



Economic Commission for Africa

Compendium on Best Practices in
Small-Scale Mining
in Africa



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Acknowledgements

The minerals and energy team of the Regional Cooperation and Integration Division (RCID) of ECA, led by Antonio M.A. Pedro and under the overall guidance of Mr Youssif A. Suliman, the Director of the Division, compiled this compendium, with Wilson Mutagwaba, of MTL, Tanzania, as consultant. Elleni Negash did the typing and Berhanou Haile Mikhael provided research assistance.

We would like to thank Beatrice Labonne of UNDESA, Brian Chambers of UNCTAD, Jeffrey Davidson of CASM and the World Bank, and Edmund Bugnosen, of Bugnosen Minerals Engineering, UK, for their initial comments on the terms of reference for this study. Our gratitude is also extended to Fui Tsikata of Reindorf Chambers and the Faculty of Law, University of Ghana, Brigitte Bocoum of the African Development Bank (AfDB), Anatoli Belov of UNDESA, Elizabeth Marie Hoadley of the University of Witwatersrand, South Africa, Kevin D'Souza of Wardell-Armstrong, UK, Pierre Adama Traore, a retired ECA Senior Economic Affairs Officer and former Minerals and Energy Programme Leader, Blackmore Gondwe, a retired ECA Economic Affairs Officer and member of the Minerals and Energy Team, Namakau Kaingu, Regional Chairperson and Coordinator, African Women in Mining and SADC Women in Mining Trust, S. Serumola, of the Ministry of Minerals, Energy and Water Affairs, Botswana, Geraldo Valoi, of the Ministry of Mineral Resources and Energy, Mozambique, E.S.Osumo of the Ministry of Environment and Natural Resources of Kenya, Getachew Tesfaye, of the Ministry of Mines of Ethiopia, Hudson Mtegha of the Minerals and Energy Policy Centre, South Africa, Ben Aryee and Joseph Hoyte Eyison of the Minerals Commission, Ghana, Aloyece Tesha of the Ministry of Energy and Minerals, Tanzania, Veston Malango of the Ministry of Mines and Energy, Namibia, and Rob Guest of MINTEK, South Africa for their comments on the earlier versions of this compendium.

We are also obliged to the 34 participants of the joint ECA and UNDESA Seminar on “Artisanal and Small-scale Mining in Africa: Identifying Best Practices and Building Sustainable Livelihoods of Communities”, held in Yaounde, Cameroon, 18-22 November 2002, who reviewed the document, validated its main findings, conclusions and recommendations and provided additional valid inputs.

We are also thankful for the internal peer review done by the Sustainable Development Division (SDD) in particular Kwadu Tutu, Isatou Gaye and Joan Kagwanja and by Albert Yama Nkouna of the ECA office for Central Africa.

The contribution of Lorna Davidson and Maria Thundu, Seifu Dagnachew and Teshome Yoahnes of ECA’s Communication Team who respectively edited and designed and produced the compendium is acknowledged with appreciation.

Abstract

Small-scale mining (SSM) is an activity that is increasingly gaining momentum in Africa. It is largely practised in rural areas by artisans who lack the requisite education, training, management skills and essential equipment. Small-scale miners also lack financial resources with no access to bank loans. Very often, the mining operations are done haphazardly with severe consequences to the environment, the surrounding, and even distant, communities and to the miners themselves. Other constraints include lack of technico- economic information for long-term planning.

Although SSM in Africa is still far from achieving its full potential, there are indications of positive efforts by individual countries to promote the sector. The practices documented herein represent some of the examples, selected through literature review and consultations, of how the sector can be promoted to ensure its positive contribution to the establishment of sustainable community life and rural economic development.

Most initiatives have been isolated practices that do not reverse the poverty cycle that limits development of the SSM sector in Africa. There is limited evidence of participatory integrated approaches that aim to promote and develop the sector through putting clear policies, strategies and implementation plans in place. Most approaches have been developed to respond to a certain crisis, e.g., dealing with mining rush gangs.

Promotion of the sector should be done in an integrated manner in order to ensure that:

- Legal, organizational, technical, management, environmental and socio-economic issues are accorded the same importance;
- Programmes for promotion of the sector take into consideration the need to integrate mining activities within much wider rural development programmes as the “mining-alone” programme approach, usually dealing with isolated issues, has very little overall impact;

- Poverty reduction strategies are mainstreamed in the mining policies of member States and where relevant SSM is integrated in their Poverty Reduction Strategy Papers (PRSPs); and
- Provisions and incentives exist to encourage illegal SSM activities to evolve into legal, licensed small businesses.

Putting an efficient legal framework in place without enhancing the financial capacity of miners or raising their awareness of their legal obligations does not help to eradicate illegal mining activities. Similarly, enacting regulations for improving health and safety standards or environmental management without improving access to technology, finance, information and support services might have little long-lasting impact. Even, where all these have been put in place, other factors have to be considered, such as ensuring that at government level there is adequate human and technical capacity to support the sector and enforce laws and regulations in a sustainable manner.

The practices documented in this compendium as best practices should help:

- (a) Countries wishing to develop strategies for promotion of the sector;
- (b) Countries wishing to review their current strategies in order to improve effectiveness;
- (c) Donor agencies wishing to develop assistance programmes; and
- (d) NGOs, international development agencies and other interested parties working with the sector.

Acronyms

AMCOAL:	Anglo-American Coal
BGS:	British Geological Survey
BP:	British Petroleum
CDR:	Committee for the Defence of the Revolution
CDC:	Commonwealth Development Corporation
CDE:	Centre for the Development of Enterprises
CDI:	Centre for the Development of Industries
CGA:	Coal Gold Agglomeration
CSIR:	Council for Scientific and Industrial Research
DFID:	Department for International Development (UK)
DME:	The Department of Minerals and Energy
ECA:	Economic Commission for Africa
EIA:	Environmental Impact Assessment
FFM:	Fundo de Fomento Mineiro
GSD:	Geological Survey Department
GTZ:	Deutsche Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation Agency)
IDC:	Industrial Development Corporation
ILO:	International Labour Organization
IPEC:	International Programme on Elimination of Child Labour
ITDG:	Intermediate Technology Development Group
KPM:	Kabwe Power and Metals Ltd.

MEPC:	Minerals and Energy Policy Centre
MILF:	Mining Industry Loan Fund
MMSD:	Mining, Minerals and Sustainable Development
MRD:	Mineral Resources Division
NGO:	Non-Governmental Organization
NSC:	National Steering Committee
NSMAC:	Namibia Small-scale Miners Association Centre
NSMAC:	Namibia Small-scale Miners Association Centre
NUM:	National Union of Mineworkers
ODA:	Overseas Development Administration
PMMC:	Precious Minerals Marketing Corporation
RCID:	Regional Co-operation and Integration Division
RDC:	Rural District Councils
SADC:	Southern Africa Development Community
SAWIMA:	South African Women-in-Mining Association
SEAMIC:	Southern and Eastern African Mineral Centre
SIDA:	Swedish International Development Co-operation Agency
SMAC:	Small-scale Miners Association Corporation
SMAN:	Small Miners Association of Namibia
SMC:	Shamva Mining Centre
SSM:	Small-scale Mining
SSMAZ:	Small-scale Mining Association of Zimbabwe
SZK:	Sable Zinc Kabwe Ltd.
TAMIDA:	Tanzania Mineral Dealers Association
TAWOMA:	Tanzania Women Miners Association
UDSM:	University of Dar-es-Salaam
UNIDO:	United Nations Industrial Development Organization
USAID:	United States Agency for International Development
VAT:	Value Added Tax
VETA:	Vocational Education Training Authority

Background to the Project

The significant economic benefits to be reaped from small-scale mining (SSM) activities have recently been recognized by several African countries. Indeed, the potential of the sector to contribute significantly to socio-economic development is great. Such contributions include the decisive role it can play in:

- (a) Poverty alleviation, especially in rural areas;
- (b) Reducing rural-urban migration especially for the unemployed youth;
- (c) Maintaining the vital link between people and the land;
- (d) Creating alternative economic activities;
- (e) Contributing to national incomes; and
- (f) Contributing to state revenues.

From a technical standpoint, it encourages the regulated exploitation of otherwise uneconomical reserves and provides a lead to many discoveries of large-scale deposits. In addition, because SSM is usually labour intensive, it offers a greater opportunity for direct and indirect job creation than do large-scale operations, especially in rural areas. At the micro level, revenues generated from these activities increase local purchasing power as well as the demand for local products, e.g. food, working tools, housing, and furniture. In turn, this creates more employment in other economic sectors such as agriculture, carpentry, fabrication and foundry.

Nonetheless, as with many economic activities, SSM has its negative aspects. A largely itinerant, poorly educated populace with few other employment alternatives, living mostly in remote rural areas, carries out this activity. Often, the technology employed is rudimentary, and impact severely on the local environment and miners' health. Health and safety standards are poor, and productivity and hence earnings are low. Security in camps and surrounding areas, illegal mining and marketing activities, and the use of child labour is prevalent.

Without financial resources and technical and management skills, miners can neither conduct systematic exploration of the mining areas, nor acquire adequate technico-economic information to allow long-term planning and adequate mining development. There are a number of factors, which contribute to the poor performance of the small-scale mining sector: These include lack of simple and transparent legal and fiscal frameworks, weak institutional structures; lack of capacity to implement existing regulations, and sometimes lack of political will. Inadequate support services and access to information and technology and restrictive marketing systems further contribute to making small-scale mining, not only unproductive, but also counter-productive.

Given the SSM potential, there is need to create a conducive environment, that fosters its development, encourages the application of best practices for mining, occupational health and safety, promotes environmental protection and discourage child labour and gender inequity.

Encouraging efforts are now being deployed by a number of African governments to maximize the positive impact of SSM activities on their respective economies. In countries such as Ghana, South Africa, Tanzania and Zimbabwe, best practices in SSM management and development have been identified. These can be replicated elsewhere on the continent.

This compendium is an attempt to capture these practices for dissemination across the continent. The language in the compendium is simple to facilitate reading by small-scale miners and related stakeholders. It should be considered a work in progress that requires continuous updating in tandem with the evolution and dynamics of the sector. The compendium was presented for validation to the joint ECA/UNDESA seminar on “Artisanal and Small-scale mining in Africa: Identifying Best Practices and Building the Sustainable Livelihoods of Communities” held in Yaounde, Cameroon, 19-22 November 2002. It incorporates some of its recommendations, particularly on the nexus of poverty and SSM (see Annex 1). The terms of reference for this work included the need to:

- (a) Identify “best practices” in production systems, environmental management, marketing, technical and financial assistance programmes, legal and regulatory frameworks and to maximize the SSM contribution to the creation and development of viable communities in Africa;
- (b) Analyse the success factors and commonalities in such best practices;
- (c) Carry out a desk-top study of relevant literature on small-scale mining that is specific to the African context, particularly works published locally that could fit into the broader context of the global discussion on SSM;
- (d) Undertake, if necessary, field missions to small-scale mining sites where best practices have been reported;

- (e) Evaluate how those best practices which have been identified promote viable community life and economies, especially in rural areas; and
- (f) Draw lessons and recommendations for implementation elsewhere in the continent.

2

Small-scale Mining: General Overview

2.1 Definition

There are currently no universal definitions of artisanal or small-scale mining. The lack of consensus, as echoed by several researchers, e.g., Priester et al., 1993; Taupitz et al., 1993 and others, is due to the fact that such a definition varies from country to country. Several attempts to arrive at a widely accepted definition of small-scale mining have been made, based on criteria ranging from investment costs, labour requirements, ore production rates, and size of concessions, amount of reserves, annual sales or any combination of these. Some countries have more than one definition for small-scale mining. This is because a wide range of parameters is used to provide a definition for these activities, and it is also an attempt to differentiate between artisanal and small-scale mining proper.

The United Nations uses the volume of material mined to establish the boundary between small- and large-scale mining. This boundary was set at 50,000 tons of ore per annum for underground mines and 100,000 tons per annum for open pits (Barnea, 1978). This definition raised many objections, as the amount of ore required to recover one ton of mineral A is not necessarily the same as for mineral B.

Some suggested that the definition of small-scale mining in the case of precious metals, (e.g., gold mines) should be based on the quantity of minerals produced, e.g., ounces of gold per annum rather than on tons of run-of-mine ore per annum. Other definitions use capital requirements to establish the boundary. Accordingly, any project which required less than \$US 3-5 million to develop is considered to be a SSM project (Taupitz et al., 1993).

The Southern African Development Community (SADC) Mining Co-ordinating Unit defined artisanal and small-scale mining operations by dividing them into three categories (Taupitz et al., 1993):

- Micro-scale mining or manual mining with simple tools without using mechanical energy;
- Manual mining, well organized, using some mechanical energy and plant with required investment between \$10,000 and \$100,000; and
- Industrial small-scale mining or small mines using modern, adapted technology and with required investment of \$200,000 to \$3 million.

Although the above categorization covers the entire range from artisanal to industrial SSM, the introduction of the term “micro-scale” mining was based on the argument that the dictionary defines “artisan” as someone who does skilled work with his hands. This is not necessarily the case of small-scale miners.

This is a weak argument, since the categorization of such miners as “artisans” stems from the fact that, over time, mining and mineral processing are performed using basic skills and unsophisticated technology developed within the trade, e.g., the excavation of pits as deep as 150m, devising support mechanisms, hoisting materials to surface, and fabricating mining and processing tools. This is reflected in the World Bank’s definition of artisanal mining as “a type of manual, low technology mining conducted on a small scale, predominantly in rural areas of the developing world” (World Bank, 1995).

The International Labour Organization (ILO) contends that small-scale mining means different things to different people. To some, it is dirty, dangerous, and disruptive and should be discouraged. To others, it is profitable and productive, or is simply the only way out of poverty. During a survey conducted by the organization recently, responses to the question on what defines a small-scale mine revealed that definitions vary with the criteria used, namely (ILO, 1999):

- Level of employment or number of workers for a particular mine;
- Annual production output;
- Capital investment;
- Level of mechanization;
- Size of claim; and
- Depth of the mining operation.

The survey found that a combination of several of the above factors is very often used to define small-scale mining. Table 1 provides a summary of some of the criteria used by different African countries and the United Nations.

Table 1: Different criteria used in the definition of small-scale mining

Country/Organization	Criteria
Côte d'Ivoire	Level of mechanization
Ethiopia	Annual production, level of mechanization
Ghana	Capital investment, number of participants
Guinea	Type of minerals exploited
Senegal	Depth of working, crude production levels
South Africa	Capital investment
Tanzania	Capital investment, labour and technology requirements
United Nations	Annual production capacity
Zambia	Size of concession
Zimbabwe	Size of concession, capital investment

Most of these definitions encompass certain similarities:

- In most countries, the activities are limited to nationals;
- Skilled labour and sophisticated technology are not required;
- The operations are labour intensive;
- The levels of capital investment and production capacity are generally low; and
- Room for potential transition from purely manual artisanal activities to more advanced SSM operations that employ mechanical equipment and basic technology.

This compendium uses the term small-scale mining (SSM) in reference to labour-intensive mining activities that have low per capita productivity, employ unsophisticated technology and require low capital investment. This includes artisanal mining and low-technology SSM operations at the lower end of the scale, and, on the upper end of the scale, formal mining operations employing basic mining and processing technology such as mechanical drilling and water pumping, blasting, manual loading, mechanical hoisting, mill with gravity concentrator and other similar techniques.

2.2. Significance of the sector

Despite the fact that each SSM operation is very small, the combined economic and social impact is significant in many developing economies. It is estimated that within sub-Saharan Africa, SSM produces gold and gemstones worth about \$1 billion. (ILO, 1999). Although statistics related to this sub-sector are difficult to ascertain, the economic impact on individual countries is significant.

In Tanzania, 70% of all mineral export earnings (\$49 million) in 1992 came from SSM activities. In Zambia, estimates show that small-scale miners account for about 80% of the country's emeralds production, which represents about 20% of world production (MMSD, 2001). About 15% of gold exports from Zimbabwe in 1999 were estimated to come from small-scale mining (MMSD, 2001). Globally, nearly 15-20% of the value of non-fuel minerals comes from SSM operations.

These activities provide considerable employment, especially in rural areas, and contribute substantially to poverty alleviation. Table 2 shows the numbers of participants in small-scale mining in the Southern Africa region.

Table 2: Participants in small-scale mining sector within Southern Africa*

	Malawi	Mozambique	Tanzania	South Africa	Zambia	Zimbabwe	Total
Mining contribution to GDP	0.9%	2.0%	2.8%	8.0%	12.1%	8.0%	
Formal large- & medium-scale mining employment	14,000	87,000	365,000	1,350,000	300,000	350,000	2,466,000
Number of small-scale miners (estimated)	40,000	60,000	550,000	10,000	30,000	350,000	1,040,000
% Informal small-scale miners (estimated)	90.0%	95.0%	90.0%	n.a.	60.0%	85.0%	84.0%
% women in SSM (estimated)	10.0%	30.0%	25.0%	5.0%	30.0%	> 50%	25.0%

*Source: Small-scale Mining and Sustainable Development within the SADC Region, MMSD 2001.

ILO estimates that 3.0-3.7 million people are employed in small-scale mining in Africa, 6.7-7.2 million in Asia/Pacific countries, 1.4-1.6 million in Latin America and 0.4-0.5 million in developed countries (ILO, 1999). In developing countries, the number of those whose livelihoods in one way or another depend on SSM activities is between 80-100 million people.

It is also a well-known fact that artisanal “barefoot explorers” discovered many deposits mined by large-scale mining companies. A world-class deposit with proven reserves of more than 12 million ounces of gold at Bulyanhulu in Tanzania was first stumbled upon by herdsmen and was later exploited by artisanal miners. In addition, marginal reserves that would otherwise be classified as uneconomical can be mined using SSM methods.

2.3. Negative aspects

Despite these positive contributions, SSM has a negative impact not only because of the manner in which business is conducted, but also as a result of deficiencies in the system that tries to regulate it. Although an increasing number of countries have recognized small-scale mining as a significant sector of the economy, there are still those who regard it as dreadful to mineral sector development.

In such countries, the activities are simply ignored and no institutional, technical, financial, legal and regulatory support is extended. Even in those countries that have recognized the SSM sector as important, legal and fiscal frameworks designed specifically for artisanal mining activities are absent. As a result, SSM activities are carried out illegally, thereby reducing the possibility of rent capture by the host government.

Due to this lack of adequate support and regulation, most artisanal mining activities are carried out in an uncontrolled manner. Miners and regulatory authorities play a “cat and mouse” game with negative consequences to the environment. The combination of uncontrolled activities and the lack of technical know-how and financial expertise have resulted in activities that have become synonymous with inefficiency, poor health and safety standards, negative environmental impacts and smuggling.

The uncontrolled use of mercury through amalgamation, haphazard location of pits, increased siltation in rivers, accelerated erosion, degradation of river banks and water sources, and deforestation are some of the common negative environmental impacts associated with SSM. In addition, poor security, local inflation and social ills are all too common in SSM areas. Most of these factors tend to reinforce one another, resulting in a vicious cycle that is difficult to break.

Lack of technico-mining knowledge and lack of financial and advisory services force miners to carry out ad hoc operations, largely by guesswork and trial and error. As a result, mineral resources that could otherwise have been mined more efficiently by medium- to large-scale mining methods are sometimes rendered non-viable by small-scale activities. Lack of adequate equipment, such as drilling and pumping machines also leads miners to abandon their deposits prematurely, once hard rock or water is encountered.

The use of child labour in SSM operations is a significant social issue. Children as young as 6 or 7 years old have been found breaking rocks manually, and 9-year olds have been seen working underground under poor health and safety conditions. Although the risks faced by children working in mines are similar to those faced by adult miners, their young bodies are still fragile and more vulnerable. Children work in these risky conditions for little or no pay at all; most work just to have enough to eat.

2.4. Gender issues

A substantial number of women work in the SSM sector. Women are involved in direct mineral production activities and in mining settlement-related activities. Although taboos and socio-cultural factors, financial and economic capacity, and technological and organizational aspects often curtail their entry into direct production, their numbers have been increasing in many countries. The growth of women's participation is often a necessity rather than choice, due to their lack of alternatives. The increase in retrenchments from public employment as a result of structural adjustment programmes, low commodity prices, prolonged droughts, and other factors can be linked to this growth.

According to a recent survey by ILO, about 3.5-4.0 million women out of 11.5-13 million small-scale miners worldwide are directly involved in these activities (ILO, 1999). It has been estimated by the Economic Commission for Africa (ECA) that 45-50% of the 3-3.7 million people engaged (directly or indirectly) in small-scale mining in Africa are women. Despite these impressive numbers, most women are still part-time workers, relegated to secondary activities such as manual grinding of ore, and panning. This is more pronounced where some degree of technology is employed, as in hard-rock mining.

In Zimbabwe, women represent only about 10% of the 30,000 formal miners. Their representation among the 300,000 gold panners, who are mostly illegal, is nearly 50%. In Ghana, the number of women who are concession holders, is only 10%, but they represent more than 50% of those working in minor, illegal mining activities. In Tanzania, the picture is the same. In all three countries, women working in processing activities are usually engaged as part-time labourers in manual grinding of ore, using pestle and mortar and gravity concentration by wooden pans, in addition to their usual responsibilities in agriculture (food security) and as home makers and care takers of extended families (This has been exacerbated by the HIV/AIDS pandemic).

3

Selected Best Practices in Small-scale Mining

3.1. Criteria for selection of best practices

The selection and compilation of what are considered best practices involved the identification of individual parameters and issues that have a bearing on the development of the SSM sector (see table 3). These have been discussed in the preceding sections. Although the parameters affecting SSM practices are all interrelated, an issue-by-issue analytical approach was followed since it facilitated accessing and analysing information. In addition, it should be noted that most programmes for SSM promotion in individual countries are issue specific. This compilation does not pretend to be exhaustive and it has been limited by availability of reliable information on tested practices.

Furthermore, it should be observed that what constitutes a best practice in a given environment or location may not necessarily be replicable in another, depending on local conditions, institutional culture and capacity, as well as other not so tangible factors. Whilst an attempt has been made to identify the success factors for sustainable small-scale mining development, since those would invariably be location-specific, in implementing the recommendations of the compendium, there is need therefore to understand that they may not be universally applicable and that they need to be adapted to the local context.

Table 3: Different criteria used in the definition of small-scale mining

Main Area	Specific Issues
Mining policy	<ul style="list-style-type: none"> · Policy recognition of small-scale mining and its categories · Identification of government functions and roles · Policy objectives · Recognition of small-scale mining constraints · Policy directions and strategies
Mining legislation	<ul style="list-style-type: none"> · Country definition of small-scale mining · Specific legislation for small-scale mining · Types of mineral rights · Size of concessions · Duration of tenure and renewability · Entitlement to transfer and mortgage of mineral rights · Limitation of small-scale mineral rights to nationals · Upgrading of mineral rights · Designation of areas specific for small-scale mining · Decentralization of mineral rights allocation and administration · Informal/undocumented licensing
Technology	<ul style="list-style-type: none"> · Availability of channels for access to technology · Programmes for promotion of cleaner and more efficient technology · Technical training and awareness programmes · Promotion of value-adding techniques · Specific small-scale mining technologies
Environmental management, health and safety	<ul style="list-style-type: none"> · Specific environmental legislation and regulations · Procedures for environmental impact assessment · Procedures and financing for site rehabilitation · Legislation on health and safety · Monitoring, reporting and data collection
Minerals marketing	<ul style="list-style-type: none"> · Regulation of minerals marketing · Licensing of private mineral dealers · Other forms of open local mineral markets · Local mineral pricing systems · Strategies/incentives to discourage illegal trading · Mineral export procedures for producers and dealers · Incentives to encourage value adding practices · Value-adding industries
Institutional capacity	<ul style="list-style-type: none"> · Institutional network · Adequate human and financial resources · Specialized small-scale mining units · Small-scale miners' organizations
Access to credit and finance	<ul style="list-style-type: none"> · Loan-based financing schemes · Equity-based financing schemes · Hire-purchase schemes · Donor and government support schemes · Financing through cooperation between small- and large-scale miners · Buyer credit schemes
Technical assistance programmes	<ul style="list-style-type: none"> · Specific technical assistance programmes · Special unit for provision of extension services · Specialized training institutions · Miners' access to information
Women in mining	<ul style="list-style-type: none"> · Addressing women issues in mining policies · Women Miners' Associations · Specific assistance programmes to support women miners
Child labour	<ul style="list-style-type: none"> · Addressing child-labour issues in mining policies · Child-labour elimination programmes
Other parameters	<ul style="list-style-type: none"> · Small-scale mining research and development · Cooperation between small- and large-scale miners

3.2. Best practices identified

3.2.1. Mining policy

A sound mining policy should provide guiding principles, give directions for the development of the sector and set clear objectives and strategies for realizing those objectives. Policy directions, objectives and strategies should reflect a non-discriminatory development approach between large- and small-scale mining sectors. Because small-scale mining activities are largely poverty-driven activities, it is important that a mining policy acknowledges the needs of small-scale mining and links the strategies for development of the sector to those for poverty alleviation. Based on this scenario, the following mineral policies have been identified as best practices:

Tanzania Mining Policy

Tanzania adopted a new mining policy in October 1997 as part of the country's ongoing economic restructuring. The mineral sector was identified as a lead sector in the overall economic restructuring programme. The mining policy emphasizes the shift of the government economic policies from public sector-led development to private sector-led development and market-oriented economic management. The mineral policy clearly identifies the roles, objectives and strategies for development of both small- and large-scale mining. With regard to SSM, the positive features include:

Recognition of the SSM sector: Although small-scale mining is not clearly defined, the policy consistently refers to artisanal and small-scale mining, a clear recognition of the existence of the two categories.

