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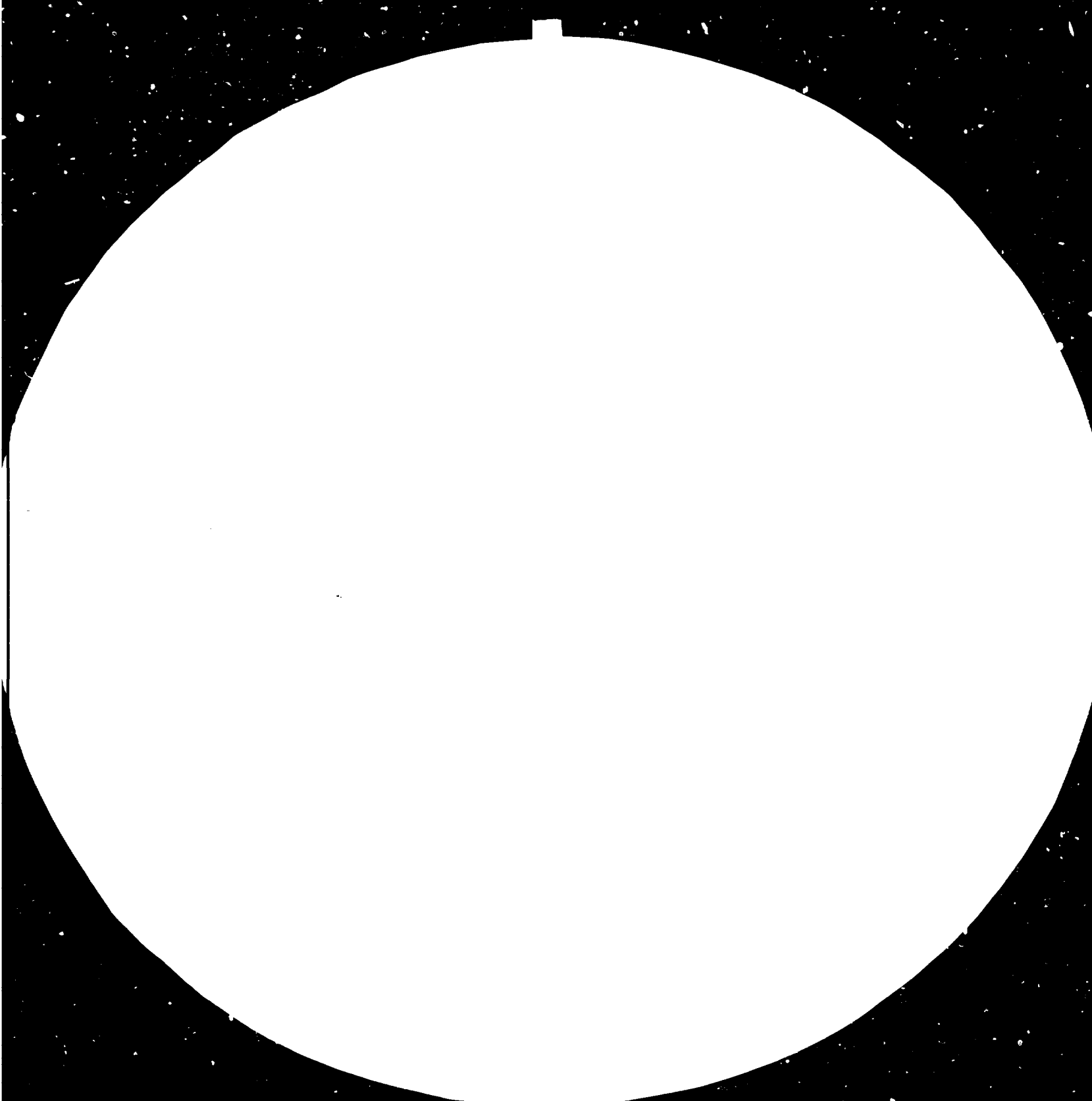

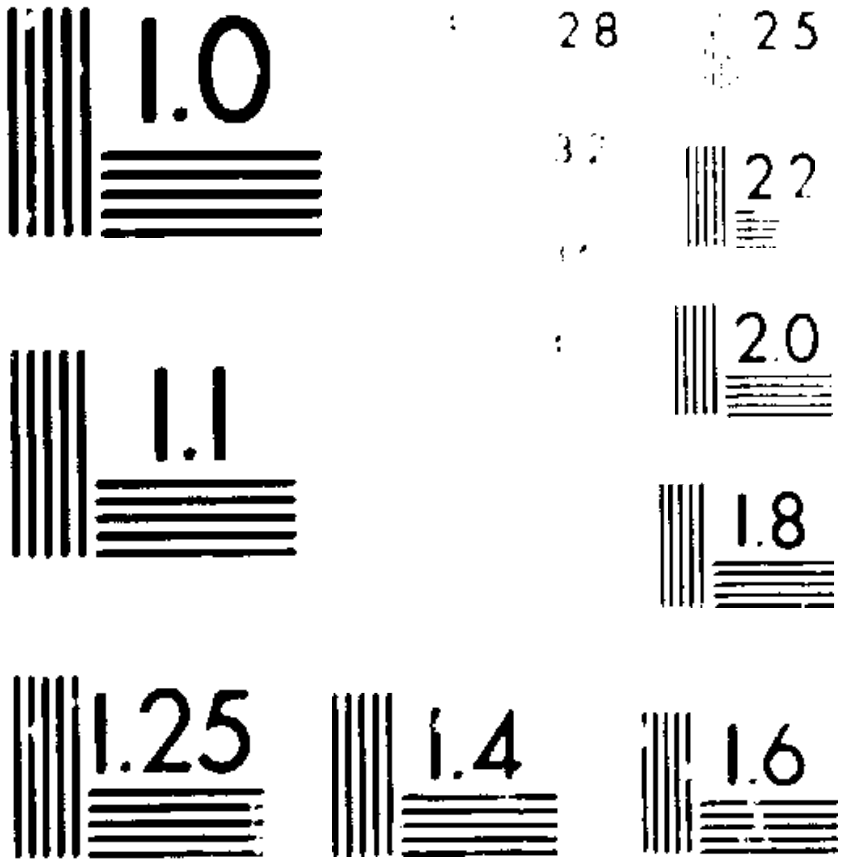

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# STRATEGY FOR PRODUCTION OF RAILS, SLEEPERS, AND OTHER STEEL MATERIALS FOR THE RAILWAYS, WITHIN THE FRAME OF DEVELOPMENT OF THE IRON AND STEEL INDUSTRY IN AFRICA*

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# I N D E X

## 1. INTRODUCTION

In its resolution 32/160 the United Nations General Assembly proclaimed the Transport and Communications Decade for Africa, 1978 - 1988. The assistance to the African railway engineering sector is one of the most urgent priorities of the Decade due to its direct relationship to the overall economic and social problems confronting African countries.

The density of the African railways network is very low. For 29 million $km^2$, the African continent has only 80,706 km of track which gives an average density of 2,63 km per 1,000 $km^2$; while in Europe, with other highly developed modes of transport, it is over 60 km per 1,000 $km^2$. On the African continent 10 countires have no national railways or section of an international railway. These are the Gambia, Niger, Somalia, Chad, Rwanda, Burundi, the Central African Republic, the Libyan Arab Jamahiriya, Lesotho, Guinea-Bissau and Equatorial Guinea.

The African railway network is made up of a series of secondary network most of which being national in character and often independent. Moreover, they do not all have the same technical characteristics. There are nine gauges in Africa but only three are widespread, namely, a normal European track gauge 1,435 m for 11,743 km (14,5 percent), a standard African track gauge 1,067 m for 49,473 km (61,3 percent) and a metric track gauge 1,000 m for 15,472 km (19,2 percent).

The normal European gauge is used in North Africa from Morocco to Egypt. The standard African track gauge is that of the South African countries' network including Zaire, Sudan, Ghana, and Nigeria. The metric track gauge is that of the railways of West Africa and East Africa. The adoption of 1,067 m as the standard gauge for the entire continent would facilitate the inter-connection of the networks, the unification, development and improvement of railway services and facilities for the production and maintenance of railway equipment.

So far, investigations have not been made on the development of the African Railways and railways industries, vis-a-vis development of the iron and steel industry on the continent, and the mutual requirements and existing constraints imposed along both lines of development. Therefore, the initiative of the UAR is very timely and suggestive, and the elaboration on this subject would be useful both for the railways and the iron and steel industries development in Africa.

In the Resolution on the Lagos Plan of Action, the Member States have recognized that transport and communications constitute a most important sector on whose development depends not only growth sector but also the socio-economic integration of Africa, as well as the promotion of intra- and extra-African trade.

In recognition of the special importance of the transport and communications sector to the African economy, the Economic Commission for Africa Conference of Ministers in March 1977 has adopted a resolution calling for the declaration of a Decade for Transport and Communications. This resolution has been endorsed first by the Economic and Social Council and secondly by the General Assembly of the United Nations which has accordingly proclaimed the Transport and Communications Decade for Africa, 1978 - 1988. This resolution has been subsequently adopted by the OAU of Heads of States and Government in Monrovia in July 1979.

On the above mentioned summit fora, the principal goals of the strategy for the decade defined by the ECA Conference of Ministers of Transport, Communications and Planning in May 1979, have been endorsed and the Member States have agreed to work towards:

(a) promotion of the integration of transport and communications infrastructures with a view to increasing intra-African trade;

(b) ensuring the co-ordination of the various transport systems in order to increase their efficiency;

(c) opening up of the land-locked countries and isolated regions;

(d) harmonization of national regulations and reduction to a minimum of physical and non-physical barriers with the aim of facilitating the movement of persons and goods;

(e) stimulating the use of local human and material resources, the standardization of networks and of equipment, research and dissemination of techniques adapted to the African context in the building of transport and communication infrastructures.

(f) promotion of industry in the field of transport and communication equipment, and

(g) mobilization of technical and financial resources during the decade, with a view to promoting the development and modernization of transport and communication infrastructures in Africa.

These goals have to be realised through the implementation of projects classified in accordance with their relevance in meeting the problems of transport and communications in Africa as follows:

(a) (i) regional projects;
(ii) sub-regional projects;
(iii) national projects with a regional or sub-regional impact.

(b) projects for the least developed, land-locked, newly independent, island and frontline and other majority ruled countries in Southern Africa.

(c) projects of concern to other countries.

It has been decided to implement the Decade in two phases:

PHASE I : 1980 to 1983

- continued implementation of ongoing projects:
- implementation of projects already identified and studies and which are only waiting to be financed;
- identification of technical feasibility and economic studies of other projects and a search for their financing.

PHASE II: 1984 to 1988

- continued implementation of projects undertaken in the course of the first phase;
- financing and implementation of new projects;
- continuation and identification of other new projects.

## 2. EVALUATION OF ACTIVITIES AND FUTURE PROSPECTS OF UAR:

The establishment of the UAR in 1974 was in response to the desire of the African countries to make railways play their full role in the economic development of the continent in view of the technical and economic advantages of this mode of land transport:

- heavy traffic over long distances;
- low energy consumption;
- generation of economic activity.

2.1. Present Activities

In 1976, the 4th General Assembly of UAR approved the short and medium-term programme of action. This programme is currently at various stages of execution, and comprises:

(a) Railway interconnections:
- Master plan for rail links in Africa (26,000 km long);
- the transport decade and the railway (1978 to 1988);
- normalization and standardization of stock and equipment.

(b) creation of sub-regional training centres;
(c) UAR Documentation and Publication Centre;
(d) sub-regional grouping of purchases;
(e) organization of railway meetings;
(f) establishment of relevant Working Committees.

2.2. Prospects

The UAR pursued its policy of co-operation with the different sub-regional agencies with a view to favouring the development of railway industries in Africa. Within this specific framework, the West African Economic Community (CEAO) has entrusted the UAR with conducting a feasibility study for a community wagen factory in the West Africa sub-region. This feasibility study will be followed by a study on execution in accordance with the CEAO's three year investment programme. This experiment is to be encouraged for obvious economic reasons, and because the construction of wagons does not demand an advance technique which African technicians and engineers have not yet mastered. The UAR will examine the possibility of setting up in each sub-region the following units:

(a) sleeper production units (wood - concrete and metal);
(b) industrial ballast production units;
(c) depending on the railways geographical situation the UAR will stimulate and encourage experiments in the use of solar energy for signalling, so as to counter-mail the constraints of traditional sources of energy;
(d) grouping of purchases;
(e) creation of Railway Documentation Centre;
(f) creation of sub-regional Training Centres;
(g) improvement of railway operating conditions.

2.3. Statistics

(1) There are three gauges, the so called standard gauge (1.435 m) is found in North Africa and in Gabon - where a new railway is under construction. The so called metric gauge (1.067 m) is found in East and Southern Africa and the (1.000 m) metric gauge is gernerally found in West and central Africa. Lines with gauges of less than (1.000 m) are in the process of being replaced.

(2) Africa today has approximately 100,000 Km of railway lines. Most of these lines were built prior to the 1950's. The use of electric traction (2,000 Km of electrified lines) is not yet wide spread, it is currently used by only 4 or 5 countries ( Algeria, Egypt, Morocco, Zaire, Zimbabwe).

(3) The average speed of train is still quite low, 30 Km/h for goods trains and 45 Km/h for passenger trains. These low-average result from the uneven geometry of tracks dating from over 50 years ago .

(4) Mining transport is the largest form of traffic, such minerals are intended exclusively for export. Traffic involving agricultural products ranks second. Passenger traffic is fairly developed in the countries of North Africa. The Egyptian railways carry over 25 million passengers annually. Efforts are being made by other countries to develop such traffic .

(5) The economic doldrums which the world as a whole is experiencing makes the operation of the African railways increasingly difficult. Financing for the renovation of rolling stock and the modernization of old lines is growing rarer or is granted under unfavourable conditions. In any even, operating results reveal a very serious deficit, some railways only survive owing to government subsidies .

(6) Despite these difficulties, and relatively unfavourable economic situation, railways, which generaly emerge in most countries as the backbone of the entire transport system, continue to wage the battle for economic development with a view to the integration of all the African economies .

