

Mining, Minerals and Sustainable Development:

A Framework for Research

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Foreword

This short note is intended to stimulate discussion on how the Mining, Minerals and Sustainable Development (MMSD) Project should select its priorities for research and analysis.

1. Choosing Priorities

The MMSD project has set ambitious objectives for research and analysis, notably:

- To assess global mining and minerals use in terms of the transition to sustainable development. This will cover the current contribution - both positive and negative - to economic prosperity, human well-being, ecosystem health and accountable decision-making, and the track record of past practice;
- To identify how the services provided by the minerals system can be delivered in accordance with sustainable development in the future;

Although the draft Project Strategy has outlined a research method for dealing with these goals, it has not tackled the question of which research issues should be studied. Meeting these objectives is challenging for a number of reasons. Taken in its broadest sense, the project could have an almost limitless scope, dealing as it does with the whole of the world's non-biomass economy and involving a realm of activity typified by extensive diversity and complexity across the globe. Among the risks this project faces are:

- *Superficiality* -- Undertaking broad-based work of insufficient depth to advance understanding.
- *Duplication* -- Another danger is that the project could carry out research that has already been done by others or is underway.
- *Over-Ambition* -- Finally, the project could initiate research activities that are unable to deliver results in time for the projected deadline of December 2001. While we accept the idea that some of the research we will initiate may not be completed that soon, if most of it is not completed by that date, our Project Report will not be informed by the results.

As a result of these factors, the project's research agenda needs to be targeted, timely and add real value. To achieve this, the project needs a planning process that generates a clear and accepted set of priorities, deciding what should and should not be undertaken. Everyone will have their own set of priority issues for analysis: IIED in its *Scoping Report* of October 1999, listed over 20 potential issues for analysis. This list is attached, as is the recent list generated by Conservation International in its work *Lightening the Lode*. One of the aims of the Strategic Planning Workshop is to help identify common priorities, based on expert opinion from across the globe.

2. Scoping the Horizons

Defining and narrowing the project's scope is one of the most pressing issues. Six key dimensions can be identified which mark out the project's horizons:

- A. *Minerals*: Over 100 different minerals are currently mined, falling into three broad groups: 1/ those produced for local markets (e.g., sand, quarry stone, aggregates); 2/ those produced for regional markets (e.g., coal, limestone); and 3/ those which compete in a truly global market (e.g., metals, diamonds). These minerals are extracted through a variety of means by an array of actors ranging from artisans to global corporations. While many of the sustainable development issues may be generic, choices need to be made on which minerals to focus on and which to exclude.
- B. *The Value Chain*: The project aspires to an integrated analysis of the sustainable development issues along the value chain, encompassing both the mining and the minerals' cycles, production and consumption. Markets for minerals range from the local to the global, with widely differing driving forces and priorities at each stage of the chain. The project will need to focus in on specific aspects of the chain – and dynamics – which are currently poorly understood, for example, the optimal balance between virgin and recycled minerals.
- C. *Geography*: Minerals are produced and consumed in every part of the world, in very different ecosystems, regulatory frameworks, political and economic conditions and cultural contexts. The Project Strategy stresses the importance placed on a decentralised approach drawing on regional concerns. Decisions are required on the geographical coverage of the project, since not every region can be covered in the same degree of detail. Furthermore, the research work will need to be carried out at different levels of analysis from the local, case study to the global aggregation.
- D. *Time*: Mining moves more material than any other human activity. As a result, its impacts on the landscape and the human environment can be near permanent impacts. The scope of the project could therefore address
 - 1/ issues of the past – the legacy of historic mining and minerals activities –
 - 2/ impacts of current operations and/or
 - 3/ project into the future the possible consequences for sustainable development of different trajectories in minerals production and consumption.
- E. *Actors*: Mining and minerals use affects numerous social groups and thus creates a wide spectrum of people with a stake in its performance: communities, governments, companies, civil society organisations, workers, universities etc. The distribution of rights, risks, rewards and responsibilities also varies within and among these groups. The project will need to ensure that the differential opportunities and threats generated by minerals development are adequately reflected.
- F. *Sustainable Development*: Finally, sustainable development itself involves a package of goals – social, economic, environmental and political – which need to be integrated, within each of which is a bundle of issues for attention. Thus, the environmental agenda could address the ways in which minerals production and consumption generates hazards to human health, impacts on potentially renewable resources (air,

biomass, soil, water), depletes non-renewable resources and keeps within the Earth's absorptive capacities for wastes and pollution. Furthermore, attempts to operationalise sustainable development for analysis as well as decision-making are bedevilled by an abundance of definitions and interpretations. Classically, some take a 'weak' view of sustainability, arguing that social, economic, environmental and political goals can be traded off; others take a 'strong' view, arguing that certain values are absolute and take precedence over others. The project will obviously need to develop ways of understanding sustainable development that win broad acceptance.