Government function: This has been identified as “reinforcing the provision of extension services and assistance to artisanal and small-scale miners in adopting safe and environmentally sound mining and processing practices”.

Policy objectives: The policy has seven objectives, two of which directly address the sector and aim to:

- (a) Regularize and improve artisanal mining; and
- (b) Alleviate poverty especially for artisanal and small-scale miners.

Two other objectives, addressing environmental impact and minerals marketing, although general, are also applicable to small-scale mining.

Recognition of constraints: The policy discusses what it regards as being constraints to the development of the SSM sector.

Directions and strategies: Strategies aimed at developing a modern and efficient SSM are set out clearly and can be summarized as follows:

Rationalization of artisanal and small-scale mining

The strategies aim to:

- (a) Transform and upgrade the activities into organized and modernized mining;
- (b) Make available appropriate and affordable technology and encourage its local production;
- (c) Assist the transfer of technology by promoting partnership between miners and large-scale investors;
- (d) Provide extension services in mining, mineral processing and marketing;
- (e) Streamline and simplify licensing procedures for artisanal miners and mineral dealers;
- (f) Prepare, disseminate and enforce a code of conduct for mining and processing; and
- (g) Promote marketing arrangements that are receptive to the needs of the sector.

Legal and regulatory framework

Strategies in this category are set out in general terms that apply to both large and small-scale miners. The specific strategies for small-scale mining aim to:

- (a) Streamline the licensing procedures in order to harmonize small and large-scale mining operations; and
- (b) Ensure transparency and fairness by conferring ownership of mineral rights on a “first-come, first-serve” basis.

Financial services

In order to improve small-scale miners’ access to credit, the strategies aim to:

- (a) Support the formation of formal enterprise groups and formalize traditional funding systems, e.g., hire-cum-purchase, forward sales and mutual group saving schemes;
- (b) Encourage banks to develop mine finance expertise, and establish mobile and commercial banks in mining areas;
- (c) Encourage financial institutions to support the sector through affordable credit schemes and start-up capital requirements;
- (d) Promote the use of third party guarantees to enable institutions to assist miners to get loans;
- (e) Facilitate the creation of mineral property markets to enable discoverers to sell their properties;
- (f) Assist in the establishment of miners cooperative banks and informal financial institutions;

- (g) Establish trust funds to finance simple equipment and other inputs and devise mechanisms for its replenishment; and
- (h) Promote a savings culture amongst miners through awareness programmes.

Establishing formal marketing systems

These strategies aim at ensuring the growth of both local and export markets, by:

- (a) Simplifying licensing procedures for dealers and traders and rationalizing and streamlining fiscal terms;
- (b) Providing extension services and instituting stiff penalties on mineral smugglers;
- (c) Facilitating establishment of competitive mineral markets close to mining areas that are operated by the major stakeholders;
- (d) Establishing a system of local marketing committees that will ensure smooth and efficient operations of the mineral markets and keep statistics;
- (e) Facilitating access to up-to-date minerals markets information;
- (f) Offering incentives to encourage export promotion activities;
- (g) Promoting formal financing schemes and direct sales to foreign buyers; and
- (h) Utilizing the country foreign missions to identify markets, link them to dealers and initiate promotional programmes.

Environmental management for small-scale mining

The policy sets out separate strategies for environmental management for small- and large-scale mining. The SSM strategies aim to:

- (a) Demonstrate and encourage the utilization of environmentally sound technologies;
- (b) Provide environmental information through leaflets in national language (Kiswahili) and improve awareness through the media;
- (c) Build partnerships with different stakeholders with a view to improving environmental awareness and management;
- (d) Establish strict standards in densely mined areas and empower mining extension officers to carry out regular monitoring;
- (e) Specify environmental control measures based on the “polluter pays” principle; and
- (f) Establish proper authority structures to uphold law and order and facilitate enforcement of health and safety regulations.

Health and safety

The policy recognizes that although advancement in technology and training of employees have improved safety performance in large-scale operations, the same is not true for small-scale mining. As such, it sets out general strategies aimed at:

- (a) Establishing health and safety regulations and preventive measures for accidents and other hazards;
- (b) Strengthening and enforcing regulations and improving health and safety education and investment in health care facilities;
- (c) Encouraging mining communities to take private initiatives for private provision of essential infrastructure and services;
- (d) Incorporating the provision of social infrastructure and hygiene facilities in community development plans in highly concentrated mining areas;
- (e) Inspecting of mining sites by government health and safety staff; and
- (f) Encouraging other stakeholders' involvement in enforcing health and safety standards.

Women and children issues

In order to address the social problems that limit effective participation of women in mining and those that lead to children being employed in mines, the policy sets out strategies aimed at:

- (a) Encouraging and facilitating employment and involvement of women in mining development;
- (b) Alleviating barriers limiting women involvement as potential investors and conducting awareness programmes in order to encourage women participation;
- (c) Enforcing regulations against child labour and imposing stiff penalties on those miners who employ children;
- (d) Addressing poverty problems and providing viable alternatives; and
- (e) Promoting education for children in mining areas and supporting and promoting productivity enhancement programmes, which would reduce the need to employ children.

Institutional framework

The SSM strategies include:

- (a) Improving information flow for sensitizing and creating awareness on available opportunities and regulations governing the sector;
- (b) Strengthening the existing training institutions and establishing vocational training centres; and

- (c) Bringing administrative and technical support services closer to the mining centres.

South African Mining Policy

South Africa is in the process of developing its SSM sector. This is part of an overall strategy aimed at addressing problems and opportunities confronting the mining industry in the wake of changes in the country's policy and institutional environment. The process started with establishment of a Mineral Policy Process Steering Committee in 1995. After going through a comprehensive consultative process, a White Paper on Minerals and Mining Policy was approved by the Cabinet on 23rd September 1998. The most salient SSM aspects included:

Recognition of the SSM sector

In recognition of the significance of a flourishing small-scale mining sector, the policy document:

- (a) Considered small-scale mining as ranging from very small operations that provide subsistence or artisanal livelihoods, to the "junior" companies for which subsistence is not the prime motivator;
- (b) Recognized that small-scale mining is already practiced at a sizeable scale in the country, especially in the exploitation of gold, diamonds, coal, industrial minerals and in minerals derived from pegmatites; and
- (c) Stated clearly that it is in the interest of the country and the community at large that "all forms of mining, whether large, small or artisanal, should be subject to the same requirements in respect to licensing, safety, health and the environment".

Directions and strategies

South African strategies for the development of an efficient small-scale mining sector can be summarized as follows:

Mineral rights

To make relevant information accessible to small-scale miners on minerals rights and mineral deposits available for development.

Financial services

- (a) Encouraging and facilitating access to funding for small-scale mining through appropriate and targeted institutions; and
- (b) Carrying out cost/benefit analysis between providing state advice and support to small-scale miners and providing similar support to other mining and non-mining activities.

Access to technology

- (a) The Department of Minerals and Energy (DME) to coordinate needs-driven research to be carried out by the Science Council and disseminate its results to relevant stakeholders; and
- (b) The DME in consultation with relevant stakeholders, to investigate the establishment of training facilities for small-scale miners both in South Africa and in the southern Africa region as a whole.

Access to information

The DME to establish a “one-stop-shop”, to disseminate information to small-scale miners on all aspects relating to mineral development and exploitation.

Institutional capacity

- (a) All Government and development agencies to coordinate their SSM activities. Municipalities to be encouraged to include small-scale mining development in their local economic development strategies;
- (b) The capacity of DME to be enhanced, to facilitate small-scale mining support and establishment of self-sustaining institutional support mechanisms for the sector; and
- (c) The Government to facilitate the mutually beneficial co-existence of big and small-scale mining operations.

Legal and regulatory framework

- (a) To ensure that mining regulations are administered consistently; and
- (b) The DME, in conjunction with other relevant government departments, to streamline the regulatory and administrative procedures for mineral exploration and exploitation.

Health and safety

To maintain health and safety standards in small-scale mining operations.

Environmental management

- (a) Small-scale mining, as the rest of the industry, to adopt measures that promote environmental sustainability through application of consistent standards and acceptance of the “polluter pays” concept;
- (b) The Government to support the provision of training and skills development in environmental management;
- (c) To provide intensive environmental management guidance in areas with high concentrations of small-scale miners; and
- (d) To ensure that financial guarantees for rehabilitation are flexible and site specific.

In addition to the above environmental management requirements, small-scale miners are expected to adhere to the overall mining industry environmental management requirements that are set out in chapter four of the policy document. The requirement states that:

“A consistent standard of environmental impact management will be applied and maintained irrespective of the scale of the mining operation. Special attention will be afforded to the education and the provision of guidelines for mining entrepreneurs concerning environmental management, especially for small-scale miners. Furthermore, intensified attention and guidance will be provided in areas where a high concentration of small-scale mining activities occur”.

These environmental provisions are not considered a best practice because they do not recognize that large- and small-scale mining operators have different technological and financial capabilities and should not be subject to the same requirements.

3.2.2. Mining legislation

The recognition of SSM as an important sector of the economy and an engine for poverty alleviation has led many countries to draft specific laws for its management. However, there are still some countries that have not followed this trend. In Sudan, for example, where more than 100,000 miners are engaged in the Southern Blue Nile and Eastern Bayuda Desert areas, there is no single legislation for managing the activities. Miners are required to enter into agreements negotiated according to the provisions of Section 10 of the “Mines and Quarries Act, 1972” and the associated regulations, “Mining and Quarries Regulations, 1973”, with the Ministry of Energy and Mining through the Geological Research Authority of Sudan, (Mutagwaba, 2000). As a result, most miners end up operating illegally.

There are other countries that have enacted mining laws with specific provisions for managing small-scale mining that are detrimental to the development of the sector. The Côte d’Ivoire Mining Code which recognizes two SSM categories namely, “small-scale mining” and “semi-industrial mining”, states clearly that an authorization for minerals exploitation for the two categories gives no right to the beneficiary for obtaining a mining title and that “it is a real estate right that may not be transferred or mortgaged”. It also requires that large deposits discovered by a small-scale miner must be declared to the Minister of Mines who will decide on the conditions under which they can be exploited. These are definitely counter-productive measures that aim to control rather than to encourage development of the sector.

It is perhaps difficult at this early stage of the transformation of the sector to identify a single legislation in any specific country, which qualifies in its totality as a best

practice. With that in mind, this review looks at components of legislation that are regarded as best practices. The review is limited to Côte d'Ivoire, Ethiopia, Ghana, Tanzania, Zambia and Zimbabwe from where relevant information could be collected. The parameters used for comparison are presented in table 4.

Country definition of small-scale mining

Although it is now widely acknowledged that a universal definition for the sector is not possible due to country-specific parameters that affect it, such as level of advancement of the sector, economic variability, mining experience and other considerations, it is, however, imperative for a country to have a clear understanding of what it refers to by “artisanal”, “micro-scale”, “small-scale”, “semi-industrial”, or other terms that may be used in the country. Such clear definitions are important for directing assistance to the intended areas, including assistance provided by governments, donors, NGOs and international organizations. The following are good examples of country-specific definitions of small-scale mining.

Cote d'Ivoire (Mining Code)

- (a) “Small-scale mining - any extraction of mineral substances which use manual and traditional methods and processes.”
- (b) “Semi-industrial mining - any extraction of mineral substances which use simple and little mechanized methods and processes.”

Ethiopia (Mining Proclamation No. 52/1993 and Mining Regulations)

- (a) “Artisanal mining means, unless otherwise specified by a Ministerial directive, non-mechanized mining operations of gold, platinum, precious minerals, metals, salt, clay, and other similar minerals, essentially manual in nature, carried out by Ethiopian individuals or groups of such persons.”
- (b) “Small-scale mining operations means any mining operation of which the annual run-of-mine ore does not exceed:
 - (a) Regarding gold, platinum and silver and other precious and semi-precious minerals: 100,000m³ for placer operations and 75,000 tons for primary deposit mining.
 - (b) Regarding metallic minerals such as iron, lead, copper, nickel: 150,000 tons for open pit mining and 75,000 tons for underground mining operations.
 - (c) 120,000 tons per year for industrial minerals such as kaolin, bentonite, diatomite, dolomite, quartz and coal.
 - (d) Regarding construction minerals: 80,000 m³ for sand, gravel, pumice, stone, clay and the like, and 10,000 m³ for dimension stones such as marble and granite.
 - (e) 20,000 m³ for mineral water.

Table 4: Parameters for comparison of mining legislation

Country	Mineral Rights Category	Tenure Period (years)	Concession Size (hectares)	Renewable	Assign/Transfer	Restricted to Locals	Can be Mortgaged	
Cote d'Ivoire	Small-scale Mining Authorization	2	25 - 100	2-year periods	No	Yes	No	
	Semi-industrial Authorization							
Ethiopia	Small-scale Mining License	10 or life of deposit	- Reasonable for the operations - 20,000m ² - IND&CMIN*	<= 5-year periods	Yes (may also be inherited)	Yes	Not Specified	
	Artisanal Mining License	1	5,000 – 10,000m ² **	Indefinite 1-year periods				
Ghana	Restricted Reconnaissance License	1	<= 1000	Yes depend on performance	Discretion of the Minister	Yes	Unspecified	
	Restricted Prospecting License	2	<= 1000					
	Restricted Mining License	15	<= 1000	Periods of <= 15 years				
Tanzania	Small-scale Gold Mining License	3-5	3 – 25 acres	Periods of 3-5 years	No	Yes		
	Primary Prospecting License	1	<= 10	1-year periods	-	Yes	-	
	Primary Mining License	5	<= 10	5-year periods	Yes		Yes	
Zambia	Prospecting Permit	2	1000	No	?		?	
	Small-scale Mining License	10	<= 400	YES	?		?	
	Artisanal Mining Right	2	<= 5	No	?		?	
Zimbabwe	Gemstone License	<= 10	<= 400	YES	?		?	
	Reconnaissance License		?					
	Prospecting License		?			Yes		
	Mining License		200m x 500m					
	Alluvial Gold Panning Permit	Permit issues to Rural District Councils who are responsible for allocating areas to miners						

* Industrial and Construction Minerals

**Each license area is limited to 5,000 m² but artisanal miners are limited to two licenses with an area not exceeding 10,000 m².

? Could not be established.

- (f) Regarding thermal water: 2,000,000 m³ for bathing, recreational and medicinal purposes and 25 mega watt or geothermal steam capable of generating equivalent power for industrial and other purposes.
- (g) 14,000 tons for salts extracted from brines.

South Africa (Minerals and Mining Policy - White Paper)

- (a) “Artisanal mining means small-scale mining involving the extraction of minerals with the simplest of tools, on a subsistence level.”
- (b) “In South Africa, small-scale mining ranges from very small operations that provide subsistence living (artisanal mining), to the “junior” companies for which revenue is such that subsistence living is not the prime motivator.”

Specific legislation for small-scale mining

Tanzania Mining Act (1998): The mining legislation in Tanzania combines both small and large-scale operations, but group-specific provisions for each sector are separate. For example, Division D of the Act discusses mineral rights for SSM only. Similarly, the mining regulations, which are printed in different sections on mineral rights, health and safety, environmental, and others, provide specific provisions for SSM. The environmental regulations, for example, provide 11 specific regulations under the heading “Requirements for Artisanal and Small-Scale Miners” that regulate the SSM sector. This is regarded as a good example of legislation that is transparent and sub-sector specific.

Ethiopia Mining Proclamation No 52/1993: The Ethiopian mining legislation also combines both small and large-scale mining operations in one document, but has specific sections for each sector. In addition to providing clear definitions of the different categories of small-scale mining, the legislation has specific chapters specifying mineral rights, procedures for application and issuance, rights and obligations and other considerations for administration of the law. For example, the definition of artisanal mining is given under part I of the Act, and, sections I and II of chapter 3 under part II define the mineral rights (type, duration, renewal, etc.) for artisanal and small-scale mining respectively. Likewise, the mining regulations provide clear and separate guidance for the application procedure, size of concessions, renewal, transfer and revocation of licenses for each sector.

The Mining (Alluvial Gold) (Public Streams) Regulations, 1991 - Zimbabwe: These regulations were enacted to deal with the worsening situation of illegal panning of gold. Although it could be categorized as a crisis measure rather than a planned legislation for the promotion and development of the sector, it is a good example of how to bring the best out of a bad situation. In addition, these are provided in a form that can be amended from time to time to achieve the intended goal.

But more importantly, the specific regulations provide a unique example of decentralized administration on the low end of the SSM sector. Whilst still overseen by Central Government, the regulations put control and day-to-day administration of gold-panning activities in the hands of the Rural District Councils (RDCs).

Types of mineral rights

In almost all the legislation reviewed, mineral rights of different categories are issued to small-scale miners. In countries such as Tanzania, mineral rights are issued irrespective of the category of the small-scale mining operation or type of minerals mined. In Zimbabwe, mineral rights for small-scale mining (except gold panning) are based on the same categories as those of large-scale mining, but the terms of tenure, size of the concession and other factors are different. In Côte d'Ivoire, Ethiopia and Zambia, mineral rights for artisanal and small-scale mining are different. In Ghana, the differentiation is based on the type of minerals mined.

Mineral rights should be simple to administer, easily understood by the miners and provide for upgrading to other types. On this basis, the following types of mineral rights are considered best practices although each has inherent deficiencies, which will be discussed in the coming chapters.

Mineral rights under the Ethiopian Mining Proclamation: Two types of mineral rights are issued under the Ethiopian Mining Law, namely:

- (a) Artisanal mining license; and
- (b) Small-scale mining license.

The duration of tenure, concession sizes, application, issuance and transfer procedures and other provisions are provided for each type of mineral right.

Mineral rights under the Zimbabwean Mining Act: SSM mineral rights include “reconnaissance” “prospecting” and “mining licenses”. For artisanal mining, a “gold-panning permit” is issued by RDCs. The Zimbabwean legislation accords the same type of mineral rights for both small- and large-scale operators, and it allows small-scale miners to function by the same norms as the big operators.

Size of concessions

In most legislation, the size of the concessions granted to small-scale miners is small. This limits their capacity to develop efficient mining projects. In some cases, the shape of the concession is defined on the basis of surface features (e.g. proximity to one another), without regard to the configuration of the mineral deposit underground. There are, however, some countries that have started to address this issue and have established that the size of the concessions should depend on the type of permit issued. In this regard, best practices have been identified in the Zambian Mining Act, which differentiates the concession sizes for mineral rights and mineral types as follows:

- (a) Prospecting Permit - An area of ten square kilometres (10km²);
- (b) Small-scale Mining License: An area not exceeding 400 hectares;
- (c) Artisanal Mining Right: An area not exceeding 5 hectares; and
- (d) Gemstone License: An area not exceeding 400 hectares.

Duration of tenure and renewability

The duration of tenure for most SSM mineral rights is usually very short with no guarantee for renewal. This is unattractive to prospective investors, financiers and developers. Whilst most countries are now offering longer tenure periods to the “small-scale” mining category, the problem with the “artisanal” category remains. Some good examples of longer tenure period include the following:

Tenure periods issued under the Ethiopian Mining Act: The following tenure periods are given under the mining proclamation:

- (a) Small-scale Mining License - 10 years or the life of the deposit, whichever is shorter and renewable for maximum periods of 5 years; and
- (b) Artisanal Mining License - 1 year and may be renewed indefinitely for similar periods.

Tenure periods issued under the Zambian Mining Act: The Act offers the following tenure period for different mineral rights:

- a) Prospecting Permit - 2 years non-renewable;
- b) Small-scale Mining License - 10 years;
- c) Artisanal Mining Right - 2 years non-renewable; and
- d) Gemstone License - not more than 10 years - renewable.

Tenures of 1-2 years are common during the prospecting period even for large-scale mining to discourage companies from holding large areas for too long. However, the weak point in this legislation, like many others, is the short tenure period accorded to artisanal mining.

Tenure Periods under the Tanzanian Mining Act: Probably, the best option for the low end of small-scale mining (artisanal mining) is offered by the Tanzanian Mining Act. This Act does not have different categories for small-scale mining and hence, offers 5 years for a “Primary Mining License”, irrespective of the mineral type mined.

Entitlement to transfer and mortgage mineral rights

The ability to transfer and mortgage mineral rights is significant for it can enable miners to raise finance for project development and secure their investments. Although many mining laws and regulations now recognize small-scale mineral rights as transferable assets, which can also be mortgaged with government

approval, there are still laws that do not guarantee this. These include laws in countries such as Ghana, Namibia, Senegal and Morocco. The legislation of Côte d'Ivoire categorically denies small-scale miners the right to transfer and mortgage their mineral rights. On the opposite side is the Tanzanian Mining Act.

Transfer of Mineral Rights under the Tanzania Mining Act: The small-scale mineral rights under this Act can be transferred and mortgaged. Since the enactment of the Mining Act in 1998, small-scale miners have been selling their properties either through outright sale or through development agreements. This has enabled credible joint ventures to be formed between small and large-scale operators and mobilization of investment finance by small-scale miners. On the negative side, it has encouraged speculation on mineral titles.

Limiting small-scale mineral rights to nationals

As shown earlier, in most countries, mineral rights for small-scale mining are limited to nationals of that country. This is done to support the development of local industry and to alleviate poverty. However, care is required, as the sector needs financial and technological inputs, most of which are not available locally. A blanket ban on foreign participation might limit the sector's ability to access finance and technology through joint ventures and other similar arrangements. Best practices that allow limited foreign participation with control resting with nationals, include the following:

The Tanzania Mining Act (1998): The Act requires that when the proprietor is a company, foreign participation is allowed as long as Tanzanian nationals hold majority shares in the company.

Upgrading of mineral rights

Transition from one category of small-scale mining to another and even to large-scale is important since it allows the sector to grow and contribute to building confidence amongst participants. For example, due to limitations of foreign participation in SSM, it is sometimes necessary for a small operator to upgrade to another level in order to attract more investment in his venture. This is allowed in the case of the Tanzania Mining Act.

Upgrading of Mineral Rights - Tanzania: The legislation in Tanzania states clearly that the holder of a Primary Mining License “may apply to the Commissioner to convert the License or Licenses to a Mining License or Gemstone Mining License”. These are categories for large-scale operations. Also, in converting to a license issued to large-scale operators, small-scale miners are allowed under the law to amalgamate their licensed areas into one large block.

Designation of areas specific for small-scale mining

Setting aside areas to be used specifically for SSM is provided for in most legislation in Africa. Most legislation gives the Minister responsible for mining the power to declare an area “a designated area for small-scale operations” if it is considered to be in the public interest to encourage prospecting and mining by methods suitable for small-scale mining only. If used properly, this power can enhance the development of the sector. As described below, best practices in the management of designated areas can be drawn from Ghana and Tanzania where allocation and management procedures are provided for in the mining legislation.

Allocation of designated areas - Ghana: Under the Small-scale Gold Mining Law, the Minerals Commission is empowered to monitor small-scale gold mining operations and to establish in a designated area, a Centre known as the “District Small-scale Gold Mining Centre. The law also requires the establishment of a committee to assist the Centre to monitor, promote and develop SSM operations in the designated area effectively. Such a “Small-scale Mining Committee” consists of:

- (a) The District Chief Executive or his representative who presides as the Chairman;
- (b) The Officer-in-charge of the District Centre; and
- (c) A representative of the Development and Planning Committee of the district.