(7) The following table shows the statistics which was carried by UAR in 1979 about the total length of the lines and the rolling stock in the subregion of Africa .

| | Length of Line | No. of Coaches | No. of Wagons | Remark |
|---|---|---|---|---|
| North Africa | 16101 | 195616 | 49775 | |
| East " | 9221 | 42093 | 23790 | |
| West " | 9873 | 47154 | 11250 | |
| Central " | 10387 | 16535 | 9598 | |
| Total 1979 | 45582 | 301398 | 94413 | |
| Total in 1984 | 50000 | 5000 | 100000 | round figures putting in consideration the increase in the next 5 years. |

From the above statistics we can estimate the requirements of the African Railways as follows :

(a) **Rails : Sleepers**

1. Renovation of tracks to meet present - day demands .

   This include about 25,000 km of rails and the necessary amount of sleepers .

2. Layout about 26,000 km of new railway lines to fulfil the master plan for connecting the African countries .

(b) Rolling stock steel materials and casting

1. The steel sections profiles, plates, sheets neede for renovation of the coaches and wagons which estimated to be 5000 coaches and 100,000 wagons .
2. The steel material needed for fabricating additional amount of coaches and wagons for meeting the increase in demand and for the new railways lines .

(c) From the above statistics we can estimate that the African railways requirement from steel materials ( rails, sleepers, construction steel and steel semi fabricates for the new system and the repair and maintenance of the existing one, to be from 3 - 4 million ton yearly.

## 3. Status and development of the iron and steel industry in Africa

A survey of any industry ought to be done appropriately in the context of its world setting. This stipulation is equally if not more important in the case of a heavily capital intensive industry such as the iron and steel industry. It will be, therefore, necessary to outline in general the world's iron and steel industry, followed by a survey of the iron and steel industry in developing countries (Africa, Arab Countries, etc.) and by referring to UNIDO's technical assistance activities in the field of iron and steel industry for the developing countries and regions.

A survey of the iron and steel industry, national, regional or inter-regional is inevitably linked up with its future plans and the possibilities of their implementation; it is in the latter fields that constraints, obvious or oblivious, crop up in the case of developing countries with their limitations of scarce capital, scanty trained manpower and an extant or lean technological base.

### 3.1. IRON AND STEEL INDUSTRY - THE WORLD SETTING

The world production of crude steel has more than doubled in the last thirteen years, from 346 m tons in 1960 to 870 m tons in 1983. The growth rate of course was with regard to the individual steel producing countries not equal. Japan's share in the global growth rate was extraordinary. The big question for the future is: What about the growth rate of the steel industry in the developing countries. It is said that steel consumption is somewhat characteristic of the standard of living in a country. In this light the world still lacks a lot of steel. At present, Sweden has one of the highest per capita consumption of 700 kg, closely followed by the United States, then inter alia, by Great Britain with a per capita consumption of 400 kg; and then tail the numerous developing countries where the per capita rate is only a few kilograms of the decimal of a kg. If the developing countries increase their consumption only by a few kilograms per head, the quantities of additionally required crude steel would rise enormously.

The iron and steel industry is notably capital-intensive, with a specific requirement of $400-600[1]/ for each ton per year of steel-ingot production capacity. In addition, in certain cases, particularly in developed countries, substantial infrastructure investment has to be made. Accordingly, the establishment of an integrated iron and steel plant with a capacity of 1 million tons per year of ingots will require an investment

1/ This figure is now approaching a $1,000 mark.

of $400 million to $600 million. Additional investment "upstream", i.e. for supply of the necessary inputs, and "downstream", i.e. for processing of steel into manufactured products, will have to be considered in addition and may amount to investments of the same order of magnitude. A large portion of the capital invested in iron and steel installations correspond to heavy industrial equipment and heavy industrial construction. The iron and steel industry is, thus, a large buyer of heavy capital goods. For developing countries this may mean a heavy burden on their balance of payments.

World steel output is expected to keep growing in the future as in the past because steel is one of the most basic industrial material. This long term growth seems assured, if only because the drive to industrialise will relentlessly augment steel demand in many emerging nations. But the uptrend will continue to mask profound changes in the pattern of world consumption and production of steel.

Over the past 100 years, the rise in the world's output of steel has been spectacular. In 1870, it was just short of 10 million metric tons. A half-century later, in 1920, it had increased nearly eightfold to 75 million metric tons. By 1983 it had climbed to 870 million metric tons.

As a nation starts to industrialize, a first surge of steel demand is likely to reflect heavy investment in its economy's infrastructure - the development of a transportation and communications network, electric-power generation and distribution, and other essential facilities. A broader impetus to steel consumption comes from the industrial expansion itself, which is both a cause and a prime beneficiary of the infrastructure improvement. As economic growth takes off and affluence starts to spread, demand escalates for key consumer durables such as cars and major appliances - which in turn, boosts the use of steel.

The country's demand for steel is likely to be satisfied at first by imports. But as its requirements increase, it will attempt to shift to domestic production - initially, perhaps only for large-volume items. The establishment of a domestic steel industry will be recommended increasingly on grounds that it will stimulate supplier and use industries, provide employment and save scarce foreign exchange. It will seem attractive, too, for reasons of self-sufficiency and defence - and at times because of the prestige surrounding steel mills.

The prospects, both immediate and long-term, of the steel industry are intimately linked with the world trade in steel. A good part of the world steel production is exported. For instance, in 1955, almost 13 percent of the world steel production was exported Today, close to 23 percent of the world production is exported. Japan, the largest quantum exporter exported almost 37 percent of its production, followed by West Germany. Belgium exports more than three fifths of its production plus imports. Italy, France, Luxembourgh and Czechoslovakia also export quite a substantial portion of their production.

World trade in steel has greatly increased over a period of time. The rising trade has been engineered by Japan. The planned manner in which the top six steel producers in Japan have been pushing their steel everywhere, especially in West Europe and the US, has upset the steel production programmes in several of these countries.

One does not have to seek far for the reasons for the Japanese surge in exports. The unit costs of production in Japan is still about 40 percent of that in the US, 45 percent of that in West Germany and 60 to 65 percent of that in France, and these figures Japan is steadily still improving upon. Japan, having joined the steel producing countries' group more recently than all the other developed countries. has more up-to-date, scientifically advanced and technologically superior machinery.

In 1977, it took US steel producers some 15 man-hours to produce a tonne of steel. In 1974, it took them 11 man-hours for the same job. West Germany spent almost 37 man-hours in 1955 but only 20 man-hours in 1974. In the case of France, the man-hours spent for producing a tonne of steel came down from 35 hours to 26 hours. But the productivity of steel makers in Britain during 1974 remained almost at the same level of 35 hours. However, in the case of Japan, the man-hours needed to produce a tonne of steel came down sharply from 69 in 1955 to 9 in 1974! This alone is enough to demonstrate why Japan has forged ahead so fast while countries like the UK have remained where they were two decades ago.

The big exporters are aware that the W.Asian and African developing countries, moving towards higher economic levels, will continue to provide a boost to the production of steel in exporting countries. As the gestation period is pretty long before steel plants come into production, countries in Latin America, Africa and W.Asia will continue to demand steel.

The growth of the Third World steel industries is another structural effect and is an important factor to be reckoned when discussing world steel production.

Western World Steel Production in 1985, UNIDO Forecast 1/

| | 1974 m.tons | % | 1985 m.tons | % | 1974-1985 growth rate |
|---|---|---|---|---|---|
| Industrialized countries | 462 | 93 | 613 | 83 | 2.6 |
| Developing countries | 36 | 7 | 125 | 17 | 12.0 |
| Total Western World | 498 | 100 | 738 | 100 | 3.6 |

Most of the Third World steel producers will be state-owned and export-oriented. Governments of the industrialized countries will try to assist the Third World development with a cut of the big steel markets. This will necessitate established exporters to restrict their share of certain major markets so as to accept Third World producers' participation.

World steel demand will grow at a much slower rate than before and production will match demand. The production pattern will transform with a shift from the industrialized countries to the developing world.

Already occuring is a diversification by the private sector into other related industries and into more sophisticated products and technologies.

Since the Fifties there has been much technological development in the steel industry. The locational problem has been idely studied for reduction in construction costs, operating costs, and, above all, pollution control. Bigger units are favoured for savings in capital cost and operating cost per tonne. The following tabulations are presented to indicate the investment made, capital costs of selected major steel works. The size of the blast furnace of Fukuyama grows with every stage of expansion.

| | Inner Vol.of B.F. Cu.m. |
|---|---|
| Stage 1 | 2004 |
| Stage 2 | 2828 |
| Stage 3 | 3016 |
| Stage 4 | 4197 |
| Stage 5 | 4400 |

1/ Summary extract from IISI 68th Annual Meeting

The average investment pattern during 1971-75 in the four main steel making countries reflects the pattern of huge capital requirement of the industry.

| | | Capacity Mty. | M.$ investment |
|---|---|---|---|
| 1. | USA | 150 | 1850 |
| 2. | Japan | 144 | 2880 |
| 3. | W.Germany | 63 | 774 |
| 4. | France | 34 | 860 |

Investment costs of selcted major steelworks are shown below:

| Country | USA | Japan | France | Japan | Japan |
|---|---|---|---|---|---|
| Company | Bethlehem | Kobe | Usinor | NSC | NKK |
| Works | Burns Hbr. | Kakogawa | Dunkerque | Oita | Fukuyama |
| Cap.Mtpa | 4.0 | 6.0 | 8.0 | 8.0 | 16.0 |
| When Built | 1964-75 | 1968-73 | 1960-74 | 1971-76 | 1963-73 |
| Actual Cost | $ 1½ bill. | $ 1½ bill. | $ 1.1 bill. | $ 2 bill. | $ 2 bill. |
| Poss.1976 Cost | $ 3½ bill. | $ 3½ bill. | $ 5½ bill. | $ 4 bill. | $ 8 bill. |

Brief analysis of the situation of developing countries in regard to Iron and Steel production and consumption

The situation of developing countries can be summarized as follows:

(a) Developing countries have increased their share of world production of raw steel (ingots) from 1.5 percent in 1950 to about 11 percent in 1983;

(b) In 1983, their share of world production was roughly 104 megatons, or 11 percent, while their share of consumption was roughly 128 megatons, or 15 percent;

(c) Their per capita production and consumption (as a whole) are extremely low, about 20 to 30 kilograms, respectively;

(d) Even the most developed of the developing countries show per capita indices much lower than developed countries, i.e. about 100 kilograms and 400-600 kilograms respectively;

(e) Only a few (about 13) developing countries in Africa, Asia and Latin America have established integrated iron and steel plants, however small;

(f) The iron and steel production of developing countries has grown at about 10 percent per year since 1950, with apparent consumption growing at about 8 percent per year;

(g) Developing countries still depend on imports for about one third of their needs for steel, about 35 megatons per year;

(h) Developing countries are heavy exporters of raw materials to developed countries. They supply about 125 megatons per year, or 19 percent of all iron ore consumed in the iron and steel industry (compare that with their share of 11 percent of world steel production). Since the ore they export is of a very high grade, their ore output represents about 25 percent of the iron contained in the world ore output;

(i) Many developing countries are now engaged in major efforts to plan, establish or expand their steel industry, which is generally considered a high priority sector;

(j) The degree of self-sufficiency (percentage of demand covered by local production) attained in the last few years is roughly estimated as follows: 73 percent for Latin America; 56 percent for Asia; 12 percent for the Middle East; 7 percent for Africa.

## 3.2. THE IRON AND STEEL INDUSTRY IN AFRICA

The current per capita steel consumption in Africa is one of the lowest in the world estimated at 8 kg compared to 250 to 300 kg on an average in developed countries. The consumption of steel in Africa primarily relates to steel rods (RCC), bare, light merchant mill sections, wire rods, rails, plates and sheets. It is currently projected to rise at an annual rate of growth of 9-10 percent. This means that the total steel consumption in Africa will exceed 60 million tons by the year 2000. This, however, is considered to be a pessimistic projection. The growth rate is relatively low for countries at an early stage of development but it is more than adequate for the establishment of iron and steel industry in each of the African countries and the sub-regions. Economies of scale should be taken into account; the production facilities should, therefore, be based on a sub-regional basis with phasing of projected steel industry's development. If this co-ordination materializes, the pace of development will rise and so will the steel consumption which may as a result rise to 3 times the above figure to give a total of 180 million tons by the year 2000. In some African countries, there are abundant reserves of high grade iron ores, oil and natural gas.

Charcoal can be considered for iron smelting in countries which lack coal resources but possess good forests and forestry development programmes. The annual capacity of operational iron and steel plants in African member countries of the Organization of African Unity is now much less than two

million tons; this capacity is expected to rise 15 million tons of steel by 1985. Compare this with the world picture around 1950, the total annual steel production in developing countries was less than three million tons; mid-fifties one often heard that the world's steel industry's capacity had reached saturation levels and that the developing countries could, therefore, import their entire steel requirements from the advanced steel producing countries and further that the developing countries should not enter into the highly capital intensive and the highly technological fields of the steel industry which was stated to be beyond their means financially and technically. However, by 1970, the annual steel production capacity of the developing countries attained a figure of 27 million tons. The phenomenal increase in world annual crude steel capacity from the World War II figure of 180 million tons and 200 million tons in the immediate post-war years to its present output exceeding 860 million tons annual production represents the gigantic growth of world iron and steel industry.

What are the steel production figures for Africa? Extremely low, and the following figures for the whole of Africa speak for themselves:

Steel production in Africa (x 1000 tons)

| Africa | 1964 | 1966 | 1968 | 1970 | 1973 | 1981 | 1983 | 1984 E |
|---|---|---|---|---|---|---|---|---|
| | 3,269 | 3,503 | 4,312 | 5,346 | 6,405 | 10,860 | 11,850 | 11,970 |

The growth of Steel Consumption and local production in Africa during 1950-1982 at a compound rate (percent per annum) has been estimated at 5.95 and 9.78 respectively. The percentage of regional steel consumption covered by regional production over 1950-1982 for Africa is derived to give a figure of 3 for 1950, 5 for 1960 and 1965, 8 for 1970 and 6 for 1972, and 11 for 1982.

