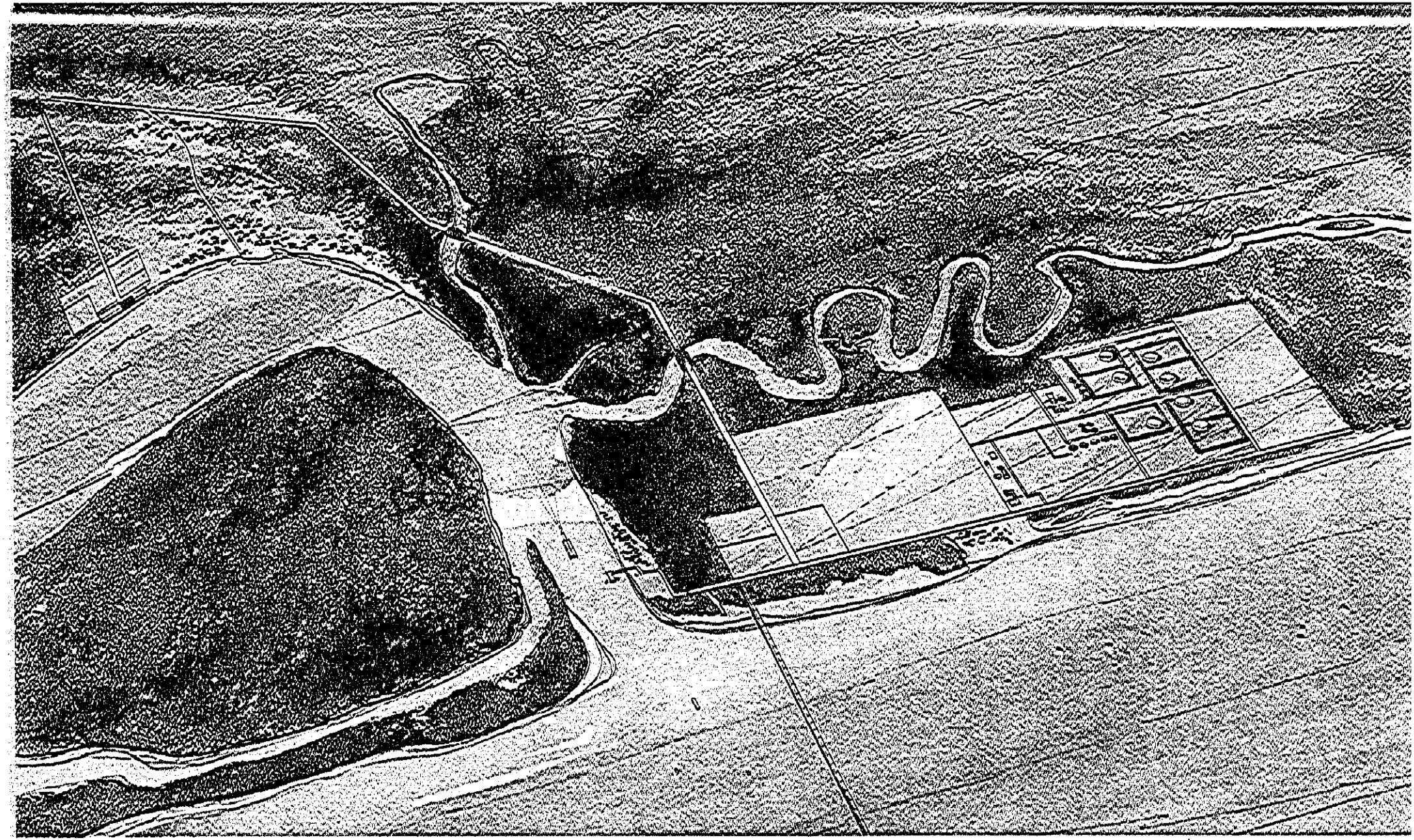
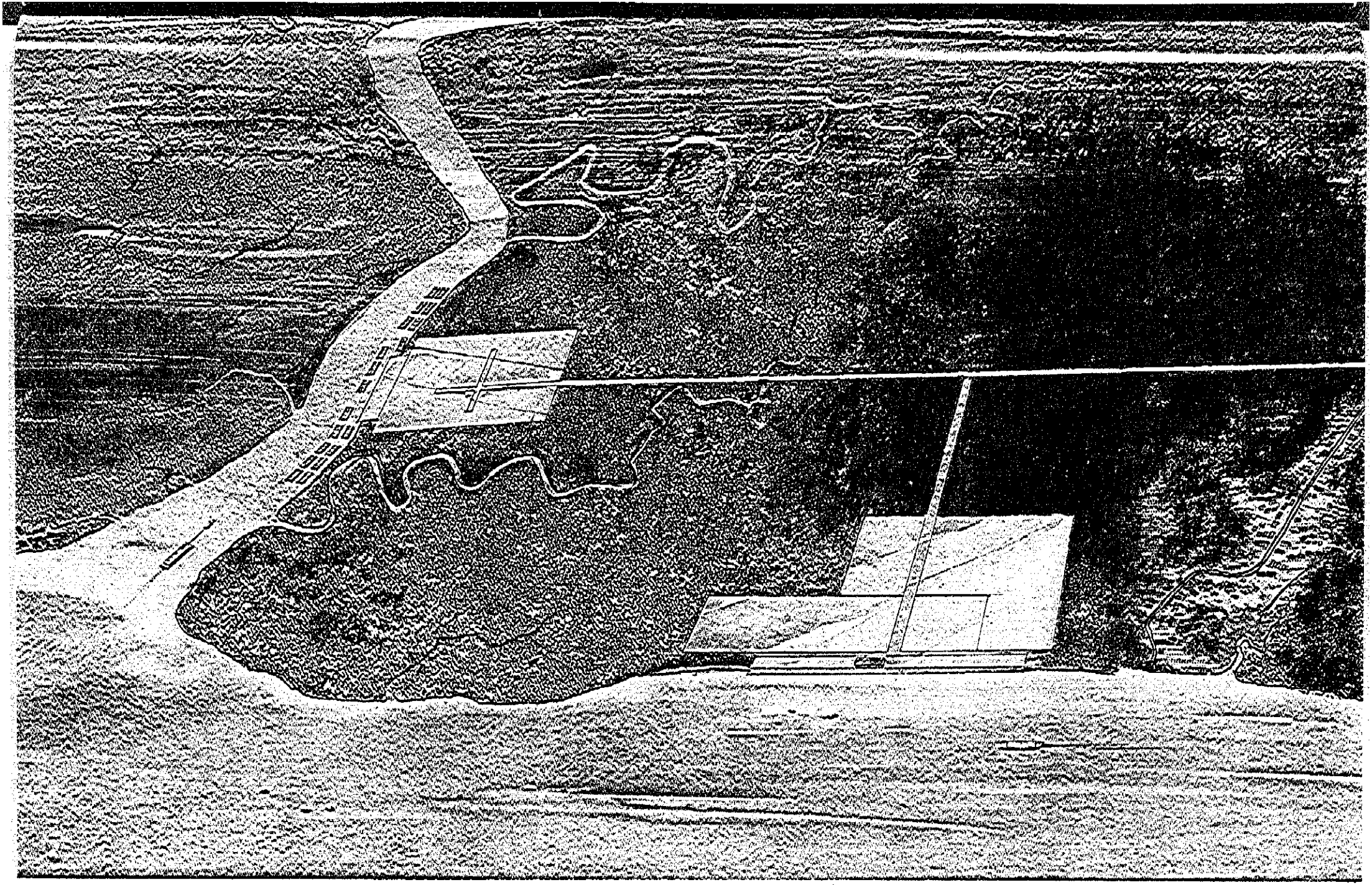
PART Ⅳ LOCAL PORT





CHAPTER 1. SCOPE OF WORK

The purpose of the study of Part IV is to sketch the planning of the local ports, which are considered to be feasible from the viewpoints of natural and socio-economic conditions in each of the three eastern sites (Opobo, Ibeno, and Jamestown).

To this end, this part examines roughly the functions and scales, and the layout of their facilities, with comments from technical and socio-economic aspects of each port.

CHAPTER 2. FUNCTIONS AND FORM OF LOCAL PORTS

IV-2-1. Functions of Local Ports

Local ports in the eastern coast can possibly have both industrial and commercial port functions.

(1) Commercial Port

The commercial port is designed to handle the following cargoes:

a. Cargoes generating from its hinterland and handled at public wharves (public general cargoes)
b. Cargoes generating particularly from the industrial complex at the port area and handled at public wharves (manufacturers' cargoes)

Therefore, necessity of developing a commercial port will depend upon the predicted volume of the above public and manufacturers' cargoes.

(2) Industrial Port

Industrial port are used either by industries which employ ships for bringing in raw materials and taking out products, or following industries which use ships, mainly, for reducing transportation cost.

a. Industries which use public wharves for bringing in raw materials or taking out products (port-related industry)
b. Industries which need wharves at those factories for bringing in raw materials or taking out products (port-oriented industry)

Therefore, the feasibility of developing an industrial port is dependant upon the possible locations of port-related and port-oriented industries. Locations for these industries are affected by the water depth of the ports and the size of berthing ships.

IV-2-2. Form of Local Ports

The major problems for port development on the eastern coast are the gentle sea bottom slope and possible siltation of the shipping channel due to suspended sediments. Therefore, these problems must be taken into consideration and solved accordingly when the local ports are planned.

The outline of the local ports are as follows:

a. Typical ships using berths are 2,000 DWT class barges and 100 G/T class fishing boats. As the draft of these ships is less than 3 m, dredging for provision and maintenance of the shipping channels is not needed.
b. Port facilities for the above mentioned ships are to be planned alongside the rivers at Opobo, Ibeno, and Jamestown. A seaberth is also to be planned for larger ships at Ibeno where the sacle of offshore sandy shoals is smaller and sea bottom topography is not complicated.
c. Inland waterway transportation is to be utilized.

CHAPTER 3. DEVELOPMENT OF COMMERCIAL PORT

IV-3-1. Basic Policy of Revised Forecast of Cargo Traffic Through the Commercial Port

(1) Target Year

The target year of the forecast is 2000 A.D., because the revised forecast of cargo traffic, namely general cargo traffic through the commercial port is included in the study on the feasibility of local port following the completion of the New Ocean Terminal.

(2) Economic Frame

Based on the recent trends of the Nigerian economy, the economic frame for the revised forecast is as follows:

Table IV-3-1 Economic Frame

Period		Economic frame
I	1975–1979	Past actual economic results
II	1979–1985	Economic program in Outline of the 4th National Development Plan
III	1985–2000	Future economic trends in Nigeria and various forecasts on world economy

(3) Method of Forecast

A macroscopic method of forecasting is used because Nigeria's general cargo traffic is in very close correlation with her gross domestic product (GDP) excluding the mining sector, as is clear from the Phase II Report.

(4) Forecast Formula

The following forecast formula from the Phase-II Report is used as the model formula:

$$Yi = 0.83\ Xi - 1577.31$$

Here, Yi : General cargo traffic in the i-th year (in 1,000 tons).

Xi : GDP (excluding the mining sector) for the i-th year (in 1,000,000 naira).

The formula's correlation coefficient, r, is 0.924.

IV-3-2. Forecast of General Cargo Traffic

The traffic volume of general cargo in the target year is determined by substituting into the above formula the forecast value for the GDP (excluding the mining sector) in 2000 A.D.

The economic growth rate governing the forecast value of GDP (excluding the mining sector) is set according to the economic frame mentioned earlier. The growth rate for each period is shown in Table IV-3-2.

Table IV-3-2 Growth Rate of Gross Domestic Product (GDP)

(Unit: %)

Period		Growth rate of GDP	Growth rate of GDP (excluding the mining sector)
I	1975–1979	9.6	9.8
II	1979–1985	7.2	8.6
III	1985–2000	4.5	5.0
–	1975–2000	6.0	6.6

The basis on which these growth rates and the evaluation of the rates are established is as follows:

(1) Growth Rate for Phase I

As Phase I data is incomplete, the actual annual average growth rate for 1970–1976 is used here as the growth rate for this period.

(2) Growth Rate for Phase II

The growth rate proposed in Outline of Nigeria's 4th National Development Plan announced in January 1981 is used as the growth rate for this period.

(3) Growth Rate for Phase III

Table IV-3-3 lists the estimated economic growth rates of the world's main economic spheres used by the Japanese Institute of Energy Economics as preconditions for their forecast of 1990 world energy supply and demand. This two-year study was conducted by referring to the economic forecasts by various countries and various regions, and the world economic forecasts of international organization. The results of the study were published in July 1980. The estimated growth rates are considered likely to be realized even under a broad scope of varying conditions.

