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SMALL-SCALE MINING IN ZAMBIA

BY

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SMALL-SCALE MINING IN ZAMBIA

ABSTRACT

The literature on the mineral deposits and small-scale mining activities in Zambia has been reviewed. The present state of the industry has been described with particular reference to the supportive services given by various institutions. The way in which the research, government and mining institutions could be of assistance to small-scale miners in matters concerning geology, mining, mineral processing, safety, marketing and finance is highlighted. In conclusion, policy recommendations which would assist the development of this industry on a sound basis are made.

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1. INTRODUCTION

1.1. OBJECTIVE

Small-scale mining in Zambia has historically been, and still is overshadowed by the big copper mines on the copperbelt. As a result, the mineral policies adopted by the government have been in favour of the big mines to the near exclusion of the small mines. Recently, however, there has been increasing interest in small-scale mining as evidenced by the establishment of the small mines equipment centre and legislation aimed at controlling the mining activities.

Exploitation of mineral deposits at small scale has been carried out since the 1930s but it is only from the late 1970s that the public has shown keen interest in this economic activity. Minerals such as gold, cassiterite, feldspar and magnetite have been exploited for the domestic industry and thus save importation and improve the self-sufficiency of the country. Since the Government Commission of inquiry into the emerald industry in 1979, there has been a general awareness of the potential contribution small-scale mining can make to government revenue and foreign exchange earnings. This sector, therefore, can not be neglected and it is imperative that a mineral policy be adopted specifically suited to the needs of the small miners.

The objective of this study is to examine the small-scale mining industry in Zambia from the government's point of view and to make some policy recommendations for its consideration.

1.2. SCOPE OF WORK

In order to appreciate the contribution small-scale mining can make to the economy, section 2.0 of the report discusses the general economic situation of Zambia and shows, to some degree, the negative impact the scarcity of foreign exchange has had on the social and economic infrastructure. The dual economy is highlighted and the country's efforts to diversify the economy in particular to agriculture are mentioned.

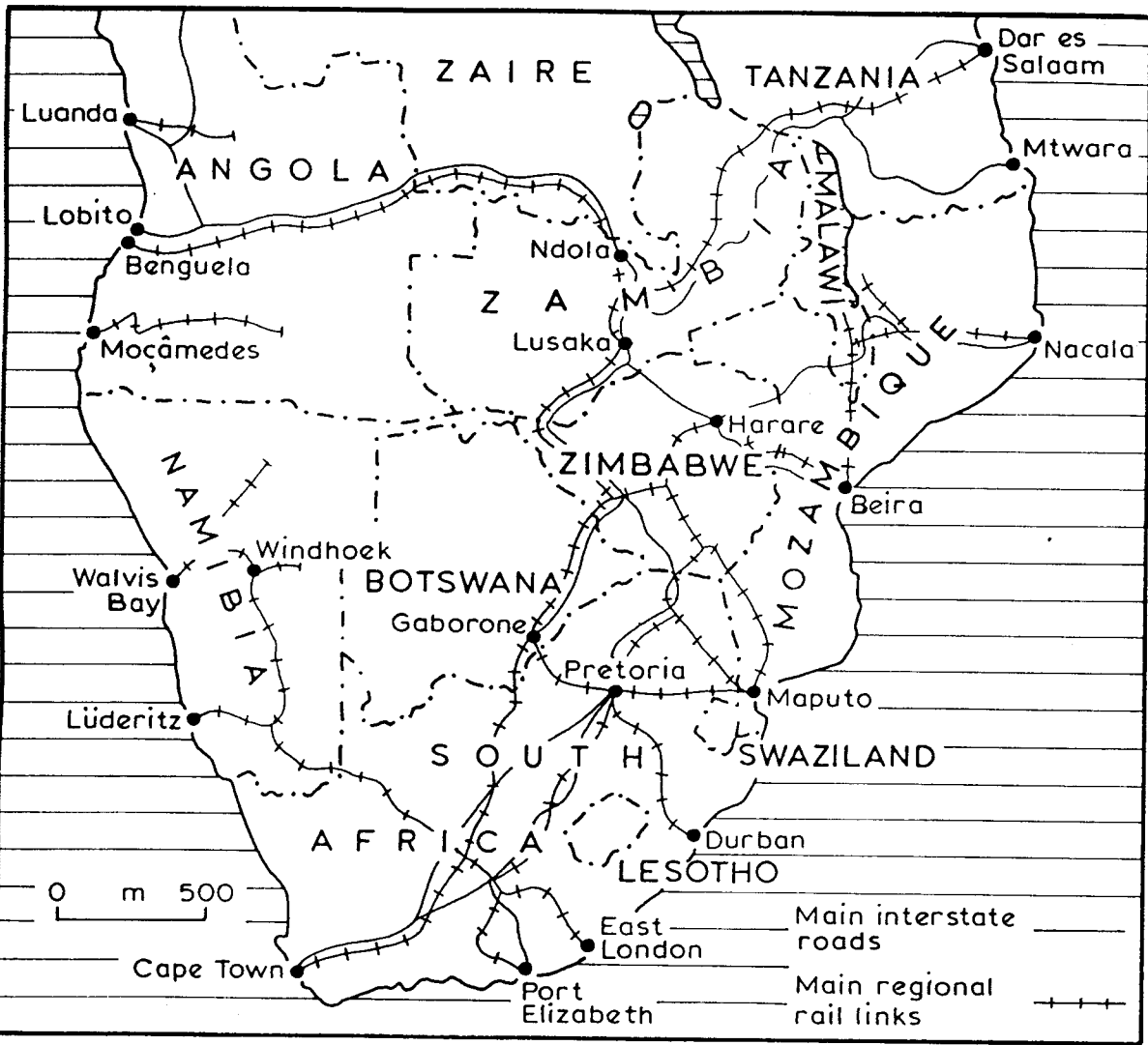
Section 3.0 discusses the requirements for small-scale mining to thrive, its benefits and costs. A review of small-scale mining activities in section 4.0 and the mineral potential for developing such an industry to the levels equal to or above those of the neighbouring states given a thriving industrial base is highlighted.

Finally, in order to discuss and make some policy recommendations in section 6.0, section 5.0 discusses the role of the state. It reviews the current institutional and fiscal policies in Zambia.

1.3. SOURCES OF INFORMATION

Many articles have been written on the impact of small-scale mining on the social structure, particularly in rural areas and its important contribution to the national income. Of particular note are

the United Nations Study of 1972 on small-scale mining in the developing countries; the articles in the report compiled by the Association of Geoscientists for International Development (AGID, report No. 8); and the paper supplied by the Ministry of Mines, Zimbabwe. In addition, other United Nations publications and many articles in international mining magazines proved invaluable in writing this report.



MAP OF SOUTHERN AFRICA

FIG. 1

2. THE ZAMBIAN ECONOMY

2.1. GENERAL

Zambia which was formerly known as Northern Rhodesia became an independent republic on 24th October, 1964. It is 752 614 square kilometres in extent and landlocked, being bound on the north by Zaire and Tanzania; on the east by Malawi; on the south by Mozambique, Zimbabwe, Botswana and the Caprivi Strip of Namibia; and on the west by Angola. The population is about 6 027 000 (1984) of whom 40 percent live in urban areas, making Zambia the most urbanised country in Africa.

Most of the land is at an altitude of 1 000 to 2 000 metres above sea level. The country has a typical tropical landscape - spacious rolling wooded land. The annual rainfall is from November to March and ranges from 1 250 mm in the north to 500 mm in the south.

2.2. HISTORICAL PERSPECTIVE

The history of Zambia has been very well documented by Philip Daniel (1) and Sir Ronald Prain (2). It will briefly be covered here as a prelude to the discussion on the Zambian economy.

In 1880 the British South Africa (BSA) Company, under the pioneership of Cecil Rhodes, obtained mining and commercial concessions over Northern Rhodesia. Cecil Rhodes' dream of gold north of the South African reefs was the main force behind the BSA company's drive into

Northern Rhodesia. The railway line, which was to be the main mode of transport, was constructed from the Cape to Broken Hill (Kabwe) in 1906. The railway into Zambia fostered the development of the mining industry, for soon afterwards a lead/zinc mine was established at Broken Hill. The success of the copper mines in the nearby Shaba Province renewed prospecting activities in what is known today as the Copperbelt. By 1930, earnest exploitation of the Copperbelt orebodies began. Mines were developed at Bwana Mkubwa, Kansashi, Roan Antelope (Luanshya), Nkana, Kalulushi, Mufulira, Nchanga and Bancroft (Konkola).

The Northern Rhodesia territory remained under the administration of the BSA company until 1924 when the charter expired and the territory became a British Protectorate. In 1953, a Central African Federation was imposed on the Rhodesia and Nyasaland and it was administered from Salisbury in Southern Rhodesia. This federation gave birth to nationalism; the political elites of the three countries united together in its opposition. This culminated in the dissolution of the federation in 1963 and the granting of independence to Zambia in 1964.

2.3. THE ECONOMY

2.3.1. Dependence on the copper industry

Copper mining, from its development in the 1930's has been a dominant economic activity and has overshadowed the development of any other industry, for example, in 1965 the copper industry alone provided 41 percent of the Gross Domestic Product (GDP), 71 percent of the

government revenue and 92 percent of the gross domestic exports. This dependence on a single industry for government revenue and foreign exchange made Zambia vulnerable to the downturns in the copper market.

In 1971, the contribution of the copper industry to GDP and government revenue were 25 and 32 percent respectively but the contribution to domestic exports remained almost unchanged at 95 percent. Thus, while the contribution to the government revenue and GDP declined, the copper industry contributed the same proportion to the value of domestic exports. In other respects, the industry had become less profitable and the foreign exchange position of the country was deteriorating. As Table 1 shows, from 1977 to date, the government has received virtually nothing in terms of revenue from this industry and in some ways, the industry has become a liability to the government. This poor performance can be attributed to a number of exogenous factors such as the volatile copper prices on the London Metal Exchange (LME), the ever escalating costs of imported inputs, production costs and transport costs. As a consequence, the government has not been able to sustain investment in agriculture, industry and the social infrastructure.

To overcome some of the difficulties brought about by the drop in revenue and foreign exchange earnings from the copper industry, the government has had to depend on external borrowing (Table 2). The external debt was only US \$ 247 million in 1969 and the service payments in the same year were 2.2 and 4.8 percent of exports and government revenue respectively. This increased over the years to US \$ 2.6 billion in 1983 with service payments being 12.6 and 16.5 percent of the exports

and government revenue respectively. Between the years 1981 to 1983 inclusive, service payments averaged at 19.5 and 24 percent of the exports and government revenue respectively. The statistical figures show how heavily indebted the Zambian government has become over the years with a big proportion of its foreign exchange earnings from exports being channelled to debt service payments. The service payments constitute a burden on the Zambian foreign reserves as most of its developing industries which are aimed at import substitution have substantial imported inputs.

As a consequence of shortfalls in revenue for the government, it has experienced recurring budget deficits which have had to be financed by internal non-bank and bank borrowing, foreign loans and grants (Table 3). Moreover, at independence the nationalist leaders looked to the copper industry to provide not only government revenue but also foreign exchange badly needed to pay for the imported capital goods and materials required for the development programmes. Since then, there have been three five-year National Development Plans and some of their objectives were to diversify the economy, bring about integration between the economic sectors and substitution of imports. A broad manufacturing industry has been established producing sugar products, processed food, leather shoes, furniture, fabricated steel, copper and electrical cables, refined petroleum, glass, textiles, explosives, fertilizers and many others. The main constraint to this programme has been poor availability of foreign exchange as these manufacturing concerns are heavily dependent on imports of machinery, spares and raw material inputs. The Bank of Zambia reported in 1982, quote "The Mining

Industry, and indeed the ~~Zambian economy generally, is very~~ import-intensive: some 80 percent of imports are production or investment related; and the direct cost of imports represents at least 40 percent of the foreign exchange earnings of the mining industry, while the indirect costs are higher still since so many local purchases contain imported inputs".(3)

The statement sums up well the fate of the manufacturing concerns due to heavy dependence on imported inputs. These inputs are materials such as equipment, chemicals and fuel whose prices have tended to increase at a faster rate than the price for Zambia's chief export, Copper. In other words, the terms of trade for Zambia have tended to deteriorate resulting in a decrease in the money receipts thereby forcing the government to spend more of its foreign reserves than it is able to generate in order to sustain its industries. Thus, while Zambia has to a certain extent expanded its industrial base, it has not been able to develop exports for both distant and regional markets for foreign exchange generation.

