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MINING AND THE ENVIRONMENT IN INDONESIA: LONG-TERM TRENDS AND REPERCUSSIONS OF THE ASIAN ECONOMIC CRISIS

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Abbreviations and Acronyms

ANDAL	Environmental assessment report
AMDAL	Procedures for environmental impact assessment
ARD	Acid rock drainage
ASM	Artisanal and small-scale mining
BAPEDAL	Indonesian Environmental Impact Management Agency
BLT	*Biro Lingkungan dan Teknik*, Bureau of Environment and Technology
CCOW	Coal contract of work
COW	Contract of work
DGM	Directorate General of Mines
DTPU	Directorate of Technical Mining
EIA	Environmental impact assessment
MME	Ministry of Mines and Energy
MOF	Ministry of Forestry
MoFEC	Ministry of Forestry and Estate Crops
NGO	Non governmental organization
OSM	Office of Surface Mining Reclamation and Enforcement, U.S. Dept. of Interior
RKL	*Rencana Pengelolaan Lingkungun*, Environmental management plan
RPL	*Rencana Pemantauan Lingkungun*, Environmental monitoring plan
TA	Technical assistance

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Acknowledgements

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The report was prepared by Mr. Gary McMahon (EMTIM) and Ms. Elly Rasdiani Subdibjo with contributions from Ms. Jean Aden (EASES); Mr. Aziz Bouzaher (SASEN); Ms. Giovanna Dore (EASES); and Ms. Ramanie Kunanayagam (CMNPO). Additional comments and peer review were provided by Mr. Kirk Hamilton (ENV); Mr. David Hanrahan (ENV); Mr. Robert Scouller (EACIF); Mr. John Strongman and Peter van der Veen (EMTIM). Ms. Anju Sachdeva (EASES) formatted and produced the report.

Executive Summary

Despite years of steady and considerable progress in socio-economic development, Indonesia was one of the first countries to feel the brunt of the East Asia financial crisis in 1997. Because of the traditional dependence of the country on its natural resource base leading to unsustainable use levels and considerable degradation threats over time, serious concerns have arisen regarding the extent to which the economic crisis would lead to environmental neglect and further undermining the sustainability of natural resource use.

This study focuses on the potential environmental impacts of the economic crisis in the mining sector in Indonesia. The findings and recommendations in this study are summarized from two separate but complementary studies undertaken during the past two years by the World Bank (forthcoming): an analysis of current environmental issues in Indonesia and a regional assessment of the environmental implications of the East Asian economic crisis, with a particular emphasis on the sustainability of natural resource management. Because of the short time elapsed since the onset of the crisis and the time lags involved in identifying impacts, the present study examines the long-term relationship between the mining sector and the environment, as well as more specific crisis-induced changes or repercussions.

It was conjectured that the economic crisis would lead to an expansion of mining activities in Indonesia for various reasons, including promotion of the sector by the Government of Indonesia in order to increase foreign exchange and tax revenues, the fall in local production costs due to the large currency devaluation, and a poverty-driven increase in small-scale mining. An increase in mining would have implications for the environment from nothing other than the scale effect. In addition, it was expected that fiscal contraction and short-term policy objectives would lead to weakening monitoring and enforcement by regulatory agencies which would further undermine environmental objectives.

The results of the current studies--keeping in mind the limited nature of the data collected--present a mixed picture of the environmental performance of the mining sector in Indonesia. The sector's overall track record is mostly driven by longer-term trends and policies similar to trends in other parts of the world, particularly in the large- and medium-scale metal and coal mining sectors. Table 1 below gives a broad--albeit partial--picture of the costs and benefits associated with mining activities. The sector's substantial financial contribution to the economy (over US$5 billion annually) comes with important social and environmental dislocations (close to US$ 0.5 billion in estimated annual environmental mitigation costs alone), some of which are yet to be well identified and understood (such as long-term impacts of acid rock deposition on terrestrial and aquatic biological resources). One of the important findings in this study relates to the artisanal and small-scale--gold and to a lesser extent coal--mining sector, which experienced the greatest impact from the economic crisis, resulting in immediate and visible environmental degradation with potential long-term damage, especially from mercury contamination. In this case, lessons from the crisis point to the need to strengthen the institutional framework to effectively deal with both the current situation and potential future crises.

The environmental impact of the mining industry in Indonesia before the crisis was not considered substantial, although there were some disturbing trends which are still ongoing. The crisis did bring about some important changes in mining, often with potentially serious implications for the environment. However, the types of changes and their motivation have been, for the most part, quite different than expected. First, the main areas of concern are medium-scale and small-scale mines. Second, the large increase in small-scale mining has not been primarily poverty driven. In addition, and perhaps more importantly, the sweeping political changes and the uncertainties surrounding the decentralization process, have given rise to new claims by local communities over resource use rights and revenues from mining projects. This situation, combined with weak monitoring and enforcement may lead –at least in

the short-term-- to further negative impacts on the environment (e.g., non permitted mining, temporary or early closures by large scale miners).

Table 1. Estimates of Annual Costs and Benefits of Mining Activities in Indonesia (million US$)

	Environmental Expenditures	Land Reclamation[a]	Other Costs (productivity loss)[b]	Value of Output
Large-scale/ Coal	10	5-7 (26-39)		1,300
Large-scale/ Metal	65	100 (550)		3,500
Medium-scale/ Coal	3	4-6 (22-34)	82	425
Artisanal and small-scale	(no data)	177 (1,000)		
TOTAL	78	286-290	82	5,225

Source: Study team

[a] Annual equivalent of rehabilitation cost over 10 years using a 12% discount rate. Numbers in parentheses refer to estimated total reclamation cost over a period of 10 years.

[b] Annual cost over seven years (see text for details)

By international standards, most of the large-scale mines appear to have up-to-date technology and practices. Large-scale mining only began to develop significantly when the Government began to promote mining in the 1980s. While there have been some concerns about the environmental impact of particular mines, most of these had improved their performance even before the onset of the crisis, and here is no evidence that their environmental performance has deteriorated since the crisis began. In addition, no new large mine has opened in the country since the onset of the crisis.

Medium-scale mining, especially coal, also began to expand in the 1980s. The environmental performance of most medium-scale mines is considered poor to very poor. Given the number of recent applications, it is likely that there will be a large increase in medium-scale coal mines as domestic operating costs have fallen dramatically due to the real devaluation of the rupiah and, unlike most metals, the crisis has had little effect on coal prices. An improvement in the performance of coal mines was an important part of the mining sector environmental technical assistance component (BLT-OSM project) in the World Bank Sumatra-Kalimantan Power Project, undertaken by the Bureau of Environmental Management (BLT) in the Directorate General of Mines, and Office of Surface Mining Reclamation and Enforcement (OSM) in the U.S. Department of the Interior. Although a proposed second mining and environment component was recently dropped from the Sumatra-Kalimantan Power Project, a similar type of effort should continue to be a top priority of the Indonesian government. The opportunity for win-win solutions is particularly viable for the coal sector, where enormous amounts of valuable but heavily polluting coal fine particulates are lost each year due to poor production methods.

Artisanal and small-scale mining (ASM) in Indonesia is undertaken with little or no environmental care. Until the 1980s ASM was quite small with limited damage. However, steady growth in the decade before the crisis and a substantial increase in ASM in Indonesia has significantly changed that situation. The results of two surveys undertaken for this study indicate that the main reasons for the significant increase in the size of ASM are higher returns in domestic currency and a partial breakdown in law and order. In short, no one is preventing people from undertaking illegal mining and the miners earn much more than in their traditional economic activities, often as much as five or ten times higher. In general, ASM activities have strong community support and their high financial returns do not account for environmental externalities. It is clear that the Government is aware of the environmental problems caused by ASM, but to date it has either not been able or not been willing to prevent them. Moreover,

given the more widespread experience of the potential returns to mining, it does not seem likely that the end of the crisis will result in an exodus from ASM. Innovative, long-term solutions, likely of a win-win nature, are needed to reduce environmental degradation. In many cases it will be necessary to find cooperative solutions between the small-scale miners and larger mining companies when the former operate on the concessions of the latter. However, the feasibility of any solution will depend significantly on the ability to enforce corrective measures for violations.

According to both the Directorate General of Mines and the BLT-OSM project the pre-crisis level and quality of environmental monitoring and enforcement was inadequate in Indonesia. Although there does not seem to have been any decrease in the amount of environmental monitoring since the crisis, the current situation may call for an increase given the expansion of ASM and medium-scale activities. Decentralization of monitoring and enforcement activities to the regional and municipal levels is the biggest institutional challenge facing the Ministry of Mines and Energy. Institutional and skill capacities do not currently exist in sufficient quantities at these lower levels of government; although considerable training has taken place, including 12 regional offices, under the mining sector environmental technical assistance project. It is therefore essential that these capacities be developed where necessary. A new phase of this technical assistance project would be a clear demonstration of the commitment of the Government to environmental protection in the mining sector.

There is also a great need to raise awareness of the public on the costs and benefits of different types of mining and processing techniques. The public and the media are often ignorant or misinformed of the potential environmental impacts of mining, whether it is heavily sophisticated, large-scale mining; or "pick and shovel" artisanal mining. An important role of the Government is to ensure that stakeholders are informed with respect to both the positive and negative consequences of new mining developments, as well as empowered to be part of the decision making process.

This study proposes a number of recommendations based on the assessments made so far of the environmental impacts of the East Asian economic crisis on the mining sector in Indonesia. While details are given in Table 2 below, some broad recommendations follow:

Short-term recommendations

- Ensure that there is no erosion in the credibility of the regulatory framework and--given budgetary constraints--identify areas of greatest impact for stricter monitoring and compliance; and focus attention on risks to human health and potential irreversible resource degradation impacts (which include strict compliance with environmental management plans for waste disposal in large- and medium-scale mines, and community outreach to minimize the impact of mercury and production practices in ASM).
- Take strong steps to strengthen intra-agency and inter-agency coordination, both nationally and at the local level, and strengthen local staff training and outreach capacity. Identify other organizations that can play a role in monitoring and enforcing environmental due diligence in partnerships with local governments.
- In dealing with ASM issues, raise awareness and involve key stakeholders and local communities in problem assessment, prioritization and policy decisions, as well as program implementation.

Long-term recommendations

- Review the sector's incentive and regulatory frameworks in order to cover ASM and strengthen compliance and enforcement across the board.
- Strengthen the social and environmental impact assessment procedures to include risk assessment of major and long-term impacts on community values and access to resources, human health, and ecological resources; to cover ASM; and to require explicitly the use of benefit-cost analysis as part of the permitting process. In addition, the evaluation and use of resource rents for There needs to be

a recognition that resource rents are finite, requiring careful long term planning, through which the revenue accrued through mining can be converted into other forms of capital that will ensure sustainable development. This is especially important in the decentralized context, as mining projects will inevitably become the main source of revenue in mineral rich regions.

- Initiate a comprehensive research and data collection program in collaboration with communities, NGOs, academic institutions, and the mining industry, in order to better understand baseline conditions, and provide assistance to decision makers and local communities for assessing the trade-offs involved in further developing mining in the country.

Next Steps

- An immediate action plan drawn from the above general recommendations could include the following three initiatives, which are described in greater detail in the Conclusions and Recommendations section at the end of the report:
- Extend environmental management technical assistance to Ministry of Mines and Energy and local government.
- Launch a public awareness program on the effects of use of heavy metals in mining on human health, in partnership with Ministry of Health, and accompanied by technical assistance to small-scale miners.
- Promote stakeholder consultation and cooperation between large-scale mines and local miners and between local communities and operating companies. Sponsor a workshop to develop stakeholder consensus on next steps.

Table 2. Recommendations on Key Environmental Issues in Mining

Key environmental issues	Short-term recommendations	Long-term recommendations
Large-scale mines • Risk of major accident (tailings spill) • Acid rock drainage (ARD) • Poor or mediocre reclamation	• Focus EIA on major risks and consequences • Identify and target potential trouble spots for extra monitoring and enforcement • Strengthen reclamation bond program	• Research on elements of good practices in reclamation of mining land • Collect case studies of the quantitative and qualitative effects of environmental damage in sampling of mines
Medium-scale coal mines[a] • Loss of forest cover • Poor management of top soil • Loss of fine coal particulates due to lack of recovery circuits • Inadequate sediment ponds • Poorly designed catchment areas • Significant ARD from tailings	• For new applications/permits focus on EIA of major impacts and credible implementation of environmental management plans • Train government and private mining personnel in identification and solution of environmental problems • Pilot environmental audits for existing mines, emphasizing "win-win" pollution prevention options • Target inspections and audits to potential trouble spots and worst offenders • Strengthen reclamation bond plan	• Expand training, especially in outlying regions with largest mining sectors • Strengthen enforcement capabilities, including introduction of schedule of penalties for offenders, increasing for repeat offenders • Engage stakeholders in developing standards for acceptable losses of fine coal particulates, and introduce technical training and pilot programs for fine coal recovery circuits • Make audit results public
Medium-scale mines (non-coal) • Weak day-to-day environmental performance • Loss of forest cover • Lack of reclamation on closure	• Target inspections and audits to potential trouble spots and worst offenders • Train government and private mining personnel in identification and solution of environmental problems • Strengthen reclamation bond plan	• Expand training, especially in outlying regions with largest mining sectors • Strengthen enforcement capabilities, including introduction of schedule of penalties for offenders, increasing for repeat offenders • Make audit results public
Artisanal and small-scale mining • Total absence of environmental management • Health effects from mercury pollution • Loss of forest cover	• Pilot mini audits and environmental training • Target worst offenders in relatively accessible areas of high environmental and cultural sensitivity • Investigate potential for partnerships between large-scale concession and ASM operators within concession boundaries • Raise public awareness of environmental and health effects of dangerous practices, and start pilot projects on better environmental technology and management, with mercury use receiving highest priority	• Extend permitting, including EIA for ASM • Expand environmental training programs for ASM operators • Close down worst offending areas • Compare studies from other countries on adaptability of solutions to problems in ASM gold mining
Institutional development • Lack of trained personnel • Poorly defined roles, overlapping responsibilities • Lack of coordination	• Improve EIA quality and linkage with permitting decisions • Strengthen coordination between MME and BAPEDAL focusing on improving EIA and standardizing environmental monitoring in the mining sector • Enhance coordination between MME and MoFEC, focusing on EIA review and consensus on reclamation goals • Continue training of inspectors, especially at regional centers • Engage industry associations, MME, NGOs, and local governments in discussion on problems and solutions • Emphasize enforcement including schedule of penalties	• Educate public on environmental and health dimensions of mining • Update and strengthen EIA procedures • Collect data set on environmental degradation caused by mining, including baseline conditions

Source: Study team

[a] Problems in this category were identified in BLT-OSM project. Other problems noted below related to medium-scale mines in general are also problems for coal mining.