Allocation of designated areas - Tanzania: In Tanzania, once an area has been declared “designated area” by the Minister, the Commissioner for Mineral Resources is then required to divide the area into numbered blocks, publish a map of the divided area for public information; and exhibit a copy at the zonal mines office responsible for the designated area. The Minister then appoints an Allocation Committee for the designated area, composed of the following:

- (a) The District Commissioner who presides as the Chairman;
- (b) A Member of Parliament for the area;
- (c) The Zonal Mines Officer;
- (d) The Chairman of the local council; and
- (e) Three persons from the regional authority

Unlike the case in Ghana, the Allocation Committee in Tanzania is only responsible for allocation of areas to eligible persons who must make their application and pay the required fees for primary mining licenses through normal channels. In allocating the areas, the committee is expected to take into consideration the following:

- (a) Technical competence of applicants;
- (b) Relevant experience of applicants;

- (c) Financial resources of applicants; and
- (d) Ensure that a reasonable part of the land is allocated to people living in the vicinity or in the missing area.

Decentralization of mineral rights allocation and administration

Decentralization of the allocation and administration of mineral rights is still a new phenomenon and is not widely practiced by many countries. If used properly, decentralization reduces delays in processing license applications and facilitates the control and management of environmental impact. In addition, it can contribute to reducing illegal activities and security problems in mining camps and surrounding areas. The case of Zimbabwe is self-revealing.

The Mining (Alluvial Gold) (Public Streams) Regulations, 1991- Zimbabwe:

The system was introduced as a way of controlling illegal gold panning, which is rampant along almost 4,600km of the country's rivers. These activities were put under the responsibility of the local authorities through the above law. In accordance with Section 274 of the Mines and Minerals Act, the regulations allow RDCs to apply for special grants for the working of alluvial gold deposits in public streams flowing through their areas. In turn, the councils are empowered to issue permits, monitor and control gold panning in those areas. The regulations require that mining should take place only within the riverbed and not closer than 3 metres to either bank. They also prohibit undercutting and require that all excavations should not be deeper than 1.5m. They further require artisanal miners to backfill all the mined-out areas and that all the recovered gold should be sold to the Reserve Bank or its agents. All these requirements are supposed to be monitored and supervised by the RDCs.

Informal/undocumented licensing

This is the type of licensing where a formal or written document is not issued; neither does it involve any formal licensing procedures. Licensing is done through provisions provided in a particular legislation allowing the exploitation of certain minerals by specific groups of the population. Where practiced, these provisions allow indigenous members of the population and landowners to exploit specified minerals for their own consumption, i.e., not for commercial use. A best practice was identified in Ghana.

Minerals and Mining Law (1986) - Ghana: Under this law, "Part X - Building and Industrial Minerals and Small-sale Mineral Operations", Section 76 discusses the "Special rights of landowners with regard to building and industrial minerals" as:

"Nothing in this Law shall prevent (a) a local authority on land owned by it; (b) the owner or lawful occupier of any land owned or occupied by him; or (c) the holder of any mineral right on land to which the right relates, from prospecting for and mining any building or industrial minerals to be used by such owner, occupier or holder solely for

building, road making or agricultural purposes on such land, so long as the exercise of such right is not inconsistent with or detrimental to the right of any other person holding a mineral right in respect of such land.”

3.2.3 Technology

Technological issues feature among the top constraints that limit small-scale mining from attaining its full potential. Although it is difficult to separate the mechanistic and social aspects of technology, this section will limit itself to the mechanistic features, e.g., extraction methods, equipment, support and ventilation in working areas. The social aspects, such as organization of production and labour, will be discussed in separate sections. Best practices associated with technology are discussed in consideration to different parameters associated with technology as detailed below.

Availability of channels for access to technology

Most countries lack local capacity to produce appropriate technology for small-scale mining due to a number of reasons including their poor level of industrialization, economic performance and mining experience. In addition, several countries have restrictive fiscal terms imposed on importation of technology, e.g., high import duties, sales tax, VAT and others. Also, the desire of most developing countries to attract investments in the large-scale mining sector at the expense of SSM, have resulted in incentives being given to large-scale operators that include importation of capital equipment free of duty and sales tax and capital allowances for development capital expenditures. Such incentives are usually not extended to small-scale miners and suppliers of technology.

There are, however, exceptions worth mentioning. These include a plant hire-purchase scheme in Zimbabwe. Small-scale miners can access mining equipment through a plant-hire scheme managed by the Mining Department. The system operates from three regional depots (Harare, Gweru and Bulawayo) chosen on the basis of local intensity of SSM activities. From these depots, miners have access to crushers, compressors, stamp mills, concentrating tables, diamond drills, chain blocks, shear legs and other equipment and tools.

In order to hire equipment, a miner has to apply to the Regional Mining Engineer’s office, which should in turn satisfy itself of the need for the applied equipment. The office will then make a report to the Mining Commissioner for the region who should satisfy himself of the miner’s ability to pay. An agreement between the miner and the Ministry is then entered into and it allows hiring with eventual purchase of the particular equipment.

However, equipment or plants that are in frequent demand are mostly limited to hiring. The hire-purchase terms are offered for 12 months for low-cost equipment

items (up to Zimbabwean dollars \$Z300), 24 months for items costing up to \$Z600 and 36 months for equipment valued above \$Z600. An interest rate of 10% annually is charged on top of the monthly hire charges. Any equipment returned before the hire-purchase term expires, is regarded as having been hired only.

Assay and testing facilities in Zimbabwe: The facilities and services are managed by the Department of Metallurgy of the Ministry responsible for mines and offers free assaying and testing services to miners. Staff from the department can also be called on site to offer free technical assistance.

Shamva Mining Centre (SMC) - Zimbabwe: SMC was set-up with the objective of assisting small-scale gold miners in the Shamva/Bushu mining areas to acquire and use appropriate technologies and skills in the mining and processing of gold, (Svotwa et al., 1993). The centre is also intended to encourage establishment of viable, safe and environmentally sound mining operations that contribute towards sustainable rural development. It was set up through technical assistance from the Intermediate Technology Development Group, UK, in collaboration with the Small-Scale Miners Association of Zimbabwe (SSMAZ) and the Zimbabwe Ministry of Mines. However, the uniqueness of the service at the time also attracted donors willing to finance the centre, including the German Technical Cooperation Agency (GTZ), Gate, European Union (EU), the UK's Department for International Development (DFID), Comic Relief and others.

On the technology front, the centre offers ore-processing (custom milling) services, provides hired drilling and blasting services, sale of explosives, arranges transport to ferry ore from the mines to the centre and provides technical extension services. In the initial phase (1989-1990), the installed milling and ore-processing facilities included a 4 t/day 3 stamp mill, a low-cost shaking table, an amalgamation barrel, settling pond and a retorting facility. By 1990, it was realized that the demand for the services exceeded the capacity of the centre. Phase two of the project was then initiated by installing a ball mill with the capacity to process 1 ton of ore per hour. A VAT leaching plant with a capacity of 100 tons per month was also installed.

The centre employs drillers and their assistants in order to provide drilling and blasting services to the miners. The extension services are usually limited to the Shamva/Bushu area and include services on safe working habits, choice of mining methods, simple sampling methods, underground support systems and boosting production. In its first 5 years of operation, the centre was well utilized by the miners in the area and processed 8,519 tons of ore yielding 40kg of gold.

In order to ensure commercial sustainability of SMC, a commercial company was set up to run the project. A manager and secretary were appointed under the guidance of a 7-member Board of Directors consisting of representatives from SSMAZ (4), finance and legal experts (2) and ITDG (1). In 1999, the

management of the centre was transferred to SSMAZ. The centre is still running, but on a much-reduced scale due to a number of problems including lack of managerial experience and the economic problems that the country is facing at the moment.

Demonstration projects - Ghana (Davidson, 1993): The Ghana Minerals Commission set up the Tarkwa Mining Centre which houses among other things, an assay laboratory and a permanent demonstration processing plant. In addition to the centre, the Commission has set-up equipment in various field sites. This approach has been well received by small-scale miners and aims at providing customized equipment packages that reflect the cost constraints and technical needs of the individual mines. Equipment is made available on cash sale or loan basis, and is manufactured in collaboration with local fabricators.

Programmes for promotion of efficient and cleaner technology

Miners need to be encouraged to adopt affordable, efficient and cleaner technologies through demonstration of the benefits for changing from their traditional techniques to the cleaner ones. The benefits have to be monetary since miners are usually not concerned with long-term effects. For example, small-scale miners have resisted using mercury retorts for gold amalgamation because the effects of the mercury on their health are of a long-term nature. Most programmes for promotion of efficient and cleaner technologies come through aid programmes promoted by donors and international agencies. They are normally not sustainable without donor funding. The countries concerned lack both capacity and political will to initiate follow-up programmes and hence ensure long-term impact. In few countries, a more long-term approach has been followed. These include:

GTZ - University of Zimbabwe Riverbed Mining Project - Zimbabwe: Following the enactment of the “The Mining (Alluvial Gold) (Public Streams) Regulations, 1991” which put the control of alluvial panning for gold in the hands of rural district councils, a number of projects have been initiated to support the move. One such project is funded by GTZ and executed by the Mining Department of the University of Zimbabwe. The project initially started in the Insiza RDC and is now about to go national. Through the project and in consultation with gold panners, new and efficient sluice boxes were designed and their usage demonstrated to the miners. The demonstration also included techniques to rehabilitate mined riverbanks.

The project, which has already achieved fairly high productivity of around 4 tons per miner/shift, requires minimum ore grades of 0.25g/t to be commercially viable. This is due to the capital investment, which is between \$ US 10,000 and \$15,000 (that is, \$500-\$750 per person) per panning group of 20 people, (Dreschler, 2001). However, despite the success, there is danger that leaving behind materials of less than 0.25g/t will bring back illegal panners in the near future.

The Uis Tin Mining Project - Namibia: This project was initiated by former employees of a large-scale tin mine in Uis, Namibia who were left jobless after the mine closed. A small group of small-scale miners, a core of them women, organized themselves and requested the support of the Ministry of Mines and Energy in Windhoek. A joint project between the Raw Materials Group of Sweden and the Ministry was initiated in 1994 with funding from the Swedish International Development Co-operation Agency (SIDA). The main aim was to create stable employment and develop a framework for legal and safe ways of carrying out SSM. Technologically, the project developed methods to improve productivity while retaining as much manual labour as economically justifiable.

Miners were trained in mining, drilling, blasting, sorting, hauling and concentrating techniques. A drilling and blasting team from the project was able to offer services to other claim holders and thus generate extra income. The technology employed included drilling and blasting, hand sorting and cobbing, mechanical concentration that involves two-stage crushing, a jig and a shaking table to extract cassiterite.

The plant was constructed from materials and equipment available locally. The project has the potential to employ 100-150 people and productivity is 1 kg of tin concentrate per day, per person. Tin and tantalite are extracted in parallel in order to improve the feasibility of the project, since tantalite commands a much higher price than tin. The Uis project is a good example of a multidisciplinary approach linking technical (geological, engineering) and socio-economic issues (organization, training and women participation). This was achieved with a total investment of \$ US 132,000 and provided an annual income for each miner of \$330 - \$440 (1996 figures).

However, when the financial support from SIDA dried up, the project ran into problems. The Raw Materials Group then requested the Government of Namibia and the Namibia Small-scale Miners Association Centre (NSMAC), a registered company, to take over the project under the EU-Sysmin loan repayment arrangement. Through this arrangement, subsidies to the tune of N\$20,000 per month were provided to the project. This enabled miners to continue operating, until stopped due to continuous losses incurred by the project.

The project has now been taken over by NSMAC who is investigating and exploring for tantalite deposits with financial assistance from CDI. The operation employs 30 people for digging trenches and winnowing. Pending the success of the exploration work, CDI is willing to finance the project which will use a mobile plant for dry pre-concentration and then an improved existing plant to produce a final concentrate. The plan includes running the new Uis Tantalite Project as a joint venture between NSMAC (70%) and a miner's cooperative, SMU (30%).

Technical training and awareness programmes

The following programmes have been selected as good examples of technical training and awareness programmes designed to build the capacity of small-scale miners to achieve higher productivity without increasing negative environmental impacts and health and safety problems.

UNIDO Abatement of Mercury Pollution programme - Ghana and Tanzania:

Between 1998 and 2001, the United Nations Industrial Development Programme (UNIDO), in collaboration with the Governments of Ghana and Tanzania, initiated programmes with the objective of assessing among other things, the environmental and human health effects caused by mercury; introducing efficient and cleaner technologies; promoting training, and raising awareness on the dangers associated with uncontrolled use of mercury. Training programmes included both formal and informal methods to ensure that a large number of miners were reached. Training covered technical and non-technical issues including:

- Mineral policy, mining law and regulations;
- Geology and exploration techniques;
- Mining and mineral processing technology;
- Occupational health and safety;
- Environmental management and mercury hazards;
- Organizational planning, business and financial management; and
- Rural development, cultural and social issues (with emphasis on women's aspects).

To be effective, the training component included training of trainers who were selected through miners' associations, cooperatives and representatives of other mining groups. Demonstration videos from Minamata and from Brazilian gold mining areas were used as part of the training and awareness-raising campaigns. Leaflets and posters written in national languages were prepared and distributed to participants and offices of the miners' associations. Copies of videos were also made available to all participants.

Given the known resistance of miners to use retorts for fear that their gold will disappear in it, specially designed glass retorts were secured and used for demonstration and training. These glass retorts known as ThermEx, are produced by a Germany company, "Metall Technic mt", and enabled miners to observe the entire process of separating gold and mercury from the amalgam.

ITDG promotion of mercury-saving retorts: Following successful development and field-testing of this retort in Zimbabwe, ITDG prepared a concise leaflet containing practical information for miners and decision makers (Twiggs, 1996). The leaflets contained details on the dangers of mercury, the need for a closed

retort, the materials and parts required to make one, procedure for making and using one and first aid treatment for mercury poisoning. The fabrication process of the retorts was explained in steps that could easily be followed by miners and contained six illustrations:

- The whole unit in operation;
- The individual parts;
- Diagram explaining stage one of the fabrication of the retort;
- Photograph of the components assembled;
- Photograph of the components before assembly; and
- A sketch showing how to collect mercury after use.

The leaflet was produced in English, Portuguese, Spanish, Kiswahili and Bahasa. An A3 coloured poster aimed at supplementing the leaflets was produced with one side containing warnings about the dangers of mercury and the reverse side, showing practical information. The poster has so far been printed in English, Spanish and Portuguese. The leaflets and posters have been distributed to miners in different countries through mining departments, NGOs and private agencies. There is no sufficient evidence that better practice resulted from the dissemination of these leaflets.

DFID, GSD and SSMAZ Training Seminars - Zimbabwe: In 1991, a series of training seminars were funded and organized by DFID, in conjunction with the Zimbabwe Geological Survey Department (GSD) and the Small-scale Miners Association of Zimbabwe (SSMAZ), (Campbell et al., 1991). Representatives chosen from each of the regions in which SSMAZ is active attended the seminars, which were aimed at training trainers. The seminars were run by experts from the British Geological Survey and were held at four different locations namely, Bulawayo, Gweru, Chenguutu and Shamva. The courses were intensive and emphasized practical work. They were each conducted for 12 continuous days and with up to 25 participants per course. Training was biased towards gold since it is the mineral most produced by small-scale miners. The course introduced participants to:

- Basic principles of geology, particularly gold mineralisation;
- Identification of rock types and minerals common to gold belts;
- Map reading and interpretation;
- Simple surveying, using tape and compass methods;
- The nature of orientation of veins and shear zones;
- Sampling, mine evaluation and planning;
- Simple exploration techniques; and
- Basic financial planning.

Practical work was carried out in small-scale mines located in close proximity to the training centres and addressed key practical problems, e.g., pegging of claims, preparation of a plan map, sampling and interpretation of assay results, arsenic testing in gold exploration and others. A visit to one of the large working gold mines in the country was an integral part of the course. There, a demonstration of techniques that can benefit small-scale gold production, e.g., heap leaching, was also carried out.

Mintek Training Programme - South Africa: Mintek is in the process of setting up an Artisanal and Small-scale Miners Training Programme that will introduce the SSMS to:

- How to obtain a permit for prospecting or mining;
- Rehabilitation and how to draw up an EIA;
- Basic geology/mineralogy;
- Mining methods;
- Minerals processing;
- Beneficiation or adding value to products;
- Safety;
- Health and understanding AIDS; and
- Brick-making.

SEAMIC Training Programmes - Tanzania: The Southern and Eastern African Mineral Centre (SEAMIC) was established as an independent regional centre of knowledge and information for southern and eastern Africa. The centre, which operates under the umbrella of ECA, is located in Dar-es-Salaam, Tanzania. The centre was founded by three countries, Ethiopia, Mozambique and Tanzania, which were later joined by Angola, the Comoros and Uganda. Membership is open to all other countries of the eastern and southern African subregion.

Amongst the many activities carried out by SEAMIC is the provision of specialized training services consisting of short, targeted courses. Although the training programme includes advanced courses on many geoscience subjects such as data processing and management, laboratory techniques, mineral processing technology, instrumental analysis and environmental technology, other courses such as pottery and ceramics, and gemmology are relevant to small-scale miners. For example, the one-week short course on “Introduction to Gemmology”, targets mineral technicians, small-scale miners, mineral dealers and brokers and other interested parties. The main goal of the gemmology training course is to enrich participants with the theoretical knowledge and practical skills necessary for the examination and identification of gemstones, diamond and their numerous simulants.

Given the increasing demand for gemstones in the region, there is a growing realization that the lack of skills to identify, grade and value gemstones and the use of inappropriate terminology hamper business transactions. More than 12 gemmology courses have been conducted so far (Pedro, 2001) and more than 100 small-scale miners from Tanzania, Uganda and Kenya have been trained.

Promotion of value-adding techniques

The poor technology employed in the recovery of most small-scale minerals leads to poor grades of the final products. Most miners produce mineral concentrates, gold containing impurities including mercury, raw gemstones and other impure mineral products that command low market prices. While many countries are keen on improving the technology used by small-scale miners, emphasis has been placed on improving productivity, ensuring high health and safety standards and minimizing environmental impact, without consideration of the quality of the output and value added. Exceptions have been identified in Tanzania, as described below.

Gemstone Cutting Training Centre - Tanzania: Under the small-scale mining component of the “Mineral Sector Development” project financed by the World Bank and the Government of Tanzania, funds were set aside to set up a centre for training small-scale miners on gemstone cutting techniques. The centre, which will be based in Arusha - famous for its production of Tanzanite - is expected to be operational before the end of 2002. The primary objective of the centre is to equip Tanzanian nationals with lapidary and stone-carving skills so as to add value to gemstone and mineral production in the country.

Specific SSM technologies

The assessment of best practices on specific technologies applied by small-scale miners across the continent takes into consideration the type of minerals being mined and the extraction method utilized. Where necessary, consideration has also been given to the influence that variations in the properties of the ore being mined have on the technology employed. This is relevant for example in the case of gold, where processes for recovering alluvial, free milling or sulphidic ores and refractory ores are analysed differently. It should be noted that although gold and gemstones are the minerals widely exploited by small-scale miners, other minerals such as industrial minerals, building materials and base metals are also covered.

Mining technologies

Rock drilling

Surface drilling - hand-held jackhammers: These are widely used in SSM to drill holes of diameters between 28-45mm (with consideration of the diameter of

explosives used). Depending on the hardness of the rock, rotary or percussion drilling machines may be used. Rotary hand-held drills are usually suitable for drilling softer rocks, e.g., coal, rock salt, gypsum, soft limestone, and others. Most hand-held rotary drills weigh between 9-15kg and can achieve outputs of between 20-50m per person/per shift, (SADC, 1994). Percussion jackhammers are suitable for drilling in hard rocks and weigh between 18-25kg. Due to good natural ventilation in surface mining, air flushing of drill holes is very common in surface drilling. These machines can be operated by one miner although it is common to have an assistant or “spanner man”. Jackhammers are powered by compressed air generated through mobile diesel compressor units. Examples of best practice in the application of these machines are found in the Uis small-scale tin mining project in Namibia. Drilling was used at Uis to prepare holes for blasting the hard rock bearing the tin ore. Prior to utilization of drilling, the rocks were dislodged manually, at low productivity. A well-trained team of two people per machine carry out both drilling and blasting at Uis and are capable of selling their services to nearby small-scale mines.

Underground drilling - jackhammer with airleg: Jackhammers mounted on airlegs (jacklegs) weighing between 18-25kg are widely used in underground SSM. The machine is usually operated by one driller and an assistant and is powered by compressed air of 6-7 bars. Given the confined working space in underground mines and poor ventilation, these machines use water to flush out the cuttings, suppress dust and cool the drill bit and steel. Depending on rock hardness, they have performances of 15-25m in hard rock, to 40-50m in dolomite rock per machine-shift, (SADC, 1994). Stopper drills mounted with fixed airlegs are also available for drilling vertical holes, e.g., in raising. Because of the fixed airlegs, these machines weigh more than jackhammers that are mounted on removable airlegs.

Rock blasting

Blasting is gaining wide application as a mechanism to break rock despite some countries (e.g., Ghana) legislating against its usage in SSM. Explosives are available in different countries with varying commercial names depending on the manufacturers. However, the commonly used explosives in SSM belong to three main categories, namely:

- (a) Ammonium nitrate blasting agent, which consists of a mixture of ammonium nitrate and fuel oil (ANFO) - safe and cheap but effective in dry conditions only;
- (b) Ammonia dynamite cartridged high explosives - high-density explosives suitable for both underground and surface-mining operations; and
- (c) Waterproof dynamite - cartridged explosives (sizes of 25mm x 200mm (130gm) and 32mm x 200mm (200gm)) - commonly used in South Africa, Zambia, Zimbabwe and Namibia.

The wide range of explosives, initiating and timing products that are available on the market shows the need for training and enforcement of strict regulations on the handling of these dangerous, but necessary mining inputs. Most countries using explosives in SSM have strict regulations that require the user to be trained and to hold a blasting permit (e.g., in Zimbabwe) or blasting certificate, (e.g., in Tanzania). Transportation procedures and storage facilities for explosives are another setback in the handling of explosives by small-scale miners, who can hardly afford to build magazines as per required standards. Practices considered good examples in explosives usage by small-scale miners include the following:

Mobile explosives storage boxes - Tanzania: The Department of Mines has designed and commissioned explosives storage boxes that small-scale miners can acquire from the department. The storage boxes are made of metal with the inside lined with timber and is sold at a nominal fee aimed only at recouping production costs.

Sharing explosives storage facilities with large-scale miners - Zimbabwe: This has been demonstrated in the Shamva area in Zimbabwe as an example of good cooperation between large and small-scale miners. Prior to establishment of the SMC, the owner of one large-scale mine in the area allowed small-scale miners to store their explosives in his magazine.

Sharing explosives storage facilities between miners - Tanzania: The National Services (Army) runs a small-scale limestone quarry in Kunduchi, Dar-es-Salaam with a crushing plant and uses explosives for rock blasting. The quarry operation also has its own explosives magazine located in the mining area. Close to the National Services quarry, there is a group of artisanal miners exploiting the same limestone reserves for feeding the Dar-es-Salaam market with aggregates. Miners employ manual drilling followed by blasting of a few holes at a time to dislodge the limestone blocks. A “contractor” who has a blasting certificate and is paid by the miners after they have sold their aggregates usually carries out blasting in the area. However, the big problem in the area was the storage of explosives. The National Service quarry unit made available its facilities to the small-scale miners. They lock their explosives in portable authorized explosive boxes.

Drilling and blasting - Gemstone Mining (Merelani, Tanzania): Blasting can be effectively used in gemstone mining; though great care must be taken. In order to avoid fracturing the gemstones, the effect of the detonation shock wave must be reduced. This can be achieved by using decoupled charges, i.e., explosives having much less diameter compared to blast hole diameters. Other effective techniques include placing explosives and stemming materials with air gaps between the rocks, firing one or very few charges at a time or the application of explosives with very low velocity of detonation (e.g., ammonium nitrate emulsion slurries).

Tanzanite miners in Merelani, Tanzania, apply the technique of firing one or very few charges at a time in order to loosen the gemstone bearing ore without damaging the Tanzanite gems. This is regarded as best practice as it has enabled those miners utilizing explosives to improve their productivity to around 1.8 tons per person/day compared to 0.7 tons per person/day for those using manual drilling followed by blasting, (Mutagwaba, 1997).

Surface mining techniques

Quarrying of dimension stones / gemstone mining: Quarrying of dimension stones requires different techniques from those used for rock breakage. The following techniques are commonly used in small-scale dimension stone quarrying:

Rock fragmentation by wedging (SADC, 1994): This is achieved by drilling a row of “plug holes” and inserting wedges to dislodge the rock block. Drill holes spaced 10-20cm apart depending on the rock hardness and penetrating at least 2/3 of the thickness of the block are commonly used. Pneumatic or petrol driven breakers are efficiently used to drive the wedges into the holes. The method can also be used in gemstone mining, e.g. for breaking hard but brittle core quartz.