2.3.2. Agriculture

The key structural characteristic of developing countries is the dualism in their economies between a subsistence, relatively poor, mostly agricultural sector and a modern relatively rich, most industrial sector. The economic units in the subsistence section, the family, village or tribe engage in production of staple foods and thus they combine both roles of producers and consumers with little exchange among

each other. This sector, has over the years tended to increase cash crop production but still on a part time basis. The increase can be attributed to the expansion of the money economy and the provision of better agricultural extension services by the government. The modern sector, on the other hand is very complex and is characterised by industries, plantations and commercial enterprises. The success of this sector is dependent on trade, more importantly participation on the international markets.

In the case of Zambia, the economy remains highly dualised, with 60 percent of the population living in rural areas where income per capital averages less than one third the level in the modern sectors. The low level of income from agriculture has resulted in poor growth of food production and an acceleration of rural to urban migration. Suffice to add that the development of the copper industry and the wage economy in general, have exercised little direct impact on agriculture. Since independence, the government has exercised control on food prices in order to keep them at levels that those in the wage economy, in particular the mining industry, can afford. In other words, those in the subsistence and agricultural sector were subsidising those in the wage economy by not charging economic prices for their commodities. These price controls were deemed necessary to stave off any unrest in the mining industry which was considered the backbone of the Zambian economy. Thus, while price controls have been good from the government's point of view, they have been a disincentive to the agricultural industry and as a consequence food production has never kept pace with population growth which occurred mostly in urban areas.

The poor performance of the economy principally due to the falling world copper and cobalt prices and exacerbated by rising import costs, external transport problems, regional political instability, the energy crisis and, most recently, drought have brought about the need to expand the agricultural sector not only to make the country self sufficient in food but for export as well. To that effect, the government in 1980 launched the "Operation Food Production" Project which is to last until 1990. In order to boost agricultural output, incentives have been provided, for example, producer prices have been raised to economic levels; foreign exchange allowance when marketed quantities are in excess of certain minimum levels of output; and low tax rates.

The mining industry has, 20 years after independence, seriously answered the call for increased food production by establishing commercial farms; so too has the Zambia Congress of Trade Unions (ZCTU) set up its own agricultural projects. Private companies have joined the national campaign for increased food production probably due to the foreign exchange incentive. This, in the main, demonstrates a national awareness that even though the nation could not be performing well economically, it should still afford to feed itself. This is much called for now that the whole sub-saharan region has been on the verge of a food crisis for a long time due to a persistent drought.

2.3.3. Trade Routes

As stated elsewhere, Zambia is a landlocked state completely dependent for her outlet to the sea on routes through the neighbouring states. These transport routes are essential for Zambia's participation in world trade. The closure of the border between Zambia and Rhodesia in 1973 and the outbreak of the civil war in Angola in 1975 disrupted Zambia's trade routes at a very high cost to the economy. Hall (4) reporting about the Unilateral Declaration of Independence (UDI) by Rhodesia in 1965 said, quote, "Countless estimates of the economic cost to Zambia from UDI have been made. After only four years, the damage was officially put in Lusaka at £50 million".

Zambia heavily depended on the southern route for its exports to reach their markets and the smooth flow of equipment, spareparts and other inputs needed to maintain the mining operations and other industries. The transport costs for imports and exports were escalating and by 1965 copper was being airlifted to Dar es Salaam direct from Ndola and the same aircrafts were used to fly oil into the country. As a result, the high costs of this form of transport lead to a serious erosion of industrial profitability.

2.3.4. Exchange Rate

The exchange rate of the currency of a developing country against the "hard" currencies of the developed countries, especially the United States dollar and Sterling gives a crude measure of the economic

performance of a country. This exchange rate can be considered an indicator of the performance of the domestic currency in the international money markets. The causal factors of exchange rate fluctuations are varied. Evident recently is political instability in a Southern African state where it has, to an extent, eroded business confidence and resulted in some measure of disinvestment. This means poor demand for a domestic currency which in turn depreciates its value.

Other causal factors which are of interest are "structural changes" between governments (5). Structural changes are taken to mean relative inflation rates, comparative rates of innovation and technological change, comparative rates of discovery of natural resources, and the balance of flows of capital and government transfer payments. For example, the main export and earner of foreign exchange in Zambia is copper which is an old metal and does not attract new investment easily. There is called for need to shift away from this traditional industry to others or a discovery of a new raw material like oil which will in many ways alleviate the current account deficits. A discovery of a new raw material attracts foreign investment which is instrumental to the appreciation of a domestic currency and improves the importing strength of the country. As can be seen from Table 4, the Kwacha-Sterling exchange rate from 1968 to 1983 was never below 0.50. It may be attributed to the Kwacha being traded at a fixed exchange rate and thus being overvalued. With the worsening of the economic situation in the past five years, little or no investment at all, the government decided to float the Kwacha in 1984. The first year of floating the Kwacha saw a 21 percent drop in its value. The first six months of this

year saw the Kwacha drop to its historical lowest level from 0.37 in January to 0.33 in June and the end of the year could see it drop to its worst level. Such market moves show a poor demand for the Kwacha and reflect lack of foreign investment in the country which could be the result of foreign concerns lacking security for their slow yielding investments.

We have so far looked at the Zambian economy in general, its dependence on copper and the consequences for such a dependence. The Mining industry's effort has been to maximise the earnings of foreign exchange to fuel the diversification drive. Some measure of diversification has been achieved but the scarcity of foreign exchange has reduced industrial productivity, retarded industrialisation and the implementation of development programmes. Furthermore, there has been no real economic growth since the mid-seventies and as a consequence, unemployment is high and the standard of living is falling. It may be concluded that though mining is of benefit to Zambia, it has produced an economy whose performance is dependent on the state of the copper market. However, there are other mineral deposits in Zambia which can be exploited profitably at lower economies of scale and hence positively contribute to the flagging economy. It has been recognised that on the national level, small-scale mining provides products that are either exported or save importation and thus substantially improve the self-sufficiency of a country. The following chapters therefore, examine small-scale mining in general and the economic and social contribution it can make to the Zambian economy.

TABLE 2. ZAMBIA'S PUBLIC EXTERNAL DEBT, 1973-83
in millions of US dollars

YEAR	Debt Outstanding at end of Year (disbursed)	Service Payments	Service Payments as percentages of Exports	Service Payments as percentage of Government Revenue
1973	703.7	368.6	30.6	61.8
1974	807.4	114.4	7.7	10.8
1975	1 155.7	96.9	10.0	14.0
1976	1 298.9	121.8	10.9	19.6
1977	1 406.5	196.3	20.9	31.5
1978	1 463.6	241.5	25.4	35.7
1979	1 823.1	256.3	16.7	34.3
1980	2 187.9	292.3	18.2	30.0
1981	2 244.5	282.3	24.4	30.0
1982	2 394.0	177.2	16.3	19.5
1983	2 638.0	126.2	12.6	16.5

SOURCES: World Bank Debt Tables, External Dept of Developing Countries; and
Central Statistical Office, Lusaka.

TABLE 3

CENTRAL GOVERNMENT
CURRENT REVENUE AND EXPENDITURE (K'000)

End of Year	Revenue	Expenditure	Surplus/Deficit
1973	385 180	394 111	- 8 931
1974	680 474	440 928	239 546
1975	448 235	609 472	- 161 237
1976	443 018	608 889	- 165 871
1977	449 017	660 695	- 211 678
1978	549 895	647 070	- 97 175
1979	592 675	791 040	- 198 365
1980	767 634	1 081 966	- 314 332
1981	820 401	1 230 532	- 410 131
1982	840 425	1 323 020	- 482 595
1983	956 546	1 150 472	- 193 926
1984*	1 175 160	1 314 990	- 139 830

* Budget figures

Deficits financed by Internal non-bank borrowing,
External borrowing and Bank borrowing.

Source : Central Statistical Office, Lusaka

TABLE 4.

The Kwacha - Sterling Exchange Rate

<u>YEAR</u>	<u>STERLING:KWACHA</u>
1968	0.59
1969	0.50
1970	0.58
1971	0.55
1972	0.60
1973	0.67
1974	0.66
1975	0.77
1976	0.74
1977	0.69
1978	0.63
1979	0.58
1980	0.52
1981	0.57
1982	0.62
1983	0.53
1984	0.42
1985 1st Jan	0.37
1st Feb	0.37
1st March	0.36
1st April	0.34
1st May	-
17th June	0.33

Sources:- International Monetary Fund,
International Financial Statistics (1981)

- Mines Development Department - Annual Report 1982.

- Bank Statements 1985.

3. SMALL-SCALE MINING IN GENERAL

3.1. DEFINITION

At the outset, what constitutes small-scale mining in selected countries should be identified. For example, the United States and Peru classify a small-scale operation on the basis of production; 360 t/day and 54 000 t/year or less respectively. In India the classification is based on labour; 400 men or less for a surface mine and 150 for an underground mine. In Mexico a small mine is one which produces a gross annual income from operations of less than 880 000 US \$. In the Kenyan context, it is one in which capital investment does not exceed 700 000 US \$. In Zambia, however, small-scale mining is understood to be mining operations which do not use complex modern equipment or high level technology and do not need large investment. Simply stated as those operations not requiring substantial expenditure or the use of specialist technology. Such a definition, though vague in not being quantitative, is expected from a country whose mining industry is dominated by the big copper mines which require large investment and specialist skills.

From the foregoing, it can be concluded that there is no general agreement on the definition of small-scale mining; the term small is relative and subjective to national economies. Frank Skelding (6) in his authoritative United Nations study of 1972 adopted the following definition of a small-scale mine: any single-unit mining operation having an annual production of 50 000 metric tonnes of ore or less, as

measured at the entrance of the mine.

3.2. REQUIREMENTS FOR SMALL-SCALE MINING

Wels (7) acknowledged that one or more of the following eight conditions must be fulfilled for small-scale mining to thrive.

3.2.1. Exploration

It must be possible to find the ore deposits without sophisticated equipment. These must be surface or near-surface deposits. A small miner more often does not possess the technical skills and finance to carry out detailed geological work and hence needs easy access to historical records and geological data available. The relevant government and parastatal institutions such as the Geological Survey and Mineral Exploration (Minex) Departments should be easily accessible.

3.2.2. Mining

The mineral should be near surface to obviate heavy capital investment in machinery or the use of specialist knowledge of rock or soil mechanics. Small-scale mining ventures do not easily attract investment and hence need mineral deposits that require as minimal capital investment as possible. The available banks or financial institutions tend to set loan conditions that are inappropriate to such ventures and their administrative channels are too complex for a

small-miner with little or no managerial skills to follow.

Mineral deposits that require skills such as rock or soil mechanics which are essential to the safety of the operations, are not suitable for a small miner as he does not usually possess such skills and tends to neglect safety in the operations. The government institutions can assist by providing loans and consultancy services.

3.2.3. Grade

Must be sufficiently high as economies of scale are not obtainable through mass production. The mineral deposit is usually small and can not carry the far higher overhead charges of the larger operations.

3.2.4. Mineral Processing

The mineral should require no treatment other than hand sorting or be amenable to simple metallurgical processes before it is transported to the buyer. This is particularly important to the developing countries who, because of the socialist policies of their governments would like to involve the rural population in small scale mining through the formation of cooperatives. Some of the minerals suitable for such operatives are gemstones, cassiterite and placer deposits of gold and diamonds.

3.2.5. Transport

The weight to be moved must be small or the market must be near to the mine. The transport costs over long distances of high value, small weight minerals such as gemstones can be borne by the operator whilst industrial minerals, which are low value and high tonnage can not be transported over long distances and the operations still remain profitable. In such cases, the user industries must be in close proximity to the mine.