1. Introduction

During the period of rapid growth that preceded the economic crisis, Indonesia's mining sector averaged 5.1 percent annual expansion from 1990-96. However, while non-oil, non-gas mining has been a growth sector and supplier of energy for export and domestic use, the environmental scale effects accompanying its growth have been substantial. These effects have included extensive land disturbance, loss of forest cover and habitat, contamination of rivers used for drinking water and food supplies, and increasing social conflict over access to mineral resources.

Several hypotheses have been offered to explain the potential impact of the East Asia economic crisis on the mining sector in Indonesia. Impacts of the economic crisis were expected to vary by scale of operations. For the large-scale multinational mining firms, whose profitability is judged in dollars and not the local currency, the currency devaluation and fall in real wages (in U.S. dollar terms) induced by the crisis would mean a significant drop in the cost of mining production. This would create a supply-side incentive for mining firms to invest and produce more.

At the level of artisanal and small-scale mining (ASM), during economic crises, people experiencing loss of income and those already living in poverty would be expected to be attracted to ASM, because entry requires little capital or skills. In the short term, the most significant changes in production levels therefore would be in ASM.

Under crisis conditions, Government might be expected to look to mining exports at global market prices to generate additional foreign exchange and tax revenue, stabilize the failing exchange rate, and keep the fiscal deficit under control. However, the contract of work (COW) system used in Indonesia makes it difficult, if not impossible, to increase tax rates on existing operations. Hence, tax revenues can only increase in the short run if existing operations increase production or profits.

These potential economic impacts of the crisis suggest several environmental implications. First, an increase in mining activities would result in more environmental damage, even if accompanied by similar environmental investments and precautions as has been the case in the past. Second, ASM operations tend to be heavy polluters relative to their output, are ordinarily difficult to monitor, and rarely comply with environmental regulations. Third, there is the possibility of significant budget cuts to the departments responsible for environmental monitoring and enforcement, which could result in reduced monitoring and relaxation of environmental requirements.

Community benefits from mining are a major issue in Indonesia, often superseding environmental concerns. On one hand, communities often tend to ignore environmental damage from mining if there are significant economic benefits. On the other hand, the economic benefits to the community, especially in the long term, can be greatly diminished by environmental damage.

The report is organized in seven sections. Section 2 contains a brief description of the Indonesian mining industry. Section 3 discusses the pre-crisis and current situations of large-scale mines in Indonesia, including the changing social landscape. Section 4 analyzes medium-sized mining, with an emphasis on coal mines. Section 5 discusses ASM with findings from two surveys undertaken for this study. Section 6 examines the institutional situation in Indonesia with respect to the mining sector, especially environmental management. The last section wraps up with conclusions and recommendations.

2. Overview of the Mining Sector in Indonesia

The mining sector in Indonesia consists of three mine types: large-scale, medium-scale, and artisanal and small scale. Each has distinct characteristics and has been affected differently by the economic crisis. Small-scale mining uses mechanization and at times heavy equipment, but artisanal mining relies mostly on hand tools and no mechanization. This study refers to these two types of mines jointly as ASM.[1] The three mine types need to be treated separately from both production and environmental viewpoints.[2]

The economic crisis in Indonesia has not led to a significant change in levels of mining investment and production in large-scale mining, largely due to a drop in prices of the important metals produced in Indonesia, (Table 2.1). This drop in prices has been due to a decrease in global demand for metals, as supplies have been roughly stable (Table 2.2). As a consequence, global investment in mineral exploration fell from US$4.0 billion in 1997 to US$2.8 billion in 1998.

The main products of mineral mining in Indonesia from 1990 to 1998 were gold, silver, copper, nickel, tin, and coal (Table 2.3). Large-scale mines produce all minerals except tin, while medium-scale mines produce all minerals except copper. The dominant product of artisanal and small-scale mining is gold, although coal production has become more prevalent in recent years. The mining sector provided 8.2 percent of Indonesia's export revenues in 1996, 7.9 percent in 1997, and 14.0 percent in 1998.[3]

Table 2.1 Prices of Metals Produced in Indonesia, 1980-1999 (Unit: U.S. dollars)

	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Gold/oz.	845	463	384	354	322	345	348	322	333	306	282	276
Copper/ton	3,032	2,066	2,662	2,288	2,139	1,836	2,094	2,459	1,971	2,101	1,588	1,336
Nickel/ton	6,519	4,899	8,864	8,156	7,001	4,978	5,752	6,891	6,443	6,392	4,443	4,198
Tin/kg	16.4	11.5	6.1	5.5	6.0	5.1	5.0	5.2	5.3	5.2	5.3	4.8
Coal/ton	43	47	42	42	41	36	33	33	32	34	33	32

Source: Global Commodity Markets, World Bank, Washington, D.C.

Table 2.2 Global Metal Production, 1994-1998 Unit: 1,000 tons

	1994	1995	1996	1997	1998
Gold	2.140	2.097	2.130	2.249	2.254
Copper	9.576	10.175	11.100	11.449	11.772
Nickel	867.0	974.0	1.027	1.024	1.020
Tin	190.0	202.0	223.0	212.0	206.0
Coal	3.551	3.699	3.755	3.775	N/A

Source: London Metals Exchange, London, U.K.

[1] Industrial minerals such as sand, gravel, and limestone also have important environmental impacts, but they are not discussed in this study as the production, pricing, processing, and environmental characteristics are different from coal and metallic minerals.

[2] Type of technology and throughput of ore are most commonly used to define the different scales of mining. An ASM metallic mine has a throughput of less than 1,000 tons per day, a medium-scale mine produces 1,000 to 5,000 tons per day, and a large-scale mine has a throughput greater than 5,000 tons per day. Alternatively, a small-scale mine has annual sales of less than US$10 million and a medium-scale mine has annual sales of between US$10 million and US$100 million (World Bank, 1996: 48). In the coal sector, less than one million tons of coal production per year is considered small-scale, one million to five million tons per year is medium scale, and more than five million tons per year is large scale. Indonesia's Ministry of Mines and Energy does not classify mining activities by the scale of operations but by the type of mineral/s produced, and a letter system: "A" for minerals vital to the economy (gold, uranium); "B" for energy- related products (coal; oil, gas); and "C" for industrial minerals (sand, gravel, limestone) and small scale gold mining.

[3] The large increase in 1998 was due to the lower dollar value of exports whose prices are determined in rupiah in contrast to commodities (including minerals) whose prices are determined in U.S. dollars on global markets. The national accounts in Indonesia do not distinguish between oil, gas, and other minerals, so the contribution of non-oil, non-gas mining is not clear, although in dollar terms, this would also have increased substantially after the economic crisis.

Table 2.3 Mineral Production in Indonesia, 1990-1998 (Unit. 1,000 tons)

	1990	1991	1992	1993	1994	1995	1996	1997	1998 e/
Gold	.011	.0169	.017	.0416	.0425	.0633	.0836	.0898	.124
Silver	.0673	.0803	.0900	.0903	.1060	.2605	.2280	.2571	n/d
Copper	169.1	219.5	290.9	309.7	333.9	461.7	525.9	548.3	682.6
Nickel	68.6	66.1	78.1	65.8	81.2	86.6	87.9	75.3	76.4
Tin	31.7	30.1	29.4	36.1	38.5	46.1	51.0	55.2	52.2
Bauxite	1,205.7	1,406.1	803.5	1,320.4	1,342.4	899.0	842.0	808.7	804.0
Coal	11,000.0	14,000.0	16,000.0	28,000.0	32,000.0	41,000.0	50,000.0	55,000.0	n/d
Numbers of companies	n/d	n/d	n/d	n/d	15	21	47	37	32
Exploration expenditure (US$ millions)	n/d	n/d	n/d	n/d	69.6	108.2	191.3	227.1	136.4
Worldwide allocation (%)	n/d	n/d	n/d	n/d	3.27	4.02	5.43	5.64	4.82

The mining sector is regulated principally by the Basic Mining Law[4] whose most important provisions concern the classification of minerals, the form of organizations eligible to engage in mining, and the legal basis on which mining can be undertaken. To obtain a concession to explore and develop a medium-scale or large-scale mine in Indonesia, a company must apply for and receive a contract of work (COW) from the Ministry of Mines and Energy. The Government of Indonesia has changed the format of the contracts several times and mining companies entering into new contracts now use a seventh generation COW.[5] Although each company enters into a partnership agreement with the Government, the company operates the mine independently of the Government.

[4] For a more detailed discussion of the legal and regulatory framework, see Section 6.

[5] Currently, the eighth generation of Contracts of Work is under negotiation. The new COW will include significant changes in the socio-economic investments to be guaranteed by the mining companies and the percentage of revenues going directly to the communities residing within the boundary of the concession area.

3. Large-Scale Mining

Five large metallic mines and four large coal mines operate in Indonesia. Since the onset of the crisis, only one new mine – the Newmont copper and gold mine – has opened, the Freeport copper and gold mine (Irian Jaya) has almost doubled its size, and the Inco nickel mine (Sulawesi) started enlarging its operations.

Until the mid-1980s the only large-scale mines in Indonesia were the Inco nickel mine in Sulawesi and the Freeport copper and gold mine in Irian Jaya. Due to both declining oil reserves and the enormous capital needed to develop a large mine, the Government took steps to make mining more attractive to foreign investment in the 1980s. During the mid-1990s, mining contributed significantly to exports and tax revenues. Table 3.1 shows the recent evolution of export production and export revenues for the main metals from Indonesia, mostly from large mines. From 1994 to 1998, export revenues from non-oil, non-gas mining increased by 74 percent compared to a 22 percent increase in exports for all sectors.[6]

However, following the onset of the crisis, exploration investment dropped from US$227 million in 1997, to only US$136 million in 1998. COW applications declined from 286 in 1996-97, to 16 from October 1997 to April 1999. The exception to these downward trends is the number of contract of work applications for coal. Besides the economic crisis there are at least two other reasons for the decline in mineral investments. First, the Busang (or Bre-X) scandal greatly reduced risk capital for the sector in Indonesia.[7] Second, the political instability accompanying the economic crisis has dampened interest in investment. Given the substantial investments needed to develop a large mine—often over US$1 billion—companies are hesitant to invest in a country in political transition, where rules of the game can change unexpectedly, from relatively simple changes such as higher royalties to dramatic changes such as partial nationalization.

Table 3.1 Exports of main metals from Indonesia, 1994-1998 (US$ in millions; 1,000 tons)

	1994		1995		1996		1997		1998	
Commodity	Tons	US$	Tons	US$	Tons	US$	Tons	US$	Tons	US$
Coal	24.1	516.0	30.9	1.0	36.4	1.2	41.7	1.3	46.3	1.1
Tin	43.6	183.0	45.0	253.0	48.8	290.0	53.0	273.0	43.1	271.0
Nickel ore	1.8	25.3	2.1	40.4	2.1	36.1	2.4	37.5	2.3	24.1
Ferronickel	26.2	35.3	54.3	83.8	46.7	73.0	48.7	64.8	31.7	38.3
Nickel matte	46.0	217.3	46.1	301.8	39.5	247.5	32.4	174.9	32.7	145.1
Copper conc.	1.0	1.1	1.5	1.7	1.7	1.7	1.9	2.0	2.6	2.1
Gold	43.5	208.0	63.3	195.0	83.0	315.0	89.1	293.0	118.2	263.0
TOTAL		2.3		3.5		4.0		4.2		4.0

Source: Directorate General of Mines, Jakarta, Indonesia.

Production costs for foreign companies have fallen due to the decrease in domestic labor costs in U.S. dollars. However, the removal of a diesel subsidy has offset this saving to some extent. The costs to domestic-owned mines—both large- and medium-scale—have fallen in a much more dramatic fashion as they are more labor intensive and rely exclusively on domestic labor. There are reports of operating costs having fallen over 30 percent. However the price of coal has not been affected much by the crisis. Coal mining is the main activity for domestic-owned, medium-scale and large-scale mines. Given that there are only two large-scale domestic-owned mines, the economic impact on domestic-owned mines has been greater in medium-scale mining.

