BASIC DESIGN STUDY REPORT ON THE PROJECT FOR IMPROVEMENT OF ARTISANAL COASTAL FISHERIES IN THE REPUBLIC OF THE GAMBIA

APRIL 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request of the Government of the Republic of the Gambia, the Government of Japan decided to conduct a Basic Design Study on the Project for the Improvement of Artisanal Coastal Fisheries in the Republic of the Gambia and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the Gambia a survey team headed by Mr. Masaru OKAMOTO, Director, Office of the Overseas Fisheries Cooperation, Oceanic Fishery Department, Fishery Agency, the Ministry of Agriculture, Forestry and Fisheries, from December 3 to December 31, 1991.

The team held discussion with the officials concerned of the Government of the Gambia and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to the Gambia in order to discuss a draft report and the present report was prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of the Gambia for their close cooperation extended to the teams.

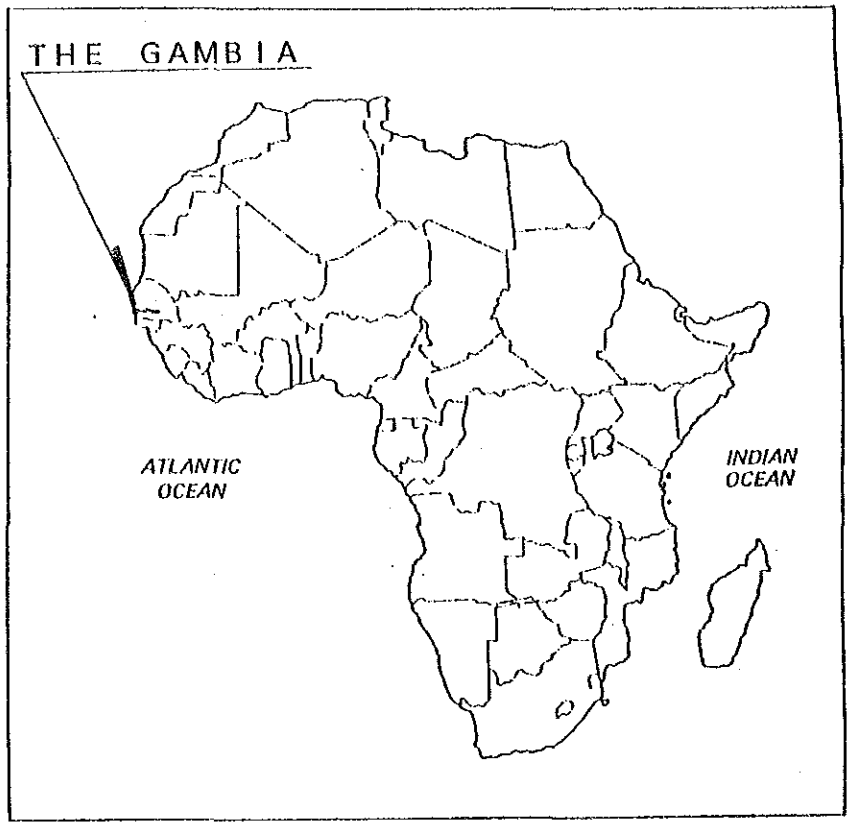
April, 1992

Kensuke Yanagiya

Kensuke Yanagiya

President

Japan International Cooperation Agency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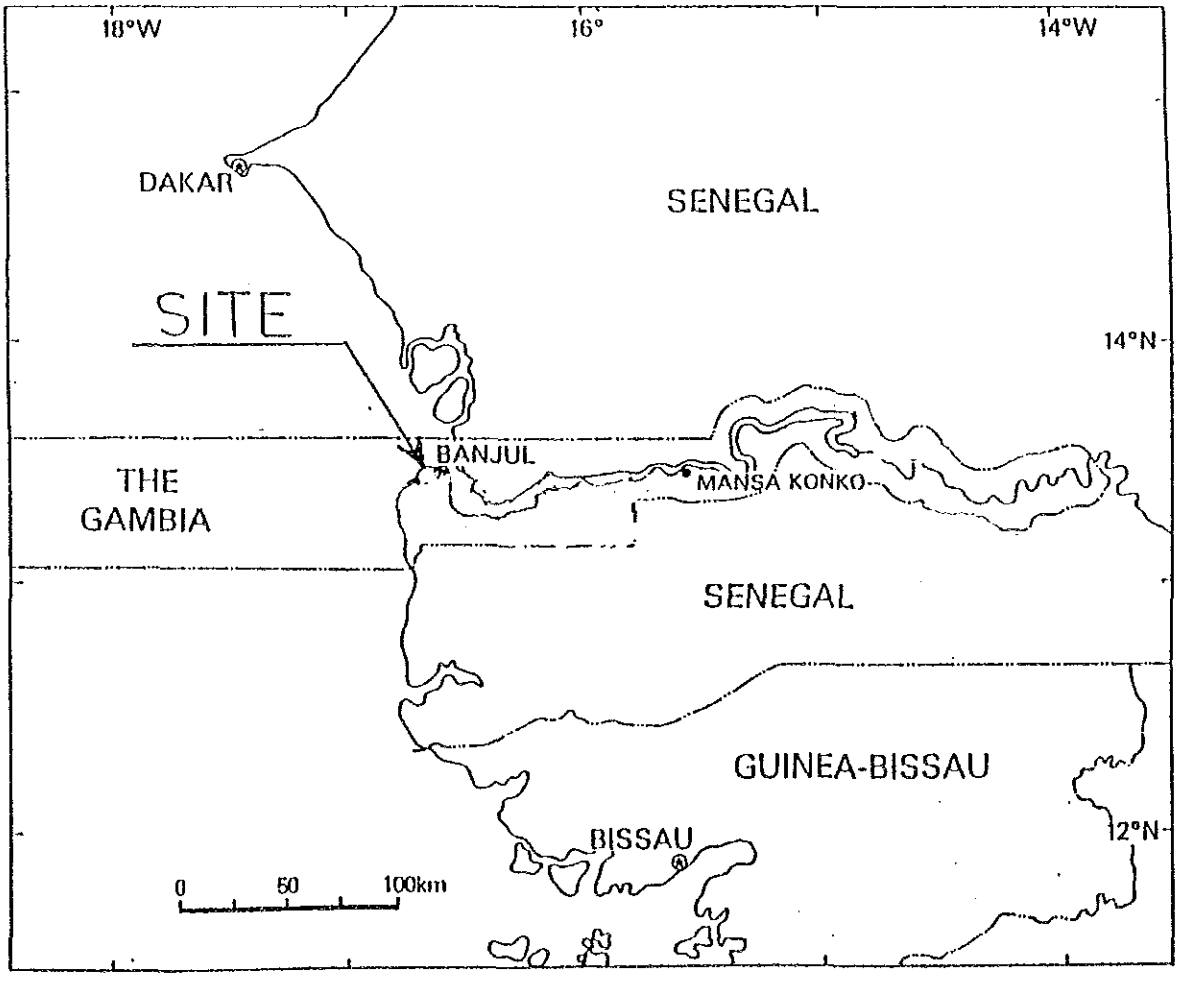
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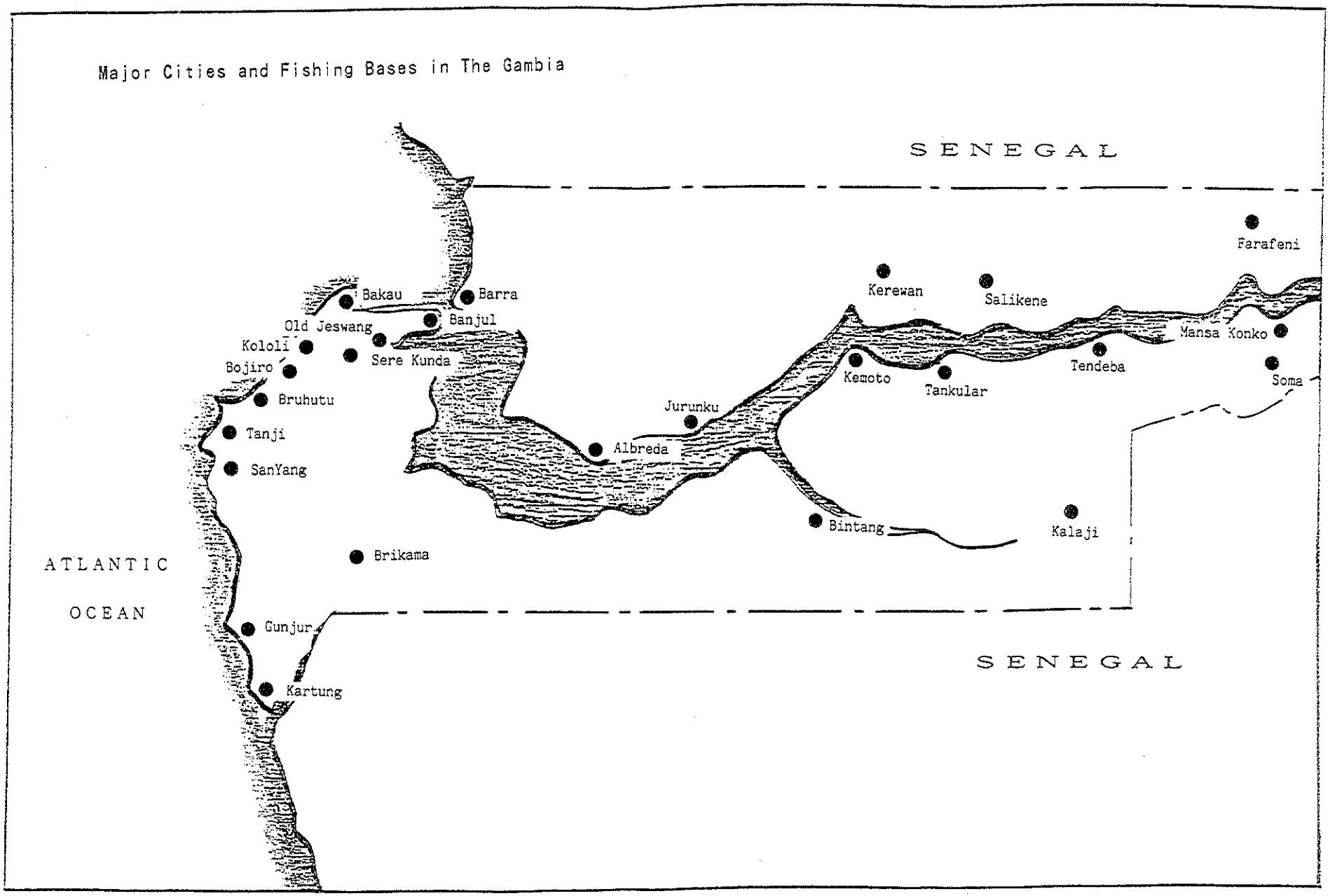
Major Cities and Fishing Bases in The Gambia
SENEGAL
Farafeni
Kerewan
Salikene
Bakau
Barra
Banjul
Old Jeswang
Kololi
Sere Kunda
Bojiro
Mansa Konko
Tendeba
Kemoto
Tankular
Soma
Bruhutu
Jurunku
Tanji
Albreda
SanYang
Bintang
Kalaji
ATLANTIC
OCEAN
Brikama
Gunjur
SENEGAL
Kartung