3.2.6. Infrastructure

Infrastructural requirements such as power, water, roads, houses etc. must be minimal - should already exist in the area. A small miner cannot finance the construction of a road or water dam on his own and therefore needs the assistance of the government.

3.2.7. Marketing

The market for the mineral products must be guaranteed if high production levels are to be maintained. Small miners require prompt payment for their products, in particular gemstones or they are tempted to clandestinely sale them to middleman who are the promoters of illicit trade. The government, as in many cases can assist by setting up marketing bodies which meet the needs of small miners.

3.2.8. Government

The government should be sympathetic and actively involved, through its relevant institutions. It can provide finance, markets, technical services such as geology, mining, mineral processing, surveying, analytical, project evaluation and, safety and can also simplify some of the requirements of the Mining Act pertaining to mining right applications and reports.

3.3. MINERAL DEPOSITS SUITABLE FOR SMALL SCALE MINING

Important factors which determine the scale of operations are the size and grade of the deposit. For example, a porphyry copper which is a large, low grade deposit can only be mined economically at large economies of scale. Conversely, a veinal, high grade tin deposit can be mined economically at lower economies of scale. The mineral deposit characteristics, together with the mineral's performance on the world commodity markets are in the main, the determinants of the scale of operations.

Four major groups of minerals are considered amenable to small operations: the pegmatite minerals, precious metals, placer deposits and industrial minerals. We shall concern ourselves to two groups of minerals which are of practical interest to Zambia.

Pegmatites

These are considered exclusively the domain of a small worker. They are formed by the crystallization of the last residual fluids after the bulk of the granite has solidified, and many of the rarer elements tend to be concentrated in them. Pegmatites are therefore, the major source of beryl, lithium and a significant source of rare earths or related minerals as well as of more commonly sought minerals such as tin, tungsten, tantalite - columbite, mica, feldspar and many varieties of precious and semi-precious minerals.

Pegmatites normally occur as a fair number of scattered, relatively small veins or lodes and economic mineralisation in them is often very erratic. When valuable minerals such as emeralds occur in these lodes, they tend to be coarsely crystalline and concentrated. These occurrences are almost wholly unpredictable and consequently foster haphazard mining methods. However, the material in the ground requires relatively careful, selective breaking and excavation if values are not be lost. This is more pronounced in the case of gemstones whose value is inherent in being flawless.

Industrial Minerals

The industrial minerals are also increasingly considered potential minerals for exploitation by small miners in developing countries. The industry for these minerals is generally a high tonnage, low value, specification conscious and environmentally important.

Industrial minerals can be classified on the basis of predominant end use into three main groups (Tables 5(a)(b))(8).

1. those minerals important to the fertilizer and chemical industries, for example rock phosphate, rock chloride salts, sulphur nitrates, borates, limestones etc.
2. those minerals important to the process industries, for example asbestos, fluorspar, clays, barytes, titanium pigment minerals, feldspars, mica, calcium carbonate, silica sand, talc, magnesite etc.
3. those minerals of importance to the building and construction industry, such as cement, sand and gravel, crushed stone, gypsum, dimension stone etc.

It is the last category of industrial minerals which is predominantly a domain of small miners. Sand, clays and aggregates are easy to produce for the construction industry as they do not require high specifications. The other minerals require specialist skills and technology to produce the material to specifications. These generally pertain to size and chemical composition. In some instances, selective mining is essential to avoid pollution of the main mineral. Some deposits can be mined by the small miners to feed the processing industry closely but fractionation of the deposit has to be avoided in order to maximise the value of the deposit.

It is acknowledged in the minerals industry that consumption of industrial minerals is directly linked with increasing industrialisation of a country and in the absence of such a growing industrial sector, the value of these minerals produced should continue to be insignificant. The low value and abundant occurrence of these minerals does not itself encourage international trade. They tend to be produced and consumed locally unless value is added to the product by virtue of increased processing or by producing the product itself of which the mineral forms an essential part. Vertical integration can be seen in glass, ceramics, cement and chemical industries: all users of substantial quantities of industrial minerals.

3.4. IMPORTANCE/ADVANTAGES OF SMALL-SCALE MINING

The value of small-scale mining does not lie in its great contribution to exports, GNP or government revenue but in its social impact on local communities. Admittedly, mineral development in developing countries is looked to as a means of capital formation for national development. In this section, the advantages and in particular the role that small-scale mining can play in the economy of Zambia will be described.

3.4.1. Foreign Exchange

Minerals exploited by the small-scale miners can be used for import substitution, thereby saving foreign exchange. Conversely, mineral production for export earns the much needed foreign exchange for

national savings or investment elsewhere in the economy.

Most developing countries are dependent on the World Bank and the developed countries for financing of national projects and supply of hard currency for international trade. The result has been heavy indebtedness to these foreign governments and financial institutions which is seen as another form of enslavement and hence have to be avoided if possible. Any foreign exchange generating or saving project, especially one with minimal foreign exchange inputs, is very much desired in developing countries. These are countries whose economies are characterised by high balance of payments deficits and the deterioration of the terms of trade in the recent years. Therefore, foreign exchange earned by these countries is much more valuable to their economies than in the case of the developed countries.

In Zambia, small scale mining continues to be of benefit to the country as demonstrated by Mindeco Small mines producing enough magnetite for the Maamba Colliery Coal preparation plant and the cooperatives producing cassiterite for the local foundaries. As a result, white metals, solders, alloys, etc. are produced for the domestic market which is a start in import substitution. On the other hand, the September 1984 auction sale of emeralds demonstrated the potential foreign exchange earning from small-scale mining. In this group also is amethyst whose prices have thrived over the past years.

3.4.2. Employment Creation

The operations tend to be labour intensive making them suitable employers of large numbers in rural areas. This helps to control rural-urban migration and to forestall some of the social problems of urban unemployment. In dual economies, the rural population looks to the urban areas for employment and the promise of affluence. Unfortunately, the growth of the wage economy has not generated sufficient jobs for all those seeking employment. This has inevitably resulted in high unemployment and the consequence of increased crime in urban areas. Small-scale mining in such cases acts as a bridge: that is, in a small way it eliminates the artificial structural economic imbalances between the rural and urban areas. Looking at Zambia for instance, those in formal employment in relation to the urban population and the total population are 16 percent and 7 percent respectively. The statistical figures to an extent indicate the high level of unemployment in the country though they do not take into account the informal sector which, in some ways is the biggest employer.

Small-scale mining projects in rural areas, like other projects create interdependent communities and implicitly introduce the region to the money economy. The wage earners become dependent on the local population for supply of the basic needs, such as food, thereby stimulating agriculture and other economic activities. In other words, trade in the community increases production and supply of the goods in demand. Thus, while rural projects create interdependent communities, they also play an important role in income distribution.

3.4.3. Seasonal Employment

The operations provide part-time or seasonal employment and are of significant importance in agricultural depressed areas. This has been amply exemplified in the case of the Southern Province tin miners. The cassiterite veins are mostly exploited during the non-agricultural periods providing an extra income. This part-time activity ensures money flows to the area which can be utilised on education and on food in times of poor harvests.

3.4.4. Income Distribution

One of the important social benefits of a small-scale mining project to a developing country is income distribution. As early as in 1973 when economists from the developing countries met in Santiago, income distribution was recognised as a big problem in their own countries. The economists claimed that, quote, "the third world with 70 percent of the world population subsists on only 20 percent of the world income - and even the meagre income is so maldistributed internally as to leave the bulk of its population in abject poverty." (9).

Furthermore, the Gini coefficient, the aggregate inequality measure, for these countries is between 0.5 and 0.7 which reflects a high level of inequality. This is not surprising considering a majority of developing countries do not have a wide economic base that can support any meaningful income transfer scheme such as social security payments, unemployment compensation etc. Small scale mining, therefore

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provides a means for income distribution to rural areas through wages and services provided to the employees and in some cases the services such as health facilities are extended to the local population.

3.4.5. Regional Development

Small operations can provide the springboard for rapid industrialisation and can be instrumental to regional development. They provide backward linkages to the domestic processing and manufacturing industries. Examples include feldspar, calcite and silicate sand for the Kapiri Mphoshi glass factory; calwhite for the detergent industry; and gemstones for the cutting and polishing industry. These industries provide training and employment opportunities to the local communities. Furthermore, they create a demand for services such as engineering and transport which have to be provided.

3.4.6. Identification of Larger Deposits.

Small-scale operations often lead to the recognition of larger deposits. Small mines have either been enlarged or given an indication of mineralisation that has later been exploited successfully. They are often a clear indication of the mineralization of an area and, as such, determine the most favourable types of geochemical and geophysical means of exploration.

The Ministry of Mines (10) reported that in Zimbabwe no less

than 80 percent of large gold mines first operated as small mines. To the large companies this can represent not only a saving in good geologists who may be scarce, but also large financial savings.

3.4.7. Early Production

The surface or near surface occurrence of the mineral deposits is an advantage to the small miner. The mine can be brought into production early guaranteeing an early cashflow which is desirable to a small miner who more often does not have easy access to a bank loan. In addition, the operations are so flexible such that production can be varied easily depending on the production constraints. In other words, the mine can easily be closed whenever conditions, such as market prices for the mineral are unfavourable and reopened whenever there is an improvement.

3.5. PROBLEMS/DISADVANTAGES OF SMALL SCALE MINING

3.5.1. Inefficient Mining

Small operators tend to be non-systematic in their operations and as a result achieve very poor extraction ratios. This is aggravated by their tendency not to engage professionals because of the costs involved. The operations are usually characterised by dumping of waste on adjacent reserves, haphazard mining, fractionation of larger deposits and excessive fragmentation of land. Such inefficient mining is not only hazardous, but minimises the value of the deposit. This is

a cost to the nation as minerals are exhaustible reserves and whatever is left insitu is difficult and in most cases impossible to reclaim.

3.5.2. High grading

The characteristics of the mineral deposit together with the limitations of capital, do not encourage small miners to exploit mineral deposits at large economies of small. In other words, profitability of their operations can not be achieved through mass production, and as a consequence they indulge in high grading. That is, their extraction methods aim at skimming off high grade ore thereby reducing the quantity of ore reserves. Such mining practice does not only reduce the life of the mine, but also mitigates against maximum utilization of mineral resources.

3.5.3. Vicious Exploitation

A small operator usually has a small operating margin over which to distribute costs and losses. He, therefore pays minimum wages for the survival of the enterprise. It is not uncommon to find working conditions hazardous and matters of safety and health of personnel ignored in the drive to maintain profitability. Not surprisingly, most governments have introduced the minimum wage policy and charged the relevant safety institutions to monitor the operations in order to combat exploitation and disregard for human life. The minimum wage policy though, increases the operating costs for small scale miners and reduces the profitability of their operations.

3.5.4. Poor Management

Small miners usually lack the basic management and technical skills to operate their mines efficiently. This has resulted in poor book keeping and staff administration; lack of exploration, production planning and equipment maintenance; bad relations with government institutions; and premature stoppages of operations. Such problems can, in some ways be overcome by active involvement of institutions not seen as law enforcers; those whose advice would not be suspect such as small industries organizations.

3.5.5. Difficult to Monitor

It has been acknowledged in the small-scale mining industry that the operations are difficult to monitor, regulate and control as they tend to be numerous and widespread in isolated areas. Unfortunately for the government, its control institutions such as Mine Safety, Mines Development and Geological Survey Departments are usually centrally located in administrative centres far removed from the mining areas. This makes it difficult to monitor the mining, mineral processing, safety and production records. It is not uncommon to find operators who do not keep true production records especially of minerals that are easily sold such as gemstones, consequently escaping the fiscal net. The developing countries have recognised this as a big problem as it has resulted in substantial loss of the much needed revenue for their central governments.

3.5.6. Financing

It has been recognised that small-scale mining is difficult to finance, promote forward linkages and to market production. The nature of operations does not easily attract investment and whenever it has been possible to obtain a loan, suretyships have been demanded which are difficult for a small miner to provide.

Production and quality of the minerals from these operations are usually unpredictable and varied. This does not only make it difficult for the buying agencies and user industries to plan their sales and purchases, but erodes the mutual trust and business confidence. The quality of the minerals has to be maintained if the user industries are to efficiently produce their products without any further processing or contamination. Unpredictable production usually leads to pooling the products from different operators before any meaningful sale can be made and delays payment.