[6] As noted above, Indonesia national accounts do not distinguish between oil and gas and other minerals, and therefore the precise contribution of coal and metallic minerals is not known.

[7] Gold samples in Kalimantan were falsified and left a negative impact on the sale of stock offerings by junior mining companies around the world and, in particular, for Indonesia-related investments.

Environmental Effects

Given the area under exploitation, relative to the country's land area, the brief history of large-scale mining in the country, and relatively new technology, large-scale mining has had a relatively limited impact on the environment in Indonesia.[8] Less than one-quarter of one percent of Indonesian territory is dedicated to medium-scale and large-scale mining. Even including ASM, this figure is still well below one-half of one percent, the global average. Much of this land has minimal agricultural value, although there could be serious biodiversity concerns. Nevertheless, without proper risk assessment at the beginning of a project, mining operations can be vulnerable to catastrophic accidents with irreversible or long-term negative environmental consequences, especially via river systems.

The greatest risk arising from a medium-scale or large-scale mining operation is a major tailings spill. According to data from the United Nations Environmental Program, the United States Committee on Large Dams, and other sources, there have been 28 major tailings spills in the last 30 years, or approximately one per year worldwide.[9] Approximately 50 of the world's 10,000 active medium-scale and large-scale mines are in Indonesia; one tailings spill could cost Indonesia an estimated US$100 million for cleanup and compensation (not including the cost of a possible loss of biodiversity or other ecological functions).[10]

The Freeport mine in Indonesia recently increased the amount of ore processed from about 125,000 tons per day to over 200,000 tons per day. After a spill in 1990 with an impact covering an area of about 30 square kilometers (3,000 hectares), the company constructed levees of 35 and 40 kilometers in length to contain the tailings in a large delta down river from the mine. However, even if the tailings disposal area is being successfully revegetated,[11] none of the mine's options for tailings disposal and land reclamation practices are entirely satisfactory, as the potential long-term impacts of such practices are not entirely known.

The new Newmont mine also claims to be following good environmental practice; its tailings will be dumped into the ocean 3.2 kilometers offshore—submarine disposal—via a 42-inch diameter pipe at a depth of 120 meters. After dumping, the tailings will flow by gravity into the adjacent ocean trench that has a depth of over 3,000 meters. The tailings from the Newmont Minahasa gold mine in Sulawesi are deposited in the ocean at a depth of 25 meters. The tailings then flow to a depth of about 80 meters. There is concern that the tailings are mixing with surface water and killing aquatic life rather than moving further out to sea. However, an inspection by the director of the BLT-OSM project revealed no evidence of tailings in surface water, even at a depth of 75 meters (Hamilton, 1998a: 21). Nevertheless, tailings deposits at such relatively shallow depths remain controversial issue in mine environmental management.

Second to a tailings spill, acid rock drainage (ARD) is the most serious environmental concern for a mine operation, as its effects can last for decades or even centuries.[12] The cost of ARD prevention and associated risks are significant within the cost-benefit evaluation of a mining operation. In Indonesia, waste rock from the Freeport mine has been dumped in a mountain lake near the pit and has generated significant acid rock drainage. However, Freeport has recently taken strong measures to reduce and neutralize the ARD. It has built a new plant to treat and recycle acid water, and eventually will drain the lake and treat the soil.

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[8] For in-depth discussion of environmental concerns and potential solutions of large-scale mining, see Ripley et al (1996).

[9] "Chronology of Major Tailings Dam Failures" is available on the internet at http://antenna.nl/wise-database/uranium/mdaf.html. Although the author does not classify them as such, the large majority of these mines are likely medium-scale mines.

[10] Estimate is based on the US$100 million spent by Placer Dome for the medium-scale Marcopper mine spill in the Philippines.

[11] As confirmed by an audit by Dames and Moore (1996) and, more recently by the Bank-financed BLT-OSM technical assistant (TA) project.

[12] Acid rock drainage is water from mine waste and tailings which is made acidic by the oxidization of sulfide materials. It kills most forms of plant and animal life. To avoid ARD the waste must be covered by water or soil in an impermeable site.

The cost of large spill clean-ups can be imposing. By examining some recent cases, it is possible to get an idea of the magnitude of the clean-up costs and (generally much lower) indemnization costs. The 1998 spill at the Los Frailes lead-zinc mine in Spain could cost US$100 million to US$200 million in clean-up. In the Philippines, a spill at the medium-scale Marcopper mine under domestic management has cost its financial partner, Placer Dome, nearly US$100 million in clean-up and indemnization payments. There is currently a court case against the Omai gold mine in Guyana asking for US$47 million in damages for the 1995 spill in the Essequibo River. Without available figures, the clean-up and indemnization costs of the spill at the El Porco lead-zinc mine in Bolivia and the Surigao del Norte gold mine in the Philippines are estimated at less than US$10 million. None of these estimates includes values for actual or probable loss of biodiversity.

To date, there is no evidence that environmental problems in large-scale mining have significantly worsened since the onset of the crisis. Due to the pressure of NGOs and new environmental procedures, possibly environmental conditions in large-scale mining have improved. However, a recent assessment of environmental practices of medium-scale mines indicated that many medium-scale mines, especially in domestically owned mines, were operated in a haphazard way, leading to production losses and significant environmental damage.[13]

Table 3.2 Environmental and Social Problems by Mine or Mine Type in Indonesia [14]

Name/ mine type	**Environmental problems**			**Social problems**
Production/value[a]	***Land***	***Water***	***Other***	
Large Scale				
Freeport: gold and copper 57,665 kg gold, US$188 million 1.8 million tons copper concentrate, US$1.9 billion	• Large amounts of overburden and waste material deposited	• Tailings management, following 1990 spill, control is improving • Risk of ARD from overburden management	• Waste management • No significant risk of biodiversity loss but further studies needed • Introduction of exotic species (cats, dogs, fish)	• Conflicts among different ethnic groups, including cultural conflicts and upsetting of traditional power structures • Land conflicts • Demand by local government and local communities for a greater share in the benefits and management of mines • General social problems of large-scale mines (prostitution, alcoholism, violence, drug abuse) • Violence by Irianese (local) people toward other Indonesians and Westerners (March 96)
Minahasa: gold 6,414 kg gold, US$21 million		• Risk to aquaculture from submarine tailings deposits • ARD risk		• Ethnic tensions • General social problems of large-scale mines • Regional government claiming revenue benefits for itself in direct contravention to Jakarta

[13] Hamilton, 1998 b.

[14] The study does not evaluate the damage caused by downstream mining activities, of which the most important is smelting, as most metals mined in Indonesia are smelted in other countries. However, this could become a future issue. Inco is building a nickel smelter in Central Sulawesi. As the industry expands, the likelihood of downstream activities taking place in Indonesia will increase.

Kelian: gold 15,050 kg gold, US$49 million		• ARD problems being addressed • High levels of manganese in water	• Main mine pit difficult to reclaim; reclaiming alternative deforested area	• Creation of short-term cash economy • Uncertain sustainability after mine closure in 2 or 3 years • Demand that disputes and land claims are settled by customary law • Company is the main source of revenue for the newly formed regional government of West Kutai • Squatting by ASM miners and related problems (see ASM below)
Aneka Tambang (Pomalaa and Gebe Island): Nickel 2,830,000 tons of nickel ore, US$40 million	• Soil erosion--3 years of exposure before land reclamation • Until recently top soil mostly lost	• Sedimentation • Risk of ARD, need to contain acid generating materials for long time	• Poor practices for revegetation, including with tree planting, no cover crops • Sulfur-dioxide emissions from smelting	
Inco: nickel 32,406 tons of nickel matte, US$175 million		• Risk of ARD, need to contain acid generating materials for long time		• Cultural conflicts as tribal area • General social problems of large-scale mines
Coal (4 mines) 37 million tons, US$925 million	• Large amounts of solid waste • Risk of land subsidence	• Sedimentation of fine particles • Heavy water use in cleaning • Risk of ARD in tailings • Drainage problems in reclamation due to large extent of operations	• Fine particles in air • One mine borders on national park; important orangutan reserve; also problems of illegal forestry	• General social problems of large-scale mines (prostitution, alcoholism), • In one case large frontier community was established in very lightly populated area; great need for social services. • In the case of Kaltim Prima Coal, the provincial government is attempting to gain a majority stake and there is growing pressure from the community for a more participatory role in management of the company.
Medium-Scale				
Medium-scale coal mines 17 million tons, US$425 million	• Catchment areas are poorly designed • Companies often do not use back filling for open pit coal mines • Top soil is poorly managed so not reclaimable	• Coal preparation plants often on river banks • Significant ARD • Sediment ponds inadequate, often overflow • Loss of fine coal particulates to water	• Fine coal particulates in air	• Usually not serious due to relatively small work force unless in culturally sensitive area
Mines: non-coal[b] 808,000 tons of bauxite, US$9 million 55,200 tons of tin, US$273 million 10 tons of gold, US$33 million	• Soil erosion • Delayed reclamation; no ground cover	• Inadequate, poorly maintained tailings dams • Sedimentation control poor, significant impact on sea and river life • Discharges of untreated mine water to rivers • Presence of heavy metals	• Poor management practices in chemical handling and storage with many leaks and limited spill prevention	• Usually not serious due to relatively small work force unless in culturally sensitive area • Squatting by artisanal miners and resulting social problems (see ASM below)

ASM				
ASM gold N/A	• Soil erosion • Loss of top soil	• Mercury pollution • Sedimentation and siltation	• Mercury vapors • Deforestation • Loss of biodiversity	• Land squatting • Ethnic conflicts • Prostitution, alcoholism, drug abuse, school absentees • Health problems, spread of disease • Loss of traditional hunting and fishing areas • Cultural destruction
ASM coal N/A	• Soil erosion • Loss of top soil	• ARD • Sedimentation	• Coal dust in air • Road damage	• Prostitution, alcoholism, drug abuse. • Health problems

Source: Study team
[a] Value is calculated using average prices received in Indonesia for exports of the commodity in 1997.
[b] The entries in this row on environmental damage are based on reports of two medium-scale mines belonging to Aneka Tambang, Kijang Bauxite and Pongkor Gold.

Estimates of the Economic Cost of Environmental Damage

While it is difficult to quantify environmental damage due to large-scale mining in Indonesia, it is possible to obtain an empirical perspective on the environmental performance of large-scale mining. A World Bank-supported technical assistance project[15] estimates that most environmental problems in large-scale mining could be rectified for minimal cost. In some cases, such as coal, better production methods would pay for most or all of the environmental investments. What follows is an estimate of the economic costs for environmental protection and reclamation for coal and other metals for large-scale mining.

Coal mining estimates. In Indonesia, there are four large coal mines that produce more than five million tons of coal per year. The largest mine, Kaltim Prima Coal spends approximately US$3 million per year on environmental protection and land reclamation, or US$0.23 per ton of coal, and has a well-developed environmental management program, which also includes an ongoing reclamation plan (Box 3.1). Using this figure as an indication of what the other companies should spend, the approximate environmental budget for large-scale coal mining should average US$10 million per year, which is much less than one percent of the gross revenues of the major four coal mines in 1998.

In comparison, Aneka Tambang, the gold and nickel mining company, has estimated land reclamation costs of US$600 per hectare for nickel and US$500 for gold. The Indonesian Mining Association reports that reclamation of tin mines without prior treatment costs US$400 per hectare. Given the more complex nature of the mining of these metals, one would expect a significantly lower figure for coal. The total concession area of the three private large-scale coal mines is 260,000 hectares.[16] Assuming that 20%-30% of the 260,000 hectares need to be reclaimed at a cost of US$500 per hectare, the total cost would be US$26-39 million, which would be spread over a period of 10 to 20 years.

[15] The Biro Lingkungan Teknik-Office of Surface Mining (BLT-OSM) project is described in Box 2.3.
[16] It has not been possible to obtain data on the size of the concession of the state-owned coal mine, Tambang Batubara Bukit Asam.

Box 3.1 Rehabilitating Kaltim Prima Coal Mine

Kaltim Prima Coal, a joint venture of Rio Tinto and British Petroleum, is located in East Kalimantan. It is the largest coal mine in Indonesia, producing over 13 million tons of coal each year. It has a successful, ongoing program of land rehabilitation that includes land preparation, nurseries, planting, and field maintenance. Kaltim Prima's environment department spends about US$3 million per year, with another US$1.5 million being spent on environmental efforts by the individual pits. Efforts by Kaltim Prima are divided into permanent and temporary rehabilitation.

Temporary rehabilitation involves the stabilization of an area that will be disturbed again at a future date, either due to further mining or road construction. It prevents soil erosion and arrests any possible shifting of overburden dumps, which could result in the production of ARD. Given that the mine must move, store, and stabilize more than 40 million tons of overburden per year, failure to temporarily rehabilitate the overburden dumps could easily lead to an environmental catastrophe. Kaltim Prima temporarily rehabilitates and stabilizes over 300 hectares per year.

Permanent rehabilitation takes place on land that will not be disturbed again. It is top soiled and planted with mostly native species of plants and trees. Usually, there is a first line planting to stabilize the soil followed by a final planting. Kaltim Prima permanently rehabilitates over 200 hectares of land per year.

