OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Distr.
LIMITED
PPD.77
28 April 1988
Original: ENGLISH

THE IRON AND STEEL INDUSTRY OF WEST, NORTH AND CENTRAL AFRICA

Sectoral Studies Series
No.41

SECTORAL STUDIES BRANCH
INDUSTRIAL POLICY AND PERSPECTIVES DIVISION

V.88-24348

Main results of the study work on industrial sectors are presented in the Sectoral Studies Series. In addition a series of Sectoral Working Papers is issued.

This document presents major results of work under the element Iron and Steel Industries in UNIDO's programme of Industrial Studies 1986/87.

Preface

The present study has been prepared by the Sectoral Studies Branch, Industrial Policy and Perspectives Division, with the aim of assessing the present situation of the iron and steel industry in West and North Africa and to present some issues, crucial for the further development of the industry in these regions. This study provides a brief general review of the iron and steel industry of the North, West and Central African subregions. Of particular interest is the current state of the subsector and the availability of those resources which could provide the basis for the development of a viable iron and steel industry.

Despite the fact that this study covers the North African countries, Egypt is not included. Egypt is reviewed in our study of the iron and steel industry in the ESCWA region (Sectoral Studies Series No. 29, PPD.24). The East and South African countries also are covered in a survey of the iron and steel sector PTA (Preferential Trade Area for Eastern and Southern Africa) and SADCC (Southern African Development Co-ordination conference) countries (UNIDO/IS/R.44) which has been carried out by Regional and Countries Studies of UNIDO's Department for Programme and Project Development within the frame-work of the Industrial Development Decade for Africa.

The study begins with an executive summary which is followed by a perspective on economic forces that motivates the development of the iron and steel industry. As a matter of fact, the production of the basic materials like coal, iron and steel, power and the build-up of heavy industries insures self-reliant development which would not have been possible if attention had been confined exclusively to consumer and/or even intermediate products without making sure of the base on which such production has necessarily to stand. Iron and steel occupies an important position in the group of heavy industries as it provides a basic material for the growth of the latter.

In chapter two socio-economic aspects of the African subregions concerned in this study and the problems and prospects for growth in the near future are covered. Chapter three provides an overview of the production, consumption and trade in the context of global and regional perspectives. In respect to steel consumption and steel intensity trend, this study indicates a possible approach to the quantitative analysis of trends of steel consumption and steel intensity, first by explaining the historical trend, and then by examining more thouroughly the various explanatory factors on the global and on the sectoral levels. It attempts to describe the relationship between two phenomena - steel consumption and economic activity that are measured using models chosen for this purpose. The model is called global model which is to equate steel consumption to GNP per capita. It is believed that this method cannot explain the very large steel consumption aberations after the 1974 recession. However, the structural adjustments have now taken place in most developed and developing countries, and steel consumption presently has fluctuated much less than since the 1974 recession. Recently Rhine-Westphalian Economic Research Institute, Federal Republic of Germany, confirmed the correlation between steel consumption trends and economic growth and denied the widely held view that the link between steel consumption trends and economic growth was broken in 1974.[1/] More importantly, the models provided satisfactory results regarding the relationships among the countries on which we focussed.

1/ Metal Bulletin 1986.

In order to more fully explore the potentials and limitations of steel and other ferrous materials, as well as the potentials of combining them with other metals and non-metallic materials, there is a need to examine the availability of mineral and energy resources. For example, Venezuela is rich in natural resources. It has the fifth largest iron ore reserves in the world, mostly high grade ore. It has the thirteenth largest natural gas reserves in the world and has one of the largest hydroelectric dams in the world. All of these resources are close to each other, and together, these resources give Venezuela an economic advantage for production of DRI (Direct Reduced Iron) which is difficult or impossible to beat. This can be investigated in chapter four.

It is very important to know what is available for the development of the iron and steel industry domestically, if a country wants to develop upstream and downstream industries in order to promote and encourage the utilization of local resources by creating related industries which increase the value-added industrial output as well as metal products. This approach is called the integrated approach to the development of the industry as a whole. For this purpose, those mineral and energy resources are worth attention. The integrated approach helps developing African countries to improve the management of mineral resources, increase industrial production efficiency and diversify industrial production in relation to the iron and steel industry.

Steel industry metals which are exclusively for steel products are iron ore, manganese, cobalt, columbium and tantalum. Almost the whole production of iron ore and manganese are destined for use by the world's steel industry. Cobalt and tantalum are used for high temperature alloys. Fuel minerals include coal, oil and natural gas, which are necessary for the operation of steel mills and the production of steel products. So is electricity; mini mills especially require a tremendous amount of electric power. Without steel industry metals and fuel minerals, running steel mills is difficult. This is why availability of mineral and energy resources are touched upon.

The prospects of the iron and steel industry as well as a concluding overview of outlook on the issues of the promotion of the iron and steel industry are provided in chapter five.

Unlike other two studies mentioned above, this study is not accompanied by substantial local survey with regard to extent and type of deposits of materials as well as natural resources extent of areas developed and potentially to be developed for metal-related industries. Neither was the assessment of the nature of existing steel industries at plant level made in order to examine main problems which steel producers in these subregions face for the development of the iron and steel industry.

So naturally, it is recommended that this review should be followed by mission-supported studies, one for each of the West, North and Central African subregions. Each study would go into greater depth to identify in detail the relevant factors affecting the development of the steel industry, and would evolve workable plans for new projects.

Contents

		Page
	EXECUTIVE SUMMARY	1
1.	GENERAL ECONOMIC OVERVIEW	4
	1.1 Geographical setting	4
	1.2 Economic situation	4
	1.3 Outlook for the future	9
2.	REGIONAL STEEL CONSUMPTION AND PRODUCTION	11
	2.1 The global and regional perspectives	11
	2.2 Steel consumption trend	25
	2.3 Steel intensity trend	34
	2.4 Steel production in West and North Africa	45
	2.4.1 Existing steel works	45
	2.4.2 Planned steelworks	49
	2.5 Steel import	51
	2.6 Demand/supply projections for steel in selected countries	54
3.	AVAILABILITY OF MINERAL AND ENERGY RESOURCES	56
	3.1 The role of minerals in the economies of the African developing countries in the context of the world economy	56
	3.2 Mineral production in developing African countries	60
	3.3 Resources needed for the iron and steel industry	63
	3.3.1 Ferrous and non-ferrous minerals	64
	3.3.2 Iron ore	64
	3.3.3 Manganese	70
	3.3.4 Cobalt	71
	3.3.5 Columbium/tantalum	71
	3.3.6 The hydrocarbon minerals	71
	3.3.7 Coal	72
	3.3.8 Petroleum and natural gas	75
	3.3.9 Electrical energy	77
	3.3.10 Non-metallic mineral resources	77
4.	PROSPECTS OF THE IRON AND STEEL INDUSTRY	80
	4.1 Constraints to development of the steel industry	80
	4.2 National constraints	80
	4.3 Regional/subregional constraints	83
	4.4 Global constraints	84
	4.5 Future development prospects for the iron and steel industry	86
	4.5.1 Extraction and beneficiation	86
	4.5.2 Iron making	87
	4.5.3 Ferroalloys manufacture	89
	4.5.4 Steel production	89
	4.6 Role of international agencies (including UNIDO) in promoting steel development	90

Tables

		Page
1.	The countries of West and North Africa	5
2.	Structure of production in the West and North African countries, 1965 and 1983	6
3.	External public debt and debt service ratios in countries of West and North Africa, 1970 and 1983	8
4.	World crude steel production, 1900-1985	12
5.	World crude steel production by country, 1975-1985	13
6.	World steel exports and production, 1970-1985	15
7.	Exports of semi-finished and finished steel products, 1975-1985	16
8.	Imports of semi-finished and finished steel products, 1975-1985	18
9.	Apparent steel consumption per head, 1975-1985	22
10.	Apparent steel consumption per head, 1965-1982	24
11.	Steel intensity and economic structure in North African countries	35
12.	GNP per capita at 1975 constant US dollar	39
13.	Steelworks of West and North Africa	46
14.	Imports of steel products by African developing countries in 1983	52
15.	Algeria - Main imports of steel products, 1975-1980	53
16.	Imports of steel products, 1976-1984	53
17.	Demand/supply for steel products, 1985, 1990 and 2000	54
18.	Iron ore exports in Africa, 1976-1985	58
19.	Iron ore production in Africa, 1976-1985	58
20.	Iron ore exports of Liberia, 1976-1985	59
21.	Iron ore of Algeria: production, exports and consumption, 1970-1985	59
22.	Export earnings deriving from mineral activities in 1981	61
23.	Share of mining and quarrying value-added in total GDP, 1970-1978	62
24.	Iron ore resources of West and North Africa	65
25.	Hydrocarbon resources of West and North Africa	73
26.	Electricity generating capacities in West and North Africa in 1980	78

Figures

		Page
1.	Algeria: 1960-1981 trend in steel consumption per capita	26
2.	Gabon: 1960-1981 trend in steel consumption per capita	26
3.	Morocco: 1960-1981 trend in steel consumption per capita	27
4.	Libyan Arab Jamahiriya: 1960-1981 trend in steel consumption per capita	27
5.	Nigeria: 1960-1981 trend in steel consumption per capita	28
6.	Togo: 1960-1981 trend in steel consumption per capita	28
7.	Tunisia: 1960-1981 trend in steel consumption per capita	29
8.	Zaire: 1960-1981 trend in steel consumption per capita	29
9.	Algeria: Variation of steel consumption per capita with GNP per capita	30
10.	Gabon: Variation of steel consumption per capita with GNP per capita	30
11.	Morocco: Variation of steel consumption per capita with GNP per capita	31
12.	Libyan Arab Jamahiriya: variation of steel consumption per capita with GNP per capita	31
13.	Nigeria: Variation of steel consumption per capita with GNP per capita	32
14.	Togo: Variation of steel consumption per capita with GNP per capita	32
15.	Tunisia: Variation of Steel Consumption per capita with GNP per capita	33
16.	Zaire: Variation of steel consumption per capita with GNP per capita	33
17.	Steel intensity of Algeria	41
18.	Steel intensity of Libyan Arab Jamahiriya	41
19.	Steel intensity of Morocco	42
20.	Steel intensity of Tunisia	42
21.	Steel intensity of Zaire	43
22.	Steel intensity of Nigeria	43
23.	Steel intensity of Senegal	44
24.	Steel intensity of Togo	44

EXPLANATORY NOTES

References to dollars ($) are to United States dollars, unless otherwise stated.

A comma (,) is used to distinguish thousands and millions.

A full stop (.) is used to indicate decimals.

A slash between dates (e.g., 1980/81) indicates a crop year, financial year or academic year.

Use of a hyphen between dates (e.g., 1960-1965) indicates the full period involved, including the beginning and end years.

Metric tons have been used throughout.

The following forms have been used in tables:

Three dots (...) indicate that data are not available or are not separately reported.

A dash (-) indicates that the amount is nil or negligible.

A blank indicates that the item is not applicable.

Totals may not add up precisely because of rounding.

Besides the common abbreviations, symbols and terms and those accepted by the International System of Units (SI), the following abbreviations and contractions have been used in this report:

Economic and Technical abbreviations

BOF	Basic oxygen furnace
DR	Direct reduction or double reduced
DRI	Direct reduced iron
EAF	Electric arc furnace
EOF	Energy optimizing furnace
GCF	Gross capital formation
GDP	Gross domestic product
GNP	Gross national product
OHF	Open hearth furnaces
OECD	Organization for economic co-operation and development
SR-BOF	Smelting reduction - oxygen converter route

Glossary

Continuous casting:	is defined as a process for solidifying steel or other material in the form of a continuous strand rather than individual ingots.
Direct reduction:	is a family of processes for making iron from ore without exceeding the melting temperature. No blast furnace is needed.
Effective capacity:	Maximum possible production during a year under normal working conditions. Attention paid to repairs, maintenance, holidays; attention also paid to reductions and additions taking place during the year. Assumption of raw material availability.
Gross capital formation:	The capital formation consists of three components, namely, construction, machinery and equipment and changes in stocks. The gross capital formation is the sum of the increase in stocks and gross fixed capital formation. Gross fixed capital formation is equal to net fixed capital formation as defined above plus depreciation.
Gross Domestic Product:	is the total value of goods and services produced by an economy over a given period, usually one year.
Gross National Product:	is defined as GDP plus the income accruing from foreign investment, less payments made to investors in foreign countries.
Integrated mini-mill:	is defined as the process which has the following stages: DR - EAF route - rolling mills.
Integrated steel works:	is defined as the process which comprised the following stages: Blast furnace - LD converter (BOF) route - rolling mills.
Killed steel:	Steel to which a deoxidizing agent has been added to prevent the excessive generation of gas.
Mini-mill:	is defined as the process which involves the mills. following stages: scrap - EAF route - rolling
Nominal capacity:	Production capacity of main equipment: Converter, electric furnace etc., disregarding factors of material supplies, im balances between processes. Equipment not in use is disregarded.
Open hearth furnace:	These are an older technology for the reduction of steel from iron. It has largely been replaced by BOF or EAF in most modern steel works.

Pellets:	Refined ore, used in mini-mills which make finished products starting with steel scrap or refined ore.
Productivity:	Out per unit of input-used, usually used to mean labor productivity, the physical quantity or value of goods produced per unit of labor input. Labor input is usually measured in worker hours.
Production capability:	Tonnage capability to produce raw steel at full demand.
Sinter:	Refined ore, used in mini steel making.
Steel capacity:	The figures for nominal, effective and production capability differ significantly from each other.
Semi-killed steel:	Steel melted in the furnace, but not wholly deoxidized.
Smelting reduction:	The smelting reduction process is designed for production of molten iron using reduced iron ore or pre-reduced ore in a molten state at a minimum temperature of 1500°C.

EXECUTIVE SUMMARY

The purpose of this study is to provide a brief general review of the iron and steel industry of the North and West African subregions. Emphasis is put on the current state of the subsector and the availability of resources which could provide the basis for the development of a viable iron and steel industry.

This report covers twenty-six countries in the West, North and Central African subregions which, together, account for about 69 per cent of developing Africa's land area and about 58 per cent of its population.

Virtually all these countries have, since about 1980, experienced severe economic stresses, arising in part from the world-wide recession and, in part, from specific problems. Falling demand for the region's exports, severe balance-of-payments deficits, declining agricultural output, exploding population growth, and heavy debt-servicing burdens have exposed the urgent need for a basic restructuring of the national and regional economies to make them more diversified and more internally self-reliant.

Considering the developing status of the countries of the area, iron and steel production and consumption are low. Whatever steel production capacity there may be is concentrated in the relatively affluent oil-producing countries such as Algeria, Nigeria and Tunisia. There is a high dependence on extra-regional imports for maintaining even the low levels of per capita steel consumption. In 1984, for instance, African developing countries produced about 2.4 million tons of crude steel but imported about 5.3 million tons.

Only about 10 of the 26 countries studied may be categorized as steel producers. These are Algeria, Ghana, Côte d'Ivoire, Libyan Arab Jamahiriya, Mauritania, Morocco, Nigeria, Togo, Tunisia and Zaire. Their aggregate crude steel production capacity is currently about 5.4 million tons per annum, of which 5.05 million tons are accounted for by three oil producers - Algeria, Libyan Arab Jamahiriya and Nigeria.

On the other hand, the aggregate steel rolling capacity is estimated at about 7.2 million tons per year, with the Maghreb countries contributing 5.25 million tons.

Most of the steel plants produce only long products - bars, rods, angles, channels, sections, etc. In fact, there is at present (late 1987) only one flat steel producer in the region which is located in Algeria; Libyan Arab Jamahiriya will start producing flat steel products to a limited extent. Most countries in the region must import their requirements of flat steel.

Several steel project plans have been announced since 1980 but only a few have reached the construction stage. Among these are the integrated blast-furnace-based Ajaokuta Steelworks in Nigeria, and the second steelworks of Algeria's Société Nationale de Sidérurgie at Jijel. Other projects at various stages of planning include the Nigerian alloy steel project at Ogbomosho, the second phase of Libyan Arab Jamahiriya's Misurata steel project (the addition of BOF), and smaller steelworks in Cameroon, Gabon and Mali.

African developing countries have relatively good mineral and energy resources, necessary for the development of a viable iron and steel industry. The region accounts for over 11 per cent of the world's iron ore reserves, with Liberia and Mauritania being the most important producers and exporters.

Other sizeable and exploitable iron ore reserves are in Algeria, Cameroon, Gabon, Guinea, Libyan Arab Jamahiriya, Nigeria and Senegal.

With respect to other ferrous minerals, Gabon is the world's fourth largest manganese ore producer and its reserves are in excess of 200 million tons. Other important sources of manganese are Ghana and Zaire. Large reserves of cobalt also occur in Zaire, while Nigeria and Zaire are important sources of columbium/tantalum.

As for the hydrocarbon minerals, developing Africa is important as a petroleum producer with four countries, - Algeria, Gabon, Libyan Arab Jamahiriya and Nigeria, - members of the Organisation of Petroleum Exporting Countries (OPEC). Many other countries also have petroleum reserves, although somewhat smaller than the OPEC member-states. Among these are Benin, Cameroon, Congo, Côte d'Ivoire, Tunisia and Zaire.

Large natural gas resources often in association with petroleum, also occur widely in the region, with the most abundant reserves in Algeria, Libyan Arab Jamahiriya, Nigeria, Sudan and Tunisia.

The West and North African subregions have coal resources but only four countries saw relatively substantial reserves of coal which bear promise for the future: Algeria, Morocco, Nigeria and Zaire.

A rapid and consistent development of the steel industry of West and North Africa is impeded by several constraints; low steel consumption, no financial resources, inadequate energy resources, lack of skilled labour and lack of domestic technological capability. At the regional/subregional level, some constraints, are the disparate degrees of industrialization and the inadequate transportation, communication and infrastructural networks. Global constraints include the lack of foreign exchange in most countries of the region which implies an inability to import adequate quantities of capital goods and other goods required for development projects.

These constraints notwithstanding, there are theoretically good prospects for a number of projects in the iron and steel sector in the West and North African subregions. Among these are:

(a) National or subregional co-operation for the development of the iron ore reserves of Cameroon, Gabon, Guinea, and Senegal.

(b) Direct reduction projects based on national gas in any of the gas-rich countries, with a view to provide the sponge iron demands of countries in the region.

(c) A collaborative project for the manufacture of ferro-manganese in Gabon or Ghana for the purpose of supplying the needs of large regional steel producers such as Nigeria.

(d) Subregionally sponsored flat steel products projects in the West African and Central African subregions, with potential market coverages of the whole of the subregions.

(e) A regional seamless tube project to meet the needs of the petroleum and natural gas producers of the North and West African area.

(f) Mini-steel and/or re-rolling mills in the smaller steel-consuming countries such as Côte d'Ivoire, Gabon, Guinea, Liberia, Sierra Leone and Sudan.

The development of the iron and steel industry can be accelerated with the assistance and co-operation of international agencies such as UNIDO. Such co-operation would include technical assistance in steel project identification and planning, raw materials investigations and characterization, training of local personnel in the areas of consultancy and project preparation and assistance in financing and management.

1. GENERAL ECONOMIC OVERVIEW

1.1 Geographical setting

West and North Africa - in the context of this report - consists of twenty six countries in three geographical subregions of the African continent:

West Africa: Benin, Burkina Faso, Gambia, Ghana, Guinea, Guinea Bissau, Côte d'Ivoire, Liberia, Mali, Mauritania, Niger, Nigeria, Sierra Leone, Senegal and Togo;

Central Africa: Cameroon, Central African Republic, Chad, Congo, Gabon, Sudan and Zaire; and

North Africa: Algeria, Libyan Arab Jamahiriya, Morocco and Tunisia.

As shown in table 1, the area under consideration is one of great diversity in both national land areas and populations. It covers 18.7 million square kilometers of Africa's total land area (exclusive of South Africa) of about 27.3 million square kilometers (i.e. 68.5 per cent), and about 57.8 per cent of its total population of 492.8 million. The West and North African area includes Nigeria which, with its mid-1983 population of 93.6 million, alone accounts for nearly 33 per cent of the area's total population, and also Gabon with a population of only 700,000. There are mineral-rich countries such as Algeria, Gabon, Libyan Arab Jamahiriya, Guinea, Nigeria and Zaire as well as countries that are essentially agricultural. In terms of natural vegetation, the area encompasses the entire spectrum from tropical rain forest to arid desert.

Notwithstanding this apparent diversity, there is considerable homogeneity within the area, particularly in economic terms. All 26 countries included are among the developing countries with relatively low average incomes.

1.2 Economic situation

The 1980s have so far been a period of intense economic crises for virtually all the countries of the West and North African region. The economic picture has been characterized by falling external demand for products of the region, growing national balance of payments deficits and mounting external debt-service payments. The growth of economic output has, in most cases, lagged behind that of population, resulting in deteriorating per capita outputs.

As shown in table 2, the contribution of agriculture to Gross Domestic Product (GDP) has declined since the 1960s to such an extent that the dependence on food imports has become intensified. Similarly, the performance of the manufacturing sector has been less than impressive, since it depends so heavily on imported inputs and resources. The competitiveness of the region's manufactured products is generally weak.

According to the Economic Commission for Africa, the African region as a whole registered an average GDP growth of 2.7 per cent per year during the 1970 to 1982 period. However, this rate was barely equal to the population growth rate. At present growth rates, Africa's population will quadruple in the next 40 years. Whereas in Asia and Latin America per capita food production is increasing and population growth is decreasing, the reverse is true in Africa.

Table 1. The countries of West and North Africa[a/]

Subregion	Country	Area (thousand sq. km)	Population mid-1983 (millions)
West Africa			
	Benin	113	3.8
	Burkina Faso	274	6.5
	Gambia	11	0.7[b/]
	Ghana	239	12.8
	Guinea	246	5.8
	Guinea Bissau	36	0.8
	Côte d'Ivoire	322	9.5
	Liberia	111	2.1
	Mali	1,240	7.2
	Mauritania	1,031	1.6
	Niger	1,267	6.1
	Nigeria	924	93.6
	Sierra Leone	72	3.6
	Senegal	196	6.2
	Togo	57	2.8
North Africa			
	Algeria	2,382	20.6
	Libyan A.J.	1,760	3.4
	Morocco	447	20.8
	Tunisia	164	6.9
Central Africa			
	Cameroon	475	9.6
	Central African Rep.	623	2.5
	Chad	1,284	4.8
	Congo	342	1.8
	Gabon	268	0.7[b/]
	Sudan	2,506	20.8
	Zaire	2,345	29.7

a/ = In the context of this report.

b/ = Mid-1982.

Source: Economic Commission for Africa 1984.

Table 2. Structure of production in the West and North African countries, 1965 and 1983

Country	GNP ($US millions)		Distribution of GDP (percentage)					
			Agriculture		Industry		Services	
	1965	1983	1965	1983	1965	1983	1965	1983
Benin	210	930	53	40	9	14	38	47
Burkina Faso	250	900	52	41	15	19	32	40
Gambia[a/]	27	213	39	26	11	...	50	...
Ghana	1,330	3,720	41	53	19	7	41	40
Guinea	520	1,910	...	38	...	23	...	39
Guinea-Bissau[a/]	...	132	...	...	...	...	...	...
Côte d'Ivoire	960	7,090	36	27	17	24	47	50
Liberia	270	980	27	36	40	26	34	38
Mali	370	980	49	46	13	11	38	43
Mauritania	160	700	32	34	36	21	32	45
Niger	370	1,340	63	33	9	31	28	37
Nigeria	4,190	64,570	53	26	19	34	29	40
Sierra Leone	320	950	34	32	28	20	38	48
Senegal	810	2,570	25	21	18	26	56	54
Togo	190	720	45	22	21	28	34	50
Algeria	3,170	47,200	15	6	34	54	51	40
Libyan Arab Jamahiriya	1,500	31,360	5	2	63	64	33	34
Morocco	2,950	13,300	23	17	28	32	49	51
Tunisia	880	7,020	22	14	24	36	54	50
Cameroon	750	7,220	32	24	17	32	50	45
C. African Rep.	140	600	46	37	16	21	38	42
Chad	240	320	47	...	12	...	41	...
Congo	200	2,110	19	7	19	55	62	38
Gabon[a/]	140	3,254	32	7	34	62	34	31
Sudan	1,330	6,850	54	34	9	15	37	51
Zaire	1,640	5,440	22	36	27	20	51	44

a/ Figures represents 1960 and 1982 .

Source: Economic Commission for Africa 1984.

Moreover, agricultural output during the period grew by only 0.7 per cent pe year, while the mining sector fell in 1982 to only about 68 per cent of the 1970 level. The manufacturing sector grew by an annual rate of 5 per cent, attributable in part to the boom in a number of the oil exporting countries as a consequence of the 1973-74 oil price rise. This resulted in rapidly increasing incomes and large-scale investments. The boom , however, short-lived, with many oil exporters now facing an oil glut, declining revenues, and severe balance-of-payments problems.

The recent pattern in the performance of the economy of the African region, as well as the subregional variations, can be seen from the following statistics compiled by the Economic Commission for Africa (ECA):

GDP growth in Africa 1982-1985 constant, 1980, prices. Percentage growth from previous year

Subregion (grouping)	1982	1983	1984	1985
Central Africa	0.3	2.8	4.8	4.0
East Africa	2.5	1.2	0.0	3.1
North Africa	-0.6	1.9	-0.2	2.6
West Africa	-0.4	-3.5	0.2	3.0
Developing Africa	0.0	0.3	-0.1	3.0
Oil exporters	-1.0	-0.1	-0.3	2.5
OPEC members	2.2	-2.2	-1.9	1.7
Non-oil exporters	1.8	0.4	0.4	3.8

There was no GDP growth in 1982. Coming after the 2.7 per cent fall recorded in 1981. The stagnation may be viewed as an improvement of the situation, but income per head fell again, down by 7.7 per cent compared to 1980.

With a GDP growth in real terms of only 0.3 per cent in 1983, followed by a decline of 0.1 per cent in 1984, there was practically no change in developing Africa's output during 1983-84. With the increasing population, it is estimated that output per capita in 1984 was, in fact, about 10 per cent below its 1980 level.

Of all the African subregions, only Central Africa registered an output growth in excess of population during the 1983-84 period. The figure of 4.8 per cent in 1984 reflects the rising oil production and exports from Angola, Cameroon, Congo, and Gabon. West Africa's GDP declined by 3.5 per cent in 1985 and recovered marginally in 1984 by 0.2 per cent. The 1983 drought is considered as the cause for this poor performance.

The problems of the OPEC member states is reflected by the 2.2 per cent GDP decline in 1983, followed by a further 1.9 per cent decline in 1984. This was caused by the over-supply situation on the world's oil market which resulted in a downward spiral of spot prices.

Although not explicitly shown above, the manufacturing sector performed poorly, a situation that should be expected in view of the sector's high dependence on imported and agricultural inputs. The African region's value-added in manufacturing grew by 1.6 per cent in 1983, but fell by 1 per cent in 1984. Only the North African subregion experienced an expansion in manufacturing, with growth rates of 5 per cent in 1983 followed by 5.2 per cent in 1984. West Africa was the poorest performer in terms of manufacturing output, with a 4.5 per cent downturn in 1983, followed by a further fall of 10.7 per cent in 1984.

Table 3 describes the 1970 and 1983 external public debt for the countries of West and North Africa. For the 26 countries covered, according to World Bank compilations, the external public debt escalated from a total of

$US 5,463 million in 1970 to $US 65,780 million in 1983, representing a twelve-fold increase. The subregional distribution of the debt was as follows:

	1970	1983
	(millions of US dollars)	
West Africa	2,260	26,182
North Africa	2,189	25,814
Central Africa	1,014	13,784

Table 3. External public debt and debt service ratios in countries of West and North Africa, 1970 and 1983

Country	External public debt millions of dollars		% of GNP		Debt service as percentage of GNP		Exports	
	1970	1983	1970	1983	1970	1983	1970	1983
Benin	41	615	16.0	59.2	0.7	2.5	2.3	...
Burkina Faso	21	398	6.4	38.2	0.6	1.3	6.3	...
Gambia	5	134	...	...	...	...	...	...
Ghana	489	1,095	24.2	28.3	1.2	1.9	5.0	14.2
Guinea	314	1,216	47.4	69.2	2.2	4.0	...	...
Guinea Bissau[a/]	...	101	...	...	...	...	...	...
Côte d'Ivoire	256	4,824	18.3	78.8	2.7	12.9	6.8	31.0
Liberia	158	699	49.6	72.1	5.5	3.2	...	6.6
Mali	238	881	88.1	89.3	0.2	1.3	1.3	6.1
Mauritania	27	1,171	13.9	158.2	1.7	5.0	3.2	10.0
Niger	32	631	8.7	48.7	0.6	5.6	3.8	...
Nigeria	480	11,757	4.8	17.7	0.6	3.1	4.2	18.6
Sierra Leone	59	359	14.3	34.5	2.9	0.9	9.9	7.2
Senegal	100	1,496	11.9	61.2	0.8	1.9	2.8	...
Togo	40	805	16.0	113.9	0.9	6.3	2.9	16.8
Algeria	937	12,942	19.3	28.0	0.9	9.8	3.8	33.1
Libyan.A.J	...	...	...	...	...	...	...	...
Morocco	711	9,445	18.0	69.6	1.5	8.3	8.4	38.2
Tunisia	541	3,427	38.2	42.4	4.5	7.4	19.0	22.3
Cameroon	131	1,883	12.1	26.7	0.8	3.1	3.1	13.9
C. African Republic	24	215	13.3	33.1	1.6	2.7	4.8	11.3
Chad	32	129	11.9	43.5	1.0	0.1	3.9	0.6
Congo	144	1,487	53.9	76.1	3.3	12.2	...	20.5
Gabon[a/]	66	322	...	...	...	...	...	...
Sudan	306	5,726	15.2	77.8	1.7	1.2	10.7	11.2
Zaire	311	4,022	17.6	91.5	2.1	2.9	4.4	...

a/ Figures are for 1970 and 1982.
Source: Economic Comission for Africa, 1984.

While the absolute magnitude and rate of growth of Africa's external debt should be a genuine cause for concern, its structure - in terms of concessional borrowings from official sources versus floating (or market) rate borrowing from private sources - has proved an even more damaging feature during the 1980s. The ECA estimates that between 1972 and 1983, Africa's debt to privately guaranteed sources grew much faster, at 14.7 per cent per annum in real terms than to official sources which grew at 12.0 per cent per annum. Since the privately guaranteed debts carry floating interest rates and since the last decade has generally been characterized by high international rates of interest, Africa's debt service burden has grown really since the early 1970s. The growth in developing African's debt dates back mostly from the period after the first oil crisis of 1973, when many countries had large external deficits, mainly because of inelastic imports.

Between 1977 and 1982 the debt nearly doubled, and its rate of growth has only recently fallen. The debt service as a percentage of GNP and export earnings is also shown in table 3 for the 26 countries of West and North Africa. In nearly all cases, there has been a substantial increase in debt service as a percentage of GNP and as a percentage of export. With so much of the export earnings devoted to debt service, little has been left for the normal economic development objectives of the region. As a matter of fact, total African debts has notched up 16 per cent of the total third world debts in 1985. This figure could be construed as numerically small, but the debt service of most African economies is prodigious in relation to their gross national products. Further, their economies are more fragile and dependent on crumbling primary prices that the other two major third world regions such as Asia and Latin America as well as having been afflicted, in recent years, by natural disasters of apocalyptic proportions.

1.3 Outlook for the future

The traumatic experience of the African countries (in terms of economic performance) since the early 1980s has led to the realization that there is an urgent need for a basic restructuring of the national economies if the goal of a fair sustained growth is to be achieved. Some countries in the region have already initiated the necessary restructuring and the effects should begin to show in the 1986-90 period. In 1985 the agricultural sector registered some recovery due to more favourable weather conditions in most of the continent, even though food deficits still persisted.

There were some further encouraging signs. Developing Africa's GDP registered a 3 per cent growth in 1985 over 1984, with all groups, except OPEC member states, recording gains in excess of 2.5 per cent. In fact, Central Africa's GDP grew by an impressive 4 per cent, West Africa's by 3 per cent, and non-oil exporting countries' by 3.8 per cent. Whether or not this change is sustained will depend in some measure on events in the industrialized countries to which African economies are tied.

The fundamental goals of long-term structural adjustment in developing African countries are to enhance efficiency, achieve equity, and expand the stock of physical and human capital. The problems of the highly indebted developing African countries are particularly urgent, and their task would be easier if world growth were to revise but the world economic recovery that began late in 1983 is weaking. For the industrial countries as a group, GDP growth reached 4.6 per cent in 1984, but then dropped to 2.8 per cent in 1985 and to an estimated 2.5 per cent in 1986. Growth slowed in the developing

countries too. Their GDP grew at 4.2 per cent in 1986, compared with 4.8 per cent in 1985 and an average of 6 per cent a year in the two decades prior to 1980.[2/]

According to available estimates[3/] all subregions of developing African countries shared in the downturn, though there were significant variations. North Africa grew 1.6 per cent, in contrast to the 3.8 per cent achieved East Africa. West Africa subregion recorded - 0.5 per cent. While oil exporters experienced - 0.3 per cent, non-oil exporters achieved an increase of 4.0 per cent, an impressive figure against the background of recent performance in the region. The overall GDP growth was 1.2 per cent and an increase of 2.5 per cent is expected in 1987.

The handling of the debt problem will also be a major determinant of African economic performance in the next five years. Given reasonable goodwill on the parts of debtor countries, creditors and international agencies (such as the International Monetary Fund, the World Bank, etc.), it should be possible for most developing African countries to reschedule or amortize a fair proportion of their debts, thus going a certain way towards re-establishing their international credit worthiness. Coupled with more prudent management of their economies at both the macro and enterprise levels, Developing African countries could see the beginning of more satisfactory levels of economic performance during the period from 1986 to 1990.

