The Study on the Integrated Development Master Plan of the Angonia Region

Sector Report 1: Economic Sector

Part 2: Mining

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Mozambique possesses a varied mineral resource base in a unique geologic environment. However, unlike her neighbors – Zimbabwe, Zambia and South Africa, the Country had not, until quite recently, developed a mining tradition. As a result, both the exploration and exploitation of Mozambique's mineral resources are still very much at the embryonic stage, thus offering a very significant resource potential for development which can serve, in turn, as a stimulus for the generation of substantial foreign exchange earnings from export of the mineral products.

Both metallic and non-metallic minerals occur in large variety in Mozambique. The more important of these are: coal, rare metals (niobium-tantalum), gold, fluorite, tin, heavy minerals, graphite, base metals, phosphorites, and mineralization related to carbonatites and pegmatites, including most notably beryl and other precious and semi-precious stones. Apart from these, kimberlites in northern Mozambique and alluvial diamond potential in the southern part of the Country have been identified.

Throughout the Country, the different varieties of clays, sands, refractory minerals and feldspar are well known and many of these deposits are being exploited for local and regional industrial mineral needs. In addition to both private and government sponsored projects already in progress, the present report outlines a number of investment opportunities that could be profitably developed, and also provides information regarding the legal and financial framework for carrying out mining operations in Mozambique.

Chapter 1. Mining Policies and Regulations

1.1. Existing Mining Policies

A coherent and comprehensive mining policy is yet to be established in Mozambique, but the Government has increasing concerns over the mining sector in pursuing sustainable development of its socio-economy. Such concerns are reflected in the statement of the current Five-Year Plan that research activities and systematic allocation of concessions for exploration and exploitation for effective control and supervision of mining activities and promotion of mining will be pursued.

More specifically, the Plan has established objectives for the mining sector as follows:

1) to make an inventory through surveys on mineral resources,
2) to increase mineral production in a sustainable way to support economic growth,
3) to contribute to improving the balance of payment of the Country,
4) to increase participation of local entrepreneurs in the sector, and
5) to establish a legal and fiscal framework for mining to attract foreign private investments.

To attain these objectives, the Plan spells out various measures. Other than general legal and institutional measures, actions for priority minerals are presented as follows:

i) To continue prospecting and survey programs on heavy sands in Micuanedeia, Pebane and Morbase of Zambezia, Moma and Angoche of Nampula, and Xai-Xai and Chibuto of Gaza;

ii) To continue investigations into basic metals such as copper, nickel, cobalt and chrome, and precious minerals such as diamond, gold, silver and platinum in the provinces of Cabo Delgado, Niassa, Tete, Manica, Sofala, Gaza and Maputo.

iii) To pursue development of mineral resources, concluding on-going actions or programs regarding the rehabilitation of coalmines in Moatize, tantalite-columbium in Morrua, Muine and Marropine, marble in Montepuez, garnet in Cuamba and Monarch, and gold in Manica;

iv) To ensure the implementation of new projects having potentials to increase the export capacity of the Country such as ornamental rocks in Tete and Memba, and phosphates in Monapo, as well as expansion of graphite in Ancuabe and marble in Montepuez;

v) To promote the establishment of mineral processing industries such as a titanium refinery in Nacala and Maputo; and

vi) To stimulate the expansion of gas and minerals at the national level to reduce the import of these products.

1.2. Mining-related Institutions and Regulations

In Mozambique, minerals and other natural resources including land are the property of the State, which controls their use and licensing. This principle, set down in the Constitution, is reiterated in the legislation governing the mineral sector, namely the Mining Law (Law 2/86 of April 16) and its regulations (approved pursuant to Decree 13/87 of February 24) as amended.

Within the Government, the Ministry of Mineral Resources and Energy (MMRE) has administrative and regulatory responsibilities for the mineral resource sector. Administration of mineral licensing procedures is carried out within the National Directorate of Mines.

Under the Mining Law, mining activities may be carried out with five different types of licenses: non-exclusive exploration license, exclusive exploration license, mining license, quarry permit, and small scale mining certificate. In addition, there is a precious meals and minerals commercial license which permits the license holder to buy and sell gemstones, gold and other precious metals. For medium to large scale ventures and for foreign investment the relevant titles are the exclusive and non-exclusive exploration licenses and mining license.

When a person wishes to conduct reconnaissance operations by using satellite and air photo imageries and/or field techniques to determine, for example, the location of a particular mineral occurrence or whether a certain geological environment contains any economic minerals of interest, a non-exclusive exploration license is issued. This instrument has the duration of one year (non-renewable), may cover relatively large areas and gives the holder a presumptive right to an exploration license for a specific mineral and for a discrete portion of the overall reconnaissance area where the occurrence or deposit has been located. This license is non-exclusive to the extent than a particular mineral occurrence is not yet specified and the holder has a priority or preference, rather than exclusivity, in claim or a right of preference before other claim or license applications are made for the area and mineral resources covered by this license.

An exclusive exploration license is issued, upon application, for a specified mineral in a specified area. The initial term is generally two years and may be renewed subject to compliance with work program, budget and abandonment obligations. The titleholder has exclusive rights to conduct exploration operations within the license area for specified mineral and preferential right in respect of associated and other minerals discovered within the license area. Upon due delineation of a resource base and submission of a mining plan, the holder of an exploration licenses is entitled to a mining license for the mineral. During the term of an exploration license, a mineral right surface tax is paid on an annual, per hectare basis. This is the only charge for the acquisition or use of the land and mineral resources in question. This tax is set at rate equivalent to US$.10 per hectare for non-exclusive exploration licenses and US$1.00 per hectare during the first year (increasing each year thereafter by US$.50) for exclusive exploration licenses. While this tax is not payable during the term of mining license, a land use fee is charged, payable to the State as the owner of all land, currently set at the equivalent US$.30 per hectare per year.

A mining license is issued for the purpose of mine development and production. The maximum initial term is 25 years or the life of mine. This term may be renewed so long as there are reserves, which are being mined.

Generally, in the case of large scale and foreign investment projects, in addition to the issuance of the exploration and/or mining license, a license agreement (a form of administrative contract) is also executed because of the complexity and duration of the mineral operations and to provide for investment guarantees and incentives. Besides establishing the schedule and content of exploration, feasibility, development and mining operations, and the continuity of the licensing rights for the minerals, the Mozambican mineral licensing agreement also contains the following provisions:

- International arbitration and expert proceeding under ICSID or ICC rules;
- Mozambican law together with applicable rules of international law governing the

licensing agreement;

- Banking and foreign exchange guarantees, rights and obligations;
- Transfer and termination procedures; and
- Any special provisions related to the project financing, firm in options, etc.

Separate regulations have not yet been issued for construction material and quarry permits so that these materials are treated under the framework for exploration and mining licenses. MMRE also carries out the licensing of potable mineral water rights. Mineral water exploration rights are issued form of a ministerial despacho or order for a period of up to six months. Production rights are awarded by the same type of instrument and may be permanent. While mining certificates are generally issued for small-scale artisanal operations, they apply also to limited prospecting purposes. A person with such a certificate may "peg" a claim and on that basis has the right to register and obtain a license to explore and mine the claim. Mining certificates may be issued only to individuals and cooperative associations.

Licensing procedures for mineral licenses are usually obtained by the submission of a formal notarized written request for an exploration or mining license for a particular area. In addition, a detail of the identity of the applicant's financial resources and technical capacity, a wok program and budget must be provided. The requirements for each type of license are fully set out in articles 11 and 26 of the Mining Law regulations.

1.3 Environmental Protection

Any development activities that may have significant environmental and socio-economic impact would have to satisfy environmental protection requirements, and large scale mining activities are among them. Specifically, an environmental management plan (EMP) would have to be prepared as a prerequisite to the development. The EMP should cover generally the following aspects although its contents should be modified to suit site-specific conditions.

- Geology, minerals and soil: For an opencast mine, this aspect would cover how the topsoil will be recovered and how the future land use and erosion will be managed.
- Disturbed and contaminated land: Measures to minimize future land degradation and contamination as well as any on-going management required for previously degraded or contaminated land would be included.
- Waste management: Measures to manage both solid and liquid and mineral and non-mineral wastes would be included. These measures could cover responsibilities regarding the handling of hazardous substance (including emergency cleanup and health and safety procedures) and the training of staff involved. Also included could be a waste management system designed to ensure "good-housekeeping", maximizing

the use of recyclable resources and to ensure the safe disposal of all non-mineral wastes.

- Landscape, land use, topography and visual impact: To be included are rehabilitation philosophy (e.g., top soil recovery, sequential in-pit tipping of overburden, future land use), and plans of post-mining topography including the slopes created during rehabilitation of operation sites.
- Fauna and flora: Descriptions of impacts on fauna and flora as well as species that would be used during rehabilitation and of how the vegetation would be managed are to be included.
- Surface water: Strategies for managing storm water, dams, rehabilitated surfaces and legitimate requirements of surface water users on affected watercourses would be included. Potential impacts to be avoided would be undesirable changes in run-off patterns and flooding due to subsidence.
- Groundwater: This would include strategies for land surface rehabilitation and designs of tailings impoundments to minimize adverse groundwater impacts and meeting requirements of legitimate groundwater users in any affected zone.
- Air quality: Details of measures to suppress dust and minimize emissions (e.g., suppression sprays – conveyors, transfer points, water browsers for roads, etc.) would be included. A major problem of air pollution with powdered coal dust and smog of exhausted gas from mining machinery should be resolved by river water showering in stockyard. If local power generation (30MW) is to be installed for backup power supply using low-grade coal, air pollution from the emission of SOx, NOx and CO2 should be managed properly.
- Noise: Details of any noise attenuation measures to be implemented would be included.
- Regional socio-economic structure: A resettlement plan that meets the World Bank guidelines OD 4.30 for to-be-relocated households due to the opencast mining would be included.
- Maintenance: Maintenance requirements for rehabilitated land, water, pollution control structures, tailings dams, or any program that requires ongoing inputs would be included.
- Socio-economic issues: Both positive and negative impact such as employment generation and changes in social habits would be included.

Chapter 2. Potentials for Mineral Resources in the Study Area

2.1. Overview of Mining Potentials

2.1.1. Geological setting

The Study Area in the northwest Mozambique is mainly covered by Precambrian and Phanerozoic terrains in the proportion of two-thirds by area. The Precambrian terrains include igneous and metamorphic rocks of Archaean to Upper Proterozoic age, while the younger terrains comprise Karoo, Jurassic, Cretaceous, Tertiary and Quaternary sedimentary basins and related volcanic rocks. In general, the older rocks underlie the northern and western parts of the Country (including the Study Area), with the Jurassic and younger rocks south of the Zambezi valley and in the northeast of Mozambique.

The Precambrian areas can be divided into three large structural units in Mozambique. Archaean and Paleo-Meso Proterozoic terrains outcrop near the Zimbabwe border, and essentially an extension of greenstone belt, the granite-gneisses of the Zimbabwe Craton and granitoides, gneisses and migmatites of the Barue complex. The younger Mozambique belt (1,100-1,350Ma), which covers extensive areas of the Country, contains evidence of three events – surprasialic terrains probably related to an old ocean discontinuity, igneous complexes, nappes, and klippen formed during a period of crustal overthrust. An intensive granitization and migmatization took place.

The third of the Precambrian structural units, dating from the Pan-African cycle (800-410 Ma), is represented by rocks of the Katanguian orogeny and by the emplacement of granites and pegmatites.

Turning to the Phanerozoic terrains, Carboniferous-Upper Jurassic age rifting was associated with sedimentation and widespread igneous activity. Three main sedimentary basins were formed, with intracratonic basins being filled with Karoo and Post-Karoo continental deposits and volcanics, and coastal basins being filled with Meso-Cenozoic continental and marine deposits. Coal-bearing sediments and volcanics represent the Karoo sequence, and a thick Plio-Quaternary cover frequently overlies the older terrains.

Figure 2.1 shows the stratigraphy and geological structure in Mozambique. The order of deposition was Archaean banded granite (igneous complex basement), green rocks, migmatites, gneiss, basic and ultra basic intrusive, and acid intrusive in Precambrian. Those Precambrian granitoides, sedimentary rocks and intrusive belonging to the Mozambique system were covered with Karoo system composed of coal-bearing sediment (sand and conglomerate) resting non-conformably on the Mozambique system and basalt, coarse basalt in the period from Upper Paraeozoic to Lower Mesozoic era. Alkaline volcanics (Jurassic) and sedimentary rocks (Cretaceous course sand) were covered on the Karoo system. Tertiary sediment and conglomerate lie on the Mesozoic rocks and

Quaternary sand/clay was covered on the surface.

Figure 2.1. Stratigraphy and Geological Structure in Mozambique

Age	Era	Period	System	Litho logy	Orogeny
(Ma) 0	Cenozoic	Quaternary	Quaternary	Sand, clay	(Ma=10^6year)
1.6 4		Tertiary	Tertiary	Sand, conglomerate	
65 146	Mesozoic	Cretaceous	Cretaceous	Course sand	
208		Jurassic	Jurassic	Alkaline Volcanics	Post-Karoo (150 Ma)
245		Triassic	Karoo System	Basalt, course basalt	
290	Paraeozoic	Permian		Sand, conglomerate	
363 409		Carboniferous		Coal bearing sediments	
		Devonian			Pan-African (500±100)
		Silurian			
		Ordovician			
570		Cambrian			
	Precambrian	Proterozoic	Mozambique System	Acid intrusive	Mozambican (1,100-950)
				Basic and ultra basic rocks	Kibaran (1,400-1,100)
2,450				Migmatites, gneiss, Amphibolites, quartzite, marble	Pre-Mozambican (1,800-1,000)
				Green rocks	
4,600		Acheozoic Archaean		Banded granite Granitoides complex	Limpopo (3,800-2,500)

2.1.2. Overall mining potentials

Economic potential of various terrains in the Study Area relates to their age and subsequent history. The Precambrian basement, for example, contains occurrences of tantalum-niobium, rare earths, gem-stones related to pegmatites, greenstone hosts gold, banded iron formations, graphite, and Mesozoic-aged fluorite and carbonatite-hosted apatite, amongst others. Other potentials include base metals (Cu, Pb, Zn), bauxite, diamonds and dimension stone. The mineral resources potentials of the Phanerozoic cover, by contrast, centers on clays, sands, refractory minerals, bentonite, limestone, heavy minerals (beach and paleo-river valley sands), coal and natural gas. Alluvial diamonds may also occur. The Country is also rich in thermal springs and mineral water occurrences related to magmatic activity.