Metal mining estimates. Existing data on four of the five large metallic mines allow an estimate of reclamation costs, with the caveat that the estimate understates environmental damage by at least the cost of annual preventive measures.[17] In three of the four cases (Freeport, Kelian, and Inco), there are data on annual expenditures. In the case of the Freeport copper and gold mines in Irian Jaya, planned environmental expenditure for 1999 is US$42 million. The Kelian gold mine in East Kalimantan spends about US$2 million per year and is considered to be a good environmental performer, recently receiving an accolade from an NGO, Community Aid Abroad. The Inco nickel mine spends about US$1 million per year. It is likely that expenditures for the Minahasa gold mine would be of the same order of magnitude as the Kelian mine, given that the mines are approximately the same size. If environmental expenditures are used as a lower bound estimate of annual environmental damage that has been prevented, the annual environmental cost of the large-scale mining is in the order of US$50 million to US$60 million. This figure should be compared against the value of annual production of the mines, which in 1998 was approximately US$3.5 billion.

Aneka Tambang has estimated reclamation costs for its Pomalaa and Gebe Island nickel mines at US$500 per hectare. The total cost of reclamation would be US$4.4 million using this figure. However in the environmental audit undertaken by Morgan Worldwide Consultants (1977), reclamation practices at Aneka Tambang's nickel mines were considered inadequate. Inco spent about US$2,500 per hectare for land reclamation from 1996 to 1998. If Inco eventually mined half of its concession area, the cost of reclamation would be US$272 million, spread over 30 to 40 years. Kelian has estimated that the total reclamation cost for its mine will be about US$25 million; reclamation cost for Minahasa is likely to be in the same order of magnitude. Freeport expects to spend about US$200 million to reclaim its mine site and tailings deposit, at an average cost of about US$7,000 per hectare. Consequently, the total reclamation amount for these five mines is about US$525 million.[18] This figure is much less than one percent of a

[17] Theoretically, if environmental costs are fully internalized, then at the margin, a firm's environmental expenditures would be enough to mitigate the true environmental damage caused by its activities. However, in practice, for a variety of reasons (such as market and institutional failures, incomplete information and time lags involved in identifying environmental damage) environmental costs are not fully internalized and, therefore, environmental expenditures by mines should be considered at best lower bounds.

[18] If it is assumed that the reclamation costs per hectare for Aneka Tambang are the same as Inco, the total amount for reclamation for the large mines would be about US$550 million.

conservative estimate of the expected value of the output of these mines, which could easily be more than US$100 billion based on past output and current reserves.

Nevertheless, it is important to stress that reclamation standards are not clearly defined in Indonesia. For example, if reclamation is defined as restoring the original ecosystems, the estimated cost of environmental damage would likely be significantly higher. At the other extreme, if reclamation only means planting enough vegetation to stabilize the soil, the costs would be significantly lower. Accordingly, it is important to determine acceptable standards and to include detailed reclamation measures in mine closure plans, including a final end use acceptable to the Government and local communities. The plans might include the option of choosing a compensatory reclamation site to substitute for the mined area in some cases. In addition, there should be provision for future negotiation of reclamation plans if a community rethinks the end use of the land beyond the life of the mine. Rio Tinto's Kelian gold mine in East Kalimantan will be the first major mine to close in Indonesia (see Box 3.2).[19]

Box 3.2 Mine Closure and Reclamation at Kelian Gold Mine

Rio Tinto's Kelian Gold Mine is scheduled to close in 2003 after 11 years of operation. The environmental performance of the mine has been good, with only one minor incident. Nevertheless, at times, the Kelian mine's performance has been compromised by the activities of illegal artisanal and small-scale miners who operate near or within the large mine's concession area. It is also likely that these miners will occupy the site once Rio Tinto leaves. In such a situation the best efforts of Rio Tinto to undertake a proper reclamation may be jeopardized as the small-scale miners generally operate without environmental controls or government supervision.

Rio Tinto will rehabilitate 800 hectares at the mine site at a cost of US$25 million. The 450 hectare pit and dam area will not be rehabilitated due to the large cost involved. However, in compensation the company will rehabilitate 500 hectares of land that has been logged in Samboja, East Kalimantan. Although the alternative site has been accepted by the Government, it does raise the issue of what is considered adequate rehabilitation of a mine area.

Rio Tinto is also working with the World Bank under the Business Partners for Development project to develop a plan that will minimize environmental and social damage associated with the mine closure. First, the participants are working together to formulate training programs and social service delivery mechanisms which will mitigate the socio-economic impact of the mine closure. Second, they are attempting to formulate a plan to prevent or mitigate environmental damage by illegal miners. In particular, they are working with the regional, provincial, and central governments to regularize ASM, including proper monitoring and enforcement by government authorities.

Government Oversight

The current budget of the Mining Environmental Unit of the Directorate General of Mines (DGM) only allows fulfilling about 20 percent of its responsibilities, which include environmental monitoring of large- and medium-scale mines. However, there is no evidence of diminished government pressure on the environmental performance of large mines. Despite budget cuts, the number of inspections has remained the same or increased since the onset of the crisis. The Ministry of Mines and Energy has taken a stronger environmental stance and is currently putting more emphasis on environmental performance than before the economic crisis. The most prominent indication of the interest of the Ministry of Mines and Energy in environmental protection has been the World Bank's BLT-OSM TA project. The objectives and main accomplishments of the project are discussed in Box 3.3.

Mining and the Community in the Era of 'Reformasi'

Most of the large foreign investment mining projects were established in the 1980s under the Suharto regime. During that time the company's relationship was essentially with the center, and revenues

[19] For further discussion of reclamation bond issues, see Section 6 on Institutional Issues.

derived from foreign enterprises flowed mainly to the center. While community development programs were undertaken, these were largely done as "add-on" measures by the company, with the view to establishing a positive relationship with the local communities. Until recently, by all standards, socio-economic expenditure by the mining companies was minimal.

Box 3.3 Joint BLT-OSM Technical Assistance Mining Environmental Project

As part of the US$261 million Sumatera and Kalimantan Power Project, the World Bank financed a three-year, $3.2 million TA project for environmental protection for medium- and large-scale mines from 1996 to 1998. Phase I objectives included policy development, organizational improvement, development of institutional capability, improvement of mining practices with respect to environmental management, and the improvement of review procedures for environmental impact assessment (EIA). The project included reviews and recommendations by experts from OSM and the U.S. Environmental Protection Agency on the state of affairs of the Indonesian mining industry from policy and institutional perspectives, as well as by on-the-ground inspections of mines. Training focused on improving the ability of relevant agencies, including authorities from 12 regions and mining company personnel, to monitor and enforce environmental requirements in the mining industry.

Many of the policy recommendations suggested by the project team have been taken up by the Ministry of Mines and Energy. These have included the adoption of a reclamation bond guarantee procedure for medium- and large-scale mines, guidelines for EIA preparation, and a schedule of penalties for environmental violations to replace the existing shut-down only option. In addition, the Ministry of Mines and Energy has accepted nearly all of the recommendations made by the project director on changes in policy, procedures, and organization (Whitehouse, 1998). The Ministry is currently developing a plan to implement these changes, which would result in a substantial reform of environmental management policy, procedures, and organization.

The end of the Suharto era has brought Indonesia into a new period of democratic reforms, commonly known as *reformasi*. The new decentralization laws will eventually change the way in which all businesses operate in Indonesia. With regard to the mining sector they have started to have an impact even before formal implementation begins in 2001. Since the fall of the New Order, community expectations about political reform have escalated though the legal reforms to address these expectations have hardly begun.

In many parts of Indonesia, poverty and dissatisfaction with the rate of reform has fueled religious and ethnic divisions and violence. In this changing social landscape, communities strongly resist the involvement of government or the judiciary in the resolution of disputes with the companies. This is both an expression of distrust of state structures and a genuine desire to develop a direct social and economic relationship with an institution living amongst them – something that was impossible during the Suharto period.

Large-scale mining companies are responding to the changing social landscape and increased uncertainty in three ways. First, they have increased spending on local socio-economic programs. For instance, Freeport expects to invest nearly US$47 million in 1999 on local socio-economic programs (Box 3.4.), which is much more than what the most profitable gold mine and some of the largest copper mines in South America spend per year on socio-economic programs. Even before starting its mining operations, Newmont spent US$1 million on community projects in 1998 and is expected to spend US$1.4 million in 1999. Furthermore, it also spends close to US$6 million per year on physical infrastructure, and makes substantial investments in a training program for potential employees and small business development. PT Kelian Equatorial Mining spent over US $2 million on community projects in 1999.

Second, given that companies and communities cannot rely on the judiciary or any other branch of government to resolve day to day or accumulated problems between themselves and the community, they are seeking other options that can define workable processes to the satisfaction of all parties – which is a

daunting task. One option could be to negotiate modus operandi or rules with NGOs that represent community interests. This is difficult because there are no statutes for the interpretation of negotiated procedures. Another option is to encourage communities to invoke their own customary law so as to resolve matters to the community's satisfaction. This initiative would be in step with current proposals to devolve certain powers to the regions. A third option would be to establish a Joint Development Task Force, composed of representatives from the different levels of government, industry and NGOs who through their resources have capacity to plan and can jointly address any emerging issues.

Box 3.4 Community Issues at Freeport Indonesia

PT Freeport Indonesia operates one of the world's largest copper and gold mines in the Timika area of Irian Jaya. In 1968 Freeport began operation as a medium-scale mine. A major ore discovery was made in the late 1980s near the original deposit. Currently Freeport processes about 220,000 tons of ore per day. It is the largest corporate taxpayer in Indonesia, as well as the largest purchaser of goods and services in Irian Jaya.

The social situation in the mine's work area is extremely complex. Before the mine development began in 1968, local people had little experience with outsiders. While the mine is in the area of highland tribes, the main settlement is located inside the region inhabited by lowland tribes. The various tribes are often in conflict, adding to the conflict among Freeport, the local people, and the Government. In March 1996, violent demonstrations took place, resulting in property damage, two hostage takings, and fatal injuries. Although the incidents were partly due to issues of recognition, respect, and justice, the most important motivators were money and land rights. Before the demonstrations, Freeport had begun major efforts to address the social problems in the area and after the protests, they intensified their efforts in this regard. Key elements in Freeport's community benefits plan included the following:

- One percent of profits go into a social and community development fund;
- Programs to build institutional capacity for local communities and activity-based organizations; proposal to create a land rights trust fund to address compensation claims;
- Commitment to bring the proportion of Irianese employees to between 35 percent and 45 percent of the total within 10 years;
- Improvement in quality and quantity of education programs;
- Continued commitment to health programs; and
- Creation of community action teams to liaison with local people.

Except for the development fund, most of the Freeport initiatives have met with significant success. In 1999 Freeport planned to spend approximately US$47 million on social programs. There is still a great need to develop local capacity in order to make the process more participatory and, just as important, to allow Freeport to distance itself somewhat from the various initiatives. In particular, there is a need to outsource many of the programs to independent development and social service agencies, including NGOs and churches.

Third, where conflict and uncertainty have become intractable, some mines have temporarily closed down, as detailed in Box 3.5. Under these circumstances, in which continued conflict and uncertainty could lead to early termination of large mining companies' operations, some of the large-scale sites could be entirely taken over by ASM operations, with the attendant increased environmental and social risks.

Recent events in Indonesia and the changing social landscape has shown that successful projects are a result of "partnership not "ownership". Both communities and local government need to feel that they have a direct stake in the project and there is a direct benefit to them in securing the project. There is a need to build local capacity both at a local government and community level, to enable both the region

and the local community to absorb a project, integrate it into a regional development planning at the earliest opportunity, and mitigate the impacts with regard to planning and preparation for closure.

Box 3.5 Conflict and Uncertainty Facing Large Scale Mines

PT Newmont Minahasa Raya – This subsidiary of the US based Newmont Mining Corporation was ordered by a district court to close its gold mine in North Sulawesi, unless the company paid taxes on its overburden (waste rock and soil classified as local building materials) although its contract with the central government exempted it from such taxes. The mine resumed operations only after Newmont agreed to contribute US$3m to the region's coffers.

PT Kelian Equatorial Mining – This Rio Tinto-owned gold mine was forced to cease operations for over 4 weeks in May 2000, due to community blockades of its access road, based on claims for unsettled compensation payments (part of the protest was that the previous government did not recognize land tenure under customary law). The community claimed that the military had forced people to move from the current lease areas in 1990, and they were therefore compelled to accept payments for less than their value.

PT Freeport Indonesia – The local government of West Papua is demanding half of the central government's 8% equity in Freeport Indonesia, and has indicated that Freeport might have to divest further equity to the local government after the autonomy laws take effect. The province's deputy governor has also demanded that a local be given a senior post at PT Freeport.

PT Kaltim Prima Coal – Situated in the Sangatta District in East Kalimantan, this coal mine, jointly owned by BP and Rio Tinto, has been forced to halt production for over 4 weeks due to industrial unrest. The downturn of the local economy due to the mine shutting down resulted in a situation where the local community were attempting to storm the mine, and force the striking workers off the premises so that the mine could resume operations.