Table IV-3-3 Estimated World Economic Growth Rates

(Unit: %)

	Actual	Forecast		
	1965~1977	1977~1985	1985~1990	1977~1990
Japan	8.1	4.5	3.7	4.2
OECD	4.0	3.1	2.9	3.0
Semi-developed countries	7.9	6.0	5.0	5.6
OPEC	9.2	6.0	5.5	5.8
Free world total	4.4	3.5	3.4	3.4
Communist bloc total	5.5	4.2	4.2	4.2
World total	4.5	3.7	3.6	3.6

Source: Japanese Institute of Energy Economics "1990 World Energy Forecast", 1980

The rates for OPEC and semi-developed countries – both of which groups include Nigeria – are much higher than that of any other group, but the economic growth rates of both of these are likely to drop from 6% during the first half of the 1980s to around 5% during the last half of the 1980s.

Further, the Nigerian economy is strapped with unstabilizing factors, which may prevent it from maintaining for any extended duration the high growth rate of its GDP (excluding the mining sector), which is prerequisite to the forecast of general cargo traffic.

The factors which could cause economic instability are as follow:

- o Shortage of social capital.
- o Increase in domestic production costs, inlcuding high labor costs, and the consequent decline of the price competitiveness of export products.
- o Shortage of skilled labor.
- o Lack of confidence in the improvement of the nation's industrial structure.
- o Deterioration of finances and of international balance of payments.

Under these circumstances, Nigeria's Phase III growth rate of GDP is set at 4.5%, applying the 1980s growth rate trends in OPEC and semi-developed countries to the 1990s and taking into consideration the growth rates of both groups in the 1990s. The nation's GDP growth rate (excluding the mining sector) is set at 5% in view of the relation between the GDP growth rate in 1975–1985 and the GDP growth rate (excluding the mining sector) over the same period.

(4) Evaluation of Economic Growth Rate Forecast

The prospect of the Nigerian economic growth rates attaining 6% for the whole of the target period of the forecast (1975–2000) is considered reasonable for the following reasons:

1) Table IV-3-4 is a Development Report released in 1979 by the World Bank. Because of the nature of the World Bank, this report is designed to review the chances of development of developing nations and purports therefore, primarily, to estimate the growth rates of such nations. The standard scenario (base) growth rates of Middle East and North Africa and Middel Income Countries during the 1980s are approximately equal to the growth rates of semi-developed countries and OPEC in Table IV-3-3. It seems therefore that in setting the Phase III growth rate for Nigeria values forecast under the above basis and in accordance with Table IV-3-3 do not differ greatly from those values forecast by international organizations.

2) Table IV-3-5 is the 1975–2000 outlook on world economy in INTERFUTURES, released by OECD in June 1979. Scenario B2 is considered most appropriate as the future frame of the world economy. An outline of scenario B2 follows:

Scenario B2:

- o Collegial management and conflicts in the developed countries.
- o Increased free trade.
- o Increasing Third World participation in world economic exchanges.
- o Sustained economic growth in the developed countries, but no rapid change in values.
- o Convergence of relative productivities.

Table IV-3-4 Future Prospects of World Economy (up to 1990)

	Average Annual Growth Rates, 1980–90 (percent, at 1975 prices)					
	Gross Domestic Product			Gross Domestic Product Per Capita		
	Base	High	Low	Base	High	Low
Low Income Countries	4.9	5.9	4.3	2.7	3.5	2.0
Africa	3.8	4.8	3.6	1.0	1.9	0.7
Asia	5.0	6.0	4.4	2.8	3.8	2.2
Middle Income Countries	5.8	6.8	4.9	3.4	4.3	2.4
East Asia and Pacific	7.6	9.3	6.4	5.6	7.1	4.3
Latin America and Caribbean	5.7	6.5	4.6	3.2	3.9	2.1
Middle East and North Africa	5.5	6.3	5.0	2.9	3.6	2.4
Sub-Saharan Africa	4.4	5.3	3.7	1.4	2.2	0.7
Southern Europe	5.4	6.5	4.7	4.2	5.2	3.4
All Developing Countries	5.6	6.6	4.8	3.3	4.2	2.4
Industrialized Countries	4.2	4.9	3.5	3.7	4.5	3.1
Capital Surplus Oil Exporters	5.0	6.1	4.6	2.2	3.2	1.7
East European Centrally Planned Economies	4.2	–	–	3.4	–	–

Source: World Bank "Development Report", 1979

Table IV-3-5 Future Prospects of World Economy (up to 2000)

Scenario / Region	GDP (1970 US$ billion)					Growth Rate (%)			
	1975	2000							
		A	B2	C	D(3)	A	B2	C	D(3)
1. United States	1,091.0	2,418	1,992	2,139	2,325		2.4		2.7
2. Canada	103.3	262	211				2.9		
3. Japan	257.5	1,365	1,095	477	1,005	6.9	6.0	2.5	5.6
4. EC	705.3	2,070	1,588	1,157	1,477		3.3		3.0
5. Western Europe other than EC	150.8	674	562	293	460		6.0		4.6
6. Australia and New Zealand	48.8	123	108	88	121		3.2		3.7
OECD	2,356.7	6,885	5,556	4,154	5,388		3.5		3.4
7. Eastern Europe	607.8	2,058	1,962	1,700	1,962		4.8		4.8
8. Latin America	235.5	1,279	1,137	964	1,085		6.5		6.3
9. South Asia	82.6	280	250	215	220		4.5		4.0
10. Southeast Asia	84.5	459	391	330	371		6.3		6.1
11. China	212.8	913	913	812	913		6.0		6.0
12. North African and Western Asia	150.3	816	645	560	645		6.0		6.0
13. Sub-Saharan Africa	49.7	208	145	121	198		4.4		5.7
Total 8–13	815.9	3,955	3,481	3,002	3,432		6.0		5.9
WORLD Total	3,802.3	12,970	11,057	8,984	10,836	5.0	4.4	3.5	4.3

Source: OECD "INTERFUTURES", 1979
Note: A : High growth scenario
B2 : Moderate growth Scenario
C : North-South rift Scenario
D : Protectionist Scenario

In scenario B2, the growth rate of North Africa and Western Asia, to which oil-producing nations are central, is 6.0%. This value is equal to the growth rate of all developing nations including semi-developed nations. In this context, Nigeria's forecast growth rate of 6.0% for 1975–2000 seems reasonable.

General cargo volume for 2000 A.D. (as shown in Table IV-3-6) was forecast by extrapolating a GDP (excluding the mining sector) figure for 2000 A.D. from the GDP (excluding the mining sector) in the base year 1975 in Table IV-3-2, then substituting the figure into the model formula for general cargo volume.

Table IV-3-6 Results of Forecast of Traffic Volume of General Cargo

Year	Traffic Volume of General Cargo (1,000 tons)	Increase Rate over 1975 Traffic Volume	Average Annual Growth Rate (%)
1975	6,110	100	7.6%
2000	38,200	625	

IV-3-3. General Cargo Handling Capacity at Nigerian Ports

Total cargo throughput at Nigerian ports was about 17 million tons in the 1979 fiscal year. This cargo volume can be assumed to be the same as the cargo handling capacity of the existing facilities for the year 2000. The following increase in the ports' handling capacity can be expected after further development of the ports.

(1) Federal Ocean Terminal

The construction of the Federal Ocean Terminal is an on-going project. This port consists of six berths (three for general cargo, one for container, one for RO-RO, and one for bulk cargo), three warehouses, and provisions for ancillary facilities. This project is expected to be completed in early 1983. The projected cargo throughput at the Federal Ocean Terminal after the completion of the construction works is approximately 2.2 million tons, according to the MIT report.

(2) Warri Port

Handling capacity of general and container cargoes at Warri Port shall be 1.95 million tons according to the projection of the Nigerian Ports Authority. Allotted portions of general and container cargoes is determined according to their share in the 1979 fiscal year.

(3) Calabar Port

According to the hearing at Calabar Port, extension of making 12 berths having water depths of $-9 \sim -13$ m might be possible. The cargo-handling capacity at existing Calabar Port, including New Calabar Port, is 1 million tons/year. If 12 berths are added to the present port, the cargo-handling capacity will go up to 3.4 million tons/year, because cargo-handling capacity per berth of the new 12 berths is approximately 200 thousand tons/year.

(4) Other Ports

The cargo-handling capacity of all the ports except New Ocean Terminal, Federal Ocean Terminal, Warri Port, and Calabar Port is assumed to remain at 1979 levels;

The total handling capacity of all ports in the year 2000 becomes as Table IV-3-7. Accordingly, general cargo handling capacity, and total cargo handling capacity will be approximately 38.3 and 52.0 million tons/year respectively.

Projected general cargo volume in the year 2000 is approximately 38.2 million tons. When all the port development plans including the New Ocean Terminal Project are executed, the general cargo handling capacity of Nigerian ports will be almost equal to the projected general cargo throughput for the year 2000.

Table IV-3-7 Estimated Cargo Handling Capacity at all Ports in 2000

(Unit: 1,000 tons)

	General	Container	Subtotal	Others	Total
Lagos	4,580	3,400	7,980	4,000	11,980
Port Harcourt	1,700	150	1,850	420	2,270
Warri	1,930	20	1,950	1,200	3,150
Federal Ocean Terminal	900	1,300	2,200	1,500	3,700
Koko	60	–	60	50	110
Burutu	10	–	10	–	10
Sapele	700	300	1,000	170	1,170
Calabar	1,400	1,800	3,200	200	3,400
Subtotal	11,280	6,970	18,250	7,540	25,790
New Ocean Terminal	6,610	13,410	20,020	6,440	26,460
Grand Total	17,890	20,380	38,270	13,980	52,250

Notes: 1. Figures for Lagos Port and New Ocean Terminal are based on the Phase II Report.
2. Figures for Warri Port are based on the NPA's estimate. Division of cargo (General and Container) were made assuming configuration of current percentages.
3. Figures for Federal Ocean Terminal are based on the MIT report. As for the division between "general" and "container", allocation was made by the ratio of berth number and on the assumption that the per-berth handling capacity for container and RO-RO berths is double that of general cargo berth. As to other cargoes of FOT, 1.5 million tons of coal was taken into account.
4. Figures for Calabar Port are based on the results of the hearing done at NPA-Calabar. As to the division of cargo, the figure for "others" is after the example of the Federal Ocean Terminal (FOT).
5. Figures for the other ports have been calculated at 1979 levels.

CHAPTER 4. DEVELOPMENT OF INDUSTRIAL PORTS

IV-4-1. Step of the Study

Based on the water depth of the harbor and the maximum size of ships studied in the former chapter, the examination of the scales of the industrial ports proceeds as follows (Fig. IV-4-1):

(1) Selection of port-oriented and port related industries to be located in the rear land of ports or in the port areas.
(2) Assumption of the industries' production scales.
(3) Estimation of the cargo volume through the ports.
(4) Allocation of industries for the three sites.

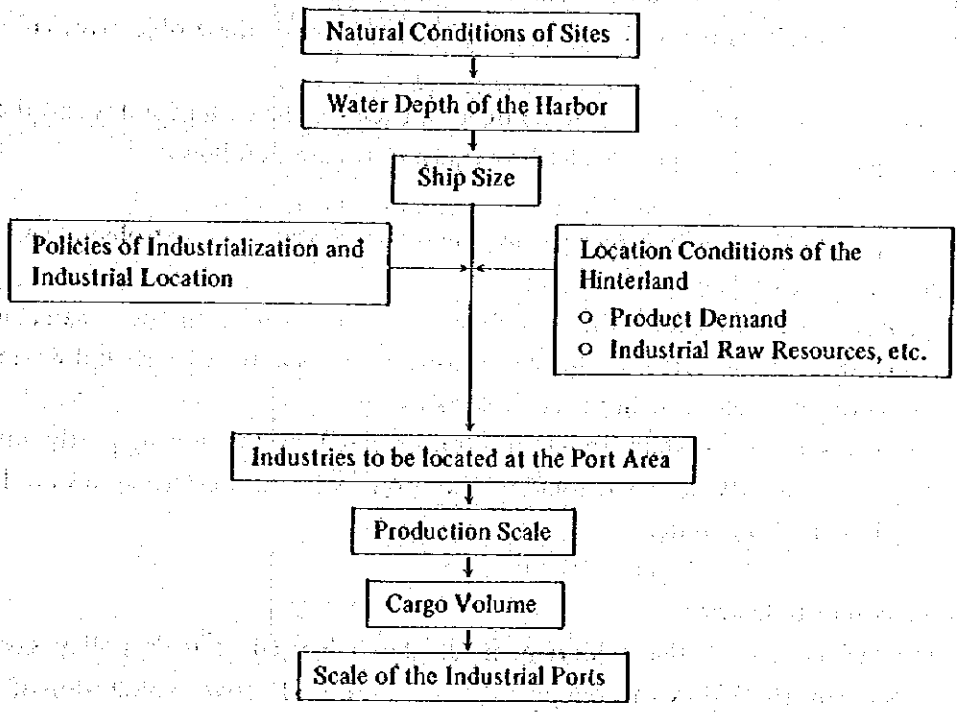


Fig. IV-4-1 Steps of this Study

IV-4-2. Selection of Industries

(1) Industrial Policy in the Fourth National Development Plan

Port-oriented and port-related industries to be located in the port area should be those which can best take advantage of the proximity of the hinterland, advancing the policy goals of industrialization and industrial location in Nigeria.

