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**MINERAL DEVELOPMENT IN AFRICA IN THE CONTEXT OF THE  
GLOBAL AND AFRICAN POLITICAL AND ECONOMIC ENVIRONMENT**

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## **SYNOPSIS.**

A global review of the economic environment surrounding the development of non-fuel minerals is provided with a view to underlining the need for alternative ways for the sustainable development of mineral resources in Africa. The political and economic environment surrounding the continent's mining industry prior to and after the cold war is provided, together with new policies which African governments have or are in the process of introducing to attract private investment in the mining industry. Policies for the integration of the African mining sectors with other economic sectors at subregional and regional levels as contained in relevant African economic integration treaties are reviewed. The role of minerals in sustainable development is emphasised together with some essential elements for sustainable development as contained in the Rio Declaration on Environment and Development and Agenda 21. Taking into account the present status of mineral development in Africa, some proposals are advanced on the activation of the African mineral industries to enhance the sustainable development of the African region.

It is especially stressed that dependence on revenue from most mineral commodity exports does not necessarily guarantee sustainable economic advancement largely because of the ever declining prices of such commodities. The sustainable development of most mineral resources demands the integration of the extractive industries with other development sectors within an economy, so that the requirements of the extractive industries are increasingly derived from the economy and the outputs of the extractive industries are increasingly converted to consumer, intermediate and capital goods within and for consumption by the economy. Within the African region this development process could be activated by national, subregional and regional associations of individual or related groups of minerals. Such associations could regularly meet to exchange information on the pertaining status of the relevant mineral industries and determine ways and means of integrating them with other economic sectors at national, subregional and regional levels. The composition of these associations could include: senior executives of mineral commodity producers, producers of intermediate products based on minerals, producers of final products based on minerals, major consumers of mineral-based products, government policy makers, the private sector including transnational corporations, relevant development institutions and other relevant groups.

## **MINERAL DEVELOPMENT IN AFRICA IN THE CONTEXT OF THE GLOBAL AND AFRICAN POLITICAL AND ECONOMIC ENVIRONMENT.**

### **A. MINERALS IN THE GLOBAL ECONOMY.**

#### **Classification, scale of production and uses of minerals.**

1. The term "minerals" encompasses a wide variety of substances taken from the earth. They are generally divided into three broad groups: (a) metals, such as aluminium, copper, gold, iron and manganese; (b) nonmetals, including industrial minerals, such as gypsum, lime, phosphate rock and potash; precious stones such as diamonds, rubies, and tormalines; and construction materials, such as clays, sand, gravel, and stone; and (c) energy minerals, such as coal, natural gas, oil and uranium. The energy minerals, though of great economic importance, are not within the scope of this paper.

2. Table 1 shows the scale of production of selected minerals in terms of weight in 1991. Of the metals, the most important in terms of weight is pig iron. Nearly twenty nine times more primary pig iron was produced than its nearest competitor, primary aluminium. Most pig iron produced is converted to steel (pig iron alloyed with small quantities of other metals such as manganese, chromium, nickel, molybdenum, tungsten and cobalt). Iron and steel are widely used in the construction of infrastructural stock (buildings, roads, bridges, and other civil works); the production of transport equipment (such as bicycles, vehicles, railway rolling stock and ships); the manufacturing of machinery (such as tractors for farming, industrial machinery and equipment); and the production of appliances (such as cookers and refrigerators). Because of its enormous intensity of use and widespread applications in construction, transportation, machinery and appliances, iron is regarded as the metal of civilisation. (6)

3. Aluminium is second to iron in quantity of production. The major uses of aluminium take advantage of its light weight and high electrical conductivity. It is extensively used in power transmission cables, building and construction, the transport industry (automobile and aircraft manufacturing), and the fabrication of durable items (such as furniture, refrigerators, packaging materials (cans and foil) and other appliances). Because of its high electrical conductivity, copper, the third-ranked metal in total tonnage, is primarily used as an electrical conductor. Zinc provides corrosion-resistant coatings for other metals because it does not corrode easily; lead is largely used in electrical storage batteries; and tin largely serves as a coating for steel cans.

4. Titanium oxide is used in the production of paints while titanium metal is used in the production of transport equipment (submarines, supersonic planes, space shuttle and space stations). Cadmium is largely used in nickel cadmium batteries. Mercury is used in a variety of industrial, scientific and military applications. Most of the gold which is laboriously mined is taken out from one hole, refined, and buried in another hole. The person who has a lot of it says he/she is "rich". (6) Gold is used as an alternative store of wealth to fiat currencies. Gold, platinum and silver are likewise used in jewelry and ornamentation; the electronics industry also uses the three metals. Platinum is additionally used as a catalyst (emissions control agent) in automobile exhaust systems.

5. Of the nonmetals group, the industrial minerals are valued for their special qualities and are traded internationally as metals. These industrial minerals include phosphates and potash which are indispensable ingredients in chemical fertilisers; lime which is a major component of the cement that binds concrete; soda ash which is an alkaline material used in many chemical processes; clays which are important ingredients in ceramics and portland cement; and salt, most of which is used in the chemical industry.

6. Other internationally traded nonmetals include naturally occurring precious stones or gems [such as diamonds, beryls (emeralds and aquamarines), corundum (rubies and sapphires) and garnets] and semiprecious stones which are rare, beautiful, durable and hard forms of common minerals used for adornment or decoration and as a "store of wealth", usually after being cut and polished. They have intrinsic value, which can be defined as value attributed by society independent of any utilitarian characteristic. Because of their hardness, some of the poor quality stones recovered in the mining of precious stones are used in industry. For example, (industrial) diamonds are used in industry as abrasives, drills, and saws.

7. The other nonmetals, stone, sand and gravel are produced most widely and in the largest quantities exceeding the tonnage of all other mineral commodities combined. These minerals constitute aggregate (crushed stone, gravel and sand) which is converted to concrete for the construction of residential, commercial and other buildings; roads, bridges and other civil works. Concrete is composed of four ingredients: portland cement as the binder; aggregate as the bulk product which must be cemented together; water to react with the cement to form new chemical compounds that have structural strength when the reactions are completed; and reinforcing materials such as steel.

