namely, Benguet and Compostela Valley. ASM miners were observed going about normal work activities in their natural work settings. These observations were conducted to collect information on the actual conditions at the ASM gold-processing sites, and about the miners' typical workday, including their processes, activities and the equipment they use. Risks and hazards were identified in the working conditions, equipment used and techniques performed. Observations were also made to include the manual and mechanised techniques the ASM miners used to process their gold. A comparison could then be made with the risk perceptions collected, and it helped to understand the details that should not be overlooked during hazard identification by the people designing and implementing mechanisation within ASM contexts.

Observations, including manual and mechanised techniques in the current gold processing of the ASM miners were recorded using a video camera for an hour. This was done to capture as many details as possible about a typical working day in an ASM community, within time constraints, in order to make the hazard identification step effective. Video recording was required for thorough analysis of the entire workplace environment, and it was also a practical way for the researcher to have primary data records to review as often as needed during the data analysis stage of the research. Fieldnotes were also taken to complement video recordings as much as possible.

Key lessons from fieldwork

Important understandings of strengths and limitations emerged when the research methodology was put into practice. Their analysis offers reflective insights in confirming whether the research goals were adequately achieved at this stage of the research study. Additionally, this analysis provides insights into whether it is possible to integrate health and safety risk management into mechanised gold-processing projects.

Strengths

The interview process predominantly used open-ended questions. Initial questions about risk were framed in a general way, so that the participant could openly express which among the risks relating to artisanal and small-scale gold processing was most relevant to them. The open-ended questioning method encouraged participants to raise diversely prolific data relating to the range of threats, opportunities and risks relevant to each stakeholder group. As Creswell (2003) stated on socially constructed knowledge claims, broadly designed questions allow participants to construct the meaning of a situation. Such meaning is a product of actual experiences and a series of interactions. Creswell argues that open-ended interviews are better as they can focus on specific contexts in which people live and work, in order to understand the historical and cultural settings of the participants.

Employing open-ended questions also allowed the participants to express their expectations of the innovative gold-processing plant project. Discussions regarding stakeholder expectations revealed their experiences and perspectives regarding the interventions that attempted to affect change. This created an inclusive space, especially for the ASM miners, in a manner that provided a sense of ownership. For instance, one miner's association in Benguet attributed the reduction in mercury use among its members to a synergy of local efforts and external collaboration. External support alone often furthers the cause only to a certain extent. It was interesting to know that there have been many organisations and government projects that have visited these communities through the years, with similar environmental objectives. Thus, two separate insights were derived: either the environmental outcomes are still yet to be fully realised in the area, or there is simply unnecessary duplication of projects and strategies.

Video recording facilitated an in-depth analysis of health and safety hazards and risks among the artisanal and small-scale mining and processing sites visited. The video recordings also show examples of how risks to health and safety from the gold-processing operations can be potentially increased if mechanisation is applied in the absence of complementary safety measures. It was observed and recorded on video that there was locally fabricated machinery, which was operated to some locally determined standards. It was quite evident how the safety features were suppressed in some cases. With the lack of capital and appropriate technical knowhow, the ASM miners and their families remain exposed to risks in such hazardous working conditions.

There were three sources of mechanised technology apparent in the ASM provinces, captured in the participant observation. First was the application of local ingenuity in order to meet local conditions. The miners find a way amongst themselves and within their community to improve their practices. This is more culturally influenced and can remain within the bounds of traditional practices. This confirms the observations cited from literature (Priester et al. 1993; Hentschel et al. 2002). Another source was the financier's scheme, which can be driven to improve efficiency in order to enhance profit. Financiers support the ASM through the provision of mechanised equipment, under a shared profit scheme. This is a similar arrangement to that found with the small-scale miners in Ghana, where foreign businessmen assist the miners technically and financially in the form of mine support services (Hilson et al. 2014). Finally, there are external sources, such as government projects and foreign investments, which can be driven by both efficiency and risk reduction, especially when they are initiated by government institutions.