2/ World Development Report 1987, The World Bank

3/ Survey of Economic and Social Conditions in Africa, 1985-1986, United Nations.

2. REGIONAL STEEL CONSUMPTION AND PRODUCTION

2.1 The global and regional perspectives

Since 1900 there has been a general upward trend in world crude steel production, as shown in table 4. Exceptions occurred during the depression and post-depression period of 1930 - 1935 and the immediate post-World War II period from 1945 to 1947. In general, there has been a world-wide increase in steel production since 1947, which continued virtually uninterrupted up to 1980, with the exception of the 1975-1977 period. An all-time world-wide crude steel production peak was achieved with 746.4 million tons in 1979. Since then, output has generally declined in reaction to the global economic depression of the early 1980s. In fact, the turn-around observed in 1984 - which saw crude steel production rise again above the 700 million metric ton mark - was a response to the brighter economic prospects which started in that year, particularly in the OECD countries.

table 5 gives the breakdown by countries and regions of world crude steel production during the decade from 1975 to 1985. The contributions of the African countries in particular and the developing countries in general are worthy of special notice. Between 1975 and 1985 the developing countries' steel output more than doubled from about 32.5 million tons to about 75.0 million tons, representing respectively 5.1 per cent and 10.4 per cent of the global totals and if People's Republic of China, Democratic People's Republic of Korea and Cuba are included, 18 per cent of total steel production. Latin America and Asia were the regions with the most impressive capacity growth during this period. Africa's output (excluding South Africa), rose from 1.44 million metric tons in 1975, - equivalent to 0.22 per cent of world total, to 2.40 million metric tons in 1985, - equivalent to about 0.34 per cent of the world output. Given Africa's size and population, its contribution in terms of world steel production is meagre, even though it is increasing at an impressive rate. It must be noted also that the major African steel producers, with the exception of Zimbabwe, are also petroleum producers and/or exporters, e.g. Algeria, Egypt, Nigeria and Tunisia.

The volume of steel in international trade as measured by exports over the 1970 to 1985 period, is shown in table 6. As a percentage of crude steel production, the proportion involved has risen from 19.7 per cent in 1970 to 29 per cent in 1984. As expected and confirmed by the country/regional breakdowns in tables 7 and 8, the major exporters are the industrialized countries of Western Europe and North America, along with Japan, Australia and South Africa. The share of the developing countries in world exports of steel (amounting to about 18.3 million metric tons in 1984, - or about 11.6 per cent) was mainly contributed by the Asian and Latin American regions, with the most active exporters being Argentina, Brazil, Mexico, the Republic of Korea and Taiwan Province of China. The only significant African steel exporter has been Zimbabwe.

Table 4. World crude steel production, 1900-1985
(millions of metric tons)

Year	Production	Year	Production
1900	28.3	1945	113.1
1901	31.0	1946	111.6
1902	34.5	1947	136.0
1903	36.1	1948	155.3
1904	36.3	1949	160.0
1905	44.9	1950	191.6
1906	51.2	1951	211.1
1907	53.0	1952	211.6
1908	41.4	1953	234.8
1909	54.2	1954	223.8
1910	60.3	1955	270.0
1911	60.5	1956	283.5
1912	72.8	1957	292.5
1913	76.4	1958	274.3
1914	60.4	1959	305.7
1915	66.6	1960	346.4
1916	78.2	1961	351.3
1917	82.0	1962	360.1
1918	77.2	1963	387.1
1919	58.5	1964	433.4
1920	72.5	1965	454.0
1921	45.2	1966	472.7
1922	68.8	1967	497.2
1923	78.3	1968	529.8
1924	78.5	1969	574.6
1925	90.4	1970	595.4
1926	93.4	1971	582.6
1927	101.8	1972	630.7
1928	110.0	1973	697.1
1929	120.8	1974	703.5
1930	95.1	1975	643.4
1931	69.6	1976	675.5
1932	50.7	1977	675.5
1933	68.0	1978	716.8
1934	82.4	1979	746.4
1935	99.5	1980	716.1
1936	124.3	1981	707.5
1937	135.7	1982	645.2
1938	110.0	1983	663.4
1939	137.1	1984	710.0
1940	140.6	1985	719.9
1941	153.8		
1942	151.4		
1943	159.6		
1944	151.2		

Source: IISI 1985, 1985 figures are taken from IISI 1986 statistics.

(thousands of metric tons)

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Argentina	2,208	2,410	2,684	2,782	3,199	2,687	2,526	2,913	2,942	2,647	2,946
Brazil	8,387	9,253	11,253	12,205	12,205	13,893	15,309	13,226	14,671	18,385	20,454
Central America	10	13	62	64	98	94	95	57	45	102	99
Chile	508	503	559	616	642	746	657	483	618	690	681
Colombia	391	356	330	390	354	420	396	425	463	502	530
Cuba	300	296	302	300	300	300	300	300	300	300	400
Ecuador	0	0	0	0	0	16	26	27	23	17	18
Mexico	5,272	5,298	5,601	6,775	7,117	7,156	7,605	7,056	6,917	7,482	7,261
Panama	0	0	0	0	0	6	10	8	15	0	0
Peru	432	346	379	374	379	447	364	272	289	337	411
Trindad & Tobago	0	0	0	0	0	0	45	219	210	172	164
Uruguay	16	16	19	7	16	18	14	20	46	41	39
Venezuela	1,100	937	854	859	1,475	1,975	2,030	2,278	2,320	2,770	3,055
Total Latin America	18,624	19,428	22,043	24,372	27,473	29,174	27,294	27,053	28,859	33,445	36,058
Algeria	221	356	410	380	242	384	522	550	700	700	600
Egypt	490	580	660	665	730	910	920	975	885	850	1,125
Nigeria	14	15	15	15	15	20	22	90	182	182	254
Tunisia	127	103	156	160	176	178	173	107	163	169	170
Zimbabwe	524	733	734	778	740	805	691	538	647	423	731
Other Africa	60	60	60	60	65	70	70	70	75	75	75
Total Africa	1,436	1,847	2,035	2,058	1,968	2,367	2,398	2,330	2,652	2,404	2,955
Iran	551	549	1,825	1,300	1,430	1,200	1,200	1,200	1,200	1,200	1,200
Israel	60	70	72	94	107	115	114	87	83	92	100
Qatar	0	0	0	127	396	396	469	495	469	478	533
Saudi Arabia	0	0	0	0	0	0	0	0	400	842	1,106
Other	70	65	51	55	170	170	180	200	200	200	200
Total Middle East	681	684	1,948	1,576	2,103	1,881	1,963	1,982	2,352	2,812	3,139

Source: IISI 1985, 1985 figures are taken from IISI 1986 statistics.

Table 5. World crude steel production by country, 1975-1985
(thousands of metric tons) (cont'd)

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Bangladesh	76	90	108	120	125	131	134	78	58	88	122
Hong Kong	120	120	120	120	120	120	120	120	120	120	120
India	7,991	9,364	10,009	10,099	10,126	9,514	10,780	10,997	10,237	10,549	11,543
Indonesia	100	139	250	225	305	360	500	500	800	1,000	1,200
Malaysia	183	190	194	203	207	210	210	210	350	350	550
Philippines	309	350	357	276	397	330	350	350	200	250	250
Singapore	196	203	215	284	293	340	263	359	305	362	365
Republic of Korea	1,994	3,511	4,346	4,969	7,610	8,558	10,753	11,753	11,915	13,034	13,539
Taiwan province of China	680	1,098	1,710	3,426	3,186	3,417	3,157	4,152	5,031	5,008	5,088
Thailand	251	281	309	346	440	450	300	350	350	350	350
Other	200	200	250	230	225	225	220	250	450	550	850
PR China	23,903	20,459	23,740	31,780	34,484	37,121	35,604	37,160	40,020	43,360	46,724
DPR Korea	2,900	3,000	4,000	5,080	5,400	5,800	5,500	5,800	6,100	6,500	8,400
Total Asia	38,903	39,005	45,608	57,155	62,918	66,576	67,891	72,084	75,736	81,573	89,101
Total Developing countries	59,644	60,964	71,634	85,161	94,462	99,998	99,546	103,449	109,599	120,234	131,253
Total Industrialized countries	391,161	415,531	399,716	420,551	442,526	406,979	401,876	338,268	343,803	375,549	374,352
Total Eastern Europe	192,623	198,960	204,169	211,083	209,444	209,158	206,127	203,450	210,025	214,203	213,476
World Total	643,428	675,455	675,519	716,795	746,432	716,135	707,549	645,167	663,427	709,986	719,081

Source: IISI 1985, 1985 figures are taken from IISI 1986 statistics.

Table 6. World steel exports and production, 1970-1985

Year	Exports (crude steel equivalent, millions of metric tons)	Production (crude steel equivalent, millions of metric tons)	Share of exports (percentage)
1970	117.5	595.4	19.7
1971	125.5	582.6	21.5
1972	133.0	630.7	21.1
1973	147.5	697.1	21.2
1974	170.0	703.5	24.2
1975	148.5	643.4	23.1
1976	164.1	675.5	24.3
1977	165.3	675.5	24.5
1976	180.1	716.8	25.1
1979	185.2	746.4	24.8
1980	182.5	716.1	25.5
1981	185.2	707.5	26.2
1982	175.0	645.2	27.1
1983	187.6	663.4	28.3
1984	205.6	710.0	29.0
1985	216.3	719.9	30.1

Source: IISI 1985, 1985 figures are taken from IISI 1986 statistics.

Table 7. Exports of semi-finished and finished steel products, 1975-1985
(thousands of metric tons)

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Argentina	41	337	265	783	541	338	608	789	677	565	1,111
Brazil	149	262	364	936	1,484	1,499	1,860	2,346	5,131	6,411	7,143
Chile	33	50	32	78	32	9	5	163	145	99	168
Colombia	5	3	0	6	5	9	4	0	0	5	0
Cuba	...	...	...	...	...	...	...	...	...	...	...
Costa Rica	8	20	26	19	17	25	17	7	8	8	17
El Salvador	11	8	7	3	31	10	2	1	1	1	0
Guatemala	0	4	10	13	13	16	19	19	16	16	10
Honduras	1	1	2	0	3	3	1	2	1	1	1
Mexico	67	145	240	367	252	67	42	293	1,004	914	439
Peru	1	1	4	8	25	6	0	8	15	2	19
Trindad and Tobago	...	...	...	...	...	...	...	...	...	...	110
Venezuela	2	1	41	65	180	241	288	293	852	583	1,074
Others	0	4	16	21	20	9	8	97	139	192	2
Total Latin America	318	836	1,007	2,299	2,603	2,232	2,954	4,018	7,989	8,798	10,092
Egypt	...	...	...	...	...	...	...	...	...	...	10
Zimbabwe	34	106	135	536	467	534	319	381	383	500	385
Total Africa	34	106	135	536	467	534	319	381	383	500	395
Israel	0	0	0	0	15	61	25	4	0	0	3
Jordan	0	0	0	0	6	5	5	7	0	0	5
Kuwait	75	177	178	62	79	70	210	210	150	150	150
Qatar	0	0	0	70	330	440	450	470	450	460	480
Total Middle East	75	177	178	132	430	576	690	691	600	610	638

Table 7. Exports of semi-finished and finished steel products, 1975-1985 (thousands of metric tons) (cont'd)

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
PR China	410	339	222	332	368	398	614	905	400	200	155
Hong Kong	24	19	33	56	101	103	119	103	321	350	50
India	508	1,414	1,101	524	61	49	0	11	24	25	150
Indonesia	0	0	0	6	115	24	16	0	0	0	116
Republic of Korea	931	1,341	1,319	1,623	3,141	4,526	4,730	5,512	5,693	5,890	5,615
Malaysia	14	13	14	85	93	20	20	20	10	0	0
Philippines	2	18	17	53	85	121	6	1	0	0	0
Singapore	182	177	372	494	356	370	412	426	318	384	382
Taiwan,P.C.	241	276	312	882	1,514	769	1,193	1,848	2,090	1,750	1,887
Thailand	9	12	9	29	39	78	55	50	40	30	70
Total Asia	2,321	3,609	3,399	4,082	5,873	6,458	7,165	8,876	8,896	8,629	8,425
Total developing countries	2,714	4,728	4,719	7,051	9,373	9,800	11,128	13,966	17,868	18,537	19,547
Total Eastern Europe	17,431	18,463	18,106	18,581	18,849	19,399	19,525	18,851	19,629	22,732	20,656
Total World	114,204	126,203	127,151	138,538	142,496	140,357	142,433	134,616	144,301	158,270	166,390

Source: IISI 1985, 1985 figures are taken from IISI 1986 statistics.

Table 8. Imports of semi-finished and finished steel products, 1975-1985
(thousands of metric tons)

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Total industrial countries	58,033	68,432	70,577	70,756	73,341	71,471	72,177	68,333	68,909	83,566	83,536
Argentina	1,771	1,035	1,044	534	700	1,084	655	609	654	904	465
Bolivia	92	60	83	90	82	49	112	55	29	29	45
Brazil	2,889	1,059	927	733	595	664	897	420	85	102	102
Chile	54	49	30	57	32	90	67	41	25	26	85
Columbia	234	259	274	382	468	462	490	565	393	400	423
Costa Rica	84	130	160	155	149	143	95	60	84	103	138
Dominican Republic	106	95	110	92	79	85	64	129	67	82	85
Ecuador	190	205	291	241	356	284	290	272	121	120	220
El Salvador	62	61	97	82	65	48	46	37	26	31	30
Guatemala	68	121	140	174	154	170	136	105	49	59	101
Honduras	30	55	68	61	86	67	49	34	31	37	37
Mexico	696	470	489	1,262	1,504	2,623	3,052	1,217	429	701	680
Peru	276	118	121	83	55	144	330	158	49	116	135
Venezuela	1,311	1,579	2,514	1,966	1,241	918	854	932	259	170	166
Others	194	185	249	296	221	289	231	424	284	329	231
Cuba	579	531	500	475	500	500	550	450	475	540	590
Total Latin America	8,636	6,012	7,097	6,683	6,287	7,620	7,918	5,508	3,060	3,749	3,533

Table 8. Imports of semi-finished and finished steel products 1975-1985 (thousands of metric tons) (cont'd)

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Algeria	965	812	1,181	1,518	1,238	1,429	1,464	1,327	1,026	957	905
Egypt	842	645	480	459	778	988	738	825	845	875	1,900
Kenya	94	206	222	270	206	186	128	92	157	168	215
Libyan Arab Jamahiriya	593	601	407	409	563	865	1,044	375	700	800	488
Morocco	374	518	626	497	532	509	485	629	550	690	642
Nigeria	976	1,464	2,681	3,196	3,346	3,814	3,869	1,013	502	314	2,148
Tanzania	52	80	71	74	43	68	32	66	70	80	80
Tunisia	48	69	148	50	71	48	99	387	319	309	257
Zaire	75	41	60	39	47	60	51	52	50	74	24
Zambia	49	32	42	24	38	23	12	9	8	10	23
Zimbabwe	4	6	99	62	56	20	50	125	160	190	250
Other Africa	593	766	1,063	797	845	900	950	850	750	786	1,000
Total Africa	4,665	5,240	7,080	7,395	7,763	8,910	8,922	5,750	5,137	5,253	7,932
Bahrain	56	82	80	30	33	47	47	78	111	95	100
Iran	3,993	3,752	3,265	4,564	1,707	2,515	1,887	2,430	3,600	1,710	3,250
Iraq	1,485	807	420	855	2,192	1,593	1,208	860	342	440	750
Israel	482	429	452	399	565	223	394	427	550	580	425
Jordan	90	204	232	185	398	268	368	325	325	300	154
Kuwait	302	692	690	580	725	644	803	900	900	970	378
Lebanon	234	69	183	289	265	285	287	275	300	350	188
Oman	-	-	60	52	81	100	194	261	256	430	365
Qatar	65	108	54	63	70	58	101	108	100	75	40
Saudi Arabia	1,019	1,483	1,461	1,887	3,310	2,921	3,825	5,483	4,950	5,000	3,450
Syrian Arab Republic	328	712	582	584	839	918	434	153	200	350	980
Other	700	1,200	950	600	1,000	900	1,200	1,800	2,500	1,600	2,500
Total Middle East	8,754	9,538	8,429	10,088	11,185	10,472	10,748	13,100	14,134	11,900	12,580

Table 8. Imports of semi-finished and finished steel products, 1975-1985 (thousands of metric tons) (cont'd)

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Bangladesh	82	90	200	181	223	232	177	165	116	110	350
Hong Kong	500	871	1,023	1,404	1,460	1,645	1,710	1,825	1,821	1,900	2,403
India	581	392	562	1,137	2,495	1,937	3,013	2,385	1,955	1,950	2,150
Indonesia	1,040	1,123	1,159	1,415	2,065	2,274	2,196	2,274	2,440	2,040	1,200
Republic of Korea	1,677	1,665	2,158	2,908	2,583	1,947	1,972	1,316	2,128	2,957	2,588
Malaysia	528	602	644	796	979	1,354	1,283	1,620	1,700	1,850	2,100
Pakistan	405	368	531	454	654	551	1,110	1,115	1,290	1,300	775
Philippines	596	815	1,012	992	1,191	906	784	1,248	1,250	1,150	500
Singapore	1,207	1,016	1,033	1,237	1,318	1,597	1,974	2,256	2,429	1,874	1,492
Taiwan Province of China	914	1,330	1,618	1,846	2,957	2,455	2,266	1,674	1,690	1,750	1,431
Thailand	568	897	1,053	1,211	1,352	1,348	1,342	1,483	1,888	1,800	1,650
Other	1,250	1,450	1,640	1,650	1,825	1,950	1,850	2,000	3,000	2,500	3,500
PR China	4,007	4,931	5,256	8,638	8,473	5,006	3,544	3,772	8,467	10,074	19,235
Other Asian CPE's	192	237	274	440	191	194	172	137	127	130	500
Total Asia	13,547	15,787	18,163	24,309	27,766	23,396	23,393	23,270	30,301	31,385	39,874
Total developing countries	35,120	36,148	40,317	48,076	52,436	50,175	50,587	47,201	52,082	51,707	63,494
Total Eastern Europe	19,064	20,781	17,150	19,396	19,198	17,935	17,647	18,030	20,331	20,411	19,693
Total World	112,217	125,361	128,044	138,228	144,975	139,581	140,411	133,564	141,322	155,684	166,723

Source: IISI 1985, 1985 figures are taken from IISI 1986 statistics.

While the African region is only a minor exporter of semi-finished and finished steel products, it is a major destination for other regions' exports. In 1984, for instance, developing Africa imported about 5.3 million metric tons of steel, equivalent to 3.4 per cent of the world total imports of 155.7 million metric tons. The important regional producers - Algeria, Egypt, Nigeria and Tunisia - were also among the most important importers. It is important also to note that in each of the years between 1975 and 1984, Africa imported by far more steel than it produced locally. The volume of yearly increasing importation, which represents the deficit of supply vis-à vis ever-increasing consumption, may roughly be indicative of the minimum potential that exists in Africa for additional steel production capacity.

A parameter that has traditionally been used as a rough index of a country's level of industrial activity is the per capita steel consumption. Table 9 shows the trend in this parameter for a selected countries over the 1975 to 1984 period. In general, whereas per capita steel consumption in the developed countries is in hundreds of kilograms (e.g. 1984 Czechoslovakia 700 kg, Japan 619 kg, Belgium-Luxemburg 570 kg, USSR 575 kg and Canada 525 kg), the figures for the developing countries of Africa are kilogram per capita (e.g in 1984, Tunisia had 81 kg, Libyan Arab Jamahiriya 100 kg, Egypt 43 kg and Nigeria 6 kg). The majority of African countries (which are not listed in table 9) generally have per capita consumptions not exceeding 30-50 kg.

The country data on steel consumption per capita consumption in table 10 in the context of this report are compiled using the information of the Sectoral Studies Branch on steel consumption. Data on apparent steel consumption per head in other countries than those shown in the table are not available. There is a decreasing tendency of steel consumption per capita in this region since 1977. This means that economic activities have been slowing down in spite of increases in GNP per capita. This means that the industrialization process in these countries has been very weak to provide the dynamics for the structural transformation of these countries to attain self-sustainment, as a rule, a process of rapid industrialization develops, with consequential increase in investment, in infrastructure, it pushes up the steel consumption rapidly. This means that growth in national output would generate growth in steel demand on the path to the industrialization although the response of steel consumption to the growth in national product varies from country to country. It depends on the degree of level of development attained by that country.

Table 9. Apparent steel consumption per head, 1975-1985
(kilograms of crude steel)

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Belgium-Luxembourg	314	467	388	402	376	324	319	460	534	570	352
Denmark	358	448	356	369	358	344	346	443	261	333	400
FR Germany	486	593	538	526	602	549	503	436	486	489	481
France	385	445	383	367	395	373	325	318	276	276	258
Greece	143	171	176	167	167	207	157	150	203	215	163
Ireland	116	150	150	134	219	126	171	161	128	130	126
Italy	318	387	368	332	400	458	345	356	320	350	362
Netherlands	332	368	322	355	308	328	272	259	237	295	305
United Kingdom	374	378	357	359	368	247	267	254	249	256	254
Austria	286	359	335	362	359	360	301	281	263	257	299
Finland	434	390	326	279	335	445	427	447	379	444	434
Norway	514	444	405	372	347	445	372	421	324	365	366
Portugal	110	118	156	153	106	122	147	171	126	118	110
Spain	306	305	249	186	214	239	214	232	244	171	175
Sweden	773	725	463	468	528	497	412	423	419	439	384
Switzerland	231	314	356	317	376	429	397	327	321	345	378
Turkey	80	94	112	81	69	73	74	86	90	105	100
Yugoslavia	248	189	239	246	250	254	223	230	230	225	221
Canada	577	543	550	575	635	541	553	371	448	525	471
United State	547	604	618	672	640	508	565	363	404	480	450
Japan	608	577	554	579	673	675	603	586	549	619	606
Australia	453	467	389	346	401	416	479	367	318	390	364
New Zealand	271	282	286	244	288	222	246	306	264	270	227
South Africa	294	232	176	153	207	211	228	186	149	160	165
Argentina	168	129	140	93	127	133	114	84	120	125	72
Brazil	106	98	107	106	107	115	115	85	61	70	88
Chile	55	48	60	62	60	64	67	47	57	69	47
Colombia	28	30	31	35	37	38	32	35	35	34	38
Mexico	103	96	93	152	122	98	164	117	100	110	113
Peru	62	34	37	30	36	50	43	26	19	27	27
Venezuela	196	229	299	237	226	237	219	213	158	198	177

Table 9. Apparent steel consumption per head, 1975-1985 (kilograms of crude steel) (cont'd)

Country	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Algeria	84	71	110	132	110	130	140	130	115	108	77
Egypt	42	34	26	25	35	35	40	45	42	42	69
Libyan Arab Jamahiriya	101	30	88	130	131	139	142	50	90	100	151
Morocco	28	41	44	33	36	30	31	37	32	38	34
Nigeria	19	28	50	56	56	62	61	16	9	6	30
Tunisia	25	65	45	34	40	36	45	91	83	81	67
Iran	163	147	171	199	85	90	90	94	129	75	113
Iraq	181	94	60	89	214	150	120	78	30	37	55
Israel	221	195	195	166	222	105	161	159	154	155	140
Kuwait	297	626	558	558	651	547	527	510	341	375	155
Lebanon	101	30	88	130	131	139	142	136	110	123	83
Saudi Arabia	206	319	308	349	415	430	545	740	757	795	446
India	14	13	15	17	18	14	19	19	16	17	18
Republic of Korea	84	110	182	180	187	148	138	192	222	255	243
Malaysia	72	78	80	124	141	159	158	124	145	152	194
PR China	38	32	38	46	47	45	39	41	50	52	65
Bulgaria	252	236	276	277	305	312	319	337	346	323	335
Czecho-slovakia	733	767	748	756	720	729	735	724	719	700	709
German Dem. Rep.	566	590	591	605	591	583	561	569	627	495	572
Hungary	361	324	343	377	338	330	337	344	328	302	316
Poland	524	533	540	561	545	542	429	398	407	416	409
Romania	464	489	506	528	563	544	509	514	479	509	491
USSR	554	566	565	587	570	565	560	555	575	575	574

Source: IISI 1985, 1985 figures are taken from IISI 1986.

Table 10. Apparent steel consumption per head, 1965-1982
(kilograms of crude steel)

Country	1965	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Ghana	14.29	7.19	7.20	1.96	5.61	8.44	9.30	7.84	11.25	5.63	3.08	2.74	2.31	1.14
Guinea	6.00	15.00	5.00	3.00	2.00	2.00	4.00	2.00	3.00	5.00	2.00	4.00	3.00	2.00
Côte d'Ivoire	28.00	19.00	25.00	26.00	25.00	23.00	37.00	27.00	29.00	28.00	28.00	20.00	20.00	14.00
Liberia	20.32	25.12	18.68	12.02	23.88	16.86	10.28	16.90	19.67	15.75	14.18	17.79	12.72	8.07
Sierra Leone	...	3.71	6.51	5.64	5.16	5.38	3.61	4.15	3.73	3.33	3.54	4.60	2.98	2.17
Senegal	...	10.54	9.29	12.30	12.14	15.92	12.05	16.03	13.71	10.57	15.93	11.83	9.44	13.41
Togo	5.86	7.92	9.16	7.04	5.04	8.94	8.73	10.60	9.90	17.66	9.77	10.66	7.37	9.09
Congo	...	22.53	40.68	30.18	34.10	44.66	23.66	29.51	28.75	11.62	21.33	61.15	56.29	40.37
Gabon	...	34.70	38.54	79.38	82.65	88.88	110.0	109.80	125.24	38.46	33.01	67.29	73.39	63.06
Sudan	4.00	7.00	6.00	5.00	7.00	7.00	5.00	6.00	10.00	4.00	5.00	7.00	9.00	5.00
Zaire	2.81	7.44	7.32	6.21	5.88	8.23	3.93	2.12	3.10	1.97	2.28	2.80	2.29	1.91

Source: Sectoral Studies Branch, IPP, UNIDO, derived from Monthly Report of the Iron and Steel Statistics of MITI (Ministry of International Trade and Industry of Japan) and JISF (Japan Iron and Steel Federation).

2.2 Steel consumption trend

With the importance attached to industrialization by all developing African countries since the attainment of political independence in the 1960s, it would be expected that steel consumption should be on the increase. The figures available for a selection of countries in the West and North African subregions confirm this expectation.

Figures 1 to 8 depict the 1960-81 trend in per capita steel consumption for eight countries for which data have been compiled by UNIDO - Algeria, Gabon, Libyan Arab Jamahiriya, Morocco, Nigeria, Togo, Tunisia and Zaire. These trends are observed and predicted by UNIDO model for forecasts of steel demand have been developed after carefully examining econometric models of IISI, OECD and JISF by changing macro variables which are considered more closely related to steel consumption. Models present the results of adjustment of macro variables such as GNP, GDP, GCF, ratio of GNP to GCF and population which fit in a specific country profile of steel demand. In these models, equations which show a good historical fit are chosen for each developing African country. The method of analysis was to regress each of various equations (appeared on each figure) against historical data for developing African countries. Although the inherent danger of extrapolating the exhibited trends beyond the period covered are appreciated, they can, however be used as a first rough approximation of the basis for projecting future steel consumption, particularly in the short term. The models were based on the fundamental hypothesis that in all countries there is a common relationship between the change in growth rate of steel consumption and the change in the rate of GNP growth which depends on the level of GNP per capita. (So far ten equations are suitable for steel demand forecasting. But they are still under scrutiny to detect a trend in steel consumption in a specific developing country).

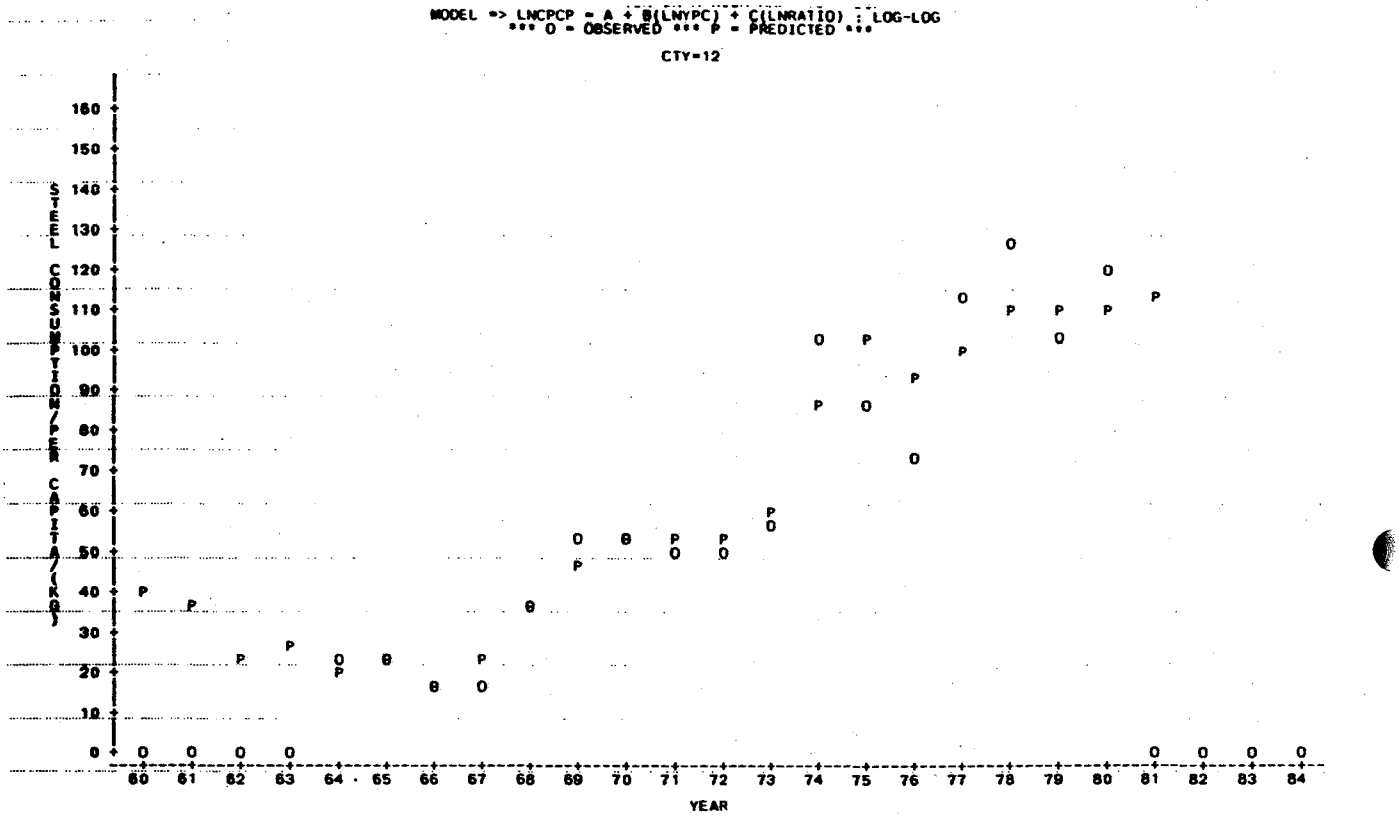
With perhaps the exception of Gabon, it is clear that each country has sustained a positive gradient over the period, although the absolute values of per capita consumption necessarily vary with the levels of economic development of the respective countries. For instance, whereas Morocco, Nigeria, Togo and Zaire have only achieved levels below 50 kg per capita, the figures for Algeria, Gabon and Libyan Arab Jamahiriya are in excess of 50 kg.

Figures 9 to 16 similarly show the variations of per capita steel consumption with Gross National Product (GNP) per capita for the same countries. In each case a positive relationship is evident. This is a generally valid relationship and provides a basis for steel consumption projections. As a rule, in the developing countries where GNP per capita is rising, resources are increasingly moving into more steel-intensive sectors, such as more advanced forms of agricultrue, mining, transport, other infrastructure development and industry itself.

Other relationships to be used for extrapolations could be derived relating national steel consumption to gross fixed formation, income per capita, industrial production and investment share. Through a judicious evaluation of the various extrapolations, it might be possible to estimate a variation pattern in the short and medium term for a nation's steel consumption.

Because of the paucity of data and uncertainties of the economic climate of the countries of West and North Africa over the next five to ten years, no attempt has been made here to project the national and aggregate figures for the area. But the data of figures 1 to 10 could serve as a basis for such projections.