Source: The Economist Intelligence Unit – April 3rd, 2000; The Economist Intelligence Unit - July 10th, 2000; Far Eastern Economic Review – July 13th, 2000

4. Medium-Scale Mining

There are four main medium-scale coal groups at work in Indonesia:

- The state-owned enterprise, PT Tambang Batubara Bukit Asam, has two main mines. It produced 10 million tons in 1998 (2 million for export and the rest mainly for domestic power generation).
- Coal Contracts of Work (CCOW). Under the first generation CCOW, there are eight foreign and two domestic companies. Nineteen companies, all domestic, have been approved under the second generation CCOW but only one is in production. There are 76 applications under the third generation CCOW, all in the general survey stage. Seven of these are foreign owned.
- Mining Authorization Holders. Only domestic companies can obtain mining authorizations. There are more than 100 of these but most are not active. They produced 3 million tons in 1998, about 6 percent of the total.
- Cooperatives. These also get mining authorizations and must have less than 100 hectares.

Medium-scale coal mining is largely undertaken by domestic companies with domestic costs. However, the output price, whether exported or not, is determined on international markets. For some companies, the local currency devaluation since the onset of the crisis has meant enormous windfall profits due to the big drop in operating costs. Many companies have been encouraged to enter the industry. In contrast to the metallic mining industry as noted above, applications for contracts of work by medium-scale coal mining companies have increased substantially. Although most medium-scale coal companies are in the general survey or exploratory stage, there is the possibility of a significant growth in medium-scale coal mines. There is currently a general oversupply of the average (low) quality Indonesian coal on the global market, and the domestic market for coal is depressed.

No important regulatory changes have been introduced since the economic crisis began. Since its introduction in 1996, the third-generation CCOW has made it easier for companies to undertake coal operations. Bureaucratic procedures were streamlined and the income tax rate was fixed at 30 percent, rather than subject to existing laws. Underground and low quality coal mines are also subject to a lower, negotiated royalty than standard open pit mines. These modifications have undoubtedly played a part in expanding the medium-scale mining industry.

Environmental Effects

The environmental performance of the medium-scale coal mines is generally poor. A significant industry expansion would not bode well for the environment of Indonesia unless their environmental performance improves substantially. See Table 3.2 for a summary of important environmental and social risks associated with medium-scale mining. Hamilton (1998a) describes some major problems, including the following:

- Coal preparation plants are often located on river banks. Such siting has no economic justification, and can be dangerous when wastes spill or are blown directly into the rivers. Moreover, siting these plants next to the mine would probably decrease transportation costs.
- Sediment ponds are usually inadequate and often overflow.
- Catchment areas are poorly designed.
- Plants do not have fine coal recovery circuits resulting in a loss of fine coal particulates.
- There is significant ARD from the tailings.
- Companies operating open-pit coal mines often do not even use back filling.
- Topsoil is poorly managed, even deposited at the bottom of the pile of overburden, which means that it is not available for reclamation.

The BLT-OSM TA project has made the case that many medium-scale coal companies have already made essential investments in pollution control equipment and infrastructure. However, recovery of reclamation costs through better handling of coal fine particulates during crushing and washing remains a major issue in medium-scale mining.[20] Improving and enforcing environmental performance of medium-scale coal mines should be a high priority for the Indonesian government.[21]

Estimates of the Economic Cost of Environmental Damage

The concessions for the nine medium-scale coal mines under contracts of work cover 224,000 hectares of land. As in large-scale mines, if a reclamation cost of US$500 per hectare is used, and assuming 20%-30% of the concession area needs to be reclaimed, the total cost would be US$22-34 million.

An estimate of the annual environmental expenditure needed for preventive measures for the medium-scale coal industry can be derived using Kaltim Prima Coal, considered by experts to be one of the best environmental performers in the Indonesian mining industry, as a guide. Kaltim Prima Coal's reported cost of US$0.23 per ton of coal can be thought of as an upper bound for the industry as a whole. This figure suggests that medium-scale coal industry of Indonesia could achieve strong environmental performance with an expenditure of about US$3 million per year, including ongoing reclamation costs. Moreover, a significant part of this cost could be recovered by reducing lost coal fine particulates. Relative to the value of coal output for the medium-scale coal industry in 1997 --about US$425 million dollars--the cost of reclamation is much less than one percent of gross revenue.

To summarize, in the past coal mining has been a source of environmental damage in Indonesia, although the relatively small area and volume of mining activities have meant that the damage is likely to have been modest. However, in the future coal could play a more prominent role in Indonesia. Unless environmental management is improved considerably, environmental damage caused by medium-scale mining is likely to increase.

[20] It is estimated in Hamilton (1998b) that the total value of coal fines lost to wind and water from 1990 to 1996 due to poor processing procedures was approximately US$576 million. To obtain this figure, Hamilton assumes that 10 percent of production was lost fine coal particulates. If the amount lost was 15 percent—a figure that Hamilton thinks is more reasonable—the value of lost coal sales would have been US$860 million. In different scenarios, he estimates that most mining operations would recover the investment needed to capture the fine coal particulates in one to three years.

[21] See Hamilton (1996: 41).

5. Artisanal and Small-Scale Mining

Artisanal and small-scale mining in Indonesia—gold and coal mining in particular – has increased since the onset of the economic crisis.[22] Some 394 ASM sites are legal traditional mining locations designated by DGM; these locations cover 1.8 million hectares.[23] An unknown number of ASM locations covering an unknown area are unregulated and illegal. ASM miners typically show little or no concern for environmental procedures.

Given the lack of documentation of ASM, two surveys were undertaken as part of this study: one at the small-scale coal mines in South Kalimantan and the other at the artisanal gold mining operations in Pongkor, West Java. As the most significant but undocumented growth in mineral production since the onset of the crisis was believed to be at the ASM level, the objective of the surveys was to document the scale of ASM activity at two quite different locations; assess the reasons individuals took up small-scale mining and whether the current rapid growth rate would likely continue after the crisis; estimate income levels of ASM miners; and assess damage and costs – environmental, social, and to human health resulting from ASM activity.[24] Table 5.1 summarizes the results of the two surveys.

The damage associated with ASM is widely known. Moreover, the location of many illegal mines is generally known. However, there is little or no attempt to close down these operations, due to powerful interests' support for substantial ASM operations, corruption and lack of law enforcement. There is a general sympathy for anyone trying to survive the crisis.[25] Therefore, it is unlikely that the end of the economic crisis will bring a decline in ASM. Instead, ASM activities seem likely to increase steadily.

The surveys indicated that many individuals who take up illegal mining face a loss or decrease in pre-crisis sources of income and believe they lack opportunities elsewhere, while others simply want to benefit from the increased rupiah profit due to the currency devaluation. Entry into the sector is made easier by availability of heavy machinery at low rental prices, especially from the currently moribund construction sector in Kalimantan and, above all, by the partial breakdown in law and order that has accompanied the crisis. An example is legal village cooperatives (KUD), with legal concession rights, that illegally sublet their concessions to better resourced miners from Java, who use heavy equipment.

Most ASM areas have a short productive life, usually less than ten years. While small-scale mining may increase rural incomes in the short term, increased reliance on mining relative to agriculture combined with significant environmental damage during the mining phase may have lasting impact on the potential for a more balanced rural development in mined-over areas. Whether local potential for balanced development is compromised or not often depends on the savings habits of the recipients --that is, how they use the windfall income generated by the mining activities. Allocation of part of this windfall to better environmental practice or land reclamation improves local development prospects in the longer run.

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[22] Artisanal mining operations are generally defined as those using little or no mechanization or heavy equipment. Small-scale mining operations involve some degree of mechanization and at times entail an investment of as much as US$2 million. Nevertheless, this amount is much less than a modern, fully mechanized mining operation, which rarely involves an investment of less than $50 million for metal mines and coal mines. Artisanal and small-scale mines are analyzed together, as they both are often illegal, unregulated, and inattentive to environmental concerns.

[23] Traditional mining is the term used by the Indonesian Government to refer to legal mining on a small scale, usually by people from the nearby communities. It mostly consists of gold, coal, and diamond mining and suffers from the same environmental deficiencies as illegal ASM. Permits are granted by the provincial government (Dinas Pertambangan).

[24] The findings of the two surveys, which form the core of the empirical analysis of this section, are more fully explained in Appendices I and II. Table 6 summarizes the results of the two surveys.

[25] The DGM has indicated the difficulty of closing down illegal mines due to corruption. Government mining inspectors can order a mine to be closed, but the local police must enforce that order. Martens (1998: 17) reports on a campaign to rid an area of North Sulawesi of illegal gold miners, mounted by the Ministry of Forestry. Three months later the number of ASM operations was the same as before the campaign.

Table 5.1 Comparative Results of ASM Surveys

Survey questions	South Kalimantan (Coal)	Pongkor, West Java (Gold)
Number of miners interviewed	25	42
Number of community leaders interviewed	17	17
Number of local people interviewed	43	26
Average years mining	2.5	2.2
Average years mining in this region	0.7	1.2
Main reasons for mining (%)	More profitable (80) Crisis induced[a] (10)	More profitable (61) Crisis induced[a] (20)
Percent saying mining is main income source	70	75
Average number of miners in operations interviewed	64	15
Percentage increase in mining in region (%)	100	500
Response to whether mine was inspected by government official (%)	Yes (90)	Yes (0)
Response to whether relations with local community are good or neutral (%)	Miners say yes (90) Community says yes (75)	Miners say yes (100) Community says yes (N/A)
Conflicts with local community (%)	Miners say yes (5) Community says yes (25)	Miners say yes (55) Community says yes (84)
Main income source of local community	Agriculture	Agriculture, mining
Main environmental problems	Miners say soil erosion, sedimentation; Community says road damage	Miners say water pollution (mercury); Community says river pollution, soil erosion, road damage
Health influences of mining according to community leaders	None	None
Community leaders in favor of small-scale mining (%)	90	100

[a] Crisis induced signifies that since the economic crisis began, the respondent had lost his primary job or the income from his primary job had fallen substantially.

Environmental and Health Effects

The main environmental effects of ASM are soil erosion, sedimentation of water bodies, mercury pollution, and a total lack of land reclamation after closure. Of these, the most irreversible and dangerous for human health is mercury contamination. Mercury is not biodegradable and, if inappropriately discarded, often combines with other elements in more toxic forms. River dumping can result in dramatic loss of plant and wildlife for considerable distances downstream, as discussed in Box 5.1.

Given that mercury use is universal in small-scale gold mining, reclamation costs can soar above those for large-scale mining, where precautionary measures to limit mercury emissions are ordinarily taken. We can calculate reclamation costs, using a modest figure of US$500 per hectare and assuming that up to 2 million hectares of legally or illegally ASM land needs to be restored. Under these assumptions, restoration costs for ASM would be up to US$1 billion. This figure is a conservative estimate that includes neither the recovery of mercury dumped into waterways (extremely difficult and usually prohibitively expensive) nor related health problems to the community and miners.

As in the case of medium- and large-scale mining, the environmental situation of ASM in Indonesia is similar to that of other countries in the region. But, given that ASM has not been regularized, and monitoring and enforcement are weak, the reality is that implementing solutions. Corruption and rent-seeking have helped ASM is difficult to thrive. The illegal activities cause substantial environmental damage, but they also provide employment and income for rural society. Although the exact number of workers in ASM operations is not known, it is in the hundreds of thousands at a minimum. Small-scale miners and processors in Indonesia ordinarily have much higher incomes than surrounding communities whose livelihoods and incomes may be jeopardized by the illegal activity. Solutions need to be of the

carrot-and-stick type. Miners must understand the health and economic benefits of compliance for themselves, local and downstream communities, as well as the penalties if they do not comply with regulatory requirements.

Box 5.1 Health Effects of Mercury Pollution

Mercury is commonly used by small-scale miners in the processing of gold ore. Direct contact in the concentration process and consumption of foods contaminated by discarded mercury can have serious health impacts. The greatest health risk to humans and wildlife comes from the consumption of contaminated fish. There are no known methods of cooking or cleaning fish that reduce the amount of mercury ingested from fish. Methyl mercury, the form most dangerous to humans, accumulates as it moves up the food chain.

Mercury affects the brain, spinal cord, kidneys, lungs, and liver. The effects of short-term exposure to high levels of mercury include tingling sensations in fingers and toes and tremors. Long-term exposure to mercury can result in symptoms that progressively worsen and lead to personality changes, tunnel vision, stupor, and coma. Mercury also affects fetal growth, preventing normal development of the brain and nervous system. Affected children show lowered intelligence, as well as poor hearing and coordination. Due to the long time span before mercury-induced illness becomes apparent or can be distinguished from other common illnesses, such as malaria, communities affected by mercury pollution often do not recognize the health risks.

Deforestation and small-scale gold mining can produce a deadly build-up of mercury. Deforestation causes soil erosion, which can release large quantities of naturally occurring mercury into river systems. A recent study indicates that mercury contamination in the Amazon basin is largely the result of deforestation, not small-scale gold mining, even though the latter releases over 130 tons of mercury per year into the surrounding environment (Pepall 1997).

By using other methods to crush the ore and limiting mercury use to the final concentration process, a miner can reduce mercury use by as much as 70 to 90 percent. The use of closed retorts to recycle the mercury substantially reduces safety hazards and can reduce the amount of waste mercury by another 10 percent to 20 percent. The ultimate goal, however, is to eliminate the use of mercury in gold production, usually by the introduction of more centralized concentration processes with proper disposal and tailings facilities (Wotruba et al, 1998 or Veiga, 1998).