From this, it is clear that full life cycle sustainable development reviews of every mineral in every part of the world is impossible. Cases and regions will need to be chosen to illustrate critical issues. A first step would be to start to winnow out specific minerals, regions or other dimensions that will not be addressed. For example, some have suggested that the project should exclude energy minerals, at least beyond the point of mining, so as not to duplicate the efforts of other terms of researchers who are focussing on climate issues. Another option would be to examine the life cycle of mineral production, consumption, and disposal in a limited number of cases to illustrate the dynamics of the different local, regional and global markets. Thus, six case studies, two corresponding from the to each of the three groups set out above could be studied. Of these three pairs of case studies, one would be drawn from a developed country and one from a developing country.

3. Research Zones: Identifying Key Steps

A stepwise approach may help to further highlight the major research zones. When looking at the areas around which improved understanding is required the following clusters emerge:

- *Baseline Assessment:* A fundamental need for the project is to synthesise existing knowledge and where necessary commission new research to establish baseline sustainable development profiles of mining and minerals. In many cases, insufficient knowledge exists of the current status of mining and minerals. A key question is thus: What are the key baseline assessments that need to be carried out on the various dimensions of MMSD?
- *Drivers of Change:* Movement towards or away from sustainable development is motivated by a number of drivers – financial, technological, institutional, political, socio-cultural etc. Some of these are poorly understood. Again, what are the key key drivers that need to be analysed?
- *Benchmarks and Targets:* An important feature of progress towards sustainable development is the setting of process and performance targets at different levels and for different institutions to ensure good practice. These targets need to be based on analysis, including risk assessments. Here, the question for research is: what are the key areas of contention around which further understanding of sustainable development benchmarks is required?
- *Tools for Improvement:* A wide variety of tools can be applied by different actors to deal with specific issues in the minerals system: regulatory, market-based, financial, civil etc. In many cases, there is inadequate knowledge of the effectiveness of these instruments and the policy mixes that are required. Here, the task is to identify the key tools that need further analysis and enquiry.

4. Suggesting Initial Preferences

Finally, issues differ in the way in which they will need to be analysed. Some issues can only be suitably addressed at a global level; some are common to all regions, but require local inputs and analysis; and some issues are unique to specific regions.

A limited number of major cross-cutting issues which justify intensive research efforts at the global level may include:

Baseline Assessment

- A. *Information Needs*: What are the critical data needed to make informed decisions on mining, minerals and sustainable development; what information is available; whose responsibility it is to bear the costs of its generation, and where is progress hindered by a lack of reliable data or poor access?
- B. *Mineral Cycles*: How can understanding of mineral cycles be improved to minimise rapid and unexpected shocks to local communities, regional and national governments, and other actors? What techniques are required for managing the cycle in tune with sustainable development?
- C. *Material Flows*: What are the overall environmental impacts of the material flows associated with mining and minerals use? How could potential improvements in eco-efficiency and resource productivity – driven by policy, markets and technology -- affect mining and minerals use in the future?

Drivers of Change

- D. *Finance*: How are mineral exploration and development projects financed, and what opportunities or constraints do these financial realities place on a transition to a more sustainable industry? To what extent do current practices in financing represent either barriers to adoption of best practice, or potential incentives to implement it?
- E. *Global Markets*: Where are the critical gaps in the governance of international trade and investment which hamper progress towards sustainable development ? What market-based instruments offer opportunities for promoting more efficient and sustainable trade and investment? To what extent are the current global mechanisms for marketing minerals barriers to greater sustainability or opportunities to achieve it?
- F. *Technology*: Which are the key technological trends will influence the prospects for sustainability in minerals production and consumption? How does the current trend to scale impact on the pursuit of sustainable development? Which areas of potential innovation are critically constrained at present?

Benchmarks and Targets

G. *Culture*: Are there examples of good practice that enable traditional, aboriginal or indigenous cultures in remote areas to assert their culture and interests in the face of minerals development and the globalisation that it brings? What are the legal, economic and political preconditions at the local, national and international levels?