In terms of population, only five countries, namely Ethiopia, Zaire, Gambia, Uganda and Tanzania have a population of more than ten million each; only two African countries have a steel consumption level of more than 100,000 tons and five African countries more than 50,000 tons per year.

In Central Africa, only Zaire has a moderate steel consumption to justify a small scale steel plant based on local raw materials. Gabon's steel consumption currently is of the order of 80,000 tpy. Ethiopia, with a population of 26 million has a large market for steel but hardly any production. Kenya is building up his industries and steel consumption is growing. Zambia, with a population of 4.5 million has its northern part somewhat industrialized where copper industry is operating and its steel consumption is rising.

In West African countries, there is no steel production except small plants in Ghana and Nigeria that are scrap-based with small merchant steel rolling mills. Steel consumption in Nigeria has currently been of the order of 650,000 tons/year followed by Ivory Coast with a steel consumption exceeding 100,000 tpy. In Nigeria, plans are under implementation for the establishment of an integrated iron and steel plant, using the Direct reduction sponge iron-electric arc furnace route. It would produce 0.5 million tons/year of sponge for export and 0.5 million tons of semis for home market; natural gas will be used for sponge making. This project will reportedly have the collaboration of C. Itoh (Japan) for marketing/financing and of Korf (FRG) for technology.

An agreement has been signed several years ago by the Government of Zaire and FINSIIER (Italy) for the latter's collaboration in the management of the Société Nationale de Siderurgie at Maliku during the first ten years of operation; this plant has a capacity of 120,000 tons per year. In Egypt, identical developments are taking place at the present time.

The Egyptian General Organization for metallurgical Industries (EGOMI) has prepared a comprehensive and long-range plan for the utilization of mineral resources for iron and steel industry in the Arab Republic of Egypt, aiming to meet the increasing demand for the iron and steel products till 1985. The Helwan Steel complex, the only integrated steel plant in the country, has recently expanded its initial crude steel capacity of about 300,000 tpy to about 1.5 million pty in two phases (each phase based on an addition of 0.6 million tpy capacity); this expansion has been carried out with Soviet technical assistance. Other units of the steel industry in ARE are based on the melting of steel scrap in electric arc furnaces and basic open hearth furnaces (all cold charge); these plants have captive merchant steel rolling mills and steel foundries. The total capacity of the non-integrated small plants, viz. Delta Steel, the Egyptian Copper Works and the National Metal Industries Co., is of the order of about 300,000 tpy of liquid steel.

Non-integrated small steel plants in Egypt using cold charges consisting of steel scrap/pig iron, are equipped with basic open hearth and electric arc furnaces. At the Delta Steel, alloy and tool steels are mainly produced whilst the other plants mainly produce plain carbon mild steels for rolling into rods (Reo) bars, etc.

Ghana has a small plant based on electric arc furnaces. Ivory Coast has large reserves of low grade iron ore only.

In Liberia, the demand for iron and steel has risen sharply in recent years. In 1967, UNIDO had sponsored a detailed study of the iron and steel industry situation in Liberia; the latter has highly developed its iron ore mining and pelletizing industries.

Crude steel production in some of the Afro-Arab countries is shown below (x 1000 tons/y):

| | 1970 | 1974 | 1981 | 1983 | 1984E |
|---|---|---|---|---|---|
| Algeria | 330 | 410 | 2,030 | 2,060 | 2,060 |
| Tunisia | 60 | 90 | 200 | 200 | 200 |
| ARE | 300 | 270 | 1,860 | 1,890 | 1,890 |
| Libya | | | 20 | 20 | 20 |
| Total | 690 | 770 | 4,110 | 4,170 | 4,170 |

Afro-Arab countries with a population exceeding 15 million, are: ARE, Morocco, Algeria and Sudan; total crude steel consumption in all these countries has been of the order of five million tons currently. Algeria is an agrarian country with good petroleum industry. Potential reseves of iron ore are also high and it has fully integrated steel plants in the country ( El Hajdar) - plans which have raised Algerian steel production considerably in trhe last several years. Mauritania has good reserves of high grade iron ore but no steel industry.

Average Chemical Analysis of high-grade lumpy iron ores/concentrates/ pellets of selected African countries 1/

| Lumpy Ore | Fe | $SiO_2$ | $Al_2O_3$ | CaO | P | S | Mn |
|---|---|---|---|---|---|---|---|
| | | | percent | | | | |
| Algeria | 52.56 | 2-6 | 0.6-1.5 | 1.8 | 0.01-0.03 | - | 0.2-1.6 |
| Gabon | 64.8 | 1.7 | 2.0 | 7.0 | 0.15 | - | - |
| Liberia | 65.8 | 2.5 | 1.0 | - | 0.05 | 0.005 | - |
| Mauritania | 65.0 | 4.3 | 1.2 | 0.2 | 0.03 | 0.01 | 0.12 |
| **High-grade concentrate (ore fines)** | | | | | | | |
| Liberia fines | 65.1 | 4.5 | 1.24 | - | 0.09 | 0.10 | - |
| Liberia fines concentrate | 64.4 | 5.3 | 0.51 | - | 0.037 | 0.022 | - |
| Mauritania fines | 62.7 | 7.2 | 1.6 | - | 0.018 | 0.002 | - |
| **Pellets - high-grade** | | | | | | | MgO |
| Liberia | 64.5 | 4.2 | 2.0 | 1.1 | 0.06 | 0.003 | 0.06 |
| Morocco | 65.5 | 2.6 | 1.2 | 0.8 | 0.006 | 0.008 | 0.97 |

1/ World Market for Iron Ores, UN New York, 1968 and Metal Bulletin 1969.

It will now be relevant to furnish some data concerning the capital and production costs of steel on an average basis under overall African conditions. Steel production costs through various process routes applicable to African conditions and raw materials are furnished in the following tables assuming reasonable unit costs and norms; these will provide the general trends on the subject.

Average Chemical Analyses of Raw Materials (percent)

| % | Fe | $SiO_2$ | $Al_2O_3$ | CaO | MgO | S | F.C. | Ash |
|---|---|---|---|---|---|---|---|---|
| Iron ore pellets | 65 | 2.4 | 1.5 | - | - | - | - | - |
| Iron ore lumps | 52 | 7.0 | 3.5 | 1.8 | 0.4 | - | - | - |
| Blast furnace limestone | - | 3.5 | 0.6 | 50.0 | 1.0 | - | - | - |
| Dolomite | 1.4 | 1.8 | 1.0 | 31.0 | 19.0 | - | - | - |
| Coke | 1.0 | 4.0 | 2.9 | 0.3 | 0.2 | 1.0 | 89 | 10 |

Unit Costs (latest price US$ per ton)

| | | |
|---|---|---|
| Iron ore pellets | 65% Fe | 28 |
| Iron ore lump | 52% Fe | 19 |
| Iron ore fines | 52% Fe | 10 |
| Manganese ore (high-grade) | | 65 |
| Limestone/dolomite | | 7 |
| Fluorspar | | 120 |
| Blast furnace coke | | 100 |
| Nut coke | | 50 |
| Fe Mn | | 450 |
| Fe Si | | 400 |
| Natural gas $10^6$ Koal | | 1.0 |
| Power KWh | | 0.1 |

## Estimates of production costs by different process routes (average approximations)[1/]

| | Direct Reduction HyL gasecus process and electric furnace | | | Sub-merged arc electric smelting of pig iron and LD oxygen steel-making | | Blast furnace LD oxygen steel-making | |
|---|---|---|---|---|---|---|---|
| Liquid steel production x 1000 t/year | 300 | 1,000 | 2,000 | 300 | 600 | 1,000 | 2,000 |
| Capital cost US$ per annual ton liquid steel capacity | 100 | 86 | 80 | 150 | 135 | 119 | 109 |
| Production cost US$/ton | | | | | | | |
| Sponge iron | 39 | 37 | 35 | - | - | - | - |
| Hot metal | - | - | - | 78 | 77 | 70 | 68 |
| Liquid steel | 70 | 69 | 67 | 99 | 96 | 87 | 84 |
| Fixed charges US$/ton[2/] | 10 | 8.5 | 8.0 | 15 | 14 | 11 | 10.0 |
| Total cost of production of liquid steel - US$/ton | 80 | 77.5 | 75 | 114 | 110 | 98 | 94 |

[1/] These estimates do not relate to any particular African country but provide approximate averages which vary from one African country to the other.

[2/] Fixed charges are based on the following:

- Interest on capital at 4.5% on 50% of the capital
- 5% depreciation
- Interest on working capital for three months production cost at 6.5%
- Total fixed charges are calculated adding 30% to the capital costs to cover infrastructure facilities (raw materials handling transport, etc.)

Reserves of African Iron Ores[1/]

| Fe % range | Proved reserves million tons | Potential reserves (unproved) million t | Total 1 + 2 million tons |
|---|---|---|---|
| 30 - 67 | 6,800 | 24,500 | 31,300 |

Grades of Iron Ores in Selected African Countries

| Country | Reserves mill. tons | Fe% | $SiO_2$% | $Al_2O_3$% | Mn% | P% | S% | Others % |
|---|---|---|---|---|---|---|---|---|
| Mauritania | 465 | 65.0 | 4-3 | 1.2 | 0.12 | 0.03 | 0.01 | - |
| Morocco | 149 | 60.0 | 7 | | | 0.05 | 1.5 | 14.6 BaO |
| | | 43.0 | 9.6 | 1.2 | 2.3 | 0.01 | - | 2.2 CaO |
| | | 52.2 | 8 | 5.9 | 0.2 | 1.04 | 0.03 | |
| Algeria | 1,579 | 40.0-56 | 3.8 | - | 2.0 | - | 0.5 | 3.4 CaO + 1.0 MgO |
| | | 49-54 | 4.9 | 4.3 | - | 0.8 | - | 0.3 MgO + 0.3 Ti |
| Tunisia | 75 | 54.0 | 4.0 | 0.8 | 2.1 | 0.03 | | 0.5 CaO |
| | | 58.0 | 4.0 | 3.7 | 2.0 | 0.10 | | 0.3 CaO |
| Libya | 3,525 | 49.0 | 10.9 | 4.9 | - | 0.94 | - | - |
| | | 50.5 | 7.05 | 4.6 | - | 1.03 | | |
| | | 51.75 | 6.15 | 4.9 | - | 0.92 | - | - |
| ARE | 433 | 46.9 | 14.10 | NA | 2-4.5 | 0.6-1.0 | NA | |
| | | 49-59 | 2.6-9.1 | | NA | 0.19-0.6 | | |
| | | 43 | 20-25 | NA | NA | NA | NA | |
| Sudan | 61 | 37-61 | NA | NA | NA | NA | NA | NA |

[1/] World Reserves of Iron Ores, United Nations, 1970

Oil and gas resources of Africa - 1973 1/

| Country | Oil million cu m | Gas billion cu m |
|---|---|---|
| Algeria | 7,550.00 | 2,960.00 |
| Angola (incl.Cabinda) | 192.00 | 28.40 |
| Congo (Bras.) | 800.00 | |
| Dahomey | 832.00 | 213.00 |
| ARE | 100.00 | |
| Gabon | 176.00 | 198.00 |
| Libya | 4,864.00 | 781.00 |
| Morocco | 160.00 | 40.00 |
| Nigeria | 2,400.00 | 1,136.00 |
| Tunisia | 160.00 | 28.40 |
| Zaire | 80.00 | |
| TOTAL | 17,314.00 | 5,304,80 |

As of 1 January 1974, Africa's (Algeria, Angola, Congo, ARE, Gabon, Libya, Morocco, Nigeria, Tunisia and Zaire) crude oil and natural gas reserves have been estimated at 10,701.34 million cu m and 5,315.59 billion cu m, respectively.

Estimates of natural gas flared in some African countries - billion $m^3$ - 2/

| Country | 1965 produced | 1965 quantity flared | 1965 proport. | 1975 (estimates) produced | 1975 (estimates) quantity flared | 1975 (estimates) proport. |
|---|---|---|---|---|---|---|
| Algeria | 3.97 | 2.10 | 53% | 11.33 | 2.27 | 20% |
| Libya | 8.61 | 8.61 | 100% | 17.85 | 12.24 | 70% |
| ARE | 0.31 | 0.25 | 84% | 2.83 | 1.42 | 50% |

1/ Oil Statistics - Government of India, Jan.-March 1973, Petroleum Information Service, New Delhi

2/ Development and utilization of natural gas resources and their vital role in accelerating economic development by Abdel Dayan A. El-Sani, Planning and Development Adviser, Kuwait.

The existing capacities of the iron and steel industry in Egypt, as well as the planned expansion with regard to the requirements of the African railways, are shown below.