Hydraulic rock splitting (SADC, 1994): This technique is based on the above principle, but instead of using wedges, it employs a hydraulic unit of 3-5kW, diesel, air or electric-driven to power-splitting cylinders, which exert pressure of between 850 - 2,500kN to split the blocks. Hand or pedal-driven pumps are also available. Like the wedging method, this technique can also be used in gemstone mining or dyke chrome mines such as those in Zimbabwe.

Hoisting of rock blocks - Mutoko Black Granite - Zimbabwe (SADC, 1994): Derrick cranes are used at this black granite quarry to lift heavy blocks of up to 20 tons. These cranes can be built locally and they do not require much maintenance. Derrick cranes can be used in clay, oxidic zinc ore or amethyst on karstic surfaces, small diamond pipes or even in alluvial diamond mining where skips containing gravel have to be lifted.

Sand mining - The Panel Method - Ghana: Mining of sand in Ghana is carried out in both artisanal and mechanized SSM operations. The difference between the two groups lies in the excavation methods employed. While artisanal miners use shovels, ground chisels and pickaxes to remove the overburden, dig and load the sand, mechanized operations employ excavators for stripping, digging and loading. However, a unique feature of the sand-mining operations is the application of the panel method, which is supervised by the Minerals Commission.

This method requires that miners divide their areas into blocks prior to any mining operation. Once the area has been divided into blocks, the overburden is stripped from one block and deposited onto the next block. The mining of sand is then carried out in the first block. After the first block is exhausted, the overburden

material is then returned to fill the hole left behind. The procedure is then repeated in the subsequent blocks. This minimizes adverse environmental impact.

Kaolin Mining - Pugu Area, Tanzania: The Pugu Kaolin mining project is a small-scale mining project employing open cast techniques to mine raw kaolin. With production capacity of approximately 50,000 tons per annum, the project employs one bulldozer and one front-end loader. For both soft and kaolinite rock material, light blasting is used to loosen the material which is then bulldozed into hips before being moved to an ore stockpile by a front-end loader. Hand-held jackhammers are used to drill and remove cuttings. Light blasting is usually employed in order to loosen the hard kaolin ore ready for dozing. Soft kaolinite rock is excavated directly by a bulldozer with a ripper. The bulldozer carries out stripping where necessary.

Underground mining of thin orebodies

Many ore bodies mined through SSM underground techniques are usually thin in dimension, which makes the application of most mining methods difficult. The following example in Zimbabwe shows the approach used to mine a flatly inclined chromite orebody with thickness ranging between 20 - 40cm. It should be noted that the project was properly designed with the assistance of the Mining Department.

Small-scale mining of thin chrome seams at Ngezi - Zimbabwe (Phimister et al.): This is a good example of a well-designed, small-scale underground mine extracting a very thin seam. The set-up of this mine can be used to mine any other orebody of similar features, particularly thin gold veins mined by most small-scale gold miners. The key features that make it a good mining practice are outlined below:

Mine design: - The mine has three inclined shafts, with the central shaft equipped with rail tracks, compressed air and water and the other two equipped with 20lb, 45cms-gauge rail tracks laid on treated timber sleepers. With a 6m thick crown pillar, the mine has levels with intervals between 12-17metres. At full production, 200t/month of chrome will be produced with a workforce of 15 people.

Shafts and drive levels: The central shaft is equipped with permanent air and a water service line and an air hoist capable of lifting a 1/2-ton cocopan or side-tipping cars from 60m down. The excavation dimensions were kept to a minimum (1.3 -1.8m) in order to reduce the amount of excavated waste.

Stope raises: The mine utilizes stope raises for the commencement of mining and they are located strategically so that production is not delayed by development work. The raises are mined on the hanging wall waste on the seam contact and after waste has been trimmed out, chrome is mined.

Resuing - mining method: Resuing was chosen as the mining method for the 20 - 40cm width ore bodies and consists of drilling and blasting the hanging wall waste to the full length of the stope face. The generated waste is then packed between the supporting props in order to fill the stope completely. The exposed chromite seam is then mined by using a paving breaker with the chipping hammer. Controlled blasting is also employed where the seam is frozen to the footwall. One-metre holes are drilled with an inclination of 70° to the stope face and each charged with one 22 x 200mm explosive cartridge. With the remaining length tamped, the charges are timed by using slow-burning ignitor cords.

The resuing mining method is well known for mining thin ore bodies including gold veins. It allows alternative cutting of waste to create working space and expose the ore that is then cut during the second phase.

Hoisting system: Given the remote location of the project and the lack of electricity, a diesel-powered hoisting system was sought. Other considerations in selecting this and other equipment included the limited skills of the miners, equipment mobility and the cost element. An ATLAS COPCO (type A10) compressed air-driven hoist that requires minimal maintenance and that is easier to operate was selected and installed. It is suitable for operation in confined spaces and is very easy to operate and maintain. The specific features of the hoist include:

A vane-type motor mounted inside the rope drum with low speed performance that can be easily started on load;

An automatic strap brake released by a manual push button; and

An operating control with poppet valves working on a lone valve seat, which results in minimal wearing.

The hoist, with a capacity to lift 1 ton and consume 42 litres per second of compressed air with pressure between 4.5 - 7.5 bars, is usually operated on loads of not more than 0.5 tons. Given the limit of the rope length, if the incline gets deeper than 70 metres, another hoist must be acquired.

Supply of compressed air: Compressed air is used in the mine to power the drilling equipment (jackhammers) and the hoist. As such, a reliable source of compressed air was sought in order to ensure uninterrupted operations. Selection of the compressor was done by taking into consideration consumption of the relevant equipment, i.e., hoist consuming 85cfm and jackhammers 95cfm at a pressure of (+-) 7 bars. However, the mine was set up in such a way that jackhammers and a hoist would not be operated at the same time. In view of that, an Ingersoll Rand compressor was selected. It is capable of producing 66 litres per second of free air delivered at an operating pressure of 7 bars. The compressor was driven by a Perkins three-cylinder diesel engine capable of producing 33.2kW at a speed of 2500 revolutions per minute. The compressor and engine system are designed for very

simple operations, require minimal maintenance and can be easily towed from one place to another.

Human resource allocation: The development of the mine (sink shaft and lateral developments) was carried out by 10 workers selected from members of the cooperative. These consisted of:

- 1 team leader, a holder of a mine blasting certificate;
- 1 assistant to the team leader, who operates both the compressor and the drilling rods sharpener;
- 2 machine drilling machine operators;
- 1 machine assistant with no experience; and
- 5 general workers who carry out cleaning and rock transportation from the face. They also assist the team leader with the installation of timber sets, tracks and any other jobs that may arise.

Material transport: Wheelbarrows move rock materials from the face and from the levels by shovelling. Half-ton cocopans are manually loaded with shovels before being hoisted to the surface through a hoist. Generally, wheelbarrows with all steel bodies, roller bearings and wide rubber tyre wheels have been found to allow one man to move up to 1-2 tons per shift over a distance of 100m, (SADC 1994).

Support of workings: Single props of untreated timber with headboards are used as support in the stopes and are placed at intervals of 1.5m on both dip and strike. Treated timber, 100mm to 125mm in diameter, is used for support in the shafts and levels. Off-cuts from the treated timber are used for sleepers.

Underground lighting: Miners relied on carbide lamps and, sometimes, candles were used due to lack of electricity and cap lamps.

Additional small-scale underground mining equipment: Apart from the equipment used in the above example, there are other equipment and tools that could fit into a small-scale underground working environment effectively. These include:

Hoisting - safety windlasses (SADC, 1994): Small-scale miners commonly use these although their improvised designs make them inefficient. A simple windlass that can be fabricated in any small metal workshop is described by the SADC Mining Coordinating Unit as consisting of an 8" pipe, 30mm rounds and a channel iron. This can be attached with a simple band brake to be used when lowering the kibble. Side chains can be fixed for securing the handle, which is attached to the pipe via a drop-in bearing. With a hoisting capacity of 55-60kg loads at a time, the windlass can deliver 0.3-0.5 tons per hour.

Hoisting - diesel/petrol engine winders: Small winders powered by a diesel or petrol engine with a clutch or friction wheel drive, low rope speeds of around 0.3 m/sec, and only one gear with no gear shifting, are also available.

Lighting - compressed air lamps: Due to lack of electricity in most SSM areas, and the fact that the traditional cap lamps are usually expensive, compressed air lamps provide a good alternative. There are several products including the mercury vapour or fluorescent lamps that provide strong enough lighting for underground workings and can be fixed directly on the supply line for the jackhammers and other compressed air-powered equipment.

Ventilation of underground mines: Adequate supply of air in underground working is required in most countries' health and safety legislation. Enough airflow is essential for removal of gases, fumes and for meeting demands of air for those doing physical activities. Whereas shallow mines (<20m) can be ventilated through natural flow of air, deeper excavations need mechanical means of air supply. Whereas some small-scale miners use compressed air for direct ventilation, (e.g, in the tanzanite mines of Merelani, Tanzania), this practice is wasteful if one considers the power consumption of the compressor. Small fans that can be locally made are good and a cheap alternative, as is the case in the Mugusu mine in Tanzania.

Blower manual-driven fan - Mugusu Mine - Tanzania: Miners at Mugusu in the Lake Victoria Goldfields area mine gold from underground excavations as deep as 100m. Although the mining area is located on the high Geita Hills and water inflow is not a problem, the depth of working makes ventilation one of their worries. Miners have designed a manually driven blower fan that has six to eight blades of thin pieces of metal sheet welded on a 16"-19" long shaft. The driving mechanism utilizes a bicycle wheel and a rubber drive belt, which connects the wheel to the shaft of the fan. A 25mm diameter PVC pipe is then connected from the fan down to the working face. This provides enough air to a single face although it takes a long time to remove fumes after blasting. A more improved version is used in Colombia, where the drive utilizes a bicycle frame and drive mechanism. A gasoline engine can also be adapted to drive the blower fan.

Mine drainage: Mine drainage, especially in underground mines, is usually necessary due to either water accumulating from drilling operations or from groundwater inflow. The Red Rose gold mine near Bulawayo is said to have water inflows of around 500 l/minute, which, for a small-scale mine, is a large inflow. In surface mines, water inflows usually derive from the collection of surface water during rainy seasons due to the shallowness of most pits. In surface excavations, the first precautionary step that has to be taken is to stop surface water from entering the mine by constructing water-catching ditches. Benches should be provided with an adequate inclination for water flow with ditches on the sides.

Similarly, underground drifts and crosscuts should also be sloped and provided with side ditches to allow water to flow to a catchment sump. Underground sumps, large enough to keep a maximum inflow of between 8-24 hours, are usually constructed close to a shaft from where it can be pumped to surface. Compressed air

pumps are convenient in SSM where electricity is not always available and these may have heads of up to 60 metres depending on air pressure. In open pit mines, pumps driven by diesel or petrol engines may be used. A good example of such pumps is a pump manufactured locally in Zimbabwe, which employs little petrol for starting the engine, and then runs on kerosene, (Hollaway, 1993).

Mineral beneficiation technologies

The review includes such techniques as crushing, grinding, sizing, floatation and gravity concentration.

Comminution

Comminution processes involve crushing and grinding in order to liberate valuable minerals from the gangue.

Crushing - impact crusher - Filabusi Gold Project - Zimbabwe: Most small-scale miners now employ crushers as the first stage in size reduction. For crushing of hard rock, a small hard rock impact crusher with 800 or 1000mm rotor beater bar circle x 500 or 600mm width has found wide applications. The Filabusi gold project design incorporates a small hard rock impact crusher with the size of 850mm diameter rotor x 670mm width powered by a 25kW drive. The crusher with the capacity to produce 20 -30 tons per hour is the smallest in the range of impact crushers. The advantage of impact crushers is that they produce cubical or spherical shaped grains unlike platy or elongated pieces produced by jaw crushers. They are also cheaper, simple to maintain and can be manufactured locally, as done in Zimbabwe.

Grinding - ball mills - Mugusu Mine - Tanzania: Ball mills have become common with most SSM operations and are used for fine grinding. At Mugusu Mine in the Lake Victoria Goldfields in Tanzania, 1-ton capacity batch mills are used as custom mills and operated by Meremeta, a gold-buying company. The feed material is either manually crushed fresh ore rock (<5mm) or screened tailings from sluicing operations. The mills are driven by diesel engines and most are designed and built in Zimbabwe and South Africa. Ball mills in the diameter size range between 0.76 and 1.5m and with throughput capacities between 0.5 to 3 tons per hour are produced by a number of manufacturers in Zimbabwe (Hosford, 1993).

To reduce the cost of liners, sections of railway tracks can be used with these mills as effective liners. The 1-ton capacity ball mills are mounted on steel frames located on a concrete floor. Given the smaller size of the mills, they have proved efficient for batch milling operations and they can be easily moved from one place to another.

Grinding - stamp mills - Zimbabwe: An “axiflow” 3 stamp mill is a 3-in-series mill that is capable of treating 3 to 5 tons per 24 hours, depending on the feed size

and type of material, (Hosford, 1993). The mills, which are manufactured in Zimbabwe, are commonly powered by a 15HP diesel engine or 11HP electric motor. The axiflow stamp mills that produce finer grind than conventional stamp mills have been installed in Zimbabwe, Tanzania and other SADC member countries.

Sizing and classification

Sizing: Screening is the common sizing method that is applied in order to separate particles in individual sizes. It employs various screen designs including grizzlies, trommels, rigid screens, vibrating screens, etc. and may be used with dry, damp or completely wet ore. A simple screen can be done through shaking by hand or by placing the ore at an inclined position so that fine particles pass through the screen and coarse fractions are retained and remain on top of the screen. Different particle sizes can be separated through a series of successive stationary screens. In small-scale operations where material is fed manually to the screens, throughputs of up to 500 kg/hr can be achieved (depending on the size of the feed).

Classification: Classification is usually applied effectively to separate particles that are too fine for effective screening. Classification methods work on the basis of velocity whereby particles fall through a fluid medium, mainly water. There are basically two main types of classifying equipment namely, mechanical and hydraulic classifiers. The classification equipment commonly used in small-scale mining include:

Hydrocyclones: These are continuously operating hydraulic classifiers that utilize centrifugal forces to accelerate the settling rate of particles. While hydrocyclones mostly work in closed circuit grinding operations, they are also used for de-sliming and thickening. This equipment is widely used in small-scale mining operations due to their cheapness, simplicity, absence of moving parts and flexibility.

Sluice box: Small-scale miners use sluice boxes both as classification equipment as well as for concentration of minerals (see details in following sections).

Concentration methods

Once the minerals have been freed in the ore through crushing, grinding and classification, they must then be separated from the gangue. There are different concentration methods even for the same type of mineral depending on the type of ore, particle size, and other considerations.

Gold concentration techniques

In addition to the particle size, gold recovery techniques are dependent on the ore type, e.g., alluvial/eluvia, free milling or sulphidic ores and refractory ores. Table 5 provides a comparison of some gold concentration methods, their costs (capital and operating) and their potential environmental impact.

Table 5: Relative* cost and potential environmental impact of gold recovery methods

Recovery method	Relative* cost	Relative* potential environmental impact
Sluice box	1	1
Jig	3	1
Shaking table	2	1
Spiral	3	1
Rotating cone	2	1
Bowl	4	1
Drum	4	1
Magnetic separation	4	1
Electrostatic separation	4	1
Hydrocycloning	2	1
Froth floatation	3-4	3
Amalgamation (mercury)	2	4
Cyanidation	3-4	3

Source: (Appleton et al., 1998)

* Qualitative ranking from low (1) to high (4).

The above parameters vary from one country to another depending on availability and prices of capital equipment and reagents on the local market, among other things. As such, a process looking expensive in one country may turn out to be cheaper in another. Selection of a recovery method should take into consideration the associated environmental impact. The use of mercury in amalgamation by small-scale miners has been extensively documented as a cause of severe environmental impact. On the other hand, it has been noted that cyanidation and froth floatation have less negative impact compared to amalgamation if proper measures are taken so that cyanide and froth floatation reagents do not enter the environment. In countries such as Zimbabwe and the Philippines, cyanidation is a widely used process in small-scale gold mining.

Some of the gold-processing methods used around the continent that may be considered best practices, include the following:

Sluice Boxes - Insiza Riverbed Mining Project - Zimbabwe: A sluice box is one of the oldest gold-processing types of equipment, and is described by Agricola (1556) in his famous book, “De Re Metallica”. Well-designed and operated sluice boxes have been shown to offer recoveries of up to 98% of gold coarser than 100µm, (Appleton et al., 1998). This has been demonstrated in a project financed by GTZ, operated by the Department of Mining Engineering of the University of Zimbabwe and implemented by the Insiza Rural District Council in Zimbabwe. Improvements in the sluice box design generated fairly high productivity of around 4 tons per miner/shift and recoveries of around 70%.

The efficiency of sluice boxes has also been tested by a combination of laboratory and field experimentation carried out by the British Geological Survey (BGS) through work done in the Philippines (Appleton et al., 1998), Guyana and Zimbabwe (Styles, 2001) on small-scale gold mining. The field tests conducted on several ores with varying gold grain size distributions in Guyana were able to show that the perceived problem of major losses of very fine-grained gold had no factual basis. Based on the Guyanese field test recommendations, it was concluded that sluice boxes are capable of achieving 80% gold recovery. The results of the BGS work in the Philippines were also interesting. The following recommendations for improving gold recovery using sluice boxes are based on those results:

- (a) Wet screening to remove material coarser than 500 μ m (which should be passed over a sluice box to recover gold coarser than 500 μ m);
- (b) Material finer than 500 μ m to be passed over a second sluice, to recover gold coarser than 200 μ m; and
- (c) Tailings from stage (b) to be wet screened to remove material coarser than 200 μ m (ideally free of gold) and then passed over a shaking table (to recover gold to 50 μ m).

Further recommendations included:

- (d) The time interval between cleaning-out operations should be short to enhance recovery of fine gold, which would otherwise be lost due to solids packed around the riffles;
- (e) The inclination angle of the box should be increased by particle size. Experience elsewhere has shown that angles of 7 $^{\circ}$ - 12 $^{\circ}$ and 12 $^{\circ}$ - 14 $^{\circ}$ are suitable for materials finer and coarser than 1mm respectively;
- (f) The feed and wash water rates should be high enough to enable efficient separation of coarse-grained gold without excessive loss of fine-grained gold;
- (g) Gold ore with a significant proportion of clay-bound and weakly cemented material should be washed (“scrubbed”) and screened prior to sluicing in order to liberate gold trapped in clay;
- (h) Ore should be screened prior to sluicing and the resulting coarse and fine streams should be diverted down different sluices (see (e)) in order to improve overall gold recovery; and
- (i) The use of alternative riffles would enable a higher recovery of gold. Expanded metal riffles are recommended for gold finer than 1mm and angle iron riffles for gold coarser than 1mm.

Shaking tables - The British Geological Survey (BGS) shaking table:

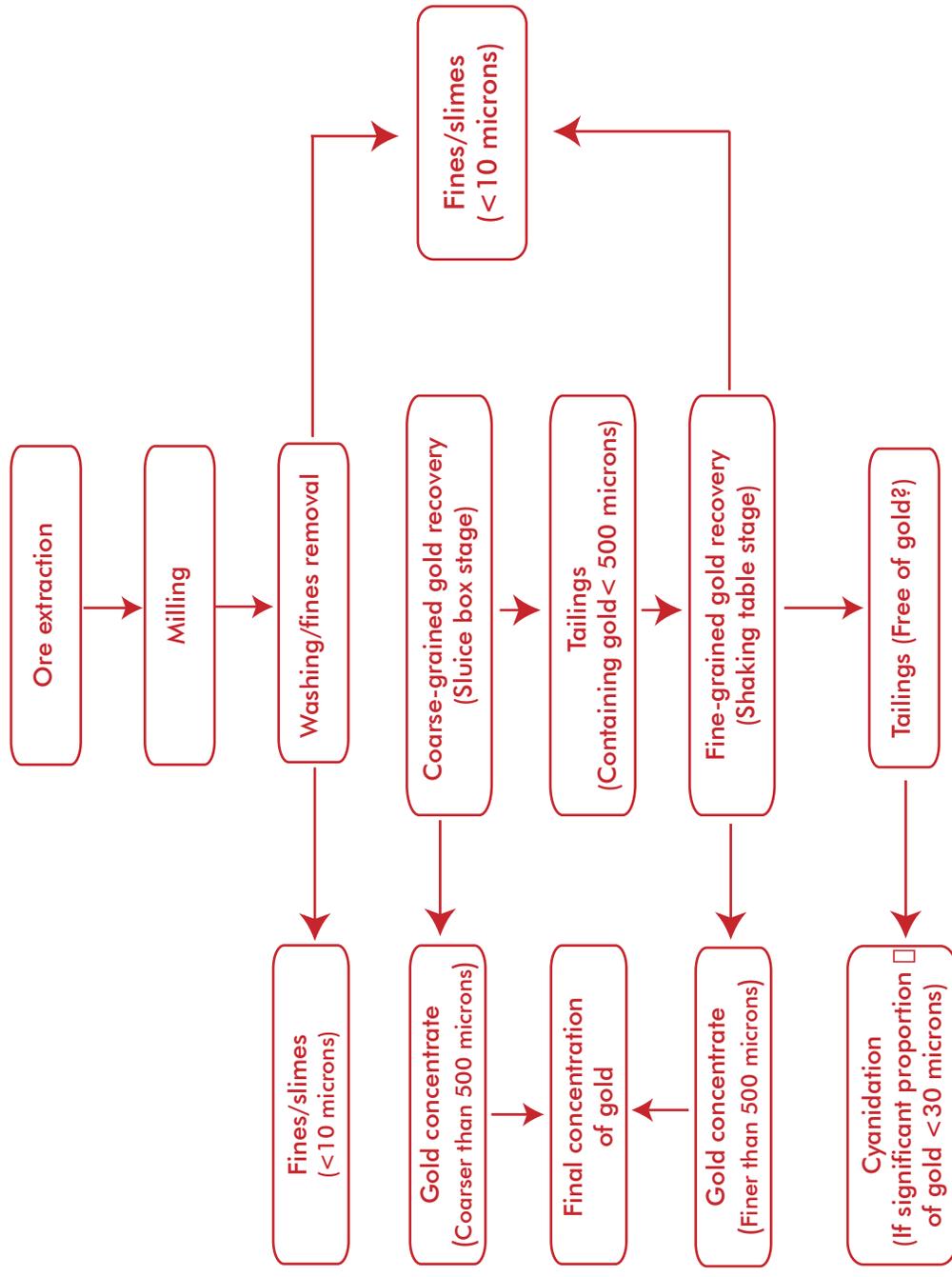
Efficient recovery of fine gold (<100 μ m) was achieved by the use of a shaking table type of gravity separator. Shaking tables are simple devices consisting of a

flat deck with parallel riffles that are effective for processing of materials in the size range of 3mm to 50 μ m and are capable of recovering 90 wt.% of the gold present in that size range, (Appleton et al., 1998). Gravity separation is achieved through the action of shaking the table longitudinally, which allows heavy minerals to migrate along the riffles to the end of the deck, leaving light minerals to be washed over the riffles.

The BGS shaking table (Appleton et al., 1998) was designed and tested using ores obtained from the Philippines SSM areas. The table is based on a simple design of a riffled-deck using widely available materials and a manual driven mechanism. It consists of a frame and supporting base made out of hardwood with a formica deck surface slightly roughened with wet and dry abrasive paper. The drive mechanism consists of bicycle gear wheels and chains, with an appropriate gearing ratio to step up the manual drive input. Reciprocal motion required for shaking the table is achieved through the use of an eccentric cam, which is attached to the shaking table via a universal ball joint. The rotation of a handle at a speed of 1 revolution/second produces longitudinal motion of about 300 strokes per minute, which is suitable for separation of fine particles. The 'end-knock' effect is then produced by the sudden release of a stronger rubber band that is stretched by the eccentric cam. This simple design is completed with sloping of the deck controlled through appropriate wedging of the deck sub-base, wash water supplied through plastic piping and by using suitably partitioned plastic drainpipes to collect tailings and concentrate.

Field trials have proved that the simple shaking table, if set-up properly, can recover fine-grained gold. This was demonstrated through recovery of fine-grained gold from miner's tailings where the grain size was only around 30 μ m. Miners who operated the table were impressed by its performance, which is important for technology dissemination. Based on the outcome of the field trials, a more comprehensive approach which combines three processes namely, washing to remove fines and slimes; washing on a sluice box; and treatment on shaking table, was recommended as shown in figure 1.

Figure 1: Process stages for enhanced recovery of fine-grained gold.



Source: Appleton et al., 1998.