SUMMARY

SUMMARY

The Republic of the Gambia is situated at the Africa's western end and covers an area of about 11 thousand square kilometers with a population of some 860,000. Its coastline is as short as about 57 km, but the continental shelf is a worldwide known good fishing ground at which industry fisheries including many licensed foreign fishing vessels are exploiting fishery resources.

On the other hand, the artisanal coastal fisheries of the country is less developed due to lack of fishery-related infrastructure. The Government of the Gambia therefore has formulated since 1975 the first and then second Fisheries Development Program to develop the coastal fisheries, aiming at an increase of fish production, improvement in nutrition of the people, an increase of employment and so on.

In line with the Programs EC funded projects and Italian projects have been executed at villages having no related infrastructure on the Atlantic coast and at the inland areas along the Gambia River respectively with considerable good results. And now the Government of the Gambia made a project to construct and provide facilities, equipment and materials necessary to achieve the objective of the Fisheries Development Program at Bakau, which has comparatively developed social infrastructure and consuming communities including the Capital, though no fishery-related infrastructure, and requested the Government of Japan to offer a grant aid on the project, aiming at an increase of fish production, storing fish catches, improving quality of fish, and supplying fish to inland areas.

The Government of Japan, responding to the request, decided to conduct a basic study survey on the project and sent a Basic Design Study Team to the Gambia for the period between December 3 and 31, 1991. The Team discussed the contents of the request with the Gambia officials concerned and conducted necessary surveys.

Based on the results of discussions and surveys above the Team made a basic design and prepared a draft final report, which was further discussed with the Gambia side from February 28 to March 12, 1992.

The proposed site is located at Bakau, which is part of the national capital region called Greater Banjul with a population of some 250,000 together with Banjul itself and an adjacent city of Sere Kunda. The Atlantic coast of

Bakau is a prominent resort area of the country, attracting lots of European tourists, and the proposed site, about 11 km away from Banjul, the capital of the Gambia, is a traditional fish landing spot facing the Atlantic with housing and hotels behind.

The Government of the Gambia first planned to expropriate a private land west of the project site as an access to it, but this expropriation was judged to be difficult and the Government finally decided to utilize a land available on the eastern side for the access purpose. Also, on the process of discussions and surveys, the Gambia side agreed to cancel the following facilities, materials, equipment, and machinery from the original request. A landing jetty will be useful for time saving on fishing activities, improving safety of work, and a consequent increase of fish production. However, because of a decrease of the site area due to the change of the access road and cancelling some materials and equipment mentioned later, it was judged that a landing jetty should be examined in the future on its most suitable size and structure based on the result of utilization of the materials and equipment provided through the revised project and an extent of the target achieved. A freezing system was concluded to be unnecessary due to the current distribution situation exclusively depending upon fresh fish; two 4 ton type purse seiners were deleted because necessary training is now being performed at other fishing bases; one 3 ton tractor aims at hauling up fishing boats on the beach and transporting fish catches, but the Gambia side agreed to maintain the present beaching method, though labor-intensive, for some time to come; one 4 WD car for transportation can be substituted with insulated van trucks.

The executing agency of the project is the Fisheries Department, Ministry of Natural Resources and the Environment, responsible for the development of the fisheries of the country. For this purpose the Fisheries Department will set up a management committee consisting of the representatives of the Department and fishermen.

The Team confirmed that the project aimed to prepare the most suitable facilities for increasing production of the coastal artisanal fisheries of Bakau and supply fish products to the inland areas, and concluded that the following facilities, equipment and materials were the most suitable to accomplish the aim of the project.

1. Shore facilities
   (1) Ice plant
   (2) Ice bin
   (3) Cold room
   (4) Generator
   (5) Shade for fish treating
   (6) Main building
   (7) Office, Repair Shop, and Store
   (8) Fishermen's locker
   (9) Workshop
   (10) Smoking hut
   (11) Rack for drying
   (12) Fuel tank
   (13) Water tank
2. Other equipment and materials
   (1) FRP 13 m canoe type fishing boat equipped with a 27 HP diesel outboard motor
   (2) 25 HP gasoline outboard motor
   (3) Spare parts for above outboard motors
   (4) Insulated van
   (5) Tools for maintenance
   (6) Fishing gear and materials
   (7) Fish box
   (8) Other materials

The term of works is estimated at ten and a half months at total; 2 months for detail design, 2.5 months for manufacturing and procurement in Japan, 2.5 months for transport, and 5.5 months for local works.

The implementation of the project will produce an increase of some 1,700 tons of fish production and employment opportunities as well as an improvement of quality of catches and fish supply to inland areas through the utilization of the ice-making/cold storage facilities. It is expected that the living standard of Bakau fishermen, fishing activities at Bakau, and nutrition of the inland people are certain to be improved.

CONTENTS

CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

The Government of the Gambia is striving to develop fishing bases on the coast of the Atlantic Ocean and along the Gambia River in order to improve the artisanal coastal fisheries in the country.

In line with this the Government of the Gambia made a plan to develop the fishery-related infrastructure at Bakau on the Atlantic coast, and requested the Government of Japan to offer a grant aid to procure necessary equipment and materials for the plan. On the request of the Government of the Gambia, the Government of Japan decided to perform a basic design study on this project and sent a Basic Design Study Team headed by Mr. Masaru OKAMOTO, Director of Office of the Overseas Fisheries Cooperation, Oceanic Fishery Department, Fishery Agency, through Japan International Cooperation Agency (JICA), to the Gambia for the period between December 3 and 31, 1991. In order to accomplish the most suitable basic design, the Team had a series of discussions about the background, contents, necessity and appropriateness of the request with the Gambia officials concerned, investigated the EC- and Italy-financed projects, and also carried out a necessary site survey including measuring, sea floor configuration, geological survey and so on.