Appendix 1 Themes for Further Analysis: Suggestions from the Scoping Report

Economy

- 1) *Market Dynamics*: How does the global market for minerals constrain or enable the transition to sustainable development, notably in terms of the commodity price cycle, economies of scale and the globalisation of trade and investment ?
- 2) *Corporate Responsibility*: How can sustainable development become embedded in the culture of mining companies, and how far should corporate policies for sustainable development extend to joint venture operations, subcontractors and the supply chain?
- 3) *Financial Drivers*: How far will financial pressures, risk management and transnational liability become drivers of sustainable development?
- 4) *Scale and Ownership*: How far does scale and ownership affect the performance of different mining actors, in particular the artisanal sector and the various ‘junior’ players?
- 5) *Access to Markets*: How can the terms under which minerals have access to markets – both in terms of consumer choice and regulatory action – better reflect the goals of sustainable development?
- 6) *Technological Innovation*: How can research and technological innovation be accelerated to deliver solutions to today’s problems without generating new risks -- and how can these cleaner technologies best be diffused globally?

Society

- 7) *Human Rights*: What is the contribution that minerals’ development can make to the promotion of human rights in the workplace and in the local community, in particular the specific rights and traditions of indigenous peoples?
- 8) *Community Empowerment*: What are the critical factors that enable communities to play an effective role in mining developments that affect them (e.g. decision-making, benefit sharing) so that livelihoods become sustainable, particularly after closure?
- 9) *Health and Safety*: How can a more transparent and honest process of risk assessment and reduction for workers, communities and consumers be achieved, alongside the positive promotion of well-being?

Environment

- 10) *Material Flows*: What is the global impact in terms of material flows generated by mining and minerals and where does best practice exist in terms of closing the minerals’ cycle to encourage recycling and reduce dissipative use and waste and reducing energy intensity?

- 11) *Benchmarks*: How can global benchmarks for environmental management be set (e.g. for riverine and marine disposal of tailings, effluent control, acid mine drainage, biodiversity, mine-site rehabilitation) to ensure consistency?
- 12) *End-Use*: What processes are available for resolving controversial end-uses of minerals (e.g. coal, lead, uranium) and for improving efficiency in consumption?
- 13) *Finite Nature of Minerals*: How serious is the finite supply of minerals as an environmental issue, both at the level of the individual mine and globally ?
- 14) *Competing Land-Uses*: Under what circumstances should cultural or environmental factors override access to minerals ('no go' areas)?

Governance

- 15) *Historical Legacy*: What approaches have been successful in dealing with the inherited liabilities of mining (including abandoned sites) and avoiding these in the future ?
- 16) *Rent Capture and Distribution*: Are there working models of best practice for efficient and equitable capture and distribution of mineral rents between host countries, local communities and investors?
- 17) *Regulation*: How can regulation be better designed and enforced to ensure sustainable development, particularly to control 'free riders' and remove 'perverse subsidies'?
- 18) *Secondary Impacts*: How can integrated regional planning best be carried out to assess and manage the secondary social, economic and environmental impacts of new mining operations?
- 19) *Transparency*: How can all actors be made more accountable for their decisions, for example, in order to reduce opportunities for corruption?
- 20) *Stakeholder Participation*: How can relevant stakeholder participation in decision-making be improved locally, nationally and globally and lead to effective partnerships ?
- 21) *Time Horizons*: How can the longer-term perspective of sustainable development best be integrated into decision-making on mining and minerals?

Source: IIED Scoping Report, October 1999

Appendix 2 Conclusions and Recommendations

Lightening the Load: A Guide to Responsible Mining

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In this paper, we have offered a general review of the main environmental and social challenges facing the mining industry as it expands into important and delicate tropical ecosystems worldwide. The recommendations offered throughout the paper are designed to help both the mining industry and national and regional governments decrease negative impacts and increase positive contributions to conservation and community development. These recommendations should be considered and implemented in conjunction with all interested parties and relevant stakeholders to ensure that mineral development in tropical areas proceeds in a responsible manner. This process must also be accompanied by a continued shift in values among mining industry and government representatives to incorporate the acceptance of the environment and community relations as core business issues. As part of this shift, all stakeholders must recognise that, in some cases, the environmental and social costs of development will simply be too high. In these areas, large-scale industrial development should not proceed.

The following is a summary of the general recommendations that appear throughout this paper. For each set of recommendations, we have included page references to more information in the main body of the paper. While some of the recommendations are directed at the mining industry, and others at government regulators, the effective implementation of any one will require collaboration and coordination between both sectors. Together, these recommendations provide a general set of practices and methodologies that all interested parties can use to "lighten the load" of the mining industry on environmentally and culturally sensitive areas in the tropics, and elsewhere in the world.