## PRODUCTION CAPACITIES OF EGYPT

(Sections and Plates Product Mix Existing)

| Section | Sizes m.m. | | |
|---|---|---|---|
| | Light Section | Medium | Heavy |
| Billets and Squares | 40x40 to 60x60 | 80x80 | 100x100 to 130x130 |
| Bars (R.C.) and Rounds | 13.16.19 | - | 50 to 125 |
| Flate bars and Sheet bars | 6x30 8 and 10x40 | - | 30x120<br>8 to 12x300 |
| Equal Angles | 30x30<br>40x40<br>50x50 | 60x60<br>70x70<br>75x75 | 80x80<br>90x90/100x100<br>120x120/150x150 |
| Unequal Angles | - | - | 50x100<br>80x120<br>100x150 |
| Channels | - | 80.100 | 120.140.160<br>200.260 |
| I Beams | - | 120 | 140<br>160 200<br>260 |
| Rails | - | - | 18.37.52 |
| Sleepers | - | - | (For Rails)<br>47 52 54 |
| Fish Plates | - | - | (For Rails)<br>47.52.54 |

Rc.Reinforced Concrete bars

Rails identified in kg per metre

Sleepers for rails 18 kglm are also produced but by cold forming

| | Sizes m.m. | | |
|---|---|---|---|
| | Thickness | Width | Length |
| Plates | 5 to 100 | 1250.1500 | 3000.6000 |

PRODUCTION CAPACITIES OF EGYPT (to be achieved by 1987)

(Sections and Plates Product Mix Future)

| Sections | Sizes m.m. | | |
|---|---|---|---|
| | Light Section | Medium | Heavy |
| Billets and Squares | 20x20 to 30x30 | 40x40 to 80x80 | 100x100 to 130x130 |
| Bars (R.C.) and Rounds | 13,16,19,22 | 40,45,50<br>60,65,70 | 80 to 130 |
| Flate bars and<br>Sheet bars | 6x30, 8 and 10x40 | 8x50 | 30x120<br>8 to 12x300 |
| Equal Angles | 25x25<br>30x30<br>40x40 | 50x50, 60x60<br>70x70, 75x75<br>80x80 | 90x90, 100x100<br>120x120, 150x150<br>180x180, 200x200 |
| Unequal Angles | - | - | 50x100<br>80x120<br>100x150 |
| Channels | - | 80,100 | 120,140,160<br>200,220,240<br>260 |
| Beams (IPE) | - | - | 140 to 400 |
| " (IPB) | - | - | 140 to 200 |
| Rails | - | 18 | 37,52 |
| Sleepers | - | - | 47/52,54 |
| Fish plates | - | - | 47,52,54 |

| Plates | Sizes m.m. | | |
|---|---|---|---|
| | Thickness | Width | Length |
| | 50 to 100 | 1250, 1500 | 3000-9000 |

## 4. RECOMMENDATIONS FOR ACTION FOR THE DEVELOPMENT OF THE IRON AND STEEL INDUSTRY IN AFRICA, IN INTERCONNECTION WITH THE DEVELOPMENT OF THE AFRICAN RAILWAYS

In making recommendations for the development of the iron and steel industry in African Countries, one is of course, conscious of the fact that such recommendations cannot be regarded as all embracing in absolute terms. The endeavour is to focus attention on some of the problems and factors that are of critical value for the development of the iron and steel industry and seek to find pragmatic ways to tackle them.

(a) The establishment and growth of the steel industry are based on a complex network of project activities; some of the latter must precede the actual establishment of the steel industry, others have to be undertaken concurrently with the installation of the industrial plant and some perforce follow the commissioning and operation of the steel plant itself.
Thus techno-economic feasibility studies must precede the establishment of the steel industry; these studies comprise a vast spectrum covering inter alia the evaluation of raw materials and energy resources, technological process routes and choice of appropriate technology, plant layout and services, market demands and choice of product-mix, capital and production costs and financing of the industry, technical trained manpower and efficient business management, steel plant maintenance and infrastructure, etc. All such studies must be undertaken in advance of the establishment of the iron and steel industry such as at a green field site.
The steel plant's installation requires another set of co-ordinated activities concerning inter alia civil works and foundations, structural work and foundations, structural work and assembly, provision of utilities and services, commissioning of the plant units and operational trials.
The steel industry's practical operations themselves call for another set of well planned and co-ordianted activities covering the actual production of ironand steel and the product-mix based on maximum capacity utilization and adherence to optimum production norms and operational costs.
In all these fields, comprehensive planning and planned action are essential to maintain a chain of inter-related activities in order to get co-ordinated results. The African countries, like any other country, developed or developing, have to plan for the steel industry and its growth to optimum targets and endeavour to link the steel industry to

overall economic development of the country; the objectives being to make the fullest possible use of the natural resources and talents.

(b) In preparing the economic development plans, including those for the iron and steel industry, the need will inevitably arise to formulate the overall strategy for the growth of the iron and steel industry, and prepare a Master/National Plan for the iron and steel industry in the individual countries and regionally co-ordinate these Master Plans as pragmatically as possible.

(c) In the wake of long-term planning and preparation of Master Plans of the steel industry, the need to develop technical consultancy services and establish a base for indigenous technical designs and project engineering services, will be felt for the iron and steel industry and this will, of course, be a long-term strategy to be recommended to the African world.

The technical consultancy organization for the iron and steel industry will inter alia provide the following services to the latter:

(i) pre-feasibility and feasibility surveys and reports;
(ii) techno-economic project evaluation;
(iii) detailed project reports and engineering;
(iv) plant and equipment specifications;
(v) detailed layout, utilities and services;
(vi) materials balance and cost analyses;
(vii) capital costs and investment potentials;
(viii) production cost analyses and profitability;
(ix) market studies and demand projections;
(x) mode of financing and methodology of project implementation;
(xi) civil works and foundation analyses;
(xii) installation of plant and services;
(xiii) commissioning and plant running;
(xiv) overall plant operations and unit production including ancillary services;
(xv) training services and expatriate expert services.

The technical consultancy services will provide comprehensive services in the above fields for the iron and steel industry from a green field site to full operations of the steel plant, covering the entire gambit of technical self-sufficiency.

(d) The strategy for steel development would also entail the evaluation of schemes to maximum the socio-economic benefits of the steel industry; in other words, social cost analysis is recommended to be studied in order to convince the steel industry's critics who continue to maintain that the steel industry is too highly capital intensive and uneconomic for developing countries to project and further that the developing countries can buy all the steel in the world markets; but at what cost and at whose cost - these questions are mostly ignored. It is therefore recommended:

that the economic appraisal of the steel industry in the African countries (and developing countries) should not be undertaken in isolation or on absolute terms but on a national basis; the steel industry providing the basic raw materials (steel sections, rails, profiles, rods, bars, plates, sheets, structurals, to name a few) for the light, medium and heavy engineering industries (transport - rail, road and shipping, consumer products, bridges and buildings, tools and machines) and so on. Apart from providing a main sinew for industrial development, the economic growth of the country is promoted through the training of technical manpower, technicians and skilled workers and of business managers. True, the quantitative measure of such benefits can be mostly qualitatively measured and assessed nevertheless. There now exists appropriate methodology to undertake social cost analysis and benefits of the steel industry and project them quantitatively to discerning planners and investors.

(e) It is also recommended that studies on the sectoral steel demand on a national and regional market basis should be sponsored for African countries (OAU). These studies will provide to the planners with the category-wise steel demand, based on the steel consumer industries. The value of these studies on national and regional basis is important to the African steel industry as a whole; more so, in view of the diversity of steel product-mix and the category-wise demand of steel in individual countries. The iron and steel in individual countries may be inhibited by the limited domestic markets and therefore, the possibilities of developing sub-regional markets and co-operation should be pragmatically studied in order to counteract the effects of the national market constraints.

(f) It is also recommended that co-operation amongst African countries (OAU) should be examined and promoted in the following specific areas:

(i) Interchange and supply of raw materials

African countries (OAU) should take steps to promote the interchange of raw materials (high-grade iron ores/pellets), directly reduced sponge iron, etc. on a mutually advantageous basis. For example, high-grade pellets from Morocco (RIF Mines in North Morocco) could be exported to Alexandria in ARE; the latter could from its projected DR sponge plant, export highly metallized sponge to Morocco for its new steel plant's electric arc furnaces. Identical bi- and multilateral exchange of raw materials, sponge and steel is strongly advocated amongst African countries of OAU.

(ii) Interchange of metallurgical know-how, expertise and consultancy services amongst African countries

A developing country within or outside Africa which has attained high standard metallurgical expertise, technical know-how and consultancy services, could assist another developing country lacking such specialization. This type of interchange can be promoted through governmental or private action.

(iii) Interchange of steel plant and equipment manufactured indigenously

A developing country within Africa or outside which has set up technical design and manufacturing facilities for the fabrication of iron and steel plant equipment and machinery can supply them to another developing country lacking corresponding design and manufacturing capabilities; such exchanges can be promoted through bi- and multilateral trade in raw materials, fuels, finished steel products or semis, on mutually beneficial terms.

(iv) Interchange of trained manpower and business management

Some developing countries have achieved high standard business management and executives and have trained personnel (operational and administrative) for the iron and steel industry. They can assist other African developing countries in training of plant managers and executives, steel plant operators, skilled workers, technicians and trouble shooters at various levels. Foremen, superintendents, supervisors, etc. are being trained in some developing countries. Additionally, the provision of such short- or long-term expatriate staff and trained personnel can be mutually arranged amongst the developing countries through mutually acceptable terms.

(v) Interchange of capital investment, equity partnership and sharing of financial resources amongst African countries

Developing countries relatively well endowed with capital resources including foreign exchange while lacking raw materials could assist others in Africa through joint capital investment, equity participations and formulation of joint Consortia; long-term loans and bilateral financial aid may also be arranged.

(vi) Interchange of trade and complementarity of production

Developing countries in Africa can establish mutually beneficial interchange of trade in finished steel end-products and semis (billets, blooms and even steel ingots, etc.) and market arrangements, so that complementarity of their efforts may lead to mutual gain.

On the basis of the above guidelines, it is recommended that specific project studies should be sponsored for technical co-operation and assistance amongst developing countries themselves. Plans for bi-lateral and multilateral iron and steel industry development based on technical co-operation and assistance amongst African countries themselves should be promoted.

(g) Production of sponge iron using high-grade iron ores/pellets and natural gas

Several African countries such as Nigeria, Algeria, Cabon amongst others, have good resources of natural gas and have also fairly good reserves of iron ores. It is strongly recommended that industrial scale production of highly metallized sponge should be taken up in African countries based on proved gaseous DR processes (HYL, Midrex, etc.). It is necessary to pelletize the iron ore fines with or without prior beneficiation as appropriate, and set up pelletizing plants; the high-grade pellets will provide the feed to the DR sponge plants and also an added value product for export. It is recommended that a Master Plan should be prepared for the African countries for the establishment of sponge iron plants in African countries based on the use of high-grade African iron ore fines pellets and natural gas resources. The highly metallized sponge could be exported with advantage outside Africa as also mutually traded amongst the African countries themselves on barter or cash basis. UNIDO can assist in the preparation of the Regional Sponge Master Plan for Africa.

(h) Production of alloy, tool, special and stainless steels in African countries

The ratio of alloy, tool, special and stainless steel output to that of mild and plain carbon steels is normally between 5-15%. In African

countries (OAU) there is practically no production of alloy, tool, special and stainless steels except in the ARE in a small way. It is highly important to plan the production of alloy steels on a national and regional co-ordinated basis. National and regional Master Plans should be prepared for the production of alloy, tool, special and stainless steels in the Africal countries (OAU); UNIDO can promote the preparation of such Master Plans on request by the countries concerned under their respective Country Programmes for UN technical assistance.

(i) The production of ferro-alloys and steel plant refractories in African countries

There is very little production of ferro-alloys and steel plant refractories in African countries (OAU). It is strongly recommended that techno-economic feasibility studies should be undertaken with UNIDO assistance for the production of ferro-alloys and steel plant refractories in African countries (OAU); these projects are of direct and indirect value to the iron and steel industry irrespective of the latter's establishment on a national or regional basis. The production of ferro-alloys should cover ferro-manganese (different grades), ferro-silicon, ferro-chrome (different grades of high and low carbon ferro-chrome), ferro-vanadium, etc; the steel plant refractories should include acid, basic and neutral refractories, e.g. high silica bricks, magnetite and dolomitic refractories, chrome-magnesite and carbon blocks, etc. A beginning has to be made in these fields.

(j) Iron and steel industry documentation and statistical data for African countries

The importance of documentation, dissemination and cataloguing of technical information and data pertaining ot iron and steel industry and technology is obvious; however, statistical data concerning iron and steel industry in African countries are not readily and fully available. A good start has been made by the Arab Iron and Steel Union and IDCAS (Industrial Development Centre of Arab States). A centralized technical data bank for the African countries (OAU) will be most useful to the latter.

(k) Standardization of steel products in African countries

It is never too early or late to study the standardization of multiple grades of plain carbon and mild steels as also of alloy, tools, special and stainless steels. Unified and mutually accepted standards (standard

specifications) will greatly facilitate mutual co-operation and trade amongst African countries (OAU). The current practice is to apply standards and relevant specifications as formulated in developed countries (ASTM, BSS, etc.) in African countries. Whilst this may appear inevitable, sooner or later, African standards have to be prepared, accepted and applied in practice. It is strongly recommended that action in these fields should be initiated and UNIDO can assist in undertaking such work on request of the countries concerned.

(1) Manpower and training of steel industry personnel for African countries

The training of personnel, skilled workers and technicians, foremen at operational levels and of business management executives and managers, it is strongly recommended, should receive concerted attention of African countries (OAU). This subject is of short-term and long-range importance Very little appears to have been done in these fields except possibly on an ad-hoc manner in a few African countries. A review is also recommended of the educational and vocational training facilities in African countries (OAU) with a view to identify the capacity, future potential and types of technical educational facilities available in African countries. The need to do so is urgent.

It is emphasized that in the above technological training and industrial fields relating to the iron and steel industry, the process of study, survey and examination is self-generating giving rise to fresh issues, connected with the continuous growth and expansion of the iron and steel industry. An open mind will need to be kept on new issues and dimensions in order to rationally study the individual factors and needs of developing African countries and co-ordinate them on a regional platform. The importance and value of such national and regional studies and surveys of basic issues and plans cannot, therefore, be over-emphasized.

In conclusion, it is stressed that dogmatic approaches should be avoided in the establishment of the iron and steel industry in developing countries. Whilst the applications of the latest technological innovations, automation and computerized operations in developing countries are rightful ambitions and objectives, nonetheless the applications of fully appropriate technology should be encouraged depending upon the conditions and environments in each case and country.

Some of the areas in which co-ordinated action will be required by the African countries are the following:

i) raw materials development
ii) economic evaluation and strategy for development
iii) infrastructure and manpower
iv) market studies and projections including statistical data (home and export markets)
v) techno-economic feasibility studies including site selection studies
vi) detailed project reports covering project engineering.

## 5. CONCLUSIONS AND RECOMMENDATIONS

As it was mentioned above, that the iron and steel industry is a capital intensive industry and there are several approaches to make the most effective use of capital.

### (A) Existing plants

(1) To rehabilitate and increase the capacity of the existing iron and steel plants which was established since many years as the case in Egypt, Algeria and Zimbabwe, revise the product mix of the recent plants as the case in Nigeria.
The target is to produce steel materials needed for the railway requirement of the sub-region.