Major points of the mutual agreement resulted from discussions with the Gambia government were confirmed on the "Minutes of Discussions, the Basic Design Study on the Project for Improvement of Artisanal Coastal Fisheries" signed mutually. And then, based of the analysis and review of the results of the field survey, the Team assessed the effect of the project in developing the artisanal fisheries, prepared a draft final report on the basic design with the most suitable scale and content.

The Government of Japan then sent a Draft Report Explanation Team headed by Mr. Mitsunori OHI, Assistant Director of Office of the Overseas Fisheries Cooperation, Oceanic Fishery Department, Fishery Agency, to the Gambia from February 28 to March 12 to discuss the draft report with the Gambia officials concerned.

Following the discussions, this report was prepared to cover the basic design, implementation schedule and so on which were judged the most suitable for the implementation of the project and recommendations.

Member List of the Survey Team, Survey Itinerary, Member List of Related Parties in the Gambia, Minutes of Discussions, etc. are shown in the Appendix.

CHAPTER 2 BACKGROUND OF THE PROJECT

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2-1 Outlook of the Gambia

(1) General

The Republic of the Gambia is located at the western end of Africa, extending about 300 km east to west, about 30 to 50 km north to south, along the Gambia River. It belongs to the tropical savanna climate, divided in two distinct seasons, the dry season (November to May) and the rainy season (June to October). Precipitation a year is usually 800 to 1,000 mm, with less than 400 mm during a drought. The land area covers 10,689 km², and the population (1990) is about 860 thousand, of which some 60 thousand are living at Banjul, the Capital. The nation consists of 6 ethnic groups. English is the official language, but Mandingo and Wolof, the languages of the main ethnic groups, are spoken widely. About 80 percent of the population are Muslims, 10% Christians, and 10% animist. The Gambia has been a British colony since 1822, and became fully independent in February 1965 as a member of the British Commonwealth of Nations.

(2) The Economy

The mainstay of the Gambia economy is agriculture, accounting for 30% of GDP and 90% of export, with 75% of the population engaged in subsistence farming, livestock rearing and the production of groundnuts. The share of manufacturing in GDP is under 7%, consisting mainly of activities such as groundnut processing, brewing and tanning, and the production of bricks. Tourism is developing steadily, employing about 6,000 Gambians during the main season from October to April.

Because of its monocultural economy, economic performance of the Gambia is affected chiefly by the principal export product, groundnuts, and heavily vulnerable to external shocks. A large proportion of development expenditure is financed from foreign loans and grants. The government has attempted recently to improve domestic revenues by giving a boost to domestic spending in the 1991/92 budget incorporated a 6 per cent salary increase to public sector

workers, low interest loans, cutting duty on consumer items and so on.
However, foreign aid, good rains and developing tourism are, as ever, the key determinants and will remain so for the foreseeable future. Table-1 below is the trend of the foreign trade between 1985 and 1989.

Table-1 Foreign Trade (D mn)

	1985	1986	1987	1988	1989
Imports	492.7	839.1	861.6	1054.2	1447.3
Exports	138.6	222.5	218.5	316.2	238.1
Balance	-354.1	-616.6	-643.1	-738.0	-1209.2

(Source: Central Statistics Department)

Gross domestic product tends to fluctuate widely from year to year as a result of changes in agricultural production, but according to World Bank estimates GNP per caput showed an average real annual growth rate of +0.2% from 1973 to 1980, while -0.7% for sub-Saharan Africa excluding Nigeria. A real growth rate was as poor as 3% in 1979/80-1980/81 due mainly to drought, but a 9.8% rate was achieved in 1981/82 and 1982/83 respectively. Although GDP collapsed from 1983/84 to 1985/86 due to agricultural depression, a turnaround came in 1986/87 when growth reached 5.5% and this was repeated in the following year. The 1989/90 growth of 5.9% was largely due to improved production of groundnuts. Agroculture's share of GDP subjects to the weather and world prices, but it is normally between 25% and 35% of total GDP. The service sector including trade, hotels, and restaurants accounted for 53.6% of GDP in 1989/90.

Table-2 and Table-3 show the trend of GDP and GDP by main sectors respectively. The sources of both are the Central Statistics Department of the Gambia.

Table-2 Trend of GDP at market prices (D mn)

	1984/85	85/86	86/87	87/88	88/89	89/90
Total GDP						
At current prices	635.1	859.3	1078.1	1250.9	1489.5	1793.0
At 1976/77 prices	475.5	434.0	457.7	482.6	505.0	535.0
Real change (%)	-10.0	-8.7	5.5	5.4	4.6	5.9
GDP per head (1,000 D)						
At current prices	852.5	1116.0	1364.7	1544.3	1773.2	2084.9
At 1976/77 prices	642.6	563.6	579.4	595.8	601.2	622.1
Real change (%)	-12.4	-12.3	2.8	2.8	0.9	3.5

Table-3 GDP by sector (D mn)

	1985/86	%	1989/90	%
Agriculture	104.8	28.6	163.1	34.5
of which: groundnuts	25.1	6.6	46.5	8.8
Industry	35.6	9.4	56.4	11.9
of which:manufacturing	18.5	4.9	33.2	7.0
Services	235.1	62.0	253.5	53.6
Total	379.1	100.0	473.1	100.0

2-2 Outline of the fisheries

(1) Production

Despite a rather short coastline of about 57 km, the 1,500㎢ continental shelf of the Gambia is a good fishing ground for both pelagic and demersal species due to the nutrient-rich waters flowing from the Gambia River. The production a year is 20,000 to 30,000 tons, of which 50% is produced by artisanal fisheries and the rest by industry fisheries including foreign trawlers.

1) Industry fisheries

The production of the industry fisheries has been 5,000 to 10,000 tons per year, but dropped to 2,600 tons in 1990 due to the closing of the biggest company, Seagull (owned 51% by Ghana and 49% by the government of the Gambia). Difficulties of operation and maintenance of fishing vessels and facilities will be considered as the major cause of the closure. As of the end of 1991 six companies (of which 4 companies are operating fish processing) are in fishing activity. Among these companies two companies' activity is as follows (Table-4).

Table-4 Activity of Major Fishing Companies in 1991 (M/T)

Company	Landing	Processing	Export	
			Shrimp	Fish
National Partnership Enterprise (N.P.E.)	288	484	400	120
Pelican	242	275	61	60

2) Foreign Fishing Fleet

The Gambia concludes the license fisheries agreement with Senegal, providing for the size of fishing fleet (15 trawlers, 10 purse seiners, and 7 tuna long-liners) operating in the Gambia fishing zone in the year and their registered

tonnage. EC countries also have the agreements with the Gambia, providing for the total catches and fishing days available in the year with financial compensation in return. The foreign fishing vessels operating in the Gambia's 200 mile EEZ are mainly of Senegal, France, Spain, and Greek, about 30 from January to June and about 50 to 60 from July to December in 1990.

Table-5 below shows trends of fisheries production.

Table-5 Fisheries Production by sector(1981 - 1990)

Unit: M/T

	Artisanal		Total	Offshore		Industry	Grand total
	Marine	Inland		Foreign	National		
1981	11,055	1,423	12,478	1,169	-	9,614	23,261
1982	6,196	3,508	9,704	702	-	6,777	17,183
1983	6,111	644	6,755	1,610	-	5,337	13,702
1984	8,455	466	8,921	9,608	-	5,037	23,566
1985	7,709	114	7,823	13,643	-	10,009	31,475
1986	7,359	197	7,556	16,737	-	5,481	29,774
1987	9,906	-	9,906	9,580	911	10,241	30,638
1988	5,133	-	5,133	3,908	415	7,529	16,985
1989	10,941	-	10,941	7,505	256	3,773	22,475
1990	11,585	-	11,585	9,366	-	2,624	23,575

(Source: Fisheries Department)

3) Artisanal Coastal Fisheries

According to the 1990 statistics of the Fisheries Department the total number of canoes engaging in the artisanal fisheries is 1,313, of which 415 are operating marine fishing. They are performing the following fishing methods.

① Bottom gillnet

Croaker, cat fish, shark, and ray are harvested by this method at the waters 2 to 10 m deep from the surface. The fishing boat is usually 8 to 15 m long,

with a 8 to 40 HP gasoline outboard motor, 3 to 5 fishermen on board, performing a one-day fishing trip within 6 miles off the shore.