Gravity concentration - jigs: Jigs have also been shown to be efficient in the recovery of fine gold down to 75 μ m and they can be used as a replacement to sluice boxes (Appleton et al., 1998). Jigs are devices that use the force of water to separate the heavy minerals from the lighter ones. The simplest of this equipment is the hand jig, with moving bed operation used for sorting coarse grains and which may be applied for separation of alluvial gold, gemstones, etc. The jig is capable of separating up to 5-10kg per man-minute. Other jigs include:

- (a) Hand Piston Jig, which is constructed as a double jig box. The movement of the piston creates a longitudinal flow of the slurry through the jig and thus a lateral component. The up and down motion of the slurry results in a faster separation of light and heavy particles
- (b) Mechanized Piston Jig (Harzer Jig), which works like a hand piston jig, but is equipped with a mechanized drive system. An internal combustion engine can drive it via transmission or hydromechanical energy. The throughput capacity is about 1.0 tons per hour.

Gravity concentration - Knudson Bowl - Zimbabwe: The Knudson Bowl is one of the centrifugal concentrators that have found wide application for the recovery of fine gold in small-scale mining in Zimbabwe (Hosford, 1993). The popularity of the bowl can be associated with its simplicity and lesser reliance on water quantity and pressure. It consists of a rotating steel open-topped bowl fitted with a ribbed rubber insert. The material is usually fed from the top and overflows the sides allowing gold to collect between the ribs. It is operated in a batch mode, with the rubber insert removed periodically for cleaning. Other successful centrifugal concentrators used in Zimbabwe include a Knelson separator (imported mainly from Canada) and a Centrasep Concentrator.

Gravity concentration - the plane table - Zimbabwe: Small-scale miners in Zimbabwe use plane tables to treat mill and discharge material (Hosford, 1993). The unit consists of two inclined tables covered with strakes - ribbed rubber sheets with ribs arranged in the line of pulp flow. The tables are arranged such that the first is slightly elevated and overlapping the other with the concentrate launder located between the two. With the pulp flowing over the top table, water is added to wash the gold particles collecting in the strakes down to the concentrate launder. From the launder, the concentrate is directed to a collection box for later treatment. The tables that have been installed in Zimbabwe and Tanzania achieved recoveries of between 30 to 70% at throughputs between 2.6 to 10.5 tph/m in width depending on the type of ore.

Flotation methods - Zimbabwe: Concentration of fine sulphide minerals can be easily achieved using flotation methods. A good application of the technique is found in one small-scale Zimbabwean gold mine treating 50 tons per day of sulphidic ore grading approximately 4g/t of gold, 1% copper (as chalcopyrite)

and some arsenopyrite (Hosford, 1993). The mine developed a Jameson-type cell to produce a gold-copper (10% Cu, 20g/t Au) concentrate suitable as feedstock for a nearby smelter. The cell consists of a feed pipe made out of empty cyanide drums, which contains a nozzle through which pulp from the CIP tailings is pumped. The pulp is conditioned to reduce pH, and collectors and froth are added. The nozzle allows the jet impingement of the pulp into the froth column in the feed pipe. This creates a tall froth column, which allows effective particle cleaning and separation. The concentrate overflows the launder and is allowed to dewater in settling ponds prior to transportation to the smelter. The unit can be operated with very little supervision and only basic maintenance of the feed nozzles.

Cyanidation - Zimbabwe: Cyanidation methods are widely used in small-scale gold mining in Zimbabwe. The advantage of this technique is that cyanide decomposes very rapidly in solution, especially when exposed to sunlight. In addition, despite the high toxicity of cyanide, it is not a cumulative poison like mercury. Its low accident rate is demonstrated by the example of Zimbabwe, where nearly 6000 tons of cyanide is imported into the country annually for its gold mines and there have been only two accidental fatalities in 40 years, (Hollaway, 1993).

Amalgamation - Gattling Hill-6 Mill - Zimbabwe: Small-scale miners continue to use mercury for the recovery of gold without taking any protective measures despite the dangers to human health and the environment. The attraction of mercury is based on the fact that it is readily available, cheap and efficient in recovering fine-grained gold. Best practices in the application of amalgamation as a gold-recovery technique can be found at Gattling Hill-6 Mill in Zimbabwe. The mill is operated by B&K Syndicate and utilizes a 2x1350 lb stamp mill to crush the ore, which is then passed over a copper plate. A quell bowl placed in series with the copper plate is used to concentrate gold that is not collected by the copper plate.

The collected concentrate is then poured into an amalgamation barrel containing mercury and left to mix for several minutes while the barrel rolls. The amalgam is then taken out, placed inside a retort and heated to evaporate the mercury. The escaping mercury condenses inside the piping of the retort and is collected in a container filled with water. Gold is then recovered from the retort pot after cooling. The retort used is locally made and in March 1999, costed \$Z2000.

The Gattling Hill example is a best practice, which unfortunately is not followed by every small-scale miner. As used normally by small-scale miners, mercury is hazardous. Miners distil the mercury in open air and inhale its poisonous fumes. Mercury distillation retorts protect the miners from the fumes and also allow the re-use of the mercury. Although there are many types of retorts used in many countries, the following qualify as good practices:

ThermEx retort - Ghana & Tanzania: This retort is probably the first commercially available glass retort ever produced. It is compact, with dimensions compared to 2 cigarette packets, and weighs approximately 1kg. The retort has been successfully tested in Tanzania and Ghana where it is now widely marketed. The recommended selling price is \$US520. Apart from the environmental impact resulting from heating the amalgam in open air, the ThermEx manufacturers contend that miners lose up to 12% gold during the amalgam burning process. Such losses are said to occur through:

- (a) Spattering during the burning process;
- (b) Contrary to metallic retorts where the gold becomes darker or browner due to its reaction to iron, in the glass retorts, there is no colour change; and
- (c) There are less gold losses than in metallic retorts where gold infiltrates into iron surfaces.

In addition to allowing miners to observe the entire process of separation of mercury and gold from the amalgam, the Therm Ex glass retort also has the following advantages:

- (a) The retort warm-up time is shorter compared to metallic retorts (7-12 minutes);
- (b) It avoids the change in colour of the gold which occurs in metallic retorts due to gold reacting with iron and thus becoming darker or browned; and
- (c) A clean glass avoids gold losses that occur due to gold infiltrating into iron surfaces. Such lost gold is commonly recovered by using files.

Intermediate Technology Development Group (ITDG) Retort - Zimbabwe:

The ITDG researched and developed a simple retort based on materials that can be picked up from any plumber shop. The retort, which was developed between 1990-1991, was tested successfully in the field in Zimbabwe during the same period. The retort parts consist of a pipe and fittings made of ordinary galvanized iron, thus avoiding the use of copper or other metals that readily combine with mercury. The retort is based on a “do-it-yourself” principle and consists of:

- (a) One 20-inch length of ¼-inch-diameter galvanized iron pipe with a screw thread at one end. If a ¼-inch diameter pipe is not available, a ½-inch pipe is recommended, although the smaller the pipe diameter, the better;
- (b) One ½-inch to ¼-inch galvanized iron-reducing bush;
- (c) One ½-1½-inch galvanized iron reducer;
- (d) One 1½-inch galvanized iron plug; and,

- (e) A wooden stopper to fit the ¼-inch pipe (or ½-inch) at the discharge end.

Having gathered the above parts, the retort can be easily assembled by bending the pipe 4 inches from the threaded end into a smooth curve with an angle of 60-70°. A smooth pipe bend can be achieved by using a pipe-bending machine, if available, or through clamping the pipe over a larger pipe (4-6 inches) and then manually bending it. It is recommended that the pipe and fittings be heated until red hot to burn off the zinc, which reacts with mercury. After cooling, the parts are washed prior to assembling them into a retort. The retort is then assembled by connecting the ½ to ¼-inch-reducing bush to the pipe and screwing it tightly.

Note that the reducing bush is not required if a ½-inch diameter pipe is used. Once the ½-inch to 1½-inch reducer is connected to the reducing bush and the 1½-inch plug to the reducer, the retort is ready for use. A leaflet showing the retort parts, assembly procedure, step-by-step instructions on how to use it, and first-aid instructions for mercury poisoning have also been prepared by ITDG. It could not be established, however, whether these retorts have been widely accepted by miners. Its costs may have been a significant deterrent to a wider use by the small-scale mining community.

Small-scale gold processing plant - Filabusi Gold Project - Zimbabwe

The Filabusi gold project in Zimbabwe is a small-scale gold project with capacity to treat 40-50 tons of ore per day. The gold ore consists of oxidic and sulphidic quartz reef and oxidic-banded ironstones. The processing flowsheet was designed by the SADC Mining Sector Coordinating Unit and consists of the following (SADC, 1994):

Sizing: The run-of-mine ore is passed over 150mm grizzly from where large boulders are broken before entering the hopper.

Feeding the Crusher: Material is fed from the hopper to a conveyor belt via a finger grizzly with bigger pieces falling on top of fines, thus facilitating hand sorting. In addition, the inclined conveyor is slow running which facilitates hand sorting.

Crushing: A hard-rock impact crusher of smallest available size: 850mm diameter of rotor x 670mm, 25kW drive, 20-30 t/hr. The circuit contains a vertical bucket elevator feeding the crushed material to a vibrating screen, 5mm, polyurethane where the oversize material is sent back to the crusher and the undersize to the holding bin. Crushing is carried out during the day shift only.

Classification: Material from the holding bin is passed over a vibrating screen (0.8mm, polyurethane, slotted, wet) with the undersize material being passed to the concentrator section and the oversize to the grinding section.

Grinding: Grinding is carried out by grinding rolls, 600mm diameter x 300mm face width powered by 2 x 4kW drive. The water-sprayed rolls have a narrow

setting and discharge into a sump with circulating pump. The pump returns the roll mill product to the 0.8mm-vibrating screen.

Concentration: 1 pair of Bambazonke sluice boxes (while one is in operation, the other one is being cleaned) extracting 1.0-1.5 tons per day pre-concentrate consisting mainly of sulphide and heavy minerals and 300-400 gm/tons of gold. The tailings from the sluice box (with about 2g/t gold) are passed through a pair of 330mm bowl diameter centrifugal concentrators (1 working, 1 being cleaned) scavenging about 0.5 tons per day pre-concentrate with 100-150 gm/ton. The final tailings contain approximately 0.5g/t gold which is not amenable for cyanidation. The pre-concentrates, about 1.5-2.0 tons per day are upgraded in a small (260mm bowl diameter) centrifugal separator to 10kg concentrates, with 4-5% gold and intermediate tailings of about 15gm/ton, requiring about 10 “runs” per day.

The concentrates are further upgraded in a small machine to 0.8 - 1.0kg final concentrate with 40-60% gold and some 8-12kg intermediate tailings, with perhaps 100gm/ton. The intermediate tailings 1.7 - 2t/day, with 15 - 20gm/ton are either retreated in a centrifugal separator or added to feed or stored for oxidation in order to liberate gold locked in sulphide and later retreated. About 6% gold is present in the intermediary tailings of which 50% can be recovered, leading to an overall plant recovery of 92.5%. The concentrate is then roasted (when necessary), acid treated and melted to gold bullion.

Small-scale treatment of copper sulphide ores - Mufumbwe Copper Project - Zambia (SADC, 1994):

Small-scale mining of copper sulphide ore is limited to uncomplicated ores that do not require very fine grinding. The Mufumbwe Copper Project located in the northwest province of Zambia, is a good example of a small-scale copper sulphide treatment plant. The process involves manual sorting of ore, an open circuit impact crushing followed by a closed circuit grinding ball mill with cyclone, followed by floatation. A small amount of concentrate is collected in settlers that are decanted and cleaned by hand when full. The concentrate is stored and allowed to dry on drying pads and loaded into trucks for transportation to the smelter. The tailings are thickened in the tailings thickener and clear overflow water re-circulated back to the process with the underflow sent to a slimes dam.

Gemstone processing

Processing of aquamarine, beryl, tourmaline, topaz and similar minerals - SADC Mining Coordinating Unit (SADC, 1994): - This is a process proposed by the SADC Mining Coordinating Unit based on experience from the St. Anne’s Mine in Zimbabwe. The selectively mined gemstone containing ore is taken to the plant where it is manually broken into 80 -120mm pieces while watching out for good gem crystals. The material is then washed in trommels to dissolve the

clayey materials and break weak rocks, and is then passed through 4 and 9mm screens. The fine tails from the 4mm screen (<4mm) are passed through a sluice box for recovery of tantalite and the coarser fraction (4-9mm) kept for later partial picking of small stones. A rotary pan followed by a screen for the concentrate is recommended, especially in the case of tourmaline.

The coarse fraction from the 9mm screen (>9mm) is taken to a sorting conveyor belt where without cobbing or knocking, raw gem minerals are sorted including any other ore/minerals. The remaining material on the sorting belt is passed through an impact crusher with the crusher product joining the new feed to the washing trommel. This simple approach reduces damage to the gemstones or aggregates containing gemstones.

Treatment of limestone - Lirangwe (Women) Lime Makers Association - Malawi: Through funding from the European Union and technical assistance from the ITDG, the association managed to build a modern kiln for continuous lime production. This replaced the brick-built, batch-processing-based field kilns that women miners were operating in the past. The traditional kilns took 1-3 days to charge, several days to heat, burn and cool and several more days to remove the burnt lime. The new kiln is charged with limestone sized 40 - 50mm from the kiln's top, alternately with soft wood for the production of building and agricultural lime or with charcoal when producing lime for the sugar industry. The kiln, which has the capacity to produce 5 tons of lime per day, needs forced draft by air injection from the bottom. The kiln has 1.0m inside diameter, is 7m in height and requires 13 to 14 hours retention time.

3.2.4. Environmental management, health and safety

Specific environmental legislation/regulations

Small-scale mining environmental regulations requirements - Tanzania: Mining environmental issues in Tanzania are regulated according to “The Mining (Environmental Protection and Conservation) Regulations, 1999” which form part of “The Mining Act, 1998”. Like the principle act, the regulations incorporate both small and large-scale mining operations. However, the provisions specific to SSM are addressed separately (see box 1)

Box 1: Environmental regulations for SSM in Tanzania

1. The holder of a Primary Mining Licence shall ensure that washing or settling ponds are constructed in his Primary Mining Licence area to provide for washing and sluicing, and no such washing and sluicing shall be done along or close to rivers, streams or any other water sources. Where a settling pond is used as part of the mine drainage system, all channels discharging into the river system must be covered and the slopes protected from erosion.
2. Vegetation clearing will NOT be undertaken within twenty metres (20m) from any stream or riverbank.
3. The holder of a Primary Mining Licence shall NOT heat mercury amalgam to recover the gold without using a retort.
4. The holder of a Primary Mining Licence shall NOT use cyanide leaching without the written approval of the Chief Inspector.
5. No holder of a Primary Mining Licence shall commence development of new workings in his primary mining licence area without backfilling or fencing the abandoned previous workings developed by himself or his agent.
6. Prior to the commencement of mining in any area that may have been environmentally damaged, the Primary Mining Licence holder shall request an inspection of the same area by an inspector to confirm environmental disturbance. Any area, for which the authorities have not received a request for an inspection, shall be considered as normal.
7. The holder of a Primary Mining Licence shall ensure that tailings are disposed of at a proper place in a manner approved by the inspector.
8. No holder of a Primary Mining Licence shall allow children below the age of 16 to be employed or be engaged in any mining or processing operations in his primary mining licence area.
9. Every Primary Mining Licence holder shall ensure that pit latrines are constructed and maintained at a distance of not less than one hundred (100m) metres inland from any water source other than washing or settling ponds.
10. Every Primary Mining Licence holder shall ensure that each employee is provided with protective gear and no person shall handle any toxic substance without using appropriate gear.
11. Any person who contravenes any provision under this part shall be guilty of an offence and shall be liable, on conviction, to a fine not exceeding Tshs.50, 000/= (US \$62.50) or imprisonment not exceeding 3 months, or both.

Mercury Law - Ghana: The Mercury Law was enacted in 1989 with the aim of regulating the distribution, use, storage and trading of mercury. According to this law, it is a punishable offence to import, possess, buy, sell or transfer any mercury without a licence, which can be obtained from the Minister of Trade. Buying knowingly from a person who is not licensed, is also a punishable offence. Small-scale miners are allowed, under the law, to buy mercury from licensed mercury dealers in such reasonable amounts, as are necessary for their mining operations. A gold miner will also have committed an offence if found selling or dealing in mercury; in possession of more mercury than he needs; heating an amalgam without a retort; or if he does not observe good mining practices in the use of mercury.

Similarly, goldsmiths and gold dealers will have committed an offence if found processing mercury containing gold-sponge or metals without using a retort or if they do not observe best practices in the handling of mercury. Any person found guilty under this law shall on conviction be liable to a fine not exceeding \$US1000 or to imprisonment for a term not exceeding two years or both.

The Department of Minerals and Energy - Kimberley Environmental Impact Assessment (EIA) requirements - South Africa: The National Environmental Management Act of 1998, the Mining and Minerals Act of 1991, EIA guidelines of 1997, the Environmental Conservation Act of 1986 and the Aide Memoire requirements of 1992 govern environmental legislation in South Africa. The provisions provided in these laws/regulations are unintelligible to small-scale miners. For example, the latter find it difficult to adhere to the requirement to conduct EIAs or establish a fund to cover the cost of post-mining rehabilitation.

As a result, most miners decide to ignore them and opt for illegal mining operations. In recognition of these difficulties, the regional administration of the Department of Minerals and Energy in Kimberley has developed simplified EIA requirements applicable to artisanal miners (defined as non-mechanized operations). However, it should be noted, that SSM projects that receive assistance from NSC must follow the standard environmental requirements.

The DME now has a “Standard Environmental Management Programme” in a simple 50-page format, for use by the SSMs when applying for a mining permit. The Regional Offices of the DME are prepared to assist these potential miners in filling in the form.

Procedures and financing for site rehabilitation

ZimAlloys Scheme - Zimbabwe: Chrome mining on the Great Dyke in Zimbabwe is mainly carried out by small-scale miners (cooperatives) who in turn supply chrome pre-concentrates to smelters such as Zimbabwe Alloys (ZimAlloys) and Zimbabwe Mining and Smelting (Zimasco). This arrangement, which is also known as tribute mining, has created a near full-time dependency on mining

and a reliable market for the mining co-operatives in the area. In order to ensure that the mined areas are rehabilitated as mining proceeds, ZimAlloys developed a scheme whereby the company deducts \$Z20 per ton of chrome received from the supplier as “environmental rehabilitation charge”, (Dreschler, 2001).

After the site has been rehabilitated, the company pays the miner \$Z35 for every ton sold. Calculations have shown that while it costs the miner \$Z25 per ton to carry out rehabilitation, it would cost ZimAlloys \$Z50 to achieve the same. As a result, the scheme enables the miner to gain \$Z10 per ton for carrying out rehabilitation and ZimAlloys saves \$Z15 per ton.

Minerals Commission - Ghana: In order to facilitate rehabilitation in SSM areas, the Government (through the Minerals Commission and the Precious Minerals Marketing Corporation) retains 3% of the value of the mineral products sold by a small-scale miner for the “Land Reclamation Fund”. Estimates show that the procedure has generated approximately 120 million cedis to the rehabilitation fund, (Sackey, 2002). The Government uses the rehabilitation fund to rehabilitate mined-out areas.

Legislation on health and safety

Specific legislation addressing issues on health and safety for small-scale mines is rare. Most countries have health and safety issues covered under general regulations addressing the entire mining industry. A few exceptions are described below.

South Africa Mineral and Mining Policy (white paper): Health and safety issues in mines in South Africa are regulated according to the “Mine Health and Safety Act, 1996”. However, the draft Mineral and Mining Policy recognizes that there are health and safety problems specifically associated with SSM that the current legislation and Government policies do not adequately address. In addressing this shortfall, the draft policy contends that “whilst maintaining health and safety standards in the small-scale mining sector, the Government will review the current legislation to ensure that relevant provisions are practically applicable”.

Mining regulations - Zambia: As in many other African countries, SSM mining health and safety issues in Zambia are regulated as part of the overall mining sector regulations. However, the Zambian regulations have specific sections addressing the needs of small-scale mining. The health and safety issues are regulated according to “The Mining Regulations (1971)”. Section IX of the regulations is specific to SSM and addresses issues of ventilation and air pollution arising from dust, fumes and other toxic gases. It provides measures for determination of concentrations of such pollutants and sets standards for air quality and measures for minimizing their generation.

Box 2: Health and safety rules in small-scale mines at Merelani

The following health and safety rules/regulations are to be strictly observed by each member of a mining team involved in tanzanite production:

1. Following a mining disaster, all mine waste must be cleared in the area concerned and thrown into the identified pits, which must then be sealed and abandoned.
2. Walls/shaft collars of timber or concrete at least 1 metre high must be built around all openings of the Merelani mines.
3. All mines must have ladders to allow miners access in and out of the mines.
4. The mining area must be kept tidy at all times; narrow tunnels should be widened to allow free movement within the mines while working. Leaving heaps of waste inside the mines is not allowed.
5. Walls that appear weak need to be strengthened with pillars made of strong timber.
6. On all mine openings/entrances some kind of shade must be built to prevent rain from entering the mines. Cottages must be built around the mining area for mine caretakers to use them as shelter for rain or sun, as well as a resting place for the miners themselves, to avoid that they use mine pits for that purpose.
7. During the actual mining exercise, two holes/mines may be joined together. If this happens while it is raining, all work must be stopped immediately.
8. For the mine owner to monitor who is in and out of the mines, he has to have an attendance registry and at any specific time must be aware of the number of workers inside or outside the mines.
9. Mine owners must, henceforth, provide/install communication systems so that miners at work can communicate more easily with those outside the mines (e.g. battery-operated bells, hand telephones). The use of messengers to carry messages to and from the mines is strictly forbidden.
10. Mine owners must provide each miner/employee with proper protective tools for working (helmets, boots, gloves, etc.).
11. Tunnels that were built during the mining work prior to the accident must be strengthened and maintained.
12. Mine owners must provide toilets for their employees.
13. It is prohibited to use/employ children under the age of 16 in the mines.
14. Every mine owner must have a first-aid kit.

Source: ILO, 1999.

Section VI covers the hazards from dangerous surface excavations such as large cracks, subsidence, pits and protection of surface features. Safety in working areas is covered under section VII of the regulations. Given the changes in the SSM sector, especially the expansion of operations in small-scale gemstone mining in the country, these regulations need to be reviewed in order to address the current situation on the ground.

Localized regulations - Tanzanite mining - Merelani, Tanzania: In 1998, heavy rains in the region of Arusha, in north-east Tanzania, led to flooding of tanzanite mines, killing about 70 people. Following the accident, the Arusha Miners Association and the Mines and Construction Workers Union, in collaboration with the Mines Zonal Office (located a few kilometres from the site) assembled and drafted regulations aimed at avoiding similar accidents (see box 2). Although the regulations might not be ideal and did not impede the occurrence of another fatal accident in 2002, they are a departure from previous practices. More important, in their design there was consultation and broad participation of small-scale miners.

ILO - Safety and health in small-scale surface mines (Walle et al., 2001): In 2001, ILO released a handbook (Working Paper WP.168), which provides a set of health and safety guidelines for small-scale surface mines. This is in addition to ILO's Convention on Safety and Health in Mines, 1995 (No. 176), which covers all mines and provides the minimum requirements against which all changes in mining operations should be measured. Convention No. 176 is accompanied by Recommendations, No. 183, which provide more specific guidance to the Convention.

The handbook of guidelines is probably the first of its kind that addresses health and safety issues specific to small-scale mines. Although it does not cover underground operations, it is a start in the right direction. In addition to the general principles and provisions of health and safety in small-scale surface mines, the regulations also address:

- (a) Mining accidents and dangerous occurrences;
- (b) Hazards in the working environment;
- (c) Health, welfare and hygiene of mineworkers;
- (d) First aid;
- (e) Personal protection equipment;
- (f) Safety when mining;
- (g) Mechanical equipment;
- (h) Explosives and blasting; and
- (i) Mine closure.

The handbook is illustrated and can serve as a source document from which individual countries can develop regulations that address special requirements for the SSM sector. The ILO guidelines cover duties and responsibilities of the mine operator, mining authority and mineworkers, and sets out basic principles that can be used in the absence of specific regulations, which is the case of most countries.

Different countries around the world are moving towards the introduction of health and safety legislation that are specific to the requirements of the SSM sector. Examples of such national legislation include the Philippines' Small-scale Mine Safety Rules and Regulations, 1997; and China's- "Safety Regulations of Small-scale Coal Mines".