RECOMMENDATIONS

INDUSTRY ENVIRONMENTAL PRACTICES

A. Overall Environmental Strategy.

- Develop a company-wide strategy or environmental management system to guide activities at all levels and all phases of operations.
- Conduct a thorough environmental impact assessment (EIA) before beginning any mining activities or before any major modifications, to determine potential impacts and review mitigation alternatives.
- Implement a comprehensive Environmental Management Plan and a rigorous system of performance monitoring.
- Train employees on environmental and social issues, company strategies and compliance with guidelines.
- Supplement impact minimisation with proactive contributions to conservation and community development.

B. Exploration

1. Land-clearing

- Use new technologies, such as satellite imaging and remote sensing, to increase the accuracy of exploration operations and decrease the need for extensive land-clearing.
- Conduct a baseline environmental study of the area to identify natural or biological features that might be affected by the operation.
- Store removed topsoil for use in future reclamation activities.

2. Access roads and infrastructure

- Avoid building roads for exploration operations in remote areas when possible; instead use helicopters, waterways and existing tracks.
- Construct roads along existing corridors and away from steep slopes and waterways when feasible, to avoid erosion and run-off.
- Design roads with appropriate drainage features to reduce maintenance costs and negative environmental impacts.
- Avoid building roads or other infrastructure during heavy rains.

3. Drilling

- Use lighter rigs and more efficient drilling equipment to reduce direct environmental impacts.
- Consider sensitive areas when positioning drill holes and excavations.
- Maintain and store drilling equipment and materials properly, to minimise leaks and spills.
- Recycle water used in drilling with liquid/solid separators.

4. Reclamation of exploration sites

- Remove and reclaim roads and tracks that are no longer needed for mining activities-
- Dispose of contaminated soils and cap drill holes. Revegetate land areas that have been cleared, using native species.

C. Mine operation and ore extraction

- Use the same techniques to minimise erosion, sedimentation and access as during exploration operations.
- Position open pits and waste dumps whenever possible in geologically stable areas, away from surface waterways.
- Minimise waste dumps by backfilling pits whenever possible.
- Ensure proper drainage from pits and waste dumps.

D. Mineral production

- Control dust during processing with water and filters. Install collection systems in mills to control spills, water run-off and effluent.
- Collect and treat contaminated wastewater from metals processing.
- Add neutralising agents to acidic wastewater or use bioremediation before releasing into the environment.
- Remove trace metals and cyanide from wastes before disposing in a waste dump or tailings impoundment.
- Use scrubbers or precipitators to "clean" gases before they are released into the atmosphere.
- Capture potentially harmful gases for alternative industrial uses.
- Monitor gas emissions to reduce air pollution and minimise employee exposure.

E. Waste Management

1. Tailings

- Locate tailings impoundments away from watershed drainage areas and downstream from the processing plant.
- Use international standards for building large dams. Line tailings impoundments to prevent leaks.
- Install a monitoring system to detect seepage and a collection system to catch any seepage from a tailings dam.
- Control excess water in tailings dams with recycling and treatment.
- Maintain a sufficient freeboard between the top of the tailings and the top of the dam.
- Remove toxic substances from the waste stream before they get to the tailings impoundment.
- Adopt an inspection program during operations that includes periodic inspection by the design engineers, or equivalent experts.
- Monitor tailings impoundments during operations and for several years after closure to detect groundwater contamination.
- Reclaim used tailings impoundments after closure to prevent future contamination.

2. Acid rock drainage

- Use acid-base accounting and kinetic testing to predict the acid-producing potential of ore.
- Prevent acid rock drainage by limiting contact between water and exposed mine rock.
- Store acidic materials under wet or dry covers to prevent contact with oxygen or water.
- Use proper post-mining reclamation techniques to prevent the production of acid rock drainage.

F. Reclamation

- Begin planning and implementing reclamation at the start of an operation.

- Monitor reclamation activities during and after operations to ensure effectiveness.
- Reuse stored topsoil for replanting after mining ceases.
- Rehabilitate land areas through re-shaping of landforms and grading to prevent erosion.
- Revegetate project sites using native species.
- Implement a comprehensive maintenance and monitoring program for reclaimed mining sites.

II. INDUSTRY SOCIAL PRACTICES

- Employ trained professionals to oversee a community relations program.
- Ensure that communication with communities is consistent and continuous, and takes place at a senior level in the company.