The Fourth National Development Plan expresses the major objectives of government policy

in the manufacturing sector to be:

1) the ensurance of increased levels of self-reliance in the supply of industrial products.
2) the increase of local resource content manufacturing output through the substitution of domestic raw materials and manpower for imported ones.
3) the generation of greater employment opportunities.
4) the maintenance of rapid growth in the manufacturing sector with an eye toward increasing its share of the total national output.
5) the promotion of the growth of small-scale industries.
6) the removal of bottlenecks and institutional constraints on industrial growth.
7) the promotion of a more even geographical spread of industries.
8) the promotion of the development of export industries.
9) the promotion of the development of private industries.
10) the rationalization and consolidation of gains derived from the indigenization excercise.

The above objectives of the Fourth Plan are basically the same as those of its predecessors. The major national projects planned and executed to accomplish these objectives are shown in Table IV-4-1.

These projects total 40 and, by region, number 20 each for the eastern states and the western states. The characteristics of the projects in the eastern states are as follows:

a. Industries utilizing such resources in the eastern states as petroleum, natural gas, limestone and wood are central to the projects.

b. For automobile assembly which, unlike resource-based industries, can be located foot-loose, there are two projects each for commercial vehicles in the eastern and western states, but there is none for passenger cars in the eastern states.

c. The projects in the eastern states are concentrated in the south, partly due to the character of the projects. By contrast, some of the projects in the western states are located in the north, mainly in Kaduna State.

(2) Categorization of Industries

From the viewpoints of the achievement of the industrial sector's policy goals in the above-mentioned Fourth National Development Plan and the effective exploitation of the port's hinterland, it is appropriate that the port-oriented industries located at the eastern coast site be among the following six categories:

1) Resource-based industries

These industries process local resources and primary products. Efforts have been made in this connection but full efficient use of resources has not been achieved in many cases. One of the main reasons for this is the imperfection of the supply systems for these resources. The development of the agriculture, forestry, fishery and, mining industries is prerequisite to the development of the manufacturing industries using local resources and is, in fact, being emphasized under the Fourth National Development Plan.

Table IV-4-1 Main National Projects of Manufacturing Sector

	Eastern States	Western States
Iron and Steel Projects (1) Blast Furnace Comples (2) Direct Reduction Complex (3) Inland Rolling Mills	 Bendel (Warri, 1 million tons/year) Plateau (Jos, 210,000 tons/year)	 Kwara (Ajaokuta, 1.5 million tons/year) Oyo (Oshogoo, 210,000 tons/year) Kaduna (Katsina, 210,000 tons/year)
Oil Refineries	Bendel (Warri) (100,000 → 120,000 B.P.S.D.) Rivers(Port Harcourt) (existing 75,000 B.P.S.D.) (new one 100,000 B.P.S.D.)	Kaduna (Kaduna) (100,000 → 120,000 B.P.S.D.)
LNG Plant	Rivers (1.8 ~ 2.0 billion feet)	
Petrochemical plants	Bendel (Warri) (Polypropylene, 35,000 tons/year) (Carbon black, 25,000 tons/year)	Kaduna (Kaduna) (Benzen 20,000 tons/year) (Alkylbenzene 30,000 tons/year)
Nitrogenous Fertilizer Project	Rivers (near Port Harcourt) (Ammonia : 1,000 tons/day) (Urea : 1,500 tons/day) (NPK : 1,000 tons/day)	
Automobile Assembly (1) Passenger Cars (2) Commercial Vehicles	 Anambra (Enugu) Bauchi (Bauchi)	 Lagos (Lagos) Kaduna (Kaduna) Oyo (Ibadan) Kano (Kano)
Cement	Bendel (Ukpila, 150,000 → 500,000 tons/year) Cross River (Calabar 100,000 → 400,000 tons/year) Bendel (Ashaka) } 600,000 tons/year Benue (Yandev) }	Sokoto (Sokoto, 150,000 → 400,000 tons/year) Ogun (Shagamu, 600,000 tons/year)
Pulp and Paper	Cross River (Calabar 100,000 tons/year Bendel (Integrated Pulp and paper industry)	Kwara (Jebba, 60,000 → 100,000 tons/year) Ogun (Iwopin 60,000 → 100,000 tons/year) Kaduna (Integrated Pulp and paper industry)
Integrated Sugar Project Tomato Production and processing projects Feed Processing Industry	Gongola (Gavin Isa) all state capitals	Kwara (Lafiaji, Jebba) Kano (Kadawa) Kaduna (Zaria) all state capitals
Synthetic Fiber Plant	Anambra (Onitsha)	Lagos (Ikorodu/Ikeja)
Woodworking Complex	Cross River (Calabar)	
Lube Oil and Asphalt Plant	Rivers (Port Harcourt)	

Source: National Development Plans including the 4th Plan.

2) Agriculturally oriented industries

These are industries that support the development of the primary sectors including agriculture, forestry and fishery in the hinterland. These industries produce such well-known products as fertilizers, feeds, farming tools, agricultural machines and fishing boats.

3) Local market-oriented industries

These are the industries that meet local demand in the eastern states. The lag of industrialization in the eastern states is causing a gap between the supply and demand of daily necessities and this gap must be bridged.

4) Import substituting industries.

5) Export industries.

Export industries are important as an alternative to petroleum in the acquisition of foreign currency. At present, these are mainly industries utilizing resources found in the eastern states.

6) Industries improving the industrial structure of the hinterland

Typical of these are the basic material industry and the machine industry. The development of these industries can also contribute to the reduction of imports.

(3) Selection of Industries

The following are port-oriented industries that belong to any of the above-mentioned six categories and are eligible for inclusion in the Local Port, in view of the location conditions (e.g. resource availability and product demand) of the hinterland and the economic feasibility of plant construction:

Food prosessing	:	Palm oil processing, seafood processing, flour milling, and animal feed processing.
Wood products	:	Wood processing.
Chemical products	:	Chemical fertilizers and salt manufacture.
Petroleum products	:	Petroleum refining.
Ceramic stone and clay products	:	Concrete products.
Iron and steel	:	Steel shearing and slitting (steel processing).
Metal products	:	Structural metal products.
Machinery	:	Boat-building and repair, shipbuilding and repair.

The correspondence between these industries and the aforementioned six categories is shown in Table IV-4-2.

Table IV-4-2 Selection of Industries

	View-point of Selection (category of industry)					
	Resource-based industry	Agriculturally oriented industry	Local market-oriented	Import-substituting	Export	Improving industrial structure of hinterland
Palm oil processing	◎	○	○		◎	
Seafood processing	◎	○	○	◎	○	
Flour milling			◎	○		
Animal feed processing		◎	◎			
Wood processing	◎	○	○		◎	
Chemical fertilizers	◎	◎	○	◎	○	○
Salt manufacture	◎		○	○	○	
Petroleum refining	◎		○		○	○
Concrete products			◎			
Steel shearing and slitting			◎			
Structural metal products			◎			
Boat building and repair		◎	○			
Shipbuilding and repair				○	○	◎

Note: ◎ Primary viewpoint
○ Secondary viewpoint

(4) Reasons for the Selection

The reasons for selecting these 13 industries are stated below by type of industry.

1) Resource-based industries

a. Palm oil processing

This is a key industry in Cross River and neighboring states, where there are many palm oil processing plants. All these plants are located inland adjacent to the production centers of palm, and many of them are small. They refine and process crude palm oil and kennels, extracted from palm fruit crushed at the place of harvest.

The three major economic advantages of the proposed palm oil refinery's location in the port area are as follow:

① Reduction of transportation cost by exporting products directly from the plant.

② Ensurance of year-round operation of the plant by maintaining large stocks of crude palm oil.

③ Effective use of capital investment by mass production (scale merit).

Palm oil exports decreased however, from about 183,000 tons during the 1960s to less than 1,000 tons in 1974 and to nil in 1977. This is attributed mainly, to the fact that the production of palm oil did not increase in proportion to the rapidly expanded domestic demand and there was none to spare for export.

Thanks to Nigeria's present "green revolution", palm oil production is expected to increase and exports should be resumed in the near future. The Palm Produce Board (head office in Calabar, Cross River State) has requested that existing plants be modernized and that two new plants be constructed over the course of the Fourth National Development Plan. Both plants are proposed for inland location. However, the Board supports the proposal of this study team to locate in the port area an export-oriented refinery and agrees the port area is an ideal site for such a refinery. It is therefore likely that, if other conditions are satisfied, an export-oriented refinery will be constructed in the port area.

b. Wood processing

Cross River State has large forest reserves, many of which are major centers of production of industrial wood (Fig. IV-4-2). Sawmills as well as plywood and veneer plants are in operation in this state, all being located inland.

The wood processing plant proposed would also be mainly export-oriented. The major economic advantages of locating in the port area are as follows:

① Reduction of transportation cost by exporting products directly from the plant.

② Reduction of log transporting cost by using inland waterways.

③ Increase of value added by organizing a woodwork complex based on the mass and joint stocking of water-borne logs.

About 500,000 m^3 of logs were exported during the 1960s, but later log export was banned in the hope of indigenizing value added. Present wood exports include lumber, veneer, etc.

The export of wood products, like that of palm oil, has decreased due to the fact that production has not increased in proportion to the rapid expansion of domestic demand. This has

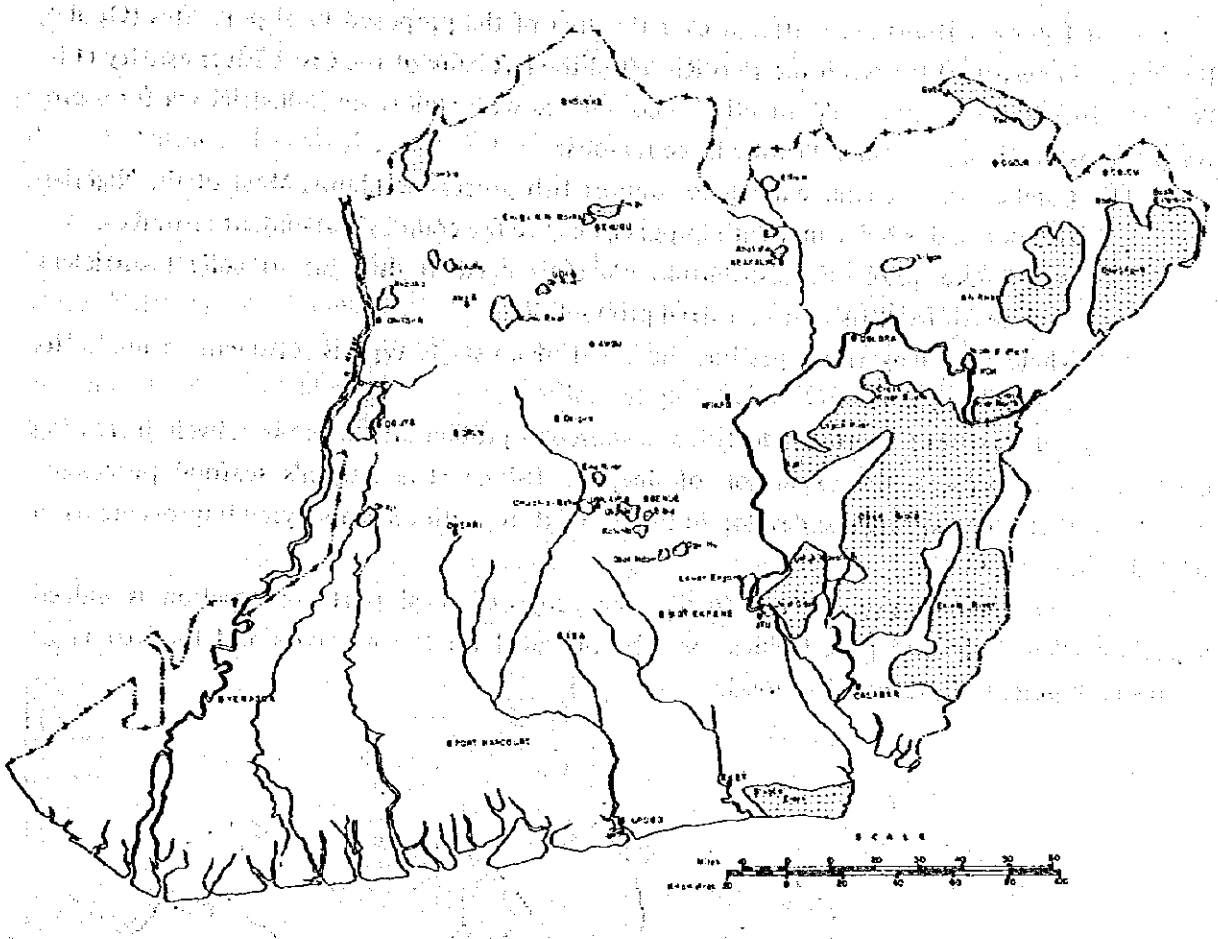


Fig. IV-4-2 Map of Forest Reserves

much to do with the problem that Nigerian forestry has traditionally relied on the cutting of natural forests and little has been done by way of reforestation after cutting.