② Purse seine net

Purse seining is mainly catching a small pelagic fish species, called Bonga (Ethmalosa firmbriata) which is caught in comparatively large quantities, accounting for about 70% of fish landing on the coastal areas as shown in Table-6. The purse seiners are usually 10 to 15 m long, with a 15 to 40 HP outboard motor, 7 to 12 fishermen on board, making also a one-day fishing trip.

③ Hand line

Hand line fishing boats are almost sailing boats, less than 6 m long, operated usually by a single fisherman to make a fishing trip on the daily basis. There are also some 8 to 12 m long boats with a 15 to 25 HP outboard motor. These motorized boats are operated with a crew of 4 to 6 for 2 or 3 days offshore, carrying an ice box on board.

④ Stow net and drift gill net

The stow net fishing is a method for taking small shrimp, performed at the mouth of the Gambia River. The target fish of drift gill net fishing are small fish such as mullet and bonga. The boat for this fishing is almost similar to a bottom gill net fishing boat in size and crew.

Besides, long line fishing and cast net fishing for bottom fish are operating in small scale.

Table-6 in the following page shows the number of coastal fishing boats by fishing method in 1990.

Table-6 Fishing Fleet by Landing Spot

Landing spot	Fisher-men	Bottom gillnet	Purse seiner	Hand line	Stow net	Drift gillnet	Others	TO-tal
Barra	161	2	2	24	7	0	0	35
Banjul	202	2	0	3	50	0	3	58
Oldjeswang	116	0	11	0	0	0	0	11
Bakau	91	5	1	30	0	0	2	38
Tanji	251	6	20	0	0	6	0	32
Bato Kunku	51	11	0	0	0	0	0	11
San Yang	102	15	1	15	1	0	0	32
Gunjur	588	49	33	1	0	0	1	84
Bijilo	15	3	0	5	0	0	0	8
Kololi	20	7	0	3	0	0	1	11
Kartong	59	10	0	0	0	0	0	10
Brufut	278	34	3	4	13	8	23	85
Total	1,934	144	71	85	71	14	30	415

(Source: Fisheries Department)

As shown above, at the Gambia River mouth area including Barra and Banjul the stow net fishing dominate, while the rest area has flourishing bottom gill net fishing and purse seining.

In 1990 the marine artisanal fishery production was 11,585 M/T, of which about 70% was bonga caught with purse seine net, followed by croaker, cat fish, and shark.

The breakdown of 1990 catch is shown on Table-7 in the following page.

Table-7 Breakdown of Marine Fishery Production in 1990

Species	Catch(M/T)	Species	Catch(M/T)
Bonga	8038.55	Lobster	94.47
Shark & Ray	629.58	Snapper	93.35
Lady fish	518.83	Grouper	86.12
Cassava fish	379.04	Sacca	96.22
Cat fish	318.59	Jotor	53.33
Sole fish	211.15	Banda	35.95
Sompat	180.26	Sardinella	23.00
Mackerel	173.50	Mullet	18.00
Barracuda	162.94	Telapia	13.52
Shine nose	143.01	Ninebones	10.94
Kujeli	105.75	Fotta	10.60
Tapandarr	99.43	Others	88.53
Grand total			11584.66

(Source: Fisheries Department)

The coastal fishing production has shown no marked fluctuations for a long time.

The main reasons include a lack of fishery-related infrastructure and the difficulty of the procurement of spare parts.

The Fisheries Department estimates the Maximum Sustainable Yield (MSY) of the Gambia waters as below (Table-8).

Table-8 Production Potential

Sardinella	30,000 M/T	Shell	1,000 M/T
Bonga	15,000 M/T	Crustacea	1,000 M/T
Demersal fish	8,000 M/T	Others	20,000 M/T

12) Department of Fisheries

The implementation agency of the project is the Department of Fisheries, the Ministry of Natural Resources and the Environment. The Department of Fisheries consists of 3 divisions, administration, research/ development, and extension, with the manpower of 107 people in 1991/92. The following are the budget, staffing, and organization of the Department of Fisheries.

Table-9 Budget and Staffing

	1990/91		1991/92	
Administration	D 221,840	35	D 170,910	30
Research/Development	D 188,430	17	D 189,220	17
Extension	D 482,840	60	D 457,740	60
Total	D 893,110	112	D 817,770	107

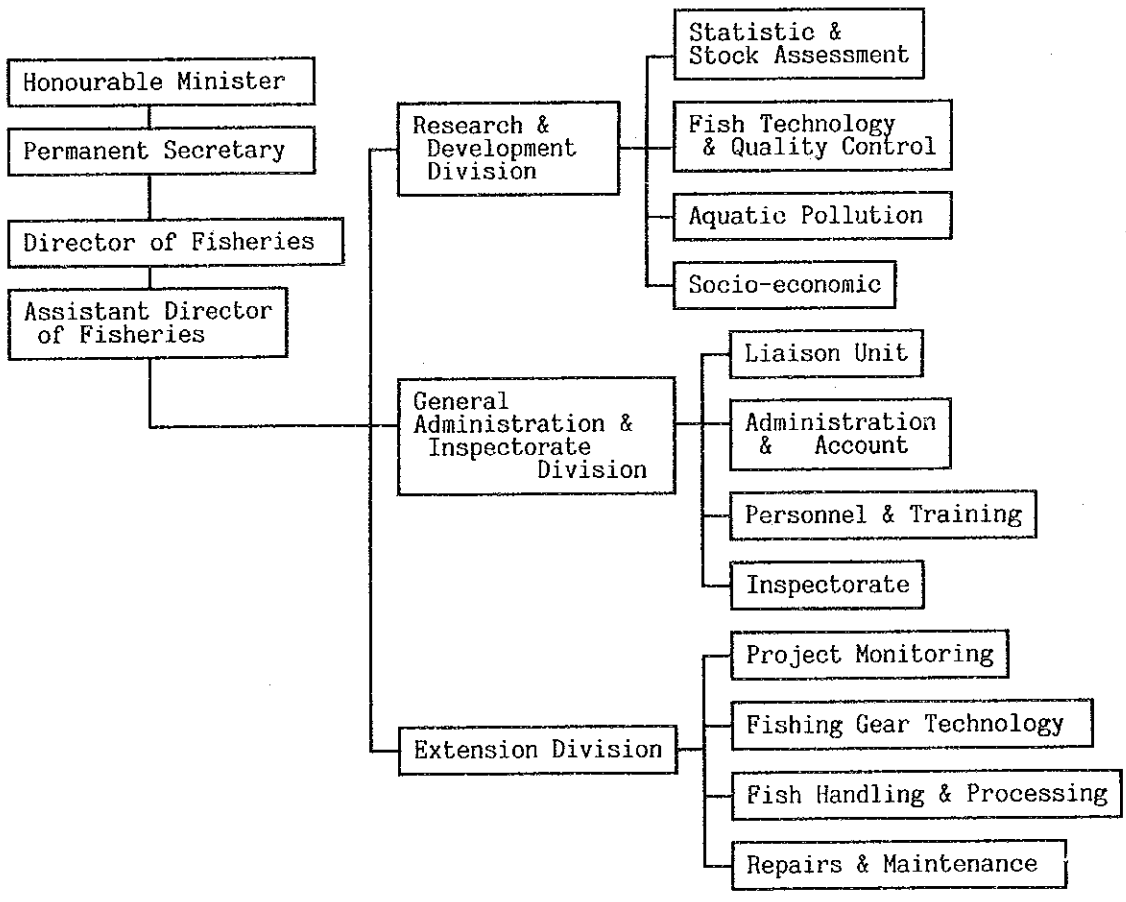

Fig.1 Organization Structure of The Department of Fisheries

(3) Fish Distribution

① Current situation of fish distribution

The 1991 statistics revealed that the population of the Gambia was 854,614, increased by 25% over 1983. It seems that this upward tendency will continue for some time to come. The per capita animal protein intake is 11.5 kg/year, considerably less than the world average of 20 kg/year. But the fact that almost 90% of animal protein intake come from fish products reflects people's preference for fish products, which have a great demand. In the Gambia the fluctuations of animal protein intake of the people are subject to the ones of fish production. It is obvious therefore that an increase of fish production will play an important role in the improvement in nutrition of the population. Table-10 below shows the ice-making facilities important for fish distribution, and two companies but Gamcool are using their ice for only their own fishing boats and processing.