Table 1. Estimated world production of selected minerals, 1991

Mineral	Production (thousand tons)
<b>Metals</b>	531,000
Pig Iron	18,500
Aluminium	9,100
Copper	6,700
Manganese	7,400
Zinc	3,800
Chromium	3,370
Lead	953
Nickel	210
Tin	110
Molybdenum	82
Titanium	39
Tungsten	34
Cobalt	20
Cadmium	14
Silver	6
Mercury	2
Gold	0.3
Platinum-Group Metals	
<b>Nonmetals</b>	11,000,000
Stone	9,000,000
Sand and Gravel	500,000
Clays	186,000
Salt	160,000
Phosphate Rock	160,000
Potash	135,000
Lime	98,000
Gypsum	33,000
Soda Ash	0.22
Natural diamonds	

All data exclude recycling; figures for metals are smelter production or metal content of ore; figures for nonmetals are material mined.

Sources: John E. Young, "Mining the Earth", Worldwatch Paper 109, July 1992; Natural diamonds estimate by ECA based on 1990 production as reported by Metals and Minerals, Annual Review 1991.

### Global distribution of mineral resources.

8. Economically extractable mineral deposits (mineral reserves) for metals, industrial minerals and precious stones are distributed unevenly around the earth, depending on geological factors and processes. Reserves consist of deposits whose existence has been documented by detailed surveying and that are judged to be minable at a cost no higher than current market prices. Mineral resources (deposits whose presence is indicated by preliminary surveys or other geological evidence but that are not yet economically viable) are far greater than reserves, and expanded exploration coverage and improvements in exploitive technology constantly move deposits from the resources to the reserves category. Many of the best mineral reserves (and probably resources) now lie in developing countries, Eastern Europe and the former Soviet Union (presently the Commonwealth of Independent States [CIS]), since industrial nations have either depleted their reserves through a long history of mining or are deficient of some mineral occurrences.(1)

9. Metals, industrial minerals and precious stones are generally expensive compared with construction materials because their occurrence is relatively rare and their production in the majority of cases involves the separation of relatively small quantities of useful minerals from large quantities of waste material. For example, the estimated world average grade of ore, the metal content in percentage terms, mined in 1991 for various metals was as follows: copper 0.91; gold 0.00033; iron 40.0; phosphate 9.3; potash 17.0; lead 2.5; aluminium/bauxite 23.0; nickel 2.5; tin 1.0; manganese 30.0; tungsten 0.25; and chromium/chromite 30.0 (1). This implies that to recover one ton of mineral commodity, the following tons of waste material had to be handled through processing: copper 110; gold 303,030; iron 2.5; phosphate 10.8; potash 5.9; lead 40; aluminium/bauxite 4.3; nickel 40; tin 100; manganese 3.3; tungsten 400; and chromium/chromite 3.3. These tonnages of mineral processing solid waste per ton of mineral commodity recovered even underestimate the amount of solid waste created during mining as overburden from surface mining and rock from underground mining operations is not included. At the end of the day, it is the mineral raw material producing country which is permanently left with the responsibility of managing the huge tonnages of waste when the valuable minerals have left the mining sites.

10. With few exceptions such as granite and marble, the construction materials (stone, sand and gravel) are ubiquitous in the earth's crust. They are relatively cheap because of their great abundance and require minimum processing before use. They are generally used near the site where they are found and do not normally enter into international trade.

### World distribution of mineral production.

11. Production of mineral commodities is widely distributed around the world with few exceptions. For example, known deposits of cobalt, chromium, and the platinum-group metals are concentrated in a few countries. Hence the major producers of these commodities (and their percentage world share during 1991) were: Zaire 50% and Zambia 21% for cobalt; South Africa 35% and CIS 30% for chromium; and South Africa 48% and CIS 44% for the platinum-group metals.



12. Major producers of mineral commodities include the United States of America (USA), the Commonwealth of Independent States (CIS), Australia and South Africa. Other important producers include Canada, China, Brazil, Chile, Mexico, Peru, Guinea, Zaire and Zambia.

#### **International trade in mineral commodities.**

13. The major importers of mineral commodities are the West European countries, Japan and the United States of America. Previously, each major industrial region looked to a corresponding part of the Third World for most of its mineral imports: the United States of America to Latin America, Western Europe to Africa, and Japan to Asia and Oceania.

14. With the changing political and economic environment in Eastern Europe and the CIS, the West European countries are likely to procure increasing volumes of their mineral raw materials requirements from such countries in future. The CIS and Eastern European countries possess large reserves of many important minerals, including iron ore, manganese, chromium, and nickel, and their potential resources are enormous. The countries' well-developed infrastructure, proximity to the European countries and perceived strategic importance are some of the other factors which might influence this development.

#### **Marketing arrangements for mineral commodities.**

15. Table 2 shows the estimated value of selected minerals produced in 1990, at 1991 average prices. Within the steel industry, captive relationships (where steel companies own and operate iron mines) are important in Australia, Canada and the United States of America. Currently, Brazil and Australia account for more than 50% of the world's total exports of iron ore. Most iron ore prices are fixed under long term sales contracts. Prices are influenced by the supply/demand conditions in the steel industry prevailing at time of renegotiation and they tend to lag behind economic activity. Freight is a major component of price. There are wide price ranges depending on grade and nature of product. Two reference prices tend to dominate the international market: the delivered prices of Brazilian ore to western Europe and Australian ore to Japan. The estimated value of world contained iron production for 1990, at 1991 average price, was US\$ 18 billion. (8)

16. With regard to the aluminium industry, historically bauxite and alumina moved within vertically integrated aluminium producers with six companies and their associates dominating the stage: Alcan, Alcoa, Alusuisse, Kaiser, Reynolds and Pechiney. The diminishing importance of the integrated company since the early 1970s (e.g. government participation in bauxite mining and the rise of independent smelters in energy rich nations of the Third World and Oceania) and fundamental changes in the economic environment have resulted in more bauxite and alumina moving under long term supply contracts, although a large proportion of bauxite/alumina sales are still within integrated producers. National bauxite levies and freight charges are major components of bauxite and alumina prices. Spot purchases became more common in the alumina market from the mid 1980s mainly because of over supply. Prices of both bauxite and alumina are increasingly related to aluminium prices by percentage formulae.