Better practices and technologies can greatly increase the poor recovery rates of small-scale miners and significantly reduce mercury use and health impacts in the case of artisanal gold mining. In the Pongkor survey the authors saw simple technologies such as sluices reducing mercury use by 90 percent. Other inexpensive devices, such as closed circuit retorts, can greatly reduce health impacts on the miners by capturing and recycling the mercury fumes.[23] There is a need for regularization of ASM, technical assistance, educational campaigns, government monitoring and enforcement, and access to finance. At least three technical assistance initiatives are being considered to reduce or eliminate mercury use in gold processing in Indonesia: a UNIDO-supported project, a GTZ-supported project in Central Kalimantan, and a CIDA-supported project in Sulawesi.

To provide incentives for small-scale miners to invest in pollution control and land reclamation, underlying land tenure issues must be addressed. As noted above, a significant part of ASM takes place on the concessions of larger mining companies. There are cases in other countries with a longer mining history, in which large- and medium-scale mines have developed stable, mutually beneficial cooperation with ASM miners operating within their concession boundaries. In the Placer Dome mine, Las Cristinas, in Venezuela, and in a medium-scale gold mine on Masbate Island in the Philippines, for example, the mining companies are giving ASM miners access to small-scale deposits on the condition that they work

[23] At a more sophisticated level, groups of miners can process their ore in highly biodegradable cyanide. The gold is separated or leached from the ore by a cyanide solution, which eventually is deposited in a tailings pond. Exposure to the sun quickly breaks down the cyanide compound. However, proper use of the cyanide is essential, as it can be fatal if improperly handled.

in an environmentally sound manner and process the ore in centrally located concentration plants.[26]

Nevertheless, international experience shows that technologies will not solve the problem by themselves. Community pressure can be vital. Citizens of surrounding communities are often supportive of the small-scale miners as they receive payments from them or are actively involved in the mines themselves. This has largely been the case in both Pongkor and South Kalimantan as evidenced by the surveys of the area mines. The communities must be made aware of the long-term environmental consequences of the mining activities for sustainable multiple use of local natural resources. They must also be made aware of the different technologies and mining practices available to the miners in order to pressure them to move to better, less damaging practices.

Overall Summary of Estimates of Sector-wide Annual Costs and Benefits

The picture emerging from the assessment of the environmental performance of the mining sector in Indonesia, compounded by the impact of the economic crisis, is mixed at best. In addition to social ills and conflicts, underlying trends range from disturbance to land and ecological resources, poorly mitigated long-term risks due to acid rock rainage and mercury contamination, large amounts of solid waste, and water quality impairment, to complete lack of public oversight over mushrooming medium to artisanal-scale coal and/or gold mining activities.

Despite the fact that the sector's financial contribution to the economy is substantial (over US$5 billion annually), a detailed evaluation of the economic costs of environmental damage is not possible at this stage – due to both the paucity of data and the uncertainty about the long-term impacts of mining activities. However, a rough estimate (representing a lower-bound) based on environmental mitigation alone (about US$0.5 billion in land reclamation and expenditures related to environmental management plans), indicates that the social cost of mining is substantial. Table 5.2 provides a summary of the of the estimated costs and benefits related to mining activities.

Table 5.2. Estimates of Annual Costs and Benefits of Mining Activities in Indonesia (million US$)

	Environmental Expenditures	Land Reclamation[a]	Productivity Loss[b]	Value of Output
Large-scale/coal	10	5-7 (26-39)	na	1,300
Large-scale/ metal	65	100 (550)	na	3,500
Medium-scale/ coal	3	4-6 (22-34)	82	425
Artisanal and small-scale	(no data)	177 (1,000)	na	na
TOTAL	78	286-290	82	5,225

Source: Study team.

[a] Annual equivalent of rehabilitation cost over 10 years using a 12% discount rate. Numbers in parentheses refer to estimated total reclamation cost over a period of 10 years.

[b] Annual cost over seven years (see text for details)

This points to the need to strengthen the institutional framework in order to effectively deal with any crisis-induced impacts, and more importantly, to insure the long-term sustainability of mining in Indonesia. This subject is taken up in the next section.

[26] See International Labour Organization (1999: 62-71) for a discussion of the Venezuela case and McMahon (1999) for a discussion of the case in the Philippines.

6. Institutional Issues

Given the sudden shift in market conditions, loss of authority of central line agencies and increased community pressure on local resource bases that accompanied the economic and political crisis, a reevaluation of the institutional framework for management of environmental impacts in the mining sector is called for. This section analyzes the adequacy of existing environmental management tools, coordination issues, both within MME and cross-sectoral, the challenge of the current rush to decentralization, and the pressing need to inform affected populations of the environmental and health risks of mining activities.

The Indonesian mining sector has experienced three periods of development with respect to the environment. The first period (1967 to mid-70s) was the pre-environmental era, in which mining development was mostly focused on supporting economic growth with basically no regulations to protect the environment. There were frequent inter-sectoral conflicts between mining and forestry, agriculture, nature conservation, and the government-sponsored transmigration program.

During the second period (mid-70s to mid-80s) the Ministry of Mines and Energy enacted several environmental regulations regarding prevention and mitigation of pollution. Nevertheless, conflicts continued among the various sectors.

During the third period (mid-80s to present) more generalized environmental awareness emerged in Indonesia. From a legal perspective, this new focus was supported by the Environmental Management Act of 1982 and Government Regulation No. 29/1986 regarding Environmental Impact Assessment (EIA). The Ministry of Mines and Energy enacted an updated regulation regarding prevention and mitigation of environmental damage and pollution in 1995. The Environmental Management Law was revised in 1997, and the AMDAL regulation was updated in 1999. The Ministries of Mines and Energy, Forestry, and Internal Affairs have issued inter-sectoral agreements to reduce conflicts regarding the use of land for forests and mining operations.

Government agencies with environmental mandates in the mining sector include: (a) the Ministry of Environment; (b) the Environmental Impact Management Agency (BAPEDAL); (c) the Ministry of Mines and Energy; and (d) agencies at provincial and district levels, especially the BAPPEDAs (planning agencies), the provincial mining agencies, and the regional BAPEDALs (BAPEDALDAs).

Environmental Management Tools

The principal environmental management tools used or under development by these agencies include: environmental assessment and management plans; inspections; and reclamation plans and guarantees. A brief discussion of MME's application of each of these tools follows.

Environmental impact assessment and management. There is a broad consensus that although the Indonesian environmental impact assessment procedure (AMDAL) is consistent with international standards, the way it is implemented in most cases limits or totally negates its effectiveness in influencing project planning, design, and implementation. AMDAL in the mining sector is no exception. To begin with, most of the environmental assessment reports (ANDAL) contain a large amount of irrelevant information but fail to focus on the key aspects of the affected environment in sufficient detail. Secondly, key issues unique to mining are not adequately addressed. For example, there is rarely any attempt to reconcile potential mining activities and potential future land use at the site. Thirdly, because of the way mining permit applications are handled (see "Coordination within MME" below), the ANDAL findings and recommendations are often not adequately taken into account in the decision to approve a permit

application or in the specifications for environment-related design or operating requirements for the proposed mine. Fourthly, there is little follow-up on the implementation of the environmental management and monitoring recommendations (RKL and RPL) submitted with the ANDAL. And finally, the AMDAL process is designed to address mine-level environmental impacts, but misses landscape-level impacts, such as impacts related to the overall scale of mining activity in a region and its rate of expansion.

Monitoring and enforcement. While MME and regional staff have received considerable training in technical and procedures aspects of environmental inspection, there are significant gaps in the toolkit of standards and responses to lack of compliance that are available to inspectors. These gaps include the lack of performance-based standards for assessing compliance with AMDAL and reclamation plan requirements; and the lack of a schedule of intermediate sanctions, tailored to the severity and frequency of violations and cognizant of the mine operator's previous record, to supplement the mine closure option, which is the single regulatory sanction currently available to inspectors.

As noted earlier, the environmental unit within the DGM considered the pre-crisis budget for environmental monitoring sufficient for discharge of no more than 20 percent of its inspection responsibilities. While there does not seem to have been any significant reduction in environmental monitoring of the mining sector since the onset of the crisis, given the large increase in ASM, much larger budget allocations would have been necessary just to keep pace. Environmental damage by artisanal and small-scale miners is known about and condemned, but remains outside the regulatory net.

Reclamation bonds. Reclamation of mined land can reduce the long-term impacts of mining with acceptable financial costs. Reclamation plans and incentives for their proper implementation can reduce the "footprint" of mining operations, limit threats of water pollution and erosion to human health and safety, return land to other productive uses, and promote conservation of biological diversity.

In 1995, the DGM issued a decree establishing a Reclamation Guarantee Program and mandating retroactively that all mining contractors in the production stage must post a guarantee of timely and proper reclamation of mining areas. The decree requires mining companies to plan for mine closure and reclamation before the last years of operation and to provide funds for MME to implement the plan if the company fails to do so. The guarantee should be posted before issuance of the exploitation permit, and the amount should be based on reclamation costs specified in the mining operation's Five-Year Environmental Management Plan.

However, several important elements of the reclamation requirements remain undefined, and this has created confusion between industry and MME. The missing elements include guidelines and a procedure for identification of post-mining land use for each mining area, provision for future renegotiation of reclamation plans to accommodate changes in local circumstances, and measurable performance indicators, by which compliance with reclamation plans can be determined.

Coordination Issues

Coordination within the Ministry of Mines and Energy. Two units within MME currently provide environmental management services and oversight. The Bureau of Environment and Technology (BLT) is located in the office of the Secretary General, which has oversight of both mining and energy, and includes the Secretariat of the Central AMDAL Commission of MME. The Directorate of Technical Mining (DTPU) is under DGM and is responsible for inspections and enforcement, including enforcement of environmental requirements.

In such a situation, there is always potential for key actions to be omitted --one unit thinks another is doing it-- and for required procedures to be overlooked or implemented inconsistently. In MME, one obvious manifestation is the "disconnect" between the feasibility study and the ANDAL within the project approval process.

To obtain a mining permit, a feasibility study and (depending on size and type of mine) an ANDAL are needed. Government Regulation 27 of 1999 specifies that both are to be prepared and reviewed together. However, a mining feasibility study is often already submitted to DGM and approved before the related ANDAL is begun. The interaction between the preparers of the ANDAL and the feasibility study that should lead to sound recommendations on environmental management cannot occur. Moreover, the two studies are not examined by the same reviewer: the feasibility study in mining activity is approved by the Director General of Mining, whereas the ANDAL is approved by the Secretary General after review by the MME AMDAL Commission, with the BLT providing the technical analysis. There is often a lack of communication and coordination between the Director General and the Secretary General regarding the results of the draft feasibility study and draft AMDAL. Therefore, the final feasibility study may contradict the final ANDAL or vice versa, even to the extent that the ANDAL could recommend against issuance of a permit which has already been approved.

A second "disconnect," which follows from the first, is the poor integration between the ANDAL and oversight of mining activities by the Directorate of Technical Mining, and the frequent lack of follow-up on the implementation of the environmental management and monitoring plans (RKL and RPL) that are attached to the approved ANDAL.

Interagency Coordination Issues. Consistent and comprehensive application of environmental impact assessment safeguards requires a partnership between MME and BAPEDAL. BAPEDAL sets framework requirements regarding AMDAL safeguards, which the line agencies translate into sector-specific AMDAL guidelines. Since the 1986 introduction of AMDAL, primary responsibility for implementing these guidelines has resided in sectoral AMDAL commissions located in the line ministries at the center. Under Government Regulation 29 of 1999, all AMDAL commissions at the central level will be abolished except the one in BAPEDAL which reviews inter-provincial, marine, and highly complex projects only, and all other AMDAL review is to be devolved to the provincial level.

One area in which improvement is needed is the way AMDAL of large mining developments is handled. They often involve several components--for instance, the mine itself, harbor facilities, and road, rail, or river transport--each of which, prior to enactment of PP 27 of 1999, was required to have an ANDAL as a free-standing project under the regulations of the Ministry concerned. There are cases in which separate AMDAL reviews by the various concerned ministries have resulted in multiple environmental management and monitoring recommendations that were not necessarily consistent and increased the cost of the project. The revised allocation of AMDAL review responsibilities between BAPEDAL and the provinces offers an opportunity to utilize the "integrated ANDAL" approach that is authorized by PP 27 of 1999 in all situations where it is appropriate. Not only does the "integrated ANDAL" save effort and expense, but it also facilitates consideration of cumulative impacts and interactions among components. And in implementation of such "integrated ANDALs," the role of BLT in the provision of technical support for review of mining projects by BAPEDAL AMDAL Commission will be important.

Regarding standards, current water quality standards promulgated by the Ministry of Environment are not appropriate for most mining operations, because they require sampling and lab work for parameters which are not typically associated with mining operations (such as fecal coliform) and do not specify standards for parameters which are (such as fine coal particulates). Closer collaboration with the Ministry of Environment is desirable to resolve these issues.

Regarding environmental oversight during mining operations, the Ministry of Mines and Energy and BAPEDAL should consider standardizing the monitoring process, and should ensure that the views and experience of large-, medium- and small-scale mining operators are taken into account. There is a need to define frequency of sampling, parameters to be analyzed, analytical methods and other monitoring protocols in practical, achievable terms, tailored to the different potential impacts and capacities of the different scale mining operators.