Table-10 Ice-making Facilities

Facility	Capacity/Day	Unit Price/MT	Location
National Partnership Enterprise (N.P.E.)	31 tons	D 600	Banjul
Pelican	7 tons	D 700	Banjul
Gamcool	2.4 tons	D 600	Brikama

The results of the field survey on the fish distribution are as follows.

② Distribution route of fish products

Most of major cities including the Capital Banjul are located at the coastal area within 25 km distance from the project site of Bakau. Fish products supplied to the coastal area are chiefly derived from the marine fishery at Bakau, Tanji, and Gunjur. As a result, an annual per capita consumption of fish in the area is estimated at as high as 50 kg, which area is very important to the project as its range of distribution. In cities in the inland area

such as Farafenni and Bansang marine products are also distributed, but almost of all these products came from Senegal due to the proximity to Senegal, good conditions of roads connecting with Senegal, more developed Senegal fisheries with appropriate cold storage facilities, dominant CFA Franc to Dalasi, and so on. Only domestic smoked bonga being consumed other than imported fish products from Senegal. This features the fish distribution situation of the Gambia.

③ Fish market

The current situation of 8 fish markets (Banjul, Bakau, Sere Kunda, Farafenni, Mansa Konko, Soma, Kemoto, Tankular) in 13 major districts were surveyed. The results are as follows;

- There is no market dealing marine products exclusively. Fish are sold at a general market together with vegetable and meat. Items and quantities are almost similar at each of 8 markets.
- Few markets are provided with lighting system and cold stores. Troubles on quality control of fish therefore frequently take place during the rainy season (June to October), and business hours are limited (from around 7 a.m. to around 7 p.m.)
- Surprisingly enough, there is no street stall of fish products which is common in developing countries.

These situations are restricting fish quality control and the distribution range in the Gambia.

④ Fish price

Fish prices are somewhat controlled, with no negotiated trade between fish retailers and consumers. Bonga, the main target fish of the project, are sold usually at an unit of 3 fishes (1 fish weighs about 250 g on an average), and its price is D1.5 to D2.5. Other major fishes are sold as shown in Table-11. It is usual that the fish price becomes higher in proportion to a distance from a producing center, but in the country there found no difference of price everywhere. However some municipalities set an upper limit of fish price to protect the poor short of cash. This is a factor to be considered at the estimation of management and maintenance costs of the project.

Table-11 Fish Prices (D/kg)

Species	Market price	Wholesale price for hotel	Species	Market price	Wholesale price for hotel
Snapper	15.00	18.00	Horse mackerel	7.00	11.00
Ladyfish	15.00	18.00	Mullet	10.00	15.00
Grouper	10.00	14.00	Lobster	100.00	90.00 - 150.00
Sole fish	13.00	18.00	Shrimp	20.00	15.00 - 45.00
Barracuda	12.00	18.00			

⑤ Distribution system

There is no authorized organizations in both production and distribution sectors in the country. The Ministry of Natural Resources and the Environment is not positive to encourage organization in the fisheries sector because of a bitter experience in the agricultural sector. Several projects implemented by the UN, EC, and Italy had also no intention to organize fishermen. A negotiated trade between fishermen and fish brokers is therefore the most common method, and anyone who has some capital can participate in fish distribution as there is no price control of fish. The movement of fishermen at Bakau and Banjul remains at low level of organization movement, only aiming at a blanket purchase of fishing gear, spare parts, materials, fuel oil, etc. at cheaper price. The actual state of distributors is known. According to hearing investigation, a boat owner sells his catch to a regular broker at a negotiated price, and a fish processor buys raw fish from a regular boat owner and sells his products to a regular broker at negotiated prices in both cases. Hence the distributors have no organization and seem to trade with regular customers at regular spots. The fish prices are established based on a catch, demand and supply, and power relationship including loans between sellers and buyers.

(4) Infrastructure

The distribution of fish, unlike other goods, requires lower and constant temperature to keep its freshness and quality. It is therefore affected

greatly by such infrastructure as road and electricity. From the viewpoint of the domestic diffusion of fish, one of objectives of the project, the current situations and problems of infrastructure are as follows;

① Road network

Two trunk roads are running along the Gambia River in the country; the 438 km South Bank Way from Banjul to Fatato and the 375 km North Bank Way from Barra on the opposite side of Banjul across the Gambia River to Fatato. The two are connected with ferries at several spots, paved throughout, serviceable even during the rainy season.

On the other hand, a road network of 63.5 km extending in the fish production area south of the Capital is almost unpaved, resulting in little usefulness during the rainy season. To develop the road important to the improvement of distribution four projects including a project between Sere Kunda and Madinaba were planned, but even a preparatory survey was not carried out.

② Electricity

Except major cities such as Banjul and Bakau electricity is a future problem to be solved. In addition, even if electricity is available it is far from stabilization because of frequent failures of facilities. As a result, there are only 5 cold storage facilities (Banjul, Brikama, Bintang, Gunjur, Mansa Konko) essential to distribution of fish products throughout the country, and the Italian project did not provide any cold room to even fish production center such as Tanji, Brufut, and Kemoto. At any rate, a shortage of electricity is the most serious impediment of the development of distribution of fish products. The Government is now requesting Japan, Denmark, and other international organizations to help in the improvement of electricity, but it will be not until, or after, the year of 2000 that electricity in the entire country is provided.

③ Other infrastructure

A communications network is very useful to develop a distribution of goods. It makes credit transactions possible by absorbing a distance between areas. In the Gambia the Gambia Telecommunication Corporation (GTC), controlling the communications network of the country, places branches at the major cities and can provide the facsimile service in some areas. But, banking, another important element to a distribution, is not improved, deploying on 13 units in 6 areas.

2-3 Problems in the Fishery Sector

In order to improve self-supply in foodstuffs, the Gambia has to increase production of fish, a major animal protein source, as well as agricultural production. Comparing the 1990 catch of about 23,500 tons with the maximum sustainable yield(MSY) of 75,000 tons estimated by the Department of Fisheries, there are sufficient resources to exploit in the Gambia fisheries.
On the other hand, the catch of fish is little increased for the past 10 years.
The problems to be solved for increasing production are as follows;
(1) Lack of fishery-related infrastructure.
(2) Short of supply of fishing gear and spare parts.
(3) Poor distribution system in inland areas.
In order to solve these problems the government of the Gambia launched the following fisheries development plans.

2-4 Outline of Related Plans

(1) National Development Plans

The Gambia's first national development plan (1975/76 - 1979/80) was launched in 1975, aiming at the achievement of relatively rapid economic growth, the diversification of agriculture and rural development. But the pace of implementation was constrained by external influences and the plan was partly revised and extended to 1980/81. During the period of the plan some improvement was seen in road networks, water supply, education, and medical services, but an increase of production, incomes, and employment was not achieved due to droughts and the depression of groundnut market. In 1982 the second national development plan (1981/82 - 1985/86) was launched. This aimed
① to improve the balance of payments;
② to strengthen the government's financial position and
③ to achieve price stability and maintain a liberal trade system,
and priority was given to agriculture, manufacturing and tourism. Real GDP growth over the plan period was projected at an average annual rate of 5.1%, well above the rate of population growth. However, most of these objectives proved unrealistic when the economy faces crisis caused from severe drought,

huge public sector deficits, failure of diversification of the production base, and the burden of external debt. An average annual real GDP growth over the period between 1975 and 1985 was only 1.8%, while the estimated population growth rate over the same period was 3.5%. In August 1985, the Economic Recovery Programme (ERP) was formulated and several measures were introduced as follows;

① The introduction of a flexible exchange rate system;
② The liberalization of pricing policies;
③ The reduction of the budget deficit and the tight rein over expenditure;
④ The introduction of a more flexible interest rate policy, and
⑤ The improvement of the efficiency of the public sector.

Reviewing the financial year 1990/91 the government announced that almost all the ERP targets had been met by March 1991.

(2) Fisheries Development Plans

1) First Fisheries Development Plan (1975 - 1980)

The objectives of the first plan were

① a 10% annual growth rate in fish production;
② the improvement of nutritional standards;
③ a rational long-term utilization of coastal and inland fisheries resources and
④ increased employment and net foreign earnings.

2) Second Fisheries Development Plan (1981 - 1986)

The objectives of the second plan were basically similar to those of the first plan. A fifth objective, expanding the participation of private Gambian entrepreneurs in the fisheries, was added. To accomplish these objectives the following strategies were adopted.