Since the Fourth National Development Plan proposes large-scale projects aimed at the cultivation of forest resources and reforestation, the export of wood products is expected to increase in the future.

Log transportation by inland waterways is not in widespread practice now, but the transportation of logs or by flat-bottomed barge or bound together as raft is more economical than truck transportation. Rivers in Cross River State, namely, the Imo, the Kwa Ibo, the Calabar and the Cross rivers have certain potential for extensive use as inland waterways.

A woodwork complex is a group of plants producing lumber, plywood, veneer, particle boards and chips. It is economical in physical distribution including the transportation of raw materials between plants, and effective for the systematization of industrial production.

c. Seafood processing

Fishing resources abound in Cross River State as well as in Rivers and Bandel States, but fishing is practised mainly in an artisanal form and deep-sea industrial fishing is not in widespread practice now.

Several fishing stations are scattered over the area of the proposed local port sites (Opobo, Ibeno and Jamestown), between the Imo River and the left bank of the Cross River estuary (Fig. IV-4-3). Most of the catch is sold directly to consumers with almost no industrial sea food processing, most likely due to the following three reasons:

① Catches are not large enough to support fish processing plants. Most of the Nigerian fish demand is being met with imports, despite the country's abundant resources.

② Inadequate wholesale distribution channels make it difficult to collect sufficient volumes of fresh fish for industrial production.

③ There are many fish types but the catch of no single type is sufficient to render its industrial production economically feasible.

Nigeria attaches importance to fish as a source of protein intake and is actively increasing catches, mainly through the expansion of deep-sea fishing. The nation's seafood processing industry is therefore expected to develop in the near future, with accompanying improvements in related infrastructures.

To the seafood processing industry, the proposed local port construction is indeed appealing. Waterfront and port facilities will be provided for fishing boats and the export or domestic shipment of processed seafood.

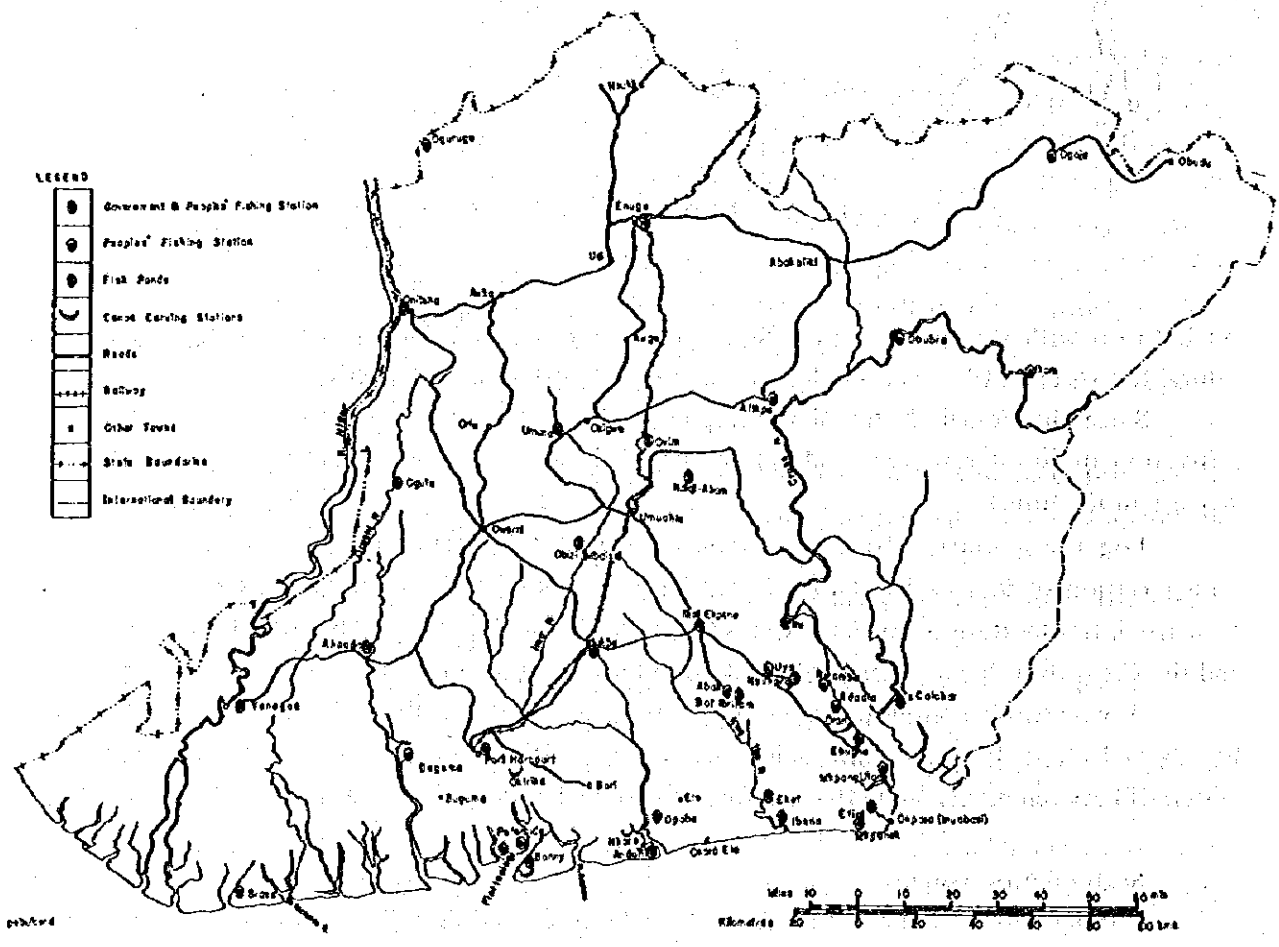


Fig. IV-4-3 Map of Fishing Stations

d. Petroleum refining

Major oilfields exist in the coastal part of Cross River State, a crude oil storage terminal is located in the Ibeno area, and a new deposit is said to have recently been discovered. (Fig. IV-4-4). This area has great potential for petroleum refining in view of the local distribution of petroleum resources.

The construction of the Local Port and the existence of crude oil are conducive to the location of an oil refinery in the port area. Export refinery projects were proposed under the Third National Development Plan but they have not yet been realized because of marketing problems. Under the Fourth Plan, more exhaustive research and preliminary studies for investment will be conducted to the end of solving these problems and defining the approach to export refinery projects under the Fifth Plan.

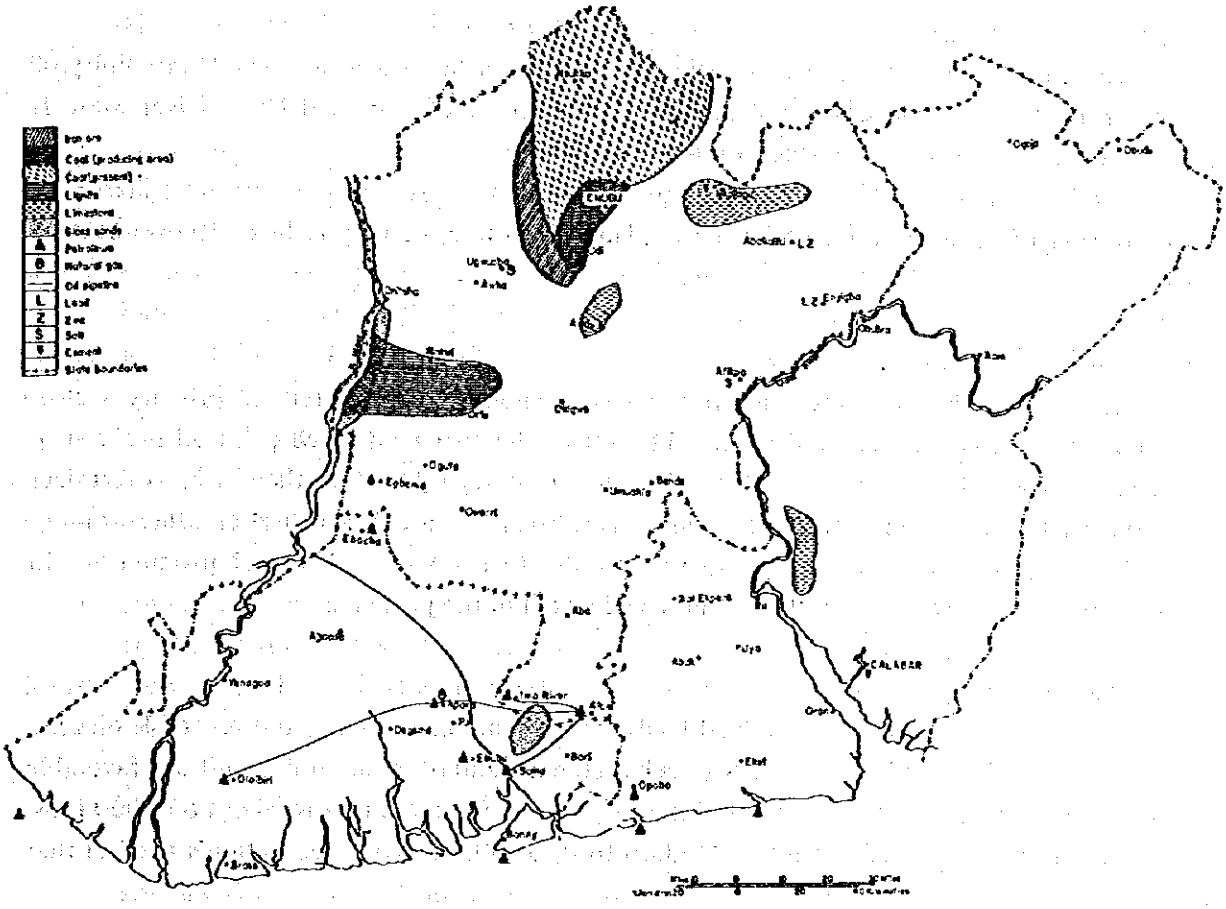


Fig. IV-4-4 Map of Minerals and Mining

The existence of crude oil in Cross River State and the construction of the Local Port there will make the location of an oil refinery in the port area highly feasible, whether the petroleum products refined there are intended for domestic consumption or for export. The Ministry of Economic Planning of Cross River State expressed great interest in the proposal of this study team to locate an oil refinery in the port area.

e. Chemical fertilizers

This project aims to make effective use of the natural gas associated with crude oil production, supplying fertilizers indispensable to agriculture and at the same time expanding the export market.

It is desirable for a chemical fertilizer plant to have two routes of raw material supply (i.e. both natural gas and naphtha) to be able to maintain steady production.

Naphtha from the above-mentioned oil refinery can be used for this purpose by the plant location in the port area.

If a chemical fertilizer plant is located in the port area, its products can be exported directly from the plant. Further, it can be supplied with naphtha by pipeline from the adjoining oil refinery, thereby cutting transportation costs.

f. Salt manufacture

This project aims at the effective use of the highly saline sea water. The high salinity of the water renders it suitable for the industrial production of salt, and Cross River State is accordingly planning a feasibility study on such production.

Sea water can be collected easily, if the salt plant is located in the port area, mass ship transportation of products directly from the plant is possible, thereby reducing transportation costs.

2) Agriculturally oriented industries

These are industries that support the development of the hinterland primary sector, including agriculture, forestry, and fishery. In a sense, the aforementioned palm oil processing, wood processing and seafood processing belong to this category as does the chemical fertilizer industry. Though the raw materials of chemical fertilizers are not agricultural or other primary products, the products are certainly essential to the increase of agricultural production. In addition to these industries, the following may be located in the port area:

a. Aminal feed processing

This industry manufactures animal feeds mainly from maize, milo, and vegetable oil cake with some use of bran, fish meal, etc. Nigeria has climatic and other natural conditions favorable for the cultivation of maize, her 1978–79 maize production amounting to about 659,000 tons. The eastern states accounted for about 335,000 tons, or 50.8% of the federation's total at that time.

