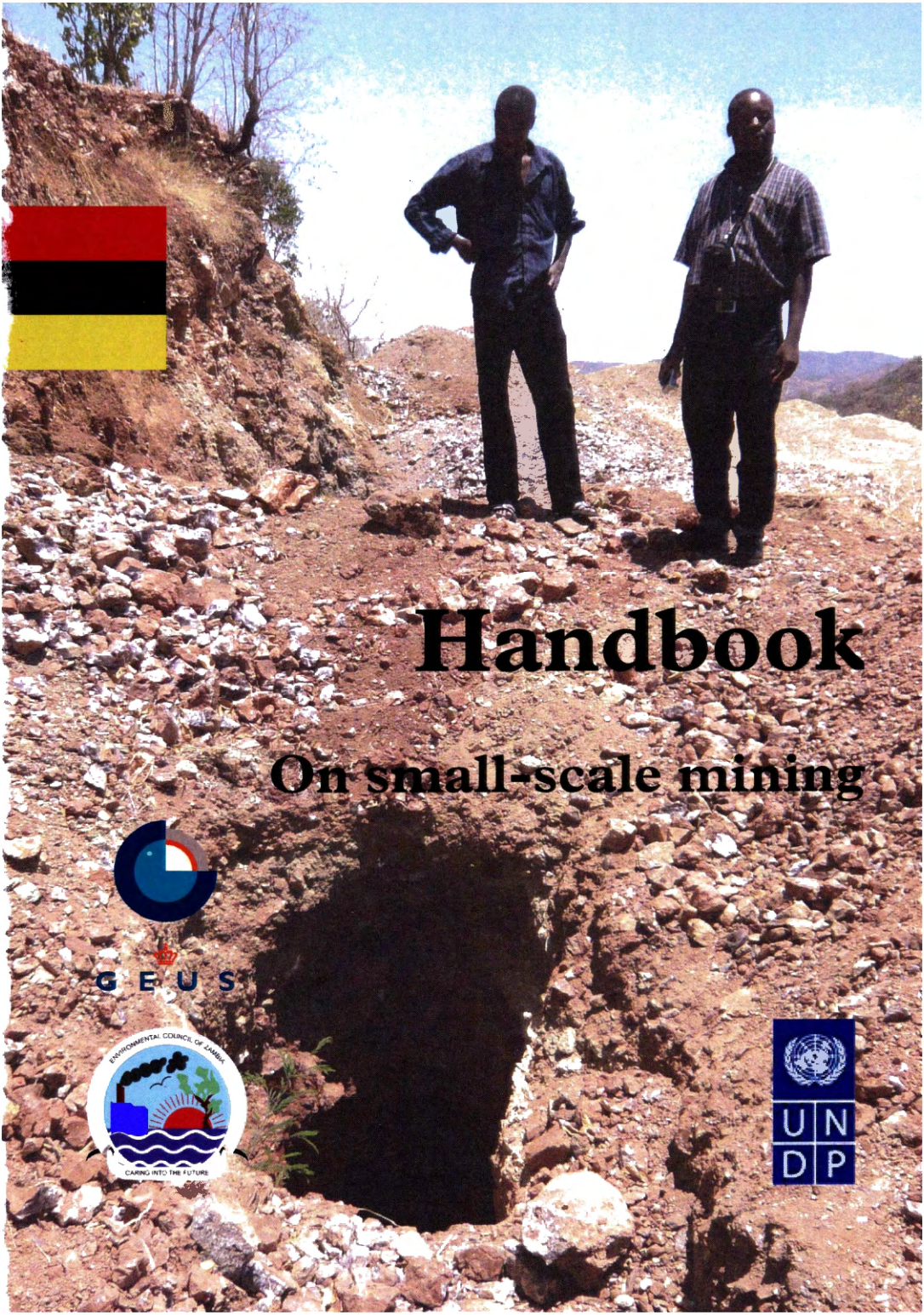
Handbook
On small-scale mining
GEUS
ENVIRONMENTAL COUNCIL OF ZAMBIA
CARING INTO THE FUTURE
UNDP

ENVIRONMENTAL COUNCIL OF ZAMBIA

Handbook

On small-scale mining

The project "Capacity Development for the Environmental Council of Zambia (ECZ) to Monitor Environmental Issues for Small-scale Mining Operations" has been financed by the Fund for Danish Consultancy Services and has been implemented by United Nations Development Program (UNDP) in Zambia. The editor is responsible for all results and conclusions presented in the report, which do not necessarily reflect the position of the Fund for Danish Consultancy Services and United Nations Development Programme.

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Content

Foreword

1

Small-scale mining (SSM) is an activity that is increasingly gaining momentum in Africa. It is largely practiced in rural areas by artisans who lack the requisite education, training, management skills and essential equipment. Small-scale miners also lack financial resources and have no access to loans. Very often the mining activities are done haphazardly with severe consequences to the environment, the surroundings, and even distant communities, as well as to the miners themselves. Other constraints include lack of technical and economic information for long-term planning. Although SSM in Zambia is still far from achieving its full potential, there are indications of positive efforts being made by the Zambian government to promote this sector.

In its Fifth National Development Plan (FNDP), the Government of Zambia considers that small-scale mining has an enormous potential to contribute to the national economy. In line with the FNDP the Government indicates that environment and gender amongst other issues are to be cross cutting in all sectors. The Government will provide help to upgrade small-scale mines in the country to commercial and viable operations and has proposed to set up a gemstone development authority (GDA) to regulate and ensure that small-scale mining contributes towards job creation and the economy in general. This measure is aimed at creating jobs and providing opportunities for local mining investors to gradually grow and compete with foreign mining companies.

In line with its stated mining policy, the Government has enacted new legislation – the Mines and Minerals Act (1995) – which greatly simplifies licensing procedures, places minimum reasonable constraints on prospecting and mining activities, and creates a very favourable investment environment, whilst allowing for international arbitration to be written into development agreements, should this be deemed necessary. A framework for responsible development has also been created through publica-

tion of the Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997.

The significant economic benefits to be reaped from small-scale mining activities have recently been recognized. Indeed, the potential of the sector to contribute significantly to sustainable development is great.

From a technical standpoint, it encourages the regulated exploitation of otherwise uneconomical reserves and provides a lead to discovery of larger deposits. In addition, because SSM is usually labour intensive, it offers greater opportunities for direct and indirect job creation than 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, tools, housing and furniture.

Nonetheless, as with many other economic activities, SSM has its negative aspects. A largely itinerant, poorly educated population with few other employment alternatives and living mostly in remote rural areas carries out this activity. Often the technology employed is rudimentary, and lack of basic environmental and geological knowledge impacts severely on the physical environment at every stage of the mining activity. The impacts range from water pollution, river siltation and erosion to deforestation leading to even larger environmental degradation. Health and safety standards are poor. Productivity and earnings are low. Insecurity in camps and surrounding areas, illegal mining and marketing activities, and the use of child labour are prevalent.

Without financial resources and improvement of technical skills, as well as a better understanding of the environmental and health aspects, the miners can neither conduct systematic exploration of the mining areas, nor acquire adequate technical-economic information to allow long-term planning and adequate mining development.

Given the SSM potential, there is a need to create and foster an environment that is conducive to the development and application of best practices for mining. Occupational health and safety promote environmental protection and discourage child labour and gender inequity.

The development of this handbook involved a participatory process that brought together the Environmental Council of Zambia and other stakeholders. The handbook is intended for use by everyone involved in small-scale mining in Zambia to foster good environmental management practices.

Victoria S. Mupwaya
Acting Director
Environmental Council of Zambia

2 Introduction

This handbook is a key outcome of the project "Capacity Development for the Environmental Council of Zambia to Monitor Environmental Issues of Small-Scale Mining Operations", which was implemented between September 2007 and July 2008.

The project was financed by the Fund for Danish Consultancy Services and has been
implemented by the United Nations Development Program (UNDP) in Zambia. It was executed by a consortium of consultants headed by the Geological Survey of Denmark and Greenland (GEUS).

The handbook is intended as a working tool for staff of the Environmental Council of Zambia (ECZ) working with small-scale mining (SSM) and having contact with SSM communities and local authorities.

A draft handbook was prepared by GEUS and associates in February and March 2008 and tested at a workshop with key staff of the ECZ and representatives from key ministries in April 2008. Based on the experience from the workshop and the recommendations from the participants this final handbook was worked out.

It is the hope of the consultant's team that the handbook and the accompanying hand-out and "Checklist for SSM" will be a useful tool for ECZ and for the dialogue between ECZ and the SSM communities in Zambia.

The consultant's team would like to express their appreciation of the logistical support and good discussions with staff from ECZ and UNDP in Zambia during the project.

John Tychsen. GEUS
Project manager
Copenhagen, June 2008

Background to small-scale mining in Zambia

3

Mining is one of the main sources of income for Zambia and has been so for many decades. The Copperbelt of Zambia has one of the highest concentrations of copper in the world, and the copper mines occur as pearls on a string throughout the Copperbelt and North-western Provinces of Zambia and continue into the Katanga province of Congo. They produce thousands of tons of copper and cobalt every year and employ thousands of people. However, copper mining also creates serious environmental problems such as air and water pollution.

Zambia hosts other mines, all of which are small compared to the copper mines. Most of those mines extract precious and semi-precious stones (gemstones) and this is mainly done on a small scale. The first accounts tell that miners working in the Copperbelt in the 1930s used their days off on prospecting and mining on a small scale for precious and semiprecious stones. This was

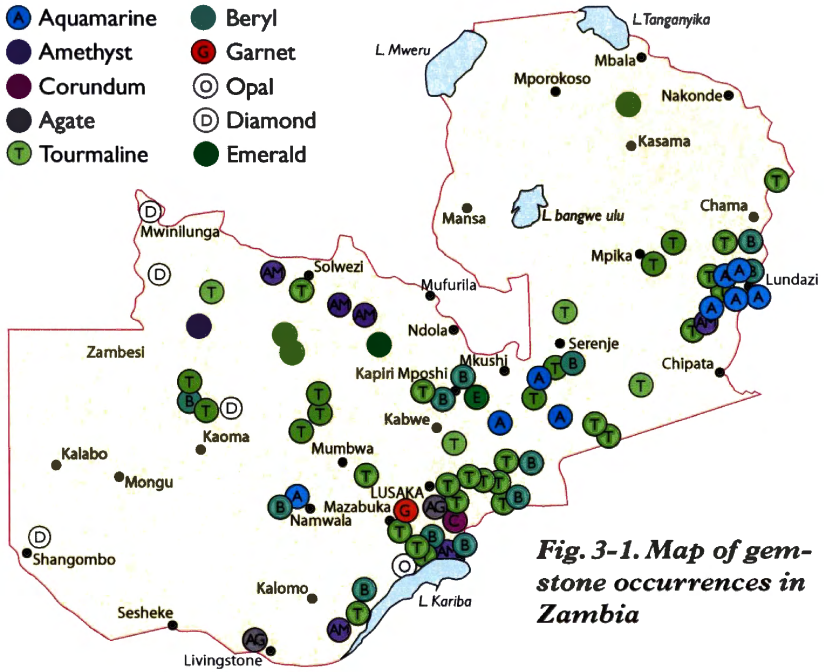

Fig. 3-1. Map of gemstone occurrences in Zambia

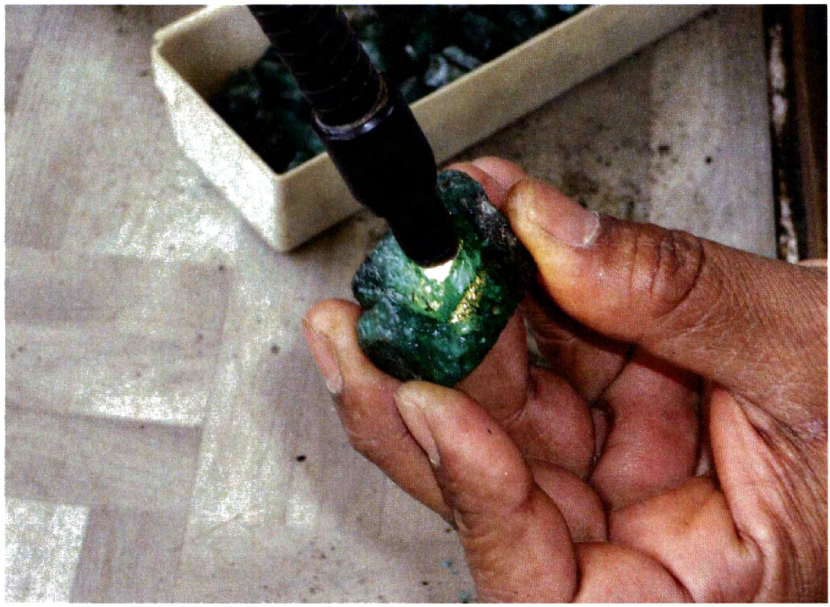

Fig. 3-2. Emerald from a mine in Kafubu Emerald area

mainly focussed on emeralds. Since the 1970s small-scale mining for emeralds really gained momentum with more than 200 companies being active in mining emeralds and beryl on a small scale in the Copperbelt.

The geology of Zambia indicates a good potential for gold deposits, and more than 300 gold occurrences have been discovered (Guernsey, 1952; Krishnan, 1981; Nutt & Van Der Merwe, 1998, Priester & Sikazwe, 2006). Some of the gold deposits developed into mines, e.g. the Dunrobin, Matala, Sasara and Chakwenga mines which, however, all have closed. Presently one gold deposit is being commercially exploited by a mining company in an area east of Lusaka. In the same area a number of small-scale miners used to extract gold by means of mercury (amalgamation) up until the 1980s. Even today the environment suffers from the mercury released more than two decades ago. In the Lundazi area small-scale gold mining is carried out in the Lukusuzi national park.

Fig.3-3. Large small scale mining operation Lufwanyama Emerald Area

In the countries neighbouring Zambia, e.g. Tanzania, Zimbabwe and Congo, there are a large number of small-scale gold miners. In Zimbabwe there is an estimated 400,000 small-scale gold miners, and many of them are likely to migrate to Zambia and carry along their knowledge of how to mine gold on a small scale.

The vast majority of small-scale gold miners use mercury to extract gold. Mercury is a very toxic metal which is harmful to the environment and to people (causes brain damage). Mercury released today will remain in the environment for a long time and will affect the health of both the present and future generations.

Although small-scale gold mining is not a problem in Zambia today, it is important that ECZ officers know how to teach future small-scale gold miners of Zambia how to use amalgamation in a safe way or use alternative gold extraction methods, before the small-scale miners embark on using mercury in extracting gold and release the mercury to the environment. It is thus appropri-

ate in this handbook to describe the problems with release of mercury by small-scale miners and how to mitigate the problems.

What is small-scale mining?

There is no world-wide accepted definition of small-scale mining or artisanal mining. The terms are very flexible. However, in simple terms small-scale mining or artisanal mining can be defined as three men and a wheelbarrow, or as legal or illegal mining at a small scale with no or few mechanical tools. In Zambia, however, the term is more flexible. In the Ndola region there are mines classified as small-scale mines which employ more than 200 people, and their pits are several hundred metres long and hundreds of metres wide (Fig. 3-3). This is in contrast to amethyst mines in the Choma region (Fig. 3-4) with only a few employees. Most of the small-scale mining operations for precious and semiprecious stones employ in the order of 15 to 50 people, and some of them use mechanical devices such as excavators, front end loaders and bulldozers on a rental basis.