① To establish a viable national industrial fisheries;
② To protect the Gambian territorial waters to allow full exploitation by Gambian vessels;
③ To provide improved marketing, storage, handling, and processing facilities for the artisanal subsector and to encourage the regular sale of fish in rural areas;

④ To make credit available to both Gambian artisanal fishermen and private entrepreneurs;
⑤ To develop fish farming as a means of increasing production and consumption in provincial areas;
⑥ To undertake further basic research on the fisheries resources and detailed surveys to establish sustainable yields;
⑦ To promote, as far as possible, regional co-operation in fisheries;
⑧ To strengthen the operational capacity of the Fisheries Department in terms of basic infrastructure and manpower development.

(3) Effects and Current Situations of Fisheries Development Plans

In order to assist the fisheries development of the Gambia some donors are providing the following projects.

1) EC project
This project aimed to increase fish production and employment opportunities and improve the fishermen's living standard in six coastal fishing villages of Brufut, Tanji, Bato Kunku, Sanyang, Gunjur and Kartong. Besides the fishery-related infrastructure, including fishermen's lockers, smoking huts, office buildings, stores, fishing net repairing sheds, windmill well pumps and so on, a road network was constructed and water was secured. At Gunjur, the biggest landing spot, the number of fishing boats and yearly fish production increased from 50 units and 3,500 tons in 1984 prior to the project to 80 units and 6,500 tons in 1990 after the completion of the project. No ice-making/cold storage facilities were constructed due to no electricity.

2) Italy-funded project
This project modelled on the EC project is now in progress at eight fishing villages (Barra, Albreda, Jurunku, Salikane, Bintang, Kemoto, Tankular, and Tendaba) along the Gambia River, aiming at increasing fish production and promoting fish distribution in the interior areas with smoking/drying huts, ice boxes, fishermen's lockers and workshops supplying. The project was completed at Tankular, a fishing village on the south bank of the Gambia

River, 203 km away from Bakau, with a population of about 800 people including some 100 fishermen operating 24 fishing boats. The facilities and equipment supplied here include 22 fishermen's lockers, a fish market, a fish processing hut, ice boxes, a store, a office building, a workshop, 2 water tanks, fish drying shelves, a smoking hut, a net repair shop, although ice boxes are not fully utilized due to short supply of ice. Also an unpaved road network makes it difficult for forwarding fish catches.

These projects have an effect in their own ways on the development of artisanal coastal fisheries, but as far as the supply of animal protein concerned, the projects are not sufficient to improve nutrition of the nation. In order to increase fish production promptly, the extension of the fishing fleet of Bakau is essential. At the same time the construction of ice-making/cold storage facilities at Bakau will make it possible to supply increased production to inland areas.

2-5 Background and Contents of the Request

(1) Background of the Request

The reason why the government of the Gambia gave priority to the artisanal coastal fisheries development project at Bakau is that despite of the proximity to the capital region and comparatively improved social infrastructure, Bakau has no fishery-related infrastructure at all.

Among the objectives of the second fisheries development plan launched in 1981 are "an increase of fish production through a rational utilization of coastal and inland fisheries resources," " increased employment and net foreign earnings," "promotion of the regular sale of fish in rural areas through the provision of improved marketing, storage, handling, and processing facilities," but increasing production is short of the goal. On line with the strategy of the plan, the Government of the Gambia requested the Government of Japan to off a grant aid to construct a fishing base including landing facilities at Bakau to achieve the objective.

(2) Contents of the request

The contents of the request by the government of the Gambia aiming at increasing

fish production, improving quality of fish, promoting fish supply to the interior, and thereby improving fishermen's living are as follows.

1) Facilities

① Freezing system

• Ice plant 2.5 t/day	1 unit
• Cold room 10 t (-20℃)	2 units
• Quick freezing system 500 kg	1 unit
• Back up generator 35 KVA/50 KVA	1 unit each

② Processing facilities

• Smoking hut 100㎡	1 unit
• Rack for drying	15 units

③ Landing jetty

• Jetty with 2 pontoons	1 unit
• Mooring buoy for 4 t fishing boat	

④ Ancillary facilities

• Office, Workshop, and Store 150㎡	1 unit
• Fisherman's store	50 units
• Shade for fish treating 100㎡	1 unit
• Water tank 10 t	1 unit
• Fuel tank 10 t	2 units

2) Equipment

① Vessels and Engines

• Purse seiner FRP 4 t	2 units
• FRP boat 13 m long	10 units
• Diesel outboard motors 27 HP	20 units
• Gasoline outboard motors 25 HP	20 units
• Spare parts for above	

② Other equipment

• Refrigerated truck 4.5 t	1 unit
• Tractor 3 t	1 unit
• 4 WD car	1 unit
• Tools for maintenance	

③ Fishing gear

• Purse seine net for 4 tonner	4 sets

• Purse seine net for canoe	4 sets
• Gill netting for bonga	10 sets
• Bottom gill net	20 sets

CHAPTER 3 PROPOSED PROJECT SITE

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3-1 Location and Socioeconomical Conditions of the Site

(1) Location of the Site

The proposed site, a beach facing the Atlantic Ocean behind the market of Bakau, is 11 km away (about 20 minute drive) from the Capital, Banjul, on the Atlantic Road. It extends along the coastline for some 500 m almost east to west, and its width is 40 m at average at high tide. Behind the site is a gentle cliff about 4 m high, and the area 50 to 90 m wide between the site and the Atlantic Road is privately owned. There is a Bakau municipal general market on the opposite side of the proposed site across the Atlantic Road, at which fish landed at the beach are sold.

(2) Socioeconomic Conditions of the Site

Around the project site there are 12 hotels, 2,856 beds in total, receiving some 100,000 tourists a year from chiefly Britain, Spain, and France. There are also a lot of high-grade restaurants for tourists, resulting in a great demand of white meat fish.

Besides tourism, many people are engaging in commerce and traffic service (bus and taxi) at Bakau due to it being involved in a commercial district centering Banjul, the capital. The population estimated in 1991 is about 9,000 at Bakau, about 20,000 at Sere Kunda 6 km away, and about 60,000 at Banjul 11 km away. With such a rather crowded population the demand for fish is great. In Greater Banjul containing Bakau and Sere Kunda a population has sharply increased from less than 80,000 in 1973 to about 150,000 in 1983 and about 250,000 in 1990. Moreover, three banks at Bakau make it possible to do business with inland areas and foreign countries.

3-2 Natural Conditions of the Site

The Republic of the Gambia belongs to the tropical savanna climate. According to the meteorological data at Banjul, the average temperature is constantly 25 - 30℃ throughout the year. Monthly precipitation is as higher as 200 - 400 mm during the rainy season from June to October, while less than 10 mm during the dry season from November to May, some months without rainfall. The strongest wind blowing during a month is less than 45 knots.

The proposed site is situated at the northern end of the Bakau district, consisting of a sea cliff with the relative height of less than 8 m and a sandy beach, 40 m wide and 500 m long, extending under it. The sea cliff is originally composed of the sedimentary rock of the Tertiary, but it has become such the residual soil as silt sand and sandy clay due to long weathering, and forms a slant of a gradient of 40 ° at the maximum by erosion. The silt sand is moderately compacted and the sandy clay is rather solid. The sandy beach is composed of mainly loosely compacted fine sand. Its layer is 1 to 2 m deep, followed by similar sedimentary rock and residual soil. The sandy beach slants at less than 3° , extending for at least 100 m offshore.

The range of the tidal level observed at the site was a little over 2 m at the spring tide. Towards a high tide a east-bound current flows and a reverse current towards a ebb tide, both at 0.6 knots at the maximum. Twice a year a wave 2 m high beats upon the shore.

(1) Climate

The meteorological data observed at Banjul (13° N, 16 ° W) are as below;

Table-12 Meteorological Conditions of Banjul

Items	Rainy season (June-October)	Dry season (November-May)
Precipitation (mm/month)	30 - 500	0 - 20
Highest temperature (℃)	33 - 35	33 - 38
Mean temperature(℃)	27 - 29	23 - 28
Lowest temperature(℃)	20 - 24	16 - 20
Relative humidity (%)	60 - 80	40 - 70
Evaporation (mm)	2 - 4	3 - 7
Maximum wind (knot)	10 - 45	10 - 15
Wind direction	not identified	not identified

(Source: Ministry of Natural Resources and the Environment)

(2) Waves

According to the interview of fishermen of Bakau, high waves of 2 m at the maximum in the height beat upon the shore, and two times a year, in December and January, 3 m high waves pass up north off the site but these waves do not approach the shore.