The foregoing sections have shown that small-scale miners may cause fragmentation of mineral rights, suffer from inadequate planning, indulge in high grading, use poor mining methods, have low recovery and cannot deal with complex metallurgy, lack safety, keep inadequate records, neglect quality control, suffer from poor marketing and low prices and have low capital availability. It is also difficult to find quantitative information about small-scale miners as they tend not to take kindly to government regulations and frequently escape the fiscal

net. On the other hand, the socio-economic importance of small mines can not be neglected. They provide foreign exchange or save importation; income and employment, full-time or seasonal, in depressed agricultural areas, and reduce the drift to towns; they create a demand for transport and service industries; lead to discovery of large deposits; and do not interfere with the social fabric of the area. These benefits, however, outweigh the costs making small-scale mining of great importance to the economies of developing countries and should be encouraged.

3.6. SMALL MINE OPERATOR

A small mine operator may be the owner of the mining right which in this case is well motivated to making a financial success of the business. It is not uncommon to find such operators without management or technical skills but they are adaptive and inventive. This category of operators can be subdivided into two: those with the capital and whose interest is in making a "quick fortune" at low capital investment and costs; and the artisan miner whose interest is in what he can get for his products. Such are the eluvial miners of Southern Province. Their criterion to invest in small-scale mining is not based on rigorous project and economic evaluation, but on on-going trends. For example, as a consequence of gemstone mining proving a lucrative business from the late 1970's, well over a hundred applications for mining rights were received by the Ministry of Mines in 1984.

The second type of small mine operators are private companies whose motivating factors to invest may be varied. Multinationals may undertake such ventures in order to make a quick fortune, to diversify business interests or for provision of cheap raw materials to a parent company located outside Zambia.

The last category of mine operators are parastatal bodies. These are government commercial institutions which may be wholly or partially owned with a minimum shareholding of 51 percent. Parastatals, as in the case of Zambia engage in small-scale mining primarily for commercial profitability, import substitution, foreign exchange earning and secondarily for social benefits such as job creation.

TABLE 5(a). Principal Types of Chemical Minerals

	Chemical raw materials	Fertilizer raw materials	Ceramic raw materials	Metallurgical fluxes
Alumina			X	
Ball clay			X	
Bauxite	X		X	
Borax	X		X	
Bromine	X			
Calcium Aluminate			X	
Chromite	X		X	
Dolomite		X	X	
Feldspar			X	
Fine Clay			X	
Fluorspar	X		X	X
Gypsum		X		
Ilmenite, Rutile	X			
Iron oxides			X	
Kaolin			X	
Kyanite			X	
Lime, Burnt	X			X
Limestone	X	X		X
Lithium salts	X			

	Chemical raw materials	Fertilizer raw materials	Ceramic raw materials	Metallurgical fluxes
Magnesite	X		X	
Mullite			X	
Phosphates	X	X	X	
Potash		X		
Salt	X			
Silica			X	
Sodium carbonates	X		X	
Sodium sulphate	X			
Sulphur	X	X		
Talc			X	
Zircon			X	

Adopted from Industrial minerals (1978),
 First Industrial Minerals, International Congress, London, 1974, pp. 35-36.

TABLE 5(b). Major types of physical minerals

	Structural Minerals	Extender and Filler pigments	Process Aids
asbestos	X	X	
attapulgite		X	X
barite		X	X
entonite		X	X
calcium Carbonate, ground		X	
cement	X		
diatomite		X	X
diatomite		X	
gypsum	X	X	
kaolin		X	
light-weight aggregates	X		
silica		X	
ephelene		X	
perlite	X		X
sand and gravel	X		
silica		X	
stone, crushed	X		
stone, dimension	X		
calc		X	
vermicule	X		
collastonite		X	

4. STATE OF THE INDUSTRY IN ZAMBIA

4.1. GENERAL

Small scale exploitation of mineral deposits on an increased commercial scale flourished with the coming of the railway to Zambia in 1904. It was later overshadowed by the development of the big copper mines on the Copperbelt and any subsequent exploration was in favour of big deposits. Initially, the minerals mined were copper, gold, lead and zinc. The intensification of geological exploration led to the discovery of many mineral deposits amenable to small-scale mining. Unfortunately, very little information, statistical or other is available concerning mineral production in the early days. Gemstone mining is reported to have started in the 1960's; emerald and amethyst from the Copperbelt and Southern Provinces respectively. These minerals continue to be exploited to today together with tin whose production started earlier, in the 1930's. Mineral production for at least the past ten years can be seen from Tables 6(a)(b)(c). Some seven copper deposits were being mined until the 1970's when they were forced to close due to the poor copper prices. In the late 1970's, amethyst production declined due to the mines being in close proximity to the bases of the freedom fighters for Zimbabwe's independence.

Annual Production of TABLE 8 (a)
Copper Concentrates by Small-Scale Miners

YEAR	Wet Tonnes Delivered	Dry Tonnes Delivered	Contained Cu (T)	Payment (K)
1969		47.225	7.594	3 813.39
1970		345.405	51.923	40 742.68
1971		92.667	12.273	6 000.56
1972		94.905	14.415	4 000.00
1973		3 696.139	557.681	391 435.00
1974		1 437,865	119.372	132 924.70
1975	170.155	1 816.109	225.420	110 064.18
1976	599.920	1 949.771	467.695	190 243.12
1977	2 907.52	3 828.260	744.643	231 905.54
1978		1 852.00	420.266	171 419.96
1979		1 077.966	240.933	169 673.79
1980		1 149.751	112.265	134 685.84
1981		1 028.678	90.275	92 660.00
1982		395.00	46.929	20 493.76

No Production Recorded

4.2. MINERAL DEPOSITS WITH POTENTIAL FOR SMALL-SCALE MINING

There are about twenty minerals being mined throughout Zambia and most have a small-scale component. Figures 2 and 3 show the country's mineral potential for this sector of the mineral industry and some are here presented.(11).

Copper.

There are 39 known copper deposits in Zambia with eleven on the copperbelt and the rest scattered all over the country in particular the Lusaka and Mumbwa areas. The tonnages range from as small as 8 200 tonnes at 3.25 % total copper (TCU) to 6 million tonnes at 1.9 % copper. In some deposits, values of up 11.0 % copper are obtained in zones of secondary enrichment which contain a few thousand tonnes of material.

Barite

The only deposits are located between 20 and 60 kilometres (KM) northeast of Chibote Mission which is 72 km from Luwingu. Tabular crystals of barite form a bed 0.3 to 0.6 m thick in red shales in the Plateau Series which dip at 10 to 55 degrees. The reserves have been estimated at 144 000 tonnes of barite rock at 90 % barium sulphate with 35 000 tonnes probably existing from surface to three metre depth.

Gold

Though numerous occurrences of gold have been reported and many investigated, nothing of major importance has been found. Mineralisation currently considered of some economic importance are the Luiiri Goldfields located 35 km southeast of Mumbwa and the Chayinda prospect. Grades ranging from 2.3 to 26.5 g/tonne have been obtained in veins 30 cm to 270 cm wide in the Luiiri area whilst the 20 000 tonne deposit at Chayinda is estimated at a grade of 3 g/t. Furthermore, the chayinda prospect is known to have gold values in the range of trace to 64 g/t erratically distributed in the near surface rubble zone. It is this rubble zone that has been of economic interest.

Gypsum

A layer of gypsiferous clay 0.7 m thick occurs on the southern edge of the kafue flats, the Lochinvar area and covers an area measuring 20 km by 10 km. Reserves in the two blocks each 600 m by 400 m adequately pitted were estimated to contain 174 000 tonnes of material grading 23.1 % gypsum recoverable on a 14 mesh screen. The better grade material is overlain by 1.0 to 2.0 m of clay. Reserves are thought to be extensive covering an area 4 Km by 1 Km. A provisional estimate is that some 1.5 million tonnes of gypsum and overlain by 1.0 million tonnes of overburden may be present where grades exceeding 15 % gypsum were located in wide - spaced pits.

kaolin

Only two sizeable kaolin deposits are known in Zambia, namely the Chitambo and Masuku deposits.

The Chitambo deposits are located 65 Km north of Serenje in Central Province. They occur in twelve circular pans, the largest about 4 Km in diameter. Though no attempt has been made to develop the deposit, a very large volume of material is available. Tests carried out in Johannesburg on the material proved that it would be suitable for less refined forms of pottery and pipe making.

The kaolin deposit at Masuku, near Choma is known to contain illinite, mica and traces of quartz. Its calculated mineralogy is approximately 75 % clay mineral; 18.5 % feldspar and 3.4 % free quartz. The deposit covers an area of about 300 000 square kilometres, goes to depths of two metres and the recoverable kaolin content has been approximated at 337 500 tonnes.

The National Council for Scientific Research (NCSR) has carried out tests on the Masuku deposit. They have proved that after beneficiation, the clay can be successfully utilized for production of earware. The physico-chemical properties of the clays have also been studied for their industrial application in rubber, plastics, factories and paper industries.

Manganese

Deposits are known to occur around Mkushi, Kabwe and Mansa districts. The first two occurrences are small and of lower grade in comparison to the Mansa deposits which are known to contain 1.5 million tonnes of manganese grading between 57 and 86 % Manganese dioxide. The occurrences are in seven near-surface deposits which are almost vertical bodies, swelling from a few centimetres up to three metres in width and vary in length from 20 to over 1 000 metres. Diamond drilling has indicated that the manganese bodies do not extend below 50 metres.

Between 1953 and 1961, 70 000 tonnes of ore grading about 50 % Manganese were mined from 2 deposits and at present a small tonnage is exploited to serve the needs of the Mansa dry cell battery factory.

Phosphates

Phosphate deposits have been identified in three areas; Kaluwe 200 Km east of Lusaka; Nkombwa Hill, 25 Km east of Isoka; and Chilembe near Nyimba. The deposits are still under investigation for possible use in fertilizer manufacture.

Zinc and Lead

Five deposits are known and they have been extensively investigated. They are Carmarnor, 25 km west of Kabwe with grades of 14.7 % zinc and 1.3 % lead; Bob zinc occurring in the Mumbwa area with

known reserves of 276.000 tonnes at 11.6 % zinc and 150 g/t silver; star zinc near Lusaka with a reserve tonnage of 277 000 at 19.7 % zinc; Chiwanda west of Kabwe along the Lukanga swamps with estimated resources of 87 000 tonnes grading 1.87 % Zn and 47 000 tonnes at 2.74 % Pb; and Chipirinyuma near Nyimba with estimated reserves of 2.1 million tonnes at 4 % zinc.

Tin

Four tin deposits are known to occur but the Choma Tin Belt is the one which has been exploited extensively. Stanniferous quartz-muscovite-feldspar-tourmaline pegmatites intruding schistose metasediments occur over a strike length of 100 km centred on Masuku mission.

The first tin production was in 1935 and intermittent production from the pegmatites and associated eluvial gravels has taken place since then mainly by the cooperatives. Between 1935 and 1961, a total of 150 tonnes of cassiterite concentrates were produced and there has been a further small production of 35 tonnes since then to 1983.

Talc

Three deposits have been located in the Lusaka area and current production is for use in the local crafts industry. Other occurrences of talc have been identified in the Ndola area and west of Kitwe on the Copperbelt. A recent evaluation of the talc deposits by a consulting

geologist from the United States of America has proved that they are not suitable for cosmetic manufacture such as baby powder.

Amethyst

The known deposits of gem quality amethyst occur in the Zambezi escarpment area of Kabanga mission, in Kalomo district. All mining rights held for this mineral are concentrated in the same area which is about 30 kilometres south-south-west of Kabanga mission and some 40 000 kg of various grades are produced each year.

Emerald, Tourmaline and Aquamarine

They occur in quartz-tourmaline or pegmatite veins generated by intrusive granites in various parts of Zambia, particularly the Kafubu, Lundazi and Nyimba areas. These minerals are being exploited but production has been rather disappointing.

4.3. MINING ACTIVITIES

Mining operations are carried out by two sectors, namely, private and parastatal. The following are brief descriptions of the two sectors.