17. Prior to the late 1970s, aluminium pricing was dominated by long term producer contracts. Today, a combination of flexible producer contracts and dealer-controlled spot market exists, with LME pricing predominant. Producer contracts are short to medium term for fixed tonnages but with frequent price negotiations, linked to terminal market prices. Energy costs exert a strong influence on aluminium prices. The collapse of Comecon and the Soviet Union has brought new influences on world aluminium markets. Exports from the former Soviet Union rose considerably in 1991, mainly through traders, and helped depress aluminium prices. These exports seem likely to persist at high rates. The estimated value of world contained aluminium (primary metal) produced in 1990, at 1991 average LME price, was US\$ 24 billion. (8)

**Table 2. Value of contained metal/mineral in annual production of selected minerals.**

	million US\$
<b>Metals</b>	
Iron ore	18000
Aluminium	24000
Copper	25000 (refined metal)
Manganese	3400 (metal content)
Zinc	10800 (refined metal)
Chromium	700
Lead	3200 (refined metal)
Nickel	7000 (refined metal)
Tin	1200 (refined metal)
Molybdenum	580
Titanium	1000
Tungsten	244
Cobalt	950 (refined metal)
Cadmium	90 (refined metal)
Silver	2000
Mercury	19
Gold	24000
Platinum Group Metals	3090
<b>Nonmetals</b>	
Phosphate	5600
Potash	2600
Natural diamonds	9400

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**Sources:** Phillip Crowson, Minerals Yearbook 1992-93, STOCKTON ORESS, 1992; ECA estimates for natural diamonds at an average of US\$ 88.25 per carat.

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18. As concerns copper, most metal is sold through annual supply contracts, although producer pricing tends to operate in protected markets such as Japan, South Korea, Taiwan and in major producing nations like Australia, Canada and South Africa. In the United States of

America copper producers sell partly on a list basis but one linked to Comex prices. Elsewhere, prices are linked to LME, or to a lesser extent Comex, prices which fluctuate markedly. Even in other markets the LME price exerts a major influence. Copper prices respond rapidly to changes in demand and stocks. They can also be sensitive to world financial and political events. The estimated value of world contained copper (refined metal) produced in 1990, at 1991 average price, was US\$ 25 billion. (8)

19. With regard to the ferroalloy metals, published price quotations for manganese only reflect the general condition of the market; prices are dependent on other factors such as chemical quality, physical character, and delivery terms. Much ore is handled by agents although some steel producers have manganese ore interests. Freight charges for manganese ore are particularly important. As concerns chromium, most ore is sold on long term contracts although there is a small free market. Some ore producers are vertically integrated from chromite mining to stainless steel production.

20. The majority of nickel is traded on producer-consumer contracts, at LME-related prices. Prices for the metal depend on demand from the stainless steel industry. Prices for ferromolybdenum are linked to concentrate prices. Prices for tungsten are traditionally highly volatile and the market is dominated by exports from China. Cobalt is mainly produced as a by-product of copper or nickel and output is relatively independent of supply/demand balances. Zaire and Zambia are major producers of cobalt. Producer contracts and spot purchases at merchants' terms are used in cobalt trading, and sometimes prices are influenced by such factors as discounting, the building up of metal stocks, and political disturbances. As will be observed from the table below, the estimated value of world ferroalloys production (with the exception of nickel) is very low compared with those for iron, aluminium and copper. (8)

21. Most zinc metal is now traded at prices based on LME quotations. Ores and concentrates are purchased by smelters at LME prices less negotiated treatment charges, though there is a steady growth of smelter production near mines in developing countries. Outside the United States of America, where domestic producer pricing operates, sales of lead are based mainly on LME terminal market prices. A substantial percentage of lead mine output is associated with zinc, copper and silver. Production of these influences both the supply of lead and its breakeven costs. Large secondary production is a major factor influencing supply and prices. (8)

22. Of the precious metals, a fairly small share of newly mined silver is from predominantly silver ores, most being derived as by-product of copper, lead and zinc. Prices of silver result from the interaction of supply and demand. The London Bullion market quotes silver, as do exchanges in New York and Chicago. The estimated value of gold production at US\$ 24 billion is the same as that for aluminium; 2 thousand tons of gold worth 18.5 million tons of aluminium! The London Bullion market provides gold reference prices. With regard to the platinum group metals prices, there is a combination of producer and dealer pricing, with futures trading in USA and Japan. With all precious metals, markets are subject to speculative activity, particularly in response to political tension, inflationary expectations, interest rates and exchange rates. (8)

23. Phosphate rock prices are fixed on a contract basis depending on quality and grade. Phosphate fertiliser contracts are usually short term in duration whilst the acid business has

annual contracts with six months' pricing. Actual prices are not published; those which are published are only guidelines. Fertiliser and acid markets are now supplied mainly by large integrated producers, with captive phosphate rock. Perhaps more than phosphates, the potash market is highly dependent on the state of the world farming economy. Long term producer pricing with prevalent discounting is practised.

24. Most diamond mines produce stones of gem quality and for industrial use, and industrial supply is controlled to a large extent by gem demand. De Beers' Central Selling Organisation (CSO) controls the bulk of the world's sales of diamonds of all types. Prices vary according to size and quality of the stones.

#### **Trends in the world intensity use of minerals.**

25. The use of minerals is heavily concentrated in the rich nations, and the disparities in use are most dramatic for metals. In 1990, the top eight industrial-nation users of aluminium, copper, and lead accounted for two thirds of world consumption. Eight or fewer wealthy countries took over half the iron ore and three fifths of zinc, tin, and steel supplies. A few decades earlier, these disparities were even greater; throughout the sixties, the industrial nations absorbed more than 80 percent of world steel production and at least 90 percent of other metals.(1)

26. Since around 1975, however, demand for mineral commodities in the industrial nations has been declining due to a number of factors. Firstly, the industrial nations have largely completed the building of their basic infrastructure of roads, railways, buildings and equipment, and now need mineral products primarily to maintain or replace worn-out equipment and structures, not for massive new construction.

27. Secondly, the industrial economies are shifting away from heavy industry towards services and high technology, so the amounts of physical materials needed are much smaller even when the economies do boom. The pharmaceutical and electronics industries, for example, are among the fastest-growing sectors in the industrial economies, and are far less materials- and energy- intensive than traditional extractive and manufacturing industries.

28. Thirdly, recycling has reduced demand for primary metals (though not for other minerals, which are not easily recycled). In the United States of America, for instance, recycling provides a substantial share of consumption for many metals. During 1990 the share of consumption provided by recycling in the USA for some metals was as follows: lead 73%, copper 60%, iron and steel 56%, gold 47%, aluminium 45%, platinum group metals 45%, zinc 43%, and tin 38%. Worldwide, nearly a third of the aluminium used each year is recycled (1).

29. Fourthly, the demand for minerals, especially for metals, has slackened because new materials such as plastics, ceramics, and high technology composites are now competing with metals, and are increasingly substituted for them, in many applications.