3.2.5. Minerals marketing

Small-scale miners have many difficulties in finding adequate markets for their minerals. The proliferation of parallel markets, especially in high-value minerals, is testimony that there are problems with existing formal minerals-marketing arrangements. A number of measures have been taken by different countries to address the problem. Best practices in small-scale minerals marketing have been identified in Tanzania and Ghana, including the following:

Regulation on minerals marketing by a Central Government - Tanzania:

In Tanzania, the Minerals Resources Division of the Ministry of Energy and Minerals regulates the marketing of minerals. The Division has three departments, namely, Mining, Minerals Development and Geological Survey. The Mining Department is responsible for the regulation of minerals marketing. It has a network of 11 regional or zonal and 12 district offices located strategically in the major mining centres of the country. The department has a section of minerals marketing that is located at the headquarters in Dar-es-Salaam and is responsible for monitoring and keeping records of minerals marketing through liaising with the regional and district offices. People who actually do the monitoring and data collection are the officers in charge of the zonal and district offices who are also inspectors within their jurisdictions.

It is required by law that all licensed mineral dealers, brokers and mineral rights owners submit returns indicating, among other things, data on minerals bought (brokers and dealers) and sold. Authorised officers can inspect these purchase and sales records without prior notice.

Licence applications for mineral dealerships are made to the Minister, although the office of the Commissioner for Mineral Resources is responsible for processing the applications. As part of the procedure, the Commissioner instructs the mine's officer in charge of the area to assess the adequacy of the applicant's facilities for conducting minerals dealership business. These include adequate office,

location, mineral storage facilities and other considerations. These conditions apply only to large operators (Dealer and Master Dealer Licence) and not to Brokers Licences. Upon receipt of a report from the mine's officer, the Commissioner makes a recommendation to the Minister for issuance or refusal of the licence.

According to the mining legislation, foreign dealers and mineral buyers are not allowed to go to SSM areas to do their business. They can only operate from district and regional centres. In order to ensure that this does not deny small-scale miners access to potential buyers/dealers, brokers were introduced to serve as a bridge between the two. However, miners are allowed to go to the district and regional centres to sell their products directly to foreign dealers.

Regulation on minerals marketing by a parastatal - Ghana: Ghana enacted the "Precious Minerals Marketing Corporation Law, 1989", that established a parastatal organization, the Precious Minerals Marketing Corporation (PMMC). PMMC oversees, regulates and participates in the marketing of precious minerals. It deals mainly with the marketing of gold and diamonds. The corporation issues buying licenses to both foreign and local companies to buy diamonds directly from the miners. It supervises the purchases and arranges all the necessary documentation for export, when the licensed buying company is ready to do so. The only requirement for a company to be licensed is that all purchases must be pre-financed through the Bank of Ghana and the buyer has to pay an annual Licence Fee of \$ US 10,000. The cost of the services offered by PMMC is 2% of the total value of rough diamonds exported at any given time.

For gold, the corporation operates through a main buying centre in Accra, a branch buying office in Tarkwa and an Agency Office in Kumasi. In addition, the corporation licenses local agents and sub-agents to buy gold from small-scale miners all over the country and sell it to more established agents or at any of its branches. The corporation sends all the gold bought through its offices to an assay laboratory, which is responsible for weighing and analysing the gold to evaluate its purity, upon which payment is made. It takes about thirty minutes for the agent or customer to collect his cash/cheque. Customers cash their cheques in a bank located within the corporation's building.

Private minerals dealers - Tanzania: The Tanzanian minerals market is one of the most open and competitive in Africa. The Mining Act (1998) and the associated regulations require that private dealers be licensed to carry out the business of minerals trading. The Government does not participate directly in any form of mineral trading and its role is limited to regulation, promotion, facilitation and provision of support services. There are 3 types of licensed mineral dealers, namely:

Mineral rights holders: All holders of mineral rights are allowed by law to sell (locally or export) their commodities without requiring an additional licence. This applies equally to small and large-scale producers.

Dealers: These are licensed to deal in gold, gemstones or any other mineral as approved by the Minister for Energy and Mines. Dealers' licences can only be issued to persons who can also meet the requirements for holders of a small-scale mining licence (Primary Mining License). As such, dealers' licenses are limited to Tanzanians only and are issued for renewable periods of 18 months.

Brokers: Unlike a dealers' licence, which must be issued by the Minister, the Commissioner for Mineral Resources issues Brokers Licenses. These authorize the holder to deal in raw gold and gemstones. Brokers buy and sell gold locally and the license does not entitle one to export minerals. Brokers' Licenses are issued to Tanzanians and are valid only for 15 months, on a renewable basis.

Private Dealers and Government Agency - Ghana: In Ghana, the law allows minerals to be traded through PMMC and private dealers. The small-scale gold mining law of 1989 allows the Minister in consultation with the Minerals Commission to provide licence to any person he may consider fit, to buy and deal in any type and form of gold. On the other hand, PMMC buys gold from licensed agents who get their supplies directly from the small-scale miners. Miners can also sell their gold directly to PMMC through its branches.

Gemstone auctions - Tanzania: One of the mineral policy objectives in Tanzania is "to promote and develop Tanzania as the gemstone centre of Africa". In pursuing this goal, the country, through the Ministry of Energy and Minerals and the Tanzania Mineral Dealers Association (TAMIDA), organizes open gemstone auctions, which bring together producers and buyers from all over the world. The auctions, which are organized once or twice a year, are usually conducted in Arusha. During auctions, miners bring their stones and display them openly for buyers to inspect and make bids. The forum also provides the Government with a good opportunity to collect its revenue directly as members of the Tanzania Revenue Authority are always present and monitoring all the sales.

Strategies/incentives to discourage illegal trading

Precious Minerals and Marketing Corporation (PMMC)-Ghana: Prior to regularization of the small-scale mining sector, gold was being sold to middlemen who in turn smuggled it out of the country in search of foreign exchange. The strategy adopted by PMMC in order to discourage illegal trading was to offer attractive prices that would lure miners away from the middlemen. The offered price was determined from the London A.M. Fix for gold for the day converted at the ruling Foreign Exchange Bureau rate of exchange of the day. Based on this, a minimum guaranteed price was announced weekly for 22-carat gold and it remained an assured price even if the world price for gold would fall. Prices for 18-24 carat gold were calculated on this basis and announced accordingly. In addition, the following incentives were also used to discourage illegal business:

- (a) Pre-financing selected licensed buying agents;
- (b) Procurement and supply of basic tools like weighing scales, shovels, pick axes, etc.; and
- (c) Institution of an Annual Award to honour the best small-scale miner in terms of quality and value of minerals sold to PMMC.

Incentives to encourage value-adding practices

Fiscal incentives for export of cut gemstones - Tanzania: Tanzania encourages the exportation of cut gemstones through removal of duty, which is otherwise paid for exporting raw gemstones. In addition, lapidary equipment is exempted from import duties. This has encouraged the establishment of lapidaries by most gemstone dealers and the number has increased from 5 in 1996 to 32 in 1999, (Phillips et al., 2001).

Mineral export procedures for producers and dealers

Unrestricted export by producers and dealers - Tanzania: All legal mineral producers, i.e., holders of mineral rights, are entitled to export their minerals without any questions asked. The only requirement is to inform the Commissioner for Mineral Resources of the amount being exported. In this regard, a special form is filled and one is issued with an export permit, which has to be presented to customs officials at the time of export. The permit can be obtained on the same day and it can be processed at any regional mine office. Regional mines officers are empowered to verify and seal any parcel due for export and to issue an export permit on behalf of the Commissioner.

However, exporters of gemstones are required to declare an estimated value of the stones being exported, for calculating the duty to be paid. After the sale, invoices should then be used to adjust the actual duty that should be paid. Exporters are allowed to request for compensation where the value of sales was less than that declared and vice versa.

The Department of Mineral Resources now acts as a “one stop-shop” for exporters of minerals so that one does not have to run between the central bank, customs offices and other government institutions looking for all kinds of permits. All the papers required by these agencies are kept in the Department, which is also responsible for sending them back as a matter of information. All that the customs officials at the point of exit (port or airport) need to see, for example, is the export permit and a package containing a Government seal.

Value-adding industry

Almost all countries with SSM production of precious minerals have some form of value-adding industry. Walking around the streets of the capitals of Ethiopia, Ghana, Tanzania, Zambia, Zimbabwe and other precious minerals

producers, one can see endless chains of jewellery shops selling products made from locally produced minerals. However, most of these do not meet the standards of the lucrative international jewellery market and they are simply initiatives of local entrepreneurs. What are recorded as best practices here are the initiatives of government or non-governmental agencies to build capacity for developing a value-adding industry that can compete at international level.

PMMC - Ghana: In addition to purchasing and exporting gold and diamonds, PMMC is also engaged in the jewellery business. This is in line with the Government's policy on local value addition of minerals. PMMC refines gold and cuts diamonds to manufacture jewellery mainly in traditional Ghanaian and African designs/motifs, e.g., designs of "Adinkra" symbols and in other African motifs in 14-karat and 18-karat gold. Gold jewellery in 20, 21 or 22-karat and in other designs can be made on request. The corporation runs an exclusive jewellery show room and shop for refined jewellery made of Ghanaian gold and diamonds. In order to expand its business, the corporation is looking to market its jewellery abroad through distributorship, agency or joint ventures.

Arusha Gemstone Carving Centre - Tanzania (MEM, 2002): The Government of Tanzania is building a gemstone centre whose primary objective is to equip Tanzania nationals with lapidary and stone-carving skills so as to add value to gem-mineral products. The centre, which is being built in Arusha, will operate as a joint venture between the Government and a selected private consultant. The joint venture arrangement will see the government shares reduced from 80% at the beginning of the operation to 20% in its third year. The initial 80% share of the Government consists of:

- (a) Buildings;
- (b) Equipment, materials and installation costs; and
- (c) Initial operating costs and salaries for employees.

The private consultant will provide expertise for training, selection and fabrication of equipment. The consultant will also be responsible for identifying and selecting personnel to establish and run the centre. The running cost borne by the Government in the first year will be progressively reduced as the centre begins to operate commercially. During the second year, the share holding is expected to be 50/50 between the Government and the consultant. In the third year, the Government may sell its share to the public.

SEAMIC - Tanzania: In addition to providing training, SEAMIC carries out pilot manufacturing of ceramic and other prototypes using a wide range of non-metallic mineral compositions made from a range of industrial minerals found in the area. The industrial minerals laboratories have equipment suitable for bench-scale product development with pilot-scale facilities for body forming and

determination of firing characteristics. These facilities allow the centre to formulate ceramic bodies and glazes for sanitary ware, tableware and low-tension electrical insulators including production of their prototypes.

3.2.6. Institutional capacity

In most countries, the capacity to oversee the small-scale sector is limited, particularly because of lack of financial and human resources especially qualified and experienced personnel. Some best practices worth mentioning include:

Minerals Commission - Ghana: The Minerals Commission was established under the “Minerals Commission Law, 1986” with the responsibility for regulation and management of the mineral resources sector of Ghana. The commission is also responsible for co-ordination of policies for all minerals in the country, which makes it the main promotional and regulatory agency in the mineral sector. The commission functions through a secretariat and consists of six departments, namely:

- (a) Planning and Policy Analysis;
- (b) Monitoring and Evaluation;
- (c) Finance;
- (d) Marketing and Research;
- (e) Personnel and Administration; and
- (f) Legal and Small-scale Mining.

In 1989, the commission launched a SSM project aimed at administering the mining law and providing technical and marketing assistance to small-scale miners. Under the project, the commission established eight district mining centres in the southern part of the country, each staffed with a Mining Engineer (as Project employee) and a Mines Inspector (from the Department of Mines). The centres were responsible for registering claims and providing technical assistance to local mines. The commission also established a mining centre in Tarkwa, with facilities for training, demonstration and administration. The district mining centres also house PMMC offices.

To meet its financial requirements, the commission is allowed to receive grants, loans, gifts and funds from any other source as well as any money accruing to it from its activities or investments.

Mineral Resources Division (MRD) - Tanzania: The Mining Department of the Mineral Resources Division of the Ministry of Energy and Mines of Tanzania is directly responsible for the day-to-day management of the small-scale mining sector. In order to accomplish its activities, the MRD has established a very extensive network of mining offices in all mining regions across the country.

The country has been divided into 11 zones, and depending on the level of activities in each zone, a number of district offices are established. For example, the Lake Victoria Goldfields, which is the most active mining region in the country, has two zonal offices, in Mwanza and Shinyanga (160km from each other) and five district offices (three for Mwanza and two for Shinyanga). The five district offices are the busiest in the country and collect most of the government revenue.

Other closely monitored areas are the gemstone mining areas of Arusha, which is a zone in itself, and Tanga, which is a district office reporting to the Eastern zonal office located in Dar-es-Salaam. Licence applications for small-scale miners can be submitted to any zonal or district office and are issued by the zonal mines officer. As the network of offices can be adjusted in accordance to changing intensity of activities, (e.g., there were 8 zonal offices in 1998 compared to 11 to date), the current set-up looks adequate to properly manage the sector.

MRD derives its financial resources from its annual budget allocation, but more important from retentions of collection of royalties, mineral rights annual rents, fees for preparation of mineral rights and any other revenue collected directly by regional and district offices.

Ministry of Mines and Minerals Development - Zambia: The Ministry of Mines and Minerals Development consists of three departments, namely, Geological Survey, Mines Development and Mines Safety. In the past, the structure of the Ministry was geared to meeting the needs of the large-scale mining sector. Now, the new structure also aims at reaching small-scale miners in the major mining centres of the country. In order to achieve this, the Mines Development Department has been subdivided into regional bureaux located in strategically selected districts near major mining areas. The department has the main co-ordination and operation office in Lusaka City, from where monitoring of mining operations in central and parts of western and southern provinces is also carried out.

Department of Minerals Development and Energy - South Africa: The Department of Minerals and Energy (DME) has regional offices in all the nine provinces of the Republic of South Africa. All regional offices have a Director for Minerals Development who is responsible for prospecting and mining authorizations. The offices in Klerksdorp and Kimberley have sub-offices in Mmabatho and Springbok, thus making a total of 11 regional DME offices. In order to enhance SSM development, the DME has created the National Small-Scale Mining Development Framework. The Directors for Minerals Development in the relevant regional offices are responsible for the administration of the framework.

A National Steering Committee of Services Providers (NSC) was established to provide technical, managerial and financial support to small-scale mining

projects. The NSC is made up of parastatal institutions including the Council for Geosciences, the Industrial Development Corporation, Khula Enterprise Finance, Minerals and Energy Policy Centre, CSIR-Miningtek, Ntsika Enterprise Promotion, MINTEK and the South African Diamond Board. The work of the Committee is co-ordinated by a Secretariat at DME.

Mintek has a Small-scale Mining division that assists SSMs to make their projects viable. Its policy is to develop rural communities and therefore a lot of emphasis is placed on beneficiation and added value. This division is mainly funded from various State grants. The European Union through Godisa has funded a non-profit making, section 21 company called Zenzele Technology Demonstration Centre. This company assists SSMs by demonstrating the viability of their projects; they handle about 36 projects each year.

Small-scale miners' organizations

Small-scale miners associations, unions and cooperatives can be effective as lobby groups, giving voice and representation to miners when dealing with the Government and handling issues of mutual interest, e.g., security, training, mobilizing infrastructural support and other socio-economic issues. The provision of assistance to the sector can be easily mobilized through the miners' organizations rather than through individual groups. However, lack of trust in leaders, coupled with poor financial resources and lack of managerial skills, make most small-scale miners associations ineffective. There are a few good examples of effective associations that are contributing to the development of the sector. These include:

The National Miners' Association - Zimbabwe: The National Miners' Association (formerly The Small-Scale Miners Association of Zimbabwe), has a membership of 5000 miners (Svotwa, 2000) which is less than 2% of the total estimated number of small-scale miners in Zimbabwe (350,000). Despite the small membership, the association has been very active in mobilizing and conducting activities aimed at benefiting its members and industry as a whole. The main contributions of this association include its participation in the development of the Shamva Mining Centre. The association is the official owner of the centre and oversees the management of its operations.

In addition, it has been able to mobilize and organize training programmes for its members and beyond. A good example is the training programme, which was organized in 1991 in collaboration with the Zimbabwe Geological Survey Department and funded by DFID. A more recent example of the effectiveness of the association was the mobilization of funding from GTZ for the Insiza gold panners project, which provides training, demonstrates the use of efficient technology and advises on the rehabilitation of mined areas.

Ngezi Small-scale Miners' Cooperative - Zimbabwe: Zimbabwe has about 100 registered mining cooperatives with a total membership between 4000 - 5000 miners. Although most have performed poorly due to lack of management skills, others like the Ngezi Small-scale Miners' Cooperative have done well. About 100 miners, former employees of a chromite company that went out of business, established the Ngezi cooperative. The cooperative applied and acquired mining claims and started extracting the ore through pig-rooting mining methods. Slowly, the group advanced to a stage where they were able to acquire equipment like compressors, percussion drills, a portable explosives magazine and a large articulated vehicle and trailer. Having acquired the claims over an area originally owned by their former employees, the cooperative benefited from the infrastructure that was left behind which included a school, clinic, running water, ablution blocks, mine road network and a large number of thatched huts. With the help of the Mining Department, the cooperative secured a loan of Z \$ 15,000 from the Zimbabwe Mining Development Corporation to develop a small-scale formal underground chromite mine. Advisory and extension services were provided by the Mining Department.

Having secured a market with smelting companies (Union Carbide), the cooperative started a monthly production of about 200 tons of clean, high-quality chrome, 16 months after commencement of operations. Ten members of the cooperative were trained in most of the underground mining operations during the mine construction phase. The success story of the Ngezi cooperative attracted more people to chrome mining and nearly 2000 people are now involved in the production of chrome in Gweru and Kwekwe. The chrome is sold to Anglo American and Union Carbide, respectively.

The Ntuthuko-Blaaubosch Mining Trust - South Africa: With the help of the Department of Minerals and Energy, a group of about 110 brick-making, small-scale miners in Osizweni township (located to the east of Newcastle in northern Kwazulu-Natal) constituted themselves into the Ntuthuko-Blaaubosch Mining Trust with a board of 15 Trustees. The Trust then signed an agreement with the NSC with the aim of promoting the Osizweni brick-making operation as an NSC pilot project.

The people of Osizweni have been mining clay at a subsistence level for over thirty years in support of a community of about 2,300 people. The new business will be owned by the Trust, which, in turn, will employ some, if not all the members. The project is being relocated to a new area because the current site has been overworked and can no longer sustain the operation. Fortunately, AMCOAL, who owns the mining rights to the adjacent site, has consented to its use for brick making by the Trust.

3.2.7. Access to credit and finance

In an ILO survey in 1999, small-scale miners identified access to credit as a major obstacle to successful development of the sector. The following are some good examples of programmes initiated to address the problem:

Loan-based financing schemes

This category includes funds that can be accessed through loans from special Government schemes, financial institutions, and other lending institutions.

Government supported loan schemes - Zimbabwe: The Government of Zimbabwe has, over the years, implemented a number of support programmes aimed at promoting the development of the SSM sector. Some of these support programmes include loan financial schemes as detailed below (Svotwa, 2000):

Loans to purchase mines: Immediately after independence, the white owners, who did not trust the new regime and decided to emigrate to South Africa and other countries, closed a number of small-scale formal mines. The new Government provided loans limited to \$Z25, 000 each, exclusive of the cost of plant and machinery at the mine, to enable new owners to purchase the mines. Repayment was over five years with a fixed interest rate of 9% per annum.

Loans to develop mines: This is aimed at developing new mining projects and covers costs for sinking of shafts, and raising or developing a reef. This loan can be written off if the work fails to expose workable ore.

Loans to set up extractive plants: This loan also provides assistance to new mining projects through provision of cash to cover up to 6 months operating costs with the aim of bringing the mine into profitable production.

Out-of-hand emergency loans: This is a loan of up to \$Z4, 000 (nominal terms) that is made available by the District Advisory (Mining) Board and is repayable within one year. It is aimed at addressing any emergency that can bring a mining project to a halt.

Mining Industry Loan Fund (MILF) - Zimbabwe: The Zimbabwe Ministry of Mines, Environment and Tourism created the Mining Industry Loan Fund (MILF) in order to assist small-scale miners, (Drechsler, 2001). The fund, which is administered by the Mining Affairs Board (MAB), amounts to around \$Z 2 million a year.

The establishment of a large number of small-scale formal mines in Zimbabwe is credited to these financial schemes, as well as to the overall assistance offered through hire/purchase schemes and extension services. Although most of these schemes are currently not operational due to the economic difficulties affecting the country, they nevertheless represented best practices in addressing the issue of shortage of finance by small-scale miners.

The Fundo de Fomento Mineiro (FFM) - Mozambique (Drechsler, 2001):

The FFM is a mining development fund set up by the Government of Mozambique to help small-scale miners gain access to finance. Applications for funds have to be made to the president of the FFM, with details of the project attached and the intended usage of the funds. For example, if the funds are required for the purchase of equipment, price quotations from the suppliers must be attached. In addition, the following is also required:

- (a) Copy of the mining licence;
- (b) Feasibility study of the project;
- (c) Proof of availability of a collateral representing 20% of the amount requested;
- (d) Guarantees in properties equivalent to the requested amount (mortgage);
- (e) Plan of payback of the credit; and
- (f) Proof of market for the product to be mined.

Financing by the National Steering Committee of Service Providers (NSC) - South Africa:

Under the South African framework for SSM development, the NSC is responsible for provision of technical, managerial and financial support to selected small-scale mining projects. Two departments of the Ministry of Trade and Industry, which are members of the committee, provide financial assistance, (i.e., Khula - which provides loans and Ntsika-which provides services in kind such as training and capacity building). Another member of the committee, the Industrial Development Corporation (IDC), provides commercial bank loans. Once a pilot project has been identified, a business plan is prepared and then submitted to IDC for evaluation. If approved, IDC grants 90% of the loan and the project promoters (usually in the form of a co-operative) are responsible for raising the remaining 10%. A number of projects across the country have already benefited from this arrangement.

Equity-based financial schemes

This group includes financing that can be accessed through joint venture partnerships, venture capital funds, investment banks, unit trust or mutual funds, stock exchanges and others risk sharing schemes. These funds impose similar conditions to those demanded by commercial banks for a bankable project. Such conditionalities make access to these funds by small-scale miners difficult. However, there are a few instances where small-scale miners have been able to access these funds successfully. These include:

Joint ventures - The Mwaca Amethyst Project - Zambia (SADC, 1999): The Amethyst Project is located in the Mapatizya area in Kalomo, Zambia. In order to fund the project, the project promoters approached HIFAB International, a

Swedish donor agency. HIFAB agreed to give the project a loan on condition that they agree to go into joint venture with a Swedish partner. On establishment of a joint venture company with 50/50 equity split between the two partners, a loan of \$ US 50,000 was advanced to the Zambian registered company and the Swedish partner raised equity capital of the same amount.

The company then employed a qualified gemmologist and embarked on a vigorous campaign of finding markets for their amethyst production. This has resulted in the establishment of business relationships with amethyst buyers in Tucson, Arizona (USA), Jaipur in India, South Africa and Hong Kong. The company is now struggling to meet the high market demand that has emerged for their products, which now include the Zebra Amethyst (highly marketable in Hong Kong). The project is currently seeking additional funding to purchase equipment that will enable them to meet the new market demands.

Equity sharing - The Zinc Tailings Recovery Project - Sable Zinc Kabwe Ltd., Zambia (SADC, 1999): Some 15 ex-miners of the defunct Kabwe Division of the Zambia Consolidated Copper Mines Ltd. formed a company named Kabwe Power and Metals Ltd. (KPM), and acquired 6 million tons of tailings rich in zinc and lead. In addition, the company acquired metallurgical plants consisting of a concentrator; leach plant, waelz kilns, a char plant and offices. KPM consulted the Commonwealth Development Corporation (CDC) venture capital subsidiary for financing. A joint venture company, Sable Zinc Kabwe Ltd. (SZK) was formed between KPM and CDC. In order to run the operations efficiently, a technical partner with experience in the processing of zinc was sought on agreement for equity sharing. The equity in the project was then shared 40% to CDC, 40% to the technical partner and 20% for KPM (15 miners). This arrangement has enabled the company to raise funds required to rehabilitate the plant. The company is now planning to raise production from the current 500 tons/year to 5,000 tons/year of zinc.

The project, which employs about 100 people, raised a total of \$ US 3.4 million with \$3 million being capital investment and the rest working capital. The 15 miners that started the project contend that it is better to own 20% of an efficiently operating project than 100% of a limping one.

Hire/purchase schemes

Plant hire/purchase scheme - Zimbabwe: The scheme is administered by the Chief Government Mining Engineer and enables small-scale miners to acquire mining and metallurgical equipment on condition that they present a sound mining proposal. Once the proposal is approved, the payback period is set at 1 to 3 years at 10% interest per annum. The payback period is fixed according to the value of the equipment, i.e., 12 months for equipment for low-cost items (up to \$Z300), 24 months for items costing up to \$Z600 and 36 months for equipment valued above \$Z600.