Figure 1.
Algeria: 1960-81 trend in steel consumption per capita



KEY: O = OBSERVED
P = PREDICTED

Figure 2.
Gabon: 1960-1981 trend in steel consumption per capita

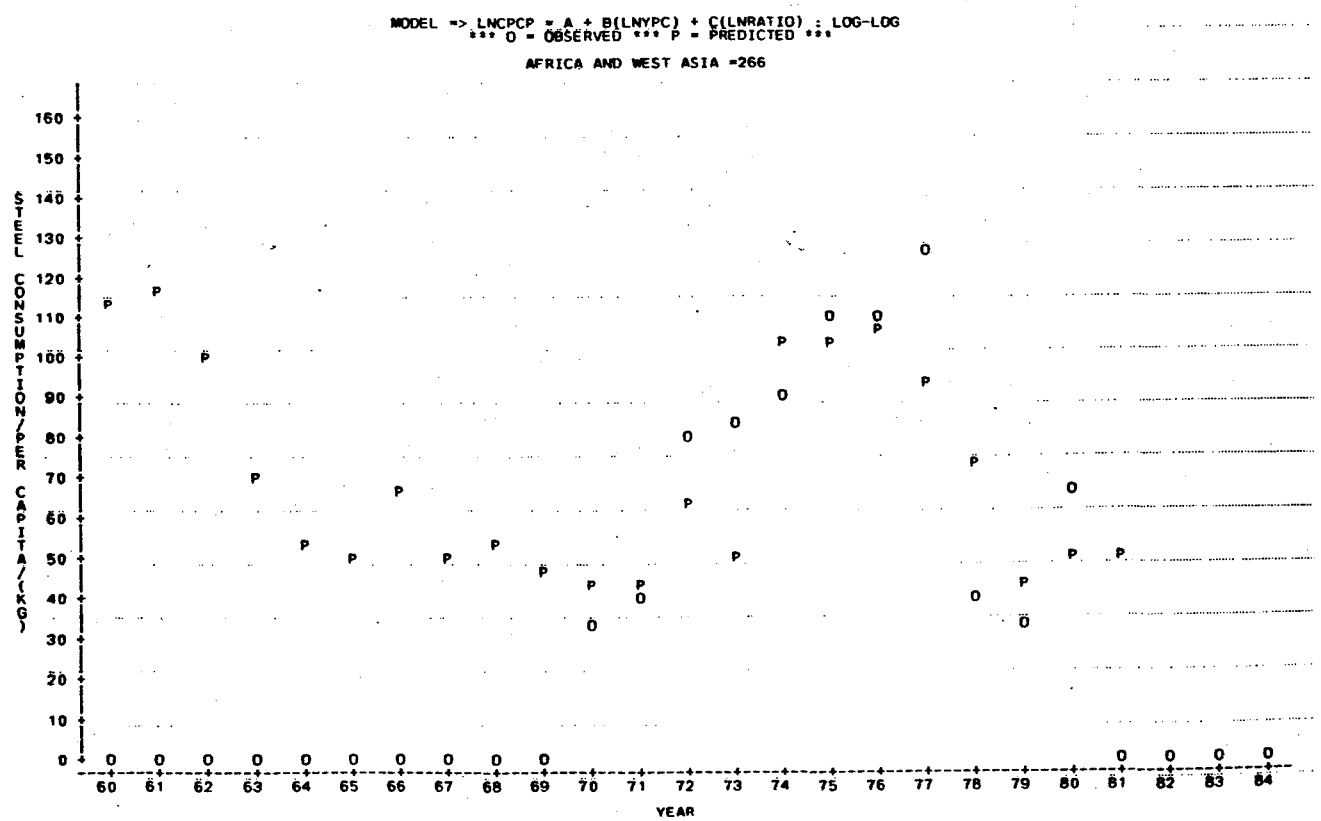
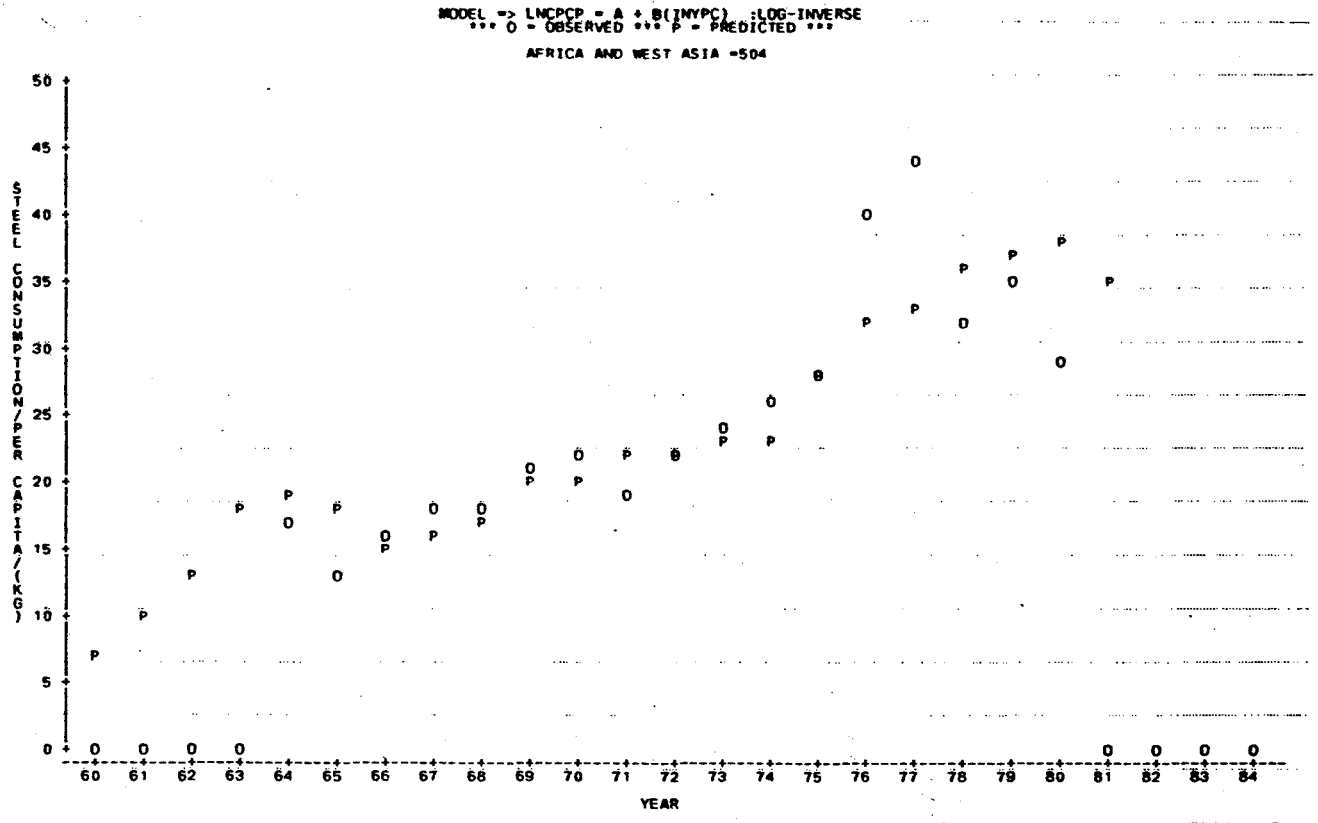


Figure 3.
Morocco: 1960-1981 trend in steel consumption per capita



KEY: O = OBSERVED
P = PREDICTED

Figure 4.
Libyan A.J.: 1960-1981 trend in steel consumption per capita

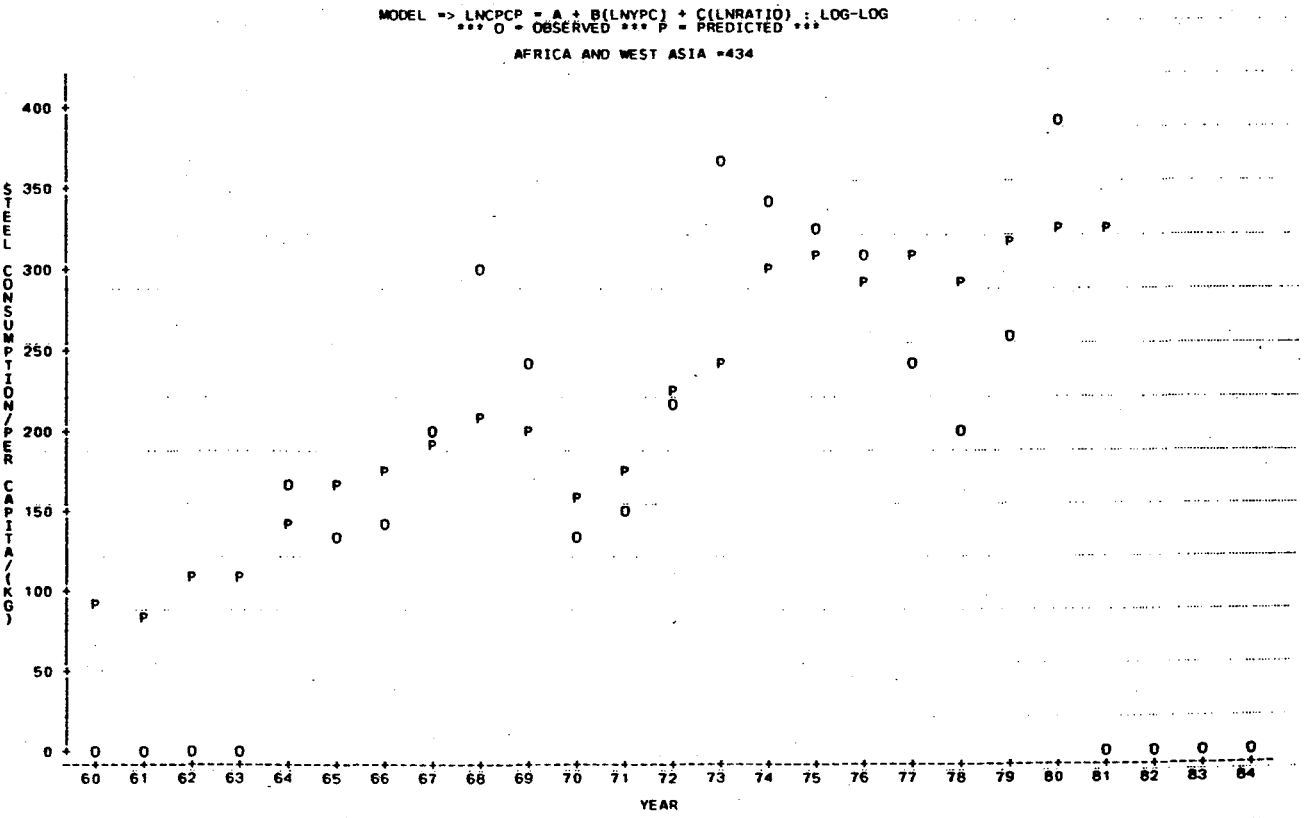
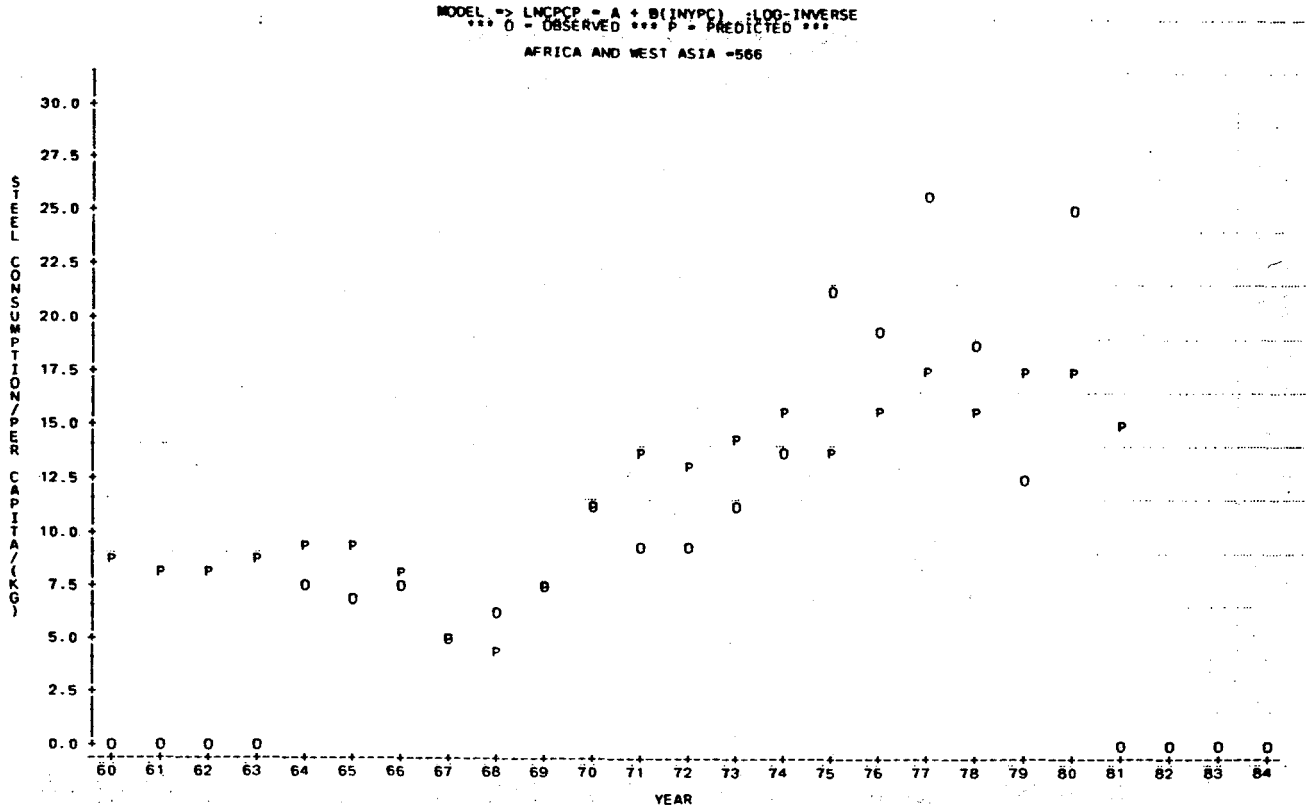


Figure 5.
Nigeria: 1960-1981 trend in steel consumption per capita



KEY: O = OBSERVED
P = PREDICTED

Figure 6.
Togo: 1960-1981 trend in steel consumption per capita

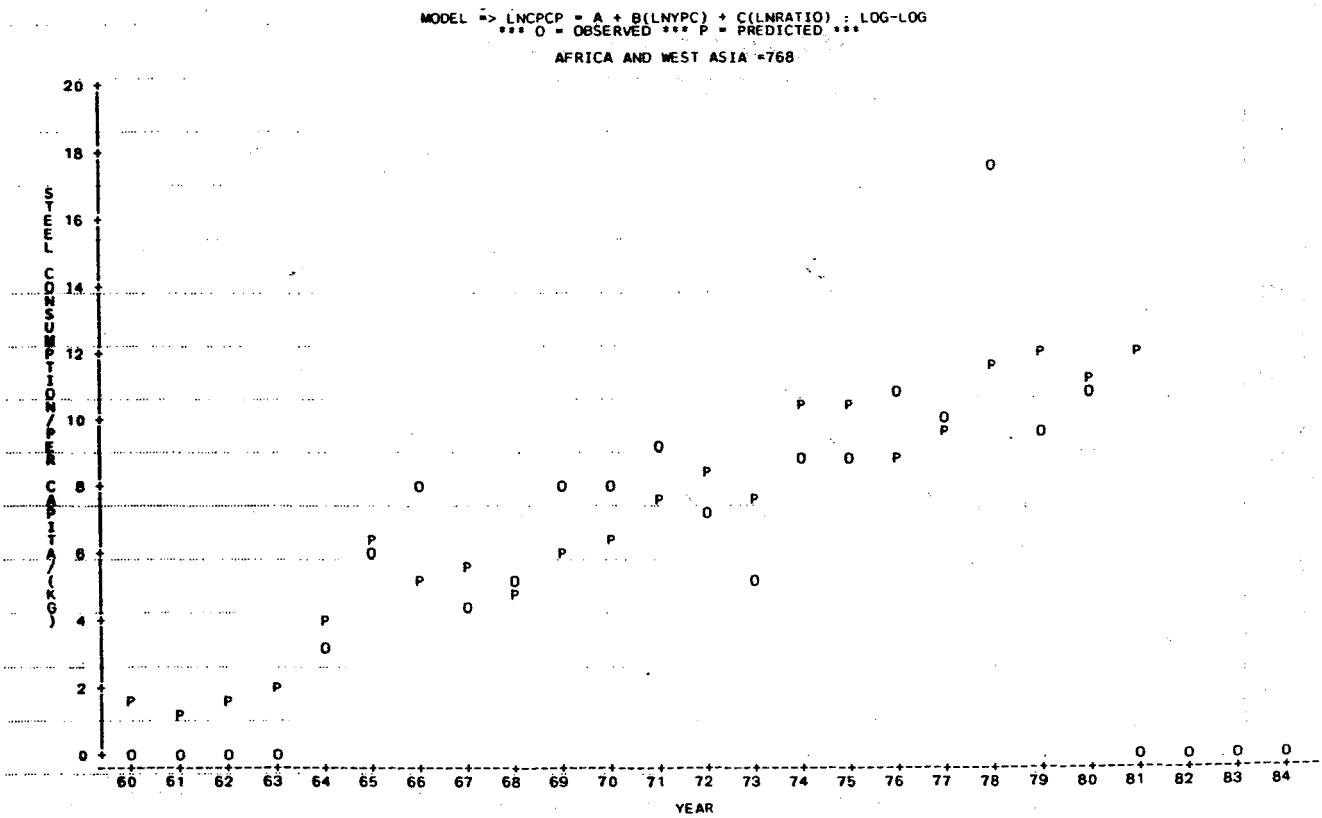
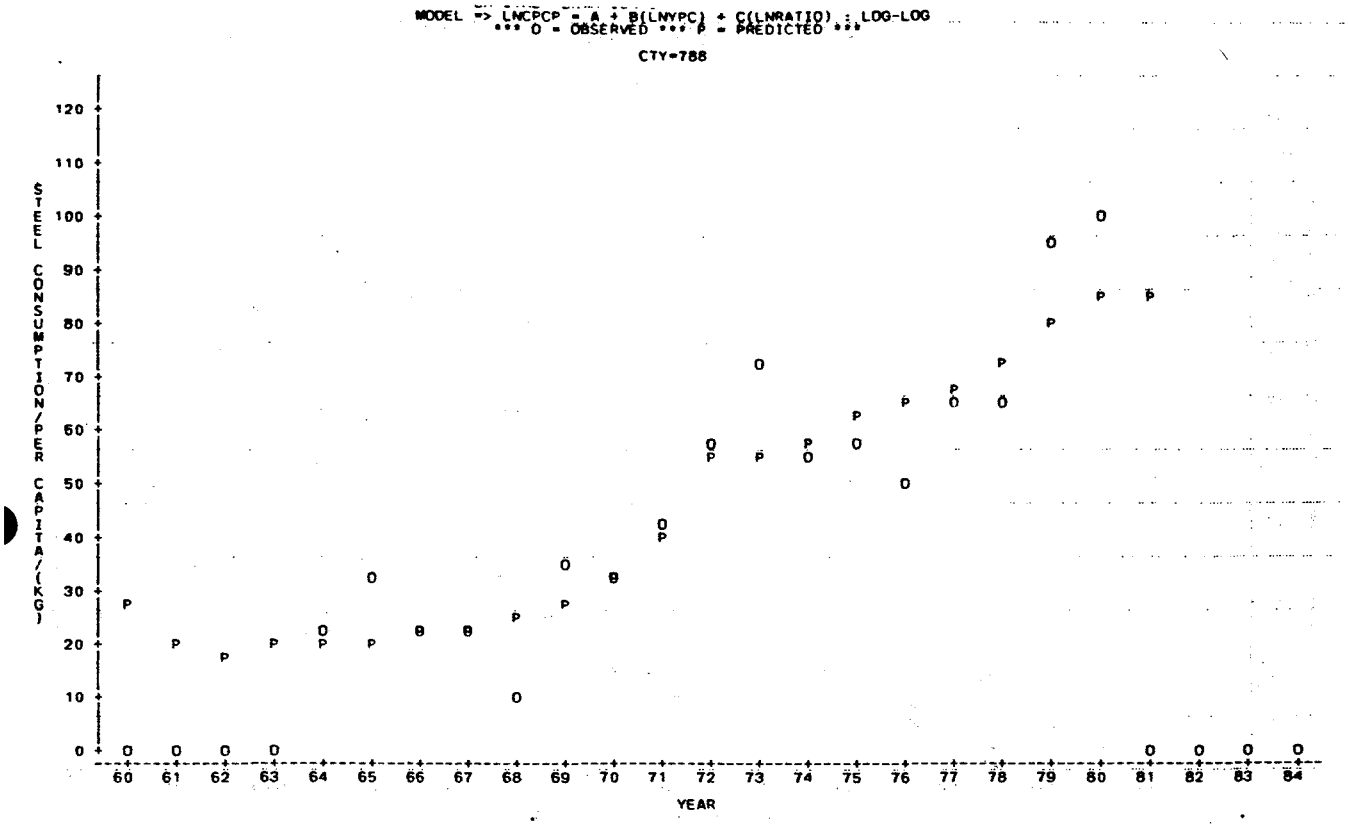


Figure 7.
Tunisia: 1960-1981 trend in steel consumption per capita



KEY: - O = OBSERVED
P = PREDICTED

Figure 8.
Zaire: 1960-1981 trend in steel consumption per capita

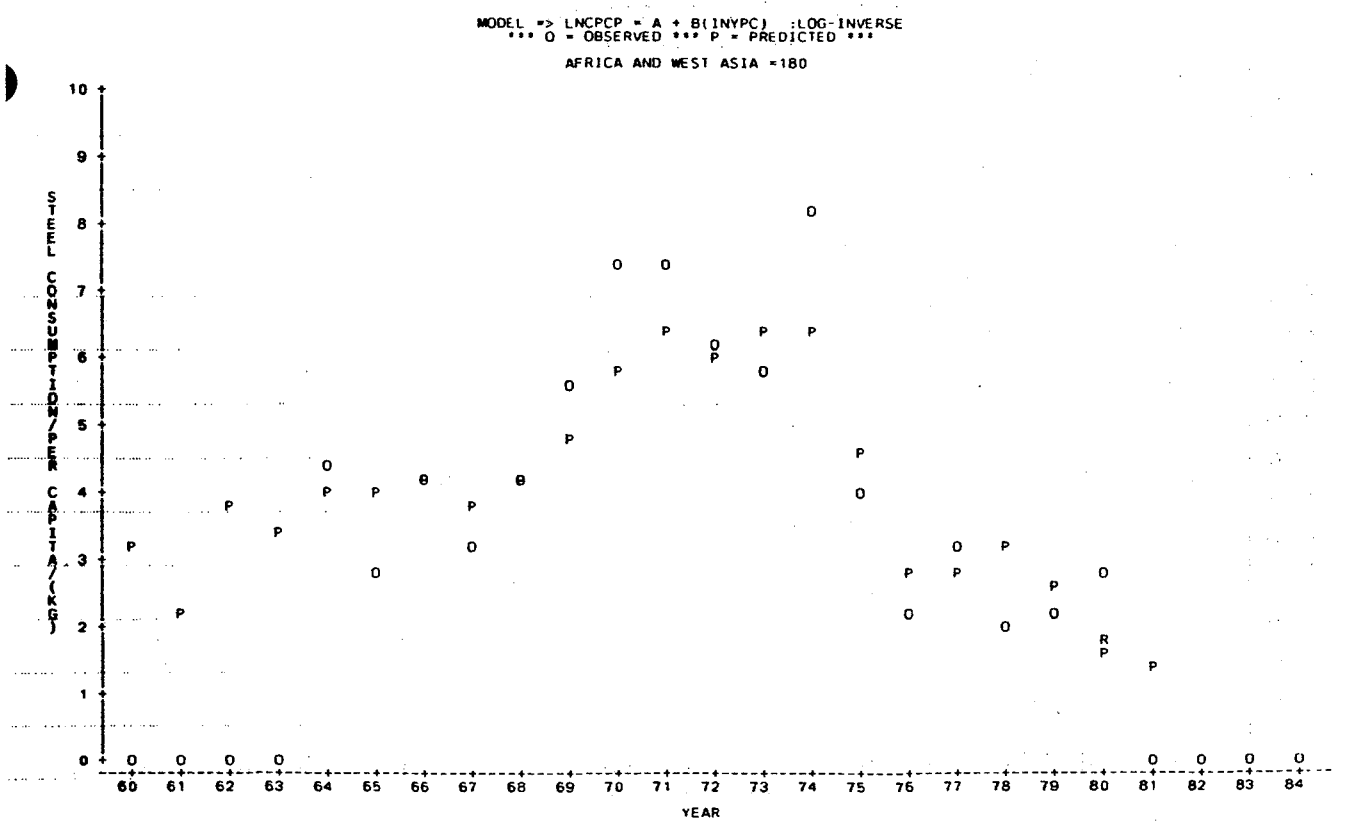


Figure 9.
Algeria: Variation of steel consumption per capita with GNP per capita

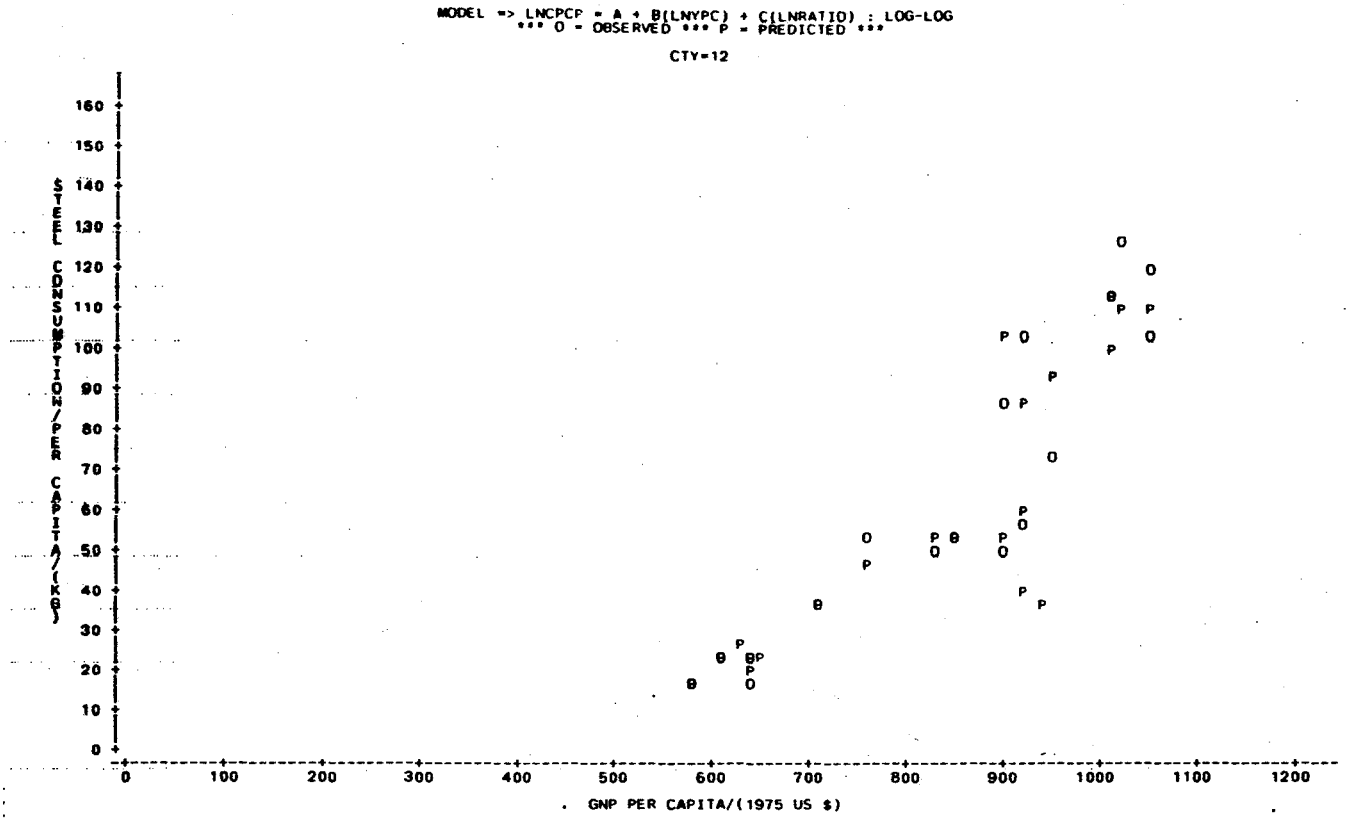


Figure 10.
Gabon: Variation of steel consumption per capita with GNP per capita

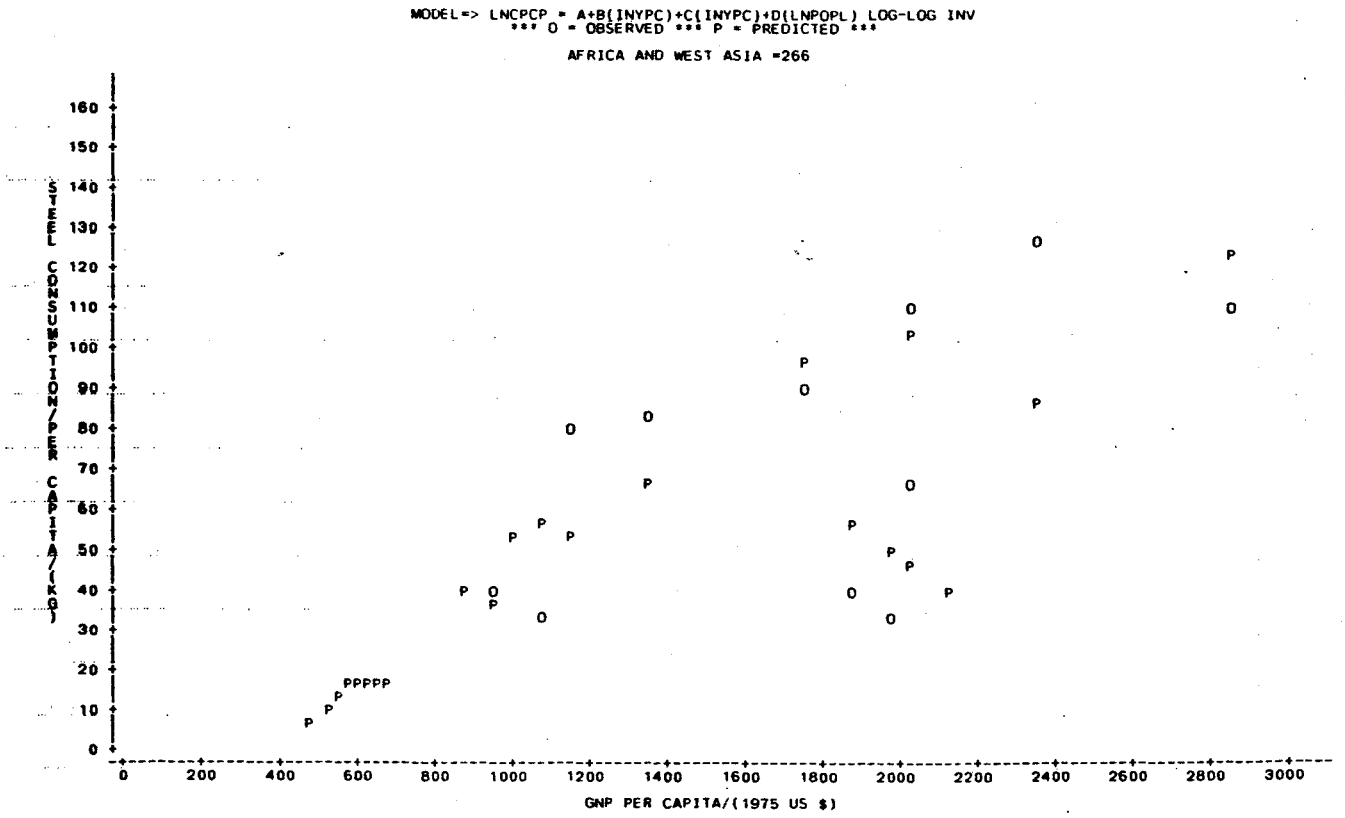


Figure 11.
Morocco: Variation of steel consumption per capita with GNP per capita

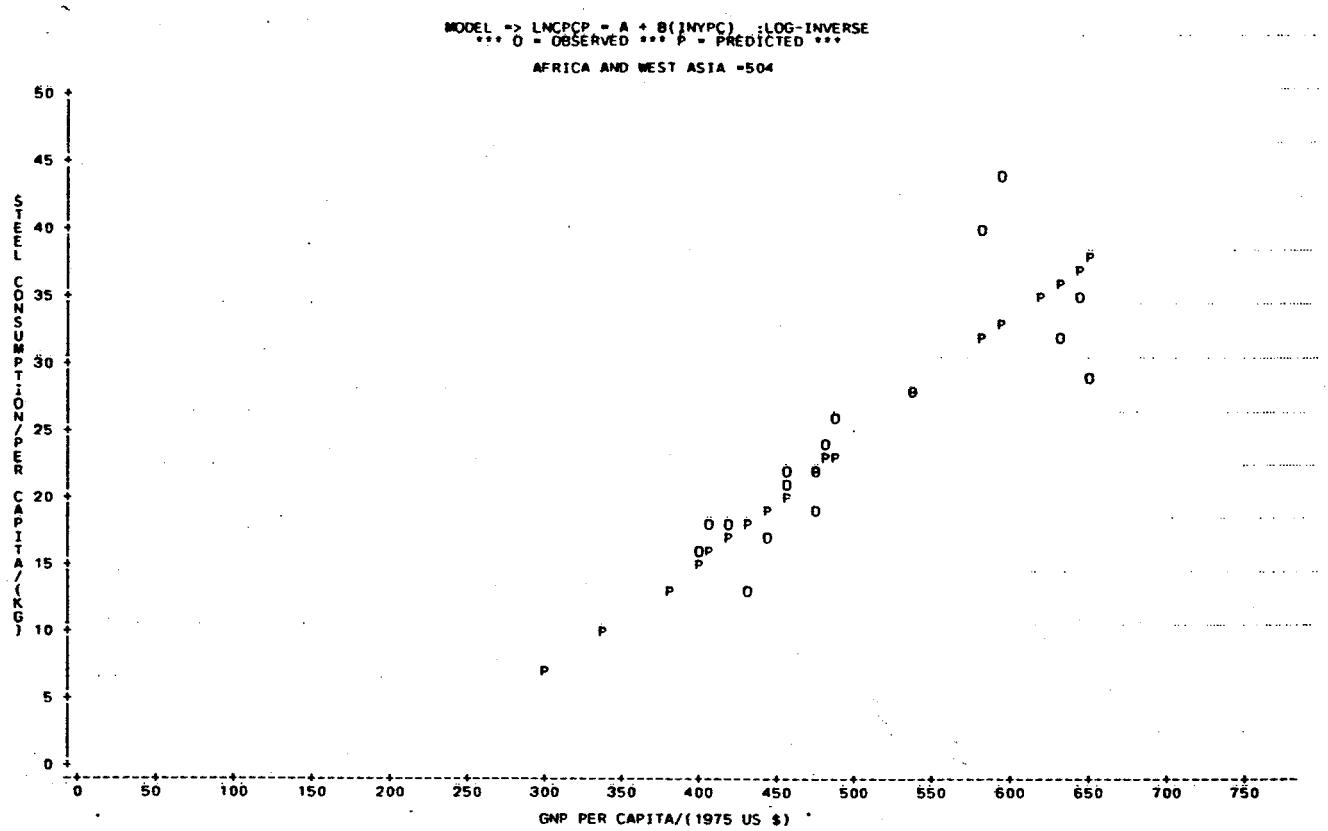


Figure 12.
Libyan A.J.: Variation of steel consumption per capita with GNP per capita