Of particular significance for future exploration, green stone-hosted gold deposits form a major target for the application of modern exploration strategies and technology. The Archaean Manica greenstone belt, which extends from western Mozambique into Zimbabwe, has hosted gold production on both sides of the border, yet knowledge about fundamental controls to mineralization such as shear zones and other structures remains largely incomplete.

Similarly, the Tete complex in the Study Area offers untested potential for the platinum-group metal resources associated with similar layered complex in the other part of the world. Covering an area of some 800km^2, the complex contains mafic, ultramafic, and anorthosistic rocks, the ultramafics occurring as thin layer within massive gabbros. The Tete complex is very similar to the occurrences of the Precambrian basement complex at the Witwatersrand basin at south-west part of Johannesburg in South Africa.

Non-metal resources include the Moatize basin coal and pegmatite hosted niobium-tantalum deposits (both of which supported past production), and coastal beach and Paleo river valley sands. In addition, carbonatite (limestone) resources at the Mt. Muambe deposit in Tete province contain fluorite resources as well as high beryllium, niobium, strontium and rare earths values. The Mt. Cone N'gose deposit, also in Tete, is believed to contain pyrochlore, monazite, barite and fluorite-apatite, with phosphate-rich rocks occurring at its core.

Tables 2.1 and 2.2 show the list of mineral ore resources and ore reserves in each mineral and non-mineral deposit in the Study Area. In the list, there are only three mines operating as of October 2000 in the Study Area.

2.2. Potentials by Mineral

2.2.1. Iron

The magnetite and ilmenite deposits in the Study Area are both primary and secondary iron titanium deposits. Description is available of many zircon localities both in primary and placer deposits. Three types iron titanium deposits of ilmenite magnetite are as follows;

1) Primary deposits of titanium-magnetite (ilmenite: $FeTiO_3$, magnetite: $FeFe_2O_4$):
    a) titanium-magnetite deposits in gabbro-anorthosites,
    b) ilmenite, magnetite, rutile in pyroxenite and alkaline rocks in Precambrian, and
    c) ilmenite-rutite in pegmatite; and
2) Primary deposits of rutile:
    a) in quartz veins or pegmatites; and
    b) in metasomatic deposit.

Table 2.1. Metallic Mineral Resources and Ore Reserves in the Study Area

Type of deposit	Name of the deposit	Location	Ore reserves	Rank*
1. Iron (Fe) and Ti (Magnetite) (Ilmenite) (Rutile)	(1) Machedua	Moatize/Tete	68.46 (Mt)	B
	(2) Cambulatsitsi	Moatize/Tete	12.34 (Mt)	B
	(3) Inhantipissa	Moatize/Tete	11.80 (Mt)	C
	(4) Massamba	Chiuta /Tete	54.50 (Mt)	C
	(5) Rioni	Moatize/Tete	–	D
	(6) Txizita	Moatize/Tete	1.10(Mt)`	C
2. Iron (Escarnitic), Apatite	(1) Monte Muande	Moatize/Tete	150.00(Mt)	A
3. Cupper (malachite, chalcopyrite)	(1) Chidue	Macanga/Tete	5,884.00	A
4. Gold (Au)	(1) Chifumbazi	Angonia/Tete	Grade(g/t) 4.5-14	C
	(2) Missale	Angonia/Tete	Grade(g/t) 3-7	C
	(3) Mulolera	Angonia/Tete	Grade(g/t) 3	C
	(4) Fundao	Angonia/Tete	Grade(g/t) 4-30	C
	(5) Muende	Angonia/Tete	Grade(g/t) 4	C
	(6) Cacabanga	Angonia/Tete	Grade(g/t) 7.6	C
	(7) Machinga	Chiuta/Tete	Grade(g/t) 7-10	B
	(8) Bumbe	Chiuta/Tete	–	B
	(9) Cato	Chiuta/Tete	–	B
	(10) Cacanga	Moatize/Tete	Grade(g/t) 3-36	C
	(11) Cansunca	Moatize/Tete	Grade(g/t) 7.7-15	C
5. Gold (Placer gold)	(1) Rio Vuboe (Chifumbazi)	Angonia/Tete	$0.60g/m^3$	C
	(2) Rio Luangu	Chiuta/Tete	–	C
6. Bauxite ($Al(OH)_3$)	(1) Salambidua	Moatize/Tete	–	C
	(2) Cheneca	Angonia/Tete	–	C

*A=large, B=medium, C=small, D=occurrences
Source: G.P.Z., Oct. 2000.

Primary deposits of magmatic origin of upper Precambrian rocks are connected with the Tete gabbro-anorthosite complex which extends for almost 120km in an irregularly E-W trending massif north of Tete city. According to Hunting (1984) it is a large sheet or lopolith between 10 to 20km thick composed of basic igneous rocks. It consists of gabbro, norite and anorthosite with minor ultramafic rock types. It also contains plenty of opaque minerals (ilmenite, magnetite, sulphides) enriched in titanium and vanadium, impoverished in chromium and cobalt when composed to those of layered intusions such as the Bushveld complex. Gabbro-anorthosites are associated with titanium-magnetite deposits, which result from a magmatic segregation and later injection into the zones of weakness. The Tete gabbro-anorthosite complex covers an area of about $6,000km^2$ and is of Upper Precambrian age. The mineralogical assemblage is composed of magnetite and ilmenite intergrown with subordinal minerals of titanospinel, ulvospinel, anatase, pyrite, chalcopyrite and pyrrhotite. Titanomagnetite deposits stretch over 140km in NW-SE direction along the north bank of the Zambezi river. The main deposits, from NW to SE, are:

- Massamba: magnetite rich deposit (40km north-west from Tete) 54,500 (Mt),
- Inhantipisas (Singere): 1,100 (Mt)
- Txizita: ilmenite rich magnetite deposit (45km north-east from Tete),
- Machedua: ilmenite rich magnetite deposit (14km east from Moatize) 68,460(Mt),
- Cateme: magnetite rich deposit (60km ENE from Tete) new deposit in the Study Area, and
- Lupata (Doa): magnetite and ilmenite deposit (125km SE from Tete).

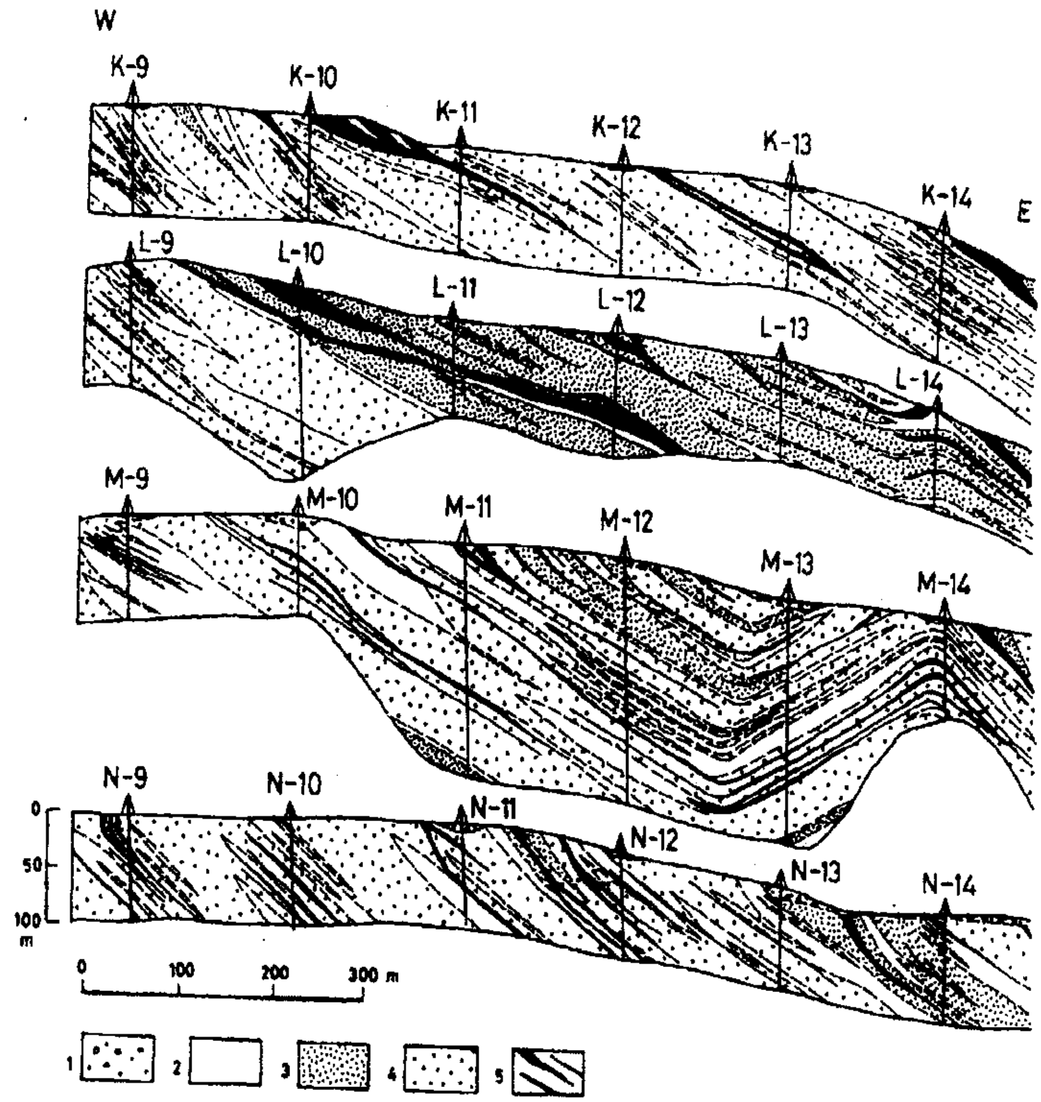
Table 2.2. Non-metallic Deposits in the Study Area

Non-metal deposit	Name of the deposit	Location	Reserves (ton)	Rank
1. Coal	(1) Moatize	Moatize/Tete	2,445.00(Mt)	A
	(2) Minjova	Moatize/Tete	450.00(Mt)	A
	(3) Muaradzi-Mcondedzi	Moatize/Tete	450.00(Mt)	B
2. Graphite	(1) Nhanhar (Madeiras)	Tsangano	–	B
	(2) Satemua	Angonia	5,537	A
3. Fluorite	(1) Monte Muambe (ap, br)	Moatize/Tete	2,500	A
	(2) Monte Muande	Moatize/Tete	1,510	A
4. Apatite	(1) Muande	Moatize/Tete	4,140	A
5. Corindo	(1) Cachoeira	Moatize/Tete	–	C
6. limestone	(1) Matema	Moatize/Tete	–	C
7. Black & Red granites	(1) Buzimuana-Necungas	Necungas/ Moatize	300.00	A
8. Anortozit (Black Granit)	(1) Monte Necungas	Necungas/ Moatize	120.00	A
	(2) Sicarabo	Cambulatsitsi/ Moatize	100.00	B
9. Thermal and mineral source of water	(1) Muambe	Moatize/Tete	–	C
10. Marble	(1) Matema	Moatize/Tete	–	B
11. Tourumarine	(1) Mazoe	Changara/Tete	–	C
	(2) Catambula	Changara/Tete	–	C
	(3) Blaundi-Bonga	Changara/Tete	–	C
12. Clay: bentonite	(1) Tambara, Tete	Tete	–	C

*A=large, B=medium, C=small, D=occurrences
Source: G.P.Z., Oct. 2000.

The average composition of titanomagnetites is: 20% TiO_2, 50% Fe_2O_3, 18% FeO, 0.60% V_2O_5. Figure 2.2 shows the profile of the Monte Muande magnetite ore deposit.

Figure 2.2. Cross-sections of the Central Zone at Monte Muande



1 elluvium
2 marble
3 marble with low grade magnetite mineralization
4 marble with medium magnetite mineralization
5 magnetite and marble rich in magnetite

Source: Geological Institute, Beograd, 1964.

2.2.2. Copper

The copper deposits of the Zambezi river basin belong to three main types:

1) Deposits associated with layers of magnetite-limestone, resulting from pyrometasomatism of intrusive granites;
2) Quartz veins in breccias an in fracture zones; and
3) Stratiform deposits, with secondary mineralization depending from intruding basic rocks.

The first type is more common in the Messeca-Fingoe region, namely in the Messeca village and Luzina river regions. On the southern flank of Mt. Mancupiti, the mineralization may be recognized for about 2km. The copper minerals identified in this area are mainly chalcopyrite, bornite, azurite and malachite. The latter two occur: a) in zones of limestone with magnetite bands which are parallel to the stratification of limestone, b) disseminated in the latter rock, and c) in the zones of the most intense tectonic breciation.

In 53 samples from the Mancupiti deposit, 10 show contents of 1.15 to 8.75%, weak superficial mineralization and discontinuity of the mineralized zones. The genesis of the primary copper mineralization of this deposit is connected with the prometasomatic contact deposits, where copper mineralization follows iron mineralization. Concerning the possibility of any economically significant copper deposits in this reason, the structure of the mineralized rocks – limestone almost vertical or dipping northwards at high angles – does not favor important concentrations near the surface. It is possible that there may exist deeper and larger copper deposits; at a greater depth, there may logically occur a secondary concentration of this metal, as the result of the leaching of the minerals found in the granite-limestone contact.