Conflicts between protection or production forestry and mining as prospective uses of the same tract of land are endemic and highly problematic in Indonesia. Many mining locations are *pinjam pakai* (loaned for use) from the Ministry of Forestry and Estate Crops (MoFEC). According to agreements between the ministries, the land should be returned to MoFEC in the same state in which it was received. However, a long-standing Presidential Decree gives mining priority over all other land uses, and a recent inter-ministerial decree, No. 2002 K/20/MPE/1998 regarding small-scale mining, fails to give MoFEC a voice in the permitting process for small-scale mining. There is at least one case of a large mine operating on land that formerly was a national park. When coal was discovered in East Kalimantan, the boundaries of Kutai National Park were redrawn so that the deposits could be developed by Kaltim Prima Coal. Citing the regulation for small-scale mining, the provincial Forestry Service of South Sulawesi has recently granted 14 mining exploitation permits in a geologically unique karst area of South Sulawesi that is under protective forest status. Given cases such as this and the rudimentary state of reclamation plans and their implementation, the requirement that land "borrowed" for mining will be returned in its original state lacks credibility.

Decentralization

Regional governments have had two distinct agencies with responsibility for mining: Kantor Wilayah (Kanwil) Pertambangan, the representative of central government (MME) in each province, and Dinas Pertambangan, the corresponding department of provincial and district governments. Dinas Pertambangan reports to the governor or the district head (bupati) and thus is indirectly under the Ministry of Home Affairs. Each agency has different responsibilities. Kanwil Pertambangan has been responsible for mining in categories "A" (gold, uranium) and "B" (coal, oil, gas). Contracts in these categories have been managed almost entirely by MME Jakarta, ordinarily with little or no consultation with regional planners, mining, or environmental services.[25] Dinas Pertambangan is responsible for mining in category "C", which includes sand, gravel, marble, and small gold mines; and has had permitting authority for these activities at the local level. Typically, the coordination between Kanwil and Dinas has been very poor.[26]

However, the recently enacted legislation for regional autonomy, Law 22 of 1999 mandates a transfer of permitting and oversight of mining activities from MME to district government. BAPEDAL functions are also to be devolved to provincial and district BAPEDALDA, including AMDAL functions, as referenced above.

The transfer of permitting and inspection responsibilities to provincial and/or district governments could potentially reduce both cross-sectoral conflicts between different prospective users of the same tract of land and existing inconsistencies in treatment of the different categories within the mining sector.

[25] The single exception is small-scale gold mining, which is under jurisdiction of the Dinas Pertambangan.

[26] Another problem that existed in the Kanwil was a confused reporting system. Administratively, Kanwil reports to the MME Secretary General, but functionally Kanwil has to report to several different directors within the DGM.

However, the change also carries with it considerable risks–for example, confusion if concessions overlap more than one regency, the risk that the bupati and the dinas, with less ability to resist strong commercial interests, especially if linked to local officials, will overlook environmental aspects of proposed mining activities, and allow a "fire sale" of local resources that sacrifices long-term sustainability for short-term cash; that the Dinas, with less capacity and less experience than the Kanwil in dealing with environmental issues in Categories "A" and "B", will be unable to provide the necessary oversight and technical advice; that the new responsibilities of the Dinas will not be matched by adequate fiscal mechanisms and financial resources to discharge them; and that MME will not let go of its authority, among others. The same potential opportunities and risks accompany the decentralization from BAPEDAL to the Regional BAPEDALDA, most of which, having been established in the last 2 to 3 years, lack experience and human and financial resources

Until recently 80 percent of mineral royalties were supposed to go to regional government and 80 percent of these (or 64 percent of the total) were to go to local communities. Law 25/1999 on Fiscal Balance Between the Center and Regions, enacted in May 1999, provides that 80 percent of general mining royalties should revert to the supplying district and 20 percent of those funds should go to the local community. In most cases pollution mitigation or environmental remediation could be paid for with a relatively small portion of the royalties, if received by the community.

Information and Public Participation

As noted above, many tens of thousands of poor and others who have lost income and/or employment due to the crisis have taken advantage of the near absence of entry barriers into small-scale mining, and have laid de facto claim to gold and coal resources in particular, regardless of whether they are located within mining concessions and/or forest boundaries. Many of those entering gold ASM with no pollution controls are exposing themselves and adjacent communities to high risk of mercury poisoning, which may not be manifested in serious adverse health impacts for ten or more years. To avert the potentially disastrous consequences of rapidly increasing exposure to mercury in small-scale gold mining areas since the onset of the crisis, a mining and health public awareness program on the effects of heavy metals on human health is desperately needed. The Ministry of Health and Ministry of Mines and Energy, in consultation with local governments and NGOs, should consider collaborating to raise public awareness of urgent health issues in the mining sector, focusing initially on mercury contamination in small-scale gold mining.

7. Conclusions and Recommendations

During the mining boom experienced by Indonesia in the 1990s, production of all but one of the country's major minerals increased by at least 20 percent, and production of coal, copper, gold, and silver grew more than three-fold.[27] The environmental effects accompanying this growth were substantial– increased land disturbance covering hundreds or thousands of hectares at each mine, increased generation of tailing wastes involving increased risk of accidents, acid rock deposits (ARD), and contamination of rivers used for drinking water and food supplies. However, with the exception of a single tailings dam rupture affecting 3,000 hectares in 1990, Indonesia has not experienced major mining accidents.[27]

While the economic crisis has not altered significantly the growth trends of the large mining companies operating in Indonesia, it has brought increased mining applications from medium-scale coal companies. Unless existing poor environmental practices in the medium-scale coal sector improve substantially, pollution intensity in that sector is likely to increase in the next 2 to 3 years, as current applications are approved and new areas are brought into production. The crisis has also sparked exponential growth of small-scale, unregulated gold and coal mining, much of which is located within mining concession boundaries and/or forest boundaries. Skyrocketing ASM output has resulted in high pollution intensity in ASM areas, and introduction of untreated toxic mercury into the waste stream in small-scale gold mining areas. Given the high economic returns to ASM operators relative to their alternative sources of income, it is unlikely that the ASM sector will shrink after the crisis abates. Innovative, long-term environmental solutions are needed for ASM, including both win-win incentives and improved enforcement capability.

Although data remain incomplete and further analysis is needed, Indonesia's experience during the crisis offers cautionary lessons. When economic growth stalls, the poor and others experiencing loss of income and/or employment are likely to turn to quick income-generating opportunities requiring little capital or skills, such as ASM. Unless safeguards are put in place quickly, ASM areas are likely to experience high pollution intensity which, left untreated, can produce serious degradation of land and water resources in a short period. Government agencies and professional mining associations need to anticipate such developments, and have in place some quick response strategies, including intensified health monitoring and carrot-and-stick technical assistance to small-scale miners.

Table 7.1 outlines detailed recommendations on key environmental issues in the mining sector, which are based on the findings of this report.

[27] See Table 3, Mineral Production in Indonesia, 1990-1998. The single major mineral with declining output during this period was bauxite. Coal production jumped from 10.6 million tons in 1990 to 55 million tons in 1997.

[27] A recent incident at Freeport, a spill following collapse of an overburden slope tail in mid-2000, was serious in terms of loss of life (3 workers presumed dead), but was not a major spill in environmental terms.

Table 7.1 Recommendations on Key Environmental Issues in the Mining Sector

Key environmental issues	Short-term recommendations	Long-term recommendations
Large-scale mines Risk of major accident (tailings spill) Acid rock drainage (ARD) Poor or mediocre reclamation	• Focus EIA on major risks and consequences • Identify and target potential trouble spots for extra monitoring and enforcement • Strengthen reclamation bond program	• Research on elements of good practices in reclamation of mining land • Collect case studies of the quantitative and qualitative effects of environmental damage in sampling of mines
Medium-scale coal mines[a] Loss of forest cover Poor management of top soil Loss of fine coal particulates due to lack of recovery circuits Inadequate sediment ponds Poorly designed catchment areas Significant ARD from tailings	• For new applications/permits focus on EIA of major impacts and credible implementation of environmental management plans • Train government and private mining personnel in identification and solution of environmental problems • Pilot environmental audits for existing mines, emphasizing "win-win" pollution prevention options • Target inspections and audits to potential trouble spots and worst offenders • Strengthen reclamation bond plan	• Expand training, especially in outlying regions with largest mining sectors • Strengthen enforcement capabilities, including introduction of schedule of penalties for offenders, increasing for repeat offenders • Engage stakeholders in developing standards for acceptable losses of fine coal particulates, and introduce technical training and pilot programs for fine coal recovery circuits • Make audit results public
Medium-scale mines (non-coal) Weak day-to-day environmental performance Loss of forest cover Lack of reclamation on closure	• Target inspections and audits to potential trouble spots and worst offenders • Train government and private mining personnel in identification and solution of environmental problems • Strengthen reclamation bond plan	• Expand training, especially in outlying regions with largest mining sectors • Strengthen enforcement capabilities, including introduction of schedule of penalties for offenders, increasing for repeat offenders • Make audit results public
Artisanal and small-scale mining Total absence of environmental management Health effects from mercury pollution Loss of forest cover	• Pilot mini audits and environmental training • Target worst offenders in relatively accessible areas of high environmental and cultural sensitivity • Investigate potential for partnerships between large-scale concession and ASM operators within concession boundaries • Raise public awareness of environmental and health effects of dangerous practices, and start pilot projects on better environmental technology and management, with mercury use receiving highest priority	• Extend permitting, including EIA for ASM • Expand environmental training programs for ASM operators • Close down worst offending areas • Compare studies from other countries on adaptability of solutions to problems in ASM gold mining
Institutional development Lack of trained personnel Poorly defined roles, overlapping responsibilities Lack of coordination	• Improve EIA quality and linkage with permitting decisions • Strengthen coordination between MME and BAPEDAL focusing on improving EIA and standardizing environmental monitoring in the mining sector • Enhance coordination between MME and MoFEC, focusing on EIA review and consensus on reclamation goals • Continue training of inspectors, especially at regional centers • Engage industry associations, MME, NGOs, and local governments in discussion on problems and solutions • Emphasize enforcement including schedule of penalties	• Educate public on environmental and health dimensions of mining • Update and strengthen EIA procedures • Collect data set on environmental degradation caused by mining, including baseline conditions

Source: Study team

[a] Problems in this category were identified in BLT-OSM project. Other problems noted below related to medium-scale mines in general are also problems for coal mining.

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Appendix I. Survey, Small-Scale Coal Mining in South Kalimantan

Background. There has been a substantial increase in small-scale, illegal coal mining in South Kalimantan since the crisis began. It is performed openly, with heavy equipment in locations that are relatively accessible to government officials. The average mine produces 200 to 300 tons of coal per day valued at about $8,000. Most miners are not from the area. The increased mining appears to be opportunistic rather than poverty-driven and results from the confluence of various factors. First, the general decline in political stability and law and order which has accompanied the crisis has made it easier to undertake illegal activities with impunity. Second, the slowdown in construction activities has released a large amount of heavy equipment now being used small scale operations. Third, there has been a general sympathy toward income-earning activities since the onset of the crisis, which has contributed to lax law enforcement.

Twenty-five small-scale coal mines were surveyed in the region near Banjarmasin, South Kalimantan. The surveyed mines comprised approximately 50 percent small-scale mines in this region and 18 percent of small-scale coal mines in South Kalimantan. In addition, 17 community leaders and 43 local persons were interviewed. The average community contained about 300 families and was almost entirely dependent on farming, mainly rice.

Key Survey Results. On average, the respondents had been miners for 2.5 years, but 88 percent of them had been in South Kalimantan for less than one year. Eighty percent began mining because it was more profitable than their previous work. For 70 percent of the respondents, mining was their main source of income. Others worked on a seasonal basis. Eighty percent of the miners had no formal training. Sixty-three percent owned their operations. The owners reported an average of 48 employees. Non-owner miners who worked for others reported an average of 95 workers. All operations averaged 64 workers.

The average mine site had three pieces of heavy equipment, with only one of the 25 surveyed sites using none. The average monthly rental for a bulldozer and excavator were US$4,500 and US$3,000, respectively. Daily production averaged 920 tons of coal per day, for which the miners received US$9 per ton (figures from week of the survey).[28] Eighty-four percent of the miners sold their coal to a stockpile or a trader. Landowners received a royalty of US$0.50 per ton on average. In some cases, land rents were also paid but the interviewers were unable to determine the amounts.

Most of the operators interviewed had never applied for any of the necessary production or environmental permits and hence they ran illegal operations. Many of the mines were within other concession areas. Table A1 lists the illegal mines and equipment being used on the concessions of seven medium- or large-scale coal mines. Some of the mines sublet from village cooperatives (KUDs) which had legal mining rights. However, the cooperatives were not permitted to use heavy equipment, making KUD operations with heavy equipment illegal. Most of the coal was transported through the middle of Banjarmasin, the principal city in the region, to its port. Coal-carrying trucks were not allowed into the city until 6 p.m., after which there was a steady stream of vehicles. The city was surrounded by coal stockpiles.

The mining operations using heavy equipment were easy to identify. Unlike many small gold mines, the coal miners could not run and hide very easily. Government authorities were aware of the most mine locations, and ninety percent of the mines reported at least one inspection by a government official. In principle, closing these mines down should be relatively easy. However, government officials said they lacked authority to close illegal mines. Because the mines were not legal, they said, the police were responsible for intervening. However, the latter have been reluctant to act.