(2) To utilize the existing capacities of the rolling stock fabricating plants in some countries to supply the requirements of the railway in the sub-region like the plant in Zimbabwe which can supply the requirements of some of the countries in the Eastern and Southern region and the plants in Egypt and Algeria which are able to supply the requirements of the countries in the North region or the central region.

(3) Utilizing the existing capacities of the railways maintenance work-shops which after additng some equipment and machinery can manu-facture some of the rolling stock as the case of railway maintenance shop in Kenya.

### (b) New Plants

(1) In establishment of iron and steel plants the approach of downward integration is preferable starting with production units which are

single processes delivering a saleable product. In this approach the primary conversion units to produce pig iron and crude steel are deliberately postponed but planned for in the overall facilities. Generally, the production of rolled products from imported billets or slabs are considered to be merely an entry into product sales than steel production proper.

(2) The deliberate delay of the iron and crude steel capacity after the rolling mill has been commissioned and operated for a time corresponds to the natural evolution of the iron and steel industry. It is important to stress that primary conversion is fairly capital intensive and in cases where there is initial crude steel capacity, this stage of iron and steel industry development requires more capital than all other stages. An important question when planning for an expanded steel production is the economic size of the plant in question. It is recommended to have the smallest size that can give reasonable economy under prevailing conditions. Since trade within the sub-regions is expected to be an important strategy in the development of the iron and steel industry, it is essential that the iron and steel technology employed is chosen with great care. In particular, the technologies to be considered include:
Iron and steel,direct reduction, steel making, continuous casting and rolling and fabrication mill technologies. Due to the enormous effect of choice of technology on production costs and price and quality competitiveness of iron and steel products, it is highly recommended that the countries of each sub-region seriously consider close collaboration and joint action in the search, evaluation and negotiation for the most modern and efficient, available and tried technology and be ready to pay appropriate prices to ensure that products from their national steel plants as well as any sub-regional one are both price and qualitatively competitive. So it is recommended in case of establishment of new integrated plants, it must be on the basis of sub-regional project and all the technical aid and assistance given by the UNIDO or other organization for the studies must be for sub-regional projects and in co-operation with ECA.

(3) In planning to put new rolling stock factories in the sub-regions, the feasibility studies must be done on the basis of sub-regional projects, whether the study is done by UAR or ECA or any other agency as the case of the West African Economic Community (CEAO).

(4) Other engineering projects for railway requirements as springs, axles and wheels, bolts and screws, welding electrodes, must be studied on the same basis.

# 1. TRACKS

—Characteristics of rails and tracks
—Length of lines and tracks
—Type of Signalling

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of Railway | Track Gauge mm. | Weight of Rail Kg/m. (1) | Axle Load (T) | LENGTH OF LINES (Km.) | | | | | | LENGTH OF TRACKS (Km.) | | | | | | |
| | | | | Electrified | | Non Electrified | | Total Km. cols. 5to8 | Ballasted Km. | Electrified | | Non Electrified | | Total Km. Cols. 11to14 | Ballasted Km. | Type of Signalling |
| | | | | Single Track | Double Track | Single Track | Double Track | | | Single Track | Double Track | Single Track | Double Track | | | |
| | | | | | | | | NORTH AFRICA | | | | | | | | |
| SNTF | 1,435<br>1,055<br>1,000 | 46 | | 299 | | 2,350<br>1,263 | | 2,649<br>1,263 | | | | | | | | |
| ER | 1.435 | 47/54 | 22 | | 25 | 2,928 | 952 | 3,905 | 3.905 | | 50 | 2,928 | 1,904 | 4,882 (2) | 4,882 | Electrical & Mechanical |
| ONCF | 1,435 | 33/54 | 22 | 549 | 163 | 1,056 | | 1,768 | 1.768 | 549 | 326 | 1,056 | | 1.931 | 1,931 | Electrical & Mechanical |
| SRC | 1,067 | | | | | 4,784.1 | | 4.784.1 | | | | 5,495.9 | | 5,495.9 | | |
| SNCFT | 1,000<br>1,437 | 25/36<br>30/46 | 16<br>18 | | | 1,282<br>414 | 18 | 1,318<br>414 | 1.318<br>414 | | | 1,476<br>479 | 18 | 1,512<br>479 | 1,512<br>479 | |
| | | | | | | | | 16101 CENTRAL AFRICA | | | | | | | | |
| ANGOLA | 1.067 | 13/60 | 13 | | | | | 3,613 | | | | | | | | |
| RNCFC | 1.000 | 26/36 | 14 | | | 1,164 | 4 | 1,168 | 1.168 | | | 1,360 | 8 | 1.368 | | Simple panels |
| CFCO | 1,067 | 30/44 | 20 | | | (3)<br>792·5 | 2.5 | 795 | 795 | | | (3)<br>1.039.6 | 2.5 | (3)<br>1,042.1 | (3)<br>1,042.1 | Mechanical and Electrical |
| OCTRA | 1,437 | 50 | 28 | | | 90 | | 90 | 90 | | | 130 | | 130 | 130 | |
| SNCZ | 600<br>1,000<br>1.067 | 9/32<br>24.4<br>24.4/40 | 8<br>12<br>15 | 858 | | 1,023<br>125<br>2,715 | | 1,023<br>125<br>3,573 | | 861 | | 1,048<br>139<br>4,179 | | 5.366 | | Mechanical |

## 1. TRACKS

—Characteristics of rails and track
—Length of lines and tracks
—Type of Signalling

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of Railway | Track Gauge mm. | Weight of Rail Kg/m. (1) | Axle Load (T) | LENGTH OF LINES (Km.) | | | | | | LENGTH OF TRACKS (Km.) | | | | | | |
| | | | | Electrified | | Non Electrified | | Total Km. cols. 5 to 8 | Ballasted Km. | Electrified | | Non Electrified | | Total Km cols. 11 to 14 | Ballasted Km. | Type of Signalling |
| | | | | Single Track | Double Track | Single Track | Double Track | | | Single Track | Double Track | Single Track | Double Track | | | |
| | | | | | | | | WEST AFRICA | | | | | | | | |
| RAN | 1,000 | 25/36 | 15 | | | 1,147 | | 1,147 | 1,120 | | | 1,144 | 19 | 1,163 | 1,157 | Mechanical |
| OCBN | 1,000 | 22/30 | 13.5 | | | 579 | | 579 | - | | | 655 | | 655 | | |
| GRH | 1,067 | | | | | | | 925 | | | | | | | | |
| ONCFG | 1,000 | | | | | | | 662 | | | | | | | | |
| LAMCO | 1,435 | | | | | | | 270 | | | | | | | | |
| REFM | 1,000 | 20/30 | 15 | | | 641 | | 641 | 641 | | | 702 | | 702 | 702 | Mechanical |
| SNIM | 1.435 | 54 | 25 | | | 650 | | 650 | 650 | | | 738 | | 738 | | Radio Control of trains |
| NRC | 1.067 | 30/40 | 18 | | | 3.523 | | 3,523 | | | | 4,846 | | 4.846 | | Predominantly Mechanical (2) |
| RCFS | 1.000 | 36 | 15 | | | 964 | 70 | 1.034 | | | | 1,116 | 70 | 1.186 | | Fixed signals |
| CFT | 1.000 | 33/36 | 12.5 | | | 442 | | 442 | | | | 497 | | 497 | | |

## 1. TRACKS

—Characteristics of rails and tracks

—Length of lines and tracks

—Type of Signalling

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of Railway | Track Gauge mm. | Weight of Rail Kg/m. (1) | Axle Load (T) | LENGTH OF LINES (Km.) | | | | | LENGTH OF TRACKS (Km.) | | | | | | | |
| | | | | Electrified | | Non Electrified | | Total Km. cols. 5–8 | Ballasted Km. | Electrified | | Non Electrified | | Total Km. cols. 11–14 | Ballasted Km. | Type of Signalling |
| | | | | Single Track | Double Track | Single Track | Double Track | | | Single Track | Double Track | Single Track | Double Track | | | |
| | | | | | | | | EAST | AFRI | CA | | | | | | |
| CFE | 1,000 | 30/20 | 14 | | | | | 781 | | | | | | | | |
| UR | 1.000 | | | | | 1,265 | | 1,265 | | | | | | | | |
| RNCFM | 1,000 | 25/37 | 14 | | | 883 | 5 | 888 | | | | 156 | | 1,044 | | Electrical & Mechanical |
| MR | 1.067 | 30/40 | 15 | | | 556 | | 556 | 351 | | | 614 | | 614 | 351 | Token |
| CFM | 1.067<br>762 | 22.5/54<br>15/24 | 12/20<br>5.5 | | | 2,427<br>90 | 30 | 2,457<br>90 | 2,417 | | | 2,965<br>140 | 30 | 2,995<br>140 | 2,905 | Electrical |
| SR | 1.067 | 40 | 16 | | | 220 | | 220 | 220 | | | 270 | | 270 | 270 | CTC |
| Tazara | 1.670 | 45 | 20 | | | 1.860 | | 1.860 | 1.860 | | | 2.044 | | 2,044 | | |
| ZR | 1.067 | 30/45 | 18 | | | | | 1.104 | | | | | | | | |

## 3. ROLLING STOCK
### 3-2. TRAILLING STOCK
### 3-2-1. PASSENGERS

(Number, Availability, Number of Seats at the end of financial year)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NAME OF RAILWAY | COACHES | | | | | | | | | | RAILCAR TRAILERS | | | | | | |
| | Number | | | | Number of Seats | | | | | | | Number of Seats | | | | | Availability % |
| | Ordinary coaches and vans | Sleeping cars | Dining cars | Total cols. 2, 3 & 4 | 1st Class | 2nd Class | Other Classes | Total cols. 6, 7 & 8 | Seats | Beds | NUMBER | 1st Class | 2nd Class | Other Classes | Seats | Beds | |
| | | | | | | | | NORTH AFRICA | | | | | | | | | |
| SNTF | | | | 475 (1) | | | | 31.894 (1) | | | | | | | | | |
| ER | 1,394 | 59 | 13 | 1,466 | 3,611 | 24,976 | 85.724 | 114,311 | 114,311 | 1,284 | 234 | 1,974 | 6,880 | 4,320 | 13.174 | | 70% |
| ONCF | 394 | 7 | | 401 | 3.042 | 10,823 | 4,558 | 18.423 | 18,353 | 70 | | | | | | | |
| SRC | 441 | 33 | 12 | 486 | 1.602 | 3,265 | 20,142 | 25,009 | 24.613 | 396 | 9 | | 96 | 750 | 846 | | 80% |
| SNCFT | 146 | 2 | 2 | 150 | 1.295 | 4,684 | | 5.979 | 5.979 | 92 | 58 | 1.028 | 5.130 | | 6.158 | | 88.4% |
| | | | | | | | | 195616 | | | | | | | | | |
| | | | | | | | | CENTRAL AFRICA | | | | | | | | | |
| ANGOLA | | | | | | | | | | | | | | | | | |
| RNCFC | 42 | 5 | 3 | 50 | 135 | 2,076 | | 2.211 | 2.211 | 104 | 57 | 140 | 3,768 | | 3.908 | | 85% |
| CFCO | 35 | 1 | 2 | 38 | 280 | 864 | 1,634 | 2.778 | 2,530 | 14 | 40 | 225 | 2.260 | | 2.215 | | 79% |
| OCTRA | 16 | | | 16 | | 800 | | 800 | 800 | | | | | | | | 100% |
| SNCZ | 129 | 68 | 22 | 219 | 1.128 | 1,624 | 7.994 | 10.746 | 8.906 | 1.840 | 15 | 910 | 92 | | 1.002 | | 40% |

## 3. ROLLING STOCK

### 3-2. TRAILLING STOCK

### 3-2-1. PASSENGERS

(Number, Availability, Number of Seats at the end of financial year)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NAME OF RAILWAY | COACHES | | | | | | | | | | RAILCAR TRAILERS | | | | | | |
| | Number | | | | Number of Seats | | | | | | Number of Seats | | | | | | Availability % |
| | Ordinary coaches and vans | Sleeping cars | Dining cars | Total cols. 2, 3 & 4 | 1st Class | 2nd Class | Other Classes | Total cols. 6, 7 & 8 | Seats | Beds | NUMBER | 1st Class | 2nd Class | Other Classes | Seats | Beds | |
| | | | | | | | | WEST AFRICA | | | | | | | | | |
| RAN | 129 | 12 | 6 | 147 | | 9,734 | | 9,968 | 9,968 | 234 | 27 | | 1,886 | | 1,886 | | 98.7% |
| OCBN | 11 | | | 11 | | 120 | | 120 | 120 | 18 | 18 | | 1,076 | | 1,078 | | 90% |
| GRH | | | | 182 | | | | | | | | | | | | | |
| ONCFG | | | | 20 | | | | | | | | | | | | | |
| LAMCO | | | | | | | | | | | | | | | | | |
| RCFM | 26 | 4 | 1 | 31 | 42 | 790 | | 888 | 888 | 64 | 16 | 204 | 932 | | 1,136 | | 73.7% |
| SNIM | 8 | | | 8 | 12 | 168 | | 180 | | | | | | | | | |
| NRC | 467 | 286 | 52 | 805 | 1,088 | 1,602 | 30,090 | 32,780 | 29,776 | 3,316 | | | | | | | |
| RCFS | 110 (1) | 4 | 2 | 116 | 210 | 2,956 | 52 | 3,218 | 3,166 | 60 | 28 | 48 | 1,598 | 109 | | | |
| CFT | 34 | | | 63 | | | | | | | 11 | | | | | | |