30. In the case of most metals, price considerations, technical superiority, environmental regulations, miniaturisation and other factors sometimes lead to the partial substitution of one metal either by another metal or non-metal material in end-use products. For example, steel

competes with aluminium and wood in the construction industry; aluminium, plastics and steel compete in machinery; aluminium competes with glass and paper in the container market; aluminium competes with copper in electrical products and car radiators; copper competes with optical fibres in telecommunications, and plastics in plumbing; gold or platinum group metals can be substituted for silver in electrical and electronic components. These examples are not exhaustive; they serve to indicate that for some functions, more than one metal or other material could be selected for the purpose.

31. In the case of industrial minerals, substitution is not possible because of their chemistry. There is no substitute for phosphate and potash mineral fertilisers used in agricultural applications. Most salt produced goes to the chemical industries for the production of soda ash or chlorine and caustic soda; soda ash is the most important basic heavy chemical, comparable to sulphuric acid on the acid side. Modern construction is almost totally dependent on portland cement for the production of high-strength concrete. Substitution for the construction materials (clays, sand, gravel and stone) other than among themselves is also limited due to their ubiquitousness and relative cheapness.

32. Many of the precious stones can now be made in industry. However, even though synthetic precious stones of identical composition may be more perfect and of better colour, naturally occurring precious stones are considered to be more valuable than synthetics. Synthetic diamonds largely produced in the developed countries compete with natural industrial diamonds which are largely produced in the developing countries.

33. Minerals use is now growing faster in some developing countries than in wealthier nations. Between 1977 and 1987, for example, the Third World's share of aluminium and copper use grew from 10 to 18 percent, and that of zinc from 16 to 24 percent. Significant increases in the consumption of metals and minerals are heavily concentrated in Brazil, Chile, Mexico and Peru in Latin America; and China, India, and the newly industrialising countries (NICs) of South-East Asia. Many products of traditional heavy industries, such as automobiles, are increasingly imported into industrialised nations from NICs, such as South Korea and Malaysia, so the mineral demand of those industries is partially shifting outside the major consumer nations. (1)(4)

#### **Mineral commodity prices.**

34. Historically, mineral commodity prices have been low compared with prices of mineral-based end products. Additionally, mineral commodity prices fluctuate dramatically depending on such factors as supply and demand. Moreover, the overriding trend for mineral commodity prices in recent decades has been downward. After adjusting for inflation, the International Monetary Fund (IMF) index of non-fuel mineral prices declined by half between 1974 and 1986. Real prices recovered somewhat in the late eighties, but have never returned to the levels of the fifties, sixties, and early seventies. They were again in decline in 1990 and 1991. (1) Prices of virtually all metals and minerals are expected to fall substantially in the early 1990s as a consequence of the slow-down in the rate of growth of most industrialised countries, the factors contributing to the declining intensity use of minerals earlier mentioned for these countries, and the coming on

stream of a number of new large-scale projects in such areas as south and north America, and the Asia and Pacific region.(4)

**Implications of mineral commodity prices on the economies of mineral-exporting developing countries.**

35. Given the growing dependence of rich nations on foreign mineral supplies and their willingness to assist with the development of these resources, developing nations would seem well positioned to benefit from their mineral wealth. But the people of most mineral-exporting developing countries have gained little from mining because of such factors as the historically established subsidised low prices of mineral commodities in the developed countries, the continuous decline of mineral commodity prices and deteriorating terms of trade for the mineral exporting countries.

36. Many developing nations, including several within Africa, seem to have been dragged down economically by their dependence on revenue from mineral exports. Table 3 shows some of the developing countries which get a third or more of their export revenues from minerals. For most of these nations, the effect of nearly two decades of falling prices has been less foreign exchange with which to purchase the manufactured goods, from tractors to pharmaceuticals to machinery and equipment, they import. Reduced foreign exchange earnings have also made it difficult or impossible for many minerals producers to repay their international debts. Many of them are among the world's most indebted nations. Generally, the share of exports receipts resulting from a unit of a mineral commodity is expected to continue declining in the foreseeable future.

37. Taking into account traditional low prices for mineral commodities, declining mineral raw materials demand in the developed consumer nations and the corresponding deterioration of prices of mineral commodities, it seems that the for many developing countries, the current strategy of export-led development based on minerals has failed to deliver long-term national economic success. The traditional response to this dilemma, followed by the United States of America and other industrialised nations with long mining histories, is to move into mineral processing and fabrication, which add more value to mineral products than earlier stages of production.

38. Unfortunately for developing countries, trade barriers within the traditional mineral consuming countries, unfavourable private investment policies pursued by many developing countries since the mid 1960s, weak cooperation by developing countries in the development of mineral-based industries to supply their own needs, among other factors, many Third World mineral producers have been unable to move heavily into the higher-value steps of the production process. The search for alternative ways for the sustainable development of mineral resources in the developing countries is therefore needed.

**Table 3: Estimated share of minerals in value of total exports for selected countries:**

Country	Mineral(s)	% Share
Guinea	bauxite, diamonds, alumina	90
Botswana	diamonds, copper, nickel	87
Zambia	copper, cobalt, lead, zinc	86
Namibia	diamonds, uranium, copper, zinc, lead, gold, silver	75
Zaire	copper, cobalt, diamonds, zinc	71
Sierra Leone	rutile, diamonds, bauxite	70
Suriname	bauxite/alumina, aluminium	69
Papua New Guinea	copper	62
Liberia	iron ore, diamonds	60
Jamaica	bauxite/alumina	58
South Africa	gold, coal, platinum group metals, diamonds, iron ore, copper, manganese ore, asbestos, chrome, vanadium	52
Togo	phosphates	50
Central Afric. Rep.	diamonds	46
Zimbabwe	gold, nickel, asbestos, copper, chrome, steel	45
Mauritania	iron ore	41
Chile	copper	41
Peru	copper, zinc, iron ore, lead, silver	39
Bolivia	zinc, tin, silver, antimony, tungsten	35
Dominican Republic	ferronickel	33
Guyana	bauxite	31
Ghana	gold, diamonds, manganese, bauxite	28

Sources: John E. Young, "Mining the Earth", Worldwatch Paper 109, July 1992; The Economist Intelligence Unit Country Profiles 1992-93; Africa Research Bulletin; most figures are for 1989, 1990 and 1991.

## **B. THE POLITICAL AND ECONOMIC ENVIRONMENT SURROUNDING MINERAL DEVELOPMENT IN AFRICA.**

39. Even with limited exploration over large areas of the continent, the African region is endowed with diverse and large quantities of mineral reserves whose tonnages are likely to improve in future with increased exploration and evaluation coverage. However, due to some political and economic factors, the development of several African minerals has not been successful in terms of increased mineral production or their contribution towards the economic development of the region, with the probable exception of the high-value minerals including gold and gemstones.