Locating an animal feed processing plant in the port area is economically unreasonable if it is to be considered a resource-based industry, now that maize, the major ingredient, is produced inland. However, the import of maize is increasing because domestic production cannot meet the rapid increases in domestic demand and from this point of view, it may be reasonable for animal feeds to be produced in the port area from imported maize and milo.

Nigeria promotes her "green revolution", building self-sufficiency in staple foods, the proposal of this study team is a step toward the stabilization of price and supply of feeds – a factor which can antribute significantly to the increase of livestock production. This can be accomplished by buying and stocking large quantities of these grains whenever they are cheap

on the world market while at the same time adjusting their domestic production and import. Like wheat, maize and milo are international commodities and their prices vary greatly with fluctuations in world supply and demand.

Some of the raw materials for animal feed production can be supplied by other industries located in the port area, specifically, fish meal from seafood processing and bran from flour milling.

b. Boat building and repair

This is a project to support the development of fishery, the main products of which will be plastic or wooden fishing boats.

3) Local market-oriented industries

The above-mentioned industries may be on the whole or in part included in this category. Additionally, the following four industries may be added:

a. Flour milling

Wheat import in 2000 is projected at one million tons in the Phase I Report in the New Ocean Terminal Project (Lagos). It is assumed in this study that a flour mill using imported wheat will be located in the Local Port of Cross River State, as well as at NOT-Lagos.

Flour milling can supply bran, a by-product, for the above-mentioned manufacture of animal feeds. Further, flour milling and animal feed processing plants can jointly own and operate large silos, greatly reducing together to transportation and storage costs of such raw materials as maize and milo. (In Japan, such cooperation is a matter of course.) The formation of this complex and the joint transportation of imported raw materials by large ships are important factors supporting the location of these industries in port areas.

b. Concrete products

This industry is aimed mainly at producing concrete products necessary for the construction of the Local Port and industrial plants to be located in the port area. Cement, the raw material, will be supplied mainly by water transport from Calabar, where there is a large cement mill.

c. Steel shearing and slitting

This industry will work steel stock plates, bars, and beams into sizes and shapes suitable for direct use. Since these steel products will be supplied by water transport from Ajaokuta, Warri, or NOT-Lagos in the future, this industry should be located in the port area. Steel shearing and slitting is one of the typical distribution processing industries that use port facilities and require waterfronts for its factories.

d. Structural metal products

This, too, is a local market-oriented industry and should be located in the port area, for the same reasons listed above for the steel shearing and slitting industry.

4) Import-substituting industries

Of the above-mentioned industries, seafood processing, salt manufacture, chemical fertilizers, and flour milling belong to this category.

5) Export industries

Of the above-mentioned industries, palm oil processing, and wood processing belong to this category, while seafood processing, petroleum refining, chemical fertilizers, and salt manufacture as well have certain potential as export industries.

6) Industries improving the industrial structure of the hinterland

Of the above-mentioned industries, it is particularly the petroleum refining and chemical fertilizer industries which contribute greatly to the improvement and reformation of the Nigeria's industrial structure. In addition, shipbuilding and repair may also be located in the port area.

a. Shipbuilding and repair

This industry engages in the building and repair of ships calling at existing ports such as Port Harcourt and Calabar including the Local Port itself. This industry will promote the development of related industries in the hinterland, especially the metal products and furniture industries. It may also have certain potential for the export of ships and the substitution of imported ships.

IV-4-3. Scale of Industrial Ports

(1) Production Scale of Industries

The production scale of the industries to be located in the Local Port was examined according to the following considerations.

1) The main factors in assuming production scales are product demand, resource volume supplied and economically feasible scales for plants.
2) Here we have assumed production scales for plants based mainly on economically feasible ones, however, as projection of product demand is beyond the scope of this study, which deals specifically with the sketch of the Local Port itself. It is hoped that product demand will be projected later in detail. Meanwhile, whatever is known about the amount of resources that can be supplied is taken into consideration in this study.

Table IV-4-3 shows the production scales of industries to be located. Total production is about 6,210,000 tons/year; total volume of required raw materials is about 10,260,000 tons/year. Petroleum refining will have a treatment capacity of 100,000 B.P.S.D., producing about 4,480,000 tons of petroleum products from about 4,710,000 tons of crude oil. The salt plant will process 4,000,000 tons of sea water by the ion exchange method and produce 100,000 tons of salt.

(2) Volume of Water-borne Cargo

Forecasting the volume of water-borne cargoes is difficult in the absence of reliable data and information, volumes are estimated by individual industry, taking into account the supply conditions of raw materials and resources; the market conditions of products, the transport characteristics of raw materials and products, and the transport conditions of the local port site. In this estimation, the total volume of water-borne cargoes is about 6,020,000 tons; about 3,380,000 tons for raw materials and about 2,640,000 tons for products (see Table IV-4-4).

The considerations used in estimating the volume of water-borne cargoes for individual industries are as follows:

1) Palm oil processing

It is assumed that all the crude palm oil, the raw material, will be crush-extracted in palm producing centers of the hinterland and transported by truck (lorries, etc). The palm oil processing plant will be an export refinery and it is expected that 50% of its products will be exported as water-borne cargo.

2) Seafood processing

All the fresh fish, the raw material, totaling 52,500 tons will be transported by fishing boats. All domestic shipment of products will be made by land transportation. An estimated 20% of products will be exported. Thus, a total of 62,500 tons, that is 10,000 tons of products for export and 52,500 tons of raw material will become water-borne cargo.

Table IV-4-3 Production Scale of Industries to be Located

	Production Scale (ton/year)	Required Raw Materials and Materials (ton/year)
Palm oil processing	Refined oil 100,000	Crude palm oil 110,000
Sea food processing	Processed sea food 50,000	Fresh fish 52,500
Flour milling	Flour and bran 500,000	Wheat 500,000
Animal feeds	200,000	Maize, milo, bran, etc. 200,000
Wood processing	Lumber, plywood, veneer, etc. 250,000	Logs 312,500
Chemical fertilizers	250,000	LNG (or naphtha) 100,000
Salt manufacture	100,000	Seawater 4,000,000
Petroleum refining	100,000 B.P.S.D 4,475,000	Crude oil 4,712,500
Concrete products	100,000	Cement 95,000
Steel shearing and slitting	100,000	Steel 105,000
Structural metal products	50,000	Steel 52,500
Boat building and repair	Fishing and other boats 1,000	Wood or plastic 1,050
Shipbuilding and repair	30,000	Steel 20,000
Total	6,206,000	10,261,050

Table IV-4-4 Volume of Water-borne Cargoes of Industrial Port

	Raw Materials		Products	
	Volume of Water-borne Cargoes	Water-borne Cargo Ratio	Volume of Water-borne Cargoes	Water-borne Cargo Ratio
Palm oil processing		0%	50,000t	50%
Sea food processing	52,500t	100%	10,000t	20%
Flour milling	500,000t	100%		0%
Animal feed processing	120,000t	60%		0%
Wood processing	156,250t	50%	125,000t	50%
Chemical fertilizers		0%	50,000t	20%
Salt manufacture		0%	20,000t	20%
Petroleum refining	2,356,250t	50%	2,257,000t	50%
Concrete products	47,500t	50%	50,000t	50%
Steel shearing and slitting	84,000t	80%	20,000t	20%
Structural metal products	42,000t	80%	10,000t	20%
Boat building and repair	525t	50%	1,000t	100%
Shipbuilding and repair	16,000t	80%	30,000t	100%
Total	3,375,025t	32.9%	2,641,000t	42.6%

Note) Water-borne cargo ratio = volume of water-borne cargoes/volume of raw materials or production x 100

3) Flour milling

The total volume of wheat (50,000 tons), the raw material, will be imported. Flour, the product, will be shipped by land because it is unsuitable for water transportation. Bran, the by-product, will be transported to the animal feed plant by conveyor, etc.

4) Animal feed processing

The total volume of maize and milo (120,000 tons or about 60% of all raw materials) will be imported by sea. The products like flour, will be shipped by land (lorries, etc.).

5) Wood processing

The three sites of Opobo, Ibeno and Jamestown are situated at the estuaries of, respectively, the Imo, the Kwa Ibo and the Cross rivers. Forest resources (forest reserves) spread over the basin of the Cross river and it seems likely that all logs can be transported on the Cross and the Calabar rivers. However, inland water transportation accompanied with the transhipment of logs from land to water, is sometimes uneconomical, depending on the transport conditions of the log producing areas (e.g. distance to the wood processing plant in the port area; distance between the log source and the river port). It is also not clear that the Cross river is navigable year-round, and it has therefore been assumed here that 156,250 tons (50% of all logs) will be transported by inland waterway.

Inland waterways may also be used for the transportation of wood products for domestic consumption, but exports will represent the bulk of water-borne cargoes. Thus, 125,000 tons (50% of all wood products) is the forecast volume of water-borne cargo. As a result, the volume of water-borne cargoes in wood processing is 281,250 tons of logs and wood products.

6) Chemical fertilizers

It is assumed that the total volume of LNG or naphtha, the raw material, will be transported by pipeline. As for the products, 50,000 tons water-borne cargo is expected in anticipation of the export of 20% of total output.

7) Salt manufacture

Sea water, the raw material, will be taken in by pipe. As for the products, 20,000 tons of water-borne cargo is expected, again in anticipation of the export of 20% of total output.

8) Petroleum refining

If all crude oil is supplied from the oilfields in the hinterland, the entire amount will be transported by pipeline. However, since the price of Nigerian crude is high, due to of its superior quality and low sulfur content, it is sometimes economical to refine relatively cheap imported crude oil while exporting Nigerian crude oil. Thus, about 2,360,000 tons of water-borne cargo is expected in anticipation of 50% total crude oil imports.

All petroleum products for domestic consumption will be distributed by the pipeline network to be constructed throughout Nigeria. Only export products, therefore, will be transported by ship, with about 2,280,000 tons (50% total petroleum product exports) of water-borne cargo anticipated.

The resulting volume of water-borne petroleum refining cargo is about 4,630,000 tons, including both crude oil and petroleum products. Since the import of crude oil and the export of petroleum products are nearly equal in quantity, oil tankers can be loaded on both incoming and outgoing trips, yielding an efficient and economical operation.

9) Concrete products

Cement, the raw material, will be supplied by the cement mills of Calabar (Cross River State), Ukpila (Bendel State), Ashaka (Bendel State) and Yandev (Benue State). Barges may be used mainly for transportation from Calabar; 47,500 tons (50% of all cement) of water-borne

cargo may therefore be expected.

As for concrete products, 50,000 tons (50% of the total) including mainly construction materials for the Local Port (caissons, wave dissipating concrete blocks, etc.) of water-borne cargoes and expected.

10) Steel shearing and slitting

Steel stock (plates, bars, beams, etc.), the raw materials, will be supplied mainly by water transportation from Ajaokuta, Warri and NOT-Lagos. 84,000 tons (80% of the total) will arrive as water-borne cargo.

Products that have been sheared or slitted will be delivered mainly by land transportation to industries (shipbuilding and repair, and structural metal industries) in the local port area and users in the hinterland. 20,000 tons (20% of the total) will leave as water-borne cargo.

11) Structural metal products

Based on the same considerations applied above to steel shearing and slitting, 42,000 tons (80% of all raw materials) and 10,000 tons (20% of all products) of water-borne cargoes are expected.

12) Boat building and repair

If plastics are to be the major raw materials, they may be transported by sea from the petrochemical plants of Warri or NOT-Lagos, or imported from abroad. If mainly wood is used, however, it need not be transported by sea providing that lumber is supplied by the wood processing plant of the Local Port. If the boats are built from wood cut within the plant, logs may be supplied by water transportation. In this case, 525 tons (50% of all raw materials) will enter as water-borne cargo.

As to the distribution of fishing boats, the products, it is assumed here that most boats will be shipped by self-propulsion, though small plastic boats may be distributed by land transportation. However, 1,000 tons (100% of the total) is the assumed volume of water-borne cargo.

13) Shipbuilding and repair

16,000 tons or 80% of all steel, the main raw material, will arrive as water-borne cargo for the same reason as in the case of steel shearing and slitting. Ships, the products, are all by self-propulsion. Thus a 30,000 ton volume of water-borne cargo is expected.

IV-4-4. Allocation of Industries for the Three Sites

The size of plant sites and the number of employees proportional to the production scale of ndustries to be located in the port area are assumed to total 222 ha and 7,300 persons, as shown n Table IV-4-5. This assumption is based on actual Japanese examples with consideration to the Nigerian socio-economic conditions. The assumed number of employees is adjusted to 150–200% he Japanese level, based on a comparison of Japanese and Nigerian labor productivities.

Then, the industries were allocated by site according to the port conditions of the three sites Opobo, Ibeno and Jamestown) and the socio-economic conditions (including recources) of the ninterland.