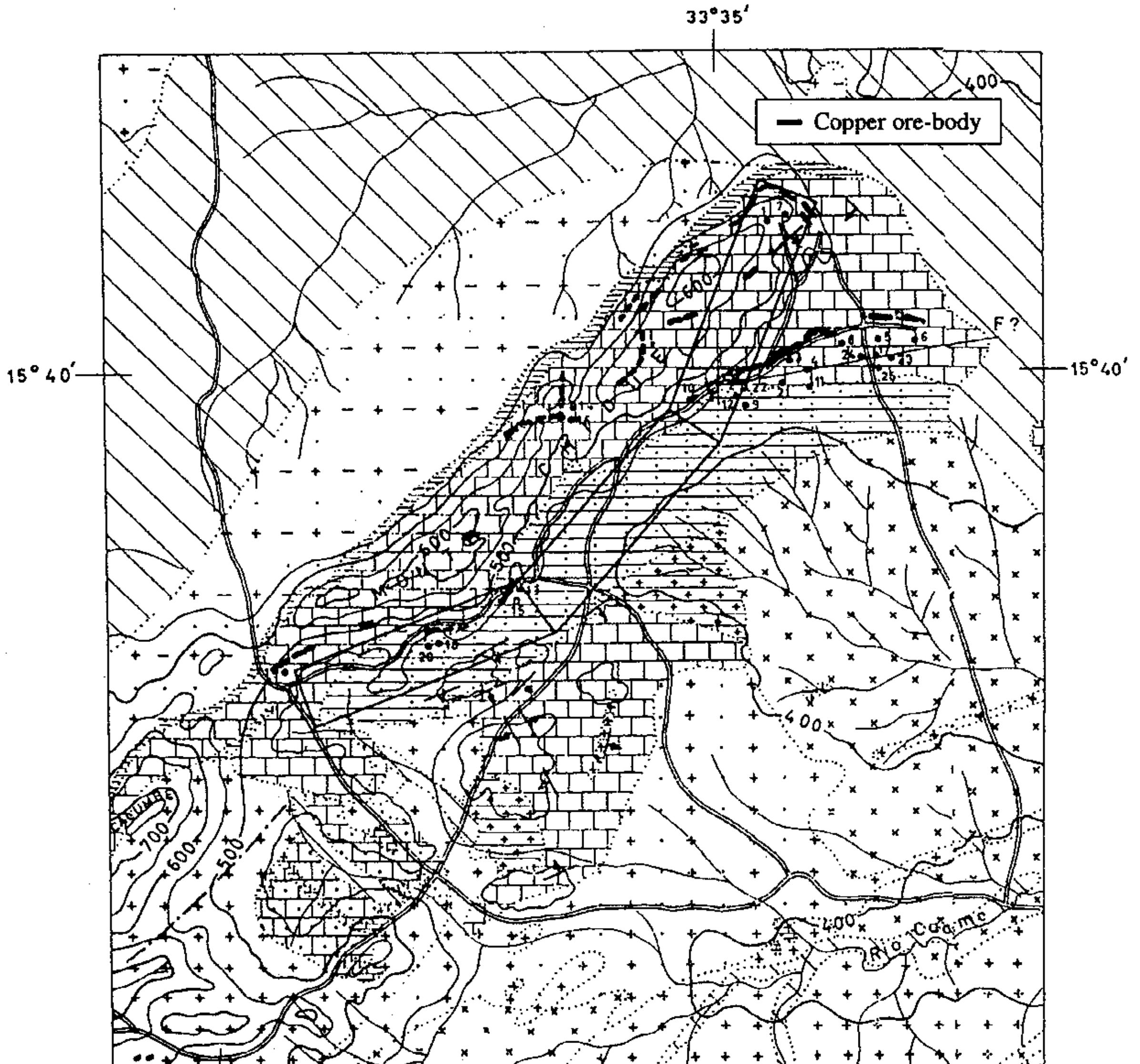
Deposits in quarts-carbonate veins, breccias and fracture zones are generally small and with minute reserves, though they occasionally show high copper content. The most important are the ones of Cacanga and Bingre. The Cacanga deposit, some 3km northeast of Moatize, corresponds to a quartz-carbonate vein, about 2.5km long, that crosses gneiss, mica-schist and pre-Cambrian limestone. In the same oxidized zone, the minerals of the vein are limonite, malachite, azurite with associated pyrite, chalcopyrite and some galena. In the oxidation zone, the medium content is 15% Cu with 3g/t Au; limestone of this zone contain 5 to 6g/t Au.

As a whole, the copper potential of this deposit seems to be small, either due to the irregular mineralization or to the relatively minor size of the veins. This type of copper deposits also occurs in the Gabbro-diorite complex of Tete. There, besides the occurrence of Bingre, exist the copper-gold deposits of Sorronhati, Chapandula, Chire river and M'Cuva. In the ultra basic massif of Mt. Achiza, there are also some signs of copper mineralization, such as the one at the sources of the Nhangose river, where a 20cm thick band, containing from 7.12 to 22.13% of Cu, occurs flanking on antigorite vein. In the

Archiza-Messeca region, there are numerous signs of copper, connected mainly with Fingoe system rocks.

The third type, stratiform deposits with secondary mineralization formed in the dependence of intruding basic rocks, is best represented in the Mt. Chidue deposit, one of the most important cupriferous zones currently known in the Zambezi river basin. Located at 15° 40' latitude south and 33° 35' longitude east of Greenwich (Figure 2.3), this deposit is composed of dolomitic limestone of the Figngoe system intruded by diorite and monzonite porphyries, diorites, monzonites and gabbros and micro gabbros of the Gabbro-diorite complex or, perhaps, of later age.

Figure 2.3. Geological Map of Chidue Copper Ore Deposit



The mineralization, seemingly conformable with the limestone stratification, is fairly thick and, in general, composed of bornite, chalcopyrite, malachite and native copper. In borings made for Campanhia Geral Mineira do Chidue, encouraging results were obtained in cores Nos, 2, 4, 5, and 17, where, for thickness of 1.3, 1.049, 4.389 and 1.85, 9.830m, there were, respectively, 5.89%, 5.23%, 2.20% and 13.61%, 2.35% Cu. The origin of the copper mineralization may be related to syenite and monzonite intrusions, or preferable to the basic rocks of the Gabbro-diorite complex, as is suggested by the relatively high cobalt contents – 1.28%, 0.80% and 0.67% – of outcropping samples. The very slightly mineralized limestone continues fairly to the southwest and to the north inflecting to the east. Accordingly, it seems that observations must be continued with basis on a detailed structural geological survey of the area; the vast limestone outcrops that occur south and northeast should be studied as well. The deposits of Mts. M'Panda-Uncua and Conua, in the Samangoe river, south of the Zambezi river, belong to the same type. They seem to offer little interest.

The mineralizations known in the Luzina river are of the same type but are devoid of any economic value. A number of base metals occurrences have been identified in the past in Sofala, Tete and Cabo Delgado, although none has yet been evaluated in detail. Metals contained in these showings include copper, nickel and cobalt. The greenstone belts – particularly in the west of Mozambique – also offer potential for base metals, given the association between this type of host environment and massive sulphides mineralization in other parts of the world. Other areas of interest for base metals lie in Tete province, along Mozambique's borders with Malawi and Zambia, in districts that have not been explored since the independence. The Chidwe and Massamba copper deposits in Tete province require further evaluation, with work conducted in the 1950s on the Chidwe East Zone having identified resources of about 1Mt of ore grading 3.3% Cu down to a depth of 240m. It also appears that follow-up work on a possible cobalt association with the copper rich zones was never completed satisfactorily. The Massamba deposit was not explored systematically, and identified soil anomalies in both prospect areas suggest that more detailed work is justified on the Chidwe formation as a whole. The cupper ore minerals at Chidue ore deposit are mainly composed of malachite, chalcopyrite and bonito in dolomitic limestone as a country rock.

2.2.3. Gold

The most important gold mineralizations are generally related to the contacts of granitic rocks with metasediments and with the amphibolites-schists of the Fingoe system, the latter possibly resulting from the metamorphism of volcanic rocks. Among the usual auriferous metasediments there are quartz-schists, tectonic brecciated quartzites, and banded quartzites. Auriferous mineralization in amphibolites are also common, namely as vein lets or quartz lenticles that cut across the amphibolites or are conformable with them.

Another type of auriferous mineralization recognized in the Zambezi river basin is found in association with basic rocks of the Gabbro-diorite complex of Tete. They are mineralization with subordinate copper minerals, or inversely, copper mineralization with some associated gold; they occur in quartz-carbonate veins that are mainly emplaced in remnants of schist or pre-Cambrian gneiss. The occurrence of Missale, Cacabanga, Mulolera and Tchindundo also belong to the auriferous area. South of this area there is an old Machinga mine where mineralization occurs in a long quartz vein, striking N 20° W and about 2km long.

Gold production is currently centered on the deposits of the Archaean Mutare- Monica green stone belt, close to the Zimbabwe border, and in northwestern Niassa province, near the shores of Lake Nyasa. Current understanding of Mozambique's greenstone belts suggests that these have similar potentials to the longstanding gold producers of Zimbabwe, and to the areas of Tanzania currently being evaluated. In the Mutare-Manica greenstone belt, gold is hosted in quartz veins, with the main controls on mineralization including the host formations and the relationship between the greenstones and basement granite-gneiss. Shear-zones and faults are particularly favorable locations, with veins typically characterized by their sub-vertical dip and extension of up to 350m. Vein thickness can range up to 3m, carrying average gold values of 6.7g/t, as well as around 3% base metal sulphides. Although these two areas are of principal interest in relation to gold occurrences, gold has been reported from all of the Country's provinces that are underlain by Precambrian basement. For example, the Mualadze-Chifunbazi-Muolera and Machinga-Cazula areas of Tete province host quartz-sulphides (mainly pyrite) veins, in which free gold elements have also been identified, of grades ranging from 2.5g/t to 9g/t in different veins. Portuguese and English mining engineers have operated these small gold mines during 1950-1980 as underground gold mines. Almost all of these gold mines closed completely before the Civil War. These 11 gold mines are distributed from the southeast to the northwest in the northern part of Tete province, and it seemed to be related to geothermal activity of gold mineralization in this area. The gold mineralization age of these gold bearing quartz veins is supposed to be very young (Tertiary or Quaternary) because some hot springs exist in this area along the branch of the Luia river.

2.2.4. Placer gold

The largest concentrations of alluvial gold are those in the Luenha river. However, the possibilities of dredging seems to be slim since the largest concentrations are inside pot-holes of the bedrock and possibly also in the dry season channel. There are also important auriferous in the confluence of the Luia and the Capoche rivers.

In the Study Area, the potential of placer gold deposits are not so high as in other provinces, Manica and Nampula. Eluvial deposits, resulting from weathering, cover some of the gold bearing formations to a depth of up to 50m. Usually, the placer gold exists in the basement of conglomerate / unconformity, and with accessory minerals such as quarts, carbon seam and sulphides minerals (pyrite, chalcopyrite, etc.). Only three placer gold mines have been reported in the Study Area, Rio Vuboe (Chifumbazi) in Angonia district and Rio Luangu in Chiuta district. The grade of placer gold is 0.60g/m^3 in Rio Vuboe of Chifumbazi area.

Gold prospecting areas exist around the porphyry copper mining district in Chidue, Chiuta district and in Mulolera and Chifumbazi in Angonia district. The sample size is 10mm in diameter. The usage of dredging ship should be very effective on this type of alluvium gold deposit in the Zambezi river and its branches in the Study Area.

2.2.5. Bauxite ($Al_2(OH)_3$)

The only deposit in production is in another province, Serra de Moriangane, also known as Alumen of Monte Snuta in Manica province just on the Zimbabwean border. Another area with some bauxite occurrence is in Monte Salambidua at 80km northwest (tourmaline, fluorite, topaz etc.) from Tete city.

Bauxite and lateritic bauxite contain several admixtures: kaolinite, chlorite, illite, quartz, often a substantial amount of titanium minerals, iron oxides, rare-earth, uranium and thorium and some metals. Within Tete province, several other localities with possible bauxite occurrences had been explored in the past (Real, 1963) and during 1980-81 (Samokhvalov, 1981). The most prominent syenite intrusions of the region are Salambidua and Cheneca composed of three massifs: Domue, Cheneca and Macanque, northeast of Furancungo on the Malawian border. Here the margins consist of gneisses and migmatites, but the central part of syenite with hornblende. The top levels are about 1,300-1,400m high surrounded by sharp slopes.

2.2.6. Coal

Apart from the huge hydroelectric capability at Cahora Bassa and other potential dam sites on the Zambezi river, Mozambique's principal energy source lies in the coal deposits of the Moatize-Minjova and Mucanha-Vuzi basins in Tete province. Studies currently underway for re-operating the Moatize mines and developing other operations in the area could be the forerunner for annual output rising to several million tons of coking coal, dependent on rehabilitation of the railway line to the port of Beira.

The Moatize basin contains seven coal seams from top to bottom: Andre (thickness of seam: 2m), Grande Falesia (12m), Intermedia (22m), Bananeiras (27m), Chipanga (30m), and Sousa Pinto (14m) within the Lower Permian Ecca formation. The seams lie within a 320-400m thick productive sequence, with the thickest single seam, the Chipanhga, varying in thickness from 21m to 67m, with an average of 36m. Reserves in the Moatize basin are estimated at some 2,445 million tons. The other main coal-bearing basin, the

Mucanha-Vuzi basin, carries six seams. The deposit is heavily block-faulted but it contains reserves estimated at over 3,600 million tons. Table 2.3 shows the chemical compositions of the coal at Moatize mine, and MINA Chipanga Ltd. (now operating).

Table 2.3. Chemical Compositions of the Coal at Moatize Mine

Moatize steam coal		Average	Mina Chipanga Ltd.
ARB (total H_2O)		10%	9~14%
Inherent Moisture (%)		0.6~1.6%	10(max)
Ash (before washing)		14%	14~25%
Sulfur (%)		0.6~0.8%	0.7~0.9%
Volatile matter (%)		20%	15~16.6
Gross calorific Value (Kcal/kg)		6,300Kcal	7,120~7,200
Size (0-25mm)		0~20mm (18%)	0~20mm
HGI		90	90
Ash-Fusion Temperature (℃)	Deformation	1,302℃	1,300℃~ +1,500℃
	Hemispheric	1,385℃	1,385℃~ +1,500℃
	Flow	1,392℃	+1,500℃

Coal production at Moatize, the responsibility of the state concern, Carbomoc, since 1978, reached a peak of around 500,000 ton in 1982 but dwindled to virtually nothing when its rail outlet to Beira was put out of action the following year. Carbomoc currently employs around 500 people, although the mine at Moatize is effectively on care-and-maintenance with limited exports of coal by truck to Malawi.

The bottleneck is the Sena line railroad between Moatize and the Beira port, which was destructed during the civil war. The cost of coal transportation by railway should be getting much lower than truck transportation (US$8-10/t) through Malawi to Tanzania.

The Minas Chipanga Limitada, one of operating coalmines at Moatize, started operation in 1998. The numbers of workers are 118 persons as of October, 2000. The monthly coal production of this mine is 6,000 tons (72,000 tons/year). The mining site is located 20km east from Tete city on EN103 to Moatize.

Two incline shafts have been operated to the Southwest direction at the length of 430m (with an average dip of about 23°) at the depth of 65m under the surface in October, 2000. The coal from Chipanga XI was transported to Dondo for cement factories and Beira for sugar factories (20-50%). The truck transportation costs range from US$38/t to US$80/t depending on the routes and the road conditions. About 55% of Moatize coal production is transported to Blantiyre in Malawi for Portland cement factories (55-80%: total 40,000t/year) by 45-50-ton trucks. The transportation cost to Blantyre is the lowest at about US$20/t by truck transportation. In addition, about 5% of Moatize coal has been exported to Zambia occasionally. The truck coal transportation cost ranges from US$20/t (to Malawi) to US$80/t (to Beira) depending on the fuel prices and road conditions. The coal mining operation cost (about $12-15/t) is much lower than transportation cost by trucks. Table 2.4 shows cost comparison of three typical coalmines (South Africa, USA and Mozambique) as of 1998. As shown in the table, the final FOB price of Moatize coal is slightly higher than that of South Africa from open-pit coalmine. The main reason is different mining operation methods: underground operation or opencast mining. About 30% of Moatize coal reserves exist between 12m and 80m from the surface. The operation cost of open-pit coal operation should range from US$10/t to US$12/t in new Moatize coalmine, and transportation cost may range from US$18/t to US$20/t after Sena railway reconstruction. The FOB price of Moatize coal at Beira should be the lowest in the world with the Sena line used for transport.