Types of mines/operations in Zambia

Mining operations can broadly be classified as large-scale and small-scale mining. The former is commonly highly mechanised mining carried out by commercial companies. The latter ranges from one man mining with a hammer and chisel to mining operations carried out by groups of people mining with or without mechanical devises. Small-scale mining is conventionally classified into the following groups:

- Illegal, informal or unregistered mining
- Artisanal mining
- Small-scale mining

1. Unregistered mining (illegal mining)

Many mining activities start with illegal mining where a person or group of persons discover mineral deposits on the surface and start extracting without any licence or permit. They sell their products to local dealers. Some miners continue as ille-

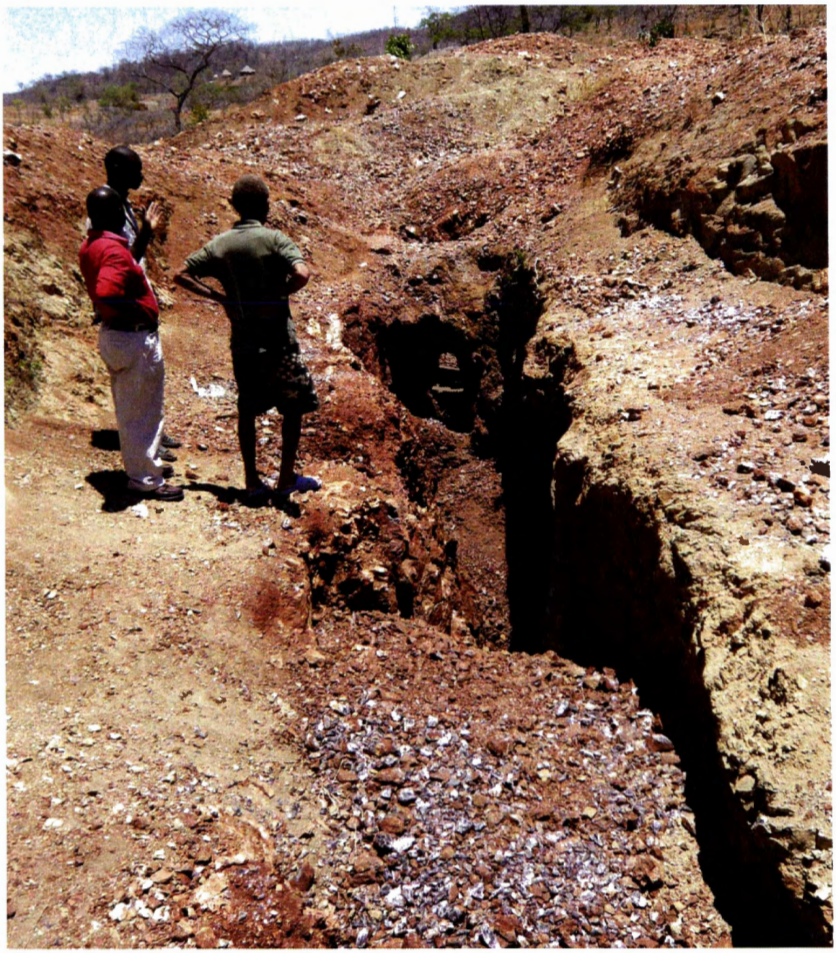

Fig. 3-4. Amethyst vein. The overburden seen in the background has been removed by bulldozer. Mapatizy area in Kalomo.

gal miners whereas others legalise their mining activities by obtaining the appropriate permits.

2. Legal small-scale mining with Artisan's Mining Right or Gemstone Mining Licence, but non-operational

After discovering a promising mineral deposit the small-scale miner or group of miners obtain a permit to extract the commodity. Such an operation starts with limited capital of the

owner, using hand tools only. In most cases the deposit discovered is near the surface or is an outcrop. When mining becomes deeper, it also becomes more difficult to mine with hand tools, and the operations need to be mechanised, e.g. with bulldozers. Hire of machinery is expensive and when the capital is exhausted the mines become non-operational. Most of the present (2007-08) gemstone pits in the Lufwanyama Emerald Area fall into this category.

3. Legal small-scale mining with Artisan's Mining Right or Gemstone Mining Licence, operational

This type of mine is operated with hand tools only, and employees receive salaries on a regular basis. The mines have a constant production. However, many operators have recently stopped putting their employees on monthly salaries. This is because they stop working or producing material to the required tonnage, since they know that they will be paid whether they produce or not.

The current trend is to employ workers, give them food for the period they are in the pits, and buy off whatever they produce. If they don't produce, they are not "paid". The more they produce the more they are "paid".

4. Legal small-scale mining with Gemstone Mining Licence, operational

Similar to the type described under 3, but mechanised. The miners operate just like large-scale miners and are fully mechanised. The only difference really would be the status of the licence – large or small scale.

Legislation

Conditions and obligations for obtaining prospecting, exploration and exploitation licences for small-scale mining are described in detail in the *Mines and Minerals Development Act, 2008.*

The first step towards mining operations is often the discovery of

a local mineral indication on the surface. The discoverer often needs to investigate the area around his discovery in order to see whether there is enough ore to start a mine. He therefore applies for a prospecting permit which allows him to stake an area where he and no one else may look for minerals. If the exploration reveals a good potential for a commodity which can be mined with a profit, then the prospector can advance to the next step which is an exploitation permit. Obtaining the different types of permit or licences is a difficult and time-consuming task which is briefly outlined below.

Prospecting permit

This permit confers on the holder exclusive rights to carry on prospecting operations in the prospecting area for the minerals (not being gemstones) specified in the licence, and to do all such other acts and things that are necessary for or reasonably incidental to the carrying on of those operations. An application for a prospecting permit:

- must be made to the Director; and
- must be in the prescribed form and be accompanied by the prescribed fee

The application must include

- a statement of the minerals, other than gemstones, for which the applicant wishes to prospect
- a description and sketch of the area of land for which the permit is sought, sufficient to enable identification of the area and to provide a plan to be annexed to the permit
- a statement of the sum the applicant intends to expend on his prospecting operations; and
- a description of any mining right which has previously been granted to the applicant or for which he has previously made an application

The Director must, within thirty days of receipt of a duly made application, grant a prospecting licence to the applicant, unless:

- he is disqualified, e.g. if he is under eighteen years or has been declared bankrupt
- the area to which he seeks a prospecting permit is already subject to a mining right; or
- the applicant is or was in breach of any conditions of any other mining right or in breach of the provisions of this Act or the regulations.

A prospecting permit must:

- state the date of the grant of the permit, the period for which the permit is granted and the conditions on which it is granted
- state the minerals in respect of which it is granted; and
- include a description and plan of the prospecting area.

The prospecting permit must include the following conditions:

- the area of the prospecting permit must not exceed ten square kilometres
- a prospecting permit cannot be granted for a period exceeding two years and cannot be renewed
- the holder of a prospecting permit must give notice to the local office of the discovery of any mineral deposits of possible commercial value within thirty days of the discovery.

Exploitation licence/Gemstone mining licence

If a prospector has been successful and discovered minerals, not including gemstones, in commercial quantities, the next step is to apply for a small-scale mining licence for removal of minerals. An exploitation licence allows the holder to extract the commodity/commodities which he has found. He may use mechanised mining methods or hammer and chisel depending on the type of ore he has found. There are a number of requirements as to auditing, taxation, safety for his employees and environmental concerns. The two latter issues are dealt with in chapter 6.

An exploitation licence contains requirements and obligations all of which cannot be listed here, but two important conditions are:

1. The licence area cannot exceed four hundred hectares.
2. The duration of the licence cannot exceed ten years, but the licence can be renewed.

The above information on legal rights and obligations applies to small-scale mining for all other commodities than gemstones. A similar set of rules are in force if a person or group of persons want to prospect for and extract gemstones. This type of extraction licence is called a Gemstone mining licence.

Artisanal mining

Artisanal mining right (AMR) is an exclusive right to explore and mine for minerals; it is granted to an individual or a community. The difference between an artisanal and a small-scale miner is subtle. The maximum size of land is five hectares. The right can be granted for a period of up to two years and cannot be renewed. In particular areas, local chiefs can issue artisanal rights to explore and mine.

An AMR can be issued to any citizen of Zambia provided they

- identify the minerals they wish to explore for or mine
- provide a map or plan with coordinates of the area of interest
- are not disqualified under the provisions of the Act, i.e. not under 18 years, not bankrupt, not having been convicted within the previous ten years

An AMR can also be issued to a chief or an appointed person when mining operations are taking place on a community basis. The AMR is valid for a period of two years.

An AMR will be renewable under the new Mines and Minerals Development Act of 2008. This was not the case under the repealed mines and minerals act of 1995.

If the holder of an AMR wishes to renew it, he must apply to the Director of Mines at least 60 days before expiry.

How do small-scale miners obtain the different types of licences?

Contact address: Mines Development Department
Registry of Mining Rights
P.O. Box 31969.10101
Lusaka

In Appendix A of this handbook is a detailed description of the various types of exploration and mining licences.

Commodities mined

The main commodities extracted by small-scale miners in Zambia are precious and semiprecious stones such as emerald, aquamarine, tourmaline, amethyst and various coloured varieties of garnet. Small-scale mining for metals is less frequent. Tin is mined in the Mapatizya area. Dolomite for construction purposes is extensively mined in an area south of Lusaka. Small-scale mining for copper is rare. The few small-scale copper miners mine the raw ore and sell it to either existing large-scale mines or to smelters erected by Chinese companies in several towns in the Copperbelt. Small-scale mining for gold was carried out near Lusaka by a number of small-scale miners, and is starting up in the area north of Lundazi. It is probably only a matter of a few years before gold will be extracted by numerous small-scale miners in different parts of Zambia as is the case in the neighbouring countries.

Mining and extraction techniques

Classification of different types of deposits

Metals and minerals are extracted from either hard rock or from eluvial or alluvial deposits.

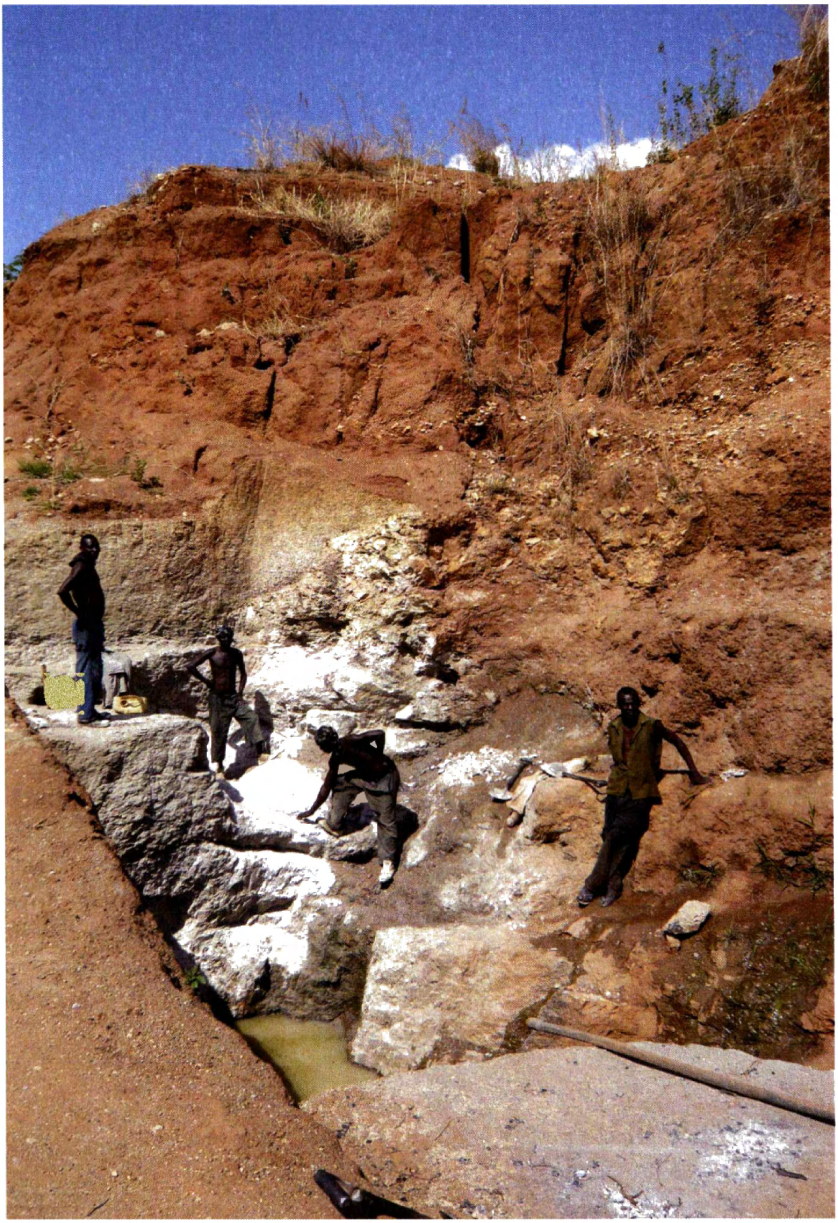

Fig. 3-5 Aquamarine prospect in Lundazi. An excavator has dug through the overburden to the hard rock with aquamarine. Mining of aquamarine is done by hammer and chisel.

Hard rock mining

The term is self-explanatory. The ore occurs in hard rock, and mining requires hammering and chiselling or use of explosives. Some small-scale miners use fires to mine hard-rock deposits. They start a fire at the wall of hard rock. When the surface is very hot, they throw water on it and the surface cracks allowing the small-scale miners to break the hard rock.

Eluvial mining

When a rock has been exposed to weathering for millions of years, some of the minerals get soft and the rock can be broken quite easily using pick and shovel. The softened rock can easily be taken apart and the precious minerals, e.g. topaz can be recovered. The partly decomposed rock is dug out and carried to a basin with water. The rock is washed in the water and the precious stones can be identified and picked out. The bottom of the basin will

Fig. 3-6. Concrete lined basin for washing elluvial material containing spessartine. The finegrained material deposited in the basin is prevented from being washed into the drainage system

Fig. 3-7. A bulldozer has removed the overburden covering a topaz deposit. The overburden is placed around the topaz deposit e.g. behind the cars. If the small-scale miners have sufficient funding they should be able to level the ground again with a bulldozer when they have exhausted the deposit.

gradually be filled with fine-grained, decomposed rock. The basin will now and then be emptied for this material which must be deposited in a level place to avoid it being washed down into the drainage system during heavy showers (Fig. 3-6).

Many deposits are buried under a thick layer of overburden (soil). In most cases the small-scale miners dig through the overburden into the ore. If they have sufficient funds they rent a bulldozer which removes the overburden (Fig. 3-5). It is important that the overburden is placed on level ground in order to prevent it from being washed into the local drainage system.