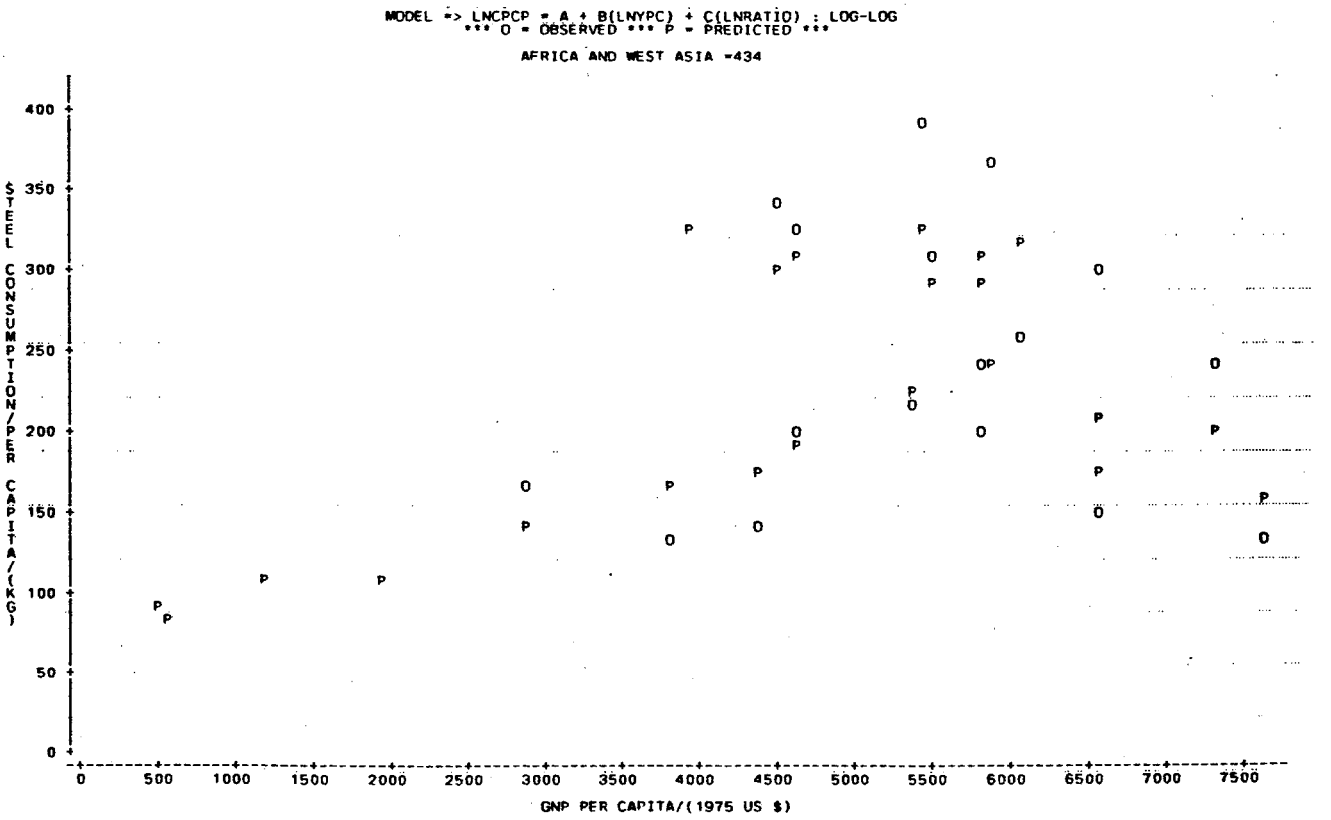


Figure 13.
Nigeria: Variation of steel consumption per capita with GNP per capita

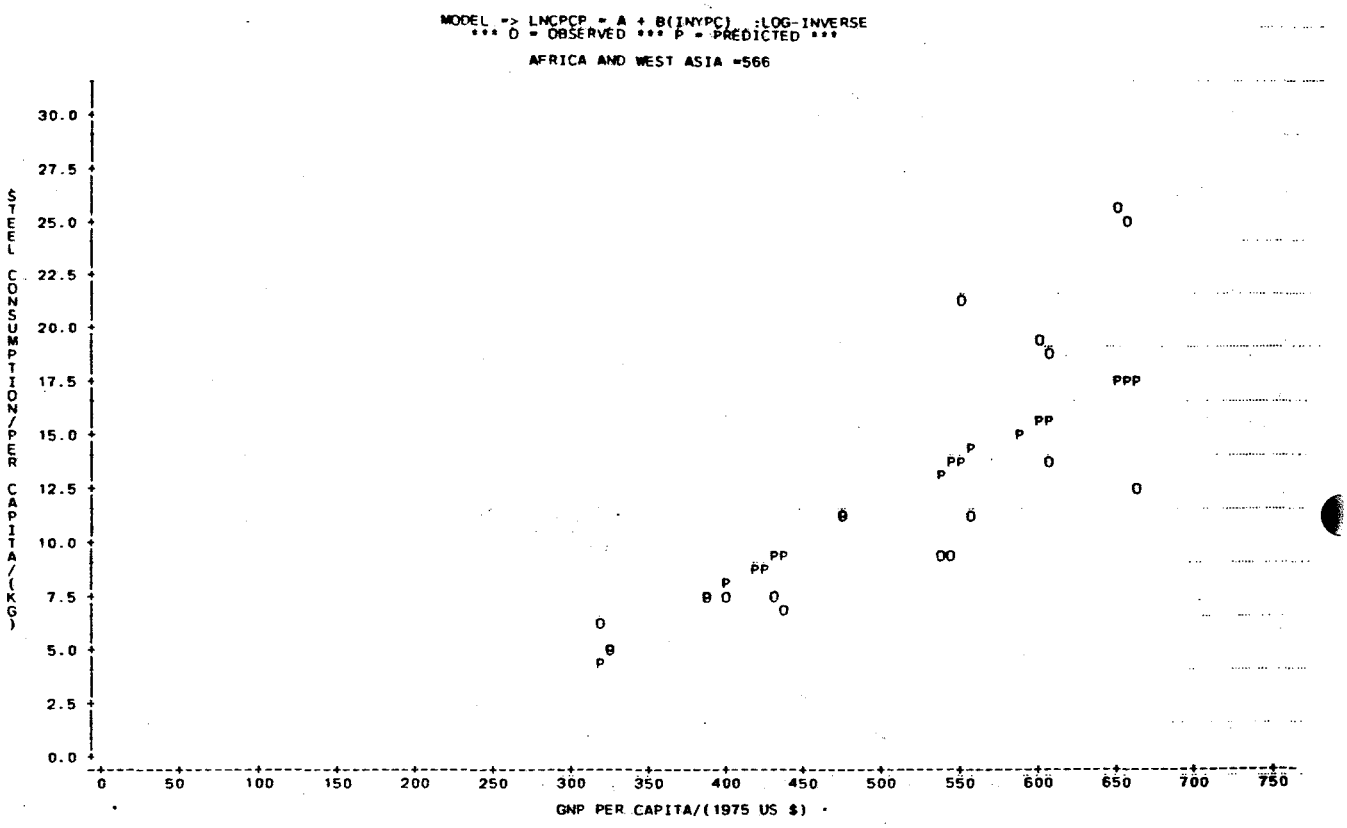


Figure 14.
Togo: Variation of steel consumption per capita with GNP per capita

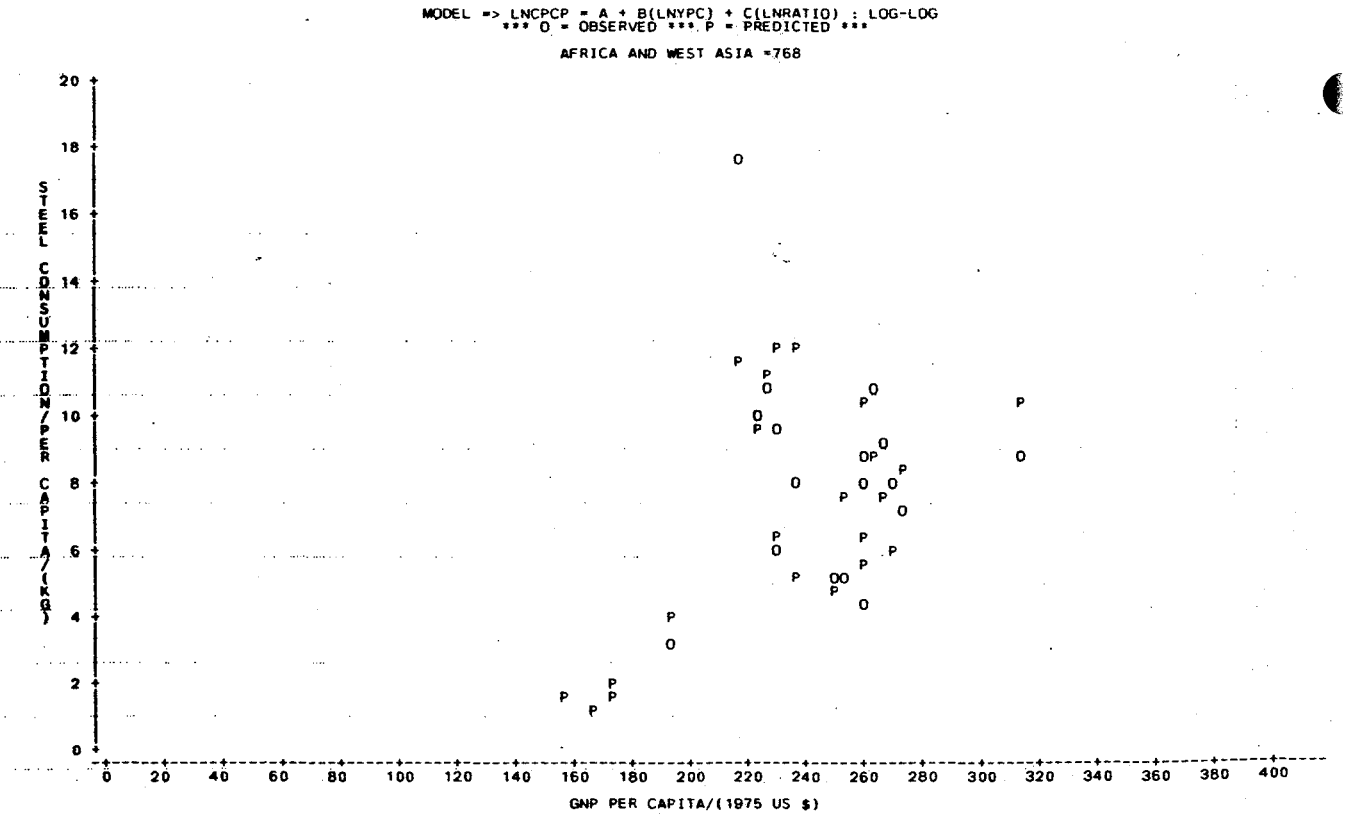


Figure 15.
Tunisia: Variation of steel consumption per capita with GNP per capita

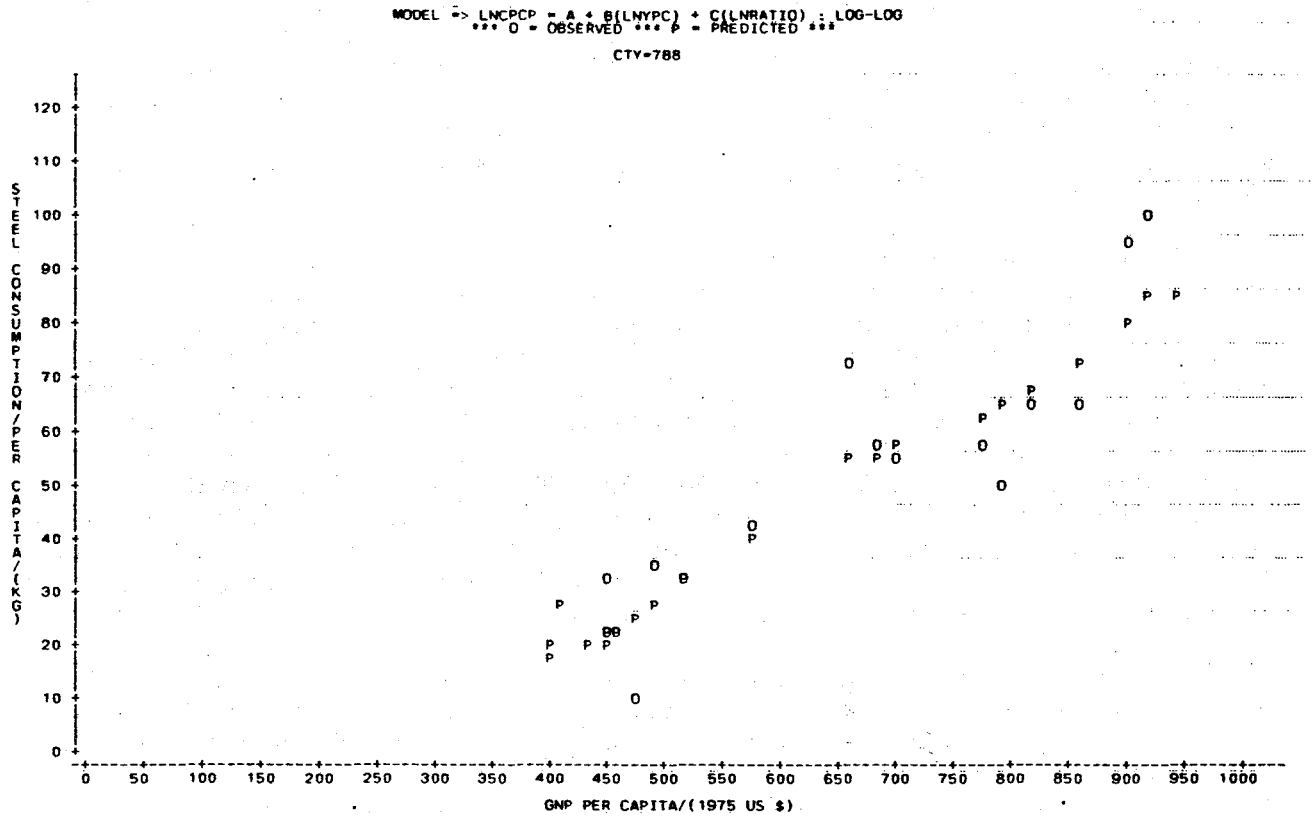
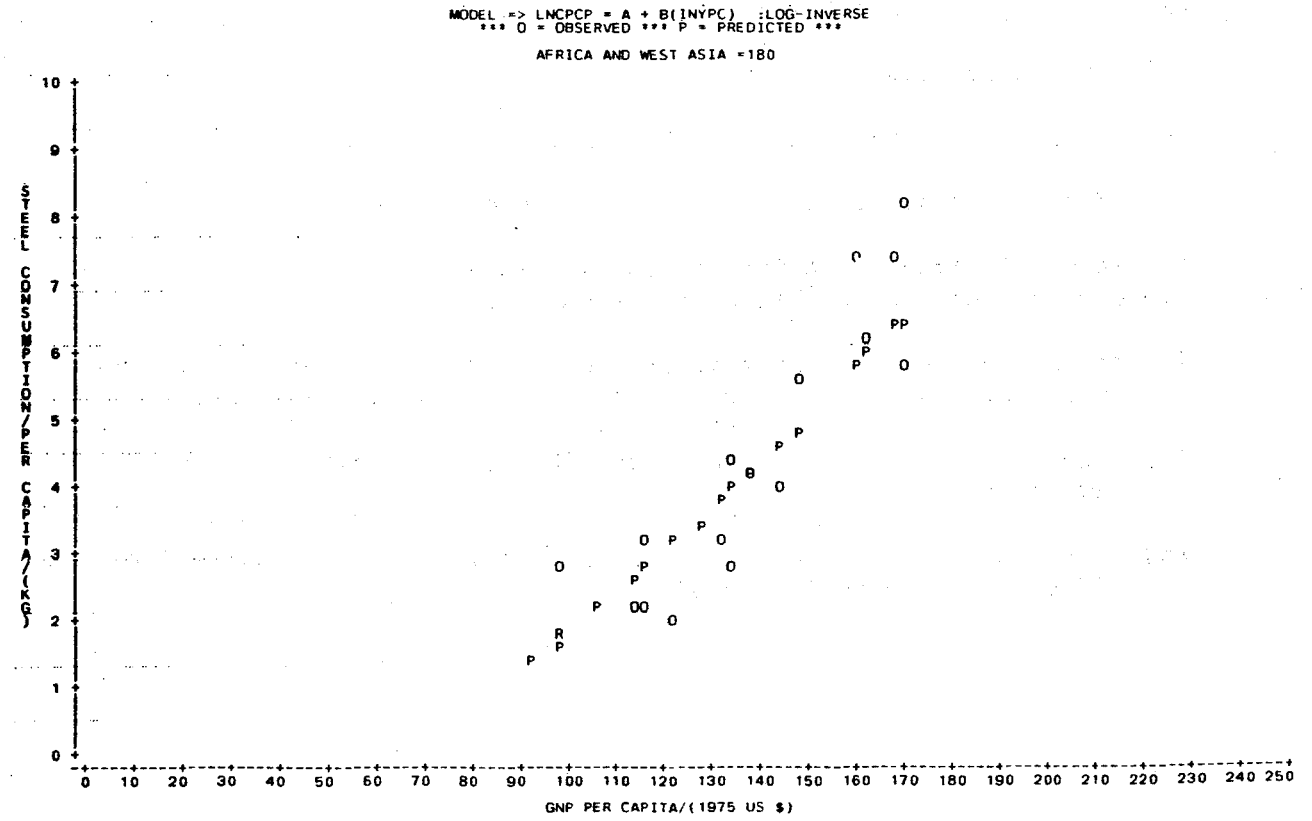


Figure 16.
Zaire: Variation of steel consumption per capita with GNP per capita



2.3 Steel intensity trend

The change in the composition of GNP are directly related to economic transition as a country progresses from a purely agrarian stage toward industrialization. This successive phase find definited reflection in the progression of capital incomes, and, for our purpose, in the steel intensity levels. In this section we examine the changes overtime of the shares of industrial sectors in GNP as a country's economy passes from one level of income per head to another and the differences between the absolute level of steel intensity of individual countries in the region concerned and these are shown in table 11.

The function of steel consumption within the economic structure of a country finds expression in the ratio of apparent steel consumption (AC) to gross national product (GNP). This ratio (AC over GNP) is called steel intensity, that is steel intensity (SI) is measured by the volume of steel consumed (AC) per value unit of total economic output. As used in this paper steel intensity is expressed as steel consumption, measured in kilograms of steel, related to the GNP, expressed in US dollar at constant, 1975, prices. The relation between steel consumption and GNP - or other indicators of economic activity - is termed steel intensity. It is assumed that changes in the steel intensity relative to changes in income is directly related to the level of income. Thus steel intensity normally increases as GNP per capita increases up to a peak and declines thereafter.

IISI makes a more detailed examination of the steel intensity curve but has not many examples of steel intensity curves in Africa. Now in the steel intensity analysis conducted by the Sectoral Studies Branch, UNIDO, steel intensities in sixteen out of twenty six countries are given with one or two steel intensity curves on graph out of eight regions namely North Africa, Central Africa and West African countries. The regression co-efficient is apparent steel consumption per capita divided by GNP per capita. The explanatory variable in this method is gross national product.

IISI considers four successive stages of economic development, that is,

(a) Developing countries and the conditions for take-off;

(b) The stage after take-off;

(c) Leveling-off phase and the timing of the peak and

(d) Mature economies and the decline in steel intensity.

All industrialized countries are considered at the stage of (d) where steel intensity tends to stablilize and then to decline.

In this study, we are mainly interested in stage (a). In studies made by IISI the indicators used to analyze the conditions for take-off are as follows:

(a) Gross Domestic Capital Formation (GDCF) at a level of a least 20 per cent of GNP;

(b) More than 20 per cent of GDP originating in manufacturing (less than 30 per cent in agriculture);

Table 11. Steel intensity and economic structure in North African countries (kg/1975 $US, per cent)

Year	Algeria				Libyan Arab Jamahiriya			
	Steel intensity	GCF/ GNP	MFG/ GDP	CAP/ MFG	Steel intensity	GCF/ GNP	MFG/ GDP	CON/ GDP
1960	...	24	13	...	...	67	7	17
1965	0.037230	19	5	10	0.0339776	18	1	5
1966	0.028483	14	6	10	0.0321368	18	1	4
1967	0.028042	18	5	10	0.0435332	18	1	5
1968	0.053852	24	5	9	0.0456047	15	1	4
1969	0.068949	29	6	2	0.0331975	13	1	3
1970	0.063289	31	8	10	0.0177450	8	1	2
1971	0.059021	31	7	9	0.0227222	11	1	4
1972	0.055178	31	7	9	0.0402540	20	1	6
1973	0.059934	33	8	10	0.0633553	19	1	8
1974	0.111579	43	9	11	0.0763396	35	2	12
1975	0.096960	49	8	11	0.0692355	34	2	12
1976	0.077950	44	8	11	0.0558967	27	2	11
1977	0.114278	46	8	12	0.0407096	27	3	11
1978	0.124355	49	8	16	0.0347213	26	3	11
1979	0.097509	48	9	20	0.0430427	28	3	10
1980	0.115110	49	9	23	0.0712033	32	3	12
1981	0.124504	51	9	25	0.1144650	45	4	14
1982	...	...	...	...	...	...	...	...

Year	Morocco				Tunisia			
	Steel intensity	GCF/ GNP	MFG/ GDP	CAP MFG	Steel Intensity	GCF/ GNP	MFG/ GDP	CAP/ MFG
1960	...	11	15	...	...	17	10	17
1965	0.0309359	10	15	16	0.074560	32	8	4
1966	0.0391438	10	16	16	0.049403	30	8	4
1967	0.0440459	14	15	17	0.050610	31	8	4
1968	0.042981	12	15	18	0.021182	28	8	4
1969	0.0471555	12	15	19	0.068985	28	9	5
1970	0.0483177	16	16	18	0.064890	25	8	5
1971	0.0411639	15	16	18	0.071426	25	9	6
1972	0.0461556	11	16	18	0.085181	27	10	7
1973	0.0491361	13	17	19	0.109770	23	10	6
1974	0.0529765	13	16	19	0.079743	27	11	8
1975	0.0522221	24	17	19	0.074376	31	10	9
1976	0.0691512	26	16	20	0.063845	32	12	10
1977	0.0732149	29	16	20	0.079141	32	12	9
1978	0.0513619	24	17	15	0.076004	34	12	11
1979	0.0551157	23	17	16	0.104701	34	13	11
1980	0.0451649	27	17	16	0.109207	33	13	11
1981	0.0482870	22	18	...	0.074224	34	13	14
1982	...	...		...	...	...	...	15

Table 11. Steel intensity and economic structure in North American countries (kg/1975 $US, per cent) (cont'd)

Year	Congo				Gabon			
	Steel intensity	GCF/ GNP	MFG/ GDP	CAP/ MFG	Steel intensity	GCF/ GNP	MFG/ GDP	CON/ GDP
1960	...	60	12	...	...	38	6	10
1965	...	24	14	...	...	23	5	9
1966	...	33	15	...	...	30	4	10
1967	...	38	16	...	...	24	4	10
1968	...	39	16	...	...	28	3	7
1969	...	39	16	...	...	26	3	6
1970	0.036826	32	10	5	0.032678	25	3	7
1971	0.066804	33	10	6	0.040612	25	5	8
1972	0.052129	34	9	6	0.069755	36	7	14
1973	0.057811	33	7	6	0.061179	32	6	14
1974	0.077810	33	7	5	0.050563	64	5	15
1975	0.043429	36	6	6	0.054482	67	5	19
1976	0.058106	32	6	6	0.038541	79	5	29
1977	0.061567	29	7	6	0.053477	66	7	21
1978	0.025995	26	8	6	0.020535	50	8	20
1979	0.045977	23	8	6	0.016789	34	9	17
1980	0.129298	22	8	6	0.033034	38	9	18
1981	0.119014	24	8	...	0.034620	38	9	18
1982	...	...	...	...	...	...	...	...

Year	Sudan				Zaire			
	Steel intensity	GCF/ GNP	MFG/ GDP	CAP/ MFG	Steel Intensity	GCF/ GNP	MFG/ GDP	CAP/ MFG
1960	...	10	7	...	...	14	4	...
1965	0.010811	12	8	2	0.021023	19	6	12
1966	0.014749	15	11	2	0.030372	17	5	11
1967	0.012618	14	11	3	0.024918	18	3	10
1968	0.013123	13	11	3	0.030321	18	8	8
1969	0.021472	11	13	3	0.038478	23	8	9
1970	0.028125	14	11	3	0.046796	26	8	10
1971	0.020772	10	12	4	0.043623	33	8	9
1972	0.015924	14	9	3	0.038369	33	8	9
1973	0.022951	16	15	3	0.034619	33	8	9
1974	0.022082	18	10	3	0.048425	35	8	10
1975	0.015873	18	9	3	0.027321	37	8	11
1976	0.018519	22	8	4	0.018340	34	8	10
1977	0.028490	17	7	3	0.026744	61	8	11
1978	0.011142	14	7	3	0.016188	37	7	11
1979	0.014749	14	8	3	0.020049	40	7	14
1980	0.021021	15	8	3	0.029215	62	6	15
1981	0.026471	16	8	...	0.024973	65	6	...
1982	...	...	...	...	...	...	...	...

Table 11. Steel intensity and economic structure in North American countries (kg/1975 $US, per cent) (cont'd)

Year	Ghana				Guinea			
	Steel intensity	GCF/ GNP	MFG/ GDP	CAP/ MFG	Steel intensity	GCF/ GNP	MFG/ GDP	CON/ GDP
1960	...	20	10	...	...	13	3	4
1965	0.029225	20	10	8	0.020549	16	5	7
1966	0.010017	18	10	7	0.027778	18	4	7
1967	0.012468	13	11	7	0.017985	16	4	8
1968	0.008576	11	12	7	0.022727	16	5	7
1969	0.008319	12	14	7	0.037037	16	5	7
1970	0.014030	15	14	7	0.038136	17	5	6
1971	0.013740	15	12	7	0.037657	16	5	7
1972	0.003936	8	11	7	0.012876	18	5	6
1973	0.010902	10	13	6	0.008511	18	5	7
1974	0.015777	13	11	6	0.008032	18	5	8
1975	0.020415	13	14	7	0.016000	19	7	7
1976	0.018454	10	14	7	0.007519	16	7	8
1977	0.026660	15	14	7	0.011952	13	7	7
1978	0.013227	13	14	7	0.019531	14	6	5
1979	0.008143	15	14	5	0.007905	15	5	5
1980	0.007784	16	14	5	0.015267	15	5	5
1981	0.006596	17	14	3	0.011494	15	5	5
1982	...	...	...	...	...	...	...	...

Year	Cote d'Ivoire				Liberia			
	Steel intensity	GCF/ GNP	MFG/ GDP	CON/ GDP	Steel intensity	GCF/ GNP	MFG/ GDP	CON/ GDP
1960	...	16	8	5	...	74	2	13
1965	...	22	9	5	0.089919	53	3	5
1966	...	23	10	6	0.063670	43	3	6
1967	...	21	10	6	0.092205	41	3	7
1968	...	20	10	5	0.052251	39	3	5
1969	...	22	10	5	0.089026	38	4	5
1970	0.010241	24	12	7	0.085461	32	4	5
1971	0.006664	23	13	8	0.057848	33	4	4
1972	0.008143	21	13	7	0.037575	28	4	4
1973	0.007988	25	13	7	0.074878	23	5	4
1974	0.007338	25	15	6	0.046204	28	6	5
1975	0.006106	23	14	7	0.034980	51	5	4
1976	0.008824	26	15	8	0.053650	45	6	5
1977	0.006164	35	15	10	0.062856	42	7	6
1978	0.006033	38	16	11	0.050326	36	7	6
1979	0.005663	35	16	10	0.052134	50	7	5
1980	0.005540	34	16	10	0.055088	41	6	4
1981	0.003909	28	16	8	0.038781	27	6	4
1982	...	...	...	...	...	...	...	...

Table 11. Steel intensity and economic structure in North American countries (kg/1975 $US, per cent) (cont'd)

Year	Senegal				Togo			
	Steel intensity	GCF/ GDP	MFG/ GDP	CAP/ GDP	Steel intensity	GCF/ GNP	MFG/ GDP	CON/ GDP
1960	...	17	10	7	...	11	4	5
1965	...	13	11	5	0.025627	22	6	6
1966	...	11	11	4	0.033412	16	11	5
1967	...	19	7	2	0.016869	12	11	7
1968	...	12	11	4	0.021035	12	11	4
1969	...	14	13	5	0.030169	13	12	4
1970	0.027392	16	13	5	0.030582	15	10	5
1971	0.024930	17	14	5	0.034311	18	9	4
1972	0.032044	17	13	5	0.025726	18	8	7
1973	0.035103	20	13	5	0.019847	20	9	6
1974	0.046161	23	14	5	0.028577	17	7	6
1975	0.032759	18	14	5	0.033591	29	7	9
1976	0.041974	17	14	5	0.040484	22	7	8
1977	0.035894	16	15	5	0.044201	42	7	10
1978	0.031769	18	15	5	0.081776	61	6	14
1979	0.045777	20	14	5	0.042308	52	6	16
1980	0.036304	16	14	5	0.047198	50	6	12
1981	0.032453	17	14	5	0.031370	50	7	12
1982								

Year	Nigeria				Sierra Leone			
	Steel intensity	GCF/ GNP	MFG/ GDP	CAP/ MFG	Steel intensity	GCF/ GNP	MFG/ GDP	CON/ GDP
1960	...	6	3	...	...	12	6	4
1965	0.015748	10	5	10	...	21	7	3
1966	0.018277	10	5	14	...	17	7	2
1967	0.015849	10	5	11	...	19	7	2
1968	0.018769	8	6	11	...	18	7	3
1969	0.079855	8	6	11	...	23	6	3
1970	0.024133	11	5	11	0.017040	18	6	3
1971	0.017084	13	5	11	0.031171	14	7	3
1972	0.017766	14	5	11	0.026026	14	7	3
1973	0.020543	19	5	11	0.023803	18	7	3
1974	0.022789	18	4	9	0.023911	17	8	3
1975	0.038004	25	5	14	0.016426	12	8	3
1976	0.032496	25	6	19	0.019052	14	7	3
1977	0.039288	25	5	24	0.017768	14	8	3
1978	0.031114	24	6	20	0.016740	14	8	3
1979	0.018894	19	7	22	0.017710	18	7	4
1980	0.038168	20	7	18	0.022037	14	7	5
1981	0.036461	25	8	20	0.015367	14	6	5
1982	...	...	...	...	...	...	...	...

(c) More than 10 per cent of manufacturing production consisting of capital goods;

(d) More than 700 tons of steel consumed per millions of US dollars of GDCF.

Our steel intensity curves are based on factors, (a), (b) and (c). Whenever data for capital goods production were missing, figures for value added in construction are used as a proxy. It is legitimate to do it since the level of construction tends to be considerably higher in developing economies where the basic infrastructure has been built up.

Even though we have no data on (d) on our database, it is assumed that higher level of steel intensity for the countries at a lower GNP level reflects the higher speed of development and of growth in capital formation. As a rule, the rapid development of the infrastructure greatly increases the share of construction, and, hence, the level of steel consumption.

Table 12 below shows GNP per capita income at 1975 constant US dollar. Libyan Arab Jamahiriya has the highest average income per capita from 1965 to 1981; then Algeria. In these countries the rising trends of steel intensity is the sharpest among sixteen countries and it is in line with the very rapid rise in the share of capital formation in GNP. But the level of steel intensity in Gabon comparatively low, although GNP per capita is one of the highest among sixteen developing countries. Steel intensity and capital formation and the share of GNP have fluctuated considerably, and definite trends cannot be discerned on the basis of available data.

Table 12. GNP per capita at 1975 constant US dollar

	Algeria	Libyan A.J.	Morocco	Tunisia	Congo	Gabon	Sudan	Zaire	Ghana
1960	924	489	299	407	371	463	353	122	492
1965	606	3,842	433	449	496	635	370	134	489
1970	846	7,620	457	520	612	1,063	320	159	513
1975	953	4,654	540	772	545	2,019	315	144	456
1980	1,052	5,447	648	918	473	2,037	333	98	352
1981	1,014	3,925	618	938	473	2,120	340	92	352

	Guniea	Cote d'Ivoire	Liberia	Nigeria	Sierra Leone	Senegal	Togo
1960	271	407	195	417	119	410	156
1965	292	436	226	437	192	422	229
1970	236	512	294	478	218	385	259
1975	250	557	294	553	220	368	260
1980	262	629	323	656	209	326	226
1981	261	616	328	588	200	291	235

Steel intensities in Algeria, Libyan Arab Jamahiriya and Tunisia are the highest. However, Algeria and Morocco have better conditions for the take-off since the ratios of GDCF to GNP have a steady increase and the ratio of MFG to GDP is far less than Algeria and Morocco, and Tunisia is situated between these two countries. However, there is no country which meets the requirement for take-off.