Environmental damage. On-site inspection and discussions with government officials indicated considerable environmental damage associated with the increase in small-scale coal mining. Hillsides and

[28] A typical medium-scale mine produces between 3,000 to 15,000 tons of coal per day.

hilltops have been carved away, resulting in substantial soil erosion and sedimentation in streams. In some areas acid rock drainage was also occurring. No actual or intended reclamation of mined areas was evident. As much as 500 to 600 hectares of land per year were being mined and then abandoned. With a conservative estimate of US$500 per hectare (given that the topsoil had not been stored), it would cost US$250,000 per year to reclaim this land.[29] In some locations the land was marginal agricultural land, but in other areas more than 50 percent of the land was previously used for rubber plantations.

Table A1. Artisanal coal mining in legal mining areas in South Kalimantan, January-October 1998

	License holder and total equipment	Number of illegal mining locations	Total area (ha)
1	PT. Jorong Barutama Greston	33	32.25
	63 excavators, 10 bulldozers		
2	PT. Antang Gunung Meratus	4	N/A
	5 excavators, 4 trucks, 1 bulldozer		
3	PT. Adaro Indonesia	8	35
	6 excavators, 1 grader, 15 trucks		
4	PT. Arutmin Indonesia	47	N/A
	8 excavators, 2 bulldozers, 1 steam roller		
5	Ex. PT. CHOMD	4	N/A
	5 excavators, 1 bulldozer		
6	PT. Sumber Kurnia Buana	32	N/A
	57 excavators, 11 bulldozers, 1 back hoe loader		
7	PT. Baramulti Suksessarana	17	N/A
	31 excavators, 2 bulldozers		

Source: Kanwil Energy and Mining Department of South Kalimantan, Banjarmasin, Indonesia.

Most mines were operating on less than 5 hectares of land, but 9 of the surveyed mines used on average 20 hectares in the previous year. Hence, roughly 500 hectares of land were mined each year. Thirty-five percent of the miners reported some sedimentation of rivers and streams, 30 percent acknowledged some soil erosion, but none of the miners perceived ARD as significant problem.

Community leaders were twice as likely to report environmental problems due to the mining operations. However, local residents expressed little concern about environmental problems related to the upsurge in mining. Road damage was their major concern. Most communities were very supportive of the mining activities and in some cases local people were involved in the mining. Rents paid by the miners took precedence over environmental and social concerns. Given local residents' low income levels and lack of prior exposure to the long-term damage to land and water resources that ordinarily accompanies small-scale mining, short-term economic rationality prevailed.

The mining operations did not appear to have had significant social or health effects. The encampments were relatively small. Miners could easily acquire goods and services in Banjarmasin. The miners reported no increase in illnesses and no serious accidents. Community leaders likewise reported no increase in illnesses and no serious accidents in local communities, although 20 percent of the community respondents reported negative effects of the mining operations on the health of mothers and children. Ninety percent of the miners and 75 percent of the community leaders reported that relations between the mines and the communities were either good or neutral. All community respondents said that the mines had not had any negative social influence, while 40 percent indicated that the mines had positive economic benefits. Although 25 percent of the community leaders said that there had been some conflicts with miners, 90 percent believed that small-scale mining should be allowed to continue and, in fact, should be nurtured.

[29] The Kamwil Energy and Mining, South Kalimantan, estimated that 600 hectares of land was mined by illegal coal mining operations 1998, and that area could double in 1999.

Appendix II. Survey, Artisanal Gold Mining in Pongkor, West Java

Background. There has been an enormous increase--by as much as 500 percent--in artisanal gold mining in Pongkor, West Java, since the economic crisis began. The DGM estimates 26,000 illegal miners are working in the area, most on the concession of a large state mining company, Aneka Tambang. None of the miners use heavy equipment, and hence classified as artisanal (rather than small-scale) miners. All are operating illegally, none had any formal training and none has been inspected by a government official, even though the area is only a few hours drive from Jakarta and easily accessible.

Forty-two artisanal miners, 17 community leaders, and 26 local persons were surveyed in Pongkor, West Java. The average community contained about 6,000 persons, and until the mining activities began, had been almost entirely dependent on farming, mainly rice.

On average miners had been mining for 2.2 years, but had been in the Pongkor region only 1.2 years. Ninety percent of the miners surveyed began to work in the region after the crisis began. Sixty percent of these miners first took up mining after the crisis. Forty-five percent of the miners chose Pongkor as it was close to home, while 50 percent migrated when they heard of good opportunities in the area. Seventy-five percent undertook the activity full-time and 25 percent on a seasonal basis. Local people were heavily involved in mining, to the extent that 62 percent of the community leaders reported that mining had overtaken farming as the main economic activity of their community. The growth in artisanal gold mining in Pongkor was not poverty driven, despite its upsurge after the crisis began. Sixty-one percent of the miners started mining because it was more profitable than the alternative activities (usually farming), while only 20 percent were mining as a result of lost jobs or reduced incomes. Respondents stated that the low-rung workers made up to 1,000 percent more than they made as laborers on rice farms. Rice field owners are finding it difficult to find laborers and must bring in labor from outside at wages 50 to 75 percent higher than construction workers in Jakarta.

Even without the group that took up mining because of lost jobs or reduced incomes, the area would still have seen a 300 percent to 400 percent increase in the number of miners. According to respondents, there were about 4,000 artisanal gold miners in the region, compared to about 750 miners two years earlier. The large discrepancy between the miners' average estimate of artisanal gold miners in the area and that of DGM (26,000 as mentioned above) could be due to miners basing their estimates on the location where they worked. There were 4 main locations in the area. Table A2 shows the number of different types of workers in each location.

Key Survey Results. Fifty-five percent of the miners worked in groups, 25 percent for themselves, and 25 percent for others. The average size operation had 15 miners and produced 100 grams of gold per week, which it sold for approximately US$5 per gram both the week of the survey and on average over the previous six months. Ninety percent sent their ore to a processing plant, usually a ball mill operation.

Environmental Damage. There was considerable environmental damage associated with the gold mining activity. All of the miners used mercury in their operations, often applying it directly to the ore during the crushing stage in a ball mill operation, which signifies much more mercury waste than when it is used only in the final amalgamation process.[30] Sixty percent of the miners said that the waste mercury

[30] For a description of the operation of a ball mill processing plant, see Martens (1998). This technique uses much more mercury than when gold is separated from the crushed rock by use of a sluice or other technology. It is generally more dangerous for the workers who generally fish the mercury amalgam out of the pool of water and crushed rock, usually without wearing any protection. Among the respondents, 55 percent used mercury directly in the ball mill operation, while 45 percent further refined the gold ore with a sluice before using mercury. On average, the miners used nearly 40 grams of mercury for each gram of gold that they obtained when they put the mercury in the ball mill, and 5 grams of mercury for each gram of gold if they used a sluice. These figures are consistent with estimates of mercury use in other parts of the world. Wotruba et al (1998) reports on mercury use in South America. See Veiga (1997) for alternative technologies for small-scale mining.

is discarded, and 40 percent said that it is recycled.[31] None of the miners was aware of any other processes for amalgamating the gold.

Table A2. Illegal Mining-Related Personnel in Pongkor area, 1999

	Location				
Workers	**Longsoran**	**Gn. Buta**	**Cepu**	**Ciurug**	**Total**
Stall owner	77	62	80	84	304
Shaft owner	65	73	69	76	283
Shaft employee	795	803	759	924	3,281
Miners	2,340	2,628	2,415	2,584	9,967
Miners helper or transportation labor	1,950	1,890	1,830	2,010	7,680
Stall helper or stall labor	840	803	656	672	2,971
Food seller	300	240	250	300	1,090
Stall employee	210	169	221	226	826
Total	6,577	6,668	6,281	6,876	26,402

Source: Authors.

All of the community leaders reported environmental damage due to the mines, especially river pollution, soil erosion, and road damage. The Cikaniki and Ciguha Rivers—important water sources for the 16,500 residents of the three villages of Cisarua, Bantar Karet, and Pangkal Jaya—are the water bodies most affected by the pollution.

Community leaders and local people agreed that there were also social problems, mainly due to a bad influence on mothers and children working at the mine sites. Neither community leaders nor other local people complained of any increase in health problems nor did the miners. Although the miners all said that their relationships with the local communities were neutral or cooperative, 55 percent of them reported that there had been conflicts with local communities. Eighty-four percent of community leaders reported conflicts with artisanal miners.

Nevertheless, there had been little or no regulatory or community pressure on the miners to change their operational procedures or close down. None of the miners reported inspection by a government official. There appeared to be several reasons for the lack of pressure. First, there had been a general decline in law and order as a result of the political instability the encompassed the economic crisis. Second, there was a general tolerance of income-earning activities in the wake of the economic crisis. Third, about half of the miners come from local communities. Although non-mining income data was not collected, mining incomes were reported to be many times higher than in the miners' previous occupations and there were strong multiplier effects to the rest of the area. Despite the environmental and social concerns noted above, all of the surveyed community leaders supported the mining activities. The increased incomes were perceived as more than adequate compensation to the communities for the environmental and social problems associated with the mining. Fourth, mercury poisoning is a slow process which often becomes noticeable after many years of exposure. Hence, the communities were not likely to be aware of the danger to which they were exposed. The first two of these factors were present in Kalimantan as well (see Appendix I). The third and fourth were specific to Pongkor.

[31] A solution that is often proposed to remedy the mercury problem is to put a large tax on the material. However, given the long-term downward trend in the price of mercury due to over-supply—largely a result of an increasing number of prohibitions on mercury in former uses—this tax would have to be very high and almost certainly result in smuggling, increasing the illegality of what is already largely an illegal activity.

Appendix III: Methodological Notes

Large-Scale and Medium-Scale Mines

In theory, one would like to compare the benefits of a mine to the costs associated with the mining production. The benefits would include value added and some measure of the direct and indirect multiplier effects, while the costs would include various opportunity inputs, including the land, and the environmental and health externalities. In reality, there is rarely enough data to even approximate most of these costs and benefits.

The alternative measures used in this study begin with the assumption that if there were no externalities and all land was reclaimed at mine closure, the benefits of the mine are greater than the costs. It seems clear that the opportunity cost of the land used for the mine is generally if not always much less than the wealth generated directly and indirectly by the mine. In fact, even in the case of small-scale mining, the results of our surveys indicate that the land is worth several magnitudes as much when used as a mine rather than farmland, if environmental externalities are not taken into account. It could be argued that the power structure allows the mine to "grab the land" even though the land would be better used in agriculture. This begs the question as to why the powerful interests do not just grab the land and use it for the (hypothesized) more profitable agriculture. In reality, many of the mines are located in remote areas where the land has little economic value.

Accordingly, the main measures used for environmental damage caused by mining are the reclamation costs and the annual preventive expenditures. If the mine is clean in the sense that it reduces environmental damage to the point where the benefits of increased expenditure are less than the costs to society, these two measures are a good lower bound for the environmental (and related health) externalities. They are a lower bound as the total benefits of the environmental expenditure may be much greater than the total costs. For example, if Mine A undertakes the proper level of environmental expenditures and the otherwise identical Mine B does not, the environmental damage caused by Mine B could be much greater than the expenditures of Mine A. Nevertheless, these expenditures (and reclamation costs) when compared when the output of the mine can give society a good sense of whether a mining project should be undertaken or not. In cases where the company (or miners) are obviously not taking proper environmental precautions, estimates are made of the amounts that they would have to spend on both reclamation and remedial expenditures based on the outlays made by the better environmental performers in Indonesia.

In addition, a rudimentary risk analysis is made of the expected costs of major tailings spills to Indonesia. It is assumed in this analysis that the risk of a tailings spill in an Indonesian mine is the same as the global average over the last 30 years. Clean-up and indemnization costs of tailings spills are generally not known, but based on the small amounts of data available, it is assumed that the average major tailings spill costs US$100 million, which is probably on the high side.

Artisanal and Small-Scale Mining

Surveys were undertaken in two ASM sites. The surveys were designed by Gary McMahon and Elly Rasdiani and undertaken by teams from universities. The main goals of the surveys were (1) to determine the main reasons for entry into ASM; (2) to determine the production and the income of miners and compare it with alternative sources of income; and (3) to determine the main production methods and associated environmental and health impacts.

The survey areas were chosen to capture two different types of operations and two minerals with quite distinct characteristics with respect to both processing techniques and value per volume. Moreover,

as Pongkor is close to areas which have suffered considerably due to the crisis, it was hypothesized that many entrants were "poverty driven", a hypothesis which was only partially correct. The case of South Kalimantan was interesting due to the larger size of the operations and their relatively fixed nature. That is, when the authorities came to inspect (or close) them, they could not easily pick up and run away and come back after they had left. Hence, there was an additional interest in analyzing the reasons they were (and are) allowed to continue. These mines are also in an area which reportedly was less affected by the crisis.

Good approximations for the incomes of the miners were obtained, although the opportunity costs did not directly come from the surveys from interviews and general knowledge of the areas. The reasons for entry were obtained as well as the main production methods and related environmental impacts. With respect to the environment, it was not possible to get any concrete measure of the effects except in the case of the amount of land used in coal mining. Nevertheless, it was possible to catalogue the most important environmental and health concerns.

The survey sizes were determined by budgetary considerations rather than some scientific process. Nevertheless, in the case of the coal survey approximately half of the known small coal mines were surveyed. In the case of the gold survey, miners in 43 different operations were surveyed. The average operation had 15 workers so about 640 workers of the estimated 26,000 miners in the region were covered to some extent.