### **Political and economic factors affecting the African mining industry up to the late 1980s.**

40. Overall African mining production from large-scale operations has been on the decline for several years due to a variety of political and economic explanations. Firstly, upon gaining their political independence and in order to stress their "sovereignty" over their mineral resources, some of the countries imposed rules and regulations which frequently precluded profitable investment by the private sector, resulting in reduced levels of investment by international mining companies. Secondly, with nationalisation and the management of mines by government corporations, insufficient mining revenues were used for reinvestment for the expansion of mining. Thirdly, public sector orientation of general production and mining policies in particular supported a dramatic increase in uncontrolled informal precious metals and gemstones mining with illegal exports in many African countries (16). Fourthly, several other internal factors including protracted civil wars, internal strife, political instability, poor infrastructure, etc. have adversely affected mineral development in several of the countries of the region.

41. Successful "commercial" mining development in Africa is largely found in countries where either the major mining companies are fully owned and operated by the private investors (e.g. Namibia, South Africa, and Zimbabwe) or joint-ventures between the private sector and government which are managed by the private partner who operates under an investment agreement (e.g. Botswana, Gabon, Ghana, and Guinea) (16). In the case of artisanal mining, realistic pricing of high-value minerals, stable and convertible currencies are probably the major economic factors for success.

42. Common factors in the mining policies of successful countries include: stable and transparent regulations which clearly spell out the rights and obligations of the investor and the government; a competitive and well-structured fiscal regime which provides an adequate return to investors and a fair share to government; assured access to foreign exchange at market rates for dividend repatriation as well as operational needs; and effective support and monitoring of private mining investment by well-organised government institutions (16).

### **The changing political and economic environment during the early 1990s.**

43. With the end of the cold war in 1991, political and economic changes are taking place in several countries worldwide, and these changes are impacting massively on the world economy, including the mining industry. Exports by the eastern European and the CIS countries of metals



such as aluminium, nickel, gold and platinum to the established market economy countries (EMEC) to earn desperately-needed foreign exchange have had and may continue to have depressing effects on mineral commodity prices. (15)

44. Total or partial privatisation of state mining enterprises is either under consideration or in the process of implementation in several countries worldwide, Latin America ( e.g. Bolivia, Chile, Mexico, and Peru), south east Asia (e.g. Indonesia, Malaysia, Philippines and Thailand - all geographically well placed to supply the region's major consumer, Japan and, increasingly, South Korea and Taiwan), Africa (Zambia has announced its intention to enter into a privatisation programme which would include the mines of the copper belt, and the Ghanaian Government plans to sell some of its interest in Ashanti Gold to investors). All over the world, including Central Europe and the former USSR, the free market system is the only economic model that seems to be working. This may imply the diversion of limited investment funding away from certain countries. (15)

45. In addition to the African countries mentioned above, other reports indicate that a growing number of African countries are paying particular attention to their mining sectors and encouraging private sector participation in the development of new or existing mines. New mining regulations and investment codes are increasingly being introduced to encourage private sector participation in mining. In addition, the degree of State participation and control is being reduced where such involvement adversely affects the efficiency of mining operations. (17)

46. Other economic policy reforms under consideration or in the process of implementation in African countries with important mining sectors include the removal or reduction of import duties on exploration and capital equipment, the introduction of tax holidays for new mines, the lowering of tax rates, the introduction of accelerated depreciation schemes, the liberalisation of exchange control mechanisms, etc. Some observers point out that taxation of mining companies should be consistent with the taxation of other sectors in the economy, but should take the specific nature of mining as a resource-based industry into account. Mining taxes should be earnings-related rather than output-or input-related to avoid distorting investment and operational decisions. Mining taxation also needs to take account of tax levels in other mining countries with a view to maintaining or establishing competitiveness of the national industry. (16)

47. The new mining legislation is likely to reduce risk and uncertainty for potential investors and ensure easy access to exploration permits and mining concessions. Permits and concessions may increasingly be transferrable with a minimum of government interference. Investment agreements provided by national institutions such as investment promotion centres provide additional assurances to protect the investor from unwarranted government interference. (16)

48. Mining institutions--Ministry of Mines, Geological Surveys and other mining related institutions--are increasingly being reorganised and strengthened to better perform their research, promotional, regulatory and monitoring functions (16). For example, with a view to attracting private sector investment, a new government body in Nigeria, the Raw Materials Research and Development Council (RMRDC), has become one of the most active promoters of business opportunities in the mining sector. It is advertising a list of reserves of a wide range of minerals for development. The council has made detailed studies of the availability of the raw materials

that are required for common industrial processes in Nigeria. RMRDC is, for example, seeking private investment for lead and zinc mining so that Nigeria can eliminate imports of these two metals. Lead imports stand at around 30,000 t/y and zinc imports at 55,000 t/y. Likewise, other African countries have in recent years prepared useful updates on their countrys' geology, minerals and legal situation in order to attract foreign investment. (15)

49. Legalisation, improved organisation and incentive-based marketing systems of artisanal high-value mineral production is in some cases registering dramatic increases in official production and revenue to governments. For example, in Tanzania gold has become one of the major official foreign exchange earning commodities following the adoption of a government policy of buying gold at parallel market rates. Officially purchased volumes increased from 116,000 grammes (1989) to 1.65 tons in 1990, 3.6 tons in 1991 and 7.24 tons for the first half of 1992. (18)

50. The democratisation process either established or in the process of formation in many of the countries of Africa may encourage increased investment in mining where these processes lead to political stability. In addition, democratisation and good governance are likely to ensure social stability and a general enabling atmosphere for economic development in the countries generally. (15) (17)

51. The factors that are likely to enhance the development of the African mining industries as outlined above should therefore be promoted and implemented by governments in the African countries with mineral potential to attract international mining companies to increase their investment in Africa for both the expansion of existing operations and for exploration and development of new mines. It should be noted, however, that the overall concerns of the political and economic policies in most countries remains largely national and mineral commodity export oriented. There seems to be need for increased recognition at the country levels of the importance of (a) the integration of the mining industry with other socio-economic sectors at the country levels and (b) the regional dimensions of political and economic reform policies to reinforce the African economic integration process in production, trade and services for sustainable development should be enhanced.

#### **Policies for the integration of the mining sector with other economic sectors.**

52. As will be illustrated later by the examples of the steel industry minerals, the base metals and the fertiliser minerals, only in very few African countries is the mining sector integrated with the other economic sectors at the national levels. This may reflect weak political direction, lack of appropriate economic policies and general economic weaknesses within some countries for promoting this essential development.