Figures 17 and 20 show steel intensities of Algeria, Libyan Arab Jamahiriya, Morocco and Tunisia which explain the relationship of steel intensity to GNP capita by means of correlation calculation. The following equation shows a regression curve:

LNSI = -17.48999277 + 2.19689990 LNYPC : Log-Log has been found to give a good fit for Algeria. Algeria and Tunisia have a steadier increase of steel intensity as their income goes up.

However, none of these countries fullfil the conditions for take-off. Especially MFG/GDP and capital goods/GDP are very low. In these countries manufacturing is still not active enough to take off for industrialization.

Steel intensities in Congo, Gabon, Sudan and Zaire are low but Congo has high steel intensity since 1980. Gabon has the highest income per capita among these countries but industrial activity is not as great as Zaire which has 20 times less income per capita. In Togo and Zaire, the rapid rise in the capital formation share of GNP has not as yet produced a full scale development of manufacturing industries. This is probably the reason why the steel-using sectors in these countries have not developed enough to produce a more rapid increase of steel consumption, in spite of a higher level and a sharp increase of capital formation.

In western African countries, Nigeria, Senegal and Togo have higher steel intensities. Côte d'Ivoire has less steel intensity than other countries despite her high income.

Figure 17.
Steel intensity of Algeria

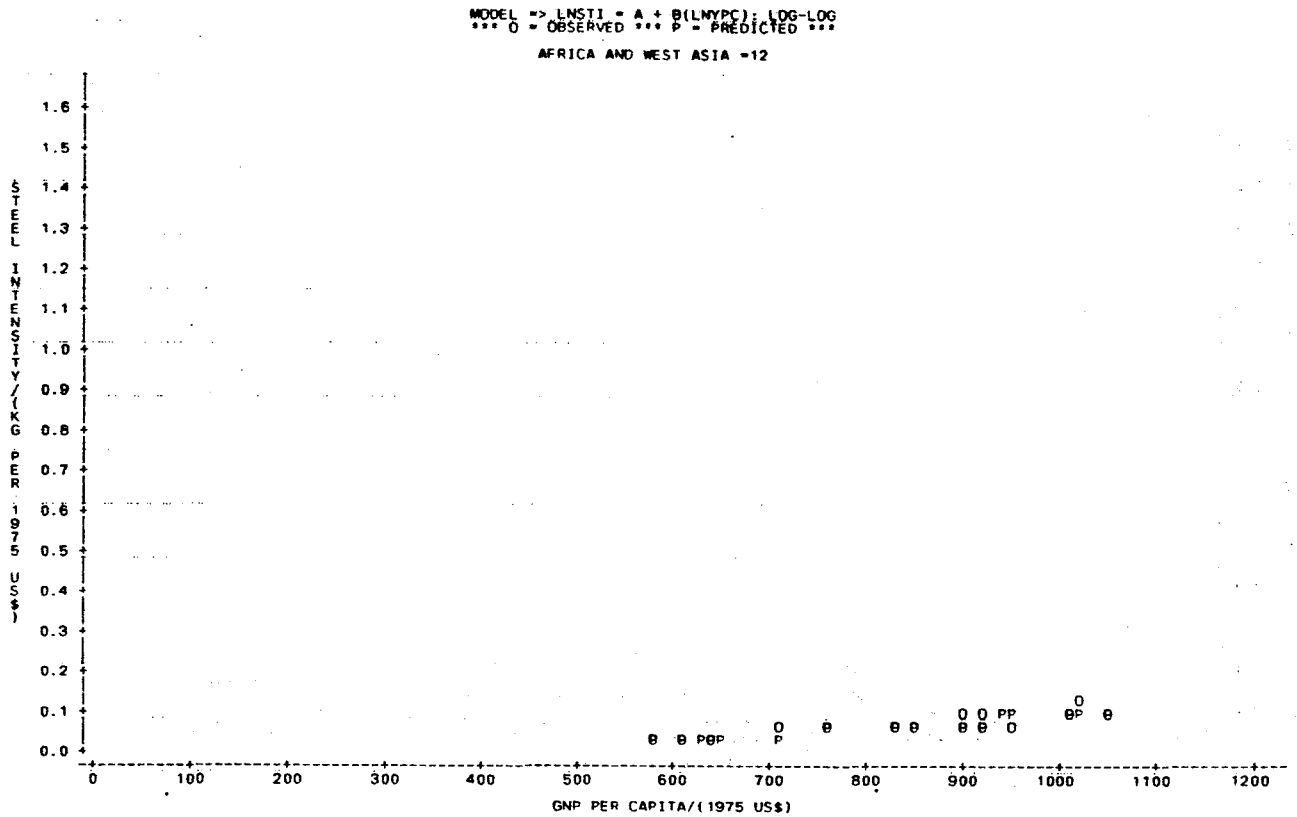


Figure 18.
Steel intensity of Libyan Arab Jamahiriya

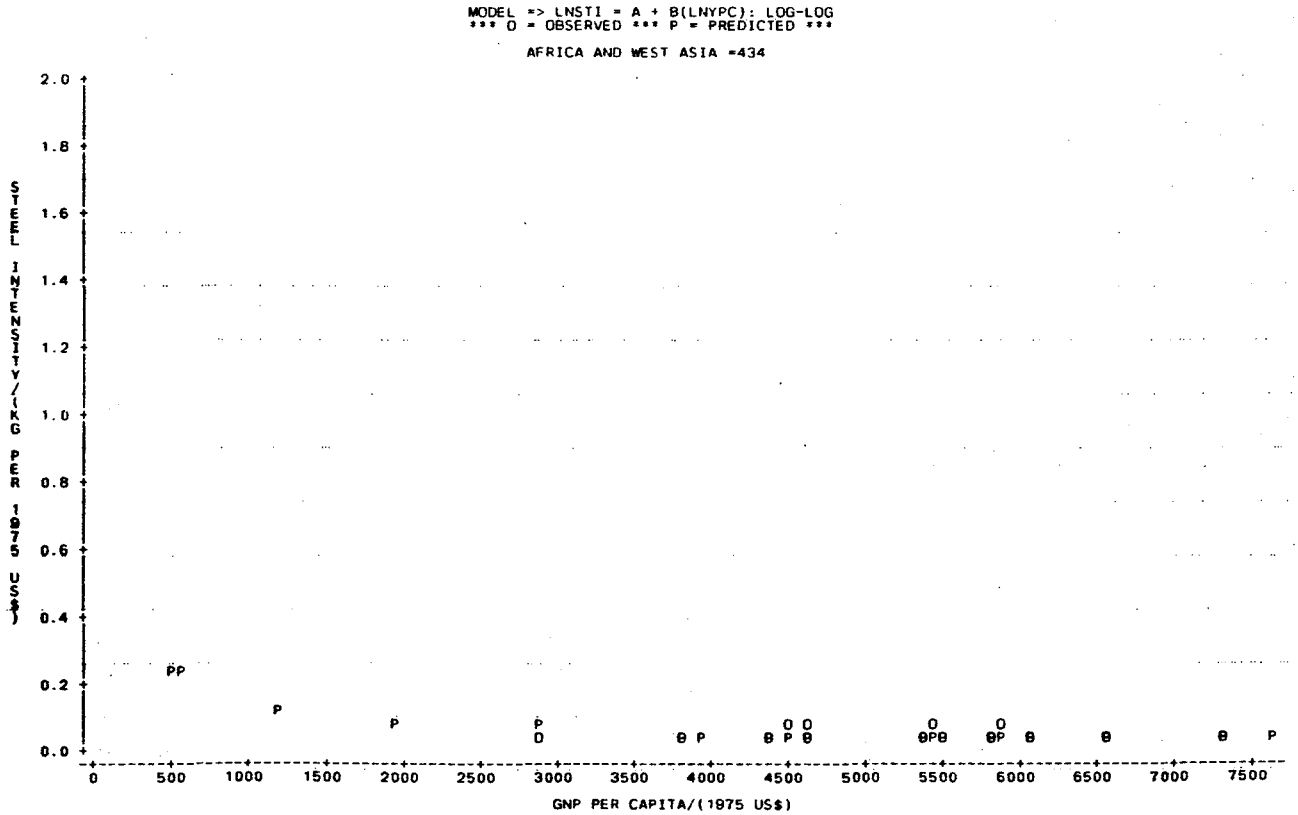


Figure 19.
Steel intensity of Morocco

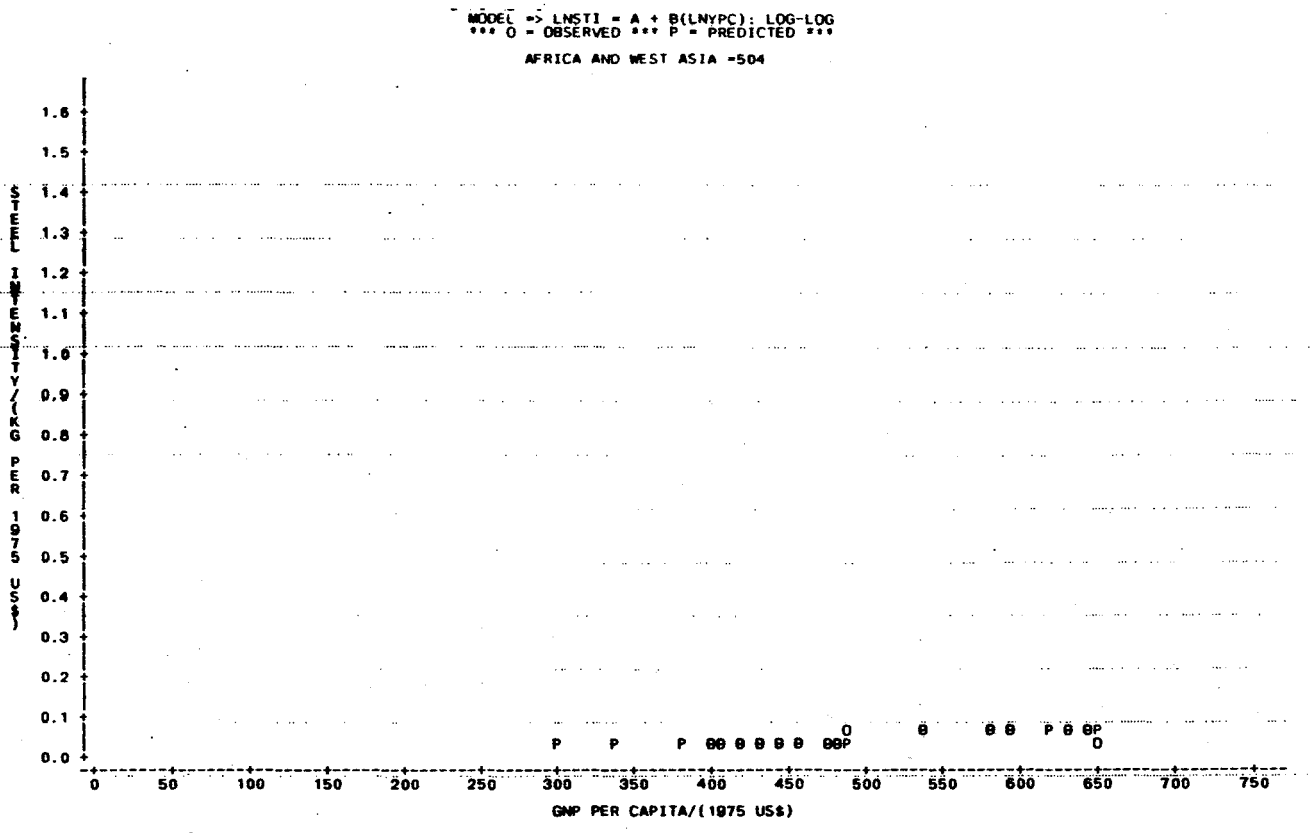


Figure 20.
Steel intensity of Tunisia

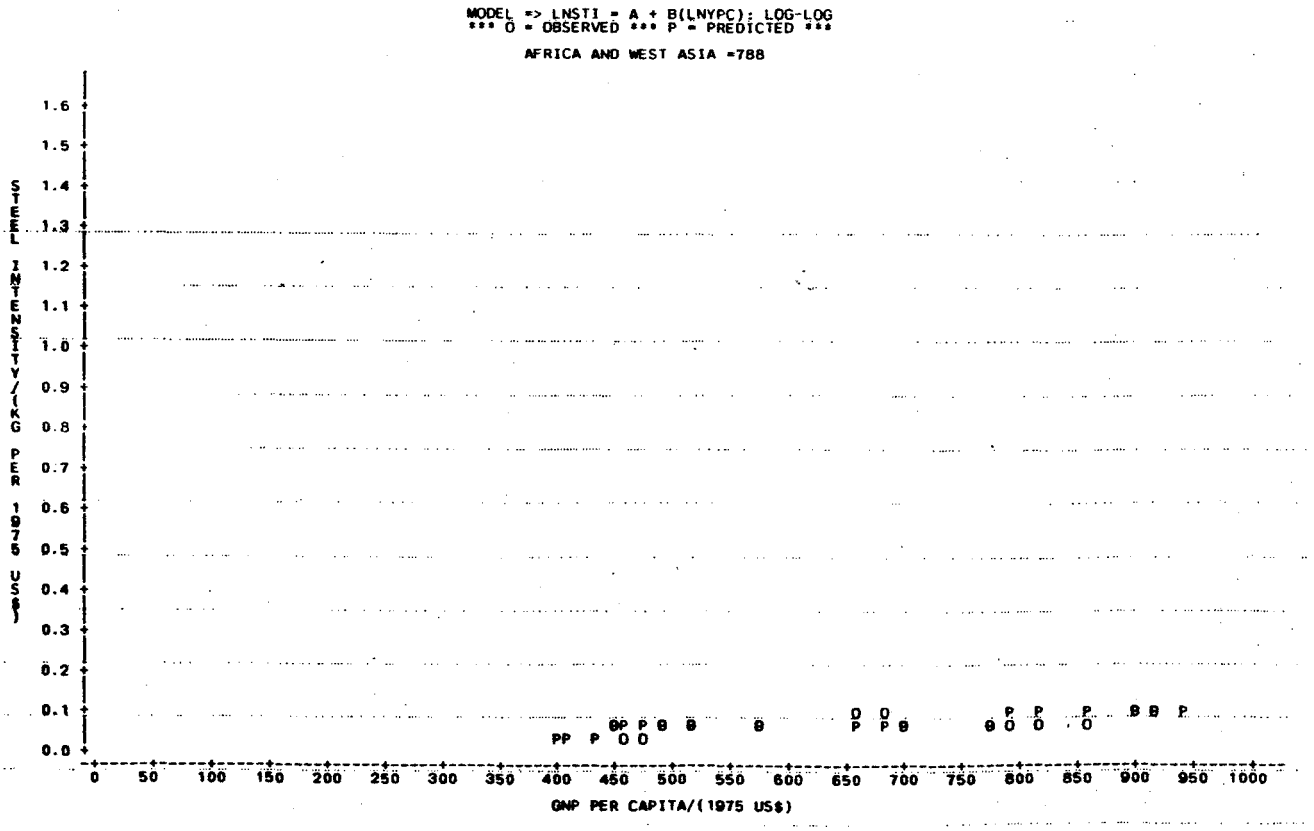


Figure 21.
Steel intensity of Zaire

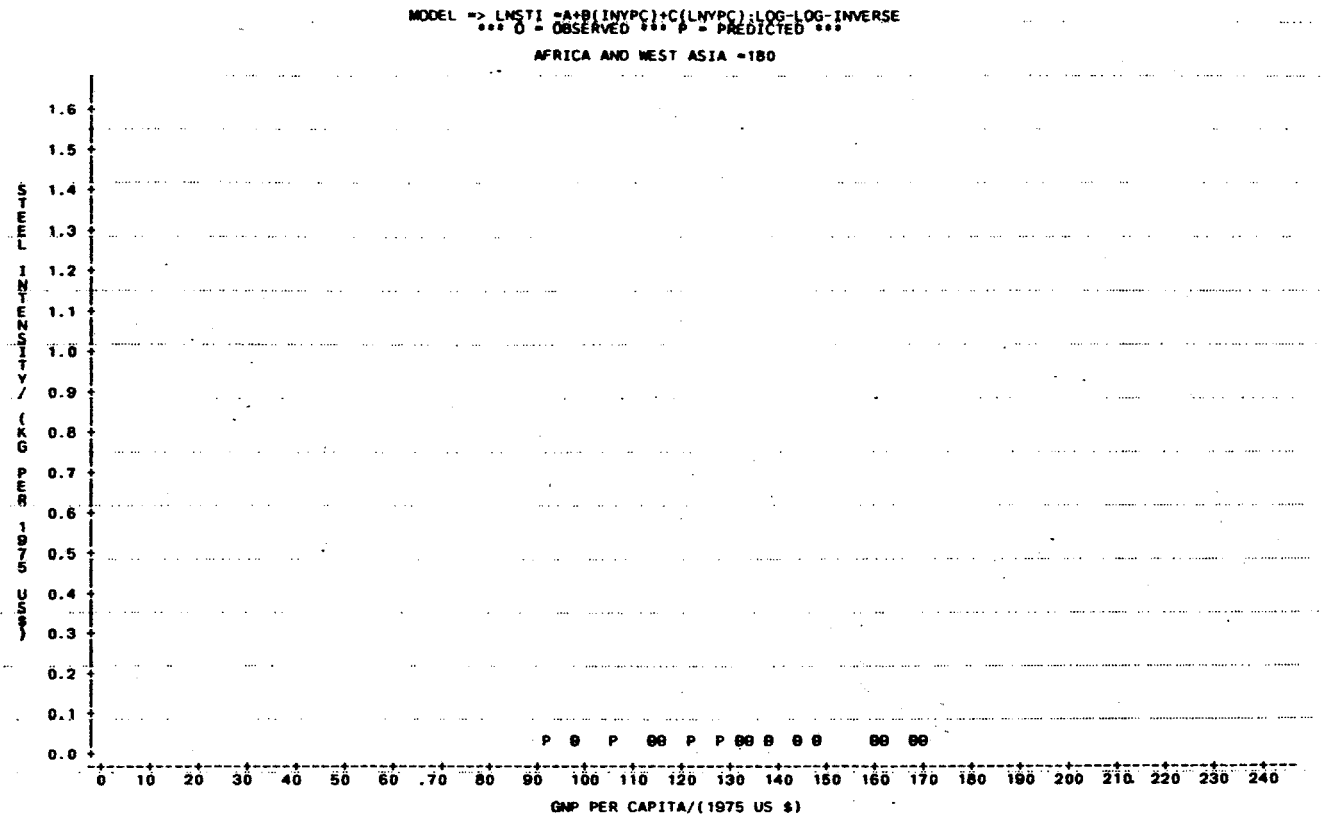


Figure 22.
Steel intensity of Nigeria

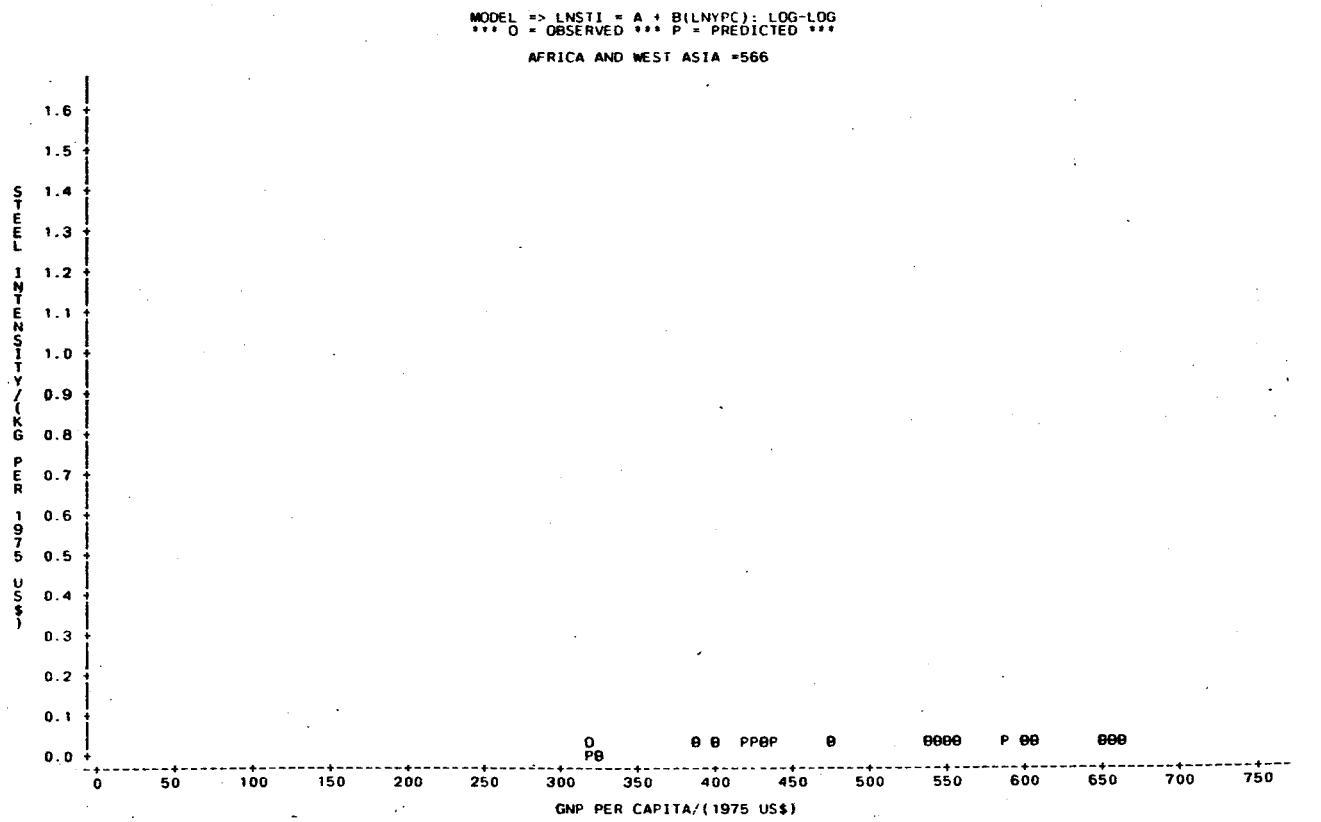


Figure 23.
Steel intensity of Senegal

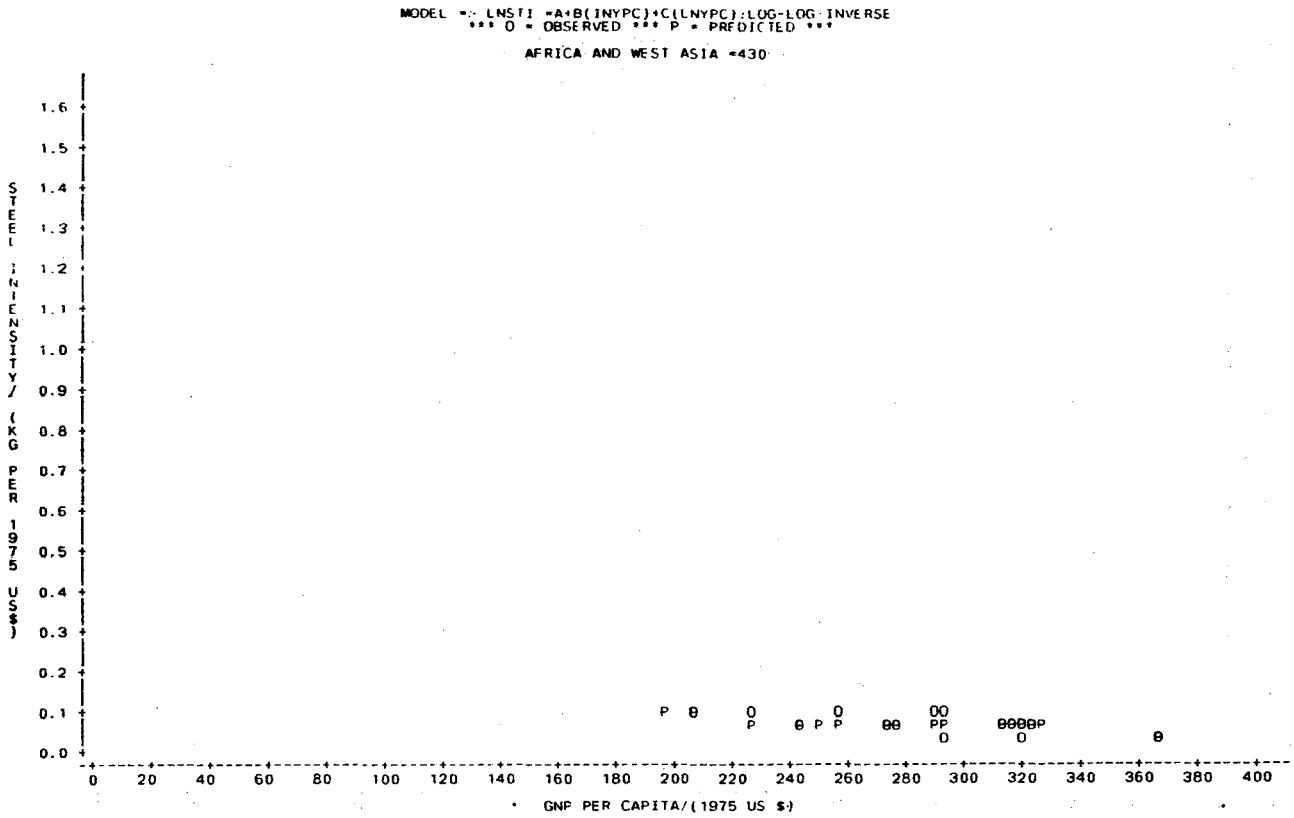
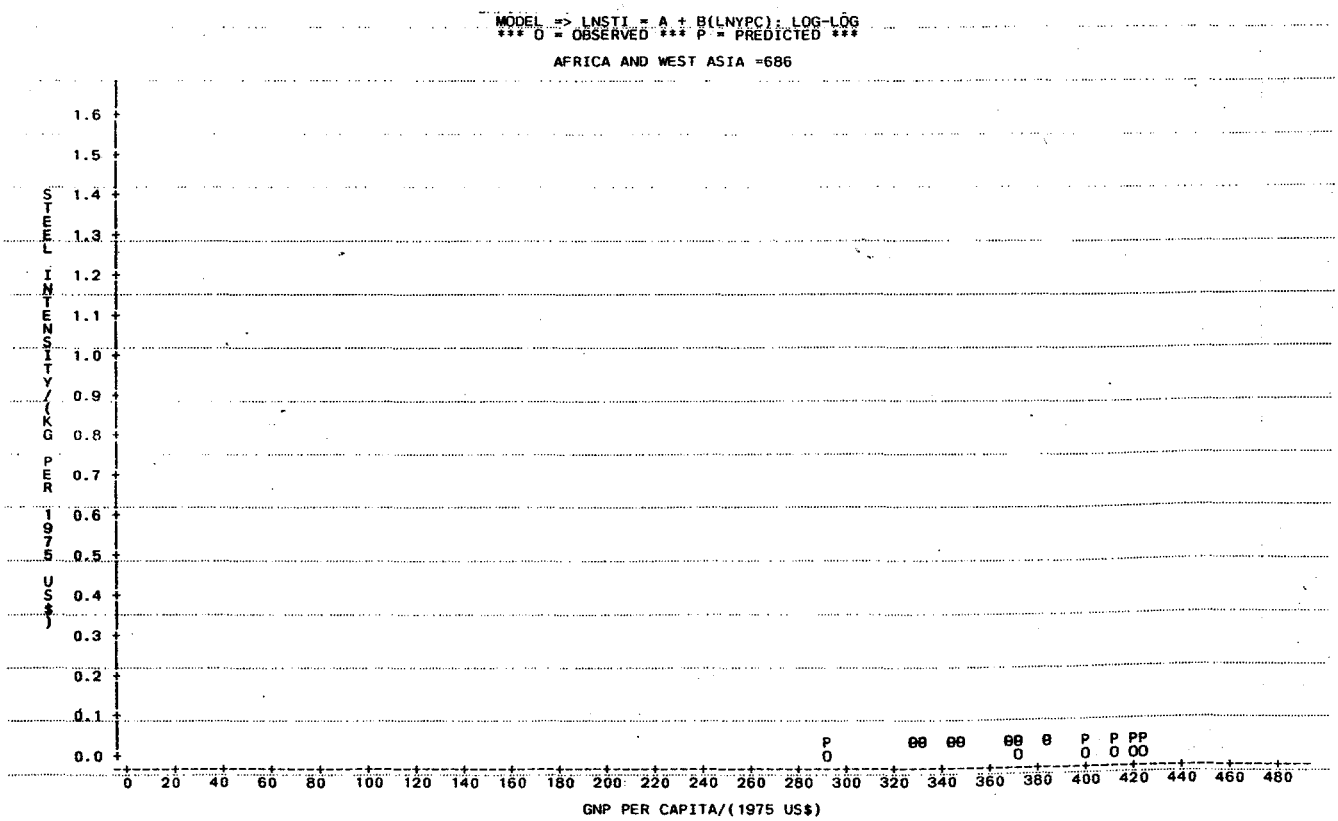


Figure 24.
Steel intensity of Togo



Our study shows that there are some developing African countries which the level of steel intensity is much lower although the level of GNP per capita is higher. This is ascribed to the fact that exports of raw materials (minerals or other primary products) have accounted for over 60 per cent of total exports, further, that the country's economy relies primarily on the exploitation for export of natural resources. The high level of personal income supported by such exports does not involve an increase of steel consumption. In some developing countries such as Liberia and Zaire, rapid increase of capital formation takes place at a very low income level (about $US 100 to $US 150 of GNP per head). In countries where we have analysed steel intensity, it seems that the conditions for take-off are gradually established over a much longer period, and the growth rate of GNP is more moderate. The level of steel intensity varies considerably at the same income levels per head. For example, in Nigeria and Cote d'Ivoire, this seems to be caused by the differences in economic structure and especially by the rate of increase of capital formation. To take off from the stage of under-development an economy needs as an essential element that capital formation for industrialization is developed smoothly within the overall framework of the economy. Fortunately in all developing African countries concerned here capital formation is on the rise. Thus, it is expected that steel consumption grows together with the steady rise of the capital formation in the share of GNP as these countries steadily progress in their industrialization and in the development of their infrastructure.

In summary the level of GNP per capita in itself is not an indication whether a country is at the take-off point nor whether it is approaching this point but the steel intensity is.

2.4 Steel production in West and North Africa

As shown in table 5 five African countries account for most of the crude steel output of the region. They are Algeria, Egypt, Nigeria, Tunisia and Zimbabwe, which together produced over 2.3 million tons of Africa's 1984 total steel output of about 2.4 million tons.

2.4.1 Existing steel works

Table 13 lists, by countries, the various operating steelworks in West and North Africa as of the end of 1985. Only about ten of the 26 countries covered by this report qualify as steel producers in the sense that they operate one or more crude steelmaking facilities and/or possess rolling mills for converting imported billets, blooms or slabs into finished bars, rods, shapes, plates, or sheets/strips. (In this context, re-rolling mills that merely cold-roll, corrugate, or galvanize imported hot-rolled sheets do not qualify for classification as steelworks).

As of end 1985, the total operating crude (liquid) steelmaking capacity of the West and North African subregions was about 5.4 million tons per annum, of which 5.05 million tons capacity was concentrated in three oil-producing countries: Algeria (2.5 million tons), Libyan Arab Jamahiriya, (1.32 million tons in 1987), and Nigeria (1.22 million tons). 4.04 million tons of crude steel capacity was located in the North African area which also had the largest integrated steel works the El Hadjar plant of Société Nationale de Sidérurgie (SNS), near Annaba in Algeria.

Table 13. Steelworks of West and North Africa

Country	Steelworks and location	Crude steel-making capacity thousand tons/yr	Rolling capacity thousand tons/yr	Product mix
Algeria	(a) Sté Nationale de Sidérurgie (SNS), El Hadjar Annaba	2,070 1,900 170	About 3,000	Hot and cold-rolled flat products
	(b) SNS, Bellara (to be commissioned in 1991)	1,100	1,050 600 450	Long products (bars, rods, sections, angles etc.)
	(c) SNS, Oran	30 (OH)		Long products
Ghana	Tema Steel Works, Tema	35(EAF)		Rebar
Côte d'Ivoire	Sté de Galvanisation de en Côte d'Ivoire, Abidjan	...	30; re-rolling mill based on imported hot strips	Strip-coated and galvanized sheets
Libyan Arab Jamahiriya	(a) Mini-steel mill at Tripoli	30	60	Rebars, angles and shapes
	(b) Libyan General Co.for Iron and Steel, Misurata (to be commissioned in Mid-1987)	1,290	1,300	Cold - and hot-rolled sheets. Bars and rods
Mauritania	Arab Metal Industries, Nouadhibou	12	36	Rebars
Morocco	(a) Sté Nationale de Sidérurgie Nador	...	420	Rebars, angles and rods
	(b) Sidérurgie du Maroc, Tangiers	30	50	Rebars
	(c) Produits Metallurgiques Galvanisés, Casablanca	...	18; based on imported hot strips	Galvanized Corrugated sheets

Table 13. Steelworks of West and North Africa (cont'd)

Country	Steelworks and location	Crude steel-making capacity thousand tons/yr	Rolling capacity thousand tons/yr	Product mix
Nigeria	(a) Delta Steel Co., Ovanwian-Aladja	1,000	300	Bars and light sections
	(b) Ajaokuta Steel Co., Ajaokuta (to be commissioned 1989)	1,500	830	Bars, rods, light and medium
	(c) Oshogbo Steel Rolling Co., Oshogbo	...	210	Wire rods, plain and deformed bars
	(d) Katsina Steel Rolling Co.	...	210	Wire rods, plain and deformed bars
	(e) Jos Steel Rolling Co., Jos	...	210	Wire rods, plain and deformed bars
	(f) Nigersteel Ltd., Emene	40	100	Bars and rods
	(g) Continental Iron and Steel	50	140	Bars and sections
	(h) Universal Steel Co., Ikeja	50	90	Bars and sections
	(i) Nigeria-Spanish Eng. Co., Kano	60	100	Bars and sections
	(j) KEW Metal Industry, Lagos	-	20	Bars and sections
	(k) Mandarin Industry, Lagos	-	15	Bars and sections
	(l) Kwara Commerical Metal and Chemical Industry, Ilorin	-	75	Plain and deformed bars
	(m) Federated Steel Industry, Otta	10	25	Plain and deformed bars
	(n) Mayor Eng. Co., Ltd, Ikorodu	-	100	Plain and deformed bars
	(o) Allied Steel Co., Onitsha	10	25	Plain and deformed bars
	(p) Qua Steel Rolling Co., Eket	-	100	Bars and sections
Togo	Société National de Sidérurgie, Lomé	20	32	Bars
Tunisia	Société Tunisienne de Tunis	175	400	Bars and rords
Zaire	Société Nationale de Sidérurgie	120	150	Wire rods, rebars, cold rolled hoop and strip

Whereas three countries in West Africa, Mauritania, Nigeria and Togo had crude steel production capacities, most of it (1.22 million tons per year, equivalent to 97 per cent) was located in Nigeria which alone had seven operating meltshops, including the largest steelworks based on direct reduction in sub-Saharan Africa, the Delta Steel Company complex at Ouwian-Aladja.