## 3. ROLLING STOCK

### 3-2. TRAILLING STOCK

### 3-2-1. PASSENGERS



(Number, Availability, Number of Seats at the end of financial year)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | COACHES | | | | | | | | | | RAILCAR TRAILERS | | | | | | |
| NAME OF RAILWAY | Number | | | | Number of Seats | | | | | | Number | Number of Seats | | | | | Availability % |
| | Ordinary coaches and vans | Sleeping cars | Dining cars | Total cols. 2, 3 & 4 | 1st Class | 2nd Class | Other Classes | Total cols. 6, 7 & 8 | Seats | Beds | | 1st Class | 2nd Class | Other Classes | Seats | Beds | |
| CFE | | | | | | | EAST AFRICA | | | | | | | | | | |
| KR | 97 | 67 | 17 | 181 | 627 | 1.422 | 8.084 | 10.133 | 10.133 | 1.835 | | | | | | | |
| RNCFM | 29 | | | 29 | 381 | 2.466 | | 2.847 | 2.027 | | 42 | 531 | 4.020 | | 3.068 | | 95.6 % |
| MR | 30 | 2 | 1 | 33 | | 88 | 2.788 | 2.876 | 2.876 | | | | | | | | 94.1 % |
| CFM | 187 | | | | 663 | 2.414 | 13.028 | 16.105 | | | | | | | | | 80 % |
| SR | | | | | | | | | | | | | | | | | |
| TAZARA | 44 | 46 | 10 | 100 | 364 | 1.584 | 3.264 | 5.212 | 3.264 | 1.948 | | | | | | | 75 % |
| ZR | 132 | 6 | 12 | 150 | 1.040 | 3.240 | 640 | 4.920 | 5.046 | 132 | 6 | | | 360 | | | |

## 3. ROLLING STOCK

### 3-2. TRAILING STOCK

### 3-2-2. GOODS

(Number. Net Weight. Availabiiity at the end of financial year)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of Railway | Covered Wagons | | Flat Wagons | | High-sided Open Wagons | | Other Wagons | | Privately-owned Wagons | | Total Number cols. 2, 4, 6, 8 & 10 | Total Net Weight (T) cols. 3, 5, 7, 9 & 11 | Availa-biiity % |
| | Number | Net Weight (T) | Number | Net Weight (T) | Number | Net Weight (T) | Number | Net Weight (T) | Number | Net Weight (T) | | | |
| | | | | | | NORTH AFRICA | | | | | | | |
| SNTF | | | | | | | | | | | 11.049 | 314,139 | |
| ER | 6.948 | 76,870 | 500 | 35.990 | 6.359 | 180.781 | 2.313 | 62.205 | | | 16.620 | 355.846 | 85% |
| ONCF | 2.337 | 55.384 | 2,099 | 51.533 | 2.087 | 46.182 | 2.897 | 122.491 | 554 | 18.066 | 9.974 | 293.656 | |
| [illegible]C | 3.523 | 105.562 | 218 | 6.658 | 979 | 28.739 | 1.283 | 34.850 | 658 | | 6.661 | 175.809 | 92% |
| [illegible]FT | 944 | 13,142 | 1,035 | 20.235 | 643 | 8.710 | 2,746 (1) | 61.875 | 103 | 2.680 | 5.471 | 106.642 | 93.47% |
| | | | | | | CENTRAL AFRICA | | | | | 49775 | | |
| ANGOLA | | | | | | | | | | | | | |
| RNCFC | 542 | 16.400 | 551 | 24.750 | 95 | 3.220 | 183 | 5.630 | 130 | 4.480 | 1.501 | 54.480 | 90% |
| CFCO | 612 (2) | 24.523 | 664 | 32.590 | 219 | 8.250 | 239 | 6.732 | 159 | 7.063 | 1.893 | 79.158 | 85.2% |
| OCTRA | 12 | 660 | 300 | 20.4000 | 1 | 50 | 8 | 485 | | | 321 | 21.595 | 100% |
| SNCZ | 2.144 | 74.219 | 1,893 | 70.834 | 530 | 18.884 | 1.032 | 34.455 | 284 | 9.656 | 5.883 | 208.048 | 56% |

9598

## 3 ROLLING STOCK

### 3-2. TRAILING STOCK

### 3-2-2. GOODS

(Number. Net Weight. Availability at the end of financial year)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of Railway | Covered Wagons | | Flat Wagons | | High-sided Open Wagons | | Other Wagons | | Privately-owned Wagons | | Total Number cols. 2, 4, 6, 8 & 10 | Total Net Weight (T) cols. 3, 5, 7, 9 & 11 | Availability % |
| | Number | Net Weight (T) | Number | Net Weight (T) | Number | Net Weight (T) | Number | Net Weight (T) | Number | Net Weight (T) | | | |
| | | | | | | WEST AFRICA | | | | | | | |
| RAN | 661 | 19,740 | 170 | 4,187 | 211 | 6,195 | 51 | 1,144 | 107 | 3,520 | 1,200 | 34,786 | |
| OCBN | 210 | 6,046 | 91 | 2,428 | 15 | 715 | 27 | 575 | 13 | 210 | 356 | 9,974 | 94.7% |
| GRH | | | | | | | | | | | | | |
| ONCFG | | | | | | | | | | | | | |
| LAMCO | | | | | | | | | | | | | |
| RCFM | 262 | 8,299 | 25 | 925 | 49 | 1,715 | 34 | | 10 | | 380 | | 89% |
| SNIM | | | 82 | 5,248 | | | 1,070 (1) | 85,154 | | | 1,152 | 90,402 | 85% |
| NRC | 3,606 | 99,912 | 45 | 1,170 | 372 | 9,435 | 2,625 | 69,709 | 590 | 17,182 | 7,257 | 196,925 | |
| RCFS | 479 | 13,470 | 58 | 1,334 | 149 | 3,675 | 39 | 330 | 180 | 6,287 | 905 | 25,096 | |
| CFT | 199 | 2,738 | 94 | 2,942 | | | | | | | | | |

## 3. ROLLING STOCK

### 3-2. TRAILING STOCK

### 3-2-2. GOODS

umber, Net Weight, Availability at the end of financial year)

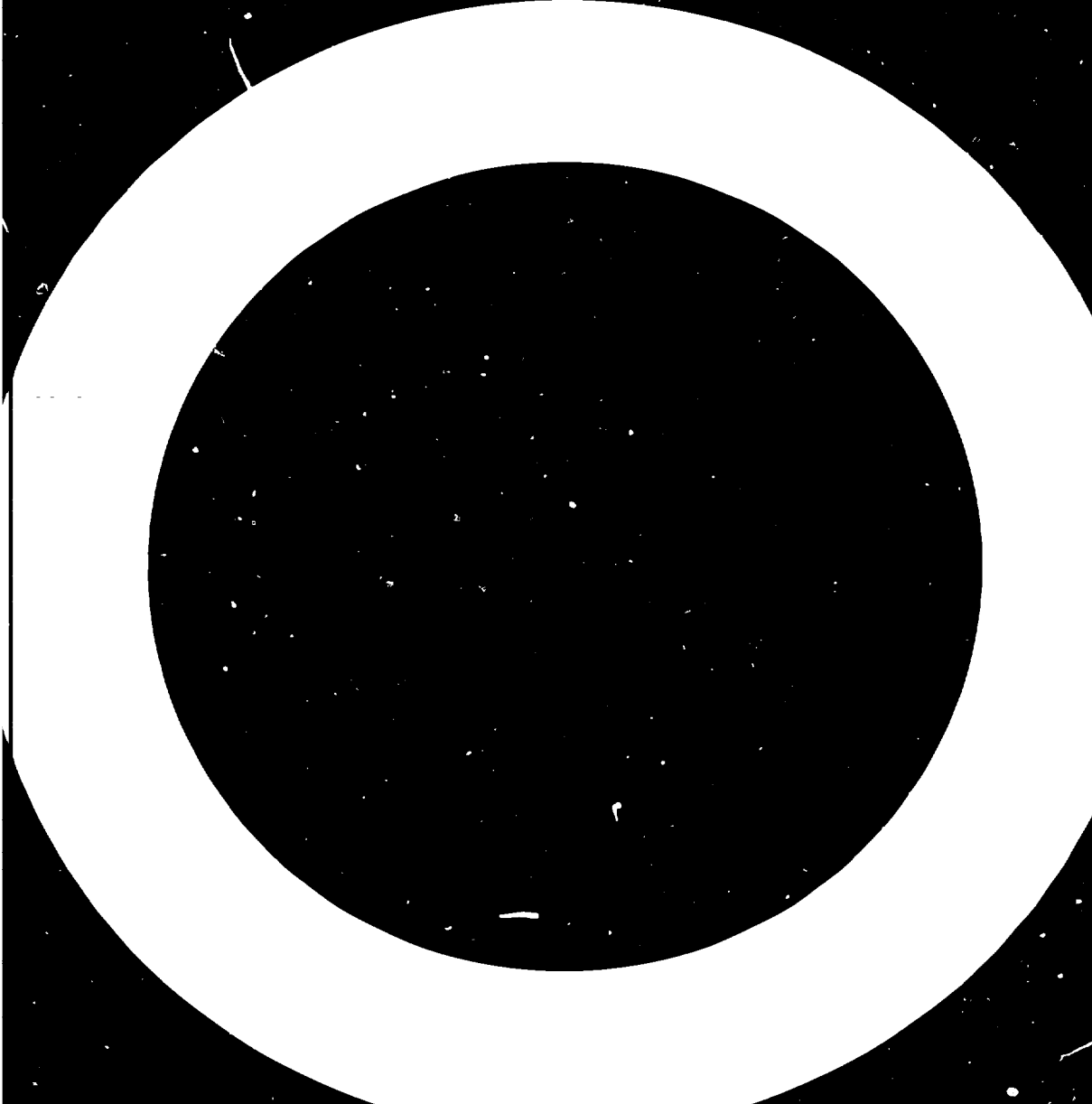
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NAME OF RAILWAY | Covered Wagons | | Flat Wagons | | High-sided Open Wagons | | Other Wagons | | Privately-owned Wagons | | Total Number cols. 2, 4, 6, 8 & 10 | Total Net Weight (T) cols. 3, 5, 7, 9 & 11 | Availability % |
| | Number | Net Weight (T) | Number | Net Weight (T) | Number | Net Weight (T) | Number | Net Weight (T) | Number | Net Weight (T) | | | |
| | | | | | | EAST | AFRICA | | | | | | |
| CFE | | | | | | | | | | | | | |
| KR | 3,246 | | 928 | | 825 | | 1.634 | | | | 6,633 | | |
| RNCFM | 545 | 14,475 | 257 | 6,736 | 92 | 2,760 | 75 | 2.526 | 78 | 2.360 | 1.047 | 28,857 | 97.3% |
| MR | 346 | 11.387 | 22 | 573 | 141 | 6.107 | 247 | 8.362 | | | 756 | 26,429 | 95.4% |
| CFM | 1.468 | 50.254 | 312 | 10.435 | 5.335 | 214.200 | 542 | 16.329 | | | 7.657 | 291.218 | 86% |
| SR | 23 | 460 | | | 535 | 9.095 | 209 | 3.971 | 20 | 400 | 787 | 13,926 | 95% |
| TAZARA | 523 | 15.690 | 892 | 44.600 | 400 | 20.000 | 285 | 5.161 | | | 2.100 | 85.601 | 97.5% |
| ZR | 311 | 9.952 | 30 | 1.200 | 4.429 | 193.721 | | 1.207 | 40 | | 4.810 | 206.080 | |

## 3. ROLLING STOCK

### 3—3. CONTAINERS

(Types, Sizes, Number and Traffic)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| Name of Railway | Types | SIZES | | | NUMBER | | TRAFFIC (in thousands) | | | |
| | | | | | | | National | | International | |
| | | Length (mm) | Width (mm) | Height (mm) | Owned by the Railway | Privately owned | Tonnage | T.K. | Tonnage | T.K. |
| | | | | | NORTH AFRICA | | | | | |
| SNTF .. .. | | | | | | | | | | |
| ER .. .. | | | | | | | | | | |
| ONCF .. .. | SCIFCT SNCF | 2.170 | 1.500 | 1.635 | 190 | | | | | |
| | Bloc tube | 2,310 | 2.200 | 1.900 | 57 | | | | | |
| SRC .. .. | | | | | | | | | | |
| SNCFT .. | 42 | 3.032 | 2.032 | 2.000 | 129 | | | | | |
| | C | 1,900 | 1,100 | 1,425 | 37 | | | | | |
| | SPB | 2,098 | 1.000 | 1,500 | 20 | | | | | |
| | SP | 2,006 | 1,604 | 1,450 | 35 | | | | | |
| | ISO | 5,695 | 2.078 | 2,078 | 53 | | | | | |
| | | | | | CENTRAL AFRICA | | | | | |
| ANGOLA .. | | | | | | | | | | |
| RNCFC .. | (1) | ISO | | | | | | | | |
| CFCO .. .. | | | | | | | | | | |
| OCTRA .. | | | | | | | | | | |
| SNCZ .. .. | | | | | | | | | | |