Alluvial mining (placer mining)

When a rock has been exposed to weathering for millions of years, some of the minerals get soft and the rock easily disintegrates during heavy rain falls. The water transports the minerals downhill into the drainage system. During transport in rivers the heavy minerals are separated from the lighter minerals. The heavy minerals, e.g. topaz or gold, are deposited in so-called alluvial deposits on the riverbed. These deposits can be mined easily by shovels. The precious minerals or the metals constitute a very small amount of the placer deposit. Most of the placer deposit is boulders, pebbles, sand and silt. Care should be taken to deposit these sediments in a safe place to avoid that they are washed down into the drainage system (Fig. 3-8).

Fig. 3-8. Alluvial (placer) gold deposit (the c. 30 cm thick pebbly layer). The overburden is removed and the gold-bearing layer is mined with shovels. In this case the overburden was not dumped in an environmentally safe place, but was thrown directly into the stream and washed away, thereby clogging up the drainage system. The gravel, sand and silt in the gold ore have likewise been dumped into the stream.

Fig. 3-9. Small small-scale mining site for dolomite Lusaka

Precious and semiprecious stones

Precious and semiprecious stones are mined from hard-rock deposits. Sometimes high-quality stones can also be extracted from eluvial deposits. Eluvial deposits cover hard rock further down. When eluvial deposits are exhausted the miners have to dig into fresh hard-rock deposits (Fig. 3-7). These deposits may also occur many metres below the surface. It may require heavy machinery such as excavators to dig down to the fresh rock (Fig. 3-7).

When the ore has been reached, mining takes place. This can be done by hammer and chisel (Fig. 3-5) or by using explosives. The chiselled or blasted ore is then lifted to the surface and inspected for gemstones. The material is then crushed and screened, and the gemstones are picked out by hand

Fig. 3-10. Crushing dolomite ore Lusaka

Dolomite.

This is mined from surficial deposits on the outskirts of Lusaka (Fig. 3-9). The overburden is removed. The next step is to break the rock which is often done in an old-fashioned but efficient way. A fire is lit at the outcropping dolomite. When the rock face is very hot, the fire is extinguished and the rock face is quickly cooled with water. The fast cooling causes the rock face to crack and the

dolomite can be removed in large chunks. The chunks are subsequently hammered down to pebble size (Fig. 3-10). The dolomite pebbles are piled up at the road side and later picked up by trucks.

Gold mining

Small-scale gold mining is not widespread in Zambia. In the Lukusuzi national park near Lundazi, placer gold mining is carried out, using shovels and gold washing pans. This gold deposit was reportedly found by a white man decades ago, and small-scale miners have recently started to extract gold there. Their extraction technique is not known in detail. They use a gold washing pan, but whether the gold is sufficiently coarse-grained to require washing only is not known. If much of the gold is fine-grained the miners will loose it unless they use mercury or other gold extraction techniques. It is a very small deposit at the bank of a small stream (Fig. 3-8). In an area east of Lusaka many small-scale miners used to extract gold from hard-rock deposits (quartz veins). Small-scale mining for gold is carried out either in hard rock or in placer deposits. In hard-rock gold mining the rock is crushed and ground. Then the heavy minerals are concentrated by various methods, depending on size of operation and number of small-scale miners. In placer deposits no crushing or grinding is needed.

1. **Crushing.** This is often done by hand, and the mined gold ore is crushed down to sizes of a few centimetres (Fig. 3-11).

2. **Grinding.** This can be done manually by using car axles in tree stems (Fig. 3-12) or by ball or rod mills (Fig. 3-13).

3. **Sluicing.**

3.1. This can be done at different scales. The simplest method consists in putting a few pieces of wood together with a rubber mat at the bottom Fig. 3-14). The sluice can be placed directly in a fast-running stream. Gold-bearing sand and gravel are sieved into the sluice and the running water flushes light minerals out of the sluice leaving heavy minerals such as gold in the rubber mat. The gold is subsequently hand picked.

Fig. 3-11. Crushing gold ore with hammer (Philippines).

3.2. Sluicing is often done on a slightly bigger scale. The ground material is washed into sluices with either cloth or riffled rubber in the bottom Fig. 3-15). Heavy particles such as gold are trapped in the cloth. After certain the process is stopped, and the cloth is washed in a bucket of water to get the heavy particles off the cloth (Fig. 3-16). The heavy minerals are then treated in an old-fashioned gold-washing pan (Fig. 3-17). The pan can be made of iron, aluminium, plastic or wood. The heavy minerals are concentrated in the pan. After some time of washing many small-scale gold miners add mercury and mix the mercury thoroughly with the mineral concentrate. This is done with their bare hands (Fig. 3-18). During this process the gold particles are "dissolved" (amalgamated) in the mer-

Fig. 3-12. Grinding gold ore by car axles in tree stems in Tanzania.

Fig. 3-13. Rod mill used for grinding gold ore in the Philippines.

Fig. 3-14. Sluicing for gold in a stream in Kyrgyz Republic.

Fig. 3-15. Sluicing with carpet in Philippines.

Fig. 3-16. Rinsing sluice carpet for gold in the Philippines.

cury. The amalgam is easily separated from the barren heavy minerals.

4. **Gold separation.** The next step is to squeeze the surplus mercury from the amalgam. This is done through a piece of cloth.

5. **Burning.** The final step is to heat the amalgam. This is mostly done in an iron bowl on a small fire (Fig. 3-19). During heating the mercury evaporates and leaves the gold behind. Much of the evaporated mercury is inhaled by the small-scale miners and the people living in nearby villages (see Chapter 6).

6. **The final** product is a small gold pellet containing a few percent mercury. This pellet is sold to local gold dealers (Fig. 3-20).

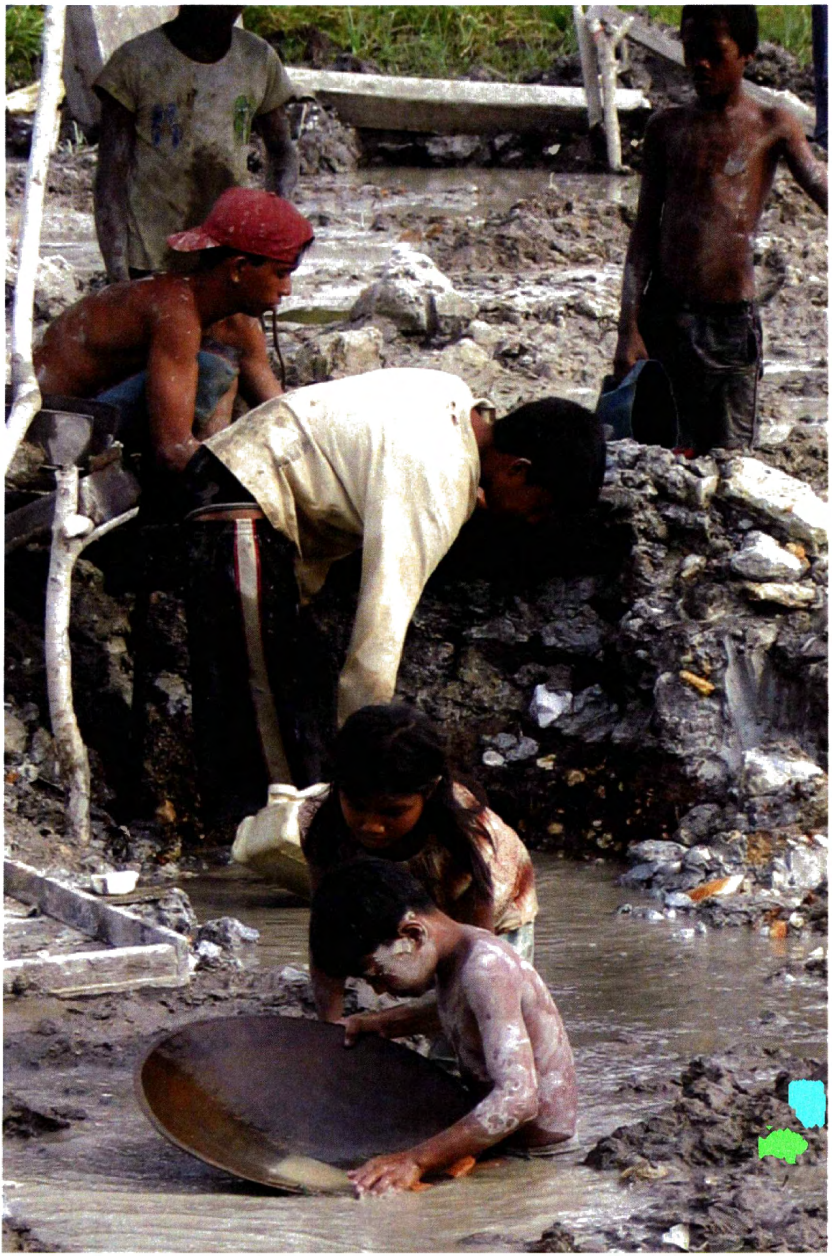

Fig. 3-17. Panning for gold from heavy mineral concentrate Philippines

Fig. 3-18. Mercury added to mineral concentrate for gold extraction in Tanzania.

Fig. 3-19. Burning amalgam over bonfire. The young guy inhales mercury vapour

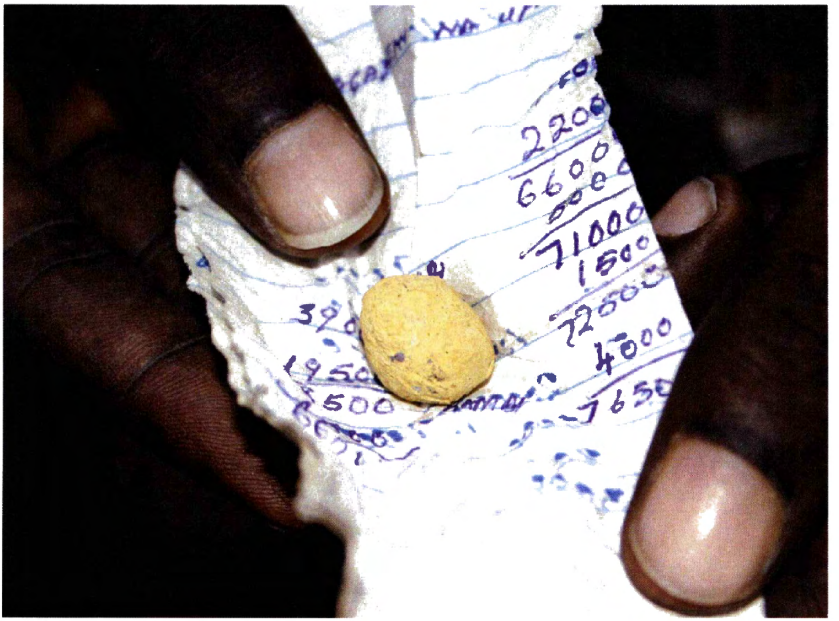

Fig. 3-20. Gold pellet ready for sale in Tanzania

7. **Gold extraction** by amalgamation is a very efficient and very easy process. It takes minutes to learn the process and it has a fairly high recovery rate, especially for fine-grained gold. Mercury is easily available in most countries, often being sold by the gold buyers. Amalgamation is used by millions of small-scale miners in Africa, South America and South-East Asia.

The amalgamation technique unfortunately creates serious health problems and environmental impacts (see Chapter 5).

Background of environmental legislation related to small-scale mining

Within Zambia, 11 ministries are involved with environmental affairs. The country has more than 30 sets of environmental legislation, and Zambia has signed a total of 21 international conventions on the environment. Most of these pieces of national environmental legislation and international environmental agreements were enacted and ratified during the 1990s and provided an improved framework for sustainable environmental development in Zambia. However, the adoption and implementation of this relatively large amount of environmental regulations within a short time frame and by different actors seem to have been affected to some extent by resource constraints and deficiencies in institutional and inter-institutional coordination.

Recently, increasing focus has therefore been on developing a more strategic and coherent environmental policy framework in Zambia. The international agreement on the *Millennium Development Goals (MDGs)* in year 2000 was followed in Zambia by formulation of a *"National Policy on Environment"* (2005) as well as strategic national development plans (*"Vision 2030"* and *"Fifth National Development Plan 2006-2010"*).

Millennium Development Goals (2000)

The eight Millennium Development Goals (MDGs), including one on sustainable management of natural resources, formed a blueprint agreed to by all the world's countries and leading development institutions. The MDGs, which are the most clear-cut and widely accepted set of development priorities ever, were agreed to by 189 heads of state at the UN Millennium Summit in September 2000.

For all eight MDGs, specific indicators have been developed together with corresponding targets to be achieved by 2015. MDG no. 7 is related to "Environmental Sustainability" which should be ensured through e.g. country efforts to "Integrate the principles

of sustainable development into country policies and programmes and reverse the loss of environmental resources". The indicators developed for MDG no. 7 are presented in Table 4.1 below.

Table 4.1: MDG no. 7: Target Indicators

- Proportion of land area covered by forest
- Ratio of area protected to maintain biological diversity to surface area
- Energy use
- Carbon dioxide emissions per capita
- Proportion of population using solid fuels

National Policy on Environment (2005)

Up to 2005, Zambia did not have a coherent policy framework for sustainable environmental and natural resources management, which could bind together targets and measures from the various environmental legislation and policy documents and the international agreements. This has traditionally led to a number of deficiencies in national environmental management such as (1) inadequate incorporation of international agreements into national legislation/policy; (2) limited involvement of local communities in implementation and enforcement of environmental legislation; and (3) the huge challenge of coordinating within and between the relatively large number of institutions and agencies involved in environmental and natural resources management in Zambia.

The National Policy on Environment, which was formulated in Zambia in 2005, presents an ambitious attempt to overcome some of the above-mentioned deficiencies and fill in the existing vacuum with relation to environmental legislation and policy in Zambia. This is the first national environmental policy in the region that broadens the sectoral approach and takes a wider environmental view. The process of formulating the policy was initiated in 2003 and followed a systematic and structured consultative ap-

proach, involving all relevant key stakeholders in the country. The document must therefore be considered to be consolidated and comprehensive.

The National Policy on Environment is a direct result of Zambia's efforts to follow up on MDG no. 7 (see above). The Policy therefore also includes quantifiable targets, which are in line with local needs and global commitments and can be monitored and evaluated continuously.
ly.

Vision 2030 and the Fifth National Development Plan, 2006-2010 (2006)
Vision 2030 is a comprehensive national development plan which sets the long-term vision for Zambia. The document is the result of a consultative process, involving line ministries, provinces, districts, the donor community and the civil society. The Vision will be operational zed through five-year medium-term plans, the first of these being the Fifth National Development Plan, 2006-2010.

With regard to the environment, the Fifth National Development Plan confirms the National Policy on Environment as the key guiding tool for environmental management in Zambia within the period and stresses the need for the National Policy on Environment to be supplemented by an Implementation Plan and a Strategic Investment Plan. The Fifth National Development Plan also emphasizes that efforts should be strengthened so that the recently established Inter-Regulatory Environmental Coordination Committee will lead to improved coordination and more effective implementation of environmental policies in Zambia.

Key Environmental Legislation
In this section some central pieces of environmental legislation in Zambia are presented. It should be noted, however, that the list is not exhaustive but includes those documents which are considered of most relevance to SSM activities.

Mining Regulations (1971)

The Mining Regulations from 1971 address important environmental and safety aspects related to mining operations.