Industries to be allocated in the Opobo area are palm oil processing, seafood processing, boat building and repair, and concrete product manufacture. Opobo area had palm oil producing cen-ers in the past and has several fishing stations, a boat-building plant, and a certain degree of rban accumulation.

The Ibeno area has the most suitable conditions for port development of the three sites. It nas potential as a port with its relatively deep water and already has a crude oil storage terminal. Therefore, flour milling, animal feed processing, petroleum refining, and shipbuilding and repair, vhich use relatively large ships are allocated to the Ibeno area. The chemical fertilizer industry is lso allocated in consideration of its connection with petroleum refining in the supply of raw naterials. Further, the salt, concrete product, and structural metal product plants are allocated to he Ibeno area in view of its superior potential for the development of an industrial complex due o the relative ease of reclaiming space for large plant sites behind the port.

The Jamestown area, close to Calabar, the capital of Cross River State, is situated at the stuary of the Cross River. It has relatively high potential for the use of inland waterways and nas several fishing stations. For these reasons, the seafood processing, wood processing, concrete product, steel shearing and slitting, and structural metal product industries are allocated to this rea.

Table IV-4-5 Plant Area, Number of Employees, and Location of Industries

	Production Scale (ton/year)	Plant Area (1,000 m²)	Number of Employees	Location		
				Opobo	Ibeno	James-town
Palm oil processing	Refined oil 100,000	50	300	O		
Seafood processing	Processed sea food 50,000	80	2,200	O		O
Flour milling	Flour and bran 500,000	60	200		O	
Animal feeds	200,000	60	200		O	
Wood processing	Boards, plywood, veneer, etc. 250,000	200	1,500			O
Chemical fertilizers	250,000	80	100		O	
Salt manufacture	100,000	400	200		O	
Petroleum refining	4,475,000	1,000	500		O	
Concrete products	100,000	40	150	O	O	O
Steel shearing and slitting	100,000	30	100			O
Structural metal products	50,000	120	1,200		O	O
Boat building and repair	Fishing and other boats 1,000	20	150	O		
Shipbuilding and repair	30,000	80	500		O	
Total	6,206,000	2,220	7,300			

CHAPTER 5. LAYOUT OF PORT FACILITIES AND INDUSTRIAL COMPLEX

IV-5-1. Volume of Cargo Handled at Ports

As explained in Chapter 3, the cargo handling capacity of the ports in the year 2000 is enough for the estimated general cargo volume. Therefore, of the port facilities required at the local ports, capacity of mooring facilities is determined by the volume of cargo generated from industries located in the hinterland of the ports.

Table IV-5-1 shows the volume of cargo handled at the ports which are generated from industries located immediately behind the ports, classified by site, industry, and incoming/outgoing.

In the Opobo area, 113,000 tons of general cargo (of which 70,000 tons are exports) and 47,500 tons of bulk cargo (all cement) pass through the port.

In the Jamestown area, 343,500 tons of general cargo (of which 135,000 tons are exports and 208,500 tons are domestic trade) and 203,800 tons of bulk cargo (logs 156,300 tons and cement 47,500 tons) will be handled at the port.

IV-5-2. Layout of Port Facilities

(1) Opobo Area

With regard to 60,000 tons of export general cargo generated from the industrial complex in the Opobo area, as the quantity is not so large as to require direct call of ocean going vessels into the ports, it will be transported to Port Harcourt or Calabar by inland waterways and then exported through these ports.

The volume of cargo handled includes 113,000 tons of general cargo and 47,500 tons of bulk cargo (cement). They are estimated at about 137,000 tons in terms of general cargo by the following formula.

$$113{,}000 \text{ tons} + 47{,}500 \text{ tons} \times 1/2 = 136{,}750 \text{ tons} \fallingdotseq 137{,}000 \text{ tons}.$$

Table IV-5-2 shows the target value of cargo handling throughput. From the above, the extension of required berthing facilities is estimated at 305 m and the planned extension of the berthing facilities will be 4 berths or 360 m assuming berthing of 2,000 DWT barges, as follows.

$$137{,}000 \text{ t} \div 450 \text{ t/m} = 304.4 \text{ m} \fallingdotseq 305 \text{ m}$$

52,500 tons of fish used for processing marine products are brought in from coastal and small scale ocean fishery.

The present fishing boats are very small but they will be enlarged to about 100 G/T in the future, for which water depth of about −3.0 m will be sufficient. For transporting cement and steel, barges will be used on inland waterways.

From the foregoing studies, it is determined that port in the Opobo area will use barges for inland water traffic and small fishing boats. No construction of embankments is planned on the Imo river.

Table IV-5-1 Volume of Cargo Handled at Ports

(Unit: '000 tons)

	Opobo							Ibeno							Jamestown						
	Foreign Trade			Domestic Trade			Total	Foreign Trade			Domestic Trade			Total	Foreign Trade			Domestic Trade			Total
	Ex.	Im.	Total	Ex.	Im.	Total		Ex.	Im.	Total	Ex.	Im.	Total		Ex.	Im.	Total	Ex.	Im.	Total	
Palm oil	50		50				50														
Seafood processing	10		10		525	525	625								10		10		525	525	625
Flour milling									500	500				500							
Animal feed processing									120	120				120							
Wood processing															125		125		1565	1563	2813
Chemical fertilizers								50		50				50							
Salt manufacture								20		20				20							
Petroleum refining								2275	2356	4631				4631							
Concrete products					47.5	47.5	47.5					47.5	47.6	47.5					47.5	47.5	47.5
Steel shearing and slitting																		20	84	104	104
Structural metal products											10	42	52	52				10	42	52	52
Boat building and repair					05	05	05														
Shipbuilding and repair											<30>	16	16	16							
	60		60		1005	1005	1605	2345	2976	5321	10	1055	1155	54365	135		135	30	3323	4623	597.3
General Cargo	60		60		53	53	113	70		70	10	58	68	138	135		135	30	1785	2085	3435
Dry bulk cargo					47.5	47.5	47.5		620	620		47.5	47.5	667.5					1565 47.5	1563 47.5	1563 47.5
Liquid bulk cargo								2275	2356	4631				4631							

Note: < > means weight of ships.
It is not included in cargo.

Fig. IV-5-1 shows the plan of the port facilities and the industrial complex in the Opobo area.

A width of 20 m has been decided upon for the quay apron in consideration of the fact that a multi-purpose use cargo handling area 40 m wide is planned behind the berth.

A transit shed (25 m x 50 m) will be installed in the cargo handling for the purpose of sorting general cargo other than industrial cargo.

A 13 m wide port road is planned behind the cargo handling area and a trunk road 25 m wide will be installed as an approach road to the public road.

Table IV-5-2 Target Values of Cargo Handling Throughput

(tons/m)

Class	Target Value
over 1,000 thousand tons of cargo/year	900
500 to 1,000 thousand tons of cargo/year	800
250 to 500 thousand tons of cargo/year	700
less than 250 thousand tons of cargo/year	450

(2) Ibeno Area

The following is planned for handling port cargo in the Ibeno area.

For exports of chemical fertilizer and salt, shipment from Port Harcort or Calabar port is considered.

For flour milling and feed processing, as the main supply source of raw materials is South America and the distance of marine transportation is short, bulk carriers of 35,000 DWT class are considered a reasonable means of transportation.

Therefore, a sea berth is planned at around a water depth of −13.0 m.

Assuming annual imports amount to 620,000 tons and a ship type of 35,000 DWT, the use of the port is a little less than 18 times per year. Therefore, an open type sea berth can be used.

Cruide oil and petroleum products are handled at the existing Qwa Ibo Oil Terminal sea berth.

For orther domestic cargo, transportation by barge could be considered.

Therefore, the required extension of berthing facilities is

138,000 tons + 47,500 tons x 1/2 = 161,500 tons ≒ 162,000 tons
162,000 tons ÷ 450 tons/m = 360 m

Then berthing facilities for 2,000 DWT barges 4 berths, are planned.

Extension of proposed berthing facilities;

90 m/berth x 4 berths = 360 m

The width of the apron will be made the same as in the Opobo area. Fig. IV-5-2 shows the layout of the port facilities and the industrial complex behind the port in the Ibeno area.

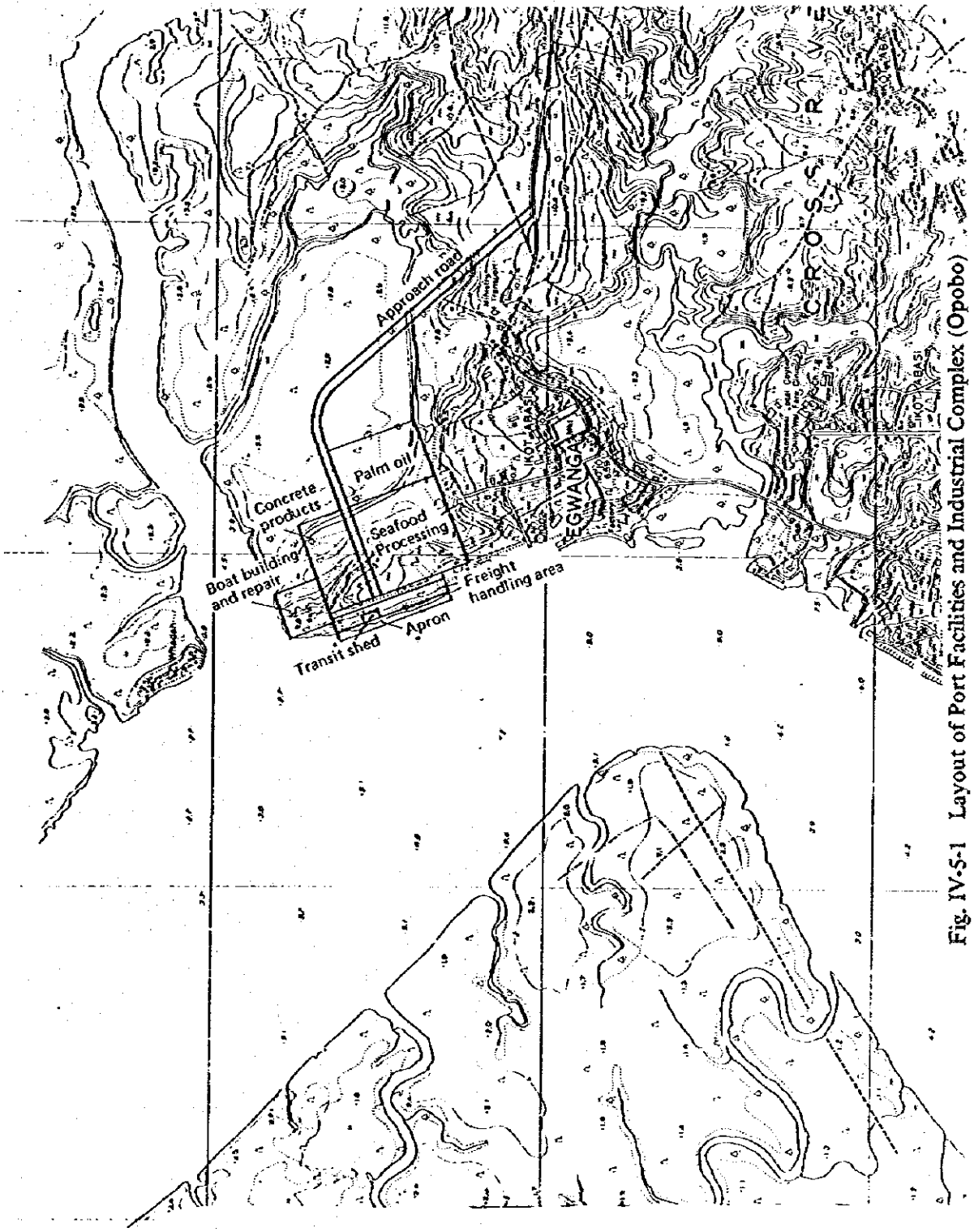


Fig. IV-5-1 Layout of Port Facilities and Industrial Complex (Opobo)