53. At the subregional levels, the treaties establishing economic communities such as the Arab Magreb Union (AMU), the Economic Community of Central African States (ECCAS), the Economic Community of West African States (ECOWAS), the Preferential Trade Area for Eastern and Southern African States (PTA) and the Southern African Development Community (SADC), the role of minerals in the promotion of industrialisation and economic integration is stressed although the political will to effect these treaties seem wanting.

54. At the continental level, within the context of the Abuja Treaty establishing the African Economic Community, the member States of the Organisation of African Unity (OAU) affirmed the principles of (a) inter-State cooperation, harmonisation of policies and integration of (development) programmes and (b) the promotion of harmonious development of economic activities among member States. [Article 3] In this regard, the objectives of the Community are, inter alia, (a) to promote economic, social and cultural development and the integration of African economies in order to increase economic self-reliance and promote an endogenous and self-sustained development, (b) to establish, on a continental scale, a framework for the development, mobilisation and utilisation of human and material resources of Africa in order to achieve a self-reliant development, and (c) to promote cooperation in all fields of human endeavour in order to raise the standard of living of African peoples, and maintain and enhance economic stability, foster close and peaceful relations among member States and contribute to the progress, development and the economic integration of the continent. [Article 4] (9)

55. In order to promote the attainment of the objectives of the Treaty, the Community will, among other things, work towards (a) the harmonisation of national policies in order to promote Community activities, particularly in the fields of agriculture, industry, transport and communications, energy, natural resources, trade, money and finance, human resources, education, culture, and science and technology, (b) the promotion and strengthening of joint investment programmes in the production and trade of major products and inputs within the framework of collective self-reliance, (c) the gradual removal, among member States, of obstacles to the free movement of persons, goods, services and capital, and (d) the establishment of appropriate organs for trade in agricultural products, minerals, metals, and manufactured and semi-manufactured goods within the Community. [Article 4] (9)

56. The Abuja Treaty and its Protocols emphasise that for the sustainable development of Africa's mineral resources, member States should harmonise their mineral development policies, plans and programmes so that the mineral development sectors in the countries may be integrated with other socio-economic sectors at national, subregional and regional levels. Cooperation in the joint mobilisation of financial, material and human resources for the implementation of subregional and regional projects based on mineral resources should be pursued. Moreover, cooperation among member States in manpower development, research, exchange of information, and endogenous capacity building is stressed. Additionally, cooperation among the member States and the international community in addressing regional and international problems associated with the development of mineral resources is considered important.

#### **The role of minerals in sustainable development.**

57. For sustainable economic development, the products of the extractive industries in Africa have to increasingly be processed within the region for the satisfaction of the continent's consumer and capital goods needs. Primary emphasis must be directed to the building of basic industries, machinery industries, engineering industries and the technologies which must surround these sectors.

58. An effective industrialisation strategy must seek the integration of the demand structure with domestic resource use. Iron and steel, nonferrous metals and chemicals are among the basic

non-fuel, mineral-based industries which have many backward and forward linkages. Structural transformation in any country requires the domestic production of these basic materials. This constitutes the necessary condition for the growth of an indigenous oriented technology (i.e., one rooted in the transformation of domestic resources to serve domestic needs).

59. It is through the use of the products of the African mining industries to promote the industrial development of the continent, to produce goods needed in the region, that the mineral resources of the region could provide maximum impact on sustainable development in the continent. This development process will require cooperation among various development actors at national, subregional, regional and international levels in order to create the necessary socio-economic environment for the sustainable development of the region's mineral resources. Some essential requirements for sustainable development especially those related to cooperation among development actors and financing mechanisms for sustainable development in developing countries are outlined below.

**The Rio Declaration on Environment and Development and Agenda 21 concerning sustainable development.**

60. The Rio Declaration recognises, among other principles, that human beings are at the centre of concerns for sustainable development, that all States and all people shall cooperate in the essential task of eradicating poverty as an indispensable requirement for sustainable development, that national authorities should endeavour to promote the internalisation of environmental costs, that States should cooperate to strengthen endogenous capacity-building for sustainable development, and that States should cooperate to promote a supportive and open international economic system that would lead to economic growth and sustainable development in all countries in order to better address the problems of environmental degradation. (5)

61. Under Agenda 21 it is stressed that stronger economic cooperation among developing countries has long been accepted as an important component of efforts to promote economic growth and technological capabilities and to accelerate development in the developing world. Therefore, the efforts of the developing countries to promote economic cooperation among themselves should be enhanced and continue to be supported by the international community. (5)

62. Although it is said that the financing of sustainable development will generally come from a country's own public and private sectors, it is recognised that for developing countries, particularly the least developed ones, overseas development assistance (ODA) and substantial new and additional external funding for sustainable development will be required. (7)

63. New and additional resources to help the poorest countries meet their sustainable development objectives are expected to come from such sources as multilateral development banks and funds (e.g. the International Development Association (IDA), regional and subregional development banks, and the Global Environment Facility); the relevant specialised agencies, other United Nations bodies and other international organisations, which have designated roles to play in supporting national governments in implementing Agenda 21; multilateral institutions for capacity-building and technical cooperation; bilateral assistance programmes; debt relief; foreign direct investment and technology transfers; the reallocation of resources at present

committed to military purposes; etc. The present status of development of some selected minerals in Africa will be given below with a view to illustrating how they could contribute to industrial and sustainable development in the African region.

### **The status and prospects for the development of selected mineral industries in Africa.**

64. Although minerals are essential for the development of basic industries in the continent, their current production towards the support of indigenous metallurgical, chemical and engineering industries is only limited to a small number of countries. More generally, the integration of African mining sector with other socio-economic activities at national, subregional and regional levels is very weak. Hence many of the mining activities in the region are not promoting mutually reinforcing intersectoral linkages at national, subregional and regional levels. To illustrate the status and prospects for the development of mineral resources in the region, the cases of the steel industry minerals, the base metals and the fertiliser minerals will be provided below.

#### **The steel industry metals.**

65. Iron ore reserves and resources are known to exist in 36 African countries, although several of these mineral deposits are not fully evaluated (10). Iron ore reserves exist in such countries as Algeria, Egypt, Guinea, Liberia, Mauritania, Morocco, Sierra Leone, South Africa, Tunisia and Zimbabwe, among others. The major exporters of iron ore in Africa (to the European Community, Japan and USA) are Liberia, Mauritania and South Africa, although in recent years production in Liberia has been drastically reduced due to internal disturbances. Algeria, Egypt, South Africa and Zimbabwe are the only four African countries which produce iron and steel from domestic iron ore, while Morocco, Nigeria and Tunisia may soon join this trend. Hence the current level of iron and steel production from the region's iron ore reserves is very unsatisfactory.