Part IV of the regulations deals with hazards from dangerous surface excavations, e.g. large cracks, subsidence and pits, and with the protection of surface features such as infrastructure and water rights. Part VII of the legislation covers protection in working areas. Part IX addresses the issues of air pollution arising from dust, fumes and other toxic gases. It provides for the determination of concentration of these pollutants in ambient air, sets air quality standards and measures to minimize or prevent generation of air pollutants from drilling and other operations likely to produce dust, toxic gases or fumes.

The overall approach for implementation of this legislation was through permitting and licensing followed by statutory reporting. Although the regulations provide for control of pollution from mining, regular monitoring is to be carried out only by the mining companies themselves.

Therefore, the Mining Regulations from 1971 do not provide an effective set-up for monitoring and control of mining activities with regard to environmental and safety standards. This aspect remained unsolved until implementation of the Environmental Protection and Pollution Control Act (1990), see below.

Environmental Protection and Pollution Control Act (1990)
The Environmental Protection and Pollution Control Act is the principal legislation with regard to environmental protection and pollution control in Zambia. Part II of the Act prescribes the establishing of the Environmental Council of Zambia (ECZ), as the main body responsible for environmental and natural resources management in the country. ECZ was established together with the Ministry of Environment and Natural Resources in 1992.

Main functions and powers assigned to ECZ by the Environmental Protection and Pollution Control Act are summarized in Table 4.2 below.

Table 4.2: Main functions of the Environmental Council of Zambia

- Advise the Government on formulation of policies relating to environmental and natural resources management.
- Coordinate activities of ministries and other institutions concerned with environmental protection and pollution control.
- Establish national environmental standards and guidelines (including on water quality, emissions, air quality, wastes, and noise levels).
- Monitor, regulate and control environmental pollution (air, water, wastes, pesticides, toxics etc.).
- Prepare regulations for conservation and protection of natural resources.
- Promote awareness of the environment and natural resources.

Source: (Environmental Protection and Pollution Control Act (1990)

Water Pollution Control Regulations (1993)

The Water Pollution Control Regulations provide the details of monitoring and control of water pollution through establishing of standards for discharging effluents and waste water into the aquatic environment, as well as information on associated permits and licenses.

Established parameters for effluents and waste water are presented in Table 4.3 next page.

Table 4.3: Main water pollution parameters

- Physical conditions (temperature, odour, taste, colour, turbidity, suspended and dissolved solids).
- Bacteriological (fecal coliforms and total coliforms).
- Chemicals (H, dissolved oxygen, chemical and biochemical oxygen demand).
- Metals (compounds of aluminium, arsenic).
- Organics (hydrocarbons, oils, phenols, fats).

Mines and Minerals Act (1995)

The Mines and Minerals Act from 1995 is the principal legislation with regard to mining activities in Zambia. Part IX of the Act provides for the elimination or minimizing of impacts on air, water, soil, flora and fauna, and for the conservation of scenic attractions and other features of cultural, architectural, archaeological and historical interests in as far as they relate to mining operations. It also provides for the rehabilitation, levelling, regressing, reforesting or contouring of land affected by prospecting or mining operations, as well as filling in sealing or fencing off of excavations, shafts and tunnels.

Air Pollution Control Regulations (1993)

The Air Pollution Control Regulations detail the monitoring and control of air pollution including the establishment of limits for ambient air pollutants, as well as information on the associated permits and licences. Main air pollution parameters are presented in Table 4.4 below.

Table 4.4: Main air pollution parameters

- Sulphur dioxide (SO_2).
- Total particulate matter (PM_{10}).
- Respirable particulate matter ($PM_{2.5}$).
- Oxides of nitrogen.
- Carbon monoxide.
- Ambient lead and dust fall.

Source: (Air Pollution Control Regulations (1993)

Environmental Protection and Pollution Control (Environmental Impact Assessment - EIA) Regulations (1997)

The Environmental Protection and Pollution Control (Environmental Impact Assessment - EIA) Regulations are the most comprehensive piece of legislation on mining and the environment in Zambia. The Regulations provide information on Environmental Impact Assessment (EIA) in determining whether a certain project will have significant impacts on the environment, or the mitigation measures proposed in a project are sufficient to minimize environmental impacts. According to the EIA process described in the Regulations, all project proponents are required before commencing a proposed project to submit an Environmental Project Brief (EPB) or an Environmental Impact Statement (EIS) to ECZ for review. The specific requirement for the EPB is described below.

The Environmental Protection and Pollution Control (Environmental Impact Assessment - EIA) Regulations also cover mine closures and aspects such as mine dumps, air quality, emission standards, water standards and storage, handling and processing of hazardous materials. The standards have been synchronized with those made under the Environmental Protection and Pollution Control Act (1990).

Complement from the Fifth National Development Plan, 2006-2010 to the EIA Regulations

In the Fifth National Development Plan, 2006-2010, are specified a number of actions to be taken within the period in order to strengthen existing EIA regulations. The most important with regard to the SSM sector are presented in Table 4.5 next page.

"Environmental Impact Assessment" means a systematic examination conducted to determine whether or not a proposed project, or alteration to an existing project, or alternatives, may have significant adverse or beneficial impacts on the environment.

Table 4.5: Compliments from FNDP to existing EIA regulations

- Developing cohesiveness between sectors and existing structures;
- Promoting effective public participation in the EIA process;
- Developing and maintaining skilled capacity to manage EIA processes;
- Strengthening regular monitoring of mitigation plans;
- Preparing and implementing district environmental plans.

The need for carrying out an Environmental Project Brief (EPB)

A project developer is not allowed to implement a project for which an EPB or an EIS is required unless the EPB/EIS has been concluded in accordance with the Environmental Protection and Pollution Control (Environmental Impact Assessment - EIA) Regulations and ECZ has issued a letter informing the developer on the outcome of the EIA review of the project. The letter contains conditions under which the project should operate to minimize the effects it might have on the environment. Projects that existed prior to the commencement of the EIA regulations of 1997 are also required to undertake an EIA.

Factors such as the nature and location of the project determine whether the developer should prepare an EPB or EIS. Projects likely to have significant negative impacts on the environment tend to fall under the EIS category. Most SSM activities, including quarrying and open-cast extraction, are types of projects required to submit an EPB, see Table 4.6 below. However, since the definition of the SSM sector in Zambia is rather flexible, some small-scale mining developers may fall within the EIS category.

Table 4.6: Mining projects that require submitting an Environmental Project Brief

- Copper mining, coal sites
- Limestone, sand, dolomite, phosphate and clay extraction of 2 Ha or more
- Precious metals (silver, zinc, cobalt, nickel)
- Industrial metals
- Gemstones

Source: (Environmental Protection and Pollution Control (Environmental Impact Assessment - EIA) Regulations, 1997)

Table 4.7: Environmental Project Brief - Guidelines

An Environmental Project Brief shall in a concise manner include the following information:

- Site description of the environment;
- Objectives and nature of the project and reasonable alternatives;
- Main activities that will be undertaken during site preparation, and construction and after the development is operational;
- Raw and other materials that the project shall use;
- Products and by-products, including solid, liquid and gaseous waste generation;
- Noise level, heat and radioactive emissions, from normal and emergency operations;
- Expected socio-economic impacts of the project and the number of people that the project will resettle or employ, directly, during construction and operation etc;
- Expected environmental impact of the project;

Source: (Environmental Protection and Pollution Control (Environmental Impact Assessment - EIA) Regulations, 1997)

Table 4.8: Environmental Project Brief - Submission and decision making process

- The project developer must submit six complete copies of the EPB to the ECZ for review and must pay a statutory re view fee to the ECZ.
- Within seven days of receiving the EPB, a copy is sent to the authorising agency for comments. The authorising agency must submit its comments to the ECZ within 30 days of receiving the EPB.
- The ECZ then considers the EPB and comments received. If the authorising agency fails to submit comments, the ECZ will proceed to consider the EPB without these.
- If the ECZ is satisfied that the project will have no significant impact on the environment, or that the project brief discloses sufficient mitigation measures to ensure the acceptability of the anticipated impacts, it will issue a permit, with conditions as appropriate, within 40 days of receiving the EPB from the developer.

Source: (Environmental Protection and Pollution Control (Environmental Impact Assessment - EIA) Regulations, 1997)

Where ECZ determines that the project is likely to have a significant impact on the environment, it will require an EIS to be prepared in accordance with the specifications outlined in the Environmental Protection and Pollution Control (Environmental Impact Assessment - EIA) Regulations, and will inform the developer accordingly within 40 days of receiving the EPB from the project developer.

Environmental and health issues related to small-scale mining

5

Small-scale mining in Zambia causes a number of environmental and health problems such as land degradation, siltation, deforestation and chemical pollution.

Land degradation

During prospecting and exploration for mineral deposits, trenches and ditches are dug in order to trace the ore-bearing structures. The next step in small-scale mining is to dig down to the ore in order to test whether it can be mined with a profit. This often requires removal of large amounts of overburden. Only few of the small-scale miners consider where they dump the overburden. They merely dump it where it is easiest for them.

Fig. 5-1. Former farmland – now badlands. Exploration and exploitation pits for gemstones have ruined the farmland. Lundazi area.

Fig. 5-2. Steep walls in a mining pit in Lundazi. It may be fatal if a person falls down the steep slope.

If an area attracts small-scale miners' attention, then within a short time large farmland areas may be littered with exploration pits and trenches making the fields useless for farming purposes. The pits need not be very deep. Fig. 5-1 shows badlands due to excavation of exploration and mining pits in the Lundazi area.

Re-establishing farmland after land degradation

Whether it is possible to get small-scale miners to re-establish the surface by filling all pits and trenches is a big question. Many of the pits are so deep and the walls so steep that it will be fatal for a person or an animal to fall into the pit (Fig. 5-2). An absolute minimum requirement from the environmental authorities is that the miners fence off active as well as abandoned pits and trenches (Fig. 5-3).

When small-scale miners dig exploration and mining pits they do not consider health risks. They dig the pits with as steep walls as possible in order to minimise the amount of overburden to be removed. Fig. 5-4 from a garnet mine in Lundazi shows near vertical walls in a very deep mining pit. Rock falling from the high, vertical wall may cause serious injuries to the miners. These walls may also cave in and burry the mine workers at the bottom of the pit. Support of the walls of pits is not commonly made. A way out is to reduce the incline of the walls or to use benching (Fig. 5-5).

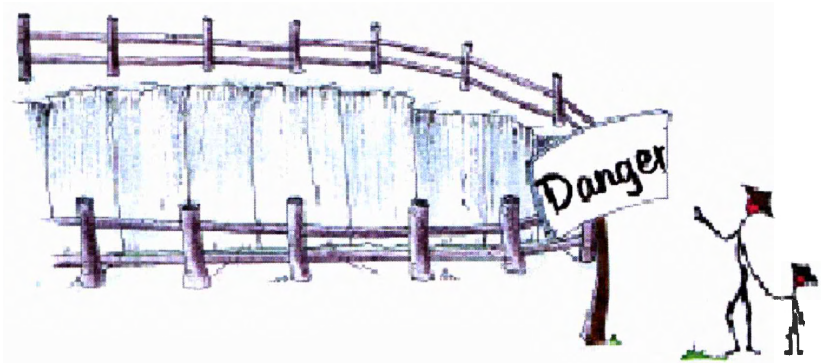

Fig. 5-3. Fencing of pits in order to avoid that people or animals falls into the pit

Fig. 5-4. Very deep pit with near vertical walls in a garnet mine in Lundazi area. The vertical wall in the left side of the picture may create rock fall causing serious injuries to the miners

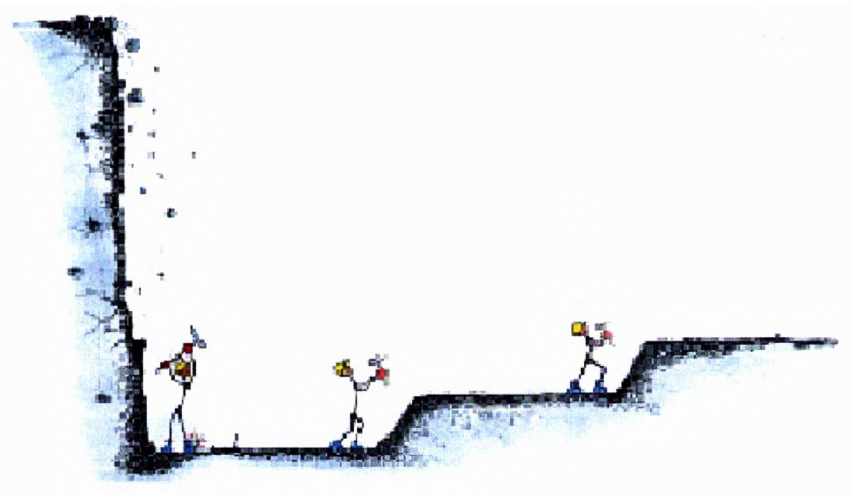

Fig. 5-5. Sketch showing unsafe steep walls with rock fall and stable benching system. The benches should not exceed 1.5 m in height and be at least 2 m wide. This will facilitate carrying up ore and waste and prevent material falling down to hurt miners in the bottom of the pit.

Siltation

When small-scale miners remove large amounts of overburden, the area is more prone to soil erosion. During the rainy seasons large amounts of fine-grained material, clay and sand will be transported by water to small and large streams.

Several of the small-scale mining operations require fairly large amounts of water for extraction purposes such as sieving ore for extracting precious and semiprecious stones or gold. The need for large amounts of water often makes small-scale miners move that part of the processing to the nearby streams. This will add considerable amounts of sand, clay, crushed and ground rock material to the streams.

This clay and sand from overburden and mineral processing will

tend to clog up the rivers and cause them to change course which may result in flooding. The large amounts of sand and clay in the river water may also influence the living conditions of the fish such that less fish can be caught.

Can siltation of drainage pattern be avoided? It is not possible to avoid siltation completely but it can certainly be significantly reduced. This requires that the small-scale miners are instructed in how to dump the overburden and the tailings from the mineral extraction.

How to reduce siltation

A good example of how to reduce siltation is shown in Fig. 3-6. A concrete lined basin has been constructed to avoid silt from the washing of spessartine ore to be transported downhill into the drainage system.

As regards the overburden it is important to teach the small-scale miners to use appropriate dumping sites, i.e. avoid dumping it on steep slopes, and seal the dumping sites with stone fences. Sealing of dumping sites can also be done fairly easily by introducing appropriate vegetation. Some sorts of grasses and bushes grow fast and their roots consolidate the dumped overburden.

Tailing dumps from small-scale mining operations pose special problems. Firstly because the material often is quite fine-grained and secondly because they may be situated next to rivers and streams. It is very important that the tailing dumps are fenced off from the streams. The fencing may consist of rocks or of plastic sacks filled with tailing material. It is also important that each tailing dump is of limited size. This is to avoid a major disaster if, during heavy rainfalls, a tailing dump breaks and discharges its content into nearby streams. Introduction of vegetation such as fast-growing grass or bushes is important. The roots of the grass and the bushes will keep the tailings in place and thus prevent siltation of streams and rivers. The forestry department is able to advice on suitable plants.