| | Algeria | Angola | Botswana | Burundi | Central African Rep. | Cameroon | Congo | Cape Verde Isl. | Egypt | Ethiopia | Gabon | Ghana | Guinea | Kenya |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alumina | | | | | | | | | | | | | 708,000 | |
| Aluminium (thousand tons) | | | | | | 43 | | | 120 | | | 188 | | |
| Antimony (tons) | - | | | | | | | | | | | | | |
| Arsenic (White) | | | | | | | | | | | | | | |
| Asbestos | | | | | | | | | 230 | | | | | 6,647 |
| Barium (tons) | 91,000 | | | | | | | | 3,000 | | | 225 | 11,759 | |
| Bauxite | | | | | | | | | | | | | | |
| Bentonite and Fuller's Earth (tons) | 41,000 | | | | | | | | 5,200 | | | | | |
| Cadmium | 150 | | | | | | | | | | | | | |
| Cadmium Ores and Concentrates (tons) | | | | | | | | | | | | | | |
| Coal (tons) | | | 371,395 | | | | | | | | | | | |
| Cobalt (metal content - tons) | | | 226 | | | | | | | | | | | |
| Copper (Mine Prod.) | 200 | | 15,554 | | | - | | | | | | | | |
| Copper (Smelter Prod.) | | | | | | | | | | | | | | |
| Diamonds | | 1,500,000 | 3,146,000 | | 279,000 | | | | | | | 1,200,000 | 84,000 | |
| Diatomite | 3,600 | | | | | | | | 100 | | | | | 1,677 |
| Feldspar | | | | | | | | | 3,600 | | | | | 367 |
| Fluorspar | | | | | | | | | 680 | | | | | 93,378 |
| Gold (Kilogram) | | ... | | 4 | | 5 | 220 | | | 280 | 28 | 10,937 | | 4 |
| Graphite | 200,000 | 25,000 | | | | | | | 690,368 | | | | | - |
| Gypsum | | | | | | | | | | | | | | |
| Iron Ore | 3,500 | ... | | | | | | | 1,870 | | | | | |
| Pig-Iron | 580 | | | | | | | | | | | | | |
| Steel Ingots and Castings | 500 | | | | | | | | 760 | | | | | |
| Ferro Alloys | | | | | | | | | ... | | | | | |
| Kaolin | 18,100 | | | 2,750 | | | | | 49,000 | 30,000 | | | | 1,487 |
| Lead | 2,400 | | | | | | 7,000 | | | | | | | |
| Refind Lead | | | | | | | | | | | | | | |
| Lithium | | | | | | | | | | | | | | |
| Magnesite | | | | | | | | | | | | | | |
| Manganese Ore | | | | | | | | | - | | 2,147,000 | 252,450 | | |
| Mercury | 1,035,000 | | | | | | | | | | | | | |
| Mica | | | | | | | | | | | | | | |
| Nickel | | | 15,442 | | | | | | | | | | | |
| Petroleum | 51,560 | 7,610 | | | | 2,790 | 3,130 | | 31,200 | | 8,880 | | | |
| Natural Gas | 14,640 | ... | | | | | | | | | ... | | | - |
| Phosphate Rock | 1,025,400 | | | | | | | | 658,000 | | | | | |
| Platinum (Group Metals, Kilograms) | | | | | | | | | | 4 | | | | |
| Potash | | | | | | | - | | | | | | | |
| Rare Earths | | | | ... | | | | | | | | | | |
| Salt | 172,000 | 50,000 | | | | | | ... | 699,000 | 106,000 | | 50,000 | | 47,016 |
| Sillimanite | | | | | | | | | | | | | | |
| Silver | 2,500 | | | | | | | | | | | | | |
| Sulphur Pyrites | | | | | | | | | 3 | | | | | |
| Talc | | | | | | | | | 4,400 | | | | | |
| Tantalum (Columbium) | | | | | | | | | | | | | | |
| Tin (Min. Prod.) | | | | | | 24 | | | | | | | | |
| Tin (Smelter Prod.) | | | | | | | | | | | | | | |

Source: World Mineral Statistics, 1976-1980, Production/Exports/Imports (Institute of Geological Sciences, Natural Environment Research Council, London, Her Majesty's Stationery Office, 1982).

ANNEX 2 page -1-

Table 2 Mineral Resources of Africa/Production, 1980, tonnes

| Ghana | Guinea | Kenya | Ivory Coast | Lesotho | Liberia | Libya | Madagascar | Mali | Mauritania | Mauritius | Morocco | Mozambique | Namibia | Niger | Nigeria | Rwanda |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 188 | 708,000 | | | | | | | | | | 549 | | 2,000 | | | |
| | | | | | | | | | | | | 800 | | | | |
| | | 6,647 | | | | | | | | | 318,000 | | | | | |
| 225 | 11,759 | | | | | | | | | | 18,100 | 1,500 | | | | |
| | | | | | | | | | | | | | 70 | | | |
| | | | | | | | 146,529 | | | | | | | | | |
| | | | | | | | | | | | 680,000 | 408,000 | | | 612,802 | |
| | | | | | | | | | | | 1,000 | | | | | |
| | | | | | | | | | - | | 8,400 | - | 39,200 | | | |
| | | | | | | | | | | | | | 40,000 | | | |
| | | | | | | | | | | | | | 1,560,000 | | | |
| 200,000 | 84,000 | | 40,000 | 53,714 | 300,000 | | | | | | | | | | | |
| | | 1,677 | | | | | | | | | | | | | 5,000 | |
| | | 387 | | | | | | | | | | - | | | | |
| | | 93,378 | | | | | | | | | | | | | | 25 |
| 10,937 | | 4 | | | 140 | | 4 | 45 | - | | 64,400 | | | | | |
| | | | | | | | 9,906 | | | | | | | 1,800 | | |
| | | - | | | | ... | | | -14,000 | | | | | | | |
| | | | | | 17,481 | | | | 8,900 | | 78 | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | 1,487 | | | | | 2,720 | | | | 115,500 | | | | ... | |
| | | | | | | | | | | | 40,300 | | 47,700 | | 100 | |
| | | | | | | | | | | | | | 42,700 | | | |
| | | | | | | | | | | | | - | 3,000 | | | ... |
| 2,450 | | | | | | | | | | | 132,200 | | | | | |
| | | | | | | | 1,642 | | | | | 200 | | | | |
| | | | | | | | | | | | 500 | | | | 100,286 | |
| | | | | | | 86,020 | | | | | 14 | | | | 1,343 | |
| | | | | | | ... | | | | | 80 | | | | | 1,37 |
| | | - | | | | | | | | | 18,824,200 | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | 20 | |
| 3,000 | | 47,016 | | | | 10,000 | 30,000 | 5,000 | | 6,000 | 104,000 | 28,000 | | | 227,000 | 14 |
| | | | | | | | | | | | | | | | 47,000 | |
| | | | | | | | | | | | 10,000 | | | | | |
| | | | | | | | | | | | 60 | | | | | |
| | | | | | | | | | | | | | | | 550 | 60 |
| | | | | | | | | | | | | - | 1,000 | 96 | 2,527 | 1,600 |
| | | | | | | | | | | | | | | | 2,684 | |

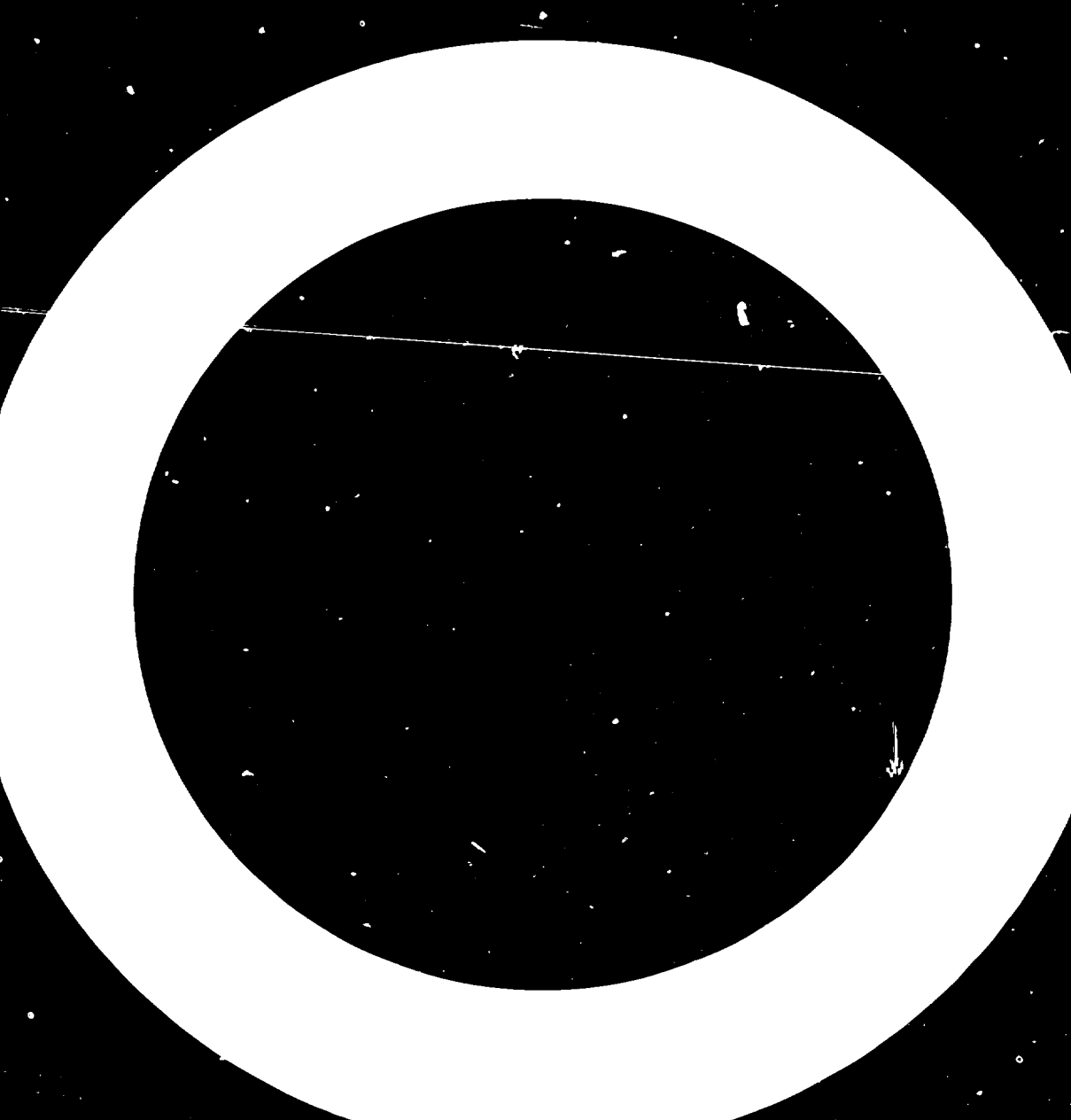
vironment

# SECTION 2

...onnes

| ...e | Morocco | Mozambique | Namibia | Niger | Nigeria | Rwanda | Senegal | Sierra Leone | South Africa | Sudan | Swaziland | Tanzania | Togo | Tunisia | Uganda | Zaire | Zambia | Zimbabwe |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 87 | | | | | | | | | |
| | | | | | | | | | 13,013 | | | | | | | | | 150 |
| | 549 | | 2,000 | | | | | | | | | | | | | | | 79 |
| | | | | | | | | | 276,734 | | 32,833 | | | | | | | 250,949 |
| | | 800 | | | | | | | 2,635 | | - | | | 26,950 | | | | 195 |
| | 318,000 | | | | | | | 674 | | | | | | | | | | |
| | | ... | | | | | | | | | | | | | | | | |
| | 18,100 | 1,500 | | | | | 3,978 | | 52,535 | | | | | | | | | |
| | | | 70 | | | | | | | | | | | | | 168 | - | |
| | | | | | | | | | 3,414,410 | 25,000 | | | | | | | . | 552,475 |
| | | | | | 612,802 | | | | 115,119,974 | | 175,989 | 4,250 | | | 138,000 | 568,799 | | 3,133,036 |
| | 680,000 | 408,000 | | | | | | | | | | | | | 14,700 | 3,310 | | |
| | 1,000 | | 39,200 | | | | | | 200,683 | | | | | | - 439,700 | 609,935 | | 24,901 |
| | 8,400 | - | 40,000 | | | | | | 185,800 | | | | | | - 425,700 | 661,348 | | 26,700 |
| | | | 1,560,600 | | | | | 592,018 | 6,521,682 | | | 269,876 | | | 10,235,000 | | | |
| | | | | | | | | | 584 | | | | | | | | | |
| | | | | | 5,000 | | | | 52,247 | | | | | | | | 475 | 1,263 |
| | | - | | | | | | | 522,718 | | | | | 30,451 | | | | - |
| | 64,400 | | | | | 15 | | | 672,786 | | | | | | | 1,243 | 257 | 11,443 |
| | | | | | | | | | - | | | | | | | | | 7,385 |
| | | | | 1,800 | | | | | 452,490 | 10,000 | | 8,119 | | 214,910 | | | - | |
| | | | | | | | | | 26,312 | | - | | | 389 | | | | 1,622 |
| | 78 | | | | | | | | 7,200 | | | | | 140 | | | | 93 |
| | | | | | | | | | 9,000 | | | | | 182 | | | | 800 |
| | | | | | | | | | 1,577,950 | | | | | | | | | 221,910 |
| | | | | | | | | | 137,854 | | - | 7,434 | | | | | | 4,450 |
| | 115,500 | | 47,700 | | ... | | | | 56,059 | | | | | 8,310 | | 14,131 | | |
| | 40,300 | | 42,700 | | 100 | | | | | | | | | 19,195 | | 10,047 | | |
| | | | 3,000 | | | ... | | | | | | | | | | | | 21,030 |
| | | - | | | | | | | 59,975 | | | | | | | | | 78,217 |
| | | | | | | | | | 5,695,426 | | | | | | 16,586 | | | |
| | 132,200 | | | | | | | | | | | | | | | | | |
| | | | | | | | | | 2,528 | 1,500 | | 3 | | | | | | 1,022 |
| | | 200 | | | | | | | 25,700 | | | | | | | | | 15,075 |
| | 500 | | | | 100,286 | | | | | | | | | 5,600 | 1,000 | | | |
| | 14 | | | | 1,343 | | | | | | | | | 355 | | | | |
| | 80 | | | | | | 1,372,603 | | 3,185,000 | | | 2,930,000 | | 4,501,907 | - | | | 130,337 |
| | 1,824,200 | | | | | | | | 192,800 | | | | | | | | | |
| | | | | | 20 | | | | | | | | | | | 51 | | |
| | 104,000 | 28,000 | | | 227,000 | | 140,000 | | 567,000 | 82,000 | | 34,734 | | 436,516 | | | | |
| | | | | | | | | | 121,317 | | | | | | | | | |
| | | | | | 47,000 | | | | 97,213 | | | | | 7,332 | | 85,003 | 23,752 | 29,681 |
| | 10,000 | | | | | | | | 307 | | | | | | | 30 | 101 | 29 |
| | 60 | | | | | | | | 14,366 | | | | | | | | | 456 |
| | | | | | 550 | 60 | | | | | | | | | | 40 | | 41 |
| | | - | 1,000 | 96 | 2,577 | 1,600 | | | 2,913 | | | | | | | 3,159 | | 934 |
| | | | | | 2,684 | | | | 1,100 | | | | | | | 300 | | 918 |