The interviews generated rich data. However, it was not always easy to gauge stakeholder perceptions of the significance and prioritisation of the issues and risks, which are important information for those that need to make informed decisions about the development of context-specific technical solutions. It was beneficial to supplement the interview information with a survey instrument that collected participant perceptions on the significance and ranking of different types of risks. To do this, a conjoint rating and categorisation instrument was created. The rating component comprised a six-point scale, where 1 = lowest risk priority and/or slightly relevant to the participant's stakeholder group and 6 = highest risk priority and/or highly relevant to the participant's stakeholder group. The categorisation component allowed the participant to provide feedback for each of the different risks: health and safety, technical, social, environmental and regulatory. The use of two different methods—interview and survey—was beneficial because it helped to neutralise limitations or biases that have been recognised in literature (Creswell 2003). For example, the results from one method can help develop or inform the other method (Greene et al. 1989). Alternatively, one method can be nested within another method to provide insight into different levels or units of analysis (Tashakkori and Teddlie 1998).

Limitations

The responses reveal an overlap associated with perceptions of the different risks (technical, social, environmental, health and safety and regulatory). There seemed to be a lack of clear distinction of each type of risk. For example, with respect to health and safety risks and environmental risks, participants seem to use these terms interchangeably. Similar responses indicating this lack of distinction were obtained from among the ASM miners, the government, partners and even some technical persons. Others use the word 'safety' even if they actually mean security issues arising from conflict. This mismatch of perceptions and expectations among stakeholder groups can introduce confounding findings within results. To overcome this limitation and because the research objectives were focused on health and safety, probing keywords were used, such as sickness, injuries and accidents, to delineate the blurred lines between health and safety and the other different types of risk.

Another limitation that was encountered was the finding that some of the government agencies and relevant stakeholder groups have limited knowledge about the project. Although this finding may be unexpected, it is fairly reasonable, given that the gold-processing plant project was still in its pre-construction stage when the fieldwork was conducted (2015). The limited information at this stage of the project can be acknowledged as a barrier to collecting sufficient data to support claims regarding the project implementation. However, some respondents were conservative in giving information about the project. Reluctance and ambivalence were common responses from stakeholders due to a degree of incompleteness. Indeed, the design and construction stages may still represent the project in its early state. However early, this stage should not be regarded as a premature time to discuss the appropriate framework to explore potential and perceived risks.

Conclusion

ASM is adopting mechanised technology in order to improve efficiency of gold processing and reduce environmental risks. In a given context, the exact purpose is driven by the source of the mechanised technology, which includes local ingenuity, financers' schemes and external sources. With the ongoing efforts of the government to improve the efficiency and mitigate environmental impacts through projects involving mechanised technology, there is an opportunity to formally include health and safety considerations.

Based on the experiences and lessons from the recent fieldwork in two Philippine ASM provinces, important health and safety risks were identified and recognised among the artisanal and small-scale mining and processing sites visited, and these risks should be addressed. However, without appropriate technical and risk management know-how, the miners and their families remain exposed to the risks associated with hazardous ASM working conditions. The risks to health and safety from the gold-processing operations can be potentially increased if mechanisation is applied in the absence of explicit health and safety considerations. There is a lack of clear distinction between environmental risks and health and safety risks, as though these two domains can be used interchangeably. This can result in some unwanted consequences due to mismatch of perceptions and expectations.

To successfully implement sustainable and effective mechanised technology in ASM contexts, it is necessary to understand the range of risks and perceptions from different stakeholder perspectives. One way to understand risk is by immersion-based research. As shown with the case study conducted in the ASM provinces of Benguet and Compostela, rich data on risk and perceptions can be collected from immersion-based research. The data was cross-examined and analysed to identify common themes. These themes can be used to form a risk management framework that helps people make informed decisions on how technical solutions can be best integrated within ASM contexts to minimise health, safety and other risks that can adversely impact the successful implementation and ongoing sustainability of a technology.

References

Alternate Forum for Research in Mindanao, Inc. (AFRIM), 2012. *A Background Study on the Small-Scale Gold Mining Operations in Benguet and South Cotabato and their Impact on the Economy, the Environment and the Community*. Quezon City, Philippines: Bantay Kita/Action for Economic Reforms.

Bugnosen, E., 1998. *A Preliminary Assessment of Small-Scale Mining Legislation and Regulatory Frameworks*. UK: Department of International Development, Intermediate Technology Development Group.

Bugnosen, E., 2002. *Country Case Study on Artisanal and Small-Scale Mining: Philippines*. England: International Institute for Environment and Development.

Buxton, A., 2013. 'Responding to the Challenge of Artisanal and Small-Scale Mining: How can Knowledge Networks Help?' *IIED Sustainable Markets Papers*. London: International Institute for Environment and Development.

Creswell, J.W., 2003. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. 2nd edition. Thousand Oaks: Sage Publications.