Only one operating crude steelmaking complex (one 55-ton electric arc furnace with a 4-strand demag continuous billet caster) has been identified in Central Africa, the Société Nationale de Sidérurgie plant in Zaire, with a liquid steelmaking capacity of 120,000 tons per annum. It has been reported that the government plans to bring in private sector partners to update the mini steel mill and increase production, which in 1981 was only 3,254 tons. This mini-mill has a merchant bar/wire rod mill and a cold reduction mill and it also has galvanizing facilities. Capacity of the plant is 100 thousand tons of bars and 150 thousand tons of sheet annually. This unit has only operated sporadically. At present the plant is virtually shut down because of problems of power supply, scrap iron supply, imports of coils for the cold rolling mill as well as because of financial and organizational problems.

Cameroon has two rolling mills at Douala. Societe de Laminage de Douala (SDLADO) owns these two rolling mills, which produce rownds, reinforced bars and small profiles from imported billets. It started operations since 1972 with a capacity of 20 thousand tons a year increased in 1985 to 35-40 thousand tons a year. Present production was 32 thousand tons in 1986.

Existing steel plants in Cameroon and Zaire are in great need of rehabilitation and expansion at least to reach planned installed capacity since the current production of Maluku steel plant in Zaire was amount to only 3 per cent of it, and at present the plant is closed.

As is conventional in the industry, the aggregate steel rolling capacity exceeds the crude steelmaking capacity. This arises from the fact that some steel plants are based exclusively on imported semi-finished billets/blooms/slabs and do not produce any of these products themselves. Additionally, designers of rolling mills purposely incorporate excess capacities into the systems in order to permit greater operating flexibility. For the West and North African area under study, the operating aggregate rolling capacity (1985) is estimated to be about 5.82 million tons per year, distributed as follows (million tons):

North Africa (Algeria, Libyan Arab Jamahiriya, Morocco and Tunisia) 3.85.

West Africa (Côte d'Ivoire, Nigeria, Mauritania and Togo) 1.82.

Central Africa (Zaire) 0.15.

One glaring peculiarity of the steel industry in North and West Africa is the preponderance of long products facilities. In fact, by 1987, there will be only two flat-products basic steelworks in the area, that of SNS in Algeria and the Libyan steelworks at Misratah. Both plants account for a combined annual rolling capacity of about 4.3 million tons. This gross product mix distortion is perhaps most evident in Nigeria where there is no operating flat products plant, in spite of the existence of at least 16 steel mills. In most counries, the steel projects were initially set up to cater for the long products demands of the construction and light engineering industries and it was thought that the production of flats would follow the development and maturation of the engineering sector. The demand for flat products has, however, developed faster than anticipated in many cases, with the result that a high proportion of the requirements is now imported. It would appear therefore that flat product based steelworks represent the type of projects that could potentially benefit from subregional cooperation in view of the fact that such plants are generally large scale, expensive, technologically sophisticated and perhaps well beyond the individual resource capability of most countries in the area.

2.4.2 Planned steelworks

The course of the past five years, several countries in the area announced plans either to commence domestic steel production or to expand their local production capacities. These plans have obviously been mitigated by the depressed economic circumstances and some of the announced projects may not yet have progressed beyond the conceptual stage.

As a result of the economic recession starting in 1981, many projects have since then been either postponed, abandoned or reduced in capacity. There is no exception for iron and steel projects in developing African countries. 1990 scenarios for the iron and steel industry (IO/WG:374/2) issued in 1982 which estimated how many steel will would operate in various developing countries by 1990 if all projects that were known by then would have come on stream by 1990, identified 138 projects, of the 138 projects 32 is in Africa, South of the Sahara.

However because of the economic turmoil above mentioned, a new project review became necessary. The new project review, which issued in April 1986 entitled iron and steel projects in developing countries (UNIDO/IS638), has been undertaken in order to determine exactly the development of the planned situation and to give a revised picture for 1990. (The new project review was made on the basis of the information available at the end of 1985).

"Iron and steel projects in developing countries" includes new projects planned between 1982 and 1985 and identifies 192 projects. Thirty one new projects in 13 countries are known to have been planned since 1982 all with very low capacity. Of 31 projects 10 (1 by 1990 and 9 after 1990) is located in developing African countries.

The total number of projects identified in the 1982 study of 1990 scenarios were - as has been said - 138, modified to 192 in the "Iron and steel projects in developing countries". The regional breakdown of projects is given as follows, together with new estimated for 1990.

	1. Comparison based on original data		2. Comparison based on adjusted data	
	1982 review	1986 review	1982 review[a/]	1986 review
Asia	38	17	70	53
Middle East	11	4	34	6
Africa	47	9	32	16
Latin America	42	24	56	39
Total	138	54	192	114

a/ Include capacities in rolling mills.

This table shows clearly the reduction in the level of planning for 1990, most notably in the Middle East and Africa, but also in other regions. In developing African countries 16 projects are expected to come on stream.

Two relatively large projects in Algeria and Nigeria are currently being implemented with a view to bringing them on-stream by 1991. They are:

(a) The second steelworks of Algeria's Société Nationale de Sidérurgie which is located at Bellara and geared to the production of long products for the domestic market. The execution of the project, which is rated at 1.9 million tons of crude steel per year will begin in 1990.

(b) The Ajaokuta Steel Complex in Nigeria whose first phase, rated at 1.5 million tons of crude steel per year, is scheduled to be commissioned in 1989. (The plant's bar/rod and light section mills are already operational on the basis of imported billets). The scope of this complex has recently been expanded to include facilities for production of flat products which are not now produced, even though they are in high demand in Nigeria.

Among the planned projects which have not gone beyond the feasibility study stage and therefore are not expected to come on-stream earlier than 1995 are the following:

(a) Nigeria: A high-alloy steel plant proposed to be located at Ogbomosho in Oyo State; backward integration of the rolling mills at Oshogbo, Jos and Katsina, to enable each of them to produce up to 720,000 tons of billets per year for internal consumption;

(b) Libyan Arab Jamahiriya: The second phase of the Misratah complex which would increase capacity to 5 million tons per year and would be based on Libyan iron ore from the Wadi Shati iron deposit.

(c) Cameroon: Société Nationale d' Investissement de Cameroon has reportedly been seeking financing to establish a EAF mini-mill at Douala rated at about 12,000 tons per year after it was approved by the government.

(d) Gabon: A joint-venture steelworks (DR-EAF-rolling mills) involving the Gabonese government and Microsider International of France is reportedly planned for implementation. To be sited at Owendo, near Libreville, the project (under the auspices of Société Gabonaise de Sidérurgie, - SOGASIDER) consists of a rolling mill with a single-shift annual capacity of about 12,000 tons.

(e) Mali: There are plans for a 30,000 ton per year facility based on iron ore from a local deposit and electricity from the recently commissioned Selingue dam project.

(f) Mauritania: There is a small mini steel mill (EAF-rolling mill) of 12,000 tons at Neuaoibeu. It has a plan to expand EAF. capacity.

(g) Central African Republic: There is a project on DR route (120,000 tpy) which uses charcoal as a reductant.

(h) Congo: It has a plan to build a mini steel plant (EAF-rolling mill) with a capacity of 20,000 tons.

(i) Liberia: DR project (34,000 tons).

2.5 Steel import

Table 14 shows from where steel is imported. It is mainly from EEC countries and other European countries. Japan's share of imports of steel products to developing African countries is 12.8 per cent. Newly industrialized countries such as the Republic of Korea and Taiwan Province of China have a share of 2.1 per cent. These newly industrialized countries export mainly light sections, sheets, and tubes and pipes. Developing African countries import light sections, sheets, and tubes and pipes as well as ingots and semis. Algeria's main imports are shown in table 15; they are: ingots and semis, bars, shapes, coils for hot rolled products and tubes and pipes. Unclassified steel products are also imported.

The total steel consumption in most of the countries covered in this study is supplied by the major exporters of industrialized countries. The ratio of import to steel consumption has increased 62 per cent in 1976 to 70 per cent in 1982 but it has started declining since 1983. Algeria and Nigeria have imported most since 1976 but the volume is now decreasing. This is because they have started to produce iron and steel themselves. Nigeria has started since 1982, thus reducing its import of steel in 1983 and in 1984. But a steel project in Algeria, a new integrated steelworks will not come on stream until 1991. In Algeria, the existing iron and steel mill, has been fully utilized since 1983, steel import has been out from 1,464 thousand metric tons to 905. It takes some time to cut steel import further. The project is to build a DR based works making one million metric tons of billets which will feed three new rolling mills at different locations. It is based on projections of strongly growing domestic demand for bar, rod and light sections. Algeria has to import quite an amount of steel products until then.

Table 14. Imports of steel products by African developing countries in 1983 (thousands of tons and percentage)

Production	Total imports		Japan		Republic of Korea		Taiwan province of China		U.S.A.		European Community (10)a/		Other European countries	
	1,000 tons	%	1,000 tons	%	1,000 tons	%	1,000 tons	%	1,000 tons	%	1,000 tons	%	1,000 tons	%
Ingots and semis	454	9.4	90	19.8	1	0.2	-	-	-	-	223	49.1	81	11.8
Heavy sections	340	7.0	3	0.9	-	-	-	-	1	0.3	256	75.3	68	20.0
Light sections	1,851	38.3	36	1.9	2	0.1	68	3.7	8	0.4	432	23.3	878	47.4
Heavy plates	210	4.4	12	5.7	1	0.5	-	-	1	0.5	177	84.3	7	3.3
Sheets	656	13.6	309	47.1	4	0.6	-	-	1	0.2	285	43.4	33	5.0
Strip & hoops	54	1.1	11	20.4	-	-	-	-	1	1.9	40	74.1	2	3.7
Tin plate	145	3.0	27	18.6	-	-	-	-	3	2.1	114	78.6	1	0.7
Railway track mateials	135	2.8	-	-	-	-	-	-	1	0.7	104	71.0	30	22.2
Wire rods	273	5.7	7	2.1	-	-	-	-	-	-	116	42.5	123	45.1
Wire	120	2.5	3	2.5	2	1.7	-	-	-	-	82	68.3	17	14.2
Tubes & pipes	586	12.1	117	20.0	5	0.9	17	2.9	9	1.5	336	57.3	92	15.7
Tyres & wheels	2	-	-	-	-	-	-	-	-	-	2	100.0	-	-
	4,827	100	616	12.8	16	0.3	86	1.8	24	0.5	2,168	44.9	1,331	27.6

a/ Ec 10 includes Belgium, Denmark, France, Federal Republic of Germany, Greece, Luxembourg, Ireland, Italy, Netherlands, and United Kingdom.

Source: ECE 1983 and JISF 1985.

Table 15. Algeria - Main imports of steel products, 1975-1980 (percentage distribution)

	Ingots and semis	Bars	Shapes	Coils for hot rolled products	Sheets	Tin-plates	Tubes and pipes	Wire and wire products	Plates
1975	7.2	10.6	18.1	0.0	1.5	3.2	20.9	5.7	21.1
1976	2.1	20.0	13.6	0.5	2.1	2.1	31.6	5.0	1.0
1977	4.6	29.7	12.2	11.4	1.4	2.0	18.9	5.2	2.1
1978	8.5	21.6	12.2	10.8	1.6	1.8	29.7	6.5	3.6
1979	18.9	13.8	8.4	12.1	5.8	3.1	24.2	4.7	1.4
1980	21.3	25.1	10.6	14.6	6.2	2.4	10.9	4.2	1.2

Source: Annual Statistics of Commerce 1986, Algerian Government.

Table 16 shows imports of steel products by selected countries. Total imports of steel products have increased since 1976 but the volume was cut substantially in 1982 because of the economic recession. Recent tendency since 1983 has remained at the 4 million tons' level.

Table 16. Imports of steel products, 1976-1984 (thousand metric tons)

	1976	1977	1978	1979	1980	1981	1982	1983	1984
Algeria	659	1,233	1,459	1,161	1,414	1,546	831	1,386	1,028
Libyan A.J.	601	477	412	562	864	1,106	276	601	314
Morocco	559	624	484	543	461	487	243	540	683
Tunisia	145	221	185	321	357	220	236	321	312
Congo	30	31	13	23	67	63	47	42	45
Gabon	85	98	29	25	51	57	49	35	47
Sudan	70	140	63	86	125	154	108	133	115
Zaire	41	60	39	46	60	51	43	31	73
Ghana	61	91	47	26	24	21	10	19	17
Guinea	6	12	18	9	16	11	7	8	15
Cote d'Ivoire	142	150	171	168	170	124	91	64	57
Liberia	22	27	22	22	28	23	13	18	17
Nigeria	988	1,330	1,085	778	1,509	1,382	1,036	632	321
Sierra Leone	10	9	8	9	12	9	6	5	6
Senegal	62	54	44	67	51	41	62	57	45
Togo	18	18	34	19	21	15	19	21	13
Total	4,334	5,419	4,976	4,746	6,209	6,320	3,838	4,759	4,283

Source: ECE 1986.

2.6 Demand/supply projections for steel in selected countries

The UN Economic Commission for Africa has made a steel demand/supply projection for the years 1990/2000, taking into account the past and present situation in the consumption of steel products in these countries. Projections for demand are calculated on the basis of past trends scenario with certain modifications for another scenario. The summary of this demand/supply projection is shown in table 17.

Table 17. Demand/supply for steel products, 1985, 1990 and 2000 (thousands metric tons)

COUNTRY	1985		1990		2000	
	Demand	Supply	Demand	Supply	Demand	Supply
Benin	25	20	30	22	40	25
Burkina Faso	20	30	25	20	30	20
Cape Verde	5	3	7	4	10	5
Central African Republic	10	5	15	10	20	15
Cameroon	80	60	100	70	320	100
Gambia	7	7	10	8	15	10
Ghana	50	23	100	85	200	90
Guinea	30	16	60	12	100	20
Guinea Bissah	10	8	15	9	20	10
Cote d'Ivoire	150	70	400	120	750	150
Liberia	50	20	70	22	100	25
Mali	20	20	30	25	50	30
Mauritania	30	20	50	45	70	50
Niger	40	40	60	44	80	50
Nigeria	2,000	720	3,500	2,500	7,700	5,200
Senegal	50	45	70	50	100	55
Sierra Leone	50	6	40	7	60	10
Togo	25	20	35	30	65	45

Source: Economic Commission for Africa 1985.

In this steel demand forecasting, some countries covered in our study are not listed. For example, Algeria, Gabon, Morocco, Libyan Arab Jamahirya, Tunisia and Zaïre are among them and for this reason we have shown the regressional equations available of our own below.

However, For this study, no attempt has been made to project the steel demand trend for the whole area over the next decade. This is because of a general lack of reliable macro-economic data on which future projections could

be based. However, data on some countries are reliable to derive good regressional equations. For example the following equations show a regression curve;

Algeria: LNCPCP = 5.96686291 - 241.74296 LNYPC + 1.43027581 LNratio
where YPC = Income per capita and ratio = Gross capital formation per capita divided by income per capita. LN stands for natural log.

Morocco: LNCPC = 4.98873125-491.92684LNYPC+0.43868184 LNratio

Togo: LNCPCP = 9.43665251 + 2.27544996LN YPC t 0.70119755 LNratio

Nigeria: LNCPCP = 4.44540750 - 309.25576 LNYPC + 0.694041 20 LNratio

Zaire: LNCPC = -63.23981551 + 1181.25316LNYPC + 11.963223997 LNYPC

Gabon: CPCP = -216.48048 + 42.32505036 LNGCP
Where GCP = Gross Capital Formation per capita.

The forecasting methodology employed for the equations above implies the continuity of past relationships between the two highly aggregated variables GNP and steel consumption. GNP, GDP and the ratio of GCF to GNP are chosen as an explanatory variable to determine the level of steel demand for future periods. The forecasting technique used is to relate consumption per unit of GNP to per capita income. The required exogenous variables in this model are forecasts for the growth in GNP and population.

3. AVAILABILITY OF MINERAL AND ENERGY RESOURCES

3.1 The role of minerals in the economies of African developing countries in the context of the world economy

It can be correctly asserted that, in an important sense, the history and economic development of Africa have been tied to the exploitation of mineral related resources such as primary metals. Also reserves of energy resources, both traditional and non-traditional are quite substantial, which could form a basis for the development of iron and steel and related industries. The latest information available indicates that Africa has some 55 billion barrels of crude oil (8.5 per cent of world proved reserves), 208,470 billion FT^3 of natural gas (7.9 per cent of world proven reserves), 88.5 billion tons of coal reserves (between 1.16 and 3.05 per cent of world estimated coal reserves - however, about 81 per cent of Africa's reserves are in South Africa), 1.7 million tons of uranium (some 25 per cent of world resources) and 200,000 MW of potential hydro-capacity (35.4 per cent of the world's potential hydro capacity). However, these substantial energy reserves are not evenly distributed between subregions and countries. Petroleum deposits are mainly concentrated in North Africa, hydro-electric resources in Central Africa, geothermal potential along the rift valley in East Africa and coal deposits in the southern and south-eastern regions of the continent.[4/]

Africa's vast natural resources in the form of minerals are another asset. For example, 33 per cent for Bauxite (31 per cent, the share of total developing Africa) 18 per cent for iron ore (11.3 per cent), 50.2 per cent for manganese (10.2 per cent), 72.3 per cent for cobalt (72.3 per cent) and 95.5 per cent for chrome ore (86.9 per cent). Without a doubt, Africa is richly endowed in iron ores, fuels, and other mineral resources, with "soft-rock" minerals tending to predominate in the northern part of the continent (e.g. petroleum, natural gas, and phosphates in Algeria, Libyan Arab Jamahiriya, Morocco and Nigeria), while "hard rock" minerals are generally found south of the equator (chromium, platinum, cobalt, vanadium, and manganese). With such rich mineral endowments, coupled with its relatively undeveloped socio-economic conditions, Africa's mineral output has historically exceeded its demand, making Africa a major supplier of largely unprocessed and semi-processed mineral raw materials to the developed economies of the industrialized world. It has been assumed that economic growth depends on investments and that investment means simply the availability and use of money rather than, in reality, the mobilization and application of relevant factor inputs to production, marketing and other processes. But economic growth in the real sense means increases in the physical output of goods and services to meet the needs of the mass of the people. Such growth must come from the conversation of raw material into semi-finished and finished products.

However, the exploitation of the known reserves has not led to the integration of the natural raw material base in the region's economic structure. The African region itself remains unable not only to utilize but even to process the minerals. These mineral raw materials, however, have provided the industrialized countries with essential inputs into their manufacturing industry (table 18). Liberia can be taken as a case in point. The exports of iron ore account for about 92 per cent and 70 per cent of total mineral and total commodity exports, respectively. Table 20 shows Liberia's export of iron ore to the rest of the world.

4/ ECA and Africa's Development 1983-2008, ECA April 1983.

As a rule all most the whole production of iron ore is destined for use by the world's steel industry. As a source of primary iron, 99 per cent is used in the iron and steel industry and 0.8 per cent for other industrial purposes.

Only 30 per cent of African iron and ore production is consumed in the domestic iron and steel industry of South Africa (48 per cent of the iron ore produced), Algeria, Egypt, Morocco, Tunisia and Zimbabwe, and 70 per cent including the bulk of production of Liberia and Mauritania is exported.

Table 19 shows the production of iron ore by African countries. If these two tables are combined, we can see the ratio of export to production by these countries. The Liberian economy is characterized by an overwhelming dependence on iron ore mining, which countributes about 32 per cent to GNP. The pattern of iron ore exports has followed that of production, reflecting the fortunes of the iron ore market, not for its own consumption. The principal consumers of Liberian iron ore are represented in table 20. The real contribution of iron ore mining to national income is, however, not as high. For instance, although mining contributed more than 30 percent to the GDP, most mines depend on loan capital by the foreign mining companies and not on their own capital. Only two iron ore companies are operating in Liberia, the Lamco Joint Venture Company and the Bong Mining Comapny which are controlled by foreign capital, and apparent consumption of iron ore is - 954,000 metric tons.

Algeria seems to have integrated its iron ore mining in its economic structure as shown in table 21. Internal consumption of iron ore has increased since 1980. Iron ore production in 1985 from the Ouenza-Boukhadra Mines was 3.8 million metric tons of which most was consumed by the domestic steel plants at El Hadjar. Exports in 1985 were only 7,000 metric tons compared with 1.1 million metric tons in 1984. All exports were destined for Albania.

Algeria has succeeded in its policy of integrated mineral development by transforming processing and manufacturing into iron and steel and finished or semi-finished products. The El Hadjar iron and steel complex, for example, with a capacity of 400,000 t per year, began production in 1973. Another integrated iron and steel began production in 1979. Now a 1,100,000 ton per year integrated iron and steel plant is under development at Bellara which obtains its ore feed from the Gara Djebilet iron deposit.

The trend of mineral production in Africa in the 1970s was disappointing and as of 1980 the situation has reached alarming proportions. Production of iron ore, chromite nickel, zinc and diamonds was below the level recorded in the mid 1970s. Poor demand resulting from world recession and depressed prices have adversely affected export prospects so that many promising projects in mineral exploitation have had to be abandoned. The challenges that face the African developing region today may thus be summarized as the rapid and extensive building up, at regional and interregional levels, of capabilities for mineral resources exploration, evaluation, extraction, primary processing, intra-African transportation and trade in minerals, for utilizing the mineral sector as a growth area.

Table 18. Iron ore exports of Africa, 1976-1985
(millions of metric tons)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Algeria	1.8	1.5	1.5	2.5	1.4	1.5	1.4	1.3	1.1	0.0
Angola	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0
Liberia	19.1	17.9	20.8	19.3	17.4	20.7	16.3	15.4	16.8	16.1
Mauritania	9.7	8.6	6.3	9.3	8.7	8.6	7.8	7.4	9.5	9.3
Sierra-Leone	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.1
Rep. of South Africa	2.5	12.1	13.4	14.2	13.8	14.0	11.3	7.8	11.9	10.2
Other Africa	0.5	0.5	0.5	0.6	0.1	0.0	0.0	0.0	0.0	0.0
Total	33.6	40.6	42.5	45.8	41.9	45.0	36.8	32.4	39.7	35.7
World	374.9	356.8	350.0	394.5	384.0	372.3	328.7	314.5	371.7	376.0

Note: Exports by Sierra-Leone recommenced in February, 1983

Source: Iron Ore Statistics, Association of Iron Ore exporting countries, January 1986.

Table 19. Iron ore production in Africa, 1976-1985
(millions of metric tons)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Algeria	2.79	3.18	3.04	3.12	3.45	3.48	3.89	3.68	3.67	3.78
Liberia	20.39	18.14	18.39	18.35	18.25	19.54	18.00	15.41	16.19	16.12
Mauritania	9.54	7.34	7.08	8.97	8.94	8.47	8.21	6.60	9.00	9.20
Morocco	0.34	0.41	0.06	0.06	0.06	0.05	0.23	0.30	0.20	0.20
South Africa	15.36	26.48	24.20	31.56	26.31	29.32	24.60	16.60	24.65	24.39
Sierra Leone	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.36	0.42	0.07
Swaziland	1.93	1.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tunisia	0.49	0.49	0.34	0.39	0.38	0.40	0.27	0.30	0.31	0.30
Others	0.60	2.00	1.80	2.10	3.50	2.90	2.80	3.00	2.80	3.10
Total	51.44	59.52	54.91	64.55	60.89	64.16	58.01	46.25	57.15	57.16
World	922.91	878.53	890.53	947.00	917.22	893.91	816.13	778.45	871.43	893.97

Source: Iron Ore Statistics, Assocaition of Iron Ore Exporting Countries, January 1986.

Table 20. Iron ore exports of Liberia, 1976-1985
(thousands of metric tons)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Argentina	0	86	118	0	0	0	0	0	0	0
Belgium	1,178	807	1,529	2,447	1,171	1,464	765	964	1,361	1,419
Canada	446	212	605	554	0	1,575	188	0	60	0
Czecho-slovakia	130	122	0	0	0	0	0	0	0	0
France	1,423	2,235	2,308	2,084	2,182	2,513	1,778	1,063	1,469	981
Germany F.R.	5,781	5,112	5,578	5,619	4,998	5,671	5,492	5,314	6,073	6,504
Italy	3,198	3,424	3,783	2,937	3,169	3,919	3,496	3,669	3,604	3,549
Japan	682	232	159	313	426	354	175	308	312	172
Nether-lands	2,358	2,200	2,017	2,307	2,060	1,391	1,018	934	724	143
Poland	0	128	128	0	0	0	0	32	62	0
Romania	159	308	1,260	706	975	556	0	0	377	51
Spain	749	1,191	1,128	575	637	695	715	932	394	554
Sweden	179	122	122	0	0	0	0	0	0	0
U.K.	575	282	195	309	191	0	0	0	0	0
U.S.A.	1,929	1,292	1,695	1,351	1,537	1,990	1,826	1,229	1,320	1,996
Other	300	163	146	146	41	542	861	1,913	1,002	757
Total	19,087	17,916	20,771	19,348	17,387	20,670	16,314	15,358	16,758	16,126

Source: Iron ore statistics, Association of Iron Ore Exporting Countries, January 1986.

Table 21. Iron ore of Algeria: production, exports and consumption, 1970-1985
(thousands of metric tons)

	Production		Exports		Consumption	
	Weight	Content	Weight	Content	Weight	Content
1970	2,947	1,591	2,047	1,105	814	439
1971	3,275	1,769	1,859	1,004	758	409
1972	3,663	1,978	2,265	1,223	873	471
1973	3,184	1,719	1,966	1,062	759	409
1974	3,797	2,050	3,165	1,709	603	325
1975	3,188	1,722	1,551	838	728	393
1976	2,788	1,506	1,780	961	948	511
1977	3,182	1,718	1,513	816	886	477
1978	3,040	1,642	1,530	826	685	348
1979	3,120	1,685	2,484	1,341	1,137	581
1980	3,454	1,789	1,432	741	1,164	1,017
1981	3,481	1,766	1,507	765	1,802	914
1982	3,892	1,946	1,444	722	2,158	1,079
1983	3,684	1,842	1,302	644	2,480	1,284
1984	3,664	1.869	1,051	526	2,265	1,193
1985	3,776	1,705	7	4	3,250	1,645

Source: Iron ore statistics, Association of Iron Ore Exporting Countries, January 1986.

The principal objective of this build-up is obviously to meet regional demand as well as demand from outside Africa for minerals in the next twenty years. As is sometimes implied in the studies[5/] of the world mineral crisis, this is not a task that is merely a matter of mobilizing vast quantities of investment capital for the expansion of the world mining industry. What is required is the expansion of African indigeneous capabilities to determine and make the best use of existing African resources. The emphasis is thus on the development of indigenous African factor inputs, principally manpower and institutions.

During the next ten years, production of iron ore, now on the declining in developing Africa, is expected to increase, both for local consumption in line with the plans to develop an iron and steel industry in Algeria, the Libyan Arab Jamahiriya, Morocco, Nigeria, the United Republic of Tanzania and Zambia, etc., and for export, particularly from the new production capacity under development or study in Côte d'Ivoire, Gabon, Guinea, Sierra Leone and Senegal.

3.2 Mineral production in developing African countries

The purpose of this section is to study the major and known potential mineral resources of developing African countries, to give a quantitative and qualitative picture of their distribution and possibilities for exploitation and to evaluate how far they will be available in the future. The major African mineral resources of steel industry metals and fuel minerals presented in this section are selected because of their current importance in the economies of developing African countries and also in light of the integrated development of the iron and steel industry which has a forward and backward linkage to other manufacturing industries. On the basis of 1981 figures, Africa's shares of the world's output of a number of important minerals were as follows:

Mineral	Share of world output %	Major African producers
Copper	17	Zambia, Zaire, South Africa
Gold	54	South Africa, Zimbabwe, Ghana
Chromite	38	South Africa, Zimbabwe, Madagascar
Cobalt	66	Zaire, Zambia, Morocco
Iron ore	8	South Africa, Liberia, Mauritania
Manganese ore	29	South Africa, Gabon, Ghana
Diamond	70	South Africa, Zaire, Botswana
Phosphate rock	23	Morocco, Tunisia, Togo
Crude Petroleum	8	Nigeria, Libyan Arab Jamahiriya, Algeria
Uranium	33	South Africa, Niger, Namibia

5/ Minerals and materials 1985 and mining magazine 1984

The occurence of these large resources has not necessarily served as a catalyst for economic transformation and social change in these countries where they occur. In fact, in some cases, they have become no more than a mixed blessing, grossly distorting the national economies and encouraging the wanton neglect of other economic sectors.

The extent of economic dependence of some of the countries of West and North Africa on the minerals subsector may be gauged from the following data (for 1981) indicating the proportions of exports earnings deriving from minerals-related activities (table 22).

Table 22. Export earnings deriving from mineral activities in 1981

Country	Share of the value of mineral production to GDP (percentage)	Value of minerals production (millions of US dollar)	The share of minerals in export earnings (percentage)
Algeria	28.5	12,000	92
Cameroon	11.2	450	40
Central African Republic	4.0	30	30
Congo	-	NA	90
Gabon	58.3	2,100	95
Ghana	18.2	510	60
Guinea	27.1	298	95
Liberia	51.1	363	69
Libyan Arab Jamahiriya	67.1	17,000	99
Mauritania	17.5	140	-
Niger	11.3	250	84
Nigeria	26.2	20,245	99
Senegal	16.9	64	15
Sierra Leone	12.6	165	76
Sudan	0.2	10	2
Togo	14.9	128	50
Tunisia	20.0	1,600	60
Zaire	30.1	1,900	86

Source: Mineral Industries of Africa, 1984.

For the African region, therefore, the minerals sector has been a driving force for some economic development, no matter how modest. For instance, the mineral industry generally accounts for the major share of economic activity, with contributions of more than 25 per cent to the GDP of Gabon, Guinea, Liberia and Zaire, as well as in all the oil-exporting countries, although the share of mining to GDP in these countries have been decreasing. Table 23 shows the share of mining and quarrying value-added in the total GDP of developing African countries at constant 1970 $US. Ranks are based on the share of mining value-added in the GDP of the countries of developing Africa concerned in this study. The first eleven countries whose share of mining and quarrying value-added in the total GDP has been greater than 10 per cent during at least one year since 1970. It should be noted that the share of mining and quarrying value-added in the GDP for developing Africa and Africa as a whole, from 1970 to 1978 ranged between 10.7 and 7.2 per cent respectively. Generally the share of mining and quarrying value-added in the total GDP of the countries of developing Africa has been declining since 1970.

Table 23. Share of mining and quarrying value-added in total GDP, 1970-1978 (percentage, GDP at constant)

Countries	1970	1972	1975	1978
Developing Africa:	10.10	9.38	7.56	7.25
Algeria	13.53	11.78	9.03	9.09
Libyan Arab Jamahiriya	63.20	38.81	20.29	20.07
Zambia	34.61	28.66	28.00	27.15
Gabon	32.04	27.78	24.93	21.60
Liberia	30.42	29.54	24.97	18.71
Mauritania	26.73	32.71	23.56	16.69
Zaire	19.61	19.43	18.64	17.53
Sierra Leone	17.47	15.71	12.02	6.43
Nigeria	10.11	14.73	11.87	10.36
Guinea	9.42	9.64	14.38	16.76
Togo	4.87	5.61	3.88	10.53
Tunisia	6.20	4.92	4.92	4.20
Morrocco	3.77	4.30	3.34	3.42
Central A.R	9.45	4.83	3.00	2.25
Ghana	1.90	2.38	2.64	2.31
Senegal	1.03	1.17	1.54	1.46
Cameroon	0.70	0.33	0.48	1.14
Niger	0.09	1.37	2.24	4.26
Congo	1.48	2.45	4.16	4.24
Chad	0.13	0.16	1.07	1.12
Sudan	0.29	0.74	0.67	0.68
Côte d'Ivoire	0.21	6.30	0.19	0.15
Benin	0.14	0.28	0.25	0.24
Gambia	-	-	-	-
Mali	-	-	-	-
Guinea-Bissau	-	-	-	-

Source: Proceedings of the first regional conference on the development and utilization of mineral resources in Africa, 1981.