4.3.1. Private Sector

This sector pioneered the development of small-scale mining in

Zambia and it principally consists of two distinct groups; international concerns or partnerships and Zambian entrepreneurs.

International companies/partnerships

There are three international concerns working solely on their own or in partnership with Zambians. They are mainly involved in gemstone mining; Lonrho and International DGC in amethyst and Nkuralu which is a partnership between an Indian national and a Zambian, in emerald. International DGC Mining is a West Germany company and produces the gemstones mainly for its parent company whilst Lonrho's production has mainly been for the international market.

Zambian Entrepreneurs

This group of entrepreneurs has operated among many mines, copper and gold deposits. Copper concentrates were sold to ZCCM whilst gold was utilized in the domestic jewellery industry. Notable in this group are the Neilsen brothers who operated the only gold mine until 1984 when the government closed it. They extracted the free gold in the rubble by employing the traditional method of amalgamation.

Zambians have also for a long time been holders of mineral permits. The mines and minerals act has even gone to the extent of restricting the grant of mineral permits to Zambians, but exemptions can be granted by the Minister if it is in the interest of the economy to do so. They mine among many industrial minerals sand, clays, stone and

gravels. In 1982, there were 337 valid mineral permits of which 211 were for sand and employed a total labour force of 3 687. As can be seen from the foregoing, Zambian entrepreneurs are mostly involved in artisanal mining which is the concept of direct application of human energy (as with a pick) directly on a one to one ratio. Local populations as in Southern Province are involved in tin mining and those on the copperbelt in emerald. These too, are minerals which are easy to exploit and have a ready market.

Mining of complex ores by this group has not been extensive due to lack of qualified personnel and to a large extent, lack of capital. Those with the skills have remained with the big copper mines where the prospects for personal development are higher. There is now a national awareness that Zambians, especially those close to the mineral deposits should be actively involved in mineral exploitation even at artisanal level. In 1983 alone, 30 prospecting licences were issued; 21 to Zambians and 9 to foreign companies or partnerships. These mainly were concerned with gemstones; emerald, aquamarine, tourmaline and amethyst - minerals which promise a quick fortune at relatively low investment.

.3.2. Parastatal Sector

The parastatal sector has promoted the utilization of the local mineral resources and exploits not only gemstones, but various other minerals as well. It consists of four companies which are members of the Zambia Industrial and Mining Corporation (ZIMCO) group of companies. These are Crushed Stone Sales, Mineral Exploration (Minex) Department,

Mindeco Small Mines and Reserved Mineral Corporation (RMC).

Crushed Stone Sales Limited

The company produces aggregates, lime products, limestone products as well as talc products. The talc deposits have been evaluated not to be suitable for the cosmetics industry but could find possible uses as paint filler, filler in plastic, and ceramic use. Its operations have not been very economic necessitating reorganisation.

Minex Department

Minex department is not involved in actual mining but is responsible for following up regional surveys of the Geological Survey Department of the Ministry of Mines and identifying economic mineral deposits which could be exploited by its sister company, Mindeco Small Mines Ltd. or others. It provides geological services to other Zimco Companies, in particular Mindeco and the public.

Mindeco Small Mines Ltd

The company is charged with the task of developing small mines throughout the country especially away from the copperbelt, diversification of mineral production, and promotion of import substitution by producing minerals to support the local industries. It produces calcium white (Calwhite) which is limestone powder, magnetite, feldspar, amethyst and tourmalines.

Mindeco produces calwhite from limestone obtained from its Michinga quarry located approximately 14 kilometres west of Lusaka. Before the company started producing the fine powder at 325 mesh, this material was being imported from South Africa, Kenya and the United Kingdom at a cost to the nation of transport costs and foreign exchange. Current production of fine and coarse powder meets the domestic demands. Fine powder is produced for the paint, putty and rubber industries at 99 per cent minus 325 mesh specifications, whilst the coarse powder has found uses in the glass industry, stockfeed preparation, detergent manufacturer and agricultural applications. The glass and stockfeed material is produced not coarser than 0.7 mm and 3 mm respectively.

The magnetite produced by Mindeco at Luiiri is from the Namatombwe deposit located 104 and 74 kilometres west of Lusaka and Luiiri respectively. The processing plant was initially erected for the purpose of treating gold but was later converted to processing magnetite. Currently the only customer is Maamba Collieries Limited who use it in their dense-media coal preparation plant. The material has a magnetic content of 95 percent and is produced to the following specifications.

20 to 30 % less than 20 microns.

40 to 50 % less than 40 microns.

2 to 10 % more than 150 microns.

Feldspar and fluorite are processed to the required standard of

the glass industry in the same plant as calwhite. Successful attempts were made to process feldspar to the requirements of British Oxygen Company but this export exercise failed due to the high transport costs. Production of this mineral is mainly constrained by lack of market, as is also the case for gypsum. Mindeco operated the Lochinvar gypsum mine from 1972 until its closure in 1980 when Chilanga cement, the major user, had switched to using cheaper synthetic gypsum from the copperbelt. The remaining mined and stockpiled crude gypsum is sold in granular form to three major users who manufacture plaster of paris and school chalk.

Mindeco also produces gemstones for the local and export market. Amethyst and tourmaline are produced from the Kabanga mission and Nyimba areas respectively. Tourmaline production has been very erratic and disappointing whilst that of amethyst has been quite successful. For vertical integration, the company in 1984 set up a lapidary plant to cut and polish gemstones. Its initial cutting and polishing activities were restricted to amethyst, malachite and tourmaline.

Reserved Mineral Corporation

The company was formed early in 1980 with the view of establishing the emerald industry on a sound basis. This was done following the recommendation of the government commission of enquiry into this industry which claimed, among many things that Zambia was losing at least US \$ 128 million every year in foreign exchange through legal mining and smuggling of emeralds(12). RMC is responsible for

mining of emeralds and marketing of reserved minerals specified under law as tourmaline, aquamarine, amazonite, gem garnet, rose quartz, tiger's eye, beryl, topaz and gem quality amphiboles.

Emerald production from RMC operations has so far been below the nation's expectations moreover, the company has incurred losses since its formation. The bulk of current production of good quality stones comes from the operations of a private company, Nkuralu. This has prompted suggestions that mining of minerals such as emeralds should be left to private companies who are well motivated to making a financial success of their business. Parastatal managers are known to lack commitment and usually do not actively supervise the mining operations; an opportunity the workers cease to steal the stones. Due to the operational constraints caused by recurring losses, the Corporation has now gone into partnership with the view of successfully exploiting the deposits on the "emeraldbelt" which covers an area of 1000 square kilometres in the Ndola, Luanshya, Kalulushi and Kitwe rural areas. The shareholding of the joint venture is 55 percent the state and the minority interest shared among the entrepreneurs from Brazil, India, Israel and Kenya. These are partners reknown in the gemstone industry and RMC is to benefit from their experience. For example, the Brazilian would like to promote forward linkages by engaging expert cutters and to sell polished gems rather than the rough stones and the Israeli is an emerald dealer with the knowledge of world markets which would ensure that competitive prices are obtained for emeralds.

To carry out its marketing function, the corporation holds

auction sales and it has, to September 1984, only held 2 which can generally be described as having been successful. Tenders are invited from international and local bidders and the highest bid naturally secures the purchase. The highest bid received so far for good quality rough stones is US \$ 15.13 per carat.

4.4. PROBLEMS OF THE INDUSTRY

The common problems of the small scale mining industry have already been identified in Chapter 3. It is not the intention to repeat what has already been said, but to discuss four particular problems besetting the industry in Zambia. They are physiography, illicit trade, under pricing and market constraints. Solutions are offered in Chapter 6.

Physiography

The size of the country, together with the spread of the mineral occurrences are major set backs to the organization of this industry on a sound basis. Mineral deposits, especially industrial minerals occurring distant from the markets are rendered uneconomic to exploit due to the high transport and administrative costs. This is the case in the operations of feldspar and magnetite mines by Mindeco where unit production costs have remained higher than the unit selling prices. These mines, though uneconomic have continued to be operated in order to meet the industrial demands for the minerals and avoid any imports.

Monitoring of the operations, which are so scattered is difficult from the government's view and it is exacerbated by the small staff establishment. Furthermore, the economy itself cannot support extensive field work by professional staff which, in itself defeats the national objective of maximum utilization of locally available mineral resources.

Illicit Trade

This is the major problem besetting the gemstone industry and has been difficult to control as organized international rackets are involved. For example, in July 1982 the Copperbelt police rounded up 1 380 aliens in an operation to rid Ndola rural of illegal emerald dealers. They included 529 Somalis, 187 Senegalese, 184 Zaireans and 480 others from Nigeria, Gambia, Upper Volta, Sierra Leone, Malawi, Angola and Tanzania. These are persons oversupplied with the Kwacha obtained from the exchange of the hard currencies, the US dollar and Sterling on the black market at rates at least five times the official bank rate. Suffice to add that the black market rate could as well be closer to the shadow price of the Kwacha and in some ways indicate overvaluation of the currency.

The black market currency exchange has enabled the traffickers to pay ridiculously high prices for the gemstones, even for fake ones and as a consequence encouraged illegal mining and trading. An on the spot government buying agency, would in such circumstances have to compete with the "Black market Kwacha" and its offer prices would be

seen as uncompetitive by the producers. The government would then have to create a more attractive market than that offered by the illegal dealers if most of the gemstones produced were to be marketed through them. As a result of clandestine sales of emeralds, only 10 percent of Zambia's emeralds are officially estimated to be legally marketed, though the writer is of the view that it could be less (13). Suffice to add, that the declared production is also suspect and is a cost to the country in terms of foreign exchange.

Under Pricing of Gemstones

It is acknowledged in the gemstone industry that knowledge of the market and its trends is essential for succesful marketing. As at the end of 1984, the country had only one qualified gemmologist with limited experience. This renders the industry susceptible to international machinations whereby the gemstones are undervalued at a loss of revenue and the much needed foreign exchange to the government. Such is the case of some of the amethyst sales prior to 1982.

	PRODUCTION	VALUE
	(Kg)	(k)
1981	45 222	133 152
1982	23 476	2 915 992
Difference	-21 746(18 %)	+2 782 840

As can be seen from the above, the 1982 production sold at an

average value of K 124 per kilogramme whilst the 1981 was only at K3 per kilogramme, a difference of K121. The amethyst value suddenly appreciated and it was in the year that the Ministry of Mines decided to actively participate in the marketing. It urged all producers to seek competitive prices for their products and to move away from their traditional markets. The Ministry had suspected underpricing for a long time either by the buyers or by mutual agreement between the producers and buyers. Thus, as can be seen, the government's knowledge of international markets for its commodities is vital if underpricing is to be avoided. Others have even claimed that whenever a parastatal company makes a profit on gemstones, it is usually half the value that would be commanded on a competitive market. This again is attributed to lack of exposure and failure to break into the gemstone market syndicates.

Market Constraints

As already stated elsewhere, industrial activity is decreasing in Zambia due to the scarcity of the foreign exchange resource needed to import other raw materials. The poor performance of the industrial sector, which is the main market for the minerals, has affected small-scale mining activities in particular industrial mineral production. There are limited industries that use calwhite, gypsum, magnetite and feldspar and even they require some imported inputs. The other user of industrial minerals is the building and construction industry, which has also been badly hit by the economic recession affecting the sand and aggregate production. Such an economic climate

hinders the development of small-scale mining.

The other kind of problem is where the market is dominated by few users who are inclined to form a kind of cartel. Such is the case of the cassiterite market which principally consists of two foundries. In 1983, the Ministry attempted to raise the price of cassiterite from K8 to K10 per kilogram on the basis that it was exploitative. The foundries stopped buying the cassiterite immediately and as a result the miner lost the only market for his commodity. The Ministry had decided to raise the price after taking into account the foundries' transport costs and selling prices for their products which were exalating. Even so, they would rather have continued purchasing the cassiterite at the old price. As can be seen, as long as the industrial base is small, the mineral production from small-scale mining shall continue to be insignificant. Small scale mining can, to a large extent thrive in the presence of a guaranteed market.