66. Similarly, reserves and resources of several ferroalloy metals are reported to exist in 26 African countries but several of these resources have yet to be evaluated. With the exceptions of Algeria, Egypt, Nigeria, South Africa and Zimbabwe other African countries do not produce special grade steel using alloying metals. (10)

67. The major manganese reserves occur in South Africa and Gabon with a combined reserve share of nearly 52% of world reserves of 816 million tonnes of manganese (8); relatively small reserves are found in Congo, Gabon, Ghana Morocco and Namibia. Manganese resources are reported to exist in countries such as Angola, Burkina Faso, Cote d'Ivoire, Togo and Zaire. Production of manganese ore is concentrated in South Africa and Gabon and to a relatively small extent in Congo, Ghana, Morocco and Namibia. The African producers of manganese ore export the commodity to such areas as the European Community, Japan and USA. The trend to forward integration into ferromanganese production is only found in South Africa and to a relatively small extent in Namibia.

68. The major chromium reserves occur in South Africa and Zimbabwe which together account for over 80% of world reserves of 418.9 million contained chromium.(8) Relatively

small chromium reserves exist in Madagascar and Sudan. Production of chrome ore takes place in the four countries with South Africa and Zimbabwe dominating the scene; all the African countries export chromite ore to such destinations as the European Community, Japan and USA although there is a growing trend worldwide, towards the production of ferrochrome near mines. South Africa and Zimbabwe produce ferrochrome; the Samancor of South Africa is totally vertically integrated from chromite mining to stainless steel production. (8)

69. The current reserves of nickel in Africa are found in South Africa, Botswana and Zimbabwe which together account for about 6.5% of the 47.7 million tonnes of the world's reserves of contained nickel. Nickel resources are also reported to exist in other countries including Burundi and Tanzania. Mine production takes place in the three countries and nickel metal production takes place in South Africa and Zimbabwe. Some of the nickel metal is exported to the developed countries.

70. Molybdenum resources are scarce in Africa although some small mine production is reported in Niger. Some tungsten reserves are reported in Zimbabwe. Small mine production of tungsten is found in Mauritania, Rwanda, Uganda, Zaire and Zimbabwe. Cobalt reserves are concentrated in Zaire and Zambia which together account for about 51.7% of world reserves of over 3.3 million tonnes of contained cobalt; relatively small reserves exist in South Africa, Botswana, Uganda and Zimbabwe. Mine production of cobalt takes place in Zaire, Zambia, South Africa, Botswana, Morocco, and Zimbabwe. Cobalt metal production takes place in Zaire, Zambia, South Africa and Zimbabwe. Exports of all these alloying metals and ores are largely directed to the main markets within western Europe, Japan and USA.

71. With the notable exceptions of Algeria, Egypt, South Africa and Zimbabwe (soon to be joined by Morocco, Nigeria and Tunisia), the development of the steel industry minerals in the African region are not integrated with other industrial sectors at the national levels. Moreover, with apparent minimal intra-African trade in ores and metals, the African steel industry is not integrated at subregional and regional levels, thus leading to the weaknesses of the steel production and engineering industries of the majority of the countries of the region.

#### **The base metals.**

72. With regard to the non-ferrous metals such as aluminium, copper, zinc, lead, their status of development in the African region is similar to the steel industry minerals. Africa's reserves of bauxite are concentrated in Guinea which has about 25.9% of the world reserves currently estimated at 21.6 billion tonnes. (8) Together with the bauxite reserves in Cameroon, Ghana and Sierra Leone, the African share of world reserves of bauxite is of the order of 31.8%. Several other African countries are reported to have bauxite resources but the evaluation of these resources remains incomplete. The main bauxite producer in Africa is Guinea, with Ghana and Sierra Leone as relatively minor producers. Practically all the bauxite produced in Africa and destined to aluminium production is exported outside the region with the exception of a relatively small amount which is refined to alumina in Guinea. Primary aluminium is produced in Cameroon, Egypt, Ghana and South Africa using imported alumina; Nigeria may soon join the list of primary aluminium producers (13). With the exception of Cameroon, Egypt and South Africa most of the region's aluminium production is exported outside the continent.

73. The African primary aluminium producers and several other African countries (such as Algeria, Kenya, Libya, Morocco, Nigeria, Tanzania, Tunisia and Zimbabwe) have some fabricating facilities for the production of aluminium semimanufactures (such as sheets, circles and extrusions) and final products (such as construction fittings, irrigation equipment, electric transmission cables, utensils and foil). However, many of these fabricating facilities are known to be operating at very low capacity utilisation because of such factors as shortages of foreign exchange to procure metal inputs, poor communications (telecommunications, roads, railways, and shipping) which restrict intra-African trade in minerals and metals, and high transport costs within the region.

74. From the above it is evident that the African aluminium industry is disjointed, uncoordinated, weak and underdeveloped. There is no country in Africa with a vertically integrated aluminium industry (incorporating bauxite mining, alumina refining, aluminium production and metal fabrication), though countries such as Cameroon, Ghana, and Guinea are planning to establish them; Algeria, Libya, Nigeria and some countries within the Southern African Development Community (SADC) are similarly planning the production of aluminium metal based on potential bauxite resources or imported bauxite/alumina. The industry is similarly not integrated at subregional or regional levels so as to have industries in one country providing inputs to other industries in other countries, with the exception of Guinea which supplies Cameroon with alumina. There seems to be need therefore for African aluminium industry officials to coordinate their perceptions, strategies and actions towards advancing a regionally integrated development of the continent's aluminium industry.

75. With regard to copper, African reserves are largely concentrated in Zaire and Zambia with relatively small reserves in South Africa, Namibia, Botswana, Zimbabwe and Egypt. Zaire, Zambia and South Africa account for about 12.4% of the world's copper reserves of 321 million tonnes of contained copper. Several other African countries are known to have copper resources which have not been explored sufficiently to establish the quantity of reserves. Of the copper producing African countries (Zambia, Zaire, South Africa, Namibia, Zimbabwe, and Egypt) which produce copper metal, the only major producer which refines its entire production is Zambia.