As of now, as we mentioned before, the industrialization process in Africa has relatively speaking failed to provide the dynamic forces for the structural transformation of the developing African economy to attain self-sustainment. In fact, mineral based manufacturing is almost non-existent in developing Africa, the bulk of the minerals being exported in raw form. Industrialization which should derive from these recources has not occured. Mineral ore has not been processed to a semi-fabricated stage because of crude results and the lack of infrastructural facilities which are also necessary for processing agricultural raw materials. Thus, most of the natural resources are exported and industrial development is adversely affected. For example, the data on the share of mining and quarrying value-added in the total GDP of mineral-rich countries of developing Africa indicate a mineral industry that is still primitive and underdeveloped. Taking the illustrative cases of South Africa, Zimbabwe and Zambia, the value of these countries' mineral output for 1978 was approximately $4,000, $1,500 and $800 million, respectively yet the share of mining and quarrying value-added in the total GDP of the three countries was, respectively 8.3, 9.6 and 27 per cent. The principal reason for this reversal in the level of output and share in GDP is that South Africa has a highly developed integrated mining sector and Zimbabwe a moderately developed integrated mining sector. Zambia's mineral industry has yet to take advantage of the multiplier effects associated with mineral processing and fabricating; processing for export has not been possible because of problems related to market entry. The existing production structure is based on small size plants with little in terms of economies of scale. In terms of employment, mineral development has often not contributed as much as had been expected because of the capital-intensive nature of large-scale mining investments. In most countries the minerals sector accounts for less than 40 per cent of the labour force.

3.3 Resources needed for the iron and steel industry

Developing African countries are endowed with ample natural resources which should be used for the integrated development of iron and steel industry as well as related engineering industry. They are particularly rich in iron, Manganese and alloying metals ores, each of very high quality. Some are already under exploitation and could be used for the processing local sponge iron and steel as well as for the ferro-alloys production. Some deposits need further work for determining their quality.

With regard to fuel and reductants, developing African countries have large reserves of coal, oil and natural gas. Each of them could be used as a reductant for a sponge iron production using a direct reduction route. The subregional and national projects already identified show that there are wide possibilities for the establishment of local integrated iron and steel production and the countries of the subregion should develop such industries at the multinational/subregional level, since many iron and steel subregional and national projects already identified remain at in initial stage or not followed up due to financial and other constraints.

In the context of this report, it is convenient to group the steel industry resources into four major categories:

(a) The ferrous and non-ferrous minerals: iron ore, manganese, chromite, nickel, columbium, tantalum, cobalt and tungsten;

(b) The hydrocarbon minerals: coal, natural gas and petroleum;

(c) Electrical energy, particularly hydro; and

(d) Non-metallic mineral resources: limestone, dolomite, refractory minerals, etc.

3.3.1 Ferrous and non-ferrous minerals

Developing Africa's percentage share of the world's reserves and consumption of the relevant ferrous minerals are estimated as follows:

Mineral	Share of reserves	Share of consumption
Iron ore	11.1	1.5
Manganese	11.6	...
Cobalt	45.2	...
Columbium	9.5	...
Tantalum	67.0	1

3.3.2 Iron ore

Table 24 shows those West and North African countries that are endowed with significant geological resources of iron ore. In the aggregate, world reserves of iron ore are estimated at around 180 billion tonnes, of crude ore in 1983 although the iron resource potential is much greater.The African continent is estimated to contain over 20 billion tons of reserves, with developing Africa accounting for about 13 billion tons. Within the West and North African subregions, the resources are distributed and characterized as follows:

Algeria Of the several iron ore occurences the Gara Djebilet deposit, which was discovered in 1952, contains what is described as one of the world's richest deposits. With over 5 billion tons the deposit is not yet being commercially exploited due to its relative inaccessibility. Plans are, underway to construct a major southern rail link to the deposit, 1,500 km long which is expected to be in production by 1995.

Algeria's present iron ore production comes from mines in the Ouenza and Abu Khadra deposits, estimated to contain over 100 million and 30 million tons respectively of iron ore. Exploitation is under the aegis of la Société Nationale de Recherches et d'Exploitation Minières (SONAREM), which had announced a production level of 5 million tons for 1985. Actual production since 1982 has averaged about 4.2 million tons per year of which 1.5 million tons had been exported, while the balance had gone to feed the El Hadjar steelworks. It is expected that virtually all Algerian iron ore production would be internally consumed when the Bellara steel works (now under construction begin to operate in the early 1990s. Other smaller iron ore deposits occur at Beni Saf (about 1 million tons), Zaccar and Timezrit.

Five countries, namely Cameroon, Central African Republic, Congo, Gabon and Zaire have substantive resources of iron ore. These deposits are still remained unexploited.

Table 24. Iron ore resources of West and North Afica

Country	Ore deposit	Estimated size of deposit (million tons)	Mineralogical characteristics
Algeria	(i) Gara Djebilet	5,000	Colitic ores partially oxidized to Fe_2O_3 and Fe_3O_4, 3,000million tons of high (48-57%Fe)grade ore and 2,000 million tons of low grade ore (38-42% Fe).
	(ii) Qunza	100	80% of ore is high-grade containing 53% Fe
	(iii) Abu Khadra	30	Friable ore high in SiO_2
	(iv) Beni Saf	1	Hematite and goethite
Cameroon	Kribi deposit	200	Under study; 30% Fe with no deleterious impurities
Central African Republic	Northwestern deposits	3.6	Small scattered deposits ranging from 40% to 70% Fe
Gabon	Beligna deposit	1,000	High-grade ore with 60-70% fe
Guinea	Nimba and Simandon deposits	800	One of the world's highest quality iron ores containing 66.5% Fe
Liberia	(i) The Nimba deposit		High-grade (63% Fe) at Nimba and medium-grade (50-54% Fe) at Tokadeh, Gangra and Yuelliton. Ore contains 61: 39 magnetite to hematite
	(ii) The Long	1,400	
	(iii) The Mano river deposit		
Libyan Arab Jamahiriya	Wati Shati deposit	795	Siderite mixed with magnetite, limonite and chlorite. Fe range from 48% to 55%
Mali	(i) Bafing-Makana deposit	150	Hematite ore with 36-37% Fe
	(ii) Faleme deposit	8	High-grade hematite and magnetite, 62-67% Fe
Mauritania	(i) The Kedia d'Idjill deposit	144	High-grade (65% Fe) ore; should be depleted in the early 1990's
	(ii) The Guelbs deposits at El-Rhein and Oum Arwagen	460	Average fe content of 35%

Table 24. Iron ore resources of West and North Africa (cont'd)

Country	Ore deposit	Estimated size of deposit (million tons)	Mineralogical characteristics
Morocco	(i) The Khuneifera deposit	59	Limonite changing to Siderite; 42.8% Fe and 9.8% SiO_2
	(ii) The Nador deposit	59	Magnetite and hematite plus pyrite; 50-60%
	(iii) Other deposits at Tafilat, Ait Ahmen and Ait Amar etc.	50	Fe, 3.2-3.6% SiO_2, 2-3-4.2% S and 0.02-0.06% P.
Niger	The Say deposit	650	Oolitic hematite containing 48% to 53% Fe and 0.5% to 0.8% P.
Nigeria	(i) The Itakpe deposit	650	Hematite ores averaging 37% Fe, 0.13% P_2O_5 and 44.8% Si_2
	(ii) The Agbaja	1,000	Colitic-pisolitic ironstones with47.8% Fe, 8.55% SiO_2, 4.16%
	(iii) Ajabanoko and Choko-choko	127	P_2O_5 (very high phosphorus) Hematite ores
Senegal	Faleme deposit	633	High-grade hematite and magnetite (62-67%Fe). deposit
Sierre Leone	The Marampa deposit		The Marampa mine ceased production in Feb. 1985. A restart of operations is being contemplated.
Togo	Daseri deposit	95	
Tunisia	(i) The Djerissa deposit		Hematite with accessory goethite and siderite containing 50% Fe and 2% Mn.
	(ii) The Tamera and Ganara deposit		Mainly goethite with hematite, pyrolusite and pyrite.
	(iii) Mali Douaria deposit		Hematite, siderite and goethite with 4% arsenic.
Zaire	(i) Katanga region	50	56% Fe.
	(ii) Lake Albert region	5,000	45 to 60% Fe.
	(iii) Luebo area	100	30% Fe.

Cameroon A joint-venture company involving the government of Cameroon and French, German and American interests, - Société d'Etudes de Fer du Cameroon (SEFERCAM), - was recently formed to study the Mamellos iron ore deposit near Kribi on the coast south of Douala. The reserve is estimated at over 200 million tons at an average ore grade of 30 per cent Fe, with no impurities.

Central African Republic Relatively insignificant iron ore prospects, from a commercial exploitability point of the view, are known to occur in the northwestern part of the country. Romanian geologists have recently estimated the size of these reserves at about 3.6 million tons in scattered deposits ranging in ore grade from 40 to 70 per cent Fe.

Gabon Gabon's iron ore resources exceed one billion tons of high grade 60-70 per cent Fe ore, of which about 200 million tons contain less than 0.1 per cent phosphorus. The major deposit is at Belinga in the northeast of the country and development is beng planned under the auspices of Société des Mines de Fer de Mekambo (SOMIFER). It had been planned that the export-oriented project would produce between 7.5 and 10 million tons of iron ore annually; however, development is being hampered by slow progress on the construction of the Trans-Gabon railroad and its northern extension. The 250-km line from Mekambo to Booue would be used to evacuate ore to the world market. A more recent iron ore discovery has also been made in the Eteke region, but the deposit has hot yet been characterized. Prefeasibility studies on the Haut-Ivindo cross-border iron ore deposits in Gabon and Congo are under way. The European Development Fund's providing $US 5.6 million of the cost for the studies.

Guinea Guinea is endowed with some of the world's richest iron ore in the mountains along the border with Liberia. Two particular deposits at Nimba and Simandou, containing over 800 million tons, are being developed by Société des Mines de Fer de Guinee pour l'Exploitation des Monts Nimba (MIFERGUI - NIMBA), under management and operating agreement with the U.S. Steel Corporation. Estimated to cost over of $US 1 billion, the project is being hampered by the political environment in Guinea and by the depressed state of the world-wide iron ore market. It is, in fact, not expected to be in production before 1995. Potential buyers of the iron ore include Nigeria (5 million tons per annum), Algeria (1.75 million tons), and Libya Arab Jamahiriya (2.5 million tons). Target annual production is 15 million tons of natural sinter-feed containing 66.5 per cent Fe, and transportation to consumers would be through Liberia, via a 265-km railway.

A study by the World Bank on various options for the development of the Mifergui-nimba iron ore deposit on the Liberia-Guinea border was completed in 1986 and a new project feasibility study to be completed in Mid 1987, was started.

Liberia Iron ore reserves exceed 1,400 million tons, and Liberia is Africa's largest producer of iron ore (14.7 million tons in 1983), as well as exporter. There are three major operating companies, LAMCO, Bong Mining Company and NIOC. LAMCO, the Liberian American Swedish Minerals Company, has the rights to high-grade deposits (50-54 per cent Fe) at Tokadeh, Gangra and Yuelliton. Its producing Nimba - Gbahm mines are expected to be depleted by about 1987 and in order to continue its operations, LAMCO would have to move to the western Nimba area. However, the current state of the iron ore market and the associated development costs, now estimated at about $US 400 million, may force a rethinking of such a move.

The Bong Mining Company operates in the western part of the Bong range on a deposit that contains 61:39 magnetite-to-hematite ratio. There are reports that Bong's mining activities may be closed down in 1986/87, although there are also expectations in some quarters that operations may be forced to continue for other than economic reasons. In 1983, production from this mine was 7.5 million tons, a level that is believed to have been sustained through 1985.

The National Iron Ore Company (NIOC) operates the Mano River Mine. Following expansion financed by the World Bank, the annual production capacity is now placed at 3.25 million tons of natural fines, a 30 per cent increase over the previous capacity of 2.5 million tons.

Libyan Arab Jamahiriya Iron ore was discovered in 1943 in the middle part of Wadi Shati. The reserve size is placed at about 795 million tons of medium-grade ore ranging in Fe content from 48 per cent to 55 per cent. Other deposits of less economic value occur southwest of Tripoli, at Dor al Guossa, and at Al Kufrah. Plans are afoot to develop the Wadi Shati deposit, a project that is linked to the proposed second phase of the integrated Misratah iron and steel complex. When the mine becomes productive in 1995, iron ore and limestone would be sent from Wadi Shati, via the 1,350 km 1.4m. - guage railway system now under construction, to Misratah, where large docking facilities are under being built. Port facilities and the two 0.550 mmt DRI plants were completed in 1986 and the plant is said to start production in 1987. The iron and steel complex is designed to produce 1.3 mmt py of liquid steel. During 1986 talks were held with several companies on the possibility of supplying pellets and lump ore.

Mali Two iron ore deposits in the southwestern part of the country near the Senegalese border have been estimated by Soviet geologists to contain about 150 million tons of probable hematitic (36-37 per cent Fe) ore. The other deposit on the right bank of the Faleme river appears to be an extension of the Senegalese Faleme deposit, and is estimated to contain about 8 million tons. There are yet undefined plans to develop a steel industry on the basis of these local iron ore resources.

Mauritania Mauritania is developing Africa's second largest iron ore producer, ranking next to Liberia. Total iron ore resources are over 600 million tons, with important deposits in the Kedia d'Idjil area near Fort Gouraud (at F'Derik, Rouessa, and Tazadit). Other minor deposits occur at Legleitat Al Kader, Alzouazil, and Al Mainariat. The Mauritanian mining enterprise is Complexe Minière du Norol (COMINOR), a wholly-owned subsidiary of the Société Nationale Industielle et Miniere de Mauritanie (SNIM), which is itself a 71 per cent state-owned company.

COMINOR operates three mines in the Kedia d'Idjil area, producing concentrates averaging 65 per cent Fe. Production began in 1960 and, at the present rate, these reserves are expected to be mined by 1992. To maintain Mauritania's credentials as a major iron ore producer, SNIM is developing the new Guelbs iron ore project to exploit the El-Rhein and Oum Arwagen deposits. Work began on this top priority project in 1980, with production from the first phase scheduled to commence in 1985, producing up to 6 million tons of concentrates by 1992. The second phase, which would be centred around the Oum Argagen deposit, and designed to produce 4 million tons per year, is not now expected to be implemented before 1995. The plans call for concetrates from

both deposits to be transported by the 650 km railway that already links the Kedia d'Idjil deposit to Nouradhibou port, where additional crushing-screening-blending is performed to commercial specifications prior to shipment.

SNIM is investing about $US 92 million in a project to reduce production costs and improve management. The World Bank provides part of the investment as a loan. The project is due to be completed by mid-1988.

Morocco Long an exporter of iron ore from the Rif area, Morocco's iron ore resources exceed 170 million tons, occuring in the Khuneifera, Nador, Tafilat, and Ait Ahman areas. Production and export have recently been in the 200,000 ton per annum range. However, with the completion of the iron and steelmaking phases of the Nador project, most of Morocco's iron ore output would be locally consumed.

Niger A recently-funded UNIDO study has documented the occurrence of a deposit of 650 million tons of eelitic hematite, with 48 per cent to 53 per cent Fe and 0.5-0.8 per cent phosphorus in the area around Say. No plans have yet been mapped out for its exploitation.

Nigeria Commercially important iron ore deposits were confirmed in 1975 on the Itakpe ridge, near Okene in Kwara State. Proven and estimated reserves have been placed at about 250 million and 400 million tons respectively. This deposit, which is now being developed by the Associated Ores Mining Company, is expected to be the major source of ore for the blast furnace-based Ajaokuta steel complex. There are also encouraging indications that pellets produced from Itakpe concentrates could be usable in the direct reduction facility of Delta Steel Company.

The extensive oolitic-pisolitic ironstones of the Agbaja plateau in Kwara State constitute another potentially significant source of iron ore for the Nigerian steel industry. The Agbaja reserve, estimated to contain over one billion tons of ore, is characterized by very high levels of phosphorus (over 4 per cent P_2O_5) which would make beneficiation by conventional mineral dressing techniques, as well as iron and steelmaking, difficult.

Other iron ore deposists of possible commerical interest include those on the Udi Plateau of Anambra State, Ajabanoko and Choko choko (on the same geological formation as Itakpe) with estimated reserves of 60 million and 67 million tons respectively, and Agbado-Okudu in Kwara State.

Senegal Reserves of magnetite ore occur around Faleme on Senegal's eastern border, some 750 km from Dakar. The deposits contain over 633 million tons, grading from 62 per cent to 67 per cent Fe. A 1982 study by the French firm, SOCOMINE, proposed the development of the Faleme reserve to produce 12 million tons of ore per year. Mines de Fer du Senegal Oriental (MIFERSO), formed in 1975, was to manage the project which would involve a total investment then estimated to be about $680 million, including a railroad between the port of Dakar and the mine, port facilities, and mine development. This project is now being re-analyzed in view of the unfavourable market outlook for iron ore. It is not expected to be in production earlier than 1995.

Sierra Leone Commercial iron ore reserves occur in the Marampa area. However, production by the Marampa Iron Ore mining company ceased in 1975, and resumed in 1983 following extensive construction and commissioning. The

mine's production capacity is 1 million tons per year of concentrates, although in 1984 only about 300,000 tons were produced. The continued operation of this mine depends very strongly on the outlook for iron ore on the international market. But the Marampa mine was closed again in 1985 after having encountered a number of operating problems in 1984 and 1985. Efforts were made during 1986 to open the mine. However this appears to have failed and no progress was reported in 1986.

Togo A deposit with about 95 million tons of probable ore reserve was discovered in 1966 around Baseri, close to the Ghanaian border and about 360 kilometres from Lome. There are plans to further document and commercially exploit this deposit.

Tunisia Iron ore reserves occur in several localities although important deposits ae limited to the areas around Djerissa (about 225 km from Tunis and 120 km from the coast), Tamera, Ganara, and Wadi Douaria. The Djerissa deposits, currently being exploited by Société du Jebel Jerissa, are largely siderite ores with 48 per cent Fe, requiring crushing and roasting before use. Tunisian iron ore production in 1980 was 390,000 tons, increasing to 396,000 tons in 1981, but declining to only 271,000 tons in 1982. Current production is around 400,000 tons, all of which is consumed at the El Foulahd steelworks of Société Tunisenne de Sidérurgie (STA) at Menzel Bourguiba.

3.3.3 Manganese

About 95 per cent of all the manganese ore produced world-wide is used in iron and steel production, either in its raw form or as an alloy, and there are no existing satisfactory substitutes for its use in these application. It fulfils a variety of functions - it improves strength, toughness, hardenability and workability of the steel and acts as deoxidizer and desulphurizer. World reserves of manganese are about 2 billion tons, of which the African continent accounts for 53.3 per cent, with developing Africa contributing over 258 million tons. Significant manganese producers in the West and North area are Gabon, Ghana and Zaire.

Gabon Gabon is the world's fourth largest manganese ore producer. In 1981, manganese production by Compagnie Minière de 1'Ogooue (COMILOG) fall drastically by 30 per cent to 1,482,000 tons. Reserves are estimated at 200 million tons of ore. There are plans to significantly increase production and to build a ferromanganese plant, but these are dependent on the completion of the Trans-Gabon railroad to Moanda.

Ghana Ghana's manganese reserves are estimated at about 6 million tons. Production of ore in 1981 was 230,000 tons, down from the levels of over 300,000 tons achieved in the early 1970's. The entire production is generally exported. In 1983, production commenced at the manganese modulizing facility operated by the Ghana National Manganese Corporation at Nsuta in the Western region. Following rehabilitation, the mine is now expected to continue to produce low and high-grade manganese ores for at least another twenty years.

Zaire Reserves of manganese are placed at about 5 million tons and production has declined in the last decade to less than 50,000 tons of ore per year. Producing mines re located near Kisenge and are operated by Société Miniere de Kisenge, a wholly-owned government company.

3.3.4 Cobalt

Cobalt is obtained mainly as a by-product of copper and nickel mining. The split of cobalt usage is more or less unchanged at about 40 per cent for all metallurgical applications, 40 per cent in chemicals of all kinds. 12 per cent for hard metals and perhaps 8 per cent for magnets. The major consuming sectors are aerospace industry, magnetic material sector, cutting and wear resistance materials, steel tools and the chemical and ceramic industry.

Zaire alone accounts for about 58 per cent of Africa's identified and economically explicitable reserves of 1.2 million tons of cobalt. Cobalt is co-produced with copper and silver by La Genereale des Carriores et des Mines du Zaires (GECAMINES) from 11 mines and 1982 output was about 5,600 tons, down from over 11,000 tons in 1981 and 14,500 tons in 1980. This was partially as a consequence of the deliberate reduction in output implemented by the company in response to a weak international market for copper.

3.3.5 Columbium/tantalum

Columibum is also called niobium and used for alloy products such as high-strength low-alloy (HSLA) steels. Columbium is also consumed for the production of stainless steels and heat-resistant steels. Tantalum is needed for the production of high-temperature alloys.

In West and North Africa, only Zaire and Nigeria are significant producers of columbite/tantalite.

Zairean reserves of over 33,600 tons occur mainly in the Kivu region where they are exploited by Société Minière et Industrielle de Kivu (SOMINKI). Production in 1982 was 60 tons, down from 80 tons in 1981.

Nigerian columbite/tantalite occurs in association with cassiterite, wolframite, monazite and ilmenite on the Jos Plateau. Reserves of columbite are still reasonably large (over 64,000 tons) although production has declined in recent years due to the severe depletion of the easily workable alluvial reserves and the difficulty of mining the marginal non-alluvial and deeper reserves.

3.3.6 The hydrocarbon minerals

We are going to check which country could adopt which process to make steel products. The ability of the mini steel mills or integrated mini-steel mills to operate at a relatively small scale made it attractive to developing countries seeking to establish an iron and steel industry to satisfy local demands for reinforcing bar, structural steel sections and similar products essential to a developing industrial sector. Now in the developing African countries, a number of nations are committed to the establishment of an indigenous industrial base of which iron and steel making forms a key part. What these countries need to produce steel products are iron ore, oil, natural gas and coal or charcoal. For a country with surplus natural gas as a by-product of petroleum operations. the obvious choice is direct reduction and Arc furnaces. In regions which have ore and coal resources the coal-based DR have proved successful. Direct reduction could form a very attractive base for development of a steel industry even though a country has no iron ores, since it could operate at small scale, employing relatively cheap and simple technology, and capable of indigenous fuels such as lignite, low grade coal, wood or charcoal.

Developing Africa contains about 9.4 per cent of the world's known petroleum reserves, 8.0 per cent of its natural gas and 0.9 per cent of the coal. Its consumption is, however, only about 1.6 per cent for petrolem, 0.5 per cent for natural gas and 0.2 per cent for coal. As such, most of the region's crude petroleum output (about 9.6 per cent of the world total) is exported, along with about 56 per cent of its gas output. Developing Africa is not a significant coal exporter.

The occurrence of hydrocarbon resources in the West and North African areas is as shown in table 25. These countries which are listed on Table 25 could develop their own integrated mini-mills based on direction reduction and electric arc furnaces.

3.3.7 Coal

The use of coal to date in DR (Direct Reduction Process) has concentrated on direct use in the rotary kiln processes. These use coal as the fuel and reductant, are suited to operation at 0.100 - 0.120 mm tons/year and so can be matched in capacity with arc furnaces, and are relatively simple plants with low investment costs.

In addition, a comparatively new steel making route called 'smelting reduction' has been developed. In this process iron ore or pre-reduced iron oxide is directly smelted at a high temperature in a furnace with injected coal and oxygen. Although this process is still in the development stage, the process has a growth potential in the wake of a mounting demand for steel making techniques compatible with the use of diverse types of coal. The process is suitable for small scale iron and steel making based on coal as fuel. Also the smelting reduction-oxygen converter process is expected to be capable of producing steel at lower cost either than the BF-BOF or direct reduction-electric arc furnace steel making routes.

Only five countries, Algeria, Morocco, Niger, Nigeria and Tunisia, have any significant coal reserves.

Algeria Coal reserves of cokable quality occur in the Gara Bechar, Gara Mazarif and Gara Antar areas, and are estimated at about 90 million tons. Only the Gara Bechar deposit is mined, although Algeria still depends heavily on imports for coke, semi-coke and coal.

Morocco Moroccan coal occurs in the Jerada basin in the eastern part of the country. Reserves are placed at about 10 million tons measured and 50-60 million tons probable and possible. The rank is anthracitic, ranging in calorific value up to 7,000 keals/kg. (washed coal). Coal production in 1983 was about 750,000 tons, of which 650,000 tons were consumed by a 165 MW. mine-mouth power plant. Plans are under way to increase production to one million tons by 1988.

Other hard coal resources have been recently discovered in the Taourirt region, while lignite occurs in the Guercif and Ghafsai sectors. None of these is, however, currently being exploited.

Niger A 66 per cent government-owned company, Société Nigerienne de Charbon d'Anou Araren (SNICHAR), was incorporated in 1977 with responsibility for developing the 6 million ton exploitable reserves at Anou Araren, about 50 km east of Agades. Production commenced in 1980 and by 1983 had reached a rate of 150,000 tons/year, all of which was consumed domestically for power generation replacing some imported petroleum products.

Table 25. Hydrocarbon resources of West and North Africa

COUNTRY	Coal resources	Petroleum resources	Gas resources
Algeria	90 million tons of coking coal containing 22-25% volatile matter, 12-25% ash, and 0.07% S.	Proved reserves = 1,023 million tons Probable reserves = 91 million tons Possible reserves = 22 million tons	Proved reserves = 2.974 billion m.m Probable reserves = 520 billion m.m Possible reserves = 299 billion m.m
Benin	-	Petroleum reserves in the offshore Seme oilfield	-
Cameroon	-	Measured recerves of 140 million barrels from the Rio del Rey and Victoria offshore fields	Offshore reserves of 110 billion cubic metre at Kribi
Congo	-	Marine reserves of over 6 billion barrels around Loango, Emerande, and Lekouala	Offshore deposit of 2.5 trillion cu. ft.
Gabon	-	About 65 million tons	-
Ghana	-	About 5 million barrels	Unquantified reserves in the Tano basin
Côte d'Ivoire	-	Offshore Belier and Espoir fields	
Libyan Arab Jamahiriya	-	22.6 billion barrels reserves	23.2 trillion cubic feet of reserve

Table 25. Hydrocarbon resources of West and North Africa (cont'd)

COUNTRY	Coal resources	Petroleum resources	Gas resources
Morocco	Up to 70 million tons of anthractic coal in the Jerada basin	-	-
Niger	Exploitable reserves of 6 million tonsin the Anou Araren deposit	-	-
Nigeria	Over 660 million tons in Anambra, Benue and Plateau States; high-volatile sub-bituminous and Lignite	16-18 billion barrels of reserves in the Niger Delta and offshore fields	90-140 trillion cubic feet
Senegal	-	Up to 3 million tons of light oil in the Dome Flore area	50 million cubic metre deposit at Diam Niadio near Dakar
Sudan	-	At least 150 million barrels in 10 separate reservoirs in the interior	130-385 billion cubic feet of gas in the Red Sea.
Tunisia	Lignite occurrences at Cap Bon and at Sabria	On-shore recoverable reserves of 80 million tons	Associated and non-associated gas reserves are estimated at about 93 billion m.m.
Zaire	750 million ton reserve in Shaba Province and in Lake Taganyika region	145 million barrels reserve	

Nigeria Nigeria's coal reserves exceed 500 million tons and occur mainly in the Anambra, Benue and Plateau States. They are either of the high-volatile sub-bituminous variety or lignitic. Recent discoveries of metallurgical coal have been reported in the Lafia-Obi area in the Benue valley of Plateau State, which is estimated to contain about 162 million tons, although indications are that this deposit may contain unacceptably high levels of sulphur and ash, thus making the coal unsuitable for blast furnace coke production.

Tunisia Scattered deposits of low-quality lignite occur around Cap Bon in northeeastern Tunisia, as well as at Sabria, southwest of the city of Gabes. There is no commercial production, however.

3.3.8 Petroleum and natural gas

Since the 1973 oil shock, there has been a proliferation of exploration and prospecting licences issued by virtually every African country to the multinational oil companies. Because of the large proportions of their foreign exchange earnings expanded on petroleum products importation by non-oil producers, it had been their hope that commerical domestic oil and gas strikes would assist in plugging this foreign exchange drain, diversify the economy, and promote over-all economic development. To an extent, some success have been recorded and, as shown in table 25, 13 countries in the West and North African areas are actual or potential producers of petroleum and gas. It has already been seen that petroleum rich African developing countries have fulfilled most of the requirements for the deployment of direct reduction processes based on natural gas. In terms of technical developments, it is probable that the two already established gas based processes will continue to maintain their position of dominance. The state of the petroleum and gas industries in the various countries is as follows:

Algeria Algeria is one of four African members of the Organisation of Petroleum Exporting Countries (OPEC). Its crude petroleum reserves amount to over 8.2 billion barrels, while its gas reserves of over 3,155 trillion cubic feet place it in the fourth position in terms of the world's reserves. Algeria is also Africa's largest natural gas producer, and hydrocarbon exports, valued at about $US 11 billion, accounted for 98% of the nation's total exports in 1981. It is projected that revenues from hydrocarbon exports would continue to contribute significantly to the national economy for the next fifty years.

Benin Petroleum was discovered in the off-shore Seme field by Union Oil Company in 1968. A service contract governing production was signed with the private Norwegian oil company, SAGA Petroleum, in 1979 and actual production began in 1982. By 1983, daily production had reached 4,000 barrels from two wells, and it was expected to exceed 10,000 barrels by 1985.

Cameroon Cameroon's petroleum and gas reserves are located in the offshore Rio del Rey basin and the Victoria field. There are also significant natural gas reserves offshore at Kribi. Total reserves are estimated to be 480 million barrels of crude petroleum and 110 billion cubic metres of gas. 1983 oil production was at the rate of about 125,000 barrels per day, making Cameroon virtually self-sufficient. Most of the associated gas is flared, and although there is no domestic market for liquefied natural gas (LNG) there is

a proposal to implement a 5 billion cubic meter per year LNG project as a foreign exchange earner. To be sited at Lolabe, the project's targets have been repeatedly delayed and it is not now expected to become a reality earlier than 1990.

Congo Petroleum and natural gas are the centre pieces of Congo's economy, contributing over 60 per cent of its GDP. There are three major oil producing areas: Loange, Emerande, and Lekouala. New figures for reserves are 2.2 billion barrels for Lekouala and 3.7 billion barrels for Emerande. A new discovery is the Mengo field. Congo's oil production in 1983 was at the rate of 91,000 barrels per day. As for gas, total reserves in the offshore Pointe Noire field is about 2.5 trillion cubic feet. Elf Congo and AGIP are under agreement to organise and promote natural gas exploration and development.

Gabon An OPEC member, Gabon's economy relies heavily on petroleum, of which proven reserves in 1984 were estimated at 65 million tons. Production is mostly from the offshore fields around Port Gentil, and reached a peak of 11.5 million tons in 1976, declining to 8.7 million tons in 1984. Prospects are for a slow but gradual decline over the next five years.

Ghana Estimates of Ghana's petroleum reserves range from 1 to 5 million barrels, but it is believed that the potential is far greater, particularly in the Tano basin.

Côte d'Ivoire Oil production comes from the Belier and Espoir offshore fields. Capacity is not expected to exceed 30,000 barrels per day, which would nevertheless make Côte d'Ivoire self-sufficient in crude petroleum.

Libyan Arab Jamahiriya A member of OPEC, Libya Arab Jamahiriya's proved crude oil and natural gas reserves rank 9th and 16th respectively in the world. These two commodities are Libya Arab Jamahiriya's dominant mineral resources, making it one of the wealthiest countries in Africa. Crude petroleum reserves exceed 22.6 billion barrels, while gas reserves are over 23 trillion cubic feet. Most of Libya Arab Jamahiriya's crude oil production is exported and its natural gas output, less the quantity required for domestic use in power stations or industrial plants, is liquefied for shipment to customers in Europe.

Nigeria In 1981, Nigeria ranked tenth in world petroleum production and was Africa's largest producer. Since the last 1960s, petroleum has been the key to Nigeria's economic development, contributing the bulk of Government revenues, foreign exchange earnings, and the GDP. Reserves, which occur both in the southern coastal belt and off shore, are estimated at between 16 and 18 billion barrels. Production has, however, declined from the level of nearly 2.3 million barrels per day in 1979/80 to the current 1.3 million barrels, in line with OPEC-mandated production quotas aimed at maintaining agreed.

With respect to natural gas, it is estimated that Nigeria's gas reserves exceed her oil reserves, in energy terms, by over 50 per cent. Associated and non-associated gas reserves amount to between 90 and 140 trillion cubic feet. Current production, however, is in the form of associated gas at an average rate of about 40 million cubic metres per day. The greater part of this output, in fact well over 90 per cent, is currently flared, although government legislation is being brought to discourage indiscriminate flaring in favour of re-injection or other gas-conserving measures.

Senegal There was a recent discovery of petroleum in the Dome Flore area, about 60 km offshore from Casamance. The existence of a light oil reserve of up to 3 million tons was confirmed and exploration continues based on seismic data. A small deposit of natural gas has also been found at Diam Niadio near Dakar with an estimated reserve of about 50 million cubic metres.

Sudan Sudan is one of the African countries with the best potential for petroleum development. Exploration has been proceeding since the mid-1970s by Chevron who first discovered oil in Sudan in 1979. Reliable estimates of the size of recoverable reserves are not available, but the latest estimate is at least 150 million barrels present in ten separate reservoirs. It was planned that petroleum production would commence in 1985 in the southern oilfields, with a daily output of 25,000 barrels for both domestic consumption and possible export.

Offshore survey and exploration in the Red Sea indicate that it may contain reserves of 130 to 385 billion cubic feet of gas and up to 30 million barrels of condensate.