5. ROLE OF THE STATE

5.1. GENERAL

It is acknowledged in the minerals industry that a government can promote or hinder the development of mineral resources through its mineral policies. These policies can either be legal, fiscal or political, but should be aimed at creating an economic environment conducive to investment. In the case of Zambia, there has historically been no mineral policy adopted specifically for small-scale mining and it has been recognised to be due to the dominance of the copper industry. For example, the mining legislation is to an extent unsuitable for the small-scale mining industry. This chapter examines the mineral policy adopted by the Zambian government to foster and control small-scale mining, with particular emphasis on the roles played by the different government institutions.

5.2. MINISTRY OF MINES

The Ministry has three autonomous departments reporting to its secretariat; the Geological Survey, Mines Development and Mines Safety Departments. The following is a brief description of the departments.

5.2.1. Geological Survey Department (GSD)

This Department is headed by a Director and is charged with the responsibility of carrying out regional surveys and monitoring of

geological operations in the country. Its staff, like those of the other sister departments carry out site visits in addition to their office and laboratory work. The laboratory has facilities for mineralogy, chemical and spectrographic analysis of samples and also mineral processing bench tests. The Department analyses samples submitted by the public and this service has proved beneficial to small operators who are unlikely to possess such analytical services of their own.

Technical reports on the fieldwork are produced regularly and these can be obtained from either the Department or the Government Printers. Economic mineralisations are adequately reported on and any further work required is recommended. Besides the technical reports, the Department in conjunction with the Mines Development Department (MDD) produces mineral maps of Zambia showing areas of mineralisation and mining rights covered by prospecting, exploration and mining activities. These maps are obtainable from the Department or the Ministry of Lands and Natural Resources. In some respects, it may be said that the technical reports and mineral maps kept by the Department constitute a comprehensive geo-data bank that can be consulted by the public. Such a central geological information service is essential to the small-scale mining industry which has already been recognised to lack the geological skills and finance to carry out exploration programmes of their own.

5.2.2. Mines Development Department

The Ministry, through this office of the Chief Mining Engineer (CME) enforces the Mines and Minerals Act. The Department is responsible for monitoring all mining activities in the country and assists in the development of small-scale mines. It provides services, such as mining legislation and technical advice, equipment hire and survey to small miners.

In 1980, a small mines equipment centre was set up principally intended to cater for those small miners who can not afford to purchase equipment of their own. The machinery is hired out on a non-profit basis and the scheme has proved quite useful. The equipment provided includes compressors, jackhammers, pneumatic breakers, submersible pneumatic water pumps, a truck and mobile explosive carriers.

The Department also encourages the formation of cooperatives to alleviate some of the problems faced by the individual small miners. It is acknowledged that it is easier to teach groups of miners about methods of prospecting and mining, mining law and markets. In addition, the provision of financial assistance in the form of grants or loans and/or the issuing of mining equipment under the plant hire scheme can more conveniently be applied to groups than to individuals because the resources are scarce. For example, hammers, shovels, picks, and pans have easily been provided to the tin cooperative miners in Southern Province and also has their cassiterite production been easy to market as a group.

5.2.3. Mine Safety Department

This Department is headed by the Chief Inspector of Mines and is responsible for administering the various safety regulations as stipulated in the Mines and Minerals Act. Safety matters of all mining operations in the country are 'Under its jurisdiction'. Its involvement with small miners, which has historically been minimal, is expected to increase with the rise in small-scale mining activities. It has been observed that safety standards in small-scale mining operations are generally very low. The role of the Department therefore, would be to educate the miners on safety matters concerning equipment use, mining methods and explosive handling. And this is to be followed by regular site visits and seminars to ensure a reasonable level of success.

5.3. NATIONAL COUNCIL FOR SCIENTIFIC RESEARCH (NCSR)

NCSR is an autonomous body engaged in research and development covering a number of fields such as minerals and agriculture. The policy of NCSR towards minerals is to develop processing techniques that would be adopted by the manufacturing industries using imported mineral resources that are available in the country. In other words, its objective is to encourage maximum utilization of locally available mineral resources and thence achieve some degree of import substitution and self sufficiency. The foreign exchange saved, could be invested elsewhere in the economy. Moreover, such research would stimulate small scale mining as the growth of the domestic industry would guarantee a

market for the minerals.

NCSR has three mineral processing research units, namely: the Industrial minerals, building research and radioisotopes research units. Brief descriptions of their activities are here given.

The Industrial Minerals Research Unit.

The unit is undertaking a project in Maamba Coal Slurries desulphurisation, beneficiation and briquetting. Laboratory scale unit operations have been successful and a pilot plant is under construction. The unit also has developed technique for salt purification, and graphite beneficiation for utilization in pencil making.

Ceramics Section of the Building Research Unit.

Research operations of the section have included clay washing, processing of ceramic minerals, fine grinding and mixing of minerals, fabrication techniques in ceramics, drying and firing of ceramics ware and decoration of ceramics. It has successfully developed a technique for making ceramics from locally available raw materials such as clay, gypsum, limestone, feldspar and the technique has to some degree been adopted in the industry.

Radioisotopes Research Unit

In this unit there is a project of Uranium ore processing based

on acid-leaching and purification of the leached by using fixed-bed ion exchange resin. The product from the plant is Ammonium di urinate, commonly known as yellow cake. The pilot plant constructed using locally available and assembled components illustrates the possibility of adopting appropriate technology for mineral processing even for large scale operations. The Uranium deposits, if proved not large enough for large operations, could be exploited by small miners who would feed a central processing plant. This would only be done after considering the market for the product.

5.4. THE DEVELOPMENT BANK OF ZAMBIA (DBZ)

There are a number of commercial banks in Zambia that could provide loan capital, but in reality, only a few are able to provide true venture capital. The Banks usually set loan conditions that too often are inappropriate for financing new projects and in most cases their funds are allocated to those entrepreneurs with suretyships such as the well established businessmen, families, etc. The chances of a small miner securing a loan even for the basic machinery in such an economic environment are minimal.

In 1972, the government established DBZ to be instrumental to economic development in conformity with the priorities of the national development plans set out from time to time. These plans relate to a number of economic activities such as manufacturing, engineering, construction, transport, power, tourism and mining. The Bank provides long and medium term loans to finance such projects. For example, the

only gold mine which was in operation until 1984 was partially financed by this bank and it operated quite successfully. The Bank, however is generally unsuitable for a small-scale miner who may wish to secure a short term loan. The procedures involved are often too complicated for him to follow considering he usually possesses little or no managerial and financial skills. This calls for setting up a financial institution or fund to specifically cater for the needs of small-scale miners.

5.5. FISCAL POLICY

It has been observed that tax concessions and similar fiscal incentives are a means of stimulating private enterprise. Such concessions and incentives have been offered to private investors to make them more productive and to induce them into exploiting mineral deposits located in less developed regions of the country. For example, the foreign exchange incentive and mineral tax concessions. Companies are allowed to retain upto 35 and 50 percent of their foreign exchange earnings from the traditional and non-traditional exports respectively. The traditional exports are copper, cobalt, lead and zinc whilst the non-traditional include amethysts, emeralds and agricultural products. And a new mine developed outside the Copperbelt is not subject to mineral tax for five years after start of production.

It has also been acknowledged that it is through the taxation regime that the government can mobilise resources to finance public expenditures; that is, the essential non-revenue yielding public services such as education, health, communications and other components

of the economic and social infrastructure. In the absence of such a fiscal policy, the private sector which consists of a minority and mostly the international concerns, would be seen to become wealthier at the expense of the majority of the population. Private income would increase and consequently savings which is the capital available for reinvestment. This assumes minimal externalization of profits. Though this is good in itself, the government would be seen to fail in discharging its duties to the nation. The problem for the state is to formulate an adequate fiscal policy conducive to investment in the minerals industry and at the same time generating sufficient revenue for its treasury.

In Zambia, income tax is levied at the rate of 45 percent on assessable income after deducting mineral tax.

Assessable Income = Revenue - Allowable Expenses

Allowable expenses generally include operating costs, interest payments and tax allowance which include capital allowances.

Mineral tax is levied at the following rates:

<u>Mineral</u>	<u>Rate %</u>
Copper	51
Lead, zinc, cobalt	20
Amethyst, beryl	15
Gold, bismuth, selenium	10

As can be seen from above, no mineral tax is levied on income accruing from exploitation of industrial minerals and cassiterite. Thus, the small-scale miners who are the main producers of these minerals can take advantage of such favourable taxation. Furthermore, the cooperatives who are the main producers of cassiterite have not been subject to income tax. In any case, the collection of tax from the cooperatives, is not feasible unless it is included in the unit price paid for the mineral. This would entail a government body buying the cassiterite from the cooperatives for resale to the foundries.

It can be seen from the foregoing that the government through its Institutions, in particular the ministry of Mines, NCSR and DBZ is committed to the development of small mines. The ministry has taken the initiative and provides services covering geology, surveying, analytical, safety and mining to the small mines. The NCSR investigations into the use of locally available mineral resources in the domestic industry will have spill over effects on small-scale mining. For example, the techniques developed by NCSR when adopted in the industry create a market for mineral products of small miners such as clays, gypsum, feldspar etc. These are markets which were either non-existent or depended on imported inputs. The establishment of DBZ by the government ensures that loan capital is available for mining projects upon submission of a preliminary evaluation report. Through these institutions, the government provides research, technical and financial services to small miners. In the following chapter, some policy issues are discussed and some recommendations made for consideration by the Ministry of Mines. They are intended to contribute,

in a small way, to policy formulation for this sector of the minerals industry.

6. DISCUSSION AND RECOMMENDATIONS

6.1. REVOLVING FUND

It is not envisaged that big mining ventures will be undertaken in the near future in Zambia; but will see an increase in small mining projects. To cater for the financial needs of small miners, it is proposed that a revolving fund be established under the administration of the Ministry of Mines. This fund would cover equipment and occasionally limited working capital needs of the small miners. The funds would be recovered with interest on a declining balance basis once the mine starts production. Besides the services that the Ministry already offers, this would be seen as active participation by the government in small-scale mining. This service is to be provided against a background that very few Zambians with the skills have sufficient capital to venture into small-scale mining.

The revolving fund could be administered on the same basis as the Mining Industry Loan Fund Scheme which has somewhat been successfully implemented in Zimbabwe. Two categories of loans are available under this scheme.

6.1.1. Speculative Development Loans

These are high-risk loans which are wholly or partly repayable depending upon the success or otherwise of the project. The loans are secured by suretyships, promisory notes and recommendations by the

appropriate board(s) for approval by the Minister. In this category, two types of loans are available, namely, 100 per cent and 50 per cent speculative loans. In the first, the Ministry of Mines puts up 100 per cent of the development capital and when the project is successful, repayment is at twelve per cent interest normally over three to five years after start of production. Whilst in the second type of loan the government provides 50 per cent of the finance required and the entrepreneur provides the remaining share. Repayment of the loan is at nine per cent interest once the mine is successful.

6.1.2. Ordinary Loans

These are loans whose repayment does not depend on the success of the project. They can be used to purchase mines, purchase equipment on hire purchase basis, develop mines, assist in marketing, establish a gold extraction plant, develop water or electricity supplies and provide finance for emergencies. Five types of loans are available under the scheme.

Development loan - to enable the development of the mine is repaid at six per cent interest.

Plant loan - at six per cent interest is secured by hire purchase agreement, that is, the processing plant is provided to the mine by the ministry and not cash.

Establishment loan - is provided at six per cent interest to

cover plant construction costs based on ore reserves.

Bridging Finance loan repaid at six per cent interest is a facility available to a small miner to enable him overcome working capital deficiency between establishment of mine and first receipt of income from production.

In addition to the above, there is a plant hire scheme whereby common user items of plant hire, such as air compressors are hired to purchase over a three year period at a ten per cent interest.

6.2. REGIONAL OFFICES

Mines Development should for the moment strategically locate three regional offices in Copperbelt, Eastern and Southern provinces. The regional officers are to monitor and control all mining operations especially small-scale mining. They are to offer free advice pertaining to the Mines and Minerals Act, mining, mineral processing and marketing of the same. This is now a matter of urgency considering there are increased small-scale mining activities in these three provinces: emerald on the copperbelt; aquamarine, beryl and tourmaline in Eastern province; amethyst and cassiterite in Southern province. This would be a big step towards overcoming the difficulties in monitoring, regulating and controlling small mines.