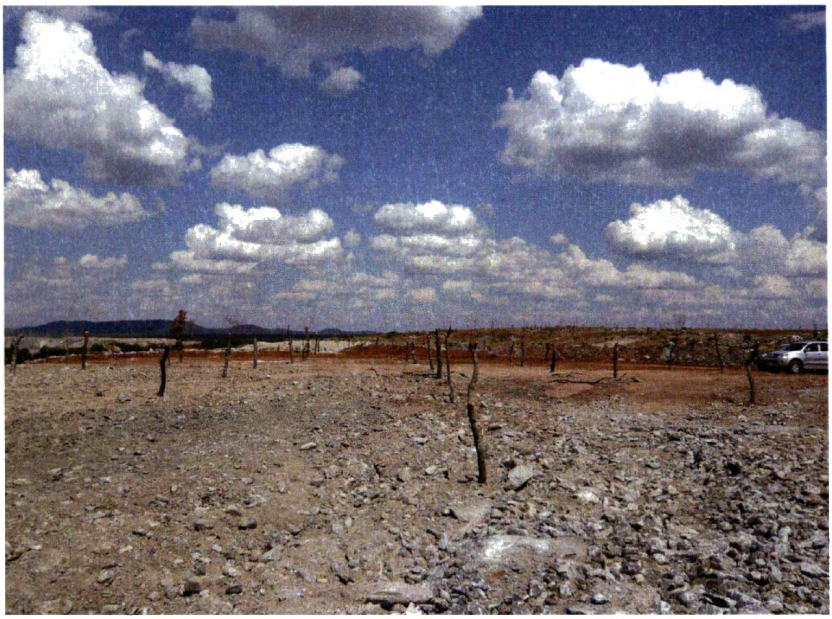

Fig. 5-6 shows an emerald mine in the Lufwanyama Emerald Area where a large number of trees have been planted on the dumps in order to prevent them from collapsing and spreading their contents of fine-grained material to the surrounding draining systems.

Deforestation

Open-pit small-scale mining in Zambia does not require much wood apart from charcoal for cooking. Small-scale mining communities will take a toll of the nearby forests, but not much more than if the same people had other types of jobs. If, however, small-scale miners learn how to support their pits by timber then a significant deforestation may take place. Some miners, e.g. amethyst miners, do underground work with small tunnels from pit to pit. This is a way to increase recovery without digging too many new pits. Unfortunately the tunnels are rarely supported as a result of which they often cave in with fatal results.

Such fatalities could be avoided if the miners learned how to sup-

port walls and roofs in tunnels and steep sides in deep excavations. This would require large amounts of timber which would be taken from nearby forests, causing considerable deforestation.

Deforestation can be a serious problem if not tackled in the right way. It is obvious that small-scale miners should not be talked into not using timber for supporting their working areas. What can be done in deforestation is to involve officers from the Forestry Department. They can teach the small-scale miners which types of trees are best for their purpose and can also teach them to plant replacement trees for the trees they use (Fig. 5-6).

Dust problems

Dust from small-scale mining operations is mostly limited to the dust inhaled by small-scale miners when they crush the rock. This is particularly dangerous if the dust is rich in quartz. Quartz-rich dust in the lungs causes stone lungs or silicosis which reduces the

Fig. 5-7. Using an inexpensive dust mask during crushing of rocks may prevent stone lungs (silicosis)

breathing capacity and may in severe cases lead to death. Silicosis cannot be cured. Fortunately it is very easy to avoid inhaling dust. A simple, inexpensive mask covering mouth and nose is a very efficient precaution against silicosis (Fig. 5-7).

It should be emphasized that not all rock dust causes silicosis. Small-scale miners working on dolomite on the outskirts of Lusaka create some dust during dolomite crushing. However, dolomite dust does not cause silicosis. This is not to say that the miners should not use masks, but merely that the health risks by crushing dolomite are small.

Chemical pollution

Mercury in the environment

Small-scale gold mining is not yet widespread in Zambia but has started in the north-eastern part of the country, and there is every reason to believe that it will gain momentum. The vast majority of the millions of small-scale gold miners worldwide use mercury to extract gold. This method (called amalgamation) is very efficient, easy to learn and fairly inexpensive. It is described in some detail in Chapter 3.

The major disadvantage of using amalgamation is that mercury is very toxic and stays virtually for ever in the environment. Thus every tonne of mercury released to day by small-scale miners will harm generations to come. It is thus of paramount importance to teach small-scale gold miners either how to recycle the mercury or to use alternative gold extraction methods.

Mercury toxicity

During gold extraction (amalgamation) the metallic mercury evaporates. Some of it will be inhaled by people doing the amalgamation and by local villagers. Mercury which is not inhaled will precipitate with rainfall on the ground and gradually be washed into the drainage system. In the aqueous environment metallic mercury is transformed by bacteria to methylated mercury which

Fig. 5-8. Paths of mercury in the environment and the food chain. Hg is the chemical symbol for mercury. The "story" starts in the lower left corner and goes on clockwise. A small-scale miner burns amalgam and thereby releases metallic mercury. He inhales some of the mercury. The rest of the mercury falls down on the soil with the rain. Then the metallic mercury is converted to methylated mercury and enters the food chain through the drainage system and ends up in cows, hens and fish. When eating them the population is poisoned by methylated mercury.

is even more toxic than metallic mercury. The methylated mercury (also called organic mercury) enters the food chain and eventually ends up in fish which are eaten by people. In this way the local population may get high concentrations of mercury in their bodies (Fig. 5-8).

Health hazards caused by mercury poisoning

Metal mercury

Metallic mercury is dangerous to health and must be handled with outmost care. The metal is able to penetrate the skin. The fumes can neither be seen nor smelled, so there is no warning against inhalation during amalgamation.

In the lungs the metal fumes are easily taken up into the blood and carried around in the body and taken up by various organs. The effects brought about by mercury depend on the dose and the length of the time of exposure. The higher the concentration inhaled, the shorter time is needed to give symptoms of poisoning.

Short exposure to high concentrations of mercury vapour leads to acute poisoning manifested by inflammation of the lungs. An example: Shortly after a tablespoon of mercury-gold amalgam was heated to evaporation on a kitchen stove, the family of an amateur gold prospector and another family living in the basement of the same house became ill with irritations in the lungs, fever, chills, chest pains and breathing difficulties.

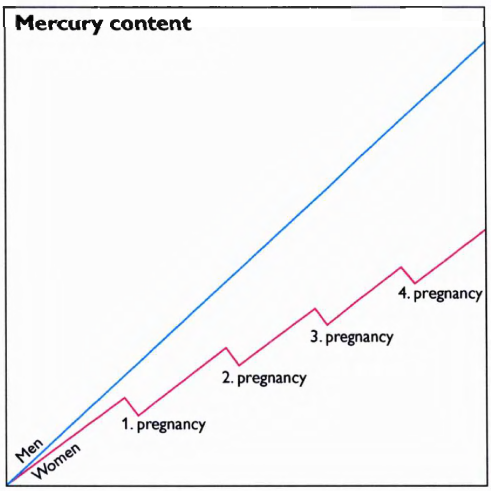

Fig. 5-9. Diagram showing build up of mercury content of men and women from birth to old age. The woman has had four pregnancies. In each case the foetus has extracted much of the mercury from the mother

The classical symptoms of mercury poisoning are tremors. In the beginning the tremors are intentional, that is, only visible when the patient is asked to approach the mouth with a glass of water, to move a finger from a distance to the nose, or to write a signature. Later, the tremors become static, and may spread to the whole body. Erethism is a mental disturbance, characterised by acute irritability, abnormal shyness, indecision and overreaction to criticism. An early sign of erethism is the intensification of tremors by the awareness of being watched. Chronic mercurialism is usually associated with inflammation of the gingiva, and metallic taste.

Mercury in the blood is able to pass the placental barrier, and the foetus will extract a large portion of the mercury from its mother. As the foetal period is the most sensitive to environmentally dangerous chemicals such as mercury, pregnant women should never be exposed to mercury. If a pregnant woman is exposed to mercury she may give birth to a mentally and/or physically disabled child (Fig. 5-9).

Mercury in the blood can also pass the barrier to the brain. Scanning of small-scale miners' brains showed that some of the miners who had used amalgamation for a long time had droplets of metallic mercury in their brains.

Methyl mercury

Methyl mercury can pass the placental barrier and cause development deficiencies in children such as loss of IQ points, decreased language skills, memory and attention. Methyl mercury in adults has also been linked to increased risk of ***cardiovascular disease*** including ***heart attack***. Methyl mercury can cause neurological symptoms such as loss of physical coordination, ***difficulty of speech, narrowing of the visual field*** (tunnel vision), ***hearing impairment, blindness***, and death.

Testing people for mercury in their bodies can be done by analysing blood or urine samples. Collecting blood and urine samples requires a medical doctor, and the storage and shipping of

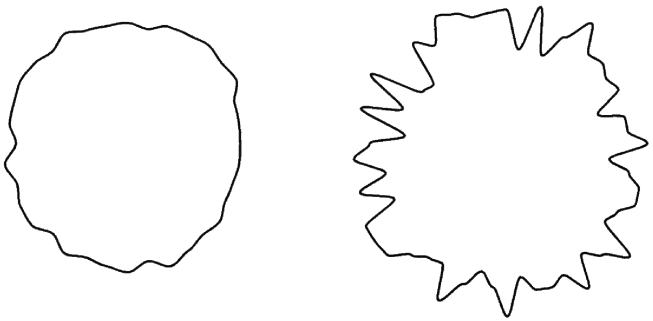

Fig. 5-10. Circles drawn by a person without mercury poisoning (left side) and by a person with mercury poisoning (right side).

the samples are complicated in warm climates. Mercury content of hair mimics to some extent the mercury content of the body. Hair samples can be collected by anybody, and shipping of the samples does not require special containers. Samples of hair in limited numbers can be analysed free of charge by the Japanese Minamata Institute (Dr. K. Nakamura at Department of International Affairs and Environmental Sciences, National Institute for Minamata Disease, Minamata, 4058-18 Hama, Kumamoto, Japan 867-0008. E-mail: kuni@nimd.go.jp). However, the mercury content of hair is not so sensitive as in blood or urine. Negative results from hair samples may thus give a false impression that people have not been poisoned by mercury.

A simple field test is to ask a person to draw a circle. If the person is poisoned by mercury he/she cannot draw a proper circle due to tremors (see Fig. 5-10).

Recycling of mercury in the amalgamation process

Gold extraction by amalgamation releases large amounts of mercury to the environment. The mercury stays in the environment and will harm present and future generations.

There are ways to mitigate this problem e.g. by recycling the mercury which reduces the release of mercury to the environment by

more than 90 percent. Alternative methods of gold extraction have also been developed.

The vital gadget for recycling is the so-called retort. The retort was invented in South America and is used by numerous small-scale miners there, and it is gradually spreading to other parts of the world. A retort is made of a few pieces of plumbing tubes (Fig. 5-11). It can be manufactured in various sizes. It is cheap to manufacture, can be produced in any country, lasts almost for ever and is easy to use.

Training manual for recycling of mercury during amalgamation

1. The first step is to teach the small-scale miners to do a thorough concentration of their heavy mineral concentrate. Fig. 3-18 in Chapter 3 shows how large a concentrate the small-scale miners use when they add mercury. Fig. 5-12 shows a heavy mineral concentrate where the small-scale miner has made a little more effort in concentrating the gold by discarding much more of the other heavy minerals.

2. A few grammes of mercury are added to the gold concentrate. Only a little mercury is needed compared to the example shown in Fig. 3-18 in Chapter 3.

3. The gold amalgamates with the mercury

4. The amalgam is squeezed through a piece of cloth. Mercury which has amalgamated with gold stays in the cloth. Mercury which goes through the cloth does not contain any gold and is stored for later use.

5. The amalgam pellet is placed on a bed of ash in the cup of the retort (Fig. 5-13). The ash is to make sure that the retort is airtight.

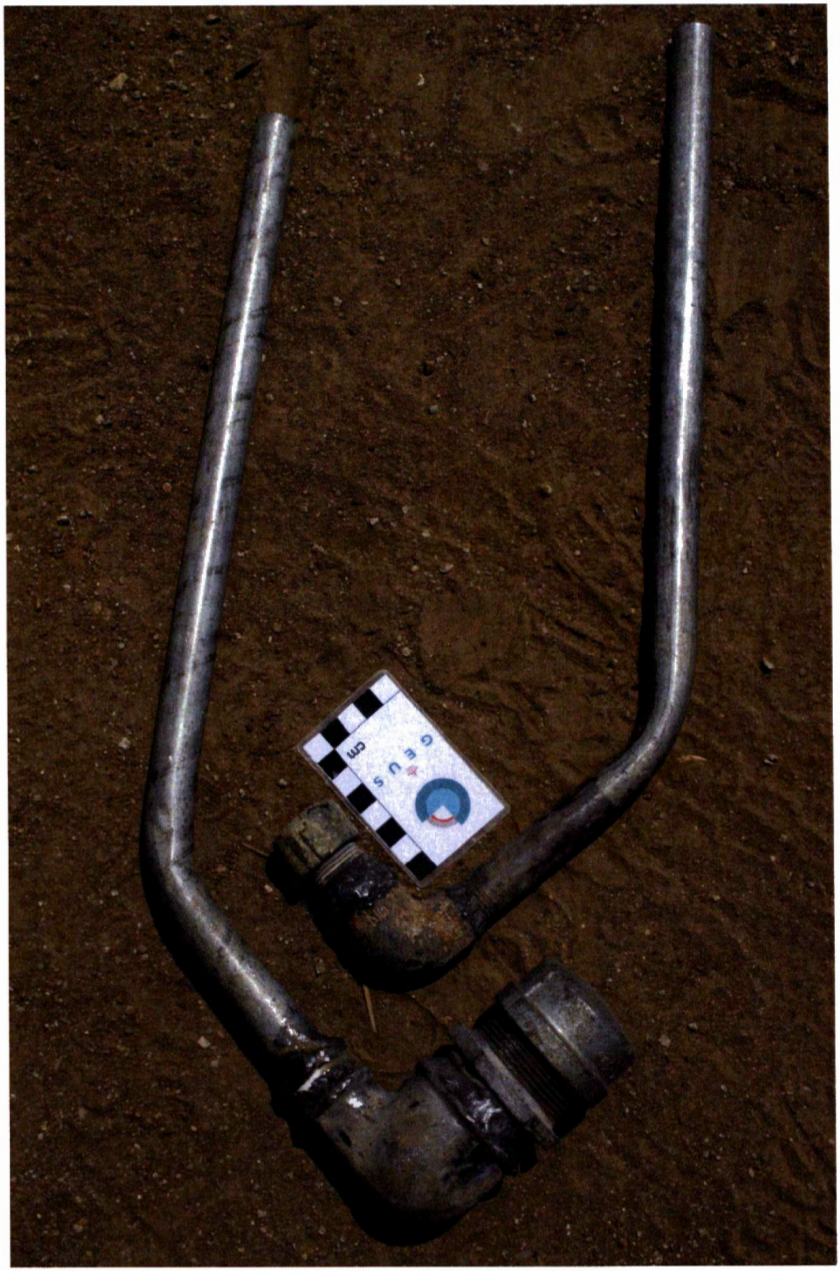

Fig. 5-11. Retort. A recycling device for mercury made of a few pieces of plumbing tubes. Scale is 10 cm.