As the major infrastructure project, JCI was involved in studies aimed at re-operating the Moatize coalmines as a source of export coking coal. A most recent report on the project envisages the production of 3.2 Mton/year of hard coking coal for shipment through Beira over an initial 17-years mine life. However, this would also involve the production of considerable amounts of lower-quality thermal coal, for which transport costs would be prohibitive. The project concept therefore involves the construction of a 1,050MW mine-mouth power station to use this fuel, with power being fed into the regional grid.

Further up the coast, Beira is the location for JCT's proposed hot briquetted iron project, as part of a larger industrial development centered on the port. The plant would also use Mozambique's natural gas, with imported iron ore fines as the feed. The project is designed to benefit from Beira's status as a Free Export Zone, with the various fiscal and other incentives that entails.

Table 2.4. Comparison of Costs at Typical Coalmines (US$/t)

Area (country)	South Africa	U.S.A.	Mozambique
Name of the coalmine	Transvall	Appalachia-C	Moatize
Mining operating cost	13.4～19.7	16.5～26.9	(17.98)
Mining product price	14.1～21.9	18,6～28.9	(15)
Land Transportation fee	6.8～7.3	13.3～18.0	(7.3)
Tax of the harbor loading	1.2～1.7	0.5～1.1	(2)
Price of FOB	22.1～30.9	32.1～48.0	27.28
Marine transportation fee	4.4～6.5	6.0～14.2	(6.5)
Price of CIF	26.5～37.5	38.1～62.1	33.78
CUF (C/Kcal/kg)	0.44～0.58	0.57～0.87	0.5362
Calorific Value (Kcal / kg)	5.970～6.450	6,690～7,165	6,300

Source: IEA Coal Research - The Clean Coal Center, London, 1998.

2.2.7. Graphite (C)

Graphite is a mineral of a hexagonal modification of carbon, black to steel-gray in color, hardness 1 to 2, and specific gravity 2.1 to 2.3. In nature, it is found in igneous, sedimentary and mainly metamorphic rocks. The three largest consuming industries are steel making, foundries and refractories.

Graphite resources in Mozambique are associated with metamorphic rocks of the Precambrian basement. Angonia district hosts graphite occurrences, some of which have been invested in part. Associated with Proterozoic paragneisses, migmatites, anorthosites and marbles, the graphite is concentrated in veins and in the weathered cover. The graphitic zone is highly metamorphosed in granulitic charnockitic facieses with several areas with an increased content of both primary and epigenetic graphite. The Satemun deposit, for example, is believed to contain over 5.6Mt of ore grading some 6% graphite to a depth of 30m, and exploration has indicated economic quantities of graphite in several other locations in this district. The Nhankar deposit, situated about 14km north west of Ulongue, is of the disseminated type, in biotite-amphibole gneisses following the zone of granulites. Mineralized graphite is developed in two layers separated by the zone of migmatites. Also here crystalline limestone with graphite is developed. An estimate of reserves in steep dipping strata, made in 1950, suggested 234,000 tons of rock with 17,200 tons of extractable graphite.

Graphite spears disseminated and in laminated aggregates, lenses and veins, ranging from 0.5 to 3mm in thickness. The dip of the graphite body is around 40' to 60" towards NE. The width is around 40m, the length around 1,200m, and the depth is greater than 90m. In 1983, the proven reserves of the central part of the deposit to a depth of 20meters were calculated at 475,000m^3 of ore, or 1,120,000 tons, with exploitable graphite content of 67,000 tons at a grade of 6%.

2.2.8. Fluorite (CaF_2)

Fluorite of commercial value is called fluospar. According to Harben-Bates (1984) fluorspar is produced in three grades: acid, ceramic and metallurgical. The acid grade fluospar is of highest quality; it is used in the chemical industry. The acid is used as an etching agent on glass, sulfur hexafluoride as a gaseous insulator in high voltage installations, element fluorine as the most important fluorating agent in organic synthesis.

Fluorite mineralization is associated with Mesozoic magmatism, with deep-seated faults connected with the East-African Rift Valley, with hydrothermal solutions. A number of carbonatite intrusions have been identified. Of these, the Mt. Muambe deposit in Tete province contains fluorite resources as well as high beryllium, niobium, strontium and rare earths values. Mt. Muambe is ring-shaped hill situated on the southern margin of the Tete complex, in a depression filled with Mesozoic sediments and volcanic of Karoo. The ring consists of Upper Karoo arcositic sandstones, whose external ring is 6km in diameter with a crater about 200m deep. The Mt. Cone N'gose deposit, also in Tete province, is believed to contain pyrochlore, monazite, barite and fluor- apatite, with phosphate-rich rocks occurring at its core.

Fluorite mineralization is found in the carbonatite, along the fractures and in brecciated fenites especially along the contact zones. The metasomatic aureole of the fluorite mineralization in the fenite is up to 50 meters wide. Fluorites, blue and yellow in color, appeared to meet the specifications of metallurgical grade. The ore is amenable to flotation to produce 98% CaF per chemical grade requirements. The estimated resources are about 1.1 million tons.

In general, the high-grade fluorite is used in the chemical industry (more than 60% of total consumption and should contain 95-97% CaF_2). It is also used in the production of hydrofluoric acid (HF-aqueous), the starting point in the production of various organic and inorganic fluoride chemicals, elemental fluorine and synthetic cryolite. Very important is the production of synthetic cryolite. Synthetic cryolite is molten electrolyte used in the Hall-Heroult aluminum processing, and about 55kg is required for the production of 1 ton of aluminum. Other uses are part of high-octane petrol, production of Teflon, glass polishing, enamel striping, electroplating, etc.

Apart from fluorite, the following minerals/elements are known to occur in the carbonatite of Mt. Muambe: (1) 1.6 million tons of martite (without TiO2), and (2) high content of Be, Nb, Sr and rare earths. Summary figures for Monte Muanbe according to the report by Brodolmpeks are: approximately 2,000m long, 10.3m wide on average and 50m deep with average mineralized rate of 45% and the total of 1,422,906 tons of fluorite, of which 1,120,088 tons are pure fluorite. Of these, the Mt. Muambe deposit contains fluorite resources as well as high beryllium, niobium, strontium and rare earths values. Mt. Muambe is ring-shaped hill situated on the southern margin of the Tete complex, in a depression filled with Mesozoic sediments and volcanic of Karroo.

Other prospective carbonatite ore deposits are found at Mt. Massatwe, Chimadzi and Cazula area in Chiuta district, 120km north and northeast from Tete city as estimated from Landsat 5 TM images. Mt. Chidwe (3km south from Cazula) in Chiuta district is also supposed to be a kind of carbonatite deposit concentrated with copper. All of these carbonatite ore deposits are good resources of dolomitic limestone for cement, fluorite and rare earth minerals.

In Manica district, technological tests made with Djalira (Maringue) fluorite confirmed that metallurgical fluospar can be produced with a CaF_2 content of 85%, and acid fluorspar with 97% CaF_2. Fluorite from Geramo (Canxixe) was tested by a private firm in 1972, and the concentrate of 97% CaF_2 was produced. The reserves of fluorite in the Djnguire area are estimated at about 0.78 million tons (proved 70,000t + probable 110,000t + possible 600,000t) by Alves, 1961-64.

Further to the northwest within the E-W section of mid-Zambezi valley and on the northern bank of the Cahora Bassa dam, is the prominent area of Cone Negose with a carbonatite intrusion and a complex mineralized with apatite, fluorite, rare earth and metals. In some places the content of fluorite is 20%, but generally is low and of no economic interest.

It is fairly clear that much of the work done in recent years at Monte Muambe is very basic. An internal demand may exist for locally produced spar, and the Mozambican Government has decided to proceed with iron and steel production. If, based on available information about iron mineral resources, a plant was set up near Tete then fluorite from Monte Muanbe may be usable (Fluorite Deposit in Mozambique, National Institute of Geology in Mozambique, 1988, p19).

2.2.9. Apatite ($Ca_5(PO_4)_3(F, Cl, OH)$)

Phosphorus is one of the most essential elements for life, and beside nitrogen and potassium, a primary material in fertilizer production. A useful phosphorus mineral of phosphates is apatite.

The Monte Muande deposit is situated about 30m NW of Tete city on the north bank of the Zambezi river and continues as the Monte Fema deposits in SW direction across the river on its south bank. It is part of hills called Serra Muande, which lies in the zone of uranium mineralization on Mavudzi type (davidite). In the past, interest was centered mainly on magnetite deposits, investigated by Nissho Company in 1960 and by the Yugoslav team in 1984.

The Muande deposit consists of medium grained crystalline marble belonging to the Chidue group, with abundant bands and crystals of magnetite, and interlayers of gneiss. The marble overlies biotite and Augean gneiss and, in the contact zones, remobilized marble penetrates in the gneiss in a thin layer (Hunting, 1984). Igneous rocks of Tete complex, mainly gabbro, with some pyroxenite, apatite and syenite, overlie marble of the Chidue group and pegmatite dykes.

Magnetite and apatite concentrations of economic importance located around the top of Monte Muande, occur within the marble massif (4.5km) as stratiform bodies concordant with the foliation. While magnetite forms different sills or is disseminated in marbles in very variable concentration, the distribution of apatite is more homogeneous.

The ore zones are of NE-SW direction; the mineralization is concentrated in three zones of which the central is the richest. The marble beds could be several 100m thick and biotite marble with apatite and none or little magnetite, but with a characteristic presence of flint nodules, alternate with magnetite-mineralized marble. The main magnetite zone is 3,500m long and 800m thick.

The progress of mineralization starts with apatite at a pneumatolytic phase of the Tete igneous complex, with coarse grains and, sometimes, concentrated layers, followed by area of ductite crystalline milestones. The apatite of the pneumatolytic phase is accompanied by rare-earth mineralization, the magnetite injection by limestone. A Yugoslav team into these primary zones divided the deposit into the following:

(a) High-grade Fe deposit – average thickness 5.15m
(Fe 3.59-60.08%, av. 34.52 % and P_2O_5 0.06-11.51%, av. 5.12%),

(b) Moderate-grade Fe deposit – average thickness 8.75m
(Fe 4.05-56.19%, av. 21.11 % and P_2O_5 0.45-11.41%, av. 5.25%), and

(c) Low-grade Fe deposit – average thickness 29.0m
(Fe 2.00-28.50%, av. 9.95 % and P_2O_5 0.89-7.56%, av. 4.02%).

Therefore, reserves were calculated as follows.

In eluvial deposit:	2,680,000 t Fe and 295,000 t P_2O_5
In primary deposit:	14,620,000 t Fe and 3,855,000 t P_2O_5
Total:	17,300,000 t Fe and 4,150,000 t P_2O_5

The calculation covers only to a depth of 140m. Further reserves may be delineated in the Monte Fema area on the bank of the Zambezi river.

2.2.10. Rare earth minerals

Rare earth (RE) minerals are a source of sixteen elements that play an increasingly important role in modern industry. Without these the present technological revolution would not have been possible. From a modest beginning of utilization in the production of gas mantels and flint stones, RE-elements found their application in every branch of industry. The rare earths group is divided in two subgroups – cerium or light subgroup and yttrium or heavy sub group. The cerium sub group consists of lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), and thorium (Th). The yttrium subgroup is composed of yttrium (Y), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), lutetium (Lu), and scandium (Sc).

The cerium subgroup is represented mainly by two minerals, bastnaesite and monazite, while the yttrium subgroup is concentrated with xenotime. These three minerals are, in fact, the only commercial sources of RE. Monazite is of a more complex composition, i.e., (Ce, La, Y, Th) PO_4 and from RE, the ratio of Ce and La is 1:1 (about 30%) and the content of ThO_2 up to 12%. Therefore, monazite is also an important source of thorium. Yttrium occurs in small quantities only. The content of RE is 50-60%.

All RE-minerals of RE accumulate in primary rocks in carbonatites only, which represent a special geochemical cycle. Exceptional are primary vein deposits of bastnaesite and monazite. Accumulations of monazite in placers – fluviatile or marine origin represent the main RE source. A new production of bastnaesite as a byproduct of iron-ore mining was started in China. In the Soviet Union, RE are recovered by a processing of apatite from the Kola peninsula. The mining of monazite and xenotime is closely related to placer deposit mining, where they are found in commercial quantities (about 1% of total heavy minerals) as a byproduct of titanium and zirconium extraction. As a result, the production level of monazite (xenotime is quite rare in placers) is dependent mainly on the market demands for titanium minerals. In fact, the content of monazite is low, but it is present in many placer deposits and large volumes of sand treated secure a constant supply and often oversupply of monazite in the world market.

In Mozambique, sites of RE occurrence are numerous and all genetic types of known deposits are covered: 1) deposits in pegmatite and granitic rocks, 2) deposits in alkaline rocks, 3) deposits in carbonatites, 4) accumulations in apatite, and 5) placer deposits. Of all these five genetic types, placer deposits in beaches and dune deposits in the coastal zone are the most important and economically most feasible ones.

Monte Muanbe carbonatite with prominent ring structure lies some 57km east-southeast of Tete city. It is some 5km in diameter and intrudes sediments of Karoo age. The intrusion shows no obvious relationship with major faulting but clearly belongs to the Chilwa Alkaline Province and is related to the East African Rift system. A local control for Monte Muanbe, distinguishing it from non-carbonatite intrusives, may be zone of weakness related to the southern margin of the Tete complex, here concealed by Karroo sediments. The central depression of the Muanbe ring structure is underlain by a wide variety of carbonatitic and feldspathic intrusive rocks including very plentiful breccias and also some rhyolite. The marginal ring of hills is composed of up tilted and thermally metamorphosed Upper Karroo sandstone. Manganese occur as fine-grained disseminations in the carbonatites. The MnO content in 58 bedrock samples was 1.71% on average. Niobium, tantalum, thorium and rare-earth elements occur in the carbonatite in phases yet to be identified. In the same samples, 0.02% was tantalum combined with niobium pent oxides and 0.4% thorium and rare-earth element oxides. Fluorite also occurs in the carbonatite breccias, and the residual soil over the central depression contains these resources in higher concentrations. A pitting program carried out by Dias et al (1961) over 2800 hectares indicated an average thickness of soil of 0.88m with the following composition: 85.00% Fe_2O_3, 2.6% of MnO, and 0.19% Ta and Nb oxides.