Financing through cooperation between small- and large-scale miners

Dumpco Project - South Africa: This is a diamond tailings re-treatment project which is owned by 36 members of the Dumpco Trust. This is constituted by ex-employees of De Beers who were retrenched in 1992. De Beers and the National Union of Mineworkers (NUM) Retrenchment Fund extended a R1.2 million interest-free loan with a payback period of 4 years. Despite having adequate financing to invest in heavy equipment, the project makes deliberate efforts to maximize employment by using labour-intensive techniques. For example, instead of using front-end-loaders, tailings are loaded and hauled manually using wheelbarrows. The tailings are transported from 6km away at Beaconsfield, where they have been deposited for nearly a century, and De Beers pays the Trust for each ton removed.

The project treats 439 tons per day to produce an average of 6 - 8 carats per 100 tons. They have occasionally managed to produce about 75 carats per day. The Trust has reached an agreement with De Beers that allows them to operate within De Beers' claims. This arrangement entitles the Trust to up to 50% of the profits. Every member gets paid an equal salary of R2000 per month and at the end of the year, 75% of the profits are shared among trustees as dividends. With tailings dumps of more than 20 million tons, the project life looks indefinite.

Buyer credit schemes

Meremeta Gold Buying Schemes - Tanzania: Meremeta is a 50/50 joint venture company formed in 1998 between the Government of Tanzania and Trienex, a South African company. The main objective of the company is to provide assistance to small-scale miners and market their gold. The operation includes:

- (a) Provision of equipment such as pumps, compressors and drilling equipment;
- (b) Installation of custom grinding equipment, which miners use for grinding and processing ore; and
- (c) Buying gold directly from the miners at a 20% reduced price to cover the cost of grinding with no questions asked about the source.

Given the lack of access to finance and equipment that affect small-scale miners, the scheme was popular and expanded to nearby districts although at a much slower rate than anticipated. The scheme also attracted other local entrepreneurs who brought in their own locally made grinding mills, which run on engines of tractors and lorries. These entrepreneurs pose stiff competition to Meremeta despite the fact that they apply a fixed charge per kilogramme of ore ground.

3.2.8. Technical assistance programmes

Specific technical assistance programmes

The National Steering Committee of Service Providers (NSC) - South Africa: Individual members of NSC contribute towards the development of the sector according to their areas of expertise. For example, the Council for Geosciences is responsible for conducting geological surveys for identified pilot projects, the outcome of which is then incorporated into the overall business plan. The Council for Scientific and Industrial Research (CSIR) through its Miningtek branch has the responsibility to develop mine plans and the technology to be deployed.

Mintek is responsible for the processing of the mined ore and for adding value to the product. Examples of this are fine milling of mica, manufacturing bricks, leaching of copper oxide ore and cementing out copper metal to manufacture curios, making pottery rather than just selling the clay, etc. Other members of the committee, MEPC, Ntsika and Industrial Development Corporation then take on the organizational development, training and marketing aspects of the project.

Technical Extension Services - Zimbabwe: The Ministry responsible for mining through the departments of Mines, Geological Survey and Metallurgy offers free technical advisory services to small-scale miners in Zimbabwe. The services are provided through a network of regional mine offices located across the country. There are also sub-offices or district offices depending on the size and level of activities in a particular region. The regional offices each have a regional geologist, mining engineer, metallurgist and a mining commissioner. The services include geological surveys, assaying, advice on mining techniques and other technical services.

Special units for provision of extension services

These include the Small-scale Mining Department of the Minerals Commission in Ghana and the Small-scale Mining Unit of the Mineral Resources Division in Tanzania.

Specialized training institutions

Zimbabwe School of Mines - Bulawayo: The school offers two-year diploma courses in mining engineering, surveying and metallurgy.

Madini Institute - Tanzania: The Madini Institute is located in Dodoma, Tanzania and trains mining technicians most of whom are absorbed by the regional and district mines offices and the private sector. The Institute, which has recently been upgraded to provide training leading to a full technician's certificate, is to be converted into a specialized Government agency.

Vocational Education Training Authority Institute - Tanzania: The Vocational Education Training Authority (VETA) in Tanzania runs vocational technical training through training institutes located in almost all regions of the

country. The training usually targets primary and secondary school leavers. As part of its expansion programmes aimed at reaching all the important sectors of the economy, the Authority has secured a loan from the East African Development Bank to build a full-fledged mining vocational training institute in Shinyanga.

3.2.9 Women in mining

Although provisions prohibiting women from working in mines are slowly disappearing, women still face a multitude of obstacles in their bid to participate fully in small-scale mining activities. However, there are already efforts in some countries to provide equal opportunities for women miners. The practices below represent a sample of such initiatives:

Addressing women issues in mining policies

The Mineral Policy of Tanzania - Women and Children Issues: “The Mineral Policy of Tanzania, 1997” recognized the social problems that evolve in the process of developing mining projects, especially those that limit effective participation of women and those that lead to the premature introduction of children to the harsh conditions of mining. In the case of women, the policy aims to alleviate barriers that limit their participation in mining by encouraging their employment and making other participants aware of the need to provide them with equal opportunities.

Women Miners Associations

SADC Women in Mining Trust - Zambia: The Trust was formed in 1997 as a regional association in order to promote networking at a regional level. The Trust has been instrumental in the formation of a number of women miners’ associations in the region and in mainstreaming gender.

Tanzania Women Miners Association (TAWOMA): TAWOMA was formed in 1997 at the initiative of women miners. The association has 192 members and headquarters in Dar-es-Salaam (August 2001). It has established branches in almost all major mining centres in the country. Its mission is “to facilitate women miners to organize and access required financial, technical and marketing services so that they can carry out mining activities that are both economically and commercially viable and environmentally sustainable and thereby raise the standard of living for women miners and their families”. The goals of the association are to:

- (a) Lobby for support of women miners nationally, regionally and internationally;
- (b) Identify training and technical needs and organize resources to meet them;
- (c) Provide relevant marketing information and facilitate minerals marketing;
- (d) Set up a revolving fund to enable women access funding; and
- (e) Serve as an advocate for women in mining to the Government.

The association has, amongst its priorities, the establishment of a gem-cutting unit and a resource and information centre. Over the long-term, it plans to establish equipment-hire, a testing-centre, lapidary and jewellery production units and a skills training-centre. TAWOMA is a member of the SADC Women in Mining Trust.

Specific programmes to support women miners

Assistance to women miners - South Africa: A group of rural, small-scale women miners have been mining kaolin from the mountainside in Nwdedwe, Kwa Zulu Natal. The kaolin is mostly sold through intermediaries to the pharmaceutical, cosmetics and pottery sectors within the local community. The miners managed to secure assistance from NSC to develop a business plan to ensure that the project operated within the legal framework and that it produced a product that would attract potential customers. NSC also agreed to assist in providing technical backup, including drilling, ore body assessment and others. Eskom (South African Electricity Commission) agreed to provide a new site for the project and facilitate market access.

SAWIMA Alluvial Diamond Project - South Africa: A group of women who are members of the South African Women-in-Mining Association (SAWIMA), own a diamond claim in Lichtenberg Area in Northwest Province. Their claim is in close proximity to another claim, which belongs to a prominent local family (the Visser family). SAWIMA mobilized assistance from the office of the Regional Commissioner, the Department of Energy Affairs for North West Province and the Visser family, to secure access to heavy equipment for mining activities.

For example, it was agreed that a front-end loader could help in digging the diamond-bearing gravel after which the women would carry out panning, washing and sorting. The Visser family operates a fairly large operation employing nearly 50 people operating 2 front-end loaders, 4 pans with throughput of 150 tons per hour and 1 excavator. Given the small volume of production from the SAWIMA project, there is no conflict of interest, especially in the use of equipment.

3.2.10 Child labour

The employment of children in SSM is very common in most countries in Africa. Young children break rocks manually and work underground in poor health and safety conditions. There are already efforts being made by a number of countries to eliminate this problem. The following are examples of such best practices.

Addressing child labour issues in mining policies

The Mineral Policy of Tanzania - Women and Children Issues: Part of the mining policy strategies aim to address social problems that lead to children being employed and thus exposed to harsh mining conditions at tender ages.

Whilst enacting and enforcing regulations and stiff penalties against the practice, the policy also aims to provide alternatives as a way of addressing poverty problems that lead to the practice in the first place.

Child labour elimination

International Programme on Elimination of Child Labour (IPEC) - ILO: ILO launched the International Programme on the Elimination of Child Labour (IPEC) in 1992, with funding from 17 industrialized countries and the European Commission (ILO, 1998). IPEC is part of a direct intervention strategy in combating child labour. Other approaches include legal and market-based initiatives. The SSM aspect of the programme, which is being implemented in Africa, Asia and Latin America, has already initiated gathering of sound data on the extent and nature of child labour in Madagascar and Burkina Faso. In Tanzania, the programme has been sensitizing all those concerned with child labour and supporting the withdrawal of children from mining areas.

3.2.11 Research and development

There are a number of initiatives to research and develop technologies that are amenable to SSM working conditions. Most of the work, however, has had little impact. Very few initiatives have adopted a participatory and long-term, impact-oriented approach. Such approaches include collaboration with small-scale miners in data gathering, field testing and commissioning of the product. However, the following projects are worth noting:

Small-scale Mining and Processing Technologies - MINTEK, South Africa (Guest, 2002): - MINTEK of South Africa is developing a number of processes and equipment for application in the SSM sector. Some of the technologies include the following:

- (a) The iGoli mercury-free gold extraction process: The iGoli process is a gold-recovery technique that has been developed at MINTEK to eliminate the use of mercury by small-scale miners. The process, which was launched in March 2001, makes use of simple household chemicals such as pool acid (HCl) and bleach (NaOCl) to dissolve the gold. This is followed by filtration and gold precipitation with sodium meta-bisulphate. In order to reduce the possibility of accidents with acids, MINTEK has developed a training programme for miners. At least one miner from a given small-scale mining community would be trained by MINTEK at their laboratories so that he/she can train other miners back in the community.

The training course includes practical test work, a visit to a small operating mine, engineering design drawings for the manufacture of strakes and a

simple booklet giving details of the process. According to MINTEK, this new chlorine leaching technology has already been tested with small-scale miners in Tanzania where recovery of gold of up to 99.9% purity was achieved.

- (b) Electricity-free processing equipment: Some equipment is being developed for small-scale miners who have no access to power. One such example is the development of strakes, which are already in use with the MINTEK iGoli process. In order to recover fine gold, strakes need to be vibrated. More research work is underway to develop ways of vibrating the strakes without using electricity.
- (c) Efficient comminution techniques: The application of conventional ball mills in the grinding of ore leads to loss of gold behind the liners. Old-fashioned stamp mills, which were designed to crush and grind, do not suffer from such a problem. As such, research is being conducted to look at the application of centrifugal forces to increase recovery or develop a more simplified comminution system.

Mercury-free recovery of gold - University of Dar-es-Salaam, Tanzania (UDSM, 2002) and Imperial College, London (Pratt, 2002): This research project aims at developing an appropriate, simple, robust and effective non-polluting gold recovery technique that can replace amalgamation. The method being proposed is based on the Coal Gold Agglomeration (CGA) process developed by British Petroleum (BP) in the 1980s as an outcome of studies on the formation of spherical coal-oil agglomerates as a means of recovering coal fines. The process was then successfully developed further as an alternative to the traditional cyanidation process for large-scale plants due to increasing environmental concerns. In 1994, the Centre successfully tested the process for SSM application for mineral technology in Brazil.

The project is still in its initial stage. Test work conducted at the University of Dar-es-Salaam in Tanzania has established parameters linked with agglomeration size distribution and the requirements for the initial rate of agglomeration. By using locally produced coal and light gas (diesel) on one hand and then coal and kerosene on the other, different process parameters of agglomeration, were established. Tests on gold recovery were carried out using a synthetic mixture (Graphite-ESCAID agglomerate) and recoveries of up to 99.8% (reproducible) were achieved. In tests using coal-diesel agglomerates (20% agglomerates to ore ratio), recoveries of between 99.1 - 99.8% (100% reproducible) were achieved. In order to study the process parameters further, more tests on gold recovery using coal-diesel agglomerates with both synthetic and natural ore will be conducted. This will lead to development of a pilot plant designed according to the established optimum parameters.

Improved Gold Recovery Project - British Geological Survey/Intermediate Technology Development Group (ITDG) - Zimbabwe (Styles, 2002): This project being carried out in Guyana and Zimbabwe aims at developing techniques for improved gold recovery and achieving environmentally friendly SSM practices, by paying particular attention to resistance to change. Following field visits and desk reviews, it was concluded that improved gold recoveries could be achieved with the use of more efficient sluice boxes. The Zimbabwean branch of ITDG designed such sluice boxes and tested and distributed them in small numbers to mining groups for long-term assessment of their quality. The initial reactions from these groups are good.

Mercury-free gold recovery - Tarkwa School of Mines²⁵, (University of Science and Technology-Kumai), Ghana (Sackey, 2002): The technology was developed with funding from the United States Agency for International Development (USAID), in collaboration with a SSM community in Dompim, near Tarkwa - a major mining town in Ghana. Although lack of further funding has hampered efforts for the countrywide testing and dissemination of the technology, a cross-section of small-scale miners in the Tarkwa area are successfully using the technology to win gold from their concentrates. The technology is based on the following:

- The gold ore is finely ground, water is added to the ground material to form a slurry which is then washed and concentrated by using a sluice box;
- The sluice box matting is removed and cleansed to dislodge gold and other heavy minerals trapped in it;
- The collected sluice box concentrate is upgraded further by panning;
- The concentrate collected from panning (heavy mineral black sands and gold) is then dried;
- The dried concentrate is spread on clean paper or cardboard from where it is blown gently whilst a small brush is used to sweep aside gold particles from the heavier black sand;
- Blowing and brushing is continued until complete separation between gold and the black sand is achieved; and
- Gold is smelted and sold.

3.2.12 Co-operation between small and large-scale miners

The relationship between large and small-scale miners is usually of a suspicious nature, to the detriment of both groups. Large-scale operators regard small-scale mining as being synonymous to illegal mining and small-scale miners accuse large companies of denying them access to potential mineral resources by tying up large

tracts of land. It is now increasingly recognized, even at the highest level (see Box 3), that there is scope for mutually advantageous co-operation between the two groups. Such co-operation creates a conducive mining environment for large-scale companies and it allows small-scale miners access to appropriate technology, markets and training. In this regard, best practices have been documented in:

Ingwe Coal Mining Company - South Africa (ILO, 1999): The Ingwe Coal Mining Company leased a small area that was unsuitable for large-scale underground mining to a small-scale mining company, Kuyasa which belongs to a group of ex-workers. Ingwe provided bridging finance and has also agreed to buy all the coal produced by Kuyasa. Kuyasa pays royalty to Ingwe who is the owner of the mine lease. The loan is being paid through a fee on its production.

Sadiola Gold Mining Project - Mali (Keita, 2002): As part of the expansion of the AngloGold mine in Sadiola, Mali, villagers of Sadiola and Farabakouta had to be relocated to new sites in order to limit the negative impact of the mine expansion on the local communities. A support project was instigated by AngloGold Mining Company to promote orderly artisanal mining and develop sustainable revenue-generating activities. The project, which is located almost 250 km from Bamako in the West part of Mali, covers the villages of Sadiola, Farabakouta, Medina and Neteko and includes a gold mining population of nearly 300 miners.

The project started with identification of the strengths and weaknesses of the existing artisanal mining activities. In addition to the 300 members of the cooperative, consultations were also carried out with other socio-economic groups to identify alternative revenue-generating activities. Other activities included working with local NGOs to identify potential partners; geological evaluation of the Farabakouta deposit; identification and testing of mining equipment and establishment of a communal development fund based on a monthly budget of US\$ 5,000.00. Furthermore, in the operational stage, geologists from AngloGold provided technical assistance to the miners in terms of alluvial and underground mining and extraction techniques, operation and maintenance of equipment, security measures and rehabilitation of mined sites. The socio-economic activities include:

- Encouraging market gardening, and fabrication of dyes and soaps by women groups;
- Initiating fruit-tree planting and fish farming as part of the rehabilitation of mined areas;
- Organization and management of grain banks and communal stores;
- Providing financial support to small projects such as bakeries, rural restaurants, woodwork shops, jewellers, and metalwork shops (64 loans were provided and 15 local enterprises were created);
- Supporting the construction and organization of a communal market;

- Construction and organization of a rural school and a learning centre for adults; and
- Providing support for construction and running of a communal health centre.

Communities around Sadiola Gold Mining project have achieved 60% of school enrolment and 80% of vaccination of local children, a comparatively good achievement in relation to other rural communities in Mali.

Box 3: Extracts of the Speech by the President of the United Republic of Tanzania, His Excellency Benjamin William Mkapa at the Inauguration of Bulyanhulu Gold Mine, Kahama, 18th July 2001

These important social and community programmes form a solid foundation for increased mutual understanding and trust between the mining companies and local communities and, therefore, make the new mines more socially and politically acceptable in the areas they are in. I urge you to continue fostering the systematic integration of mining projects into local communities, by establishing supportive relationships for harmonious coexistence and improvement of rural life and economic diversification.

In this regard, I urge mining companies to work closely with district councils to plan and identify social, infrastructural and community programmes, which when financed by the mining companies or jointly, will have the intended impact. For instance, companies could assist communities located along a water pipe line to establish well-planned villages and other infrastructure, and support various self-development initiatives planned and owned by the people themselves. Another area where the people of Tanzania can expect to benefit from the incoming investments in the mining sector is job creation, skills development and opportunity to provide auxiliary services and consumer goods to the mines.

I wish to emphasize the need to ensure that whenever trained and qualified personnel are available locally you should accord them preference.

Let me also remind the mining community in Tanzania that our mineral policy recognizes the positive contribution to the economy of both large and small-scale miners. Mining companies should, therefore, not forget that they are operating amongst local communities with small-scale miners whose livelihoods depend on mining. It should be helpful, and indeed it should be the goal of each large-scale mining operation, to foster relations of constructive co-operation and partnership with small-scale miners. I urge you to assist Government's efforts to transform and rationalise them into an organised, modern and environmentally sound mining sub-sector.

4

Success Factors

Individually, the best practices selected in this compendium may have positively contributed to the improvement of specific processes. However, overall the small-scale mining sector in the countries described in the compendium is still beset with serious problems. Even where some practices could have had a long-term impact, because of poor institutional effectiveness and capacity, as well as limited funding, they could not be sustained overtime. Furthermore, some initiatives were ad-hoc in nature and not part of a comprehensive plan to promote small-scale mining.

The problem is further compounded because there has been poor understanding about the livelihoods of small-scale mining communities and, in many cases, cross-cutting issues (gender, environment, health, human and institutional capital creation, etc) and other social variables and community dynamics have not been considered in an integrated manner during the design and implementation of programmes to support the sector. There has been little consultation and participation at grass roots level in the process of promoting some of the practices. As a result, small-scale miners have not been empowered and do not have ownership of the processes.

For example, conceptually, the mining policy and legislation of Tanzania are good examples of best practices required for the development of the small-scale mining sector, at least on paper. The mining policy identifies all issues pertinent to the development of the sector. In addition, the legislation with its regulations has established an appropriate regulatory framework for the management of the sector. Notwithstanding, lack of adequate human resources and support infrastructure at local level to administer the system and to provide assistance to the miners, have, to a certain extent, rendered these laws and regulations less effective in practice.

In Ghana, despite the passing of the Small-scale Gold Mining Law in 1989, which legalised small-scale mining and the establishment of demonstration centres aimed at enabling miners to acquire training and access to technology, there are still serious problems affecting the sector. Trust among authorities, small-scale miners and large-scale operators is not always present and, as a result, land-use competition and disputes between large- and small-scale miners are ubiquitous. On the other hand, the demonstration centres established by government have not improved productivity of small-scale mining operations drastically and some have even closed-down. The provision of technical assistance to the miners, which was assigned to the Mines Department and to the Geological Survey Department, has been fraught due to financial constraints. To a certain extent, the same problems affected the Minerals Commission.

The Shamva mining centre in Zimbabwe, which was publicized as an example of what-to-do to facilitate access to appropriate technology and equipment and develop mining skills of small-scale miners, has failed to operate in a sustainable manner, due to hasty disengagement of its main funding agency, mismanagement and lack of institutional support.

The examples above illustrate how complex the small-scale mining sector is and how difficult it is to have practices that holistically contribute to development of the sector. Table 6 below is an attempt to identify the success factors that contribute to promoting sustainable SSM development. The importance of baseline studies to identify user needs and profile the sector (including identification of local socio-cultural traits) should not be underestimated. This should form the basis upon which any successful programme to develop the sector should be designed and launched.

Table 6: Success factors for SSM development

Main Area	Success Factors
Mining policy	<ul style="list-style-type: none"> · Baseline studies to identify user needs and profile the sector; · Simple and transparent licensing system for small-scale mining; · Applications for licenses are handled by district and regional offices; · Licensing system for minerals trading that is handled at the regional level; and · Simple environmental management regulations specific to small-scale miners.
Mining legislation	<ul style="list-style-type: none"> · Clear rules to access and use mineral rights and land; · Application of mineral rights within district and regional offices located within mining areas; · Issuance of mineral rights based on first-come-first served approach; · Small-scale mining licenses do not need the Minister's approval; · The all process takes between two weeks to four weeks; · Maintain the same mineral rights categories as those issued for the large-scale operators to make administration less cumbersome; · Maintaining a single system minimizes the pressure on human and financial resources; · A single system enables miners to acquire experience on mine project development; · Large concession sizes and long tenure periods allow easy access to finance and attract investors; · A system allowing transfer and mortgage of mineral rights allows miners to raise financing through outright sale, transfer of shares (in Joint ventures) or selling part of the mineral rights; · Designation of specific areas for small-scale mining allows easy management and enforcement of regulations; and · Decentralization of mineral rights allocation and administration allow the local government to participate in administration.
Technology	<ul style="list-style-type: none"> · Allocate adequate funding for centres of innovation and adaptation of (appropriate) technology; · Replicate tested models of equipment-hiring, pay-back or hire-to-pay schemes from other countries; · Programmes for promotion of efficient technology which enable miners to identify and operate them with the aim of improving productivity and hence earnings; · Technical training programmes: <ul style="list-style-type: none"> o Provide training to trainers to access more miners; o Raise awareness on the negative health and environmental issues; o Establish baseline data regarding mercury levels in miners, water, fish and sediments in the mining areas; · Develop mining methods that can be easily adopted to mine other minerals; · Application of equipment that: <ul style="list-style-type: none"> o Is simple in design and can be produced locally; o Use accessories, e.g., grinding media that are readily available; o Is mobile and easy to install and operate; o Is powered by small diesel engines (diesel is available in most mining areas); o Is cheap and can be afforded by individual miners; o Is efficient and have minimum environmental impacts; o Has low power consumption; · Utilize selective mining techniques that allow focusing on particular types and grade of ore; and · Apply methods that combine both manual and mechanized processing techniques.

Main Area	Success Factors
<p>Environmental management, health and safety</p>	<ul style="list-style-type: none"> · Health and safety legislation establishes control over distribution and trading of dangerous chemicals; · Legislation allows users to be known and hence can be easily monitored for compliance and assistance; · It allows data on the amount of chemicals entering the country, amount used and other relevant information to be accessed; · Legislation that leads to increased use of safe methods and reduction of health and environmental negative impacts. · Establishment of locally enforced safety security systems which allow miners to watch each other's mining practices to ensure that the set safety standards are adhered to; · Establishment of regulations that contribute to improved working relations between miners, authorities and their organizations; and · Regulations specific to small-scale mining operations.
<p>Minerals marketing</p>	<ul style="list-style-type: none"> · Simplified licensing of minerals marketing by processing applications at district and regional offices; · Monitoring is localized and more efficient; · Data collection is simplified as officers have to cover smaller areas within their jurisdictions; · Establishment of a "one-stop-shop" where mineral traders can easily access information and process their exports; · Establishment of a specialized body in minerals marketing that is capable of offering more specialized services to mineral traders; · Mineral rights holders do not require another license to market or export their minerals; · Establishment of gemstone auctions that: <ul style="list-style-type: none"> o Provide producers direct contact with international dealers; o Allow miners to gain experience of gemstones grading and evaluation through contact with experienced dealers; o Enable miners get access to information on international gemstone markets and pricing systems; o Accord Government a direct chance to collect revenue. · Develop strategies to curb illegal mineral trading so that: <ul style="list-style-type: none"> o Miners get good prices and hence have no incentives for trading illegally; · Establish gemstone cutting centres in order to: <ul style="list-style-type: none"> o Create jobs by training gemstone cutters and rock carvers; o Improve quality of the cut gemstones for export and thus earn more revenue; and o Promote local consumption of gemstone products through improved quality. · Providing continuous training to small-scale miners in gemmology and processing of industrial minerals.
<p>Institutional capacity</p>	<ul style="list-style-type: none"> · Establishment of offices that are close to major mining areas and that: <ul style="list-style-type: none"> o Are well-funded; o Can recruit adequate well-trained personnel; o Can collect revenue effectively and retain part of it for SSM activities; o Can provide extension services, monitor the activities of small-scale miners; and o Well-distributed and known by the end-users. · Create small-scale miners' organisations that: <ul style="list-style-type: none"> o Are the mouthpiece of small-scale miners in the country especially in handling negotiations with the Government, NGO and the donor community; and o Can mobilize assistance to small-scale miners.