6.3. GRANT OF MINING RIGHTS

The illegal gemstone miners have proved to be successful artisan geologists. They located the Hofmeyer tourmaline deposit and of late, the numerous gemstone occurrences in the Lukusuzi National Park. This is by no way comprehensive as there could be many deposits as yet to be reported. The state in its efforts to control illegal mining has declared certain areas restricted areas in accordance with the Protected Places and Areas Act Chapter 107: such as the Copperbelt Province emerald field and the Hofmeyer tourmaline mineralisation in Eastern Province. Such measures have not produced the desired results, instead they have set in complications in the execution of the Mines and Minerals Act and security. Despite deploying a paramilitary force on the emerald field, illegal mining was rampant and it was alleged that the police even collaborated with the illegal miners. At Hofmeyer, no police force was deployed but despite declaring the area a restricted area illegal mining intensified resulting in loss of revenue to the government.

It is evident from both cases that illegal mining can not be controlled through the Protected Places and Areas Act. One solution to this problem of illegal mining is the early grant of mining rights to a reported gemstone deposit. Delays due to the government red tape only provide opportunities to the illegal miners to make a fortune at a cost to the nation. This has clearly been demonstrated in the case of both restricted areas. For example, Mindeco Small Mines was granted mining rights to the Hofmeyer tourmaline deposit three years after illegal mining was reported. The delay resulted in this weathered, pegmatite

tourmaline deposit being worked at least five times over before Mindeco moved on site. The good quality tourmaline crystals occurring in the five metre subsoil were exploited leaving only a barren hill for Mindeco to work. Two years after being granted a mining licence, Mindeco has not reported any significant production.

It is strongly recommended to the Ministry that it reviews its procedures involved in granting mining rights especially where it concerns gemstones. The owner of the mining right assumes responsibility for security over the mining area thereby not subjecting the state to the expensive policing exercise.

6.4. Prescribed Fees

The prescribed fees were enacted by Parliament in 1984 in the light of increased illegal mining and marketing of gemstones. In 1983, Mines Development Department processed an unusually high number of reconnaissance permits for gemstones which led the Ministry to conclude that a lot of persons were carrying out clandestine mining operations under the guise of undertaking reconnaissance work. Such operations, unfortunately are always beyond the reach of the fiscal dragnet. It was imperative, therefore that the Ministry introduce fees as a means of screening the applicants and at the same time earning the government some revenue. The area charges were also intended to discourage the small miners from holding large areas which in effect reduced the potential mining area available to other entrepreneurs. For example, one company held a mining area of about 250 square kilometres which

reduced to 25 square kilometres on introduction of the fees. In this case the area charges have encouraged maximum utilisation of land and concentration of mining operations. On the other hand, the fees are a disincentive to investment in mining. They increase the development costs of the mine and when reflected in the calculations of cut-off grade, would inevitably tend to increase it thereby reducing the value of the ore reserves. However, there is a provision within the Act for the fees to be waived. It reads, quote "Upon the recommendation of the Engineer, the Minister may, by Statutory order, reduce or remit the fees prescribed in the schedule either generally or in respect of any person or class of persons, if he is satisfied that it is in the interest of mining generally to do so."(14). It would appear, therefore that an entrepreneur could negotiate with the Ministry for exemption. The provision is limitless and is dependent upon the Chief Mining Engineer to effect it.

6.5. CENTRAL PROCESSING

This scheme works well where small-scale mining is concentrated such as along the great dyke in Zimbabwe. Custom mills, smelters and roasting plants built by governments at strategic locations with respect to centres of mining activity provide facilities that small miners could individually not afford. In Zimbabwe for instance, the government operates a roasting plant at Kwekwe for arsenic gold ores. In the case of Zambia, the small metalliferous ore deposits are so scattered as to make such a scheme not possible to implement. The other possibility for small-scale central processing is in industrial minerals. Again like

the metalliferous ores, the specification conscious minerals are already being exploited economically by well established parastatal companies like Chilanga Cement and Ndola Lime company, a subsidiary of ZCCM. These minerals, limestone, phyllite etc are being mined and processed at large economies of scale and therefore can not afford to fragmentate the deposits in order to accomodate the small miners.

Central processing is, to some degree being employed by RMC in its sorting of emeralds. The rough stones produced by different companies are sorted into different grades by a consultant gemmologist some days before the auction sale. The grading is by size, colour, with no cloudiness or inclusions and absence of internal fractures. Central sorting is necessary for quality control of stones that go on the market and winning the confidence of the international markets in Zambian gemstones. This scheme could be extended to amethyst. With the emergence of a number of amethyst miners, some with little or no knowledge of amethyst processing and marketing, central processing is a matter of high priority. For the scheme to succeed, it wold entail RMC being made the sole legal buyer of all types of gemstones. Such a measure would ensure that the gemstones fetch competitive prices and at the same time seal the loopholes for deliberate underpricing by the producers at a loss of revenue and foreign exchange to the state. This would require RMC successfully breaking into international markets and closely monitoring the market trends.

Currently, the corporation only holds auction sales of emeralds on behalf of the producers. Under the proposed scheme, it could

exercise its marketing functions by proceeding in three ways, namely:

- a) Conducting or negotiating sales on behalf of the producer. For example emerald auction sales.
- b) Authorising sales excluding emeralds to meet domestic demands.
- c) Purchasing the minerals for resale.

The first method of sale is not at all beneficial to a small miner with cash problems. Such sales, unavoidably take time as the outputs of individual producers have to be pooled together before a meaningful auction sale could be held. In situations where a small miner has cash problems, the Corporation could advance him with some money to see him through to the time of the auction sale at which the money would be recovered. Cash advances could also be made to other gemstone producers whilst the Corporation negotiates sales on their behalf.

The third method of sales has its own advantage of eliminating middlemen. These are persons who are a cost to the nation as they are untouchable by the fiscal dragnet and are sponsors of illegal mining through cash payments for the gemstones at the point of production. The middlemen have capitalised on the fact that the gemstone industry is still in its infancy in Zambia and the majority of the miners are not quite conversant with the marketing of their products. The third method

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sale could be employed whenever the emerald field shall be open to an restricted number of small miners with different financial backgrounds payment for their production is immediate. In other words, the third method is attractive to small miners with cashflow problems and undoubtedly require immediate cash payments for their products.

PRODUCTION QUOTA SCHEME

A concomitant service to central processing is the production quota scheme. The small mine operators would be given production targets set out from time to time by RMC. This would ensure that there is adequate production of the minerals to satisfy the customer demands. On the other hand, it would serve to control production as dictated by market forces. That is, production could be decreased in times of price depression and could be increased during a price boom to take advantage of the rise in prices.

CONSISTENT PRICE POLICY

The government could stimulate mineral production, in particular through a guaranteed minimum price policy. This is essential if a small miner who can not attain profitability through economies of scale is not to be thrown out of business. In times of price depression, the government would pay the minimum prices for the metals and when there is a price boom, it would then recoup its expenditure at a percentage of the increase in price. The rate employed to recover expenditure would be subject to review from time to time, depending on the circumstances in

the mining industry and the commodity markets such as the gold market and LME. This scheme has successfully been employed in Zimbabwe and has proved of benefit to all gold producers, including individual small miners and cooperatives. The minimum price paid by the Reserve Bank of Zimbabwe for gold is Z\$ 500 per ounce and when the market price rises beyond Z\$ 500 per ounce, the Bank recoups its expenditure at the rate of 25 per cent of the increase in price. This, undoubtedly has promoted gold production.

6.8. PRICE BASED TAXATION

Taxation in Zambia is based on profits which means they can be levied only when the companies keep honest accounts reflecting actual profitability of the operations. It is not uncommon, however, to find small miners who alter their accounts in order to pay less taxes. To overcome such malpractices, the government would need to have honest and trained individuals to carry out periodic inspections of the accounts of the companies, though such an exercise is costly.

One of the solutions to this problem, would be for the government to include taxes in the prices paid for the minerals. Such a levy would be easier to implement and ensures that the government receives some revenue. Arce (15) suggested that average production costs could be estimated and profitability of the operations calculated therefrom. The scheme is claimed to have been successful in Bolivia. Another consideration in the prices would be equipment allowances which would remove company accounting for tax purposes.

6.9. CONTRIBUTION OF SMALL-SCALE MINING TO EXPORT EARNINGS

Gemstones have been recognised in the country as potential foreign exchange earners. It was reported in the 1983 Mining Annual Review (16) that Zambia was losing up to £60 million a year through illicit gem mining and smuggling rackets involving foreign syndicates. The reported annual loss of £60 million in 1982 was 6 per cent and 10 per cent of Zambia's total foreign exchange requirements (£ 0.93 billion) and export earnings respectively. The loss was and still is quite substantial considering the impact that foreign exchange would have had on the economy if it were realised. The source of the figures being not known, casts doubts on their authenticity. However, it is possible to earn that much from gemstones by engaging in cutting and polishing. Good quality emeralds have been known to sell at £ 9 000 a carat and even higher at £10 000 a carat for bigger stones. Uncut good quality Zambian amethysts sell at US \$ 200 per kilogram whilst facets fetch US \$ 3.5 per carat. It is recommended that a lapidary industry be set up immediately to take advantage of the increase in the value of gemstones once they are cut and polished. The development of the lapidary industry together with a successful break into the international gemstone market, would undoubtedly increase the contribution of gemstones to the national annual foreign exchange requirements.

6.10. TECHNICAL SERVICES

NCSR, University of Zambia, Ministry of Mines, Minex, Mindeco and ZCCM are organisations actively engaged in the minerals industry. Their activities cover a wide spectrum, they include research, geology, mining, mineral processing and management. Their activities if well coordinated could provide a wide consultancy service to small miners and the industry as a whole. For example, ore reserve estimations and project evaluation could be done by any of the relevant organizations on behalf of the small miners and the fees recovered whenever the mine became productive. Such a scheme would ensure that geological and project evaluation reports are produced on any mineral venture and at the same time facilitating data collection for the geo-data bank.

6.11. FORMATION OF SMALL-SCALE MINERS ASSOCIATION

Currently, there is no organization which represents the interests of small scale miners and as such it is recommended that the Ministry assists in forming such an association. It would be easier for the Ministry to organize regional training seminars through the association and besides it instils a spirit of group cooperation. The association would provide a medium for interchange of ideas and information pertaining to the various mining activities.

It is also recommended that the Ministry may, in conjunction with the association, produce annual reports on small-scale mining activities. The reports are to cover mineral production, production costs, markets,

market trends etc. This would provide a record and also a medium of disseminating information on this sector of the minerals industry.

6.12. MERGER OF CRUSHED STONE SALES AND MINDECO SMALL MINES.

The two companies belong to the same group of companies, Zimco and are engaged in similar mining operations. Crushed stone sales produces only two products, limestone and talc, which Mindeco Small mines is capable of producing. It would appear, therefore that their operations are duplicated and as such a merger is recommended. Some of the benefits of the merger would be: coordinated planning and direction of capital expenditure, extraction and production; the better deployment of the scarce technical skills available to the two companies; and important economies of scale and rationalisation in operations, marketing and other specialist services. As a single company, it would probably achieve higher profit margins.

7. CONCLUSIONS

Small-scale mining is, and shall continue to be of benefit to Zambia and should be encouraged. It provides many benefits in the form of diversification of the mining industry, import substitution, foreign exchange earning, job creation, raising the standard of living of local communities, government revenue, extended use of infrastructure and creates a demand of services in largely underdeveloped regions of the country. These economic and social benefits are of great value to Zambia considering the current economic situation. The costs of the small-scale mining industry in a flagging economy appear insignificant and can be ignored.

As has been disclosed in this study, the Ministry of Mines is committed to the promotion of small-scale mining. This is done through services rendered to the industry by its administrative, professional and technical departments as well as parastatal organisations. This is consistent with the government's declared policy of maximising utilization of local mineral resources.

However, more research is required to increase the availability of information concerning small-scale mining, to identify problems confronting small miners and cooperatives to provide long term solutions, and to come with a strategy that will cope with the problem of illegal mining. In this vein, some policy recommendations have been made for consideration by the Ministry.