During the mapping and reconnaissance conducted by Brodolmpeks (1984), anomalous levels of yttrium (1,200 to 1,700ppm); lanthanum (350 to 700ppm), cerium (3,000ppm);

beryllium (10,000ppm) and niobium (220ppm) were recorded. Numerous values up to 10,000ppm strontium were also discovered. However, it appears that the soils were not examined during their most recent survey.

Production of rare earth from primary deposits, other than pegmatite, is unlikely to occur except as a byproduct of other types of mining. The possible exception is the high-grade material reported. In Monte Muanbe, the best mix of mining is mainly production of fluorite and by-product as rare-earth minerals.

2.2.11. Limestone ($CaCO_3$)

Limestone and marls of sedimentary origin should cover the entire demands for calcium carbonate both in a production of cement and lime, and in order industrial uses such as ceramics and glass. Very pure limestone occur in the Cheringoma and Joffane formations and should be used as filler in paper, plastic, rubber, foodstuff, paint, in ultra fine ground products.

Small sites of an occurrence of crystalline limestone were found at Angonia, in the Ulongue metalogenic zone in which marbles coincide with the western graphite zones. The locality is named Fornos and remnants of old lime furnaces confirm the use of marble by the local population.

Another small lime production unit is in operation at Boroma in Tete province by C.I. Tete. The installed capacity of lime is 3,000 tons per year. The lime produced in Mozambique is used just marginally in the building industry, in agriculture and mainly for saturation purpose in sugarcane factories. In Songo, 350m^3 per hour capacity units were established for usage of the Cahora Bassa dam construction. In Mozambique, the total lime production units are in 26 localities and their annual total capacity is only 6 million m^3.

2.2.12. Dimension stones (rocks for construction)

Mozambique has substantial resources of dimension stone of igneous, metamorphic and sedimentary origin. Dark colored igneous rocks include gabbro, granite and dolerite, while their lighter counterparts include granite, anorthosite, rhyolite and syenite. Metamorphic dimension stones include marble, quartzite and serpentine, while limestone and travertine comprise those of sedimentary origin. Other decorative materials, such as rhodonite and fossil wood, also occur in smaller amounts but still offer potential for economic extraction.

"Marlyn Granite", a member of the Anglo American group, is prospecting in parts of the Tete complex, in an areas of some 6,000km^2 that outcrops on the Zambezi river, just north of Tete city. Studies on the complex, which consists of basic igneous rocks – anorthosite and gabbro-diorite – have compared it to the Bushveld complex in South Africa and the Great Dyke in Zimbabwe. Although this work is still in its infancy, the formation is believed to be Precambrian in age. Pilot quarries are being opened, with large sample blocks of high ornamental value extracted for evaluation on the international market. The black and blown granite, 76km east from Tete, consists of two types of black (dark gray in color) and dark blown granite. The M trading Tete produces and exports these granite blocks (9-16m^3) through South Africa to Italy since 1998. The mining company has 24 persons for mining and two wheel loaders at the stockyard. The monthly production is 5-6 blocks (50-70m^3/month). The price of black granite is usually US$1,000 /$m^3$. The price of blown granite is more than US$1,200/$m^3$.

Another operating material mine is LABOR-CETA Joint venture in Moatize. The mine's products are mainly 16mm under grain size rock for constructing road and building materials. The total amount of monthly production of quartzite fragments is 1,200m^3 including byproduct (3/4", 3/8", 12/2" grain size sand). The numbers of workers in the company are only 10 persons (four operators and six workers).

2.2.13. Marble ($CaCO_3$)

Marble is present in almost all crystalline complexes of Mozambique including Archaean and Precambrian rocks. They are originally sedimentary rocks metamorphosed during several orogenetic phases and deposited either as a platform or geosynclinals sediments. The latter case is more common. There are still vast areas in which crystalline limestone deposits may be found. Primary attention should be given to mobile belts of the Precambrian with carbonatic sediments, to greenstones belt and generally to the upper structural level of the Mozambican belt with prevailing metasediments.

The Archaean rocks in the Luia group of central Tete province with narrow bands of marble and banded ironstones are enclosed in granulites of acid composition. The marbles are coarsely granular, white or gray rocks, almost pure calcite, but also contain lamina of calc-silicate minerals. In part, they are dolomite and always closely associated with the marbles. They occur mainly around the river Luatize NE of Fingoe and around Chiputo near the Zambian border.

Precambrian formations are divided into several groups. The Chidue group situated on the periphery of the Tete complex over an area extending from Massamba to Estima, represents metasediments outcropping as marble, schist, quartzite and associated metasediments. Marble of the Mufa-Boroma area is white or cream, medium-grained, forming usually distinctive structural ridges such as Chacocoma marble. Near Tete city, marble was used in lime production.

The crystalline limestone of Chidue is also a bearer of tungsten, rare earths, copper and gold mineralization. Marble in the southern part of Matema (Lat. 15° 51'12"S, Lon. 33° 28'17"E) was used in lime production and road construction materials from 1994 to 1995. The mining open pit was 150m in diameter. The marbles concentrate in skarn minerals (amphibole, epidote, garnet, etc.) with small account of ore disseminations (pyrite, magnetite, chalcopyrite, and arsenic-pyrite).

2.2.14. Tourmaline

In the Study Area, there is not enough information for the tourmaline and their location. This mineral usually occurs with fluorite, chlorite in carbonatite ore deposit and pegmatite rocks.

2.2.15. Clay (bentonite)

The name bentonite refers to a clayey rock characterized by mixture of different clay minerals in which montmorillonite prevails accounting for the typical properties of the rock such as a high absorption capacity, high cation exchange capability, swelling plasticity and bonding power. The two most important smectites are sodium montmorillonite known as sodium bentonite, which is swelling, and calcium montmorillonite called calcium bentonite, which is non-swelling.

Bentonite is used in many industrial processes – in refining, filtration and de-colorization of vegetable oils, wine and drinking water, cosmetics, and pharmaceutical products. The biggest part of bentonite is used in foundry sands (about 3-5% as binding agent) and in rotary drilling as a lubricant and coating material for an uncased wall of hole, and to increase viscosity of the drilling mud.

The main and best known bentonite deposits are located at about 49km southwest of Maputo in the Boane Bassa area on the slope of Little Lebombo Mts. Zimbabwean border. In the Angonia region, the Tambara mining area in Tete was reported as a small bentonite deposit.

Chapter 3. Strategy for Mining in the Study Area

Mining in general is a risky business, as it depends on sub-surface resources. Established markets for mineral products are almost always international, often dominated by a few large suppliers, and prices are sometimes vagarious. The Study Area is endowed with a variety of seemingly rich mineral resources, but most of them are still at an early stage of development. A sensible approach to mining for the Angonia regional development, therefore, is to identify and concentrate on a few most promising mineral resources in view of the quality assessed on the basis of sufficient data and marketing prospects.

Following this approach, strategy for mining in the Study Area is established with the three broad components: 1) stage-wise development of Moatize coal, 2) systematic exploration of a few most promising minerals, and 3) local processing of non-metallic minerals. Each component is described below. For any activity in this sector, the private sector initiative is expected supported by MMRE for information services and by GPZ for facilitation of licensing and other procedures.

3.1. Stage-wise Development of Moatize Coal

The coal reserve in Moatize has the highest priority for development. It was once developed successfully with the peak production of 600,000 tons/year, it has a well-established reserve of 2.4 billion tons, and the quality is very high. It is potentially price competitive with about US$15/ton at the site, while the international norm is US$18/ton. In view of major issues of transportation means and product mix with markets, the following stage-wise development strategy should be taken.

3.1.1. Short to medium term

Production of Moatize coal should increase steadily for export to neighboring countries as well as the domestic market over the next five years or so. During this period, it is expected for minimal rehabilitation of the Sena railway to be undertaken. Coal briquette manufacturing should be introduced in the nearest future and expanded along with the coal production, as coal briquettes have ready and growing regional/domestic markets. Other possibilities for diversifying value-added products may be examined during this period by mine operators supported by MMRE to improve the viability of coal production, including coal sorting and pre-treatment.

3.1.2. Medium to long term

Full scale development of Moatize coal should be undertaken during Phase 2, aiming at 6.0 million ton annual production to be transported mainly by the Sena railway for shipping from the Beira port. A good portion of this will be in the form of coking coal. To utilize low quality thermal coal to be left after coking coal manufacturing, a mine-mouth coalfired thermal power plant may be constructed. A preliminary power supply-demand analysis of Mozambique seems to justify the construction of a thermal power plant with at least 1,000MW capacity by the year 2025, even if all the proposed major hydropower plants are implemented (Energy Sector Report).

3.2. Systematic Exploration of Most Promising Minerals

Systematic exploration should be undertaken for a few most promising mineral resources: copper at Mt. Chidue in Chiuta district, the Mt. Muambe deposit, graphite in Angonia, and apatite at Monte Muande. According to an early work, Cu contents of samples from Mt. Chidue are high (10 weight % Cu or higher). Further works should be undertaken to determine the reserve and also to explore possible cobalt association. The Mt. Muambe deposit should be further explored, aiming at the product mix of fluorite and rare earth minerals such as beryllium, niobium and strontium.

Graphite deposits in Angonia have been partly developed in small scale, and estimate of reserves made for some deposits. A systematic exploration should start with compilation and analysis of the existing data for all the deposits while small scale extraction may be undertaken immediately. Interest in the Monte Muande deposit centered on magnetite in the past, but it hosts sizeable marble massif containing both magnetite and apatite concentrations of economic importance. Reserves have been calculated to a depth of 140m for Fe and P_2O_5. Further exploration beyond the depth and into neighboring deposits at Monte Fema should be undertaken.

3.3. Local Processing of Non-metallic Minerals.

The Study Area is rich in other non-metallic minerals such as limestone, dimension stones and marble, and clay (bentonite) as well as gravels and stones. Some of them are locally utilized in small scale. For instance, production of bricks from clay is commonly practiced throughout the Study Area. The existing lime production unit at Boroma may expand as the demand for lime increases for road construction, agriculture and other purposes. As the construction demand increases, local cement manufacturing may be established in the Study Area. Dimension stones and marble have good prospects for export to neighboring countries as well. Quarrying for gravels and stone will expand to produce construction materials, including gabions to be used for weirs, riverbank protection and other purposes. Local processing of these non-metallic mineral resources should be promoted as a matter of principle as it will localize value-added and facilitate better management by local communities.

Chapter 4. Mineral Resources Exploration and Development Program

The strategy for the mining sector in the Study Area, as established in the previous section, consists of three components: (1) stage-wise development of Moatize coal, (2) systematic exploration of most promising minerals, and (3) local processing of non-metallic minerals. Most promising metallic minerals in the Study Area are iron deposits and copper reserves. Non-metallic minerals that may be processed locally include graphite, fluorite, apatite, granite, and limestone. Exploration and development of these mineral resources as well as Moatize coal constitute the mining sector program as part of the Angonia regional development. The program is described below, and more details on selected mineral resources are contained in the Project Report (separate volume).

4.1. Moatize Coal Development

Moatize coal is potentially highly price-competitive with the production cost of US$15/ton at the site while the international norm is US$18/ton. A major constraint is the transportation cost. To make Moatize coal competitive in the international market, the restoration of the Sena railway is a prerequisite. By the railway transportation, an FOB price of US$27/ton may be realized at the Beira port. While the coal prices in the international market have been declining over the past few decades, the Japanese benchmark price for coal was US$29.95 in 1999.

Technically, it is possible to produce Moatize coal at as large scale as its huge reserve allows. Production at 22 million tons annually was recommended by a recent study. In reality, however, the development scale of Moatize coal is constrained by the capacity of the Sena railway. The transport capacity of the Sena railway may increase from 1 million tons/year initially to 6 million tons/year at the maximum. If the coal production exceeds the capacity in any point in time, part of the production would have to be exported to neighboring countries by trucks or would otherwise be used locally.

Moatize coal is considered to be bituminous and of low volatility with modest coking properties, depending on the areas, but with high ash contents. Its typical ash contents are in the range of 20-40% (21% on average) with 0.5-1.0% sulfur. The coal can be washed up to a 10% ash content with acceptable yields.

It is recommended that Moatize coal be developed in stages, starting with the production level of 1 million tons/year, possibly at a few locations. The maximum production of 6 million tons/year may be reached within a few to several years. Further increase in production is subject to the development of domestic markets as well as increased export to neighboring countries. Promising domestic markets include manufacturing of cement, coal thermal power generation and briquette manufacturing.

4.2. Iron and Steel

There are several types of iron deposits in the Study Area, including magmatic deposits of residual liquid injection, prometasomatic deposits and metamorphosed sedimentary deposits. The most important of the first type is titanomagnetites in the Machedua deposits, which have an average composition of 50% Fe_2O_3, 18% FeO, 20% TiO_2 and 0.60% V_2O_5. The high titanium content as well as the geographic conditions make this type of deposit difficult for iron extraction. According to a semi-industrial scale test conducted recently in North America, however, the Machedua ores showed favorable results for steel production. Production costs may be competitive in the international market, provided that the annual output is at least 750,000 tons. Byproducts such as titanium and vanadium may further improve the economic viability. These known deposits would deserve a further study.

Promising deposits related to skarn (pyrometasomatic contact), the second type, are found at Messeca in Mt. Muengue and in the Luzinariver area. The composition of most significant samples of these deposits is 90% SiO_2, 65.3% Fe, 0.037% P, 0.50% Mn, and a slight trace of TiO_2 with no S. While the ore quality is good, these deposits are generally small in amount.

The third type of deposits generally has higher iron contents and practically no S, P and TiO_2 but the reserves are much smaller. Deposits at Milange, Nhacungue, Muiu-a-Chipungo, Camitala, and Vuzi river in the Zambezi river basin belong to this type. The ore at Mt. Camitala is relatively poor in quality but worthy of detailed study because of the size of the mineralized zone.

4.3. Copper Mining

Crystalline limestone of Chifunde is a bearer of tungsten, rare earths, copper, and gold mineralization. The copper reserves are estimated by the Geological Institute of Mozambique at 5,884,000 tons with 5% Cu. There are several other exploration efforts and reports, which give not-totally-consistent evaluation of the reserves and their quality. Despite these efforts in the past, the extent of boring is not enough to determine the reserves and their quality. The Mt. Chidue copper mine would deserve further exploration since a preliminary analysis on the most likely reserve and quality based on the available data shows a high economic rate of return (over 20%). Details are given in the Project Report (separate volume). The economic viability is most sensitive to gold prices and gold recovery ratios.