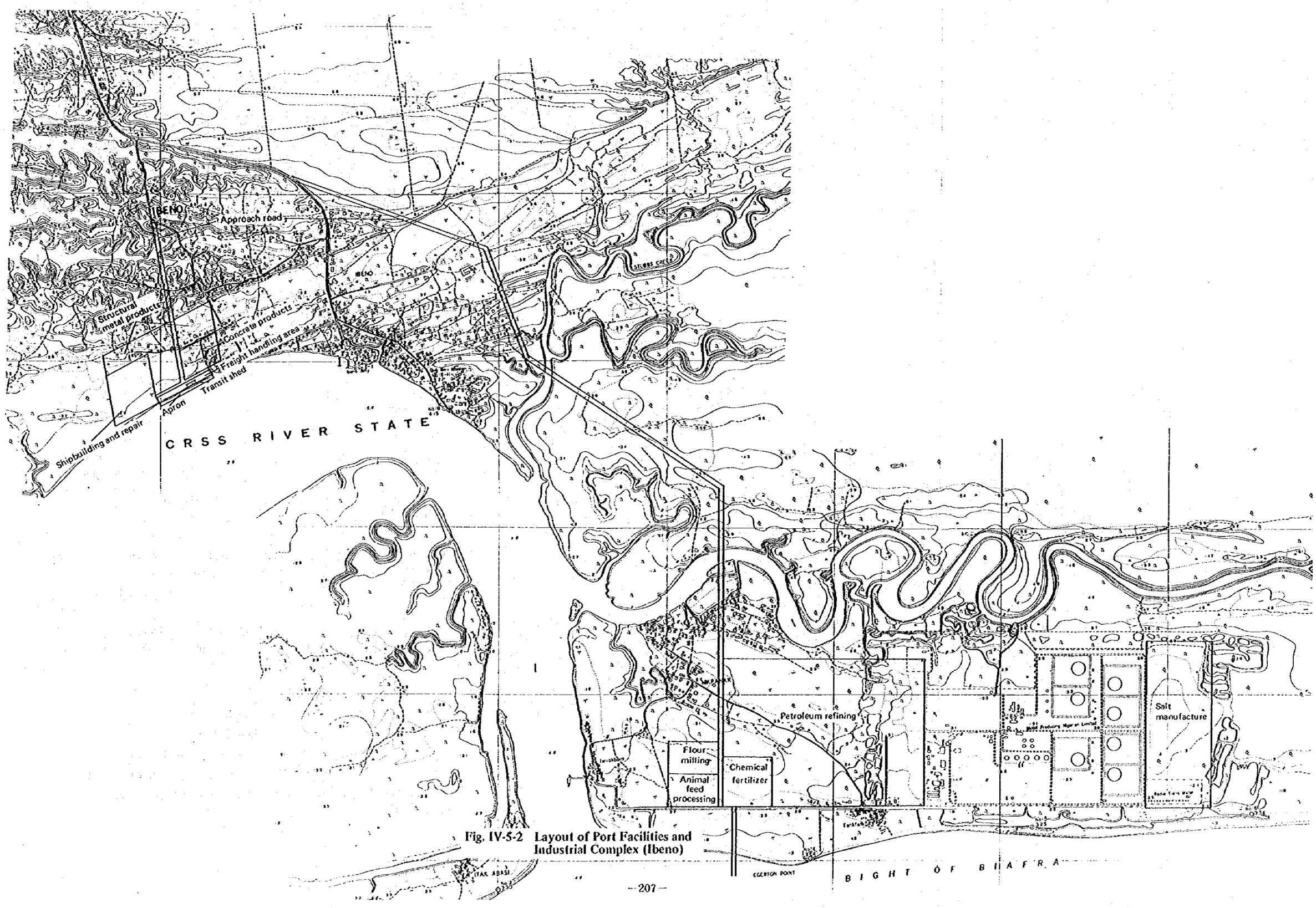


Fig. IV-5-2 Layout of Port Facilities and Industrial Complex (Ibeno)

(3) Jamestown Area

Of the cargo handled, 135,000 tons of exports are planned for shipment through Calabar port or offshore loading in the Jamestown site.

156,300 tons of logs are brought in by using rivers. Cement and steel are to be transported through inland waterways. The required facilities are as follows.

1) Extension of berthing facilities;

343,500 tons + 47,500 tons x 1/2 = 367,500 tons ≒ 368,000 tons
368,000 tons ÷ 700 tons/m = 526 m ≒ 530 m

2) Log handling facilities;

a. Log sorting area

① Water depth

A water depth of −2.0 m at the water sorting area is considered.

② Area

The area for the log sorting area is obtained by the following formula.

$$\text{Required area} = \frac{\text{annual handling volume x sorting period/365 x concentration ratio}}{\text{storage capacity per unit area x use rate}}$$

sorting period = 25 days
use rate = 0.8
concentration ratio = 1.4 ~ 1.7
storage capacity per unit area = 0.6 t/m²

$$\text{Required area} = \frac{156{,}300 \times 25/365 \times 1.7}{0.6 \times 0.8} = 37{,}915 \text{ m}^2 \fallingdotseq 38{,}000 \text{ m}^2$$

③ The log sorting area must be properly separated into sections using buoys and pilings to secure the water area for traffic, to facilitate transportation of logs, to facilitate sorting, and to prevent overflow.

b. Landing place

The water depth of the landing place is −2.0m and handling capacity is 500 t/m in a year.
156,300 tons ÷ 500 tons/m = 312.6 m ≒ 315 m

c. Log pond

The area of the log pond is obtained by the following formula.

$$\text{Required area} = \frac{\text{annual handling volume x number of months logs are stored/12}}{\text{storage capacity per unit area x use rate}}$$

number of months logs are stored = 2 months
use rate and storage capacity per unit area are same as ② of "Log sorting area".

Required area = 156,300 x 2/12/(0.6 x 0.8) = 54,270 ≒ 55,000 m²

Use of a creek might be considered for the log sorting and log pond areas.

Then, berthing facilities for 2,000 DWT barges(6 berths) and 315 m of log landing place will be planned.

Extension of proposed berthing facilities

90 m/berth x 6 berths = 540 m

The width of the apron is the same as in the Opobo area.

Fig. IV-5-3 shows the plan of the port facilities and the industrial complex behind the port in the Jamestown area.

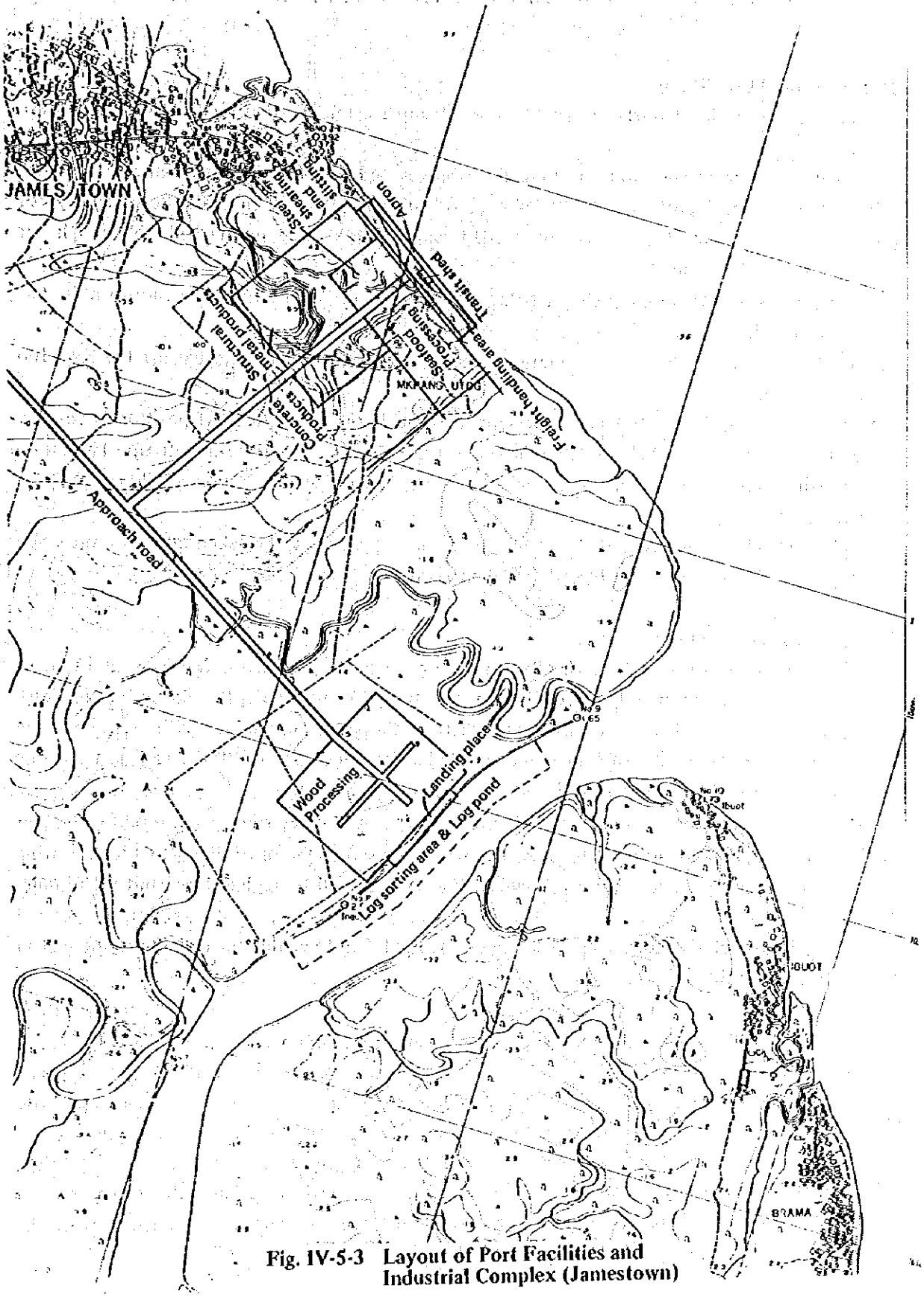


Fig. IV-5-3 Layout of Port Facilities and Industrial Complex (Jamestown)

CHAPTER 6. COMMENTS FROM THE TECHNICAL VIEWPOINTS

IV-6-1. Natural Conditions

As wharves of local ports are to be situated along estuaries, they will rarely suffer wave attacks.

Possible problems are siltation along the wharves and of the shipping channels. However, ships calling at local ports are 2,000 DWT class barges of about 2 m draft. So, dredging for provision of shipping channels is not needed and the following points will be enough for maintenance of the channels.

(1) At Opobo site, the shipping channel through the sand bar at the Imo river mouth must be deep enough.

(2) At Ibeno site, the shipping channel must be deep enough on the sand bar off the Kwa Ibo river mouth.

(3) At Jamestown, the sea bottom at present in front of the planned wharf position is covered with mud. This may indicate that in the future this site might easily silt up. Therefore, though water depth in front of the wharf is not so deep (–3 m), siltation should carefully be prevented.

Table III-4-1 can be used to identify dimensions of waves to be taken into account when designing the sea a berth and trestle off Ibeno site.

IV-6-2. Designing and Construction

Mooring facilities planned for the three sites are –3 m deep wharves. The structural type of wharves is determined mainly according to the alongside water depth and soil conditions. L-shaped concrete block will be most suitable from the viewpoints of feasibility, construction and durability. A foundation of L-shaped concrete blocks will consist of 20 – 50 kg stones with a thickness of 0.3 – 0.5 m and will be leveled to –3.0 m.

But for catering for local soil condition, this type may require some small modification on the foundation portion. In order to provide a necessary safety factor of sliding and load bearing pressure, a simple riprap foundation shown in Fig. IV-6-1 shall be replaced by sand fill foundation.

Crown height of this concrete block will be +1.0~+1.5 m to enable the concrete to be placed in situ during low tide.

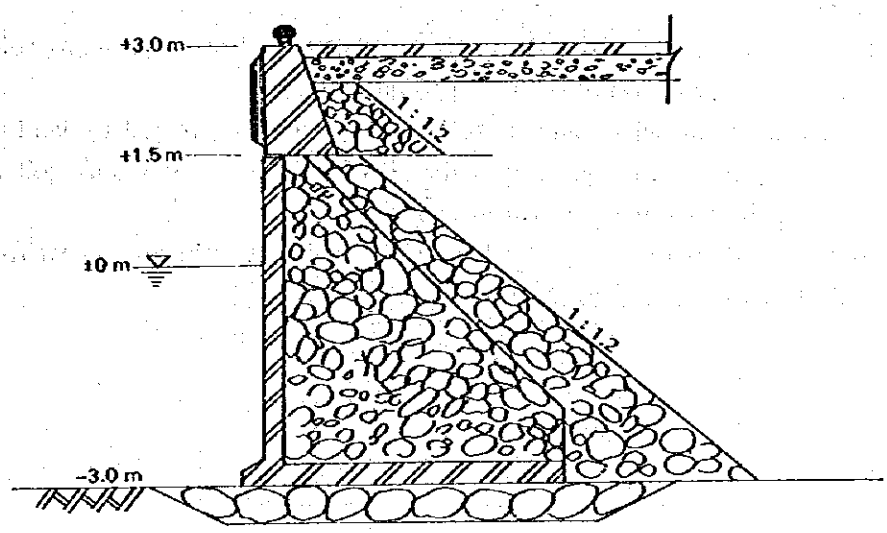


Fig. IV-6-1 L-shaped Concrete Block Wharf

Table IV-6-1 Construction Cost of Wharves

Type of wharves	Cost	Remarks
L-shaped concrete block Steel sheet piles Concrete block	1,800N/m 3,000N/m 2,500N/m	Costs of concrete pavement and fenders are not included.