8. APPENDICES

8.1. REFERENCES

8.2. GENERALISATION OF SCALE OF MINING OPERATIONS

8.3. AMETHYST PRICES

8.4. MINERAL PROCESSING FACILITIES:

GEOLOGICAL SURVEY DEPARTMENT

8.5. PRESCRIBED FEES

APPENDIX 8.1.

REFERENCES

1. Daniel, P., Africanisation, Nationalism and Inequality (Cambridge Press 1979).
2. Prain, R., Reflections on an Era. (Metal Bulletin Books Ltd 1981).
3. Bank of Zambia, Financial Report 1982. p.11.
4. Hall, R., Zambia The first twenty years (The Observer Oct. 1984, p.10).
5. Lipsey, R.G., An introduction to positive Economics (1983) p.146.
6. United Nations, Department of Economics and Social Affairs. Small Scale mining in the developing countries. UN 1972.
7. Wels, T.A., Small-scale mining - the forgotten partner (IMM Publ. Jan. 1983), pp19-27.
8. Industrial Minerals, First IM International Congress, London, 1974, (IM Publ. 1975) pp.35,36,233-237.
9. Todaro, M.P., Economics for a Developing World. (Longman 1982) p.1, pp141-153.
10. Ministry of Mines, Small-scale Mining Industry in Zimbabwe (M.O.M. 1985) pp.1-7.
11. ZCCM Geological Report - Summary of Deposits which have potential for exploitation, particularly by small mines.
12. MINING Annual Review - 1980, p.137.
13. Chief Mining Engineer, Press Statement, (Times of Zambia, Dec. 8., 1983).

14. THE MINES AND MINERALS (AMENDMENT) ACT,
(27th January, 1984) pp.1-3.
15. Arce, R., Small mining in Bolivia (UNITAR 1978) pp.219-216.
16. Mining Annual Review - 1983, p.121.
17. AGID, Strategies for small-scale minig and mineral industries.
(AGID Report, No.8., 1980).
18. Cunningham, S., The Copper Industry in Zambia.
19. Mininstry of Mines, Workshop on Mineral Processing For small
scale operators, Lusaka, (M.O.M. Abstracts, 1985).
20. Ministry of Mines, Mines Development Annual Report 1982.

APPENDIX 8.2.

Generalization of scale of mining operations usually
associated with specific minerals

Mineral	Typical scale of mining operations				
	Usually large	Medium to large	Usually small	Important small- scale component	Co-product or by-product
Aluminium <u>a/</u>	X				
Antimony				X	X
Arsenic, white					X
Asbestos		X		X	
Barite			X		
Bauxite	X				
Beryl			X		
Bismuth				X	X
Boron		X			
Cadmium					X
Cement, all grades <u>b/</u>		X		X	
Chromite		X		X	
Clays			X		
Coal, all grades		X		X	
Columbium-tantalum			X		X
Copper, mine	X			X	
Copper, smelter <u>a/</u>	X				
Diamond, gem		X		X	
Diamond, industrial		X		X	
Diatomite		X			
Feldspar			X		
Fluorspar			X		
Gem stones, precious			X		
Gem stones, semi- precious			X		
Gold		X		X	X
Graphite		X		X	
Gypsum			X		
Iron ore	X				
Lead, mine		X		X	
Lead, smelter <u>a/</u>		X		X	

Typical scale of mining operations

Mineral	Usually large	Medium to large	Usually small	Important small- scale component	Co-produ or by-produ
Lithium minerals			X		
Magnesite, crude			X		
Magnesium metal <u>a/</u>	X				
Magnese ore		X		X	
Mercury			X		
Mica, including scrap			X		
Molybdenum	X				X
Nickel		X			
Peat			X		
Phospahte rock		X			
Platinum-group metals		X			
Potash, K ₂ O equivalent	X				
Pumice			X		
Pyrite		X			
Bare earth minerals, all			X		X
Slat		X		X	
Selenium					X
Silver		X		X	X
Strontium minerals			X		
Sulphur, native		X		X	
Sulphur, byproduct (including recovered)		X			X
Talc, soapstone, prophyllite			X		
Tellurium					X
Tin, mine		X		X	
Tin, smelter <u>a/</u>	X				
Titanium, ilmenite		X			
Titanium, rutile		X			
Tungsten			X		X
Uranium minerals		X		X	
Vanadium		X			X

Typical scale of mining operations					
MINERAL	Usually large	Medium to large	Usually small	Important small- scale component	Co-product or by-product
Vermiculite			X		
Zinc, mine		X			
Zinc, smelter <u>a/</u>		X			
Miscellaneous construction and industrial minerals		X		X	

a/ The pyrometallurgical production of metals from ores and concentrates is usually, but not always, a concomitant of large-scale mining. Artisanal operations do smelt copper, lead and iron, for example.

b/ Although cement is not, strictly speaking, a mine product, it is usually produced at or near the mine and is a specific mineral product of advanced processing carried out at the mine. It is one of the few (mercury is another) which are often the end products of small-scale mining operations.

SOURCE : United Nations (1972, ref. 25).

APPENDIX 8.3.

AMETHYST PRICES

1. Low Grade US 50 Dollars/Kg.
2. High Grade US 100 Dollars/Kg.
3. Export Grade US 200 Dollars/Kg.
4. Facets US 3.5 Dollars/Carat.
5. Cabachons US 1.00 Dollar/Carat.

SOURCE : Ministry of Mines, Zambia.

Telex Ref. 127/85 HCuz

29th April, 1985.

APPENDIX 8.4.

MINERAL PROCESSING FACILITIES: GEOLOGICAL SURVEY DEPARTMENT

CRUSHING

1. Jaw crusher
2. Denver roll crusher
3. Sturtevant Jaw crusher
4. Big metallic mortar
5. Denver Gyratory cone crusher

GRINDING

6. CHAS, W. Cool Grinder
7. Sturtevant Disco Grinder
8. Ball Mill
9. Mill Roller
10. 1 fritsch micro pulverizer

MAGNETIC SEPARATION

11. Carpco Dry Magnetic Separator
12. Carpco Dry Magnetic Separator (fine)
13. Wedag magnetic tube tests
14. Box Mag-Rapid Electro-magnetic Mineral Separator.

ELECTRICAL CONDUCTIVITY MAGNETIC SEPARATOR

Coronamagnetic mineral separator

VITY CONCENTRATORS

Denver jigging maching

Shaking table (Denver)

CHAS. W. Cook Michael's panner

ATION

Denver flotation machine

NG

ritsch sieve shaker

suspended Denver sieve shaker

NG

scal sample splitter

es (manual) splitter

Hot - plate

25. 2 x Baird and Tatlock Drying ovens.

INSTRUMENTATION

26. Philips pH meter with electrode

27. Copenhagen pH meter

28. Mettler H80 Balance

29. Avery mechanical scale

30. Mettler Balance

31. Oertling mechanical Balance

32. 1 Kamamoto vernier caliper

FIRE ASSAY

3. Electric Carbolite furnance

4. Electric Carbolite

5. 2 x electric Barnes Furnance

CHEMICAL ANALYSIS

. Atomic Absorption Spectrophotometry

i. Varian Techtron AAS - 475 unit

ii. Varian Techtron AAS - 4 unit

Fluorimetry

Jarrel Ash

Fluorimeters 3 units

38. Flame Photometry

- i. Corring - 435
- ii. Gallenkamp Flame Analyser

39. Spectrophotometry

- i. Varian - 634
- ii. Zeiss - PM2K

40. Specific Electrode Meter

41. Bom Calorimetry (Gallenkamp)

MINERALOGY AND PETROLOGY

42. Ultrasonic Cleaner (fritsch)

43. Planetary Ball Mill

44. Spex Mixer Mill

45. Vibratory Feeder

46. Agitate hand grinding mortars

47. Micro mortar grinder

48. Hardness tester (Leitz)

49. Horse-shoe magnet

50. Leitz jelly refractometer

51. Abbe refractometer

52. Photometer (EEL)

53. Rayners refractometer

54. Sample divider

55. Sieve set
56. U/V Lamp mineralight
57. Ultrasonic Disintegration
58. Jaw Crusher (Fritsch)
59. Isodynamic Mag. Separator
60. Tema Mill Barrel
61. Dischroscope
62. Polariscope
63. Reflectometer (Jewellers Eye)
64. Back Spectroscope
65. Riffle Splitter
66. Hydraulic Splitter (cut tock)
67. Tema pulverizer
68. Furnance DTA
69. Thermogravimetric Balance
70. Universal X-ray Spectograph
71. X-ray Camera (Siemens)

APPENDIX 8.5.

Prescribed Fees

LICENCES, PERMITS, AUTHORISATIONS, ETC.

A. Authority to carry out reconnaissance investigations (section 16)

Fees
K

(1) Precious minerals	50
(2) Semi-precious minerals	40
(3) Any other mineral	20

B. Prospecting Licences (under Part IV) and Exploration Licences (under Part V)

The following fees shall apply to each prospecting licence or exploration licence:

(1) Precious minerals:	
(a) Basic licence fee	500
(b) Area charges per hectare per year	50
(c) For each additional precious mineral (per hectare per year)	50
(d) For each additional semi-precious mineral (per hectare per year)	25
(e) For each additional mineral other than precious or semi-precious mineral (per hectare per year)	10
(2) Semi-precious minerals:	
(a) Basic licence fee	250
(b) Area charges per hectare per year	25
(c) For additional minerals the charges shall be the same as in item B (1);	
(3) Any other minerals:	
(a) Basic licence fee	100
(b) Area charges per square kilometre per year	10
(c) For each additional precious mineral (per hectare per year)	50
(d) For each additional semi-precious mineral (per hectare per year)	25

C. Mining Licences (under Part VII)

(1) Precious minerals:	
(a) Basic licence fee	5,000
(b) Area charge per hectare per year	500
(c) For each additional precious mineral (per hectare per year)	500
(d) For each additional semi-precious mineral (per hectare per year)	250
(e) For each additional mineral other than precious or semi-precious mineral (per hectare per year with a maximum of K250 per year for each such addition)	10

(2) Semi-precious minerals:	K
(a) Basic licence fee	2,500
(b) Area charge per hectare per year	250
(c) For additional minerals, the charges shall be the same as in item C (1);	
(3) Any other minerals:	500
(a) Basic licence fee	100
(b) Area charges per square kilometre per year	
(c) For additional minerals, the charges shall be the same as in item C (1);	

D. Building and Industrial Minerals (under Part VIII)

(1) Prospecting licence:	
(a) Basic licence fee	100
(b) Area charge per square kilometre per year	10
(2) Mining licence:	500
(a) Basic licence fee	100
(b) Area charges per hectare per year	
(c) Fees for excavation or utilisation of the mineral covered by the licence or permit (per tonne per year)	1
(3) Mineral permit:	
(a) Basic licence fee	100
(b) Area charges per hectare per year	100
(c) Fees for excavation or utilisation of the mineral covered by the licence or permit (per tonne per year)	1

E. Surveying charges

- (1) Basic fees for carrying out any survey under the Act (per hectare) 250
- (2) Other related charges for transport, subsistence, etc., shall be determined by the Engineer in accordance with the scale approved from time to time by the Minister.

NOTES:

1. In this Schedule—

“precious minerals” means diamonds, emeralds and ruby and such other minerals as the Minister may, by statutory order, specify from time to time;

“semi-precious minerals” means amethysts, aquamarine, amazonite, green garnet, rose quartz, tiger’s eye, beryl, topaz, tourmaline (deep green, pale green, yellow, pink, red and varieties thereof), gem quality of amphiboles, and such other minerals as the Minister may, from time to time, specify.

2. Wherever in this Schedule a fee is prescribed for a year, per hectare or per square kilometre the same fee shall also apply to a part thereof.

3. Whenever a person liable to pay fees under this Schedule ceases or suspends operations, the fees shall continue to be payable notwithstanding such ceasure or suspension:

Provided that if the Minister is satisfied that such ceasure or suspension was due to unforeseeable circumstances beyond the control of such person he may exercise his powers contained in section four A in respect of such person.