4.4. Non-metallic Minerals

4.4.1. Fluorite

One of the several fluorite deposits in Mozambique is found at Monte Muambe in the

Study Area in a carbonatite of ring structure, 780m in height and 6km in external diameter. The ore reserves are estimated at 1.4 million tons. Blue fluorite contains a significant amount of rare earth minerals such as Nb, Y, La, Be, and Sr while yellow fluorite is usually poorer in Mn, Y, and Be. Also found with the fluorite vein in carbonatite are MnO and P_2O_2.

The Monte Muambe fluorite ore deposits may be developed as truck-less or underground mining by a joint venture company between Mozambique and other countries. This is expected only after the Sena railway is rehabilitated and an access road of several kilometers is constructed. The maximum annual production is estimated to be 8,000-30,000 tons/year, and rare earth elements are also estimated at 800 tons/year as byproducts. The mine will also produce carbonatite ($CaCO_3$) as a cement raw material for domestic use in the Tete city and Mozatize area.

4.4.2. Graphite

The largest graphite deposit site in the Study Area is at Satemua in Angonia district. The average grade is 6% but may be enhanced by hand separation process. Flotation may enhance the grade up to 94%. The proved ore reserves are 1.12 million tons (6% grade) and probably reserves are 6.64 million tons. The price of graphite is estimated at US$1,000/ton at the site. The Satemua graphite mine would be viable with the FOB price of US$1,580/ton at Beira if the transportation problem is solved with access roads and the Sena railway.

4.4.3. Limestone

Three large cement factories exist in Mozambique, all established before the independence, in Matola near Maputo, Dondo near Beira and the port of Nacala. The total capacity of clinker is 990,000 tons or approximately 1 million tons of cement. A small cement factory exists at Boroma in Tete province with the capacity of 3,000 tons/year. At present, some 80% of coal exported to Malawi from the Moatize coalmine is used for cement kilns there. A cement factory in Moatize or nearby would be certainly more competitive than imported cement due to savings in transportation costs. This would contribute also to enhancing the economic viability of the Moatize coal mining.

The Study on the Integrated Development Master Plan of the Angonia Region

Sector Report 1: Economic Sector

Part 3: Industry and Small and Medium Business

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Sector Report 1: Economic Sector

Part 3: Industry and Small and Medium Business

Chapter 1. General Conditions of Industrial Sector in Mozambique

1.1. Background

With the independence in 1975, some 200,000 Portuguese left the Country, leaving Mozambicans largely without skills, technology, professionals and management. The Mozambican government adopted a state planned economic system, and introduced mainly heavy industries, which failed subsequently. Destruction of socio-economic infrastructure by the civil war was combined in the 1980's with damages caused by rising crude oil prices and natural disasters such as cyclones, floods and prolonged droughts. The real GDP per capita decreased to a half of the pre-independence level.

Since the late 1980's, Mozambique has started to introduce market-oriented economy and democracy, and its economy has turned positive. The civil war ended in 1992. The annual GDP growth rate attained 6% on average during 1987-95, although the manufacturing sector remained in the state of deterioration. Since 1995, measures have been taken to promote privatization of stale enterprises and investments, and to reduce import duties. Consequently, the manufacturing sector expanded rapidly at the average annual rate of ... in real terms over 1995-98 (Table 3.1).

Table 3.1. Industrial Production by Economic Activities

	1995	1996	1997	1998
Production value (US$ million)	206.4	248.9	340.8	403.5
Percentage change (%)	-	20.6	36.9	18.4

Source: Calculated from *Statistical Yearbook*, 1998.

1.2. Manufacturing Production

The food processing, beverage and tobacco industry is the largest subsector in Mozambique, accounting for 60% of the total manufacturing production value. Non-metallic mineral products and the chemical industry, including petroleum products, follow with a share of more or less 10%, respectively. The large expansion of the sector during 1995-98 was largely due to increase in production value of the food, beverages and tobacco industry (Table 3.2).

1.3. Trade of Manufactured Goods

Export and import value by product group in 1998 is shown in Tables 3.3 and 3.4, respectively. Major export products are live animal and their products with a 27.2% share in the total export value, and vegetable products with 25.0%. Total export value of agriculture and minerals related products, excluding cotton and textile products account for some 80% of the total export value. In 1998, the textile products, including cotton and yarn, earned US$21 million, increased from US$14 million in 1994, but cotton export accounts for 53% of the export value of textile products. Export of final products of apparel and clothing is small compared to export of raw materials and textile fabrics.

Table 3.2. Industrial Production by Subsector, 1997

(Unit: Mt. 10^6)

Category	1995	1996	1997	1998
31 Food, beverages & tobacco	1,003,007	1,653,848	2,400,339	2,992,277
32 Textiles, clothing & leather	87,951	119,629	267,882	234,906
33 Wood & cork	29,203	28,283	45,853	48,660
34 Paper industry. Printing & publishing	73,523	98,066	124,477	135,952
35 Chemical industry and petrol derivation	207,554	331,738	432,682	448,746
36 Non-metallic mineral products	284,118	376,561	434,078	485,289
37 Basic metal industry	65,069	35,049	42,701	81,034
38 Metal prod, machinery & transport equipment	83,315	128,238	132,388	269,797
39 Other manufacturing industry	1,187	1,794	2,512	3,042
Total	1,834,927	2,773,206	3,882,912	4,699,703
Percent increased	--	51%	40%	21%

Source: *Statistical Yearbook*, 1998.

Table 3.3. List of Export Products, 1998

Code	Category	1,000US$	Share (%)
01	Live animals and products Fish and crustaceans, mollusks and other aquatic invertebrates	66,531	27.2
02	Vegetable products Edible fruits and nuts; peels of citrus or melon	61,144	25.0
04	Food products, beverages and tobacco Tobacco and sugar	11,373	4.7
05	Mineral products Mineral fuels, mineral oils and products of their distillation	38,894	15.9
11	Textile products Cotton, textile fabrics and apparel articles and clothing accessories	20,941	8.6
16	Machinery, equipment and electrical machinery Tools, implements and cutlery	14,139	5.8
17	Transport equipment Railway and vehicles rolling stock and parts and accessories	8,246	3.4
	Other products	23,331	9.4
	Total	244,599	100.0

Source: ibid.

Table 3.4. List of Import Products, 1998

Code	Category	1,000US$	Share (%)
01	Live animals and products Fish and crustaceans, mollusks and other aquatic invertebrates, dairy products, birds' eggs, natural honey and live animals	25,289	3.1
02	Vegetable products Cereals, malts, starches, oil seeds and oleaginous fruits	114,901	14.1
04	Food products, beverages and tobacco Sugar and sugar confectionery, beverages, spirits and vinegar	60,201	7.4
05	Mineral products Mineral fuels, mineral oils and products of their distillation	78,382	9.6
06	Chemical industry Inorganic chemical, pharmaceutical products, soaps, etc.	51,348	6.3
07	Rubber and plastic products	22,911	2.8
10	Paper products, printing and publishing	23,038	2.8
11	Textile products Cotton, apparel articles and clothing accessories and other textile articles; sets	45,460	5.6
15	Iron and steel, articles of iron or steel and aluminum	80,642	9.9
16	Machinery, equipment and electrical machinery Nuclear reactors, machinery and mechanical appliances, electrical machinery and equipment, and their parts	155,296	19.0
17	Transport equipment Vehicles rolling stock and parts and accessories	77,927	9.5
	Other products	81,880	9.9
	Total	817,275	100.0

Source: ibid.

Other major export products are machinery, equipment, and electrical machinery (5.8%), and transport equipment (3.4%). Judging from the production data presented above, those machinery and equipment are re-exported, but not produced in Mozambique. In fact, machinery, equipment and electrical equipment represent the largest import item, accounting for 19% of the total value in 1998. Transport equipment also has a large share of 9.5%.

The shares of iron and steel and their articles in import are 3.1% and 5.3%, respectively. Part of these imports may be re-exported to neighboring land-locked countries. Other major import goods are vegetable products (14.1%), food products (7.4%), and mineral products (9.6%). Import of these processed goods is unfortunate, when Mozambique produces a lot of raw materials of primary production. In other words, the industry in Mozambique is at a stage where import substitution may be promoted as a first step.

Chapter 2. Existing Industrial Policy and Strategy

2.1. Objectives of Industrial Policy

The Industrial Policy approved in 1997 has established its objectives as follows:

(1) support the value-added use of natural resources,
(2) contribute to the balance of external trade,
(3) contribute to the satisfaction of basic needs, and
(4) promote the development of labor intensive technologies.

Each objective is clarified.

(1) Value-added use of natural resources

Rich endowments of natural resources in Mozambique offer opportunities for dynamic and varied industrial development. Effective use of natural resources should be realized through the following:

1) development of inter-sector linkages,
2) increase in domestic value-added,
3) diversification of the industrial structure by the use of under-utilized resources, and
4) development of comparative advantages based on geo-economic as well as natural resources.

(2) Trade balance

Industry should participate in the overall efforts of the Country to reduce trade imbalance as one of priorities in economic development through foreign exchange earning and saving. This should be realized through the following:

1) recovery and improvement of traditional export industries,
2) development of new industries with export potentials, and
3) import substitution, in particular at the level of manufacturing input that can be produced locally.

(3) Satisfaction of basic needs

Poverty alleviation is a central objective of the government policy. The industrial sector should contribute to meeting the basic needs of the populace as a prerequisite to development. The pursuit of this objective require that the priority be given to industries that promote the following:

1) supply of essential consumer goods, input and means of production,
2) direct and indirect job creation and improvement in the qualifications of the workforce,
3) development of micro, small and medium industries, and
4) production of raw materials and accessories, basic infrastructure and equipment.

(4) Technology development

Technology development is critically important to ensure competitiveness in internal and external markets through improving quality and increasing productivity. It can be achieved through the following:

1) modernization of existing viable production lines,
2) development of such industries that encourage the use of technological externalities,
3) development of capacity for technological innovation and assimilation, and
4) development of human resources.

2.2. Priority Areas for Industrial Development

The Industrial Policy defines priority subsector industries as follows.

(1) Food industry and agro-industry
  1) Commodity supply industries for domestic and export markets
    - sugar, cotton
  2) Export-oriented industries
    - cashew, tea, copra
  3) Import substitution industries
    - cereals, fruits and vegetables, other food commodities such as beverages, mineral water, meat products, etc.

(2) Textile, clothing and shoe industries
    - Cotton textile and clothing manufacturing

(3) Metal working and electro-machinery industries
    - Base metal work, foundries, forges, thermal treatment and machinery parts

(4) Construction materials

(5) Others of high prospects
    - Metallurgical industries, packaging industry, graphic art, paper and publishing.

2.3. Industrial Strategy

The Government has adopted the basic strategy for industrial development with the following general principles:

1) Creation of a more favorable environment for industrial activities,
2) Promotion of industrial investment,
3) Rehabilitation and modernization of the industrial sector,
4) Promotion of the private sector,
5) Industrial growth,
6) Industrial development along with the lines defined in the industrial policy, and
7) Development of a strong competitive industrial sector within the context of regional integration.

In line with these, the industrial strategy varies for short, medium and long terms as outlined below.

(1) First stage

This stage comprises the short and medium terms (five and 10 years, respectively). Principal aims are to continue with the rehabilitation and modernization, and to improve conditions for expansion. This stage prepares conditions for the sector's long-term sustained growth through the following:

1) Creation of favorable investment climate,
2) Increase in productivity,
3) Technological updating,
4) Infrastructure development and training,
5) Export promotion, and
6) Regional integration.

Activities to be undertaken during the short term (1997-2002) include rehabilitation, facilitation of credit for operating capital, and acquisition of spare parts. Immediate measures to be taken include strengthening of customs control on industrial goods entering the Country and pursuit of tax system reform.

In the medium term up to the year 2007, the sector is to recover through continued rehabilitation and encouragement of new start-ups. Main focus is on the modernization and increased productivity of the sector.

(2) Second stage

Based on the structural innovation to be accomplished through the first stage, the second stage aims at expansion of the sector through the following:

1) Start-up of export-oriented industries,
2) Development of export-oriented industry, and
3) Mobilization of foreign investments.

2.4. Development of Micro, Small and Medium Industries

The Government recognizes the importance of small and micro business not only for industrial development through promotion of industrial linkages and new business but also for social development through creation of employment. The government strategy for micro, small and medium industries aims at the following:

(1) cohesive and competitive network in rural and suburban zones,
(2) economic use of local raw materials, and
(3) use of appropriate technology.

2.5. Trade Policy

The Ministry of Industry, Trade and Tourism prepared the Trade Policy and Strategy in 1999 for supporting the development of agriculture and industrial production, contributing to reduction of the trade imbalance, and participating in meeting the basic needs of the population and economic use of the country's resources. Objectives and priorities of the Policy are as follows.

(1) Domestic trade

1) Rehabilitation and expansion of the rural trade network,
2) Marketing of agricultural products of the family sector, and the enhancement of food security,
3) Sustainable increase in consumers and products with improved distribution throughout the country,
4) Creation of mechanisms to encourage the gradual integration of the formal and the informal sectors,
5) Facilitation and simplification of the mechanism for trade licenses, and
6) Coordination with concerned institutions for the rehabilitation and development of the road network.

(2) External trade

1) Increasing and diversifying exports, particularly of non-traditional products,
2) Exploring new markets for export production,
3) Ensuring provision of raw materials and equipment for the domestic market,
4) Monitoring external markets and supporting for marketing, market and products development, and quality improvement of products,
5) Increasing cooperation and economic integration at regional level,
6) Harmonizing tariffs and trade policies, and facilitating cross-border trade, and
7) Promoting the use of national infrastructure by the trade sector for external trade operations.

(3) Roles of the State and the private sector

As the State's responsibility, the state should create a favorable environment for national and foreign investments in the trade sector. In this regard, simplification of bureaucratic procedures, adjustments in trade legislation and establishment of appropriate incentive systems are required to support the private initiatives. It is necessary to develop a national laboratory network and to establish a national standard system.

On the other hand, the roles of the private sector are to promote investments, expansion and modernization of the trade network. The private sector should execute purchase of agricultural surplus for domestic and export markets, diversification of exportable production and market research. In addition, the informal sector is expected to play an important role of trades. Informal sector trade fill the vacuum which the formal sector is still not covering and contributes to i) the supply of goods and services, ii) the modernization of the rural economy and iii) the generation of employment alternatives.