Fig. 5-12. Small pan for producing a gold concentrate.

Fig. 5-13. Amalgam (mercury – gold mixture) ready for burning in the retort

Fig. 5-14. Teaching small-scale miners in Tanzania how to recycle mercury with a retort.

Fig. 5-15. Heating the retort over a charcoal burner.

Fig. 5-16. Mercury condenses in a bowl of water and can be used again and again.

Fig. 5-17. Burning of amalgam in the retort is finished and the gold is ready for selling

6. The retort is placed on a charcoal burner (Figs 5-14 and 15). The operator blows on the charcoal to increase the temperature. The tube of the retort is placed in a bowl with water and a piece of wet cloth for cooling is placed on the tube.

7. After some time of heating, gentle tapping on the tube will cause the condensed metallic mercury in the tube to run as small drops into the bowl with water (Fig. 5-16). The mercury can be used again and again.

8. After 15 to 20 minutes, depending on the temperature of the charcoal, the retorting is finished. The retort is cooled down and opened and the gold can be seen in the cup of the retort (Fig. 5-17).

Other safety issues

Extracting gemstones from hard rock deposits is often done by hammer and chisel. A major problem is that splinters from the rock may hit the eye and cause blindness if safety goggles are not

Fig. 5-18. Sketch promoting use of safety goggles

used (Fig. 5-18). It is therefore important to instruct workers in using safety goggles which are both efficient and inexpensive.

Pits and tunnels are dangerous working places, but simple inexpensive means, e.g. safety boots, safety helmets and protective gloves, will protect miners against many accidents (Fig. 5-19).

If an accident does happen it is important to have a first-aid kit near the mining site and someone who has been taught the basics of first aid (Fig. 5-20).

Fig. 5-19. Always use safety helmet, boots and gloves

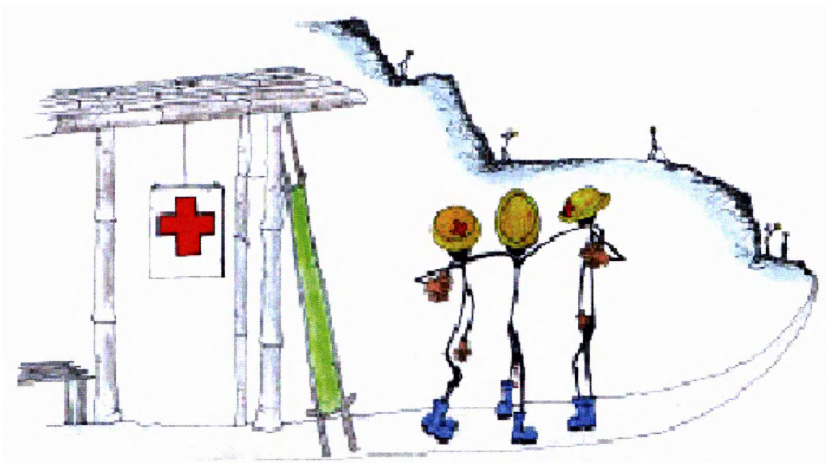

Fig. 5-20. Always have first aid kit available and help in case of accident

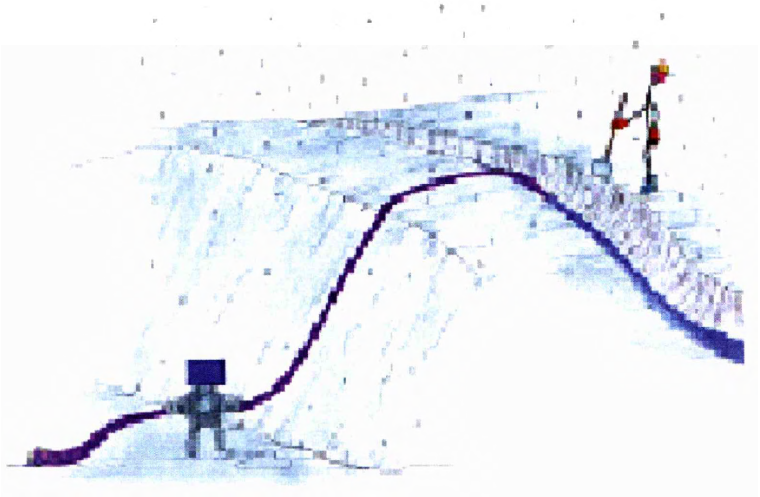

Fig. 5-21. Keep water out of your pit

Malaria

During the rainy season many pits get partly filled with water. These small ponds are excellent breeding grounds for malaria mosquitoes. Too much water at the bottom of the pits also increases the risk of collapse of the walls. It is thus important to drain the pits (Fig. 5-21).

6 Socio-economic issues related to small-scale mining

Small-scale mining (SSM) is a growing economic sector in many African countries. In addition, due to the characteristics of the SSM sector, its potential role in rural development and poverty alleviation within the countries has been widely described and recognized in a number of studies carried out during the last decade.

In its recent medium- and long-term vision and strategic plan, the Government of Zambia emphasizes the potential of the small-scale mining sector in the country – in particular the gemstone sector – as one of the future drivers of economic and social development within rural areas.

Today, however, the SSM sector in Zambia faces a range of socio-economic challenges which must be fully understood and acted upon if the sector is to experience a viable development. Many SSM operations are taking place in rather isolated rural areas with limited or no access to a number of important basic requirements such as water, sanitation, health care, education and communication. Moreover, many SSM sites are accessible only through poor roads.

In the following, some key socio-economic issues related to SSM in Zambia are briefly presented. Focus is on describing socio-economic conditions and trends related to households of SSM employees and illegal miners, which represent the major socio-economic groups of SSM actors in Zambia.

Economic characteristics – income, assets, livelihoods and employment

Demographic studies indicate that the majority of SSM employees and illegal miners in Zambia are married, and that the size of their households is relatively large. A first direct implication of this is the level of income required to ensure the well-being of the household.

Figure 6-1. Mine workers

Studies show that SSM households in Zambia only generate little additional income from other sources, and then mainly from agricultural and/or trading activities. Most households of SSM employees own some assets, mainly in the form of livestock (chickens, goats, cattle) and a few household items (mainly radios and bicycles). Houses are mainly build of grass and mud and are either owned by the household themselves or by the employer.

Many SSM employees seem to work on no or only very low salaries, paid out on a high irregular basis. Instead the employees are often promised that should valuable stones be found, the profits will be shared with them. The income flow for the illegal miners can to some extent be compared to that of the employees.

This leaves a significant number of the households of SSM employees and illegal miners with an average income well below subsistence level, i.e. without sufficient resources to cover basic needs in terms of food and other life necessary items for their household. In addition, due to the insecurity with regard to future income this makes any planning difficult (children's school attendance, medical treatment etc.).

Add to this that the economic conditions of SSM employees often are aggravated when mine owners do not have sufficient capital to continue their mining operations. Most SSM operations start working with pick and shovel; however, at a certain point of time some level of mechanization of the process is often required, which means a need for additional financial and/or technical input.

Experience from the SSM sector in Zambia shows that in many cases SSM licence holders cannot obtain the credit required and/or do not have sufficient technical knowledge, and the operations are therefore closed down. Out of more than 500 gemstone

Figure 6-2. Closed down small-scale mining operation

licence holders in Zambia, the majority are currently not active, mainly due to the financial/technical constraints described above.

From a socio-economic and resource utilization point of view the above-mentioned problems give rise to a number of critical issues:

- Insufficient and insecure present and future income for SSM employees and illegal miners. This seems often to lead to theft and other crime within SSM areas.
- Loss of initial investment (saving, pension) for SSM owners.
- Mine owners with a licence but insufficient capital and/or technical knowledge to develop their mine block the way for people with better capacity.
- Avoidance of payment of company and income tax, pension and compensation funds for employees etc.

These economic characteristics of the SSM sector in Zambia are currently limiting the potential of the sector to contribute to the economic development of Zambia, on the macro as well as the micro level. There seems to be a need for better linking the attainment of mining licenses with the financial and technical capacity of the applicants to develop their mine sites. Besides, the enforcement of the legal aspects of mining operations should be improved.

Education

The educational level of the households of SSM employees and illegal miners in Zambia is in general very low. The majority of the household members have not completed grade 7. The nature of income (low and irregular) for these households serves to give some explanation of why children drop out of school early.

It seems also that gemstone mining represents an important "pull" factor. Gemstone mining does not require any particular skills, and may therefore attract people with low educational skills. The nature of SSM communities (isolated, with little or no demand

for skilled labour), combined with the potential attraction of making fast money in the mining business, limits incentives to continue education in school.

Health and Safety

Overall, *health* problems of small-scale miners in Zambia directly related to the SSM activities appear not to be a big concern. There seems to be relatively little mentioning by small-scale miners of serious health problems and major injuries, and many claim that they take precautions against dust problems.

Some *indirect* health problems from small-scale mining activities can, however, be detected:

- **Malaria**. Open pits filled with water are excellent breeding grounds for mosquitoes, which potentially increase the risk of malaria

- **HIV/AIDS**. The characteristics of SSM communities (remote places, concentration of men away from their wives) make HIV/AIDS a potential high-risk factor

With regards to *safety* issues, the following issues are to be considered:

- **Open pits.** Many pit owners fail to establish fencing around their pits and exploration trenches to prevent people and animals from falling down

- **Protective clothing and/or safety gear.** Many small-scale miners seem not to use adequate protective clothing and/or safety gear.

- **Digging tunnels vs. benching.** Although a large number of small-scale miners working in pits claim that they use benching, there still seem to be a number of places where this is not the case.

- **Other safety measures.** Safety measures such as support of roofs and walls in underground workings are often not carried out.

Women in Small-scale Mining

Empirical studies show that the proportion of women involved in SSM activities may reach 25-30% of the total SSM employment in Zambia. Women, however, typically have more marginalized jobs and fewer earnings from their activities. Main women SSM activities include transporting, washing and sorting stones and collecting materials from dumping sites.

Although women face a number of the same challenges as men with regard to SSM activities (limited or no access to credit, inadequate knowledge and skills, poor technological development etc.), studies reveal that women may be more successful in keeping mining activities going despite the above-mentioned challenges. This seems to be attributed to factors such as women's ability to organize and cooperate better as well as better management and accounting skills. Compared to male SSM owners, female owners also appear to be caring more for their workers in terms of safety and health issues, food support and education.

In addition, several socio-economic studies of women's participation in income-related activities point to the conclusion that women, on average, spend a larger share of their income on children's education and health than men do. This contributes to raising levels of education and health within households and communities.

It is therefore reasonable to believe that a larger and more productive involvement of women in small-scale mining activities will create progress, both for the small-scale communities themselves and the SSM sector in general, and benefit overall socio-economic development and poverty alleviation efforts in Zambia.

Figure 6-3.Woman working with small-scale mining

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Sectoral Activities Programme, Working Paper (W.P. 168), 2001.
International Labour Office – Geneva. ISBN 92-2-112475-4.
Permission to use the drawings has been obtained.

9 Appendix A

Requirements and obligations for obtaining prospecting, exploration and exploitation licences for small-scale and artisanal miners

1. Extract of relevant sections from the Mines and Minerals Development Act, 2008.

(d) the applicant is in breach of any condition of the licence or any provision of this Act.

(7) The Director shall not reject an application on any ground referred to in—

(a) paragraph *(a)* of subsection (6), unless the Director has given the applicant the details of the default and the applicant has failed to remedy the default within three months of the notification;

(b) paragraph *(b)* of subsection (6), unless the Director has given the applicant an opportunity to make written representations thereon to the Director; or

(c) paragraph (c) of subsection (6), unless the Director has notified the applicant and the applicant has failed to propose amendments to the proposed programme of mining operations within three months of the notification.

(8) Subject to the other provisions of this Act, the period of renewal of a large-scale gemstone licence shall be such period, not exceeding ten years, as is reasonably required to carry out the mining programme.

(9) The Director shall, on the renewal of a large-scale gemstone licence, attach to the licence the approved program of mining operations to be carried out in the period of renewal.

PART IV

SMALL-SCALE MINING OPERATIONS

Division I -Prospecting permit

Application for prospecting permit

47. (1) An application for a prospecting permit shall be made to the Director of Geological Survey in the prescribed manner and form upon payment of the prescribed fee.

(2) An application made under subsection

(1) shall include—

(a) a statement of the minerals, other than gemstones, for which the applicant wishes to prospect;

(b) a description and sketch with geographical coordinates of the area of land for which the permit is sought, but not exceeding three hundred cadastre units and

represented by whole numbers of cadastre units, sufficient to enable identification of the area and to provide a plan to be annexed to the permit;

(c) an environmental management plan including the applicant's proposals for the prevention of pollution, the treatment of waste, the protection and reclamation of land and water resources, and for eliminating or minimising the adverse effects on the environment of the prospecting operations; and

(d) a statement of the sum the applicant intends to expend on the prospecting operations;

(e) a description of any mining right which has previously been granted to the applicant or for which the applicant has previously made an application; and

(f) a tax clearance certificate issued under the Income Tax Act. Cap. 323

Consideration of application for prospecting permit

48. (1) The Director of Geological Survey shall, in considering an application made under section *forty-seven* take the following into account:

(a) that the applicant has, or has secured access to, adequate financial resources, technical competence and experience to carry on effective prospecting operations;

(b) that the proposed programme of prospecting operations is adequate and makes proper provision for environmental protection;

(c) where consent is required for the area under any written law, the applicant has submitted evidence of the consent; and

(d) where the area relates to a prospecting area or mining area or part thereof, the applicant has obtained the consent of the holder of the prospecting licence or other licence and the holder thereof will not be prejudiced by the grant of the prospecting permit.

(2) The Director of Geological Survey may cause such investigations to be made or such consultations to be carried on as the Director may consider necessary to assess whether or not the criteria in subsection (1) has been met.

(3) The Director of Geological Survey shall reject an application for a prospecting permit where—

(a) the applicant is disqualified under section *seven* from holding the permit;

(b) the area over which the applicant seeks a prospecting permit is already subject to a mining right; or

(c) the applicant is in breach of any condition of any other mining right or any provision of this Act.

(4) The Director of Geological Survey shall, where the Director of Geological Survey rejects an application under subsection (3), inform the applicant of the rejection and give the reasons therefor.

Grant of prospecting permit

49. (1) The Director of Geological Survey shall, within thirty days of receipt of an application under section *forty-seven,* where the application meets the requirements of this Act, grant a prospecting permit to the applicant on such terms and conditions as the Director may determine.

(2) A prospecting permit shall—

(a) state the date of the grant of the permit, the period for which it is granted and the conditions on which it is granted;

(b) specify the minerals in respect of which it is granted; and

(c) include a description and plan of the prospecting area.

(3) There shall be appended to a prospecting permit the programme of prospecting operations, as approved by the Director of Geological Survey, which shall form part of the conditions of the permit.

(4) The area of a prospecting permit shall not exceed three hundred cadastre units.

Duration of prospecting permit and transfer of permit

50. A prospecting permit shall be granted for a period not exceeding five years and shall not be renewed.

Rights conferred by prospecting permit and transfer of prospecting permit

51. (1) A prospecting permit confers on the holder exclusive rights to carry on prospecting operations in the prospecting area for the minerals, except gemstones, specified in the licence, and to do all such other acts and things as are necessary for or incidental to the carrying on of the operations.