(3) Tide

The results of measuring with a tide gage at the site are shown as below (see Appendix I - ⑤-1).

Table-13 Tidal Observations

Items	Results
Previous highest tidal level	2.30 m
Mean high level at the spring	2.14 m
Mean high level	1.87 m
Mean high level at the neap	1.61 m
Mean water level	1.15 m
Mean low level at the neap	0.69 m
Mean low level	0.43 m
Mean low level at the spring	0.16 m
Previous lowest tidal level	0 m

(the datum plane = 0)

(4) Current direction

Appendix I - ⑤-2 shows the results of a float tracking test at the site. The maximum current speed observed during the survey is 0.6 knots. Towards a high tide the current flows from east to west and towards and ebb tide it reverses.

(5) Land topography

The land topography of the project site is shown in Appendix I - ⑤-6. The site is located at the northernmost part of the Bakau district, consisting of a residual soil slope facing the Atlantic Ocean and a sand beach sedimented below the slope. A typical section is shown in Appendix I - ⑤-3. The eastern end of the site is a sea cliff of the sedimentary rock consisting of mainly laterite. The gradient of the residual soil slope is 40° at the maximum. The sand beach below the slope slants very gently at an angle of 2° to 3° . The distance between the shore line and the foot of the slope is generally less than 25 m at full tide at the spring, and it widens to 75 m at the maximum at ebb tide at the spring; that is, the shore line moves back 50 m offshore.

(6) Submarine topography

The submarine topography is shown jointly in Appendix I - ⑤-6. Generally the sea bottom is slanting evenly at an angle of less than 2° .

(7) Soil

According to the "Gambia Geological Map" published by the Government of the Gambia, the soil of the project site is estimated to be mainly sedimentary rock consisting of sandstone and pelite formed in the Tertiary period (3 to 10 million years ago). This sedimentary rock has become residual soil because of severe weathering, and forms a slope with an angle of 40 ° at the maximum. There is a sea cliff of sandstone involving comparatively less weathered laterite at the eastern end of the site. Appendix I - ⑤-5 is the results of the boring test and the soil test.

(8) Construction materials

Aggregates observed at construction sites in Banjul were generally crushed laterite, which is too fine and fragile to use as concrete aggregate. The test result of aggregate used by several projects is shown in Appendix I - ⑤-4. Though produced locally wood is in short supply and white wood and red wood are imported from Guinea-Bissau and others.

(9) Earthquake

No earthquake is recorded.

3-3 Social Infrastructure of the Site

Being involved in the capital region, Bakau have comparatively improved infrastructure as follows;

(1) Road network

A paved two-lane road, the Atlantic Road, is running along the project site, which is also connected to Sere Kunda and Banjul with paved road. The South Bank Way, running on the south bank of the Gambia River and connecting Banjul and Fatato, is semi-paved and serviceable even during the rainy season. However the roads running southward from the project site are not paved,

impassable when raining or during the rainy season. The Government planned 4 projects to improve several roads, including a road between Sere Kunda and Mandinaba, but no survey is conducted at all.

(2) Communications

A telephone network is developed in the capital region and public telephones are served at the project site, but fish landing spots south of the site have no communication means at all, and the Fisheries Department has its exclusive wireless telephone.

(3) Electricity

Electricity is supplied to the site but power failures and voltage fluctuations are frequent. Electric apparatuses to be supplied to the project require a countermeasure against a voltage fluctuation. A high-tension line is 11,500 V, 3 phase, 4 wires, 415 V, single phase, 220 V.

Table-14 Electric charges

	Household	Commercial	Hotel, Industry
Leading-in charge	D 60	D 2,000	D 2,000
Minimum charge	D 38.78/KWH	-	-
to 130 KWH	D 1.29/KWH	-	-
130 to 1,000 KWH	D 1.58/KWH	-	-
1,000 KWH over	D 1.84/KWH	D 1.84/KWH	D 2.11/KWH

(4) Water supply

Ground water is supplied from the elevated water tank. Since the pumping hour to supply water to the tank is limited, water supply is sometimes suspended. The examination of water brought back to Japan with the Basic Design Study Team revealed that the water can be used for ice production as it is.

Table-15 Water rates

	Household	Commercial	Hotel, Industry
to 5,000 gal	D 8.72/1,000 gal		
5,000 to 10,000 gal	D13.57/1,000 gal		
10,000 gal over	D18.42/1,000 gal	D13.57/1,000 gal	D26.17/1,000 gal

(5) Gas

There is no public gas service but propane gas is available.

(6) Others

A public hospital and a school stand around the proposed site. It is necessary to exercise care to prevent construction noises, accidents, smell of smoking huts.

3-4 Outline of the Fisheries of the Site

(1) Types of fisheries

The proposed site is, in terms of fisheries, characterized by a rather great demand of fresh fish due to the proximity to the capital. The major fishing activities are bonga purse seining, bottom gillnetting, and hand-lining. The bulk of fishing boats at Bakau are small boats (4 to 5 m long) for hand-lining. Though less than bonga in quantity, white meat fish are considerably landed.

1) Hand-lining

Hand-lining is conducted with a one-man sailing boat or a powered boat. The former, 4 - 6 m long, operated by a fisherman, who lives generally at the streets about twenty minutes walk away from the beach and keeping a mast, sail, paddle, and fishing gear in his own house, leaves the beach for fishing usually 8 or 9 o'clock in the morning. The fisherman usually fishes 2 to 3 miles off the Kotu Point within a restricted range due to the direction of wind. There is no available data, but a catch a day is estimated at about 15 kg at average. When the boat returns to the beach at 4 p.m. to 6 p.m., a specified fish

broker helps the fisherman with landing work and clearance work as well as buys up his whole catch. The fisherman brings back his mast, paddle, sail, and fishing gear.

The latter with a crew of 3 to 7 fishes along the shoal offshore between Barra and Brufut, and makes a 2 to 3 day trip when carrying ice. The consumption of gasoline of the 25 HP outboard motor is about 30 ℓ a day. It brings 420 kg of fish, mainly large croaker, on an average a one-day trip.

2) Bottom gillnetting

Target fish are shark, croaker, cat fish, etc., and the area 2 miles offshore Bakau and the area around No. 2 beacon (13° 32'N, 17° 49'W) are the main fishing grounds.

The net is previously set at a fishing ground. Bottom gillnetting fishermen leave the beach in the morning for hauling up it to take in fish caught with the net. If any large damage is found on the net, its broken part is brought back to the shore for mending. Living at the streets about 20 minutes on foot from the beach, the fishermen can leave the beach in the afternoon when the fishing ground is near.

The fishing boat is usually 8 to 10 m in the length, manned by 4 to 5 fishermen, equipped with a 15 to 25 HP outboard motor. Since no scouting activity is performed, fuel consumption is less than that of the bonga boat, usually some 25 ℓ a trip.

The length of the net is usually 600 to 1000 m, but they use two types of netting, one is 210 D/12, 100 mm mesh, 3 m deep, and the other is 210 D/27, 120 mm mesh, 3.3 m deep.

When the boat returns to the beach between 4 p.m. and 6 p.m., a specified broker helps land a catch of fish and buy up it. The catch is about 40 kg per boat on an average, varying depending on the length of a net.

The fishing can be conducted throughout the year, and any 4 months among 7 months from February to August see a catch including a lot of croaker and cat fish. October and November are a season of cassava fish with a rather good catch.

3) Purse seining

The major fishing ground this fishery is an area between No. 2 beacon and No. 3

beacon (13° 35'N, 17° 44'W), 7 to 8 m deep, 5 to 6 miles offshore. This area is a common fishing ground of fishermen from Brufut, Barra, and Banjul, including Bakau. The fishermen start from the beach at about 7 p.m. to 9 p.m., with a outboard motor, fuel oil, drinking water, fishing gear and so on loading in their boat, and return at 4 p.m. to 6 p.m. A purse seiner with a crew of 7 - 10, 12 to 15 m long, seines a school of bonga found on the sea surface. Usually the bonga boat makes one-day fishing trip with seining performed twice a day. Sometimes it has no catch because of finding no school. In order to find schools the boat must move around on a fairly wide area to search schools, so it is motorized with 15 to 40 HP outboard motors. Each boat consumes about 40 ℓ of gasoline a fishing trip, together with about 20 ℓ of fresh water and field ration (biscuits, tea, sugar, etc). Nylon multifilament net, 210 D/9, 90 mm mesh, 200 m long, 5 m deep, recommended by the Fisheries Department is most widely used. A daily catch is about 980 kg on an average.