2.6. GPZ Strategy and Programs for the Industrial Sector

(1) Strategy

GPZ strategy concerning industrial development in Zambezi Valley aims at the promotion of the private sector for employment generation, development of public infrastructure, and integration of small enterprises in a broader context of scale economies. In particular, the promotion of the private sector is considered the basic condition for sustainable regional development. GPZ activities focus on the following aspects:

1) integrated rural development,
2) management of economic and social programs,
3) support for self-employment,
4) small enterprises and private sector development,
5) development of institutional capacity for project management,
6) environmental management to lead investors and people to assume responsibilities in sustainable management of natural resources, and
7) studies conducive to better planning and formulation of policies and strategy to support the regional development.

(2) Major programs

For industrial development, GPZ is expected to organize itself and function as a "one stop service center" for national and international investors. The fundamental objective is to facilitate investments as well as reducing costs involved in the investment process.

Major programs in Zambezi Valley include the following:

1) Second phase of Cahora Bassa hydropower development,
2) Two hydropower dams on the Zambezi main stream,
3) Rehabilitation of the Sena railway,
4) Development of irrigated agriculture,
5) Exploitation of Moatize coal,
6) Rehabilitation of National Game Park,
7) Development of steel and aluminum industries, and
8) Rehabilitation of sugar factories.

Chapter 3. Existing Conditions of Industries and Small and Medium Business

3.1. Overview

Table 3.5 shows major commercial, industrial and service units in the six districts of the Study Area, prepared by the Provincial Directorate of Industry, Commerce and Tourism. Major economic activities are retailing and grain milling. Tete province used to have 347 shops, including those in Tete city, of which 111 were closed as of 1999. Most shops locate in district capitals and Tete city, while small stalls selling primary goods are found in the countryside. In addition to these formal shops, many informal open-air markets are found both in towns and in the countryside. Most commodities, except perishables, are imported from neighboring countries of Malawi, Zimbabwe and South Africa. Some manufactured goods are imported from China and India at low prices such as bicycles, kitchenware and pencils from China, and tools and razor blades from India. Used clothes are sold commonly. These situations reflect the under-development of light industries in Mozambique.

Table 3.5. Number of Major Commercial, Industrial and Service Units by District

	Commercial premises		Industrial premises		Service premises	
District	Operation	Non-operation	Operation	Non-operation	Operation	Non-operation
Moatize	17 shops	22 shops	75 mills 11 carpentry 2 saw mills 1 bakery		4 garages 3 stations	
Angonia	11 shops	21 shops	71 mills carpentry		Bank hotel	
Tsangano	3 shops 48 stalls	2 shops	29 mills			1 garage
Macanga	4 shops	1 shop	13 mills carpentry			
Chifunde	3 shops 52 stalls		12 mills			
Chiuta	2 shops 40 stalls	4 shops	16 mills			

Source: UNDP, *ZMM-GT Mozambique Country Profile.*

Major small scale industries are grain milling and carpentry. Grain milling is the largest industry as local farmers traditionally prefer their grains to be threshed for own or local consumption. Other industries include carpentry to produce wooden furniture, metal working only by smith to produce buckets and other metal goods, and a few garages to serve limited vehicles.

3.2. Existing Conditions by District

Existing conditions related to industry and small and medium business are described by district. Only four districts are covered as there exist virtually no industrial activities in

Chifunde and Chiuta.

3.2.1. Moatize

Moatize district has an area of 8,700km^2 and a population of 112,000 as of 1997 (population density at 12.9/km^2). The district capital of Moatize is the second largest town in Tete province, located at 20km from the Tete city on a national road. Because of the development of coal mining and of the headquarters of Sena Railway, the historical town has well developed compared to other towns.

Agriculture is the main industry with crops such as cotton, tobacco, maize, millet, sweet potato, etc. Moatize also has abundant mineral resources. Coal reserves are estimated to be 1.0% of the world's reserves. A joint venture with the South African company has recently obtained concession to re-exploit the Moatize deposit; however, its mining activity at present is still on a small scale. In addition, there exist large and diversified deposits of mineral resources such as iron, fluorite and apatite, which are scarcely exploited and utilized.

There are several kinds of industries such as carpentry, bakery and workshops and brick makers. They are small and micro scale enterprises and seldom use local resources. Brick makers utilize coal but consumption volume is very small.

3.2.2. Angonia

Angonia district has the largest population of 245,000 with an area of 3,300km^2 (population density at 74.2/km^2). The soil conditions are well suited for crop cultivation. Major crops are maize, beans and vegetables. Family farming is the biggest industry. The main market for agricultural products is inside the district and the area bordering on Malawi. The currency mainly used in the boarder trading is the Malawian kwacha.

There is no trading system of their products. Thus, farmers bring their own crops and other purchased crops to the frontier for sales, and negotiate with Malawian traders for prices. Cash crops are always in oversupply because of the small size of the market. Besides, lack of transport and bad road conditions make access to other markets difficult.

The majority of consumer goods and other necessary articles are imported from Malawi. Residents of rural area freely cross the border to trade them.

Industrial infrastructure is very poor. Only the central part of Ulongue, the district capital, is provided with electricity but no water supply system exists in the whole district. Telecommunications is quite limited and the residents rely on community radio links.

There exist several kinds of industries such as milling, carpentries, hotels and shops in Ulongue. However, it is difficult to expand their business due to lack of telecommunications and other infrastructure.

There is a branch of Bank of Austral in Ulongue but it is very difficult to obtain credit for both working capital and new investments. A large amount of money is required to obtain mortgages but many properties were destroyed during the civil war. At the moment, the right of land use is not subject to the mortgage.

3.2.3. Tsangano

Tsangano district has an area of 3,200km^2 with a population of 109,000 as of 1997 (population density at 34.1/km^2). The soil in the district is fertile but only 21,000 hectares (6% of the district area) are cultivated. Main crops include maize, beans groundnuts and tobacco. The market for agricultural products, mainly maize and vegetables, is within the district and in Malawi, similar to other districts. There are open markets along the road of border where farmers bring to sell their products. One of the problems on agricultural production is shortage of seed, fertilizers and tools due to financial difficulty, as there is no formal credit supply system for them.

There is no water supply, telecommunications or electric supply systems in the rural area. The road network in the district connecting to major roads is mostly unpaved and impassible during the rainy season. There are few small stores in the district capital and grain milling is the main private industry.

3.2.4. Macanga

Macanga district has an area of 7,000km^2 with the smallest population of 46,000 (population density at 6.6/km^2) in 1997. The main crop is maize but it is in oversupply. Since no trading business has been established in the district, farmers must negotiate with traders by themselves without proper information of prices. Other major crops include beans, vegetables and fruits.

Grain milling, carpentry and shops are the main industries. Diesel engines are used for power because the whole district is not supplied with electricity. There is no water supply system and limited telecommunications. Only radio links are used for communication. Lack of transportation and bad road conditions obstruct access to markets in larger towns outside.

3.3. Industrial Structure

Table 3.6 shows employment in Tete province by sector and areas (urban/rural) in 1997. The largest employer is the agriculture and forestry sector engaging about 90% of people. The commerce and finance sector follows with a 2.7% share in the total employment. It should be noted that this sector accounts for only 1.4% in rural areas while it employs 17% in urban areas.

The industry sector, including mining, manufacturing, energy and construction, employs 3,732 people in urban areas, accounting for 11.6%. Although 7,742 people are employed by the sector in rural areas, this accounts for only 2.2% of the total rural employment. It is estimated that the unemployment rate was about 40% in urban areas in 1997, partly due to a large number of returned refugees. In total, 5,859 people are engaged in their won business in the commercial sector (3,288 in rural and 2,571 in urban areas). Small stores and canteens with only the owners or a few employees at most are dominant. Other commercial businesses by the private sector employ 1,652 people in urban areas, accounting for 30.1%.

Table 3.6. Working Population over Age 15 by Industry

Industry	Urban area		Rural area		Tete province	
Agriculture and forestry	14,327	44.4%	337,550	94.5%	351,877	90.4%
Mining	144	0.4%	58	0.0%	202	0.1%
Manufacturing	2,003	6.2%	3,847	1.1%	5,850	1.5%
Energy	295	0.9%	62	0.0%	357	0.1%
Construction	1,729	5.4%	3,775	1.1%	5,504	1.4%
Transport and communication	1,077	3.3%	419	0.1%	1,496	0.4%
Commerce and finance	5,488	17.0%	4,983	1.4%	10,466	2.7%
Service administration	4,613	14.3%	3,119	0.9%	7,732	2.0%
Other services	1,347	4.2%	738	0.2%	2,085	0.5%
Other	1,223	3.8%	2,476	0.7%	3,699	1.0%
Total	32,246	99.9%	357,027	100.0%	389,268	100.1%

Source: *General Censuses for Population and Habitation 1997*, Tete Province.

Table 3.7 shows the working population by industry and sector. Excluding agriculture, the category of own business has the largest working population, accounting for 37.5%. In rural areas, 2,427 people operate their own manufacturing business. These are mainly small milling factories as local farmers traditionally prefer to thrash their grains in or near their villages. In the manufacturing sector of urban areas, there are 801 people engaged in the private sector, about as many as those small business owners (784). Government offices account for 25.1% of the working population while private enterprises have a smaller share of 21.4%.

3.4. Regulations

(1) Company registration

The legal requirements concerning licenses and registry procedures for enterprises were revoked in 1998, and a new regulation has introduced differentiated legal treatment of small, medium and large companies. It is meant to support the development of new small and medium enterprises for their survival, satisfaction of basic standard of living, profit making and growth.

Table 3.7. Working Population over Age 15 by Industry and Sector

	Government office	Private sector	Public enterprise	Corporate sector	House/family work	Business owner	Sub-total
Urban area	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Agriculture & forestry	145 (1.0)	293 (2.0)	48 (0.3)	39 (0.3)	6,466 (45.1)	7,336 (51.2)	14,327 (100)
Mining	75 (52.1)	14 (9.7)	53 (36.8)	0 (0.0)	0 (0.0)	2 (1.4)	144 (100)
Manufacturing	123 (6.1)	801 (40.0)	124 (6.2)	15 (0.7)	156 (7.8)	784 (39.1)	2,003 (100)
Energy	100 (33.9)	100 (33.9)	81 (27.5)	4 (1.4)	0 (0.0)	10 (3.4)	295 (100)
Construction	219 (12.7)	741 (42.9)	205 (11.9)	15 (0.9)	76 (4.4)	473 (27.4)	1,729 (100)
Transport & communication	234 (21.7)	433 (40.2)	254 (23.6)	17 (1.6)	11 (1.0)	128 (11.9)	1,077 (100)
Commerce & finance	323 (5.9)	1,652 (30.1)	277 (5.1)	40 (0.7)	493 (9.0)	2,698 (49.2)	5,483 (100)
Service administration	4,000 (86.7)	232 (5.0)	267 (5.8)	37 (0.8)	15 (0.3)	62 (1.3)	4,613 (100)
Other services	180 (13.4)	745 (55.3)	164 (12.2)	40 (3.0)	44 (3.3)	174 (12.9)	1,347 (100)
Sub-total	5,399 (17.4)	5,011 (16.2)	1,473 (4.7)	207 (0.7)	7,261 (23.4)	11,667 (37.6)	31,018 (100)
Rural area	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Agriculture & forestry	756 (0.2)	2,063 (0.6)	248 (0.1)	222 (0.1)	129,471 (38.4)	204,790 (60.7)	337,550 (100)
Mining	11 (19.0)	11 (19.0)	10 (17.2)	1 (1.7)	11 (19.0)	14 (24.1)	58 (100)
Manufacturing	165 (1.7)	633 (16.5)	73 (1.9)	9 (0.2)	591 (15.4)	2,476 (64.4)	3,847 (100)
Energy	17 (27.4)	19 (30.6)	19 (30.6)	2 (3.2)	3 (4.8)	2 (3.2)	62 (100)
Construction	165 (4.4)	623 (16.5)	185 (4.9)	11 (0.3)	867 (23.0)	1,924 (51.0)	3,775 (100)
Transport & communication	98 (23.4)	127 (30.3)	49 (11.7)	9 (2.1)	48 (11.5)	88 (21.0)	419 (100)
Commerce & finance	79 (1.6)	670 (13.4)	63 (1.3)	27 (0.5)	781 (15.7)	3,363 (67.5)	4,983 (100)
Service administration	2,667 (85.5)	139 (4.5)	53 (1.7)	6 (0.2)	54 (1.7)	200 (6.4)	3,119 (100)
Other services	88 (11.9)	280 (37.9)	23 (3.1)	14 (1.9)	158 (21.4)	175 (23.7)	738 (100)
Sub-total	4,046 (1.1)	4,565 (1.3)	723 (0.2)	301 (0.1)	131,984 (37.2)	213,032 (60.1)	354,551 (100)
Tete province	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Agriculture & forestry	901 (0.8)	2,356 (0.7)	296 (0.1)	261 (0.1)	135,937 (38.6)	212,126 (60.3)	351,877 (100)
Mining	86 (42.6)	25 (12.4)	63 (31.2)	1 (0.5)	11 (5.4)	16 (7.9)	202 (100)
Manufacturing	188 (3.2)	1,434 (24.5)	197 (3.4)	24 (0.4)	747 (12.8)	3,260 (55.7)	5,850 (100)
Energy	117 (32.8)	119 (33.3)	100 (28.0)	6 (1.7)	3 (0.8)	12 (3.4)	357 (100)
Construction	384 (7.0)	1,364 (24.8)	390 (7.1)	26 (0.5)	943 (17.1)	2,397 (43.6)	5,504 (100)
Transport & communication	332 (22.2)	560 (37.4)	303 (20.3)	26 (1.7)	59 (3.9)	216 (14.4)	1,496 (100)
Commerce & finance	402 (3.8)	2,322 (22.2)	340 (3.2)	67 (0.6)	1,274 (12.2)	6,061 (57.9)	10,466 (100)
Service administration	6,667 (86.2)	371 (4.8)	320 (4.1)	43 (0.6)	69 (0.9)	262 (3.4)	7,732 (100)
Other services	268 (12.9)	1,025 (49.2)	187 (9.0)	54 (2.6)	202 (9.7)	349 (16.7)	2,085 (100)
Sub-total	9,345 (2.4)	9,576 (2.5)	2,196 (0.6)	508 (0.1)	139,245 (36.1)	224,699 (58.3)	385,569 (100)
Excluding agriculture & forestry	8,444 (25.1)	7,220 (21.4)	1,900 (5.6)	247 (0.7)	3,308 (9.8)	12,573 (37.3)	33,692 (100)

Source: ibid.