(2) A prospecting permit or any interest therein shall not be transferred, assigned, encumbered or dealt with in any other manner without the approval of the Director of Goelogical Survey.

(3) A holder of a prospecting permit who intends to transfer, assign, encumber or deal in any manner with the permit shall apply to the Director of Geological Survey giving such particulars concerning the proposed transferee, assignee, or other party concerned as would be required in an application for a prospecting permit.

(4) The Director of Geological Survey shall, where an application made under subsection (3) meets the requirements of this Act and the transferee is not disqualified under any provision of this Act from holding a prospecting permit, grant approval to the transfer, assignment, encumbrance or other dealing with the exploration permit or interest therein for the unexpired period of the permit.

(5) Any transaction purporting to transfer a prospecting permit in contravention of this Act is void.

(6) For the purpose of this section, "interest" in prospecting permit means in the case of holder who is a private company, a controlling interest in such holder.

Obligations of holder of prospecting permit

52. A holder of a prospecting permit shall—

(a) give notice to the local office of the discovery of any mineral deposit of possible commercial value in the prospecting area within thirty days of the discovery;

(b) keep at the office of the holder, full and accurate records of the prospecting operations which shall show—

(i) the boreholes drilled;

(ii) the strata penetrated, with detailed logs of the strata;

(iii) the minerals discovered;

(iv) the results of any seismic survey or geo-chemical, geo-physical and remote sensing data analysis;

(v) the results of any analysis or identification of minerals;

(vi) the geological interpretation of the records maintained under items (i) to (v) inclusive;

(vii) the number of persons employed;

(viii) other work done in connection with the prospecting permit;

(ix) the costs incurred; and

(x) such other matters as may be prescribed by the Minister, by statutory instrument; and

(c) keep and preserve for such period as the Minister may prescribe by statutory instrument, records in relation to the protection of the environment.

Restrictions on removal of minerals

53. (1) Except for the purposes of having the mineral analysed or conducting tests on the mineral, a holder of a prospecting permit shall not remove any mineral from the prospecting area without the written permission of the authorised officer at the local office and shall, when so removing any mineral, comply with such conditions as the authorised officer may specify in the written permission.

(2) The Minister may, by statutory instrument, determine the quantities of mineral samples to be removed from a prospecting area for the purpose of mineral analysis or conducting tests on the mineral.

Division II -Small -Scale Mining Licence

Application for small-scale mining licence

54. (1) A holder of a prospecting permit may, at any time during the currency of the permit, apply to the Director for a small-scale mining licence over any part of the prospecting area, in the prescribed manner and form upon payment of the prescribed fee.

(2) An application made under subsection (1) shall include

(a) an identification of the relevant prospecting permit;

(b) a description and sketch of the area of land, not exceeding one hundred and twenty cadastre units, over which the small-scale mining licence is sought, sufficient to enable identification of the area;

(c) a description of the proposed program of mining operations, which shall include a forecast of investment, the estimated recovery rate of ore and the applicant's proposal for its treatment and disposal;

(d) a description to the best of the applicant's knowledge and belief of the mineral deposits in the area over which the licence is sought;

(e) a statement of the duration, not exceeding ten years, for which the small-scale mining licence is sought;

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(f) a tax clearance certificate issued under the Income Tax Act; and

(g) such other information as the Director may require for disposing of the application.

Consideration of application for small-scale mining licence

55. (1) The Director shall, in considering an application made under section *fifty-four* take the following into account:

(a) that the applicant has, or has secured access to, adequate financial resources, technical competence and experience to carry on effective small-scale mining operations;

(b) that the proposed programme of small-scale mining operations is adequate and makes proper provision for environmental protection; and

(c) where consent is required for the area under any written law, the applicant has submitted evidence of the consent.

(2) The Director may cause such investigations to be made or such consultations to be carried on as the Director may consider necessary to assess whether or not the criteria in subsection (1) has been met.

(3) The Director shall reject an application for a small-scale mining licence where—

(a) the applicant has, under section *sixty-two*, been required to apply for a large-scale mining licence;

(b) the applicant is disqualified under section *seven;*

(c) the area in respect of which a small-scale mining licence is sought is in excess of the area required to mine the deposits identified by the applicant; or

(d) the applicant is in breach of any condition of any other mining right or any provision of this Act.

(4) The Director shall, where the Director rejects an application under subsection (3), inform the applicant of the rejection and give the reasons therefor.

Grant of small-scale mining licence

56. (1) The Director shall, within thirty days of receipt of an application under section *fifty-four* where the application meets the requirements of this Act, grant a small-scale mining licence to the applicant on such terms and conditions as the Director may determine.

(2) A small-scale mining licence shall—

(a) state the date of the grant of the licence, the period for which it is granted and the conditions on which it is granted;

(b) specify the minerals in respect of which it is granted; and

(c) include a description and plan of the mining area.

(3) There shall be appended to a small-scale mining licence the programme of mining operations, as approved by the Director, which shall form part of the conditions of the licence.

(4) The area of a small-scale mining licence shall not exceed one hundred and twenty cadastre units.

Duration of small-scale mining licence

57. A small-scale mining licence shall be granted for a period not exceeding ten years.

Rights conferred by small scale mining licence

58. (1) A small scale mining licence confers on the holder exclusive rights to carry on mining operations in the mining area for minerals other than gemstones, and to do all such other acts and things as are necessary for or reasonably incidental to the carrying on of those operations.

(2) Without limiting the generality of subsection (1), a holder of a small-scale mining licence may—

(a) enter into or upon the mining area and take all reasonable measures on or under the surface for the purpose of the mining operations;

(b) erect the necessary equipment, plant and buildings for the purposes of mining, transporting, dressing or treating the mineral recovered in the course of the mining operations;

(c) dispose of any mineral products recovered;

(d) prospect within the mining area for any mineral; and

(e) stack or dump any mineral or waste product.

Obligations of holder of small-scale mining licence

59. (1) A holder of a small-scale mining licence shall—

(a) develop the mining area and commence and carry on mining operations, with due diligence and in accordance with the programme of mining operations;

(b) demarcate the mining area, and keep it demarcated, in the prescribed manner;

(c) maintain at the holder's office—

(i) complete and accurate technical records of the operations in the mining area, in such form as the Director may approve;

(ii) copies of all maps and geological reports, including interpretations, mineral analyses, aerial photographs, core logs, analyses and test results obtained and compiled by the holder in respect of the mining area;

(iii) accurate and systematic financial records of the operations in the mining area and such other books of account and financial records as the Director may require; and

(iv) where the holder is engaged in any other activity not connected with the operations under the mining licence, separate books of account of the operations under the licence;

(d) permit an authorised officer at any time to inspect the books and records maintained in pursuance of paragraph *(a)* and deliver to the Director, without charge, copies of any part of the books and records as the Director may require;

(e) keep and preserve, as the Minister may prescribe, records in relation to the protection of the environment;

(f) furnish the Director with a copy of the annual audited financial statements within three months of the end of each financial year showing the profit or loss for the year and the state of the financial affairs of the holder at the end of each financial year; and

(g) submit to the Director such reports, records and other information as the Director may require concerning the conduct of the operations in the mining area.

(2) A person who—

(a) fails to keep any record or information required to be kept under subsection (1);

(b) fails to supply any record to the Director in accordance with subsection (1); or

(c) supplies any false or misleading record or information;

commits an offence and is liable, upon conviction, to a fine not exceeding two hundred thousand penalty units or to imprisonment for a period not exceeding two years, or to both.

Renewal of small-scale mining licence

60. (1) A holder of a small-scale mining licence may apply to the Director at least sixty days before the expiry of the small-scale mining licence, for the renewal of the licence in the prescribed manner and form upon payment of the prescribed fee.

(2) Subject to subsection (3), the Director shall, where an application for the renewal of a small-scale mining licence complies with the requirements of this Act, renew the small-scale mining licence for a period not exceeding ten years, on such terms and conditions as the Director may determine.

(3) The Director shall reject an application for the renewal of a small-scale mining licence where-

(a) the development of the mining area has not proceeded with reasonable diligence;

(b) minerals in the workable quantities do not remain to be produced;

(c) the programme of the intended mining operations will not ensure the proper conservation and use in the national interest of the mineral resources of the mining area; or

(d) the applicant is in breach of any condition of the licence or any provision of this Act.

(4) The Director shall not reject an application on any ground referred to in—

(a) paragraph *(a)* of subsection (3), unless the Director has given the applicant the details of the default and the applicant has failed to remedy the default within three months of the notification;

(b) paragraph *(b)* of subsection (3), unless the Director has given the applicant reasonable opportunity to make written representations thereon to the Director; or

(c) paragraph *(c)* of subsection (3), unless the Director has notified the applicant and the applicant has failed to propose amendments to the operations within three months of the notification.

(5) The Director shall, on the renewal of a small-scale mining licence, attach to the licence the approved program of mining operations to be carried out in the period of renewal.

Transfer of small-scale mining licence

61. (1) A small-scale mining licence or any interest therein shall not be transferred, assigned, encumbered or dealt with in any other manner without the approval of the Director.

(2) A holder of a small-scale mining licence who intends to transfer, assign, encumber or deal in any manner with the licence shall apply to the Director giving such particulars concerning the proposed transferee, assignee, or other party concerned as would be required in an application for a small-scale mining licence.

(3) The Director shall, where an application meets the requirements of this Act and the transferee is not disqualified under any provision of this Act from holding a small-scale mining licence, grant approval to the transfer, assignment, encumbrance or other dealing with the small-scale mining licence or interest therein for the unexpired period of the small-scale mining licence.

(4) For the purposes of this section, " interest " in a small-scale mining licence means, in the case of a holder who is a private company, a controlling interest in such holder.

(5) Any transaction purporting to transfer a small-scale mining licence in contravention of this section shall be void and of no effect.

Requirement to convert small-scale mining licence to large-scale mining licence

62. (1) The Director may require—

(a) an applicant for a small-scale mining licence; or

(b) the holder of a small-scale mining licence where the Director considers on reasonable grounds that the holder

is engaged in mining operations on a substantial scale;

to apply for a large-scale mining licence.

(2) Where the Director requires an applicant or holder of a small-scale mining licence to apply for a large-scale mining licence under subsection (1), the provisions of this Act shall apply to the applicant as if the applicant were the holder of a prospecting licence who applies for a large-scale mining licence.

Termination of small-scale mining licence for insufficient production

63. Where over a continuous period of three years or longer, a holder of a small-scale mining licence has failed to carry on mining operations in accordance with the proposed plan of mining operation and over such period has in each year of production recovered less than fifty per centum of the ore which should have been recovered under the estimated recovery rate, the Director shall cancel the licence.

Division III - Small-Scale Gemstone Licence

Application for small-scale gemstone licence

64. (1) A person shall apply to the Director for a small-scale gemstone licence in the prescribed manner and form upon payment of the prescribed fee.

(2) An application made under subsection (1) shall include—

(a) a description and sketch, with geographical coordinates of the area of land over which the gemstone licence is sought, but not exceeding one hundred and twenty cadastre units and with whole numbers of cadastre units, sufficient to enable the officers at the local office to identify the area and provide a plan to be annexed to the licence;

(b) the proposed program of mining operations, including a forecast of investment and the estimated recovery rate of ore and gemstones;

(c) a statement, to the best of the applicant's knowledge and belief, of the gemstone deposits in the area over which the licence is sought;

(d) a tax clearance certificate issued under the Income Tax Act; and Cap. 323

(e) such other information as the Director may require for disposing of the application.

Consideration of application for small-scale gemstone

65. (1) The Director shall, in considering an application made under section *sixty-four* take the following into account:

(a) that the applicant has, or has secured access to, adequate financial resources, technical competence and experience to carry on effective small-scale gemstone mining operations;

(b) that the proposed programme of gemstone mining operations is adequate and makes proper provision for environmental protection; and

(c) where consent is required for the area under any written law, the applicant has submitted evidence of the consent.

(2) The Director may cause such investigations to be made or such consultations to be carried on as the Director may consider necessary to assess whether or not the criteria in subsection (1) has been met.

(3) The Director shall reject an application for a small-scale gemstone licence where—

(a) the applicant has, under section *seventy-two*, been required to apply for large-scale gemstone licence;

(b) the applicant is disqualified under section *seven;*

(c) the area over which the applicant seeks a small-scale gemstone licence is already subject to a mining right and the holder has not granted consent;

(d) the area in respect of which a small-scale gemstone licence is sought is in excess of the area required to mine the deposits identified by the applicant; or

(e) the applicant is in breach of any condition of any other mining right or any provision of this Act.

(4) The Director shall, where the Director rejects an application under subsection (3), inform the applicant of the rejection and give the reasons therefor.

Grant of small-scale gemstone licence

66. (1) The Director shall, within thirty days of receipt of an application under section *sixty-four*, where the application meets the requirements of this Act, grant a small-scale gemstone licence to the applicant on such terms and conditions as the Director may determine.

(2) A small-scale gemstone licence shall —

(a) state the date of the grant of the licence, the period for which it is granted and the conditions on which it is granted;

(b) specify the minerals in respect of which it is granted; and

(c) include a description and plan of the mining area.

(3) There shall be appended to a small-scale gemstone licence the programme of mining operations, as approved by the Director, which shall form part of the conditions of the small-scale gemstone licence.

(4) A small-scale gemstone licence shall not be granted over an area exceeding one hundred and twenty cadastre units.

Duration of small-scale gemstone licence

67. A small-scale gemstone licence shall be granted for a period not exceeding ten years.

Rights conferred by small-scale gemstone licence

68. A small-scale gemstone licence confers on the holder the same exclusive rights as a prospecting permit and a small-scale mining licence, but only in relation to gemstones.

Obligations of holder of small-scale gemstone licence

69. (1) A holder of a small-scale gemstone licence shall—

(a) give notice to the Director of the discovery of any mineral deposit of possible commercial value within thirty days of the discovery;

(b) keep and preserve, for such period as the Minister may prescribe, by statutory instrument, the records in relation to the protection of the environment.

(2) A person who contravenes subsection (1)commits an offence and is liable, upon conviction, to a fine not exceeding two hundred thousand penalty units or to imprisonment for a period not exceeding two years, or to both.

Renewal of small-scale gemstone licence

70. (1) A holder of a small-scale gemstone licence may apply to the Director at least sixty days before the expiry of the licence, for the renewal of the licence in the prescribed manner and form upon payment of the prescribed fee.

(2) Subject to subsection (3), the Director shall, where an application for the renewal of a small-scale gemstone licence complies with the requirements of this Act, renew the small-scale gemstone licence for a period not exceeding ten years, on such terms and conditions as the Director may determine.

(3) The Director shall reject an application for renewal of a small-scale gemstone licence where—

(a) the development of the mining area has not proceeded with reasonable diligence;

(b) minerals in workable quantities do not remain to be produced;

(c) the programme of the intended mining operations will not ensure the proper conservation and use in the national interest of the mineral resources of the mining area; or

(d) the applicant is in breach of any condition of the licence or any provision of this Act.