76. The African continent exports most of its copper to western Europe, North America and Asia. Fabricating facilities for copper semimanufactures (wire, rods, bars, sections, sheet etc.) and final products (power and communications cables, transformers, electric motors, radiators, brass/bronze products etc.) are to be found largely in countries which produce copper and few which import the metal, including Algeria, Egypt, Kenya, Morocco, South Africa, Zambia, Zaire, and Zimbabwe. The small number of African countries in the copper fabricating business reflects a low level of intra-African trade in copper metal and a corresponding low level of development of copper fabricating facilities in the region. Intra-African trade in copper semimanufactures and manufactures is also understood to be minimal. There therefore seem to be room for cooperation by African countries in the expansion of the region's production of copper semimanufactures and manufactures in order to produce copper-based products for consumption in the African economies.

77. Lead and zinc ores are often associated and occur in the same geological environments either as co-products or separately. Africa is estimated to possess 4.2 million tons of metal content or 6% of the world's lead reserves and 11.8 million tons of metal content or 8% of the world's zinc reserves. (11) African reserves of lead/zinc occur in South Africa, Morocco, Namibia, Algeria, Tunisia and Zambia. Reserves in Burkina Faso and Zaire only contain zinc. Resources of the two metals are known to exist in some of the same countries and others such as Angola, Cameroon, Cote d'Ivoire, Congo, Gabon, Kenya, Madagascar, Mali, Mauritania, Niger, Nigeria and Zimbabwe, but further detailed technical and economic studies are required to determine their viability for exploitation. Mine production of the two metals takes place in Morocco, Namibia, South Africa and Zambia; zinc is mined in Zaire. Primary lead smelters and refining facilities exist in Morocco, Namibia and Zambia. Primary zinc smelters exist in Algeria, South Africa, Zambia and Zaire. Most of these metals are exported outside the region and their integration with the region's economic development seems weak.

#### **The fertiliser minerals.**

78. Phosphate rock reserves and resources occur in a number of African countries but reserves are largely concentrated in Morocco, Western Sahara and South Africa which together account for over 67% of world reserves estimated at 12.6 billion tonnes (8). Other relatively small reserves exist in Algeria, Egypt, Senegal, Togo, Tunisia and Zimbabwe. Phosphate resources are reported to exist in several other countries such as Mozambique, Uganda and Tanzania. Within Africa phosphate rock is produced in Algeria, Egypt, Morocco, Senegal, South Africa, Togo, Tunisia, and Zimbabwe. The main phosphate rock exporter in Africa is Morocco; other countries which export phosphate rock include Algeria, Senegal, South Africa, Togo and Tunisia. These exports are largely destined to western Europe, Japan and USA. Phosphate fertilisers are only produced in a few African countries including Morocco, South Africa, Egypt, Tunisia, Algeria, Senegal and Zimbabwe.

79. For several years Morocco has made considerable investment in the processing of phosphates and this has contributed to the strong growth of phosphate fertiliser exports by north African countries. However, trade in fertilisers among north African countries is weak and virtually non-existent between the north African countries and the rest of Africa. Many countries in Africa depend heavily on imports of phosphate fertilisers originating from outside the region. (10)

80. Potash resources are found in eight African countries; the most promising deposits occur in the Congo and Ethiopia. However, all these potash resources remain undeveloped and the continent imports all its potassium fertilisers (10).

81. As was the cases of the other minerals reviewed above, with very few exceptions at the national levels, the development of the fertiliser minerals in the African region are not integrated with the industrial and agricultural sectors at national, subregional and regional levels. Clearly, possibilities of cooperation by African countries in fertiliser production and trading in the region exist. Within the central, eastern and southern African subregions, for example, South Africa could be the main supplier of phosphate fertilisers to several countries which do not have domestic reserves for fertiliser production (14).



### C. THE WAY FORWARD.

82. The fact that the bulk of the African mining industries are not integrated with other economic sectors at national, subregional and regional levels means that (a) some mineral resources which could have been used in the region remain undeveloped, (b) intra-African trade in mineral commodities, intermediate mineral products and final mineral-based products remains minimal (c) industrial development in the region is retarded and (d) mineral development in the region is not on the whole contributing towards the sustainable development of the continent.

83. It seems probable that the future prospects for the sustainable development of the mineral industries of the African region could best be activated by national, subregional and regional associations of individual or related groups of minerals; for example, the association of African steel industries, the association of African base metals industries, the African association of chemical industry minerals, the African association of mineral construction industries, the African association of precious metal industries, the African association of gemstone industries, or individual associations of specific minerals within the proposed groups. Such associations could meet regularly to exchange information on the pertaining status of the African minerals industries and determine ways and means of integrating them with other development sectors at national, subregional and regional levels.

84. The composition of the associations could include senior executives of mineral commodity producers, producers of intermediate goods based on minerals, producers of final products based on minerals, major consumers of mineral-based products, government policy makers, the private sector including relevant transnational corporations, relevant financial institutions, and other relevant groups. Such representatives could determine modalities of cooperation among the different African industries so that increasingly, indigenous African inputs including raw materials, and intermediate goods, equipment, spare parts, skills and technology are made available to support the manufacturing industrial development of the African region.

85. It should further be noted that a comprehensive and rational planning of industrialisation and sustainable development must be preceded by a reliable inventory of a country's natural resources and the establishment of technological training facilities for the human power to exploit such natural resources (12). Some observers suggest that the search for mineral resources could be facilitated by a simple and transparent mining legislation that gives title to the discoverer of a mineral resource in the form of a freely tradeable property right; the mining law should ensure that the country is open for prospecting on a "finder's keeper's" basis, with mineral claims having priority over surface rights. Secondly, a mining claim should be easily transferable because the owner of a mineral title may not have the resources to operate a mine. A largely unregulated market of mining claims should be established where the buyer and seller operate without any government intervention, except for the purpose of registering the change of title. Under these legal arrangements, it is profitable for persons to seek minerals for others to develop; it has proved a success in the mining industries of, for example, Zimbabwe, North America and Australia (2), (16).

86. With regard to technical training, the African mineral industries need more "practical operators" in the form of technicians than have been available in the past; technicians in geology,

mining, mineral processing, metallurgy and those required to operate manufacturing industries based on minerals, who have undergone diploma-level courses at local institutions (2). The other key areas are power (including mineral fuels), transportation infrastructure (where construction minerals and metals are widely used), small scale industries (such as machine tools production) and agricultural industries from fertilisers to textiles. (12)

87. While the role of government in the mineral industries (in terms of ownership and control) continues to be under revision in several African countries, in favour of the private sector, government participation in some mineral related industries might be necessary where, for example: private investors are not available, or public financing is a necessary element; a private investor insists on some kind of government or local investors participation to satisfy nationalistic sentiments and ensure security of investment; and a portion of the industrial output provides assured inputs to other local industries.

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