Most small business in the Study Area are grain mills, carpentry, brick making, oil press, metal working and bakery, more than five years old with high depreciation level, and fall in the third category. This classification does not incorporate the level of technology involved. All documents are processed in the provincial capital but applications in the first category are sent to Maputo.

Since 1995, the Administrative Orders to Remoe Barriers to Investment have reduced official requirements considerably for licensing procedures of small and medium companies, but there still remain many regulations that are complicated and yet not comprehensive, related to land rights, labor regulation, company registration, import/export regulation, tax procedures, product category licenses, etc. The major concerns identified in the Study Area are: 1) incorrect bureaucratic procedures, 2) application of outdated legislation, 3) improper coordination among government agencies, 4) lack of adequate information, 5) arbitrary interpretation of legislation and regulation, and 6) lack of legal redress/complaint mechanism.

(2) Land regulation

Documentation for land use in the following categories needs to be filed with respective ministries: agricultural use, commercial use, industrial or tourism use, residential use, and state reserves. After several consultations at different levels, the application is forwarded to the Governor or the Ministry depending on the size of the land. A provisional license is given, valid for five years for nationals and two years for foreigners.

Review of planned land use is hampered by insufficient coordination between related government entities and also between the public and the private sectors. This situation also encourages land speculation. This issue together with land ownership remains one of the most serious obstacles to investments, in addition to tedious bureaucratic procedure and centralized decision-making, discouraging potential investors, particularly in the small and medium industry sector.

(3) Environmental certificate

The Ministry for Coordination of Environmental Affairs (MICOA) is in charge of issuing business licenses concerning environment. For this purpose, MICOA carries out an environmental impact study at the cost of the applicant.

(4) Labor regulation

For the registration of a company, the following must be submitted to the Ministry of Labor or its Provincial Directorate: alvará (business certificate), workers contract, work card, working hours, and staff registry. In operating a business, several procedures and rules related to the labor regulation have to be observed, including those concerning monthly salary, holiday plan, social security, minimum wage, termination of contract, workers' union, and company regulations. Some entrepreneurs consider labor inspection one of major harassments. Most of the problems reported are related to arbitrary interpretation of legislation by labor department staff.

3.5. Taxation System

The Ministry of Planning and Finance (MPF) distinguishes three categories for taxation according to the volume of sale as follows.

Group A: Enterprises that have organized accountancy, and sales volume over MT250 million per year.

Group B: Enterprises with obligatory minimum accountancy and sales volume of MT150-200 million per year.

Group C: Enterprises without organized accountancy and sales volume of MT 100 million per year or less.

In parallel with the process to obtain a business license, every business has to register with MPF. This is obligatory for any business even if it is temporary or exempt from tax. Taxes relevant to the private business are: 1) industrial contribution/corporate tax, 2) income tax on work profit, 3) income tax on package sales, 4) complementary tax, and 5) IVA (value added tax).

Import/export regulations pose another obstacle to business operations due to non-transparent procedures and frequent delay as well as complicated legal framework and extensive regulations. It is noted that provincial custom delegations are not well aware of incentives for import tax reduction as specified in the Zambezi River Valley Project.

3.6. Formal and Informal Sectors

Various informal sectors proliferated after the civil war. The Government, recognizing the importance of the informal sector in nation building, granted it incentives to substitute partially the formal sector.

The formal business is required to obtain business license and registration, and imposed with several regulations by the Government as mentioned above. The informal business, on the other hand, is controlled by local governments. The formal business is subject to national taxes whereas the informal business is charged comparatively small amount by the local administration. Such a different treatment, however, tends to work as disincentive for small informal business to expand into the formal sector.

3.7. Technology and Training

Technological levels of products may be defined as low grade or local technology accepted within certain territories, intermediate or domestic technology accepted in the national market, and international level technology. The level of technology in the Study Area may generally be between the local and the domestic technology. Training, both basic or theoretical and practical or on-the-job, is necessary to improve production technology and corporate management.

3.8. Industrial Infrastructure

The road network in the Study Area accommodates transit traffic between neighboring countries and between those and the port of Beira, but even Tete city does not enjoy much effect of such economic transactions. This is partly due to the lack of regional integration as the hinterland is not well linked with the capital city. Inter-regional links are also very weak, and the Study Area is sometimes cut off from the more developed south during the rainy season. Rail link has yet to be restored, and air link is weak.

Despite the proximity to the huge hydropower at Cahora Bassa, most areas are deprived of electricity. Most people rely on firewood and charcoal for cooking, as kerosene and propane gas are not popular. Telecommunications and piped water supply are very limited.

There exists an industrial zone in Tete city, but no particular common facilities are provided for industries located there. A leather industry (shoe maker) is provided with sewerage facilities funded by UNIDO.

Chapter 4. Enterprise Survey

An enterprise survey was planned and executed jointly by the member of JICA Study team in charge of the sector and staff members of UNIDO in Quelimane office. The methods of the enterprise survey are outlined and its results summarized.

4.1. Methods of Survey

4.1.1. Scope of the survey

The enterprise survey was carried out to analyze the present situation and constraints common to enterprises existing in the Study Area. The survey team visited six districts, Moatize, Angonia, Tsangano, Macanga, Chiuta and Chifunde, and inquired major entrepreneurs in each district about the present situation and the constrains of their business. In addition, the team visited enterprises selected randomly from the list of enterprises prepared by the Directorate of Industry and Commercial Association and conducted interviews based on questionnaires. Two sets of questionnaire were prepared, one for small and micro enterprises and the other for small and medium scale enterprises in Tete city. Seventy samples were collected. The survey team interviewed sixty-one enterprises. The list of enterprises interviewed is attached in the Appendix.

4.1.2. Questionnaires

The survey team prepared two sets of questionnaires because small and micro scale enterprises in the districts of the Study Area and small and medium scale enterprises in Tete city have different characteristics in their business activities. The questionnaires covered the following aspects: outline of company, equipment and facilities, constraints on corporate management and financial conditions, competitiveness of products and sales strategy, production technology, development of technology, technological support, and other constraints

4.1.3. Survey schedule

The field survey was executed on the following schedule.

Day	Date	Activities
1	9 Oct., 2000	Meeting with Directorate of Industry and Commercial Association, Tete Travel to Angonia through Moatize and Tsangano
2	10 Oct.	Arrangement for meeting in Angonia
3	11 Oct.	Meeting and interview in Angonia
4	12 Oct.	Meeting and interview in Tsangano
5	13 Oct.	Meeting and interview in Macanga
6	14 Oct.	Travel to the border between Mozambique and Malawi, and back to Tete city
7	16 Oct.	Meeting and interview in Chifunde
9	17 Oct.	Meeting and interview in Chiuta

10	18 Oct.	Meeting and interview in Moatize and Tete
11	19 Oct.	Meeting and interview in Tete
12	20 Oct.	Meeting and interview in Tete

4.2. Summary of Survey Results

4.2.1. Characteristics of enterprises interviewed

(1) Type of business

The enterprises surveyed are predominated by manufacturing (22%), commerce and services (49%), followed by processing (16%), construction (6%), and agro-industry (6%).

(2) Established year

The majority of the industries (65%) have been operating for 5-10 years. These enterprises established their business following the peace in the 1990's. Around 36% are recently established operating only for about 3-5 years and 12% newly established within a year.

(3) Scale of enterprises

Close to a half (42%) of the enterprises are micro enterprises with their capital of less than Mt.10 million (about US$440). Their activities are small trading activities, service and processing types of business. Of the remaining, 22% are small businesses with Mt. 10-50 million (about US$440-US$2,200) of investment. These types of enterprises are usually mills, carpentry, mechanical shops and services (transport and hotels).

(4) Finance

For the source of financing, 74% of enterprises use their own funds or savings while 24% resort to borrowing from family members (6%) or friends (1%). Only 9% have access to loans from banks and other financial institutions.

4.2.2. Condition of business operations

(1) Raw materials

The majority of the enterprises (78%) report that raw materials are procured locally in the province or within the district. A significant number of entrepreneurs (22%) import their raw materials from other countries, particularly Malawi. About a half (51%) of the enterprises state that the quantity of available raw materials is reasonable, and 18% find it difficult to access materials they need. All the enterprises are satisfied with the quality of materials. Delivery time of materials is reported reasonable by 28% of the respondents and on time by 68%. The perception on the cost of raw materials ranges from "reasonable" (53%) to "good" (37%) with only 5%

reporting "high".

(2) Equipment

Of the equipment used by the enterprises, 88% are sourced locally and the remaining 12% imported. Production equipment is generally in "good" condition (95%) with 4% "bad" and 1% "not functioning". A half of the equipment is less than five years old, 19% more than five years old and 31% more than 10 years old.

(3) Quality of workers

The mean age of workers is 33 years old. The majority of workers fall within the 20-30 year-old age range (52%). Workers with primary education account for 67% and those with secondary education are 32%. Only 1% has post-secondary education. About two-thirds (66%) of the enterprises have fewer than 5 workers. The rest have 5-10 workers (13%) or more than 10 workers (21%). Some workers receive technical training, especially in carpentry, metal work and tobacco treatment. About equal numbers of the business owners report that qualified labors are available in the area (47%) or not readily available (53%).

(4) Market

The main market is the local population (96%) and 50% of the enterprises do business only within their district while 46% operate outside the district such as Macanga district, Tete city, Beira and Maputo, and 4% export to Malawi. Most entrepreneurs (85%) depend on their own market research and the others (15%) rely on market information from the Government and other institutions.

(5) Profit utilization

Some respondents report that business is a major source of income (22%) whereas 48% report that their business provides only supplementary income. About one-third of the respondents (37%) report that they use profits to expand their business.

4.3. Existing Enterprises in the Study Area

4.3.1. Business activities

The service industry is a major industry in the Study Area, which accounts for 49% of the enterprises interviewed (Table 3.8). The service industry consists of shops and hotels (24), bakeries (7), workshops (5), school and manpower supply (3) and a transportation company (1). Major activities of the service sector are small shops and bakeries in the district areas. Medium size enterprises exist mainly in Tete city.

The manufacturing industry accounts for 22% of the total enterprises. It consists of carpentry (11), metal works (3), tailoring (1), brick maker (1) and tobacco leaf company (1). Flour milling is a major processing industry in the district areas. Every village has several milling factories of maize flour with a few workers. Large scale construction companies exist only in Tete city.

Table 3.8. Number of Enterprises by Business Activity

Region	Manufacturing	Processing	Construction	Agriculture	Service	Total
Angonia	8	6	-	-	8	22
Chifunde	-	-	-	-	1	1
Chiuta	2	-	-	-	9	11
Macanga	1	0	-	2	3	6
Moatize	2	2	-	-	6	10
Tete city	5	3	5	-	10	23
Tsangano	-	2	-	3	3	8
Total	18	13	5	5	40	81

4.3.2. Business license

On the whole, 43% of the enterprises interviewed have licenses issued by the Ministry/Directory of Industry and Commerce (Alvara) or Municipal Council (Conselho Municipal) as shown in Table 3.9. The remaining 14% have not registered. Micro and medium scale enterprises in the districts areas have registered in Municipal Council. Though the Government expects their business to expand and their business licenses to be converted to Alvara, a half of the registered enterprises still have Municipal license.

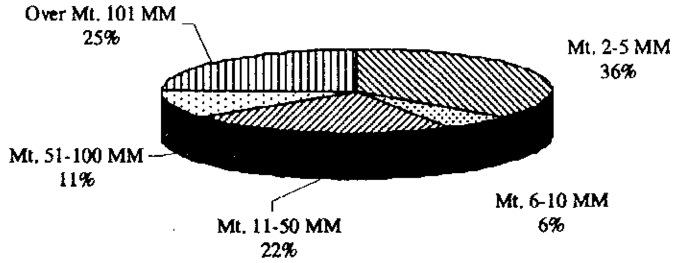
Table 3.9. Number of Enterprises by Type of License

Region	Ministry/Directorate	Municipal	Unlicensed	Total
Angonia	11	7	4	22
Chifunde	2	2	-	4
Chiuta	2	9	1	12
Macanga	-	3	3	6
Moatize	4	5	1	10
Tete city	11	4	-	15
Tsangano	3	3	2	8
Total	33	33	11	77

4.3.3. Scale of enterprises

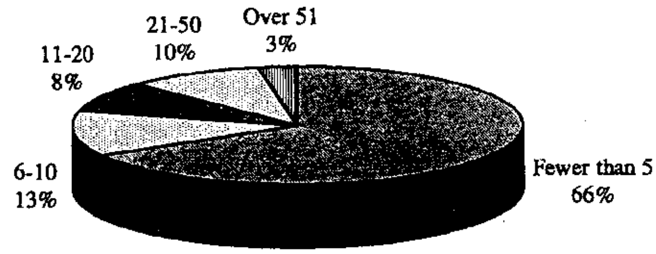
Figures 3.1 and 3.2 show the percentage of companies by capital scale and by the number of employees, respectively. Enterprises with capital of Mt. 2-5 million ($115-575) account for 36% of the total enterprises interviewed. Enterprises with capital below Mt. 50 million ($5,750) account for 65%. Enterprises with capital over Mt. 101 million ($11,600) account for 25%, of which 10 exist in Tete city.

Figure 3.1. Percentage of Companies by Capital Size



Enterprises that employ fewer than five employees account for 66%. They are small shops and grain millings etc. in the district areas. There are only two companies that employ more than 51 workers in Tete city. Other medium scale companies are an agricultural producer and tobacco leaf company in Angonia district.

Figure 3.2. Percentage of Companies by Number of Employees



4.4. Existing Conditions and Constraints

4.4.1. Financial conditions

As for the financial resources, 74% of the enterprises raise their capitals in the self-fund (Figure 3.3). The enterprises that are borrowing from banks account for only 10%. During the field survey, many entrepreneurs including farmers voiced the difficulty in obtaining credit, pointing out that it obstructed new investments.

Figure 3.3. Percentage of Financial Resources

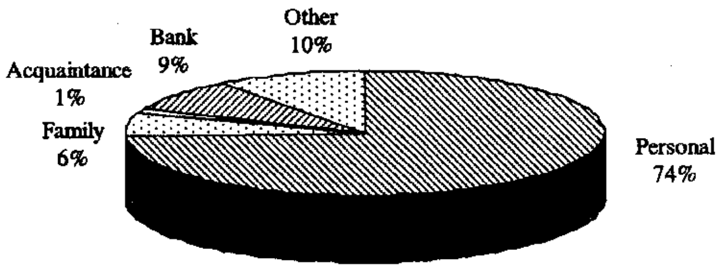


Table 3.10 shows the number of companies by loan condition in case of fund raising with bank loans. Annual interest rates are high. The rates of most debts exceed 10%. However, three quarters of the entrepreneurs consider the high interest rates as a burden.