A. Social assessment and monitoring

- Conduct a thorough social assessment at the exploration stage, to predict impacts and understand local needs and desires.
- Integrate the social assessment with any environmental impact assessments.
- Conduct new or additional assessments for each major stage of a project.
- Contract impartial third parties to monitor compliance with social management plans.

B. Stakeholder identification

- Before beginning exploration, prepare preliminary national, regional and local social profiles to identify stakeholders and potential sources of conflict and cooperation.
- Establish formal communication mechanisms with all identified stakeholders.
- Recognise that local populations are comprised of several diverse groups, with different, often competing, needs and goals.
- Avoid policies that might exacerbate divisions in local communities.

C. Consultation and participation

- Engage stakeholders in a two-way consultation and negotiation process, starting at the earliest stages of exploration.
- Ensure that negotiations and discussions are always between groups, rather than individuals.
- Ensure that all parties can participate in consultation as fully as possible by providing assistance to weaker groups.
- Provide clear and accessible information on the project to all stakeholders-
- Conduct any communication in a common language, using appropriate and easy-to-understand methods of communication.
- Ensure that communication remains continuous, open and honest throughout the entire life of the mine.

D. Recognition of land rights

- Recognise all land claims, and attempt to negotiate with all parties.

- When appropriate, seek an agreement to use land for a stated period of time, rather than a transfer of land ownership.

E. Relocation

- Fully involve local communities in the process of determining where the new community will be located and what the appropriate compensation will be.
- Ensure that the relocation program includes full resettlement.
- Sponsor a baseline study of the community as it exists before the project, to better match a new location to the community's needs.
- Provide sufficient financial and in-kind compensation, in addition to new land and village infrastructure.

F. Economic compensation and support

- Ensure that any compensation scheme is comprehensive, long-term and sustainable.
- Make arrangements for infrastructure, such as health clinics, to remain viable after closure-
- Work with local people to determine what industries or economic activities will be most important to the area once the mine closes.
- Adopt a policy of hiring local people and providing training if they lack the right skills.
- Support local businesses and use local products when- ever feasible.
- Assist local people in getting loans to start their own businesses.
- Complete a formal, written agreement between the company and community, to ensure clarity and transparency.

III. GOVERNMENT TOOLS

A. Land-use planning

- Work with stakeholders to develop a long-term, strategic land-use plan to determine where mining and other development is appropriate and where it should be avoided.
- Avoid mining activity in national parks and lands that are home to voluntarily isolated indigenous groups.
- Set priorities for conservation, community development, mining and other economic activities through consultation with stakeholders and experts.
- Establish clarity on land rights and the specific boundaries of indigenous territories.

B. Government capacity

- Train government officials in mining and environmental agencies in both technical skills and regulation, administration and enforcement of laws.
- Clarify and reform roles and responsibilities within and among government agencies-
- Ensure effective communication and cooperation among government agencies involved in the mining sector.
- Bridge gaps in funding with contributions from multi- lateral development agencies or corporations.

C Legislation and regulation

- Enact national and regional legislation regulating mining activities.
- Ensure that all laws are clear and transparent, and apply equally to all parties.
- Provide detailed information on regulations to companies.
- Supplement mining codes with specific environmental and social legislation that covers both national standards and sector-specific regulations.
- Develop guidelines and standards in a participatory manner, with relevant governmental and non-governmental stakeholders.
- Require environmental and social impact assessments for all mining activity, including exploration.
- Conduct assessments at the ecosystem or regional level, looking at both direct and indirect impacts.
- Require new or partial assessments for any major change or addition to a mining project.
- Enact a set of legislation designed to regulate and assist small-scale miners.

D. Financial tools

- Utilise taxes or tax breaks and fines to encourage pollution control and waste reduction.
- Require the posting of performance bonds to ensure that funds will be available to mitigate damage or complete reclamation at a mining site.
- Establish national or project-specific trust funds to provide additional funding for conservation or community development.
- Ensure that proceeds from taxes, bonds or trust funds reach their intended beneficiaries.
- Encourage the use of conservation offsets to increase the positive benefits of mining projects.

E. Monitoring and enforcement.

- Implement regular monitoring of compliance with environmental and social relations.
- Institute company audit requirements to check the performance of mining operations.
- Ensure consistent and fair enforcement of regulations.
- Criminalize violations of environmental and social statutes.
- Allow citizens to have a voice in developing laws, and recourse to legal action in case of violations.