Main Area	Success Factors
Access to credit and finance	<ul style="list-style-type: none"> · Draft a small-scale mining lending policy; · Establishing loans targeted to specific needs of small-scale mining projects; · The government is the grantor so that small-scale miners do not have to have a collateral when applying for loans; · Amount of loan based on actual requirements following an assessment by mining experts from the government; · Establishing equity-based financing to promote joint-ventures; and · Establishing hire/purchase schemes that enable small-scale miners to access and acquire equipment through payment of small affordable instalments.
Technical assistance programmes	<ul style="list-style-type: none"> · Establish assistance programmes: <ul style="list-style-type: none"> o That allow miners to get assistance from specialized institutions; o That start from project conceptualisation to full implementation; o Where miners can get services paid at a nominal fee; and o Where miners can access assistance quickly because the district/ regional mines offices are located close to mining areas. · Establish specialized training institutions: <ul style="list-style-type: none"> o That offer full-certificate level training to technicians who can then go and work directly with small-scale miners, without any further training; o That provide specialized training to small-scale miners either through formal training or on-the-job training; and o That offer students practical training by facilitating attachment to small-scale mining operations with a view to impart on the students a better understanding of SSM needs and problems.
Women in mining	<ul style="list-style-type: none"> · Enacting mining policies that: bring to the forefront issues limiting women participation in mining and help to raise awareness of the miners and the public; · Establishment of women miners' organizations that: <ul style="list-style-type: none"> o Provide a single voice for women miners; o Are able to encourage and mobilize women to take-up mining as an economic activity; and o Are active in organizing members in trusts so as to promote group mining projects and are mobilizing assistance.
Child labour	<ul style="list-style-type: none"> · Enacting mining policies that: <ul style="list-style-type: none"> o Enable miners and the public in general to become more aware of the dangers of employing children under dangerous mining environment; and o Can attract support to eradicate child labour, e.g., the Tanzania/IPEC Programme supported by the International Labour Organization.
Other parameters	<ul style="list-style-type: none"> · Promote research and development programmes that: <ul style="list-style-type: none"> o Encourage production of safe and efficient technologies; o Develop technology that can be used with the same or improved efficiency in environments without electricity, which are common in small-scale mining areas; o Provide training to miners on the safe use of technologies developed; o Focus on the integration of mining projects with rural development programmes; · Promote relationships between small- and large-scale miners that: <ul style="list-style-type: none"> o Allow small-scale miners access to reserves that originally belonged to large mining companies, but that can not be efficiently exploited by them; o Assure miners a market for their products by selling to the larger companies; o Encourage large-scale miners to provide bridge financing for new ventures promoted by small-scale miners; and o Encourage co-operation and the establishment of a good working environment between them.

Conclusions and Recommendations

Review of the current SSM situation in Africa and experiences learned from the analyses of the practices documented above, suggest that the following strategies should be pursued for the development of the sector:

Develop a mining policy that incorporates a poverty reduction dimension in SSM strategies and recognizes small-scale mining as a potential economic sector with clear identification of constraints and potential.

The development of the SSM sector in a country has to start at the policy level. It is necessary to adopt a policy that recognizes SSM as a distinct sector, notes its different categories, and proposes objectives and strategies aimed at decreasing poverty and improving livelihoods in SSM communities in a sustainable manner.

In this regard, the Tanzania Mining Policy represents a good example. Linking small-scale development strategies to those of poverty alleviation calls for a policy that does not embrace a “mining only” approach, but one, which tries to incorporate mining in other rural development strategies. Development of alternative revenue-generating activities in parallel with SSM is imperative to ensuring sustainable rural economic development. The documented practices from Mali (the Sadiola Gold Mining Project) and those under development in Namaqualand and Kwa Zulu Natal (South Africa) are illustrative.

Mining policy design should be done in a participatory manner. Consultations should involve different stakeholders including miners, relevant government institutions, rural development experts, local communities, NGOs, the private sector, international development agencies and other interested parties.

Develop a programme of action with procedures, institutions, targets and a time frame for implementation.

It is common in most countries to have good policies that never get implemented. Whilst implementation takes more than just an action programme (e.g., needs political will and financial and human resources), an action programme helps to monitor progress, identify bottlenecks and change the course of action where relevant and when needed. The procedure for developing an action programme should involve stakeholder's participation and consultation so as to ensure that it is practical and serves the needs of the target groups. A plan of action for the implementation of the identified policy strategies should, among other things, indicate how to legalize the illegal operators and how to lend them the necessary support in terms of training and advisory and extensional services on technical and socio-economic mining aspects. A programme for development of alternative revenue-generating activities should form an integral part of the implementation plan. Time frames for achieving the development strategies should be clearly indicated.

As part of the implementation of the policy strategies, develop clear mining legislation and associated regulations.

Like the procedure for drafting the mining policy, mining legislation should be developed following participatory and consultative approaches. The legislation should aim to provide speedy and streamlined processes for acquisition of mineral rights, improve security of tenure, provide reasonable tenure periods and ensure that mineral rights are transferable and renewable. Simple, stable, appropriate and specific regulations for implementation of the legislation should be developed and aim to minimize restrictive tendencies on reporting and compliance procedures.

Legal requirements for environmental protection, minerals marketing, health and safety standards, security in camps, gender balance and child labour should be addressed with due regard to the specific conditions of the sector. The legislation should be seen to be just, protect the right of the indigenous miners and ensure that the discoverer has entitlement to mineral rights. Requirements and procedures for demarcation of licensed areas, record keeping and reporting, and the roles and powers of mine inspectors should be regulated transparently rather than on an ad hoc basis.

In documenting best practices, it became apparent that categorization of SSM mineral rights is an issue that needs to be covered by mining legislation. It is therefore recommended that in developing a SSM regulatory framework, the following should be considered:

- Categorization that differentiates artisanal or subsistence mining from SSM properly, so as to allow transition from one level to another, limit artisanal activities to nationals and allow limited participation of foreigners in the SSM category to allow its growth and development.
- Small-scale mineral rights should be issued with due consideration to standard mining development stages, e.g., reconnaissance, prospecting and mining.
- A single authorization or permit for artisanal operations: The authorization should include information on the type of minerals which will be mined, concession size, tenure period, etc., as provided by the regulations. This will ensure that the system is simple to administer and miners find it easy to understand.
- Decentralization of the administration system, especially for the artisanal permits and authorizations, so as to encourage involvement of local authorities, enable effective control and ensure benefits to local economies.

In allocating concessions to small-scale miners, due consideration has to be given to their size, based on the license type. On one hand, the concessions should not be too small to stifle project expansion and development, but on the other hand, they should not be too large for the scale of operations. Where 1.2 hectares (3 acres) offered for an individual gold miner in Ghana is too small, 1000 hectares (10km²) offered in Zambia (prospecting permit) is probably too large for small-scale operations. The following approach is recommended in determining optimal SSM concession sizes:

- Define concession sizes for artisanal mining activities depending on whether permits are issued in designated areas by local councils or through a centralized system. Where permits are issued through a central system, e.g., as currently practiced in Tanzania and Zambia, 5 hectares should be recommended;
- SSM concession sizes should also be based on the stage of project development, i.e., reconnaissance, prospecting and/or mining stages. Areas should decrease as one moves from reconnaissance to prospecting and eventually to mining development. Fees charged per unit of area occupied should reflect this need so as to avoid undue holding-up of areas. As is common for large-scale operators, a substantial area (up to 50%) should be relinquished on every renewal of the reconnaissance and prospecting concessions.
- Although actual sizes should be determined at the country level depending on various considerations, the following are given as guidelines: 400 hectares (4km²) for reconnaissance, 200 hectares (2km²) for

prospecting and 100 hectares (1km²) for mining activities for all minerals, other than gemstones and building materials. Fifty hectares (0.5km²) should be the maximum concession size for mining of gemstones and building materials.

As for the duration of the permit, the situation is variable. Most countries offer short licenses to warrant adequate sector development; only Ethiopia, Ghana and Zambia offer tenure periods of up to 10 years. For artisanal licenses issued centrally, a renewable tenure period of 5 years would be adequate. For artisanal permits/authorizations offered in designated areas and/or areas under the jurisdiction of local authorities, tenure periods should be linked to the license type and hence the stage of project development.

In this regard, tenure during a reconnaissance period should be 2 years renewable; for prospecting stages, the period should be 3 years renewable; and for mining, 10-15 years renewable. The tenure for reconnaissance has to be kept short and possibly limited to only one renewal to avoid unnecessary retention of areas. For the same reasons, tenure during the prospecting stage should be limited to 2 renewable periods. A useful consideration in deciding on tenure periods for mining licenses would be to peg the initial period to the life of the mine as identified in a feasibility study. This is already practiced in Ethiopia.

Devise transparent mechanisms within the legislation and associated regulations to encourage and promote designation of specific areas for SSM operations.

The designation of specific SSM areas is an important undertaking for ensuring easy access to mineral rights, especially access to reserves that are amenable to small-scale techniques. A number of countries already provide such undertakings in their mining legislation, e.g., Ghana and Tanzania, although the laws are sometimes open to abuse by those in search of political gains. The decision to declare an area designated for small-scale mining need to be backed by geological information, which can be obtained through:

- Specific geological investigation programmes carried out by national geological surveys to identify reserves that are suitable for SSM.
- Information based on geological investigations carried out by large-scale mining companies. This can be either an area relinquished during renewals and found to have reserves that are uneconomical for large-scale mining or through special allocation by the company of areas that it finds to be only suitable for SSM. This can be linked to programmes for promoting cooperation between small and large-scale miners. The Sadiola Gold Mining Project in Mali is a good example to emulate.

- Areas designated for rural development programmes and that are found through geological investigations to contain suitable reserves for SSM.

The allocation and administration of designated areas should be done with the involvement of local governments. The documented procedures from Ghana and Tanzania provide practices worth considering.

Develop guidelines that aim to promote efficiency, minimize negative environmental impact, promote high health and safety standards and identify obligations for all stakeholders.

Simple guidelines should be developed in order to encourage miners to adopt working methods that are appropriate to the local environment in terms of efficiency, health and safety standards and minimization of negative environmental impact. These guidelines should be developed by carrying out field exercises and bringing together mining and environmental experts, social scientists and miners, to review existing techniques and identify constraints. In order to improve acceptability, the guidelines should be prepared in consultation with stakeholders.

Develop specific regulations for small-scale mining in order to address environmental protection, health and safety requirements that are practical, implementable and within the technical and financial capacities of the miners.

As in the rest of the sector, SSM needs to comply with the requirements for minimizing negative environmental impact and upholding high health and safety standards. However, methodologies for ensuring that the sector complies with the set rules need to take into consideration the miners' capacity, in terms of both technical and financial requirements. Conducting EIAs, for example, requires specialized knowledge and is not cheap. Unless specific mechanisms are put in place to enable miners to get both the technical and financial assistance required for such an undertaking, it is almost impossible to expect small-scale miners to conduct EIAs. A good example of such an approach includes that adopted by the NSC in South Africa where they fund the EIA of all projects under their jurisdiction. The problem with depending entirely on such an approach is that only a few projects can comply with the regulations while the rest go underground.

Similarly, the financial requirements for rehabilitation of mined-out areas are usually out of the reach of most small-scale miners. The regulations should be able to establish mechanisms where miners finance the rehabilitation through continuous, but small contributions that do not affect their earnings substantially. The case in Ghana where the Government deducts 3% of the value of

sales made by small-scale miners to fund the rehabilitation fund is one of the best practices encountered. Also, the approach adopted by the chrome-mining company in Insiza Zimbabwe whereby miners are paid extra per ton sold to carry out rehabilitation, is another good practical example.

Development of simple regulations for environmental protection, e.g, environmental regulations for SSM in Tanzania, or the Mercury Law in Ghana, are a prerequisite to miners' compliance. In countries where environmental and health and safety regulations do not differentiate between small- and large-scale mining needs, problems with compliance by small-scale miners are on the increase. Simple regulations that can be easily understood by miners also make it easy for authorities to enforce them.

Educational programmes addressing environmental management and health and safety requirements should form part of the extension services offered by the SSM unit/department. Small-scale miners usually accept change reluctantly especially when the benefits of change are of a long-term nature. The resistance to adopt mercury distillation retorts despite the health and economic benefits associated with them reflects this attitude. Compliance is enhanced if specially tailored programmes take into consideration the cultural and educational backgrounds of the miners. The use of visual aids and other modern demonstration techniques also facilitates acceptance. Monetary benefits associated with the adoption of new working techniques need to be demonstrated.

Establish a specialized small-scale mining unit/department within the Ministry responsible for mining that will promote and provide support services to the sector.

The unit must have a core of multi-disciplinary qualified personnel and should have regional offices strategically located close to SSM areas. Experts in mining technology, environment, gender, and child labour, financing, minerals marketing, and others, should be provided.

Establish a network of regional and district offices located in all key mining areas so that monitoring and assistance programmes can be executed effectively.

In order to monitor, supervise and assist the SSM sector effectively, a network of mining offices located in all major mining areas should be set up. Each office should have qualified experts to assist the miners. The set-up will enable the district or regional office to deal with a relatively small group of miners and operate more effectively. By being located close to mining areas, the offices can easily deal with emergencies, deliver assistance programmes quickly, and develop the trust and good relations with the miners that are essential for development of the

sector. The DMCs in Ghana, which are strategically located in areas with active SSM activities and are dealing only with monitoring and promotion of the sector, are one of the documented best practices.

Through the small-scale unit/department, develop extension services aimed at assisting miners to adopt working techniques that are efficient and environmentally acceptable.

These programmes should be developed in consultation with the miners, and to maximize impact, they should be localized in the regional and district offices.

Identify and develop mechanisms that will allow small-scale miners to have access to training, demonstration of efficient working techniques and acquisition of appropriate working equipment.

This has been successfully demonstrated in the Shamva Mining Centre in Zimbabwe. Burkina Faso, Ghana, Mali and Tanzania are following suit. These demonstration centres must use technology locally produced, as it is easily available and is more affordable.

Specialized training institutions can also play a role in promoting the use of efficient and environmentally acceptable technology. One such example is the Gemstone Cutting and Stone Carving Centre being built in Tanzania.

Access to appropriate equipment and technology can be facilitated if fiscal and other incentives are accorded to manufacturers or importers of SSM equipment.

Liberalize minerals marketing systems through simplification of licensing procedures for private mineral dealers

The marketing of minerals is, in most countries, still under the control of monopoly government organizations that determine and set prices that are not reflective of the world mineral market prices. As a result, illegal traders seize the opportunity to offer the miners prices that are more attractive, thus denying the government foreign exchange earnings. Liberalization of mineral markets through simplification of licensing procedures for private mineral dealers would lead to most miners trading through legal channels. Processing of mineral marketing licenses and monitoring of the trade should be carried out by the regional and district centres. This will enable the authorities to know their clients well.

A localized system coordinated from the headquarters enables effective monitoring and collection of revenue and data. This practice, which has been introduced in Tanzania, should be replicated elsewhere.

Where a government-based organization is used in minerals marketing, it should be made to operate in an open market, i.e., it should be allowed to compete with private dealers. The PMMC in Ghana is a good example of a government parastatal organization that has managed to operate effectively in an open market.

Producers of minerals should be allowed freedom to search for better export markets. The export procedures should also be simplified through creation of a “one-stop-shop” where miners and dealers can access information on markets and process mineral exports. The procedures in most countries force an exporter to collect and fill endless forms from several offices, a process that is impractical for a rural-based, small-scale miner. The practice in Tanzania allows the Mining Officer in charge of the regional office (not district) to process and seal mineral export packages.

Develop incentives to encourage value adding.

Most minerals produced by small-scale miners are traded in raw form or as mineral concentrates which do not usually command high prices. In order to encourage miners and mineral dealers to add value to their minerals, e.g., by cutting gemstones, refining and recovering of minerals from concentrates, special incentives should be devised. The practice in Tanzania whereby exporters of cut gemstones are exempted from paying royalties is worth noting.

Develop mechanisms to enable the department responsible for mining to have access to adequate financing to execute its development programmes and develop efficient human resources.

Most mining departments fail to carry out their planned functions due to meagre budget allocations from the government. In order to promote and develop SSM as a potential economic sector, there must be enough capacity within the agency responsible for the sector to monitor, supervise and assist the miners. Given the budgetary limitations of most governments, it is imperative that specific mechanisms for raising finance and training of staff are devised without much dependency on government budget allocations. Arrangements can be made with the government to allow the department to retain part of the collected revenue to finance the day-to-day management of the sector activities.

In addition, training of staff through collaboration with large-scale mines should be promoted. These arrangements, which have been documented as best practices, are already being used in Tanzania. Furthermore, the government may create a semi-autonomous agency responsible for the management of the sector and with special authority to raise funds outside the government’s budgetary allocations. The Minerals Commission in Ghana is an example that has been documented as a best practice.

Identify and develop schemes that will enable miners to have access to finance.

Financial empowerment of small-scale miners is a prerequisite for the success of the overall development strategy of the sector. This requires the establishment of special financing schemes, such as government/donor-supported financing programmes, revolving loans, equity-based schemes, hire/lease/purchase schemes, buyers' credits, group schemes and others.

Fiscal incentives aimed at reducing the cost of acquiring SSM equipment and technology should be devised and accorded to miners and suppliers of such technology. Reduction in import duties on capital equipment, which is commonly accorded to large-scale miners in most countries, should also be provided to SSM and this could go a long way in facilitating access to technology by small-scale miners. Incentives for acquisition of raw materials required by manufacturers and fabricators of equipment and tools are also necessary for building local capacity to produce the required technology. As such, the financing schemes should be long term and broad based.

A mining legislation that allows miners to transfer and trade their mineral rights is a prerequisite to facilitating miners' access to finance. Although most countries limit small-scale mining to local people as a way of ensuring their full participation in the control of natural resources, mechanisms for allowing foreign participation need to be considered. Examples of joint ventures (Mwaca Gemstone project) and equity sharing (The Zinc Tailings Recovery Project - Sable Zinc Kabwe Ltd.) from Zambia illustrate this. The ability to mortgage mineral rights has also been known to enable miners to raise financing through selling part of their mineral rights and developing others. This is already being practiced in Tanzania.

Encourage formation of small-scale miners organizations and develop programmes for their support.

Miners organizations or associations provide a single voice that can help miners in conducting negotiations, mobilizing assistance programmes (e.g., training, finance, etc.), conducting awareness campaigns amongst its members and organizing security and other mining camp-related activities. For it to be trusted and representative, the process of formation of such associations should be led and owned by miners with little or no intervention from governments. Associations that have been formed through direct Government intervention, i.e., through top-down approaches, have in most cases failed due to members' mistrust of the leaders, accusing them of representing government interests.

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Annex 1

Seminar on Artisanal & Small-scale Mining in Africa: Identifying Best Practices & Building the Sustainable Livelihoods of Communities

Recommendations

Yaoundé, Cameroon, 19-22 November 2002

“YAOUNDE VISION STATEMENT”

Contribute to sustainably reduce poverty and improve livelihood in African Artisanal and Small-scale Mining (ASM) communities by the year 2015 in line with the Millennium Development Goals.

GOALS:

- Acknowledge and reflect the ASM sectorial issues in national legislation, and codes;
- Mainstream poverty reduction strategies into mining policy inclusive of ASM policies.
- Integrate ASM policy into the Poverty Reduction Strategy Paper process with linkages to other rural sectors, and develop a strategic framework for PRSPs
- Revisit existing thinking on ASM legislation (traditional land rights, and modern land use legislation nexus) and role of central government;
- Strengthen Institutions:
- Improve the availability of appropriate technologies

- Develop analytical & business skills
 - Undertake necessary reforms of the ASM sector: Improve policies, institutions, processes and the ASM stakeholders' livelihood, develop partnerships, promote sustainable use of natural resources, infrastructure development and land use management.

THE CHALLENGES facing the ASM sector

- Dwindling rural livelihood choices in marginal and remote regions.
- Increasing number of people seeking a livelihood in ASM.
- Limited public budgets & competing needs.
- Increasing poverty exacerbated by HIV/AIDS/STDs, natural disasters, etc.
- Increasing pressure on available resources (institutions, land, mineral resources, etc.)

What to do:

For Governments and Development Partners¹

- Formalize government commitment to ASM issues.
- Revisit mining policies in order to assess their capacity as an engine for poverty alleviation (link to the Poverty Reduction Strategy Paper process).
- Increase the profile of ASM in International Financial Organizations

(IFIs) and donor agencies

- Undertake necessary reform of the ASM sector:
 - Ensure appropriate legislation for ASM: Acknowledge and reflect ASM sector in national legislation, and codes;
 - Revisit existing ASM policies and legislations on the implication of traditional land rights on modern land use legislation and role of central government; Update rules, regulations, and legislations.

¹ Governments (national, local)
 ASM communities and CBOs
 Opinion leaders
 IFIs and donor agencies
 NGOs, private sector
 Academia, public institutions
 Banks

- Adopt appropriate and enforceable Health & Safety guidelines
- Adopt appropriate and enforceable Environmental guidelines
- Establish partnerships with NGOs (i.e., BPD - Care International, etc.)
- Ensure gender equality
- Launch child labour reduction programmes
- Provide credit facilities, and co-operative saving schemes. Make available credit and loans schemes, micro credit, and credit co-operatives
- Ensure free and equitable markets
- Improve the availability of appropriate technologies
- Facilitate Institutional Strengthening and Community Training:
 - Ascertain areas suitable for ASM activities (better knowledge of mineral resources) and improve the methods of exploration, extraction processing and marketing so as to maximize efficiency and effectiveness of ASM as a business venture
 - Community health issues: establish HIV/AIDS and STDs general community health awareness programmes
 - The Essence of sustainable livelihoods
- Stimulate stakeholders' partnership (government as all levels, NGOs, banking organizations, professional organizations, mining companies, etc...)
- Identify alternative livelihoods strategies realizing that ASM is a finite venture
 - Integrate ASM sector into rural community development programmes
 - Stimulate capacity-building, and technical and organizational development
 - Facilitate access to basic social services and transport infrastructure development
 - Streamline marketing channels
- Facilitate community-led activities:
 - Sensitisation and empowerment campaign to promote community organisation and micro-business development:
 - Develop analytical & business skills.
 - Establish ASM co-operatives and associations
 - Community-based saving plans for productive investment

- Identification of women leaders to stimulate alternative income generating activities
- Health cooperative for prevention and care of sick people, particularly those living with HIV/AIDS
- Child education to reduce child labour on ASM sites
- Build community based partnerships with local authorities, and opinion leaders.

Tasks for International Stake Holders

(Private sector, IFI, donors, NGOs)

- Identify and disseminate best/good practices regulations (Pan-African)(CASM)
- Present the recommendations/vision statement of the Yaoundé Seminar to the WB/EIR Regional consultative workshop in Maputo, Mozambique, 13 January 2003 (UNECA - UNDESA)
- Establish a Yaoundé communication network through CASM and encourage other countries to join (March 2003)
- Identify available resources for ASM support (CASM)
- Review existing baseline surveys to assess relevance to “Yaoundé vision statement” in selected countries (CASM and UNDESA, September 2003)
- CASM AGM and learning event in Africa, September 2003
- Identify key stakeholders (affected, interested, beneficiaries, providers, developers, donors) to build the Yaoundé Network by August 2003
- Establish an inter-agency (UNAIDS, UNDESA, ECA, etc.) working group on HIV/AIDS in mining by August 2003

National Level Tasks Forstakeholders, Governements, Private Sector, NGOS/cbos

- Lobby and increase the profile of ASM issues within governments and country (ASM organizations)
- Convene national workshops:
 - Build partnerships with government
 - Baseline survey - identify key issues, both positive and negative and establish common benchmarks
- Collate, consolidate existing information (Government)
 - Liase with global ASM networks (e.g. CASM)

Deadline: September 2003

How

- Inputs:
 - People (human resources)
 - Finance
 - Equipment
 - Knowledge
 - Political will