Greene, J.C., V.J. Caracelli and W.F. Graham, 1989. 'Toward a Conceptual Framework for Mixed-Method Evaluation Designs.' *Educational Evaluation and Policy Analysis* 11(3): 255–74. doi.org/10.3102/01623737011003255

Hentschel, T., F. Hruschka and M. Priester, 2002. *Global Report on Artisanal & Small-Scale Mining*. Minerals Mining and Sustainable Development, no. 70. International Institute for Environment and Development, World Business Council for Sustainable Development.

Hermanus, M.A., 2007. 'Occupational Health and Safety in Mining Status, New Developments, and Concerns.' *Journal of The South African Institute of Mining and Metallurgy* 107(8): 531–8.

Hilson, G., A. Hilson and E. Adu-Darko, 2014. 'Chinese Participation in Ghana's Informal Gold Mining Economy: Drivers, Implications and Clarifications.' *Journal of Rural Studies* 34: 292–303. doi.org/10.1016/j.jrurstud.2014.03.001

Hruschka, F., 2011. *Swiss Agency for Development and Cooperation (SDC) Experiences with Formalization and Responsible Environmental Practices in Artisanal and Small-Scale Gold Mining in Latin America and Asia (Mongolia)*. Available at doc.rero.ch/record/30885/files/05-GoldMining_LatinAmericaAndAsia.pdf

Lahiri-Dutt, K., 2004. 'Informality in Mineral Resource Management in Asia: Raising Questions Relating to Community Economies and Sustainable Development.' *Natural Resources Forum* 28(2): 123–32. doi.org/10.1111/j.1477-8947.2004.00079.x

Lu, J., 2012. 'Occupational Health and Safety in Small-Scale Mining: Focus on Women Workers in the Philippines.' *Journal of International Women's Studies* 13(3): 103–13.

Marriott, A., 2008. 'Extending Health and Safety Protection to Informal Workers: An Analysis of Small Scale Mining in KwaZulu-Natal.' Research Report No. 76. Durban: School of Development Studies, University of KwaZulu Natal.

Mines and Geosciences Bureau, 2016. 'Mining Industry Statistics.' 5 August. Available at www.mgb.gov.ph/images/MIS_1997-present-5 Aug16.pdf

Mutagwaba, W., R. Mwaipopo-Ako and A. Mlaki, 1997. 'The Impact of Technology on Poverty Alleviation: The Case of Artisanal Mining in Tanzania.' Research Report No 97.2. Dar es Salaam: Inter Press Tanzania Ltd.

Nuwayhid, I.A., 2004. 'Occupational Health Research in Developing Countries: A Partner for Social Justice.' *American Journal of Public Health* 94(11): 1916–21. doi.org/10.2105/AJPH.94.11.1916

Priester, M., T. Hentschel and B. Benthin, 1993. *Tools for Mining: Techniques and Processes for Small-Scale Mining*. Germany: Friedr. Vieweg & Sohn Verlagsgesellschaft mbH (Informatica International, Incorporated).

Rawls, J.J., R.J. Orsi and M. Smith-Baranzini, 1999. *A Golden State: Mining and Economic Development in Gold Rush California.* Berkeley: University of California Press.

Standards Australia/Standards New Zealand Committee, 2009. 'AS/NZS ISO 31000:2009 Risk Management—Principles and Guidelines.' November.

Tashakkori, A. and C. Teddlie, 1998. *Mixed Methodology: Combining Qualitative and Quantitative Approaches*. Applied Social Research Methods Series (Vol. 46). Thousand Oaks, California: Sage Publicaitons.

Verbrugge, B., 2014. 'Capital Interests: A Historical Analysis of the Transformation of Small-Scale Gold Mining in Compostela Valley Province, Southern Philippines.' *The Extractive Industries and Society* 1(1): 86–95. doi.org/10.1016/j.exis.2014.01.004

Verbrugge, B. and B. Besmanos, 2016. 'Formalizing Artisanal and Small-Scale Mining: Whither the Workforce?' *Resources Policy* 47: 134–41. doi.org/10.1016/j.resourpol.2016.01.008

Weber-Fahr, M., 2002. *Treasure or Trouble? Mining in Developing Countries*. Washington, DC: World Bank and International Finance Corporation.

This text is taken from *Between the Plough and the Pick: Informal, artisanal and small-scale mining in the contemporary world*, edited by Kuntala Lahiri-Dutt, published 2018 by ANU Press, The Australian National University, Canberra, Australia.

doi.org/10.22459/BPP.03.2018.09