(4) The Director shall not reject an application on any ground referred to in—

(a) paragraph *(a)* of subsection (3), unless the Director has given the applicant the details of the default and the applicant has failed to remedy the default within three months of the notification;

(b) paragraph (b) of subsection (3), unless the Director has given the applicant reasonable opportunity to make written representations thereon to the Director; or

(c) paragraph *(c)* of subsection (3), unless the Director has notified the applicant and the applicant has failed to propose amendments to the operations within three months of the notification.

(5) The Director shall, on the renewal of a small-scale gemstone licence, attach to the licence the program of mining operations to be carried out in the period of renewal.

Transfer of small-scale gemstone licence

71. (1) A small-scale gemstone licence or any interest therein shall not be transferred, assigned, encumbered or dealt with in any other manner without the approval of the Director.

(2) A holder of a small-scale gemstone licence who intends to transfer, assign, encumber or deal in any manner with the licence shall apply to the Director giving such particulars concerning the proposed transferee, assignee, or other party concerned as would be required in an application for a small-scale gemstone licence.

(3) The Director shall, where an application meets the requirements of this Act and the transferee is not disqualified under any provision of this Act from holding a small-scale gemstone licence, grant approval to the transfer, assignment, encumbrance or other dealing with the small-scale gemstone licence or interest therein for the unexpired period of the licence.

(4) For the purposes of this section, " interest " in a small-scale gemstone licence means in the case of a holder who is a private company, a controlling interest in such holder.

(5) Any transaction purporting to transfer a right in contravention of this section is void and of no effect.

Requirement to convert small-scale gemstone licence to large-scale gemstone licence

72. (1) The Director may require—

(a) an applicant for a small-scale gemstone licence; or

(b) the holder of a small-scale gemstone licence where the Minister considers on reasonable grounds that the holder is engaged in mining operations on a substantial scale;

to apply for a large-scale gemstone licence.

(2) Where the Minister requires an applicant or holder of a small-scale gemstone licence to apply for a large-scale gemstone licence under subsection (1), the provisions of this Act shall apply, with any necessary modifications, to the applicant as if the applicant were the holder of a prospecting licence who applies for a large-scale mining licence.

Termination of small-scale gemstone licence for insufficient production

73. Where a holder of a small-scale gemstone licence has failed to carry on mining operations in accordance with the proposed plan of mining operations and the gross proceeds of sale of minerals from an area subject to the small-scale gemstone licence in each of any three successive years is less than half of the deemed turnover applicable to that licence in each of those years, the Director shall cancel the licence.

PART V

ARTISANAL MINING

Application for artisan's mining right

74. (1) Any citizen of Zambia who has identified a mineral deposit may apply to the Director for an artisan's mining right.

(2) An application for an artisan's mining right shall be made in the prescribed manner and form upon payment of the prescribed fee.

Grant of artisan's mining right

75. (1) Subject to this section, the Director shall, within thirty days of receipt of an application under section *seventy-four*, and on the recommendation of the Mining Cadastre Office, grant an artisan's mining right to the applicant, to explore and mine the deposit referred to in the application.

(2) An artisan's mining right shall—

(a) identify the minerals in respect of which it is granted; and

(b) be granted over an area not exceeding two cadastre units, not being an area that is already subject to a mining right, which shall be delineated on a plan attached to the right.

(3) The Director shall, where the Director is satisfied that in a particular area, mining operations are being carried on a community basis in accordance with customary practices, authorise such operations by the grant of an artisan's mining right to the chief of the area or such other person as the Minister may, by statutory instrument, prescribe.

(4) The Director shall not grant an artisan's mining right to any person disqualified by section *seven* or who has been convicted of an offence under this Act.

(5) The Director shall, where the Director rejects an application under this Part, give the applicant the reasons therefor.

Duration of artisan's mining right

76. An artisan's mining right shall be valid for a period of two years.

Renewal of artisan's mining right

77. (1) A holder of an artisan's mining right may apply to the Director at least sixty days before the expiry of the artisan's mining right, for the renewal of the artisan's mining right in the prescribed manner and form upon payment of the prescribed fee.

(2) Subject to subsection (3), the Director shall, where an application for the renewal of an artisan's mining right complies with the requirements of this Act, renew the artisan's mining right for a period not exceeding two years, on such terms and conditions as the Director may determine.

(3) The Director shall reject an application for renewal of an artisan's mining right where—

(a) the development of the mining area has not proceeded with reasonable diligence;

(b) minerals in workable quantities do not remain to be produced;

(c) the programme of the intended mining operations will not ensure the proper conservation and use in the national interest of the mineral resources of the mining area; or

(d) the applicant is in breach of any condition of the right or any provision of this Act.

(4) The Director shall not reject an application on any ground referred to in—

(a) paragraph *(a)* of subsection (3), unless the Director has given the applicant the details of the default and the applicant has failed to remedy the default within three months of the notification;

(b) paragraph *(b)* of subsection (3) unless the Director has given the applicant reasonable opportunity to make written representations thereon to the Director; or

(c) paragraph *(c)* of subsection (3) unless the Director has notified the applicant and the applicant has failed to propose amendments to the operations within three months of the notification.

(5) The Director shall, on the renewal of an artisan's mining right, attach to the licence the approved program of mining operations to be carried out in the period of renewal.

Rights conferred by artisan's mining right

78. An artisan's mining right shall confer on the person to whom it is granted, or in the case of a right granted in accordance with subsection (3) of section *seventy five,* on the community concerned, exclusive rights to mine according to its terms in respect of the mineral specified in the permit within the area for which it is granted.

Suspension or cancellation of artisan's mining right

79. The Director may suspend or cancel an artisan's mining right where—

(a) the holder of the right has been disqualified under section *seven;*

(b) the holder has been convicted of an offence under this Act; or

(c) the holder contravenes this Act or any condition of the right.

Right to building materials

80. (1) Except as otherwise provided by statutory instrument made under this Act, nothing in this Act shall prevent—

(a) the taking, by the owner or occupier of any land that is not subject to a mining right, of limestone or other building materials ordinarily used for building, road making or agricultural purposes, from the land, where—

(i) the materials so taken are for use on the land; and

(ii) such owner or occupier is the holder of a permit from the Director authorising such taking;

(b) the taking, by the holder of a mining right in respect of any land, of such materials from the land for use on the land;

(c) the taking, by the owner or occupier of any land that is subject to a mining right, of such materials from the land with the consent of the holder of the mining right and for use on the land; or

(d) the taking by the Republic, any local authority, a highway authority, or any person duly authorised by any such authority and acting under the Public Roads Act, of such materials for public purposes.

(2) The provisions of this section shall not affect any requirement of this or any other Act to obtain any requisite consent from any owner or occupier of land or any public authority or other person.

Obligations of holder of artisan's mining right

81. (1) A holder of an artisan's mining right shall—

(a) maintain at the holder's office—

(i) complete and accurate technical records of the operations in the mining area, in such form as the Director may approve;

(ii) copies of all maps and geological reports, including interpretations, mineral analyses, core logs, analyses and test results obtained and compiled by the holder in respect of the mining area;

(iii) accurate and systematic financial records of the operations in the mining area and such other books of account and financial records as the Director may require; and

(iv) where the holder is engaged in any other activity not connected with the operations under the artisan's mining right, separate books of account from the operations under the licence;

(b) permit an authorised officer at any time to inspect the books and records maintained in pursuance of paragraph *(a)* and deliver to the Director, without charge, copies of any part of the books and records as the Director may require;

(c) keep and preserve, as the Minister may prescribe, records in relation to the protection of the environment;

(d) submit to the Director such reports, records and other information as the Director may require concerning the conduct of the operations in the mining area; and

(e) furnish the Director with a copy of the financial statements within three months of the end of each financial year showing the profit or loss for the year and the state of the financial affairs of the holder at the end of each financial year.

(2) A person who—

(a) fails to keep any record or information required to be kept under subsection (1);

(b) fails to supply any record to the Director in accordance with subsection (1); or

(c) supplies any false or misleading record or information; commits an offence and is liable, upon conviction, to a fine not exceeding two hundred thousand penalty units or to imprisonment for a period not exceeding two years, or to both.

PART VI

MINERAL PROCESSING LICENCE

Application for mineral processing licence

82. (1) An application for a mineral processing licence shall be made to the Director of Geological Survey in the prescribed manner and form upon payment of the prescribed fee.

(2) An application referred to in subsection (1) shall include—

(a) a full description of the area of land over which the licence is sought, including its surrounding settlements or developments and plans of the area prepared in such a manner and showing such particulars as the Director of Geological Survey may require;

(b) a statement of the minerals to be processed;

(c) a copy of the applicant's title to the land or written consent from a surface right holder or mining right holder;

(d) the proposed programme for mineral processing operations including a forecast of plant capacity, capital investment, facilities, mineral processing methods and the estimated mineral recoveries;

(e) an environmental management plan including the applicant's proposals for the prevention of pollution, the treatment of waste, the protection and reclamation of land and water resources, and for eliminating or minimising the adverse effects on the environment of

Appendix B

Check list for personnel of Environmental Council of Zambia during inspection of small-scale mining activities

Check list for ECZ personnel during inspection of small-scale mining activities

General information	
District	
Name of small-scale mine	
Licence number	
GPS location	
Has the mine an EPB?	
Prospecting/reconnaissance	
How many trenches and pits have been dug since prospecting started?	
Was the dug out material deposited on a safe site so it cannot be washed down slope during heavy rainfall?	
Have trenches been refilled after use?	
Have badlands been reclaimed (e.g. plants or trees planted)?	
Hard rock mining	
Earth removal activities	
How much overburden has been removed since last inspection?	
Has the overburden been deposited at a safe place with no risk of being washed down slope during heavy rain?	
Have tailings been deposited at a safe place with no risk of being washed down slope during heavy rain?	
Excavation	
Arial extent of pit	
How deep is the pit?	
Is the pit filled with water for extended periods?	
Are there high steep walls which could cave in or cause rock fall?	
Is benching used during excavation?	
Does the bench size exceed 1.5 m in height and 2 m in width?	
How much has been excavated since last inspection?	
Has the pit been fenced in?	

Underground mining	
Is tunnelling used in the mining operation?	
Are roofs and walls of the tunnels properly supported?	
Eluvial mining	
Is the ore (soil with precious minerals or metals) processed at the mining site or carried to nearby streams?	
Has a dam been constructed at or near the mining site for washing the precious stones?	
Is the water in the dam blocked from running down into the drainage system?	
If the ore is carried to a nearby stream, is the processing carried out in a way to prevent siltation of the river, such as settling ponds?	
Placer mining	
How much sand and gravel has been processed since last inspection?	
Where was the processed sediment deposited?	
Which measures have been taken to restore the river bed?	
Which measures have been taken to prevent siltation of the river?	
Deforestation	
Have the miners cleared large areas for trees?	
What do they use the wood for: cooking or mining purposes?	
What are their plans for planting trees?	
Closing down mining operations	
Has the pit been refilled, and the ground levelled?	
If the pit has not been refilled has measures been take to prevent people or animals to fall into the pit e.g. fencing?	
Has removed overburden been brought back to cover the levelled working areas, and measures been taken to regain vegetation?	
Has removed tailings or host rock been deposited in a way to prevent them to be washed into the drainage system during heavy rain?	
Have trees or plants been planted on dumps of overburden/tailings in order to reclaim the land?	
Has Forestry been consulted in order to plant the best trees or plants for reclaiming the mining site?	
Has the mining site been cleared for mining equipment, garbage and other items related to the mining operation?	
Safety measures	
Do small-scale miners use protective clothing and footwear?	
Do small-scale miners use hard hats?	
Do small-scale miners use safety goggles?	
Is first aid kit easily available?	
Are dust masks used during crushing?	

Appendix C

How to start as a small scale miner

GEUS

How to start as a small scale miner

First step is to obtain the appropriate permit forms:

Mines development department. Registry of Mining rights.
P. O. Box 31969.10101
Lusaka.

Below is a scheme with all relevant details

Prospecting permit

The application shall among other include

- a statement of the minerals the applicant want to prospect for
- a description and sketch of the area of land for which the permit is sought, sufficient to enable identification of the area and to provide a plan to be annexed to the permit
- a statement of the sum the applicant intends to expend on his prospecting operations; and

The Director shall, within thirty days of receipt of an application duly made, grant a prospecting permit to the applicant.

Exploitation licence/Gemstone mining licence

If a prospector has been successful and discovered minerals, not including gemstones, in commercial quantities then next step is to apply for a small-scale mining licence for removal of minerals. An exploitation licence allows the owner to extract the commodity/commodities which h has found. The owner may use mechanised mining method or use hammer and chisel depending or the type of ore he has found. There are a number of requirements as to auditing, taxation, safety for his employees and environmental concerns.

An exploitation licence has requirements and obligations all of which cannot be listed here. Two important conditions are:

1. The license area cannot exceed four hundred hectares.
2. The duration of the licence cannot exceed ten year, but the license can be renewed.

The above information on legal rights and obligations are for small-scale mining for all other commodities than gemstones. A similar set of rules are set if a person or group of persons want to prospect and later extract gemstones. This type of extraction licence is called Gemstone Mining Licence.

List of ECZ offices to contact for further information on environmental matters:

Head office
The Director
P.O.Box 35131, Lusaka
Tel. 260-1-254130/1
Fax. 260-1-254164/254023
E-mail: ezc@necz.org.zm

Chirundu Border Office
Technical Officer
P. O. Box CRU 31, Chirundu
Tel/Fax: 260-1-515261
E-mail: ecz@necz.org.zm

Northern Regional Office
Regional Manager
P.O.Box 71302, Ndola
Tel: 260-2-621048/610407
Fax: 260-2-610246
E-mail: ecz@necz.org.zm

Livingstone Office
Senior Inspector
P. O. Box 60195, Livingstone
Tel/Fax: 260-3-321295
E-mail: ecz@necz.org.zm

Important environmental and health concerns related to small-scale mining

Small-scale mining for gemstones create a number of environmental problems which must be mitigated as much as possible:

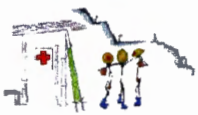
1. Land degradation. Exploration and mining pits damage the surface and prevent future use for farming. Deep pits without fencing pose risks for people and cattle. Benches should not be more than 1.5 m high and at least 2 m wide. This will facilitate walking up bench with heavy load and prevent stones falling from above to harm the workers in the bottom of the pit.

Fence your pit

Avoid high steep walls.
Use benching

2. Siltation of rivers. Before mining an ore body the overburden must often be removed and deposited elsewhere. The dumps of overburden or tailing have to be protected to prevent the material being washed into the rivers during heavy rainfall. If the material is washed into the rivers they may clog up or become full of fine-grained material which will disturb the fish stock in the rivers.
3. Deforestation. Underground mining ought to use timber for supporting walls and tunnels.
4. Crushing rocks create a lot of dust. If the crushed rock has high contents of quartz (silica) the dust may cause stone lungs or silicosis. This can be easily avoided by using a simple low cost dust mask.
5. Mining with hammer and chisel in hard rock may damage your eyes of you do not protect them.

Use safety goggles



Have emergency equipment ready

Use of dust mask will prevent (silicosis) stone lungs

ENVIRONMENTAL COUNCIL OF ZAMBIA

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