(1) Opobo Site

The total length of the −3 m deep wharf is 360 m (90 m x 4 berths). The Apron will be of concrete pavement.

A small craft building yard adjacent to this wharf will be constructed with common type slipway. A lifting device for small crafts and a wheel type trailer should also be attached to the yard in order to make full use of the yard. Soil conditions at Opobo site are fairly good, so soil stabilization will not be necessary.

Reclamation should be carried out so that the quantities of soil to be cut and filled will be balanced.

(2) Ibeno Site

A sea berth will be constructed at a site of −13 m deep, 10 km off the coast. The distance between the sea berth and Ibeno site will be connected using trestle supported by double rows of steel pipe piles.

The upper part of two piles is to be reinforced by steel cross beams. It will be jointed by field welding, otherwise fabricated using the jacket method.

Taking rough conditions into consideration, piles be installed using either self-elevating platform or driving machine moving on the rail which is mounted on the steel pile already drived.

(3) Jamestown Site

Since the ground surface is composed of layers of silt and clay, the existing soil should be displaced with sand for the provision of the wharf foundation.

A factory area behind the wharf and a steel mill area will be created by land reclamation using soil from a nearby hill. As the ground in the area of the steel mill is soft, soil stabilization should be carried out to increase the soil bearing capacity.

Since no existing road to the site is fit for access by heavy vehicles, a new road must be constructed to link the existing main road to the project site.

APPENDIX

APPENDIX 1 List of Unit Prices for Cost Estimation in 1981

Table 1-1 List of Unit Prices

Unit: N

Item		Unit	Lagos	East
Labor Wages				
Unskilled Labor		month	140	130
Skilled Labor		"	170	160
Driver or operator		"	300	300
Foreman		"	400	360
Sailor		"	150	150
Crew, Engineer, Skilled Foreigner		"	1,400 – 1,900	1,400 – 1,900
Material price				
Gravel for concrete at site		m^3	28	45
Crusher run	"	"	24	42
Stone 10 kg – 8,000 kg	"	"	20	34
Sand	"	"	5	5
Cement	"	t	80	80
Wood (Timber)	"	m^3	280	280
Asphalt	"	t	200	200
Steel Pipe Pile	"	t	450	450
Steel Sheet Pile	"	t	350	350
Steel Bar (Deformed)	"	t	520	520
Fuel				
Gasoline		ℓ	0.15	0.15
Gas Oil		ℓ	0.11	0.11
Marine Diesel Oil		ℓ	0.11	0.11
Rental of Equipment				
Dump Truck	2 tons	month	550	550
	11 tons	"	2,750	2,750
	30 tons	"	8,250	8,250
Wheel Dozer	D-6C	"	4,800	4,800
	D-8K	"	9,500	9,500
Crane (crawler)	25 t	"	2,500	2,500
Crane (truck)	35 t	"	4,000	4,000

Table 1-2 Operational Costs of Workships

Unit: ₦

	Capacity	Operational Hours per Month	Operational Cost per Month		
			Total	L/C	F/C
Flat Barge	200 t	30 days	2,700	500	2,200
"	350 t	30 days	3,800	500	3,300
"	1,000 t	30 days	9,000	500	8,500
Tug Boat	250 Ps	165 h	8,300	2,900	5,400
"	500 Ps	165 h	11,600	4,300	7,300
"	1,000 Ps	165 h	16,000	5,500	10,500
Anchor Boat	15 t	135 h	11,000	2,200	8,800
"	30 t	135 h	18,000	3,500	14,500
Barge (self-propeller)	350 m^3	240 h	18,000	6,000	12,000
"	650 m^3	240 h	35,000	10,000	25,000
"	3,000 m^3	500 h	150,000	55,000	95,000
Floating crane	30 t	100 h	11,400	3,100	8,300
"	50 t	100 h	13,800	3,300	10,500
"	100 t	100 h	21,000	4,500	16,500
Diver Boat	30 Ps – 5 T	180 h	5,200	1,400	3,800
Dredger	D 4000	425 h	250,000	54,000	196,000
"	DE 8000	425 h	445,000	100,000	345,000
Pile driving boat	D-22	150 h	15,000	5,000	10,000
"	D-40	150 h	26,000	7,000	19,000
"	D-70	150 h	67,000	13,000	54,000

APPENDIX 2 Rough Estimate of Construction Cost of Port Facilities

1. Conditions of Cost Estimates

1) Exchange rate is ₦1 = ¥300

2) Unit price of estimation

Cost estimates were done using the same unit prices as those used for NOT-Lagos in the Phase II Report, with the exception of the unit prices of stone materials.

3) Estimated unit prices of stone materials

Table 2-1 Unit Prices of Stone Materials

Unit: ₦

	Lagos	East	Difference
Gravel for concrete (at site)	28	45	17
Crusher run (at site)	24	42	18
Stone 10 kg – 800 kg (at site)	20	34	14

2. Comparison of Construction Cost of Lagos and East

(1) Commercial port

Table 2-2 Construction Cost of Commercial Port

Unit: Million ₦

	Lagos			East		
	Total	F/C	L/C	Total	F/C	L/C
I. Preliminary and Temporary Work	55.5	39.0	16.5	54.0	37.9	16.1
II. Breakwaters and Shore Protection Facilities						
1. Breakwaters	111.8	89.4	22.4	146.9	114.9	32.0
2. Shore Protection Facilities	10.1	8.1	2.0	5.4	4.4	1.0
3. Training Jetty	–	–	–	15.0	12.0	3.0
III. Mooring Facilities and Related Facilities						
1. General Cargo Berth 33 Berth	175.0	132.8	42.0	211.2	160.3	50.9
2. Container Berth 27 B	746.9	605.0	141.9	789.7	639.7	150.0
3. Bulk Cargo Berth 1 B	35.7	28.2	7.5	37.5	29.6	7.9
4. Petroleum Berth 3 B	34.5	26.9	7.6	34.3	26.8	7.5
5. Small Crafts Berth	2.5	2.1	0.4	4.7	3.9	0.8
IV. Dredging and Reclamation	165.6	129.1	36.5	269.5	210.1	59.4
V. Administration Office and Related Buildings	8.2	6.5	1.7	8.2	6.5	1.7
VI. Utilities						
1. Water Supply	16.3	13.0	3.3	16.3	13.0	3.3
2. Sewage and Drainage	11.0	6.6	4.4	11.0	6.6	4.4
3. Electricity Supply	9.0	8.1	0.9	9.0	8.1	0.9
4. Road and Green Belt for Port Service Area	8.3	5.0	3.3	8.3	5.0	3.3
5. Communications System	3.0	2.7	0.3	3.0	2.7	0.3
VII. Navigation Aids	4.0	3.5	0.5	4.0	3.5	0.5
VIII. Port Service Boats	9.6	9.6	–	9.6	9.6	–
IX. Power Station 400 MW	88.0	72.0	16.0	88.0	72.0	16.0
Total	1,495.0	1,187.6	307.4	1,725.6	1,366.6	359

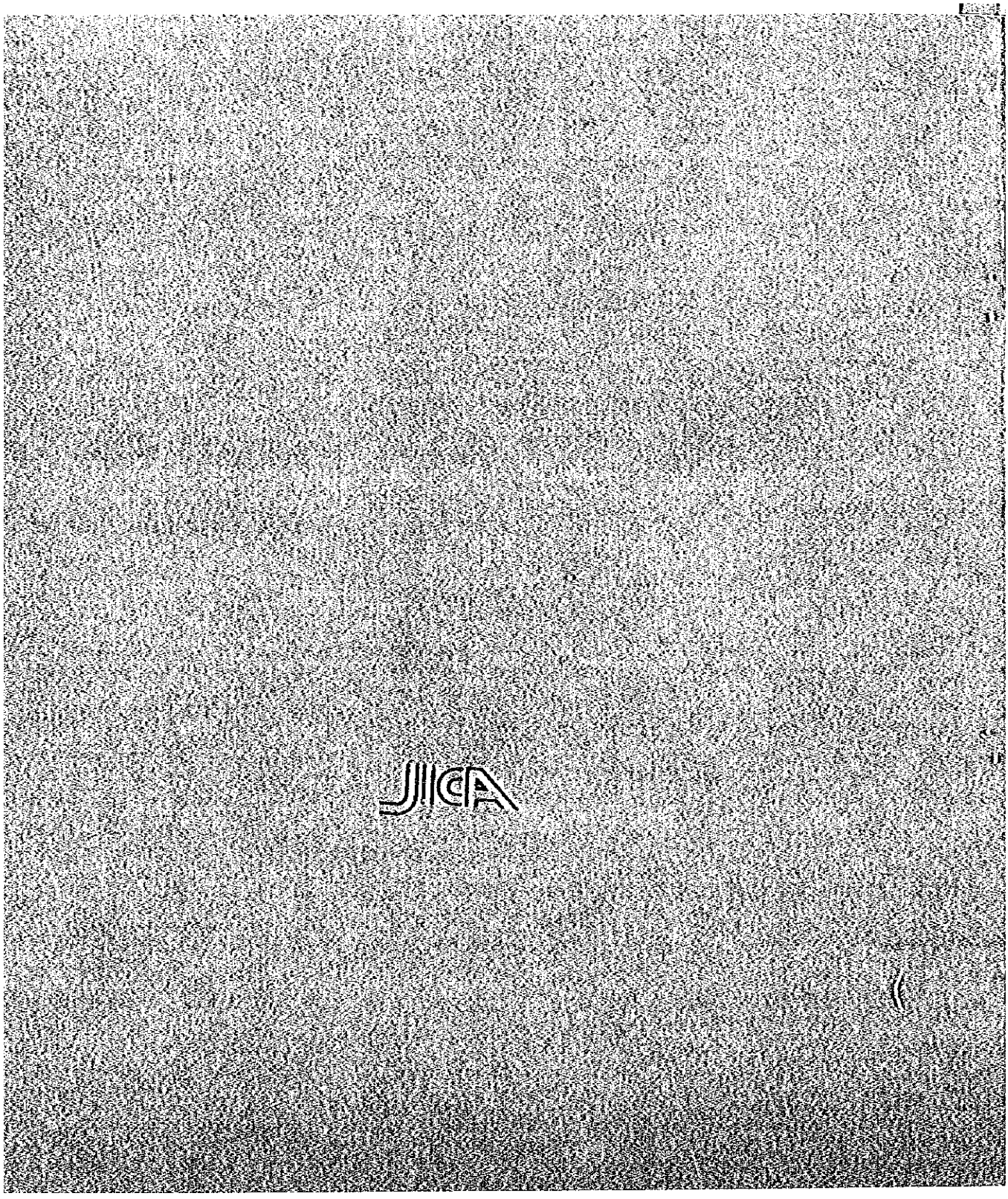
(2) Industrial port

Table 2-3 Construction Cost of Industrial Port

Unit: Million ₦

		Lagos			East		
		Total	F/C	L/C	Total	F/C	L/C
I. Preliminary and Temporary Work		11.5	8.1	3.4	11.5	8.1	3.4
II. Mooring Facilities							
1. Iron and Steel Berth							
a. Iron Ore Berth	2 Berth	30.9	26.6	4.3	34.7	26.6	8.1
b. Coal Berth	1 B	13.2	11.4	1.8	14.9	11.4	3.5
c. Limestone Berth	1 B	6.8	5.8	1.0	9.1	5.8	3.3
d. Steel Product Berth	9 B	29.1	23.5	5.6	36.2	29.2	7.0
2. Oil Berth							
a. Crude Oil Berth	2 B	5.3	4.4	0.9	5.4	4.4	1.0
b. Refined Oil Berth	1 B	2.0	1.7	0.3	2.2	1.9	0.3
3. Chemicals Berth							
a. Chemical Materials	1 B	3.2	2.6	0.6	4.0	3.3	0.7
b. Chemicals	5 B	16.1	13.0	3.1	20.1	16.3	3.8
4. Shipbuilding Berth	3 B	9.7	7.8	1.9	12.1	9.7	2.4
5. Bulk Cargo Berth	1 B	11.3	9.7	1.6	13.2	11.3	1.9
III. Dredging & Reclamation		36.6	28.5	8.1	60.0	46.7	13.3
Total		175.7	143.1	32.6	223.4	174.7	48.7

(1) Commercial Port	1,495.0	1,187.6	307.4	1,725.6	1,366.6	359.0
(2) Industrial Port	175.7	143.1	32.6	223.4	174.7	48.7
Total	1,670.7	1,330.7	340.0	1,949.0	1,541.3	407.7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