Tunisia Petroleum is Tunisia's most important export commodity and the country ranks as the seventh largest oil producer in Africa. Recoverable reserves mostly on shore, are estimated at about 70 million tons, out of total proven and probable reserves of about 80 million tons. With recent discoveries, crude oil production levels should remain stable or increase slowly in the next few years. Total gas reserves are estimated at about 93 billion cubic metres, and in 1981, production matched the country's needs of 380 million cubic meters. Production could increase significantly in the future if a decision is made to develop the Miskar offshore gas field.

Zaire An oil field has been discovered at the mouth of the Zaire River and production by Zaire Gulf Oil in 1981 was at the rate of 20,300 barrels per day. Total reserves are estimated to be about 145 million barrels.

3.3.9 Electrical energy

The steel industry is a major consumer of energy. In the OECD countries, for instance, the industry typically accounts for about 7.5 per cent of total energy consumption, and for 18-20 per cent of the total industrial energy consumption. Electrical energy availability at reasonable prices is particularly important for the African steel industry since the relatively modest plant capacities almost invariably dictate the adoption of the electric arc furnace route (based on scrap and/or sponge iron) for steel production.

Electricity generation and consumption per capita are uniformly low in Africa in relation to the levels in the industrialized countries. Table 26 shows the installed capacities in 1980, as well as the capacities that were hydro-based. The great rivers of West and North Africa: Zaire, Niger, Nile, and Volta, represent an enormous hydro-potential that is hardly exploited. For instance, it is estimated that Zaire alone possesses about 13 per cent of the world's hydroelectric potential. Other countries in the region that have sizable potentials partially developed to varying degrees are: Congo, Gabon, Ghana, Guinea, Nigeria and Sudan.

Table 26. Electricity generating capacities in West and North Africa in 1980

Country	Total installed generating capacity (MW)	Hydro-capacity (MW)
Algeria	3,500 [a/]	...
Benin	19.5	...
Burkina Faso	30	...
Cameroon	681 [b/]	300
Central African Republic	12	12
Chad	38	...
Congo	116	...
Gabon	265	160
Ghana	1,317	1,200
Guinea	75	75
Côte d'Ivoire	750	675
Liberia	327	69
Mali	50	...
Morocco	1,650 [c/]	610
Nigeria	1,823	780
Sudan	480 [c/]	240
Togo	100	...
Tunisia	500	65
Zaire	1,694	...

a/ 1986
b/ 1985
c/ 1983

3.3.10 Non-metallic mineral resources

The non-metallic mineral resources relevant to the iron and steel industry may be grouped into the slag formers and conditioners and the refractory minerals.

The slag formers include limestone or calcium carbonate ($CaCO_3$), dolomite ((Ca, Mg) CO_3), silica (Si O_2), alumina (Al_2O_3), and fluorspar (CaF_2). These minerals generally act as fluxes, rendering the gangue impurities in iron ore more readily fusible while providing a vehicle for their convenient elimination during iron and steelmaking. The refractory (or high-temperature) minerals, on the other hand, serve an essentially structural function insofar as they are used for the construction of furnace walls and for lining of metal-holding vessels. The specific refractory material employed in a given situation is dictated by the chemical composition of both the refractory and the substance with which it will be in contact, as well as by operating temperatures and economic considerations. Groups of refractory minerals include siliceous minerals such as quartz and sandstone, fireclay, alumina, the magnesium silicates, magnesia-lime, and chromite.

The slag formers and conditioners occur extensively in Africa. There are few countries without exploitable reserves of limestone and sand. In fact, small and large-scale quarrying of these minerals is a popular low-investment industry throughout the region. It is not foreseen that the non-availability of these minerals in any country or subregion would constitute a constraint to the evolution or flourishing of a steel industry.

As for the refractory minerals, some are abundant such as fireclay, quartz, and sandstone, whereas the more exotic chromites and magnesites are more limited in their occurrence. In any case, a significant proportion of the refractories consumed by currently operating steelworks in developing Africa are imported and therefore constitute a foreign exchange drain. It may therefore be inferred that since some African countries are richly endowed with these minerals, e.g. Madagascar, Sudan, Zimbabwe projects for the manufacture of steel plant refractories would be a good basis for subregional or regional co-operation.

4. PROSPECTS FOR THE IRON AND STEEL INDUSTRY

It is apparent from the preceeding discussion that in spite of the relative abundance of important ferrous mineral resources, the iron and steel industry of West and North Africa is still relatively under-developed, notwithstanding the existence of substantial steelmaking capacities in a few countries such as Algeria, Libyan Arab Jamahiriya and Nigeria. Not only is domestic production extremely limited, but even the low levels of per capita steel consumption are sustained mainly through import. However the existence of a steel industry could contribute to the industrialization of a country especially by import substitution, which means savings in foreign exchange. The development of a steel industry gives the multiplying effects on the other (steel consuming) sectors of the economy and wider opportunities for employment because of its forward and backward linkages to other industries. The maximum effect on the economy is only possible if the steel industry is based on indigenous resources.

This chapter examines a large number of elements which hampers the development of iron and steel industry in developing African countries with the intention of finding constructive solutions for problems affecting the prosperity and growth of the iron and steel industry in this region.

4.1 Constraints to development of the steel industry

The constraints that have historically militated against the development of the industry will be analysed from three perspectives: national, regional and subregional, and global, each level of analysis highlighting the dominant factors that operate and could be controlled at that level.

4.2 National constraints

(a) Low volume of domestic consumption

As discussed in chapter 3, the per capita steel consumption in developing Africa is measured only in tens of kilograms, rather than in the hundreds as in the industrialized countries. Given such low levels of consumption, the aggregate national steel demand for most countries is too low to absorb the output of an economically sized steel plant.

Under these conditions, subregional co-operation presents itself as a potentially viable option for steel projects. By pooling together their resources and markets, two or more countries might be able to generate the demand necessary to justify an economically-sized project to supply the steel needs of the collaborating parties. For example, in the central African subregion, a subregional approach to iron and steel development is of paramount importance because of the large number of LDSs in the subregion. As shown in table 2, there is significant difference between percentage figures for non-LDCs and least developed countries. With the same quantity of labor forces non-LDCs produced approximately twice more than LDCs.[6/] In other wrods, subregional co-operation should be considered as the most appropriate mechanism for establishing and developing strong mining and metallurgical activities in order to facilitate industrial and economic development within the subregion.

6/ Survey of economic and social conditions in Africa, ECA, 1984-1985

Such a project of limited scale of production, could use one or more of the following process routes:

(i) Iron making via the direct reduction route, probably employing a solid reductant technology such as the SL/RN process which could be economical at plant capacities as small as 30,000 tons per year;

(ii) Steelmaking using the electric arc furnace, and based either on scrap or direct reduced (sponge) iron. As is apparent from table 13, arc furnace meltshops as small in capacity as 10,000 tons per year could be economically feasible;

(iii) Rolling mills for the production of simple shapes (bars, rods, angles, channels, etc), consuming imported billets from either other steelworks in the region or from overseas sources.

(b) Scarcity of investment finance

Since the early 1970s, many African developing countries (particularly the non-oil producers) have been buffeted on the one hand by declining and unstable market prices for their primary commodity exports and, on the other, by huge energy import bills. As such, domestic savings have been minimal. Public enterprises in which governments have invested huge resources have traditionally not returned any surpluses. Quite often they have been kept in business only through massive doses of government subsidies and loans. Thus investment resources have not been forthcoming and, even where some resources exist, other considerations have made it more prudent to invest in simpler less capital-intensive projects which barely help facilitate the industrialization of African developing countries. In the case of mineral industry, the predominant picture is that the non-fuel minerals produced by African developing countries are exported in crude or near-crude form, to be processed and consumed in the industrialized countries. But increased local processing has the potential to offer very considerable benefits to African countries for financing investment, by way of increased export proceeds due to more value added goods, a speed-up of economic growth, and promotion of general industrialization through forward and backward linkages created by the processing activities.

(c) Mismanagement of natural resource endowments

The development of a steel industry is generally facilitated by the local availability of all the essential raw material and energy resources iron ore, coal or other hydrocarbons, electricity, etc. Given the abundance of iron ore in West and North Africa, with Liberia and Mauritania ranking with the world's leading producers, it would be expected that the basis existed for a flourishing steel industry. This is not the case and, as if to underline the supremacy of investment resources, it is the oil-exporting countries which generated substantial savings during the 1970s, that have succeeded in installing large steelmaking capacities. This notwithstanding, it must be acknowledged that entry into the group of steel producers is easier, other things being equal, if a country has local resources of minerals and energy since technology for making iron and steel is now internationally well diffused and available to all who can pay for it. This can be caused by the in-effective government policy which canalizes resources and creating conditions for the development of the local steel industry.

(d) Weak forward linkages

The central role usually assigned by many developing countries to the iron and steel industry in their industrial development plans derives from the vast linkage potentials of the industry to other sectors of the economy. For instance, the engineering, construction, transportation, defence, and agricultural industries are positively stimulated by and benefit directly from the existence of an iron and steel industry. In developing Africa, however, many countries have either contented themselves with the mere extraction and beneficiation for export of primary iron ore. If processing is carried beyond the refined metal stage, into fabricating and manufacturing of metal containing components and products, it may encourage local production of non-metal inputs into such products. In this way forward integration from mining can afford an approach, towards lessening the country's mineral dependence, and promote a general diversification of national economy for strong forward linkages.

By thus limiting their activities to the very early stages of the conversion process, many countries in the region have failed to benefit from the higher value-added and more meaningful technology transfers associated with the later processing stages. But developing African countries can derive very considerable benefits in terms of a boost to their industrialization process, increased export earnings and a faster growth of GNP from efforts to expand the processing of minerals extracted within their territories. For the African developing countries to realise the full benefits accruing from their natural resource endowments, the mining and extraction of iron ores must be perceived as the foundation for a vigorous iron and steel production industry which, in turn, would supply the requirements of the engineering and other manufacturing sectors of the economy.

(e) Lack of domestic technological capability

The technological under-development of the African region manifests itself in the preponderance of imported (and often inappropriate) equipment and machinery, low-quality manufactured products that are unable to compete with foreign products, a perennial shortage of spare and replacement parts, and inadequate service and repair facilities. Most African countries suffer from a severe shortage of qualified and competent personnel in the managerial, technical, engineering and scientific cadres. Problems therefore abound in the operation of industrial plants, in effective co-ordination of operations, and in project identification, formulation, evaluation and implementation.

(f) Inadequate development plans

Although most African countries have adopted the development planning concept, the plans often lack comprehensiveness and long-range perspective. As a result, projects tend to be seen in isolation rather than as elements of a development continuum to be carefully integrated with preceding and subsequent activities. The short-sighted and ill-motivated projects that are implemented often fail to produce the desired socio-economic impact, resulting in a misapplication of scarce national resources. Another constraint arises from the weakness of national planning institutions where they exist: the activities of such institutions are often not well co-ordinated, and there are numerous instances of conflicts, contradictions, rivalries and duplications within the planning institution, and between it and the executing arms of the economy.

(g) Weak indigenous entrepreneurship

The weakness of the local entrepreneurial class is responsible, at least in part, for the importance by default, of transnational corporations and public enterprises in the industrial sector of African countries. The activities and priorities of the former have traditionally been dictated by their over-riding global interests which may not always be in harmony with the development goals of host developing countries. On the other hand, the performance of the latter, in terms of returning surpluses, has generally been unimpressive in most countries. The sooner, therefore, that national entrepreneurial classes can emerge to complement and/or replace the multinationals and the government as a major investor in industry, the sooner African manufactured products (including steel) would be in a position to compete effectively in the international market.

4.3 Regional/subregional constraints

(a) Disparate levels of industrialisation

The disparity in the levels of industrialisation among the twenty-six member states of the West and North African area is illustrated by the respective contributions of industry to GDP as shown in table 2. In 1983 for instance, these contributions ranged from 64 per cent for Libya Arab Jamahiriya and 62 per cent for Gabon to 11 per cent for Mali and 7 per cent for Ghana. Given such wide disparities, the industrialization priorities of the various member states inevitably diverge. More specifically, the priority attached to the development of the steel and other basic industries tends to favour the more industrially developed countries. Moreover, the balance of advantage in programmes of regional and subregional co-operation in steel projects would lie with the relatively stronger industrial economies which, most probably, would also have the domestic markets for steel, as well as relatively developed infrastructures and financial resources. It is thought that this factor is primarily responsible for the limited number of subregionally sponsored industrial projects in the ECOWAS sub region, where Nigeria, on the basis of the 1983 statistics, is predominant both in terms of population and industrialisation.

(b) Poor transportation, communications and infrastructural linkages

The transportation and communications network in most subregions of Africa were designed to expedite primary exports and urban imports. There was no effort made to achieve subregional integration. Accordingly, difficulties and bottlenecks are often encountered in trade between countries as well as between subregions, resulting in high costs and often placing locally produced goods at a competitive disadvantage vis-a-vis imports. It is therefore apparent that the transportation and communication related sectors demand priority attention if regional integration and self-reliance are to be attained in Africa. A related consideration is the problem created by customs bottlenecks. There is no consistency in customs procedures which often inadvertently favour overseas imports to the detriment of intra-regional trade.

(c) Lack of complementarities in steel development plans and projects

In general, African steel producers had planned their projects with a view towards serving their own national markets, and without consideration to

the demands of other subregional consumers. The potential that exists for exploitation of subregional and regional markets through complementary investments and product specialisations has therefore been unexploited. Given the limited resources available for industrialisation, complementary planning based on subregional markets and resources would appear to be a means for effecting a uniform development of the industrial sector in general.

(d) Inadequate institutional machinery

Since the attainment of independence in the 1960s, African developing countries have established a number of subregional and regional organisations whose terms of reference include the advancement of social, economic and cultural integration. Among these organisations are the Economic Community of West African States (ECOWAS), the Mano River Union, the West African Economic Community (CEAO), the West African Monetary Union (UMOA), the Liptako-Gourma Authority, etc. Whereas substantial political premium is placed by member states on these organisations, they have generally not been equipped with the resources to efficaciously execute their mandates. Support from member states has often been lack-luster. There is a need to strengthen these international institutions, particularly those involved in the promotion and integration of the region's industrial sector, especially in view of the importance attached to the sector in the framework of each country's development. Specifically for the iron and steel industry. There is some value in the formation of subregional communities (e.g. West African Iron and Steel Community; Central African Iron and Steel Community) with responsibility for promoting the comprehensive planning and orderly development of the industry within a subregional context.

(e) Differences in political/economic orientations

Because of their different colonial histories, the countries of West and North Africa have developed differing perspectives with respect to economic and political ideologies. Development strategies therefore necessarily vary as do the links with the previous colonial power. Such linkages may make it difficult to develope a subregional projects

4.4 Global constraints

(a) Foreign exchange limitations

Mineral-exporting countries are likely to continue to utilize their endowments of mineral deposits to stimulate economic growth. Mineral exports generate foreign exchange, which is used import modern technology and consumer durables in addition to servicing past and future external loans extended by the international lending community. The extent to which these hard currency earnings can continue to be used to promote economic growth has recently been called into question due to the evolving economic environment in the mid-1980s. This environment is one of depressed minerals prices, projections suggesting reduced growth in global demand for minerals and shifting market shares away from traditional sources towards more recently discovered and more economic deposits and/or more secure sources of supply.

This factor has been both a cause and a consequence of the economic problems of the developing countries since about 1980. With the decline and instability of prices for primary products severe shortages of foreign exchange have occurred which, in turn, have hampered the ability of the developing countries to import the capital and consumer goods necessary to sustain the economy.

(b) Increasing foreign debt

Aggregate thrid world debt burgeoned in the last half decade- from 500 billion in 1980 to 800 billion dollars. Total African debt has notched up 16 per cent of the total. A figure that could be construed as numerically small, but as stated before the debt service of most developing African economies is prodigious in relation to their gross domestic products. Further their economies are more fragile and depending on crumbling primary commodity prices than other major third world regions, as well as having been afflicted in recent years, by natural disasters of apocalyptic proportions. The stark implications of the dynamics of borrowing on halting the internal development process is that 70-80 per cent of the new loan to many of the bigger debtors since 1979 have gone into paying interest on the old loans. Related to this occurrence is the gargantuan transfer of net resources from developing African countries to the major lendors, the transnational banks. The outcome is ineluctable: They are literally being driven to market fatter and fatter volumes of primary commodities at lower and lower prices on the global market in return for higher prices goods and services imports, which means that larger and larger amounts of their dwindling export earnings must reimburse an unending spiral of bigger and bigger debt interest and amortization payments.

As discussed previously, the escalation of developing Africa's debt burden over the last decade is a serious concern to the region. With a large proportion of their foreign exchange earnings devoted to debt repayment and servicing, little is left for procurement of these goods and services necessary to revitalize and transform the economy. The performance of African economies in the next decade will materially depend on how effectively they solve their debt problem.

(c) The role of transnationals

The role of the transnationals in the development of Third World countries has been the subject of vigorous debate for many decades. On the one hand, they have undoubtedly played a useful role by applying their vast financial and technological resources in the pursuit of economic development, especially in the primary extraction industries. On the other hand, their activities which are usually directed towards fostering their global goals have not always protected the national interests of their hosts. For example, there is often an implicity (sometimes even explicit) division of labor between a public enterprise and a transnational corporation - the former handles the intermediate stages while the latter takes care of downstream final processing as well as marketing of the finished commodities. This means growing concentration of product market, financial resources and technological power in the hands of a smaller set of transnationals and innovations, leading to fresh investment demand in developing African countries almost entirely depends on transnationals to provide the technical means to carry out upgrading of capacity and the establishment of new industrial branches, since they hold considerable technological command, enjoy ready access to huge financial resources (whether internally generated or raised on capital markets) in convertible currencies, exercise global market power, and wield, directly and indirectly, a fair measure of political influence.

The emphasis is made on maximizing TNC involvement in the most lucrative area of a sector but whether or not TNC's objectives are really the most suitable for the developing African countries is another issue. In countries like Liberia and Mauritania, the process of building-up national competence in the mineral field just started a few years back, and the dependence of these countries on full-scale foreign collaboration and foreign participation remains high.

In this climate, several developing countries have evolved measures for controlling the activities of the transnationals and for aligning their activities with the developmental objectives of the countries. What has resulted is a more equitable allocation of the benefits of their natural resources. But most cases have failed and only facilitated capital flights out of developing African countries.

4.5 Future development prospects for the iron and steel industry

Three distinct areas will be discussed below.

(a) Iron ore and coal extraction and beneficiation;
(b) Iron making and ferroalloys manufacturing;
(c) Steel production.

4.5.1 Extraction and beneficiation

As discussed in chapter 4, and itemized in tables 24 and 25, the West and North African subregions are fairly well-endowed with iron ore and hydrocarbon resources, including what are often described as the world's best iron ore deposits. The most significant of these are the Belinga deposits in Gabon, the Nimba and Simandou deposits on the Liberia - Guinea border of Guinea, and the Faleme deposits of Senegal and Mali. As for hydrocarbons, the oil and gas resources of Algeria, Gabon, Libyan Arab Jamahiriya, Nigeria and Cameroon are sufficiently vast to constitute the backbone of their respective national economies.

While the iron ore resources of Liberia and Mauritania are well exploited, those of Cameroon, Gabon, Guinea, Senegal and Togo represent potentially important assets that could be exploited nationally or subregionally. The prospects for early exploitation of these resources may be judged from the following status reports:

(a) Gabon

Gabon's Belinga reserves are particularly marketable in view of the fact that at least half the reserves contain no phosphorus, thus simplifying and reducing the costs of ore beneficiation and iron and steelmaking. Because this deposit extends into Congo, its development is amenable to subregional co-operation. In fact, in 1983, both Gabon and Congo had seriously considered such a co-operative venture, and had jointly sponsored an investigation covering an area of about 3,000 hectares on both sides of the Congo-Gabon border, with a view to increasing the reserves. It had also been decided that both countries would approach the European Development Fund for loans and subsidies with which to exploit the deposits. As of early 1986, it would appear that only the Gabonese aspect of the development is being pursued, with a target production date in 1986. Meeting this target depends, however, on the completion of the Transgabon railroad to Mekambo, 250-km from Boous, as well as an improvement in the world iron and steel markets.

(b) Guinea

Studies on the development of the Nimba and Simandou deposits have been going on over the last decade. Present estimates of the cost of development are in the neighbourhood of $US 1 billion and the implementing entity, Société des Mines de Fer de Guinee pour l'Exploitation des Monts Nimba (Mifergui-Nimba), has recently expressed optimism regarding its ability to arrange the necessary financing. The project is truly international in the

sense that it is to be managed by United States Steel Corporation, and equity holders include Nigeria, Libyan Arab Jamahiriya and Algeria. The ore would be exported through Liberia on the LAMCO railway to the port of Buchanan. It was planned that a third of the annual output would be purchased by Nigeria (i.e. 5 million tons), while Algeria and Libya would take 1.75 million tons and 2.5 million tons respectively. In view of the recent sluggish nature of the iron and steel markets, it is not expected that this project could come on-stream earlier than 1995.

(c) Senegal

In 1983, the Senegalese government had announced its intention to proceed with development of the Faleme deposit and, to this end, had commissioned a consulting consortium headed by SOCOMINE to conduct a feasibilty study. The proposed project would produce enough ore for an annual export level of 12 million tons of marketable ore for at least 23 years. The development also included a rail line between the port of Dakar and the mine, as well as port facilities. It is thought that the development is now in suspension while arrangements for financing and marketing are being made.

(d) Cameroon

A study is in progress by SEFERCAM, owned 35 per cent by the Cameroonian government and 65 per cent by a consortium of European and U.S. firms, to document Cameroon's iron and steel potential with particular emphasis on the Mamalles desposit near Kribi.

(e) Togo

The Baseri deposit, though not large in comparison with the Gabonese and Guinean reserves, is currently under study under the aegis of the Togolese government.

4.5.2 Iron making

As a result of the drastic increases in energy costs since the early 1970s, researchers have evolved several iron reduction processes aimed at overcoming the high energy-intensity and costs of the traditional iron blast furnace technology. Most of these novel processes such as smelting reduction have, however, not yet matured to the stage of commercialisation. Thus, for large-scale iron making, only the time-tested blast furnace and the relatively new direct reduction processes can be considered at present:

The blast furnace as a source of iron making units, in the context of West and North Africa, suffers from a number of important handicaps:

(a) Although there are exceptions, conventional wisdom and economic considerations dictate that for iron production rates below about 2 million tons per annum, the blast furnace option is not attractive. The exceptions refer to the experience of Brazil and other countries which have economically operated small blast furnaces (up to about 500 tons per day) on the basis of charcoal. This however assumes the existence of large forest resources coupled with well-executed afforestation programmes. This would argue against iron making via this route in Africa.

(b) Except for the charcoal-based plants mentioned, most other blast furnaces around the world are fueled by metallurgical coke. Coal of metallurgical quality occurs only in Algeria (of the 26 countries covered by this report). Even here, the known reserves are only 90 million tons;

(c) Blast furnace steelworks require very heavy capital investments as a result of the need to instal, in addition to the furnace, several ancillary facilities, materials handling devices, and infrastructures. The financial resources of most countries in the African region are now so meagre that large investment projects, such as blast furnace steelworks, are not a top priority.

It is for the above reasons that the newer direct reduction technologies for converting ore into iron without melting have emerged as a popular option, particularly in energy-rich developing countries. In this respect, although there are well over thirty different published processes, only a handful have reached the stage of commercialisation. Of the natural gas-based processes, the Midrex and HyL technologies have been dominant. The former process had enjoyed a technological advantage due to its continuous flow-scheme, but that advantage has now been designed into the latest model of the HyL technology (HyL-III). Other gas-based processes that had been commercially tested with less than totally satisfactory results are the Armco, Purofer and FIOR processes.

Of the solid fuel processes, perhaps the SL/RN process possesses the brightest prospects, especially among coal-endowed developing countries. But, as discussed in chapter 4, only a few countries of the West and North African subregions can boast of large good quality coal resources. What is more, several of the potential coal producers are also blessed with large resources of natural gas and petroleum, e.g. Algeria, Nigeria and Tunisia.

This being the case, the prospects of gas-based direct reduction processes are considered very good in the West and North African areas. Those countries that are endowed with both exploitable iron ore reserves and natural gas are in the best position to implement, or be the locations for, direct reduction plants. Among such countries are Algeria, Cameroon, Gabon, Libya Arab Jamahiriya, Nigeria and Tunisia. In fact, Nigeria already has a two-module Midrex direct reduction plant (rated at 1.2 million tons of sponge iron per year) in operation at the Delta Steel Company's steelworks at Ovwian-Aladja. Algeria also has under construction a Midrex direct reduction plant at Bellara rated at 1.1 million tons of sponge iron per year.

A sponge iron project idea had also been mooted and presented to the Sixth Meeting of the Council of Ministers of the Niamey MULPOC at its meeting in Cotonou in 1983. With an initial capacity of 800,000 tons per year, expandable to 1.5-2 million tons by the year 2000, the project was to be under the joint sponsorship of the Mano River Union, the CEAO, and the Liptako-Gourma Authority, and possible locations included Guinea, Liberia, Sierra Leone and Mauritania. Although the project was only at the early conceptual stage and no process specifics were presented, it would appear that energy availability considerations would constitute an important constraint to the implementation of this project. No doubt there is an abundance of high-quality iron ore in the collaborating countries, but hydrocarbon energy resources are very limited at the present time.

4.5.3 Ferroalloys manufacture

West and North Africa's ferroalloy minerals consist of manganese, cobalt, and columbium/tantalum. Of these, manganese possesses the best prospects for locally enhancing its value-added through additional processing prior to export.

The largest reserves (200 million tons) occur in Gabon which is the world's fourth largest producer of manganese ore. Ghana and Zaire, with reserves of 6 million tons and 5 million tons respectively, are also important sources of manganese. Plans have been announced for a ferromanganese plant in Gabon, but the project has yet to take off on account of the recent depression of the world's steel market, as well as the delay in completing the Trans-Gabon railway on which the project depends.

A ferromanganese project located in Ghana and under the sponsorship of ECOWAS would appear worthy of analysis and implementation as a means of promoting subregional cooperation. In fact, given the steel production capacity already installed in Nigeria (1.22 million tons of crude steel rising to over 2.5 million tons by 1989), it would make sense for Nigeria and Ghana to consider joint promotion of such a project, with Nigeria targeted as a significant outlet for the plant's product.

4.5.4 Steel production

Future steelmaking projects in the West and North African subregions should be aimed at not only increasing the quantity of local production, but also at diversifying the product mix. As shown in table 13, for instance, all but two of the steelworks of the area produce long products: bars, rods, angles, channels, etc. In fact, there is no single flat products (sheets, strips, plates) producer in Western and Central Africa. Accordingly, with the exception of Algeria and Libyan Arab Jamahiriya, all the 26 countries covered by this report import their entire requirements of flat steel. Similarly, there is no local manufacture of high-alloy and stainless steel, as well as seamless pipes, in the entire area, in spite of the obvious demand for such steel products by the oil and natural gas industries. The following project concepts therefore deserve closer analysis with a view towards their promotion under national or subregional auspices:

(a) A West African flat products steelworks

The project scheme would probably include a direct reduction plant to furnish sponge iron, an electric furnace steelworks equipped with continuous bloom/slab casters, and hot and cold rolling mills to produce plates, sheets and strips. Because of the need to include a sponge iron plant, the best location would be in a country that can supply cheap natural gas or coal, and that would also supply iron ore or be readily accessible to ore from the world market. In the West African context, Nigeria would appear to come closest to fulfilling these prerequisites at the present time. Nigeria has recently decided to instal a flat products plant at the Ajaokuta steelworks, with a capacity to supply at least a portion of the nation's flat steel demand.

(b) A Central African flat products steelworks

As discussed in chapter 2, Central Africa has only one operating steelworks in Zaire. Its product mix consists essentially of bars and rods. There is no production of flats, although SNS in Zaire re-rolls imported hot-rolled steel into cold-rolled hoops and strips.

The subregion appears to be well positioned to spearhead a small flat products project on a subregional basis. Iron ore reserves of good quality occur in Congo, Cameroon and Gabon, and natural gas for fueling a direct reduction plant occurs in Cameroon and Congo. What is more, vast underdeveloped hydroelectric resources exist in Congo, Gabon, and Zaire. It is conceptually feasible, therefore, to produce iron ore in one country of the subregion, convert it to sponge iron locally or in another country and produce flat steel from the sponge iron using the electric arc furnace process. In view of the various factors favourable to such a scheme, Cameroon could be a location for such a project. It would obtain iron ore from either its Kribi deposit when developed, or from neighboring Gabon, and natural gas would come from the reserves offshore near Kribi.

(c) A regional seamless tube project

The oil and gas industries, as well as the oil refining, chemical and high-pressure-steam industries consume large quantities of seamless pipe. They are employed as drill pipes and well casing in oil and gas production, and as pressure line pipes in the oil refining and chemical industries. Given the importance of these industries, particularly in the oil-producing countries of Africa an effort to produce seamless pipes locally would be of potentially very interesting.

The iron and steelmaking processes in a seamless steelworks are relatively conventional. Steels melted by many processes can be successfully converted into seamless tubes. In general, however, killed and semi-killed steels made by electric furnace and basic oxygen processes are used.

(d) Re-rolling mills

Opportunities exist in most countries of North and West Africa for the installation of re-rolling mills based on imported billets (preferably from other countries in the region) and producing simple merchant product for local and contiguous national markets. Although the feasibility of each project would have to be carefully assessed as an integral element of project planning, the location of one or more re-rolling miils coudl be discussed in the following countries: Cameroon, Côte d'Ivoire, Gabon, Guinea, Ghana, Liberia, Mali, Senegal, Sierra Leone and Sudan.

4.6 Role of international agencies (including UNIDO) in promoting steel development

The need to accelerate the economic and social progress of the developing countries has been a continuous pre-occupation of the developing countries themselves as well as of various international organizations such as UNIDO.

Development of the steel industry, which is capital intensive, as an integral part of planned growth, will naturally require careful evaluation by the national planning agencies of the developing countries. The national agencies will have to ensure development of the necessary infrastructure of power, water, transport and raw materials to ensure proper functioning of the steel industry, the pre-training of cadres and the simultaneous development of the downstream consumer industries for the steel. Ensuring easy availability of essential stores and spares within the country or on a basis of regional cooperation is an essential prerequisite.

As already mentioned before, many developing African countries are deficient in one or other raw material or energy resource for developing an iron and steel industry. By estblishing regional cooperation, they could complement each other in providing for deficiencies in input resources to their mutual benefit. Moreover, there are the immense disparities in size, population, politici-economic ideologies, and resource endowments, which make coordinated and integrated development of the iron and steel industry of the west and north African area difficult.

Those developing countries that have already gone through a good deal of the developmental process could share their experience with others so that some of the pitfalls could be avoided. It would be relevant to learn from the past experiences of the developing countries which have by now established the iron and steel industry. Several organizations in the developing countries are now capable of providing technical know-how on mini-mills based on technologies assimilated in economic and social conditions similar to countries where an iron and steel base is yet to be initiated.

In all these areas concerned, the role played by international organizations such as UNIDO is bridging the technology gap of the developing African countries would be invaluable. The roles of such organisations must, however, be supportive of rather than alternative to, national efforts and must be geared to prevent unnecessary duplications and waste of resources, as well as promoting self-sufficiency and self-reliance in steel production in the region.

To this end, international agencies such as UNIDO can assist the orderly development of the iron and steel industry through:

(a) Technical assistance to national and inter-governmental institutions in identification and planning of iron and steel projects. Such assistance could take the form of preparation of pre-investment studies, providing information on optimum plant sizes, raw materials, appropriate technologies, and potential markets;

(b) Assistance through sectoral studies for the purpose of the development of an integrated development of the iron and steel industry in respect to the type and level of integration between the iron and steel industry and other sectors of the economy at the national and regional levels, taking into account the level of dependence on the international economy. This is because an analysis of the specific sector approach is helpful in making decisions in concrete problems in the different industries.

(c) Assistance in characterizing natural resources endowments through reserve quantifications, mineral analyses, and identification of optimal industrial applications for mineral resources;

(d) Assistance through training aimed at developing indigenous capabilities in project planning, project consultancy, project preparation, and procurement of supplies;

(e) Promotion of specialised state-of-the-art-technology meetings aimed at assisting decision-makers in the optimum choice of iron and steelmaking technologies since the right selection of the process route and plant capacity, based on natural resources available and end-use of steel, is crucial;

(f) Dissemination of information and documents on choice of iron and steel technologies to ensure that the best choices are made among the numerous potential alternatives;

(g) Assistance in identifying potential sources of finance and in packaging project financing to reflect the interests of the African countries;

(h) Identification of potential joint-venture and equity partners from both the developed and developing countries; and

(i) Co-ordinating the efforts of development organisations such as the ECA, OAU etc in order to minimize duplication and waste of limited assistance resources.

For the guidance of our publications programme in order to assist in our publication activities, we would appreciate your completing the questionnaire below and returning it to UNIDO, Industrial Policy and Perspectives Division, D-2119, P.O. Box 300, A-1400 Vienna, Austria

---

Q U E S T I O N N A I R E

The iron and steel industry of West, North and Central Africa

		(please check appropriate box) yes	no
(1)	Were the data contained in the study useful?	/_/	/_/
(2)	Was the information provided new?	/_/	/_/
(3)	Were the format and style easy to read?	/_/	/_/
(4)	Would you like to make additions to the bibliography?	/_/	/_/
(5)	Would you like to make additions to the lime directory?	/_/	/_/
		If yes, please list overleaf indicating section	
(6)	Do you wish to be put on our documents mailing list?	/_/	/_/
		If yes, please specify subjects of interest	
(7)	Do you wish to receive the latest list of documents prepared by the Industrial Policy and Perspectives Division?	/_/	/_/
(8)	Any other comments?		

Name:
(in capitals) .....

Institution:
(please give full address) .....

Date: .....