# SECTION 3



IRON AND STEEL INDUSTRY IN AFRICA 4/

| No. | Countries 1/ | Population (years) (Rounded off figures) 1972/73 (IBRD) x 1000 | 1985 (UN) | 2000 (MIS) | Critical Raw Materials 3/ Iron Ores: Reserves million tons | Percentage (Averages) Fe | $SiO_2$ | $Al_2O_3$ | Mn | P | S | Others | Remarks | Coal 2/ Reserves million tons | Quality | Oil million m³ | Gas billion m³ | Per capita steel consumption per year 1973 kg/ | 2000 kg/ | Ingot Steel Product x 1000 tons 1973 kg/per capita |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Nigeria | 70,000 | 85,000 | 105,000 | 266 60 | 45 32 | | | | | | | | 350 | non bituminous | 2,400 | 1,135 | 1.4 | 28 | (0.02 p.c.) |
| 2. | A.R. Egypt | 35,000 | 53,500 | 75,000 | 433 | 46 50-59 | 14 2 - 9 | | 2-4 | .6 1-9 | | | | | | 100 | | 28 | 200 | 340 (7 kg p.c.) |
| 3. | Ethiopia | 26,000 | 35,800 | 50,000 | | 43 | 25 | | | 0.4 | | | | | | | | | | |
| 4. | Zaire | 20,000 | 25,800 | 34,000 | 29 5050 | 30/40 30 to | 13/33 9 | | | .1 | | | | 73 | non bituminous | 80 | | | | |
| 5. | Sudan | 17,000 | 26,100 | 40,000 | 61 | 38 37- 61 | | | | | | | | | non bituminous | | | | | |
| 6. | Morocco | 16,000 | 26,800 | 41,000 | 149 | 23 -66 | 7- 10 | 1-6 | .2+ 2.3 | .01 to -1.5 | 0.03 | 14.6 CaC | 2.2 CaO | 58 28 | bituminous anthracite | 180 | 40 | 2. | 150 | (9.3 p.c.) |
| 7. | Algeria | 14,000 | 24,000 | 38,000 | 1,580 | 40-56 49-54 | 3.8 4.9 | - 4.3 | 2 - | 1.2 0.8 | 0.05 - | 3.4CaO+2.1MgO .3MgO +.3Ti | | 20 | non bituminous | 7,550 | 1,260 | 70 | 440 | 336 (25 kg p.c.) |
| 8. | Tanzania | 14,000 | 20,000 | 29,000 | 121 | 50. 30. | | | upto 11 | | | $TiO_2$ -13 | | | | | | | | |
| 9. | Kenya | 12,000 | 18,000 | 26,500 | 27 | 60 | 5 | - | - | 0.2 | | | | | | | | 10 | 25 | 25 (1 kg p.c.) |
| 10. | Uganda | 10,500 | 13,100 | 18,000 | 98 | 60 -67 | 1.1 | 0.05 -2.6 | | | | $TiO_2$ 10-20 | | | | | | 15 | 100 | 15 (1 kg p.c.) |
| 11. | Ghana | 9,000 | 15,000 | 24,000 | 405 | 46 -51 | 3 | | | 1.0 | | | | | | | | 1 | 25 | |
| 12. | Mozambique | 8,000 | 10.900 | 14.000 | 261 | 52 to 67 | 1 to 24 | | | .05 | .02 | | | 700 | non bituminous | | | | | |
| 13. | Malagasy Rep. | 7,400 | 10.800 | 16,000 | 251 | 25 to46 | 1 | | | .15 | .3 | | | | | | | | | |
| 14. | Cameroon | 6,000 | 8,000 | 11,000 | 120 | 38 | | | | .08 | .2 | | | | | | | | | |
| 15. | Angola | 5,600 | 8,100 | 12,000 | 1100 | 62 | 3-8 | | | .05 | .03 -1.0 | | | | | 194 (inclusive | 28.1 Cabinda) | | | |
| 16. | Upper Volta | 5,600 | 7,700 | 10.500 | 50 | 58 | 2.2 | 1.5 | .2 | .06 | | V-0.33 | | | | | | | | |
| 17. | Ivory Coast | 5,400 | 6,500 | 8,000 | 2,400 | 30 -46 | 39 | | | .06 | .01 | | | | | | | | | |
| 18. | Tunisia | 5,300 | 8,500 | 13,000 | 75 | 54 58 | 4 4 | .5 3.7 | 2 2 | .03 .1 | - - | 0.5 CaO 0.3 CaO | | 20 | Lignite | 150 | 25.4 | 50 | 400 | (16 kg p.c.) |
| 19. | Mali | 5,300 | 7,600 | 11,000 | 69 | 64 | | | | | | | | | | | | | | |
| 20. | Guinea (Z) | 5,100 | 7,000 | 10,000 | 1544 | 52 -64 | 3 -24 | | | .06 | .1 | | | | | | | | | |
| 21. | Malawi | 4,700 | 6,800 | 10,000 | | | | | | | | | | | | | | | | |
| 22. | Zambia | 4,500 | 7,000 | 10,000 | 346 | 40 -62 | 6 -20 | | 1.9 | | | | | 115 | non bituminous | | | | | |
| 23. | Niger | 4,300 | 6,200 | 9,500 | 680 | | | | | | | | | | | | | | | |
| 24. | Senegal | 4,000 | 6,500 | 10,000 | 100 | 58 | 5 | | | .03 | .08 | | | | | | | | | |
| 25. | Rwanda | 4,000 | 5,700 | 9,800 | | | | | | | | | | | | | | | | |
| 26. | Chad | 3,800 | 5,500 | 9,000 | | | | | | | | | | | | | | | | |
| 27. | Burundi | 3,500 | 5,300 | 8,300 | | | | | | | | | | | | | | | | |
| 28. | Somalia | 3,000 | 4,300 | 6,500 | 170 | 30 -35 | | | | | | | | | | | | | | |
| 29. | Dahomey | 2,800 | 4,100 | 5,500 | 290 | 50 -58 | 3 -16 | | | .8 | .04 | | | | | 8.2 | 21.3 | | | |
| 30. | Sierra Leone | 2,700 | 3,800 | 5,800 | 200 | 60 | 6 -13 | | | .01 -.03 | .005 | | | | | | | | | |
| 31. | Libya | 2,000 | 3,100 | 5,000 | 3,525 | 50 | 6 -11 | 4.9 | - | 1.0 | | | | | | 4,864 | 781 | 138 | 800 | |
| 32. | Togo | 2,000 | 2,800 | 4,300 | 642 | 35 -40 | 20 | 16 | | .23 | .05 | | | | | | | | | |
| 33. | Central African Rep. | 1,700 | 2,100 | 3,000 | - | - | - | - | - | - | - | | | | | | | | | |
| 34. | Liberia | 1,600 | 1,800 | 2,200 | 713 | 65,8 | 4.2 | 1.2 | 0.12 | .03 | .001 | | | | | | | 30 | 500 | |
| 35. | Mauritania | 1,200 | 1,700 | 2,500 | 465 | 65 | 4-3 | 1.2 | 0.12 | .03 | .01 | | | | | | | | | |
| 36. | Congo (Braz.) | 1,200 | 1,350 | 1,600 | 100 | 43 | 20 | | | | | | | | | 400 | | | | |
| 37. | Spanish Sahara | - | 56 | 65 | 150 | 54 | | | | | Ti-14 | | | | | | | | | |
| 38. | Gabon | 500 | 600 | 800 | 1,216 | 65 | 1.7 | 2 | | 0.15 | CaO -0.2 | | | 4,022 | non-bituminous | 175 | 198 | 66 | 500 | |
| 39. | Swaziland | 450 | 680 | 990 | 280 | 61 | 4.2 | | 6.9 to 0.4 | | | | | | | | | 1 | 200 | |
| 40. | Gambia | 380 | 514 | 750 | | | | | | | | | | | | | | | | |
| | Others | 2,200 | 3,500 | 5,000 | 600 | | | | | | | | | | | | | | | |
| | TOTALS | 347,730 | 491,40 | 707,10 | | | | | | | | | | | | | | | | 882 2.5kg p.c. |

1/ Excluding South Africa and Rhodesia

2/ There are no coking coal reserves in these African countries (excluding South Africa and Rhodesia) - Resources of anthracite to sub-bituminous coals are 7,000 m/tons

3/ Total reserves of iron ores in Africa (30-67% Fe) proved = 6,800 m tons/Potential unproved reserves iron ores = 24,500 m/tons; total = 31,300 m/tons

4/ All Metric Tons

SECTION 1

## ...E AFRICAN COUNTRIES

| Ingot Steel Production x million tons | | | Raw Materials | | | | | | Present Status of Industrialisation | | | | Prospective Iron and Steel Industry | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Years | | per year | Poor (P) | Fair (F) | | Good (G) | Excellent (E) | | Poor (P) | Fair (F) | Good (G) | Excellent (E) | Poor (P) | Fair (F) | Fa... |
| 1980 | 1985 | 2000 | Iron Ores | Coal Coking | Coal Non-Coking | Charcoal | Oil | Gas | | | | | | | |
| 0.5 | 1.5 | 5. | P | P | P | - | G | G | P | | | | | | |
| 3. | 8. | 15-5 | P | P | P | - | P | P | - | P | | | | | |
| | 0.5 | 2. | P | P | P | P | P | P | P | | | | P | | |
| 0.5 | 1. | 3. | P | P | P | P | P | P | P | | | | | P | |
| | 1. | 3. | P | P | P | P | P | P | P | | | | | P | |
| | 1.5 | 6. | G | P | P | - | P | P | P | | | | | | |
| 5. | 6. | 15. | P | P | P | - | G | G | - | P | | | | | |
| | | 1. | P | - | - | - | - | - | P | | | | | P | |
| 0.3 | 0.5 | 2. | P | - | - | - | - | - | P | | | | | P | |
| 0.5 | 1. | 2.0 | P | - | - | P | - | - | P | | | | P | | |
| 0.1 | 0.2 | 1. | P | - | - | P | - | - | P | | | | P | | |
| | | | P | - | P | - | - | - | P | | | | P | | |
| | | 1. | P | - | - | - | - | - | P | | | | P | | |
| | | 0.5 | P | - | - | - | - | - | P | | | | P | | |
| | | 1.5 | P | - | - | - | P | P | P | | | | | | |
| | | 0.2 | P | - | - | - | - | - | P | | | | P | | |
| | 0.4 | 1.0 | P | | | | | | P | | | | | | |
| 0.3 | 1.5 | 4. | P | - | - | - | | | P | | | | P | | |
| 0.3 | 0.6 | 1. | P | - | - | - | | | P | | | | P | | |
| | | 2. | P | - | - | - | | | P | | | | P | | |
| | | | - | - | - | - | | | P | | | | P | | |
| | | 1. | P | - | P | P | | | P | | | | P | | |
| | | | P | - | - | - | | | P | | | | P | | |
| | | 1. | P | - | - | - | | | P | | | | | P | |
| | | | - | - | - | - | | | P | | | | P | | |
| | | | - | - | - | - | | | P | | | | P | | |
| | | | - | - | - | - | | | P | | | | | P | |
| | | | P | - | - | - | | | P | | | | P | | |
| | | | P | - | - | - | ? | P | P | | | | P | | |
| | | | P | - | - | - | - | - | P | | | | P | | |
| - | 2.0 | 5. | ? | - | - | - | E | ? | P | | | | | | |
| | | | P | - | - | - | | | P | | | | P | | |
| | | | P | - | - | - | | | P | | | | P | | |
| | 0.5 | 2. | G | - | - | - | | | P | | | | | P | |
| | 1. | 2. | G | - | - | - | | | P | | | | | | |
| | | | P | - | - | - | P | | P | | | | P | | |
| | | | - | - | - | - | | | P | | | | P | | |
| | 0.5 | 1.5 | ? | | ? | - | | | P | | | | | P | |
| | .3 | .45 | P | | | | | | P | | | | P | | |
| | | | - | | | | | | P | | | | P | | |
| | | | | | | | | | | | | | | | |
| 77 = 72 kg p.c. | 89.0= 57 kg p.c. | 79.85 = 80= 115 kg p.c. | | | | | | | | | | | | | |

# SECTION 2

| | Present Status of Industrialisation | | | | Prospective Iron and Steel Industry in the Year 2000 | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | Poor (P) | Fair (F) | Good (G) | Excellent (E) | Poor (P) | Fair (F) | Good (G) | Excellent (E) | General Analyses based on resources (men and materials) for the Iron and Steel Industry: A to G represents the status of the Steel Industry of African Countries |
| | P | | | | | | G | | (G) Iron and steel industry will be expanded to make Nigeria a leading steel production in Africa. |
| | | F | | | | | G | | (E) Iron and steel industry is being expanded and SAR will be a leading steel producer in Africa |
| | P | | | | P | | | | Needs a small iron and steel industry |
| | P | | | | | F | | | " " " " " " |
| | P | | | | | F | | | Iron and steel industry needs top priority |
| | P | | | | | | G | | (F) Morocco should have a medium sized steel industry in Africa. |
| | - | F | | | | | G | | (B) Iron and steel industry's expansion is being given a top priority and Algeria will lead the African countries in steel production. |
| | P | | | | | F | | | |
| | P | | | | | F | | | |
| | P | | | | P | | | | |
| | P | | | | P | | | | |
| | P | | | | P | | | | |
| | P | | | | P | | | | |
| | P | | | | P | | | | |
| P | P | | | | P | | G | | |
| | P | | | | P | | | | |
| | P | | | | | | G | | |
| | P | | | | P | | | | (E) Tunisia will have a medium size steel industry in Africa |
| | P | | | | P | | | | |
| | P | | | | P | | | | |
| | P | | | | P | | | | |
| | P | | | | P | | | | |
| | P | | | | P | | | | |
| | P | | | | | F | | | |
| | P | | | | P | | | | |
| | P | | | | | F | | | |
| | P | | | | P | | | | |
| | P | | | | P | | | | |
| | P | | | | P | | | | |
| | P | | | | | | G | | (D) Iron and steel industry needs top priority. Libya will be a leading steel producer in Africa. |
| | P | | | | P | | | | |
| | P | | | | P | | | | |
| | P | | | | | F | | | (T) Liberia will have a medium size steel industry amongst the African countries. |
| | P | | | | | | G | | |
| | P | | | | P | | | | |
| | P | | | | P | | | | |
| | P | | | | | F | | | |
| | P | | | | P | | | | |
| | - | | | | P | | | | |

SECTION 3