When the boat returns, waiting brokers carry the day's catch from the boat to the beach and buy up it at auction. After that the boat is beached by the fishermen with the help of village women, sometimes children joining, who can get some bongas as reward.

Fishing is conducted throughout the year. There is some fluctuation of catch, but no distinct fishing season is found. Every fish landing spot on the Atlantic coast has a similar fishing conditions due to a rather short coastline of 57 km and similar submarine topography.

(2) Labor conditions of fishermen

Fishermen are usually blood relatives of each boat owner. Wages payable to fishermen are settled every trip with a catch incentive system which is usually as follows;

- The amount deducted the expenses of gasoline and food from the total sales is divided among fishermen, a boat, a fishing net, and an outboard motor at one share each, or
- A 20-30% of the total sales minus gasoline and food is offered to the boat owner and the rest is divided among fishermen.

In either case, the master fisherman receives a bonus depending on a catch from the owner.

(3) Marketing

A negotiated transaction, like other areas, is performed between a boat's owner or fishing master and a broker. In case of a bonga boats the transaction is often negotiated with two or more brokers because the catches are rather large. A hand-lining boat sell usually its catch to a specified broker. Bottom gillnetters also contract with each specified broker. The fish price is settled by the boat's owner and the broker through negotiation. Fish not distributed at fresh state such as ray, shark, catfish, etc. are bought by processors (mainly women). In the field survey the producer price of bonga was D0.70/kg, catfish D1.00/kg, and white meat fish D7.00/kg on the average.

CHAPTER 4 OUTLINE OF THE PROJECT

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4-1 Objectives of the Project

The Government of the Gambia put an emphasis on an increase of fish production through the optimum exploitation of fisheries resources, the promotion of fish distribution in the inland areas, the improvement of the people's nutrition, and an increase of employment opportunities in its fisheries development plan.

4-2 Study and Examination of the Request

(1) Appropriateness and necessity of the project

In order to achieve the objectives above, the project aims at providing facilities capabling of increasing fish production at Bakau less developed in terms of fishery-related infrastructure and then promoting distribution of white meat fish with higher value added. The project site also has an advantage over others in that it is directly connected with a big consuming region consisting of Bakau, Sere Kunda, and Banjul. In addition, a regular supply of quality fish to inland areas can be expected. It is judged therefore that the project has a full necessity and an appropriateness as grant aid project of Japan.

(2) Similar projects and the relationship with other project funded by foreign donors

As part of the fisheries development program, the Government of the Gambia is executing a few projects similar to the project, that is, the EC project at the fish landing spots on the Atlantic Ocean and the Italy-funded project at the fishing villages on the Gambia River. Both projects aim at an increase of fish production at the coastal areas and an improvement of processing facilities, and hence, have some similarities but no duplication compared with the Bakau project.

(3) Components of the project

1) Function of each component

The project, aiming to increase fish production and improve fish distribution,

has to have such functions as production, preparation for fishing, landing, storing, and distribution.

The equipment and materials to fulfill the production function are fishing boats and fishing gear, and a repair shop and a store are needed to support fishing activities. For the preparation for fishing the facilities to supply fishing boats with fuel, ice, water, etc, that is an ice-plant, fuel/water tanks, etc., are required. As for fish landing, a shade for fish treating, a cold room and so on are needed to unload, sort, wash, and store fish. For fish distribution a cold store, an ice plant, insulated vans, fish boxes and so on are required to accomplish successful distribution.

These functions are collectively depicted as the figure on the following page.

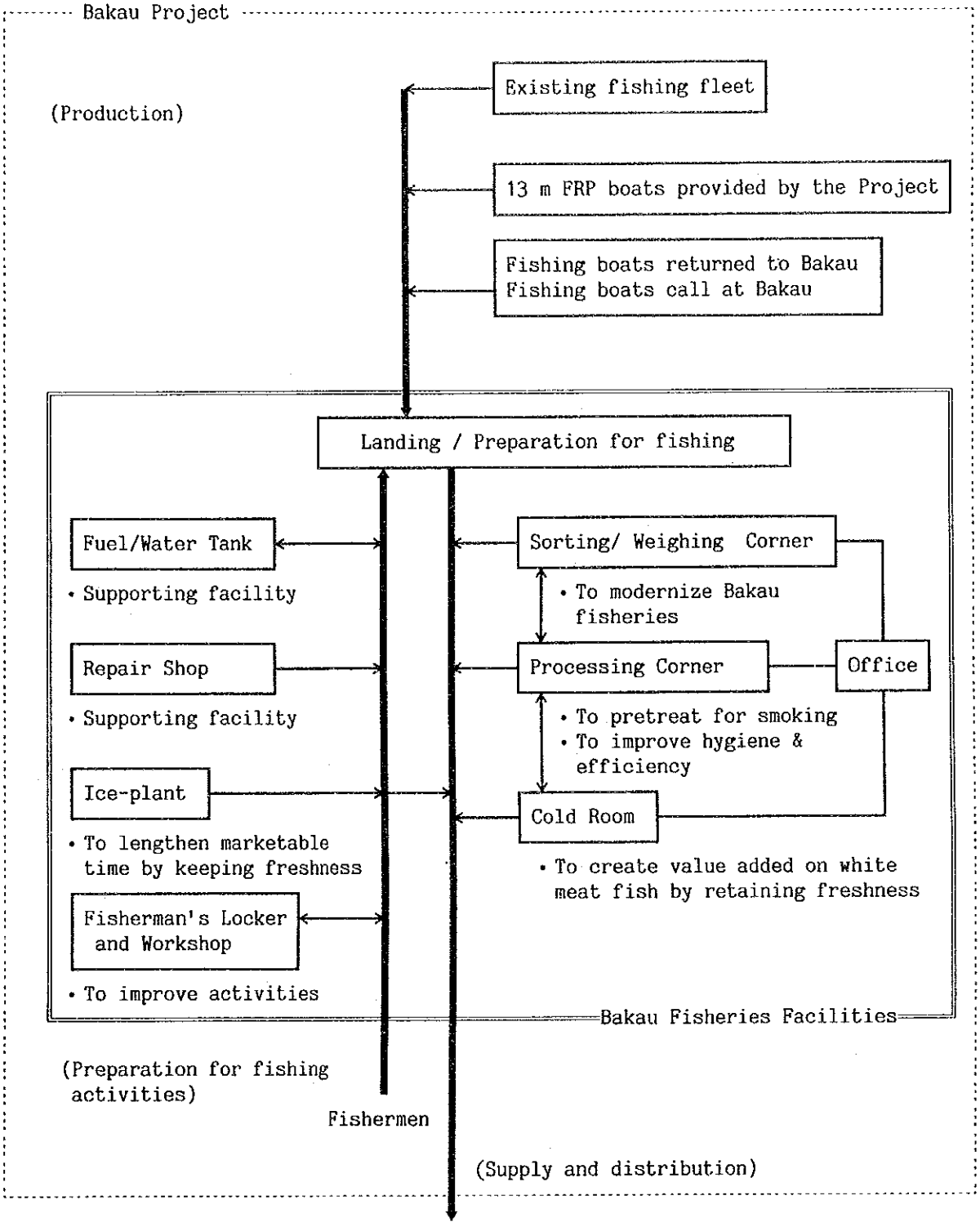


Fig. 2 Components of the Project

Effects of the Project

- An increase of fish supply to Greater Banjul region
- Creating value added on white meat fish
- An increase of white meat fish supply to hotels and restaurants at Bakau
- A stable distribution of fish in the inland areas

2) Modification of the request and its reason

① Items eliminated from the request

• Landing jetty

The original plan included a private land western part of the proposed site as access to the site, but the expropriation of this land became difficult and the plan thereby was changed to have an access on the eastern land available.

Although a landing jetty will be useful for time saving on fishing activities, improving safety of work, and a consequent increase of fish production, it was judged that the size and structure of a landing jetty should be examined on the result of the plan changed its content including some materials and equipment.

• Quick freezing system

One of the objectives of the Bakau project is an improvement in domestic distribution, and there is no necessity for freezing coastal fisheries products which are not exported.

• Refrigerated truck

Since the quick freezing system was eliminated, the refrigerated truck was cancelled.

• FRP 4 ton purse seiner and its mooring buoy

The item was requested for extension service, but, the facilities of Tanji and Gunjur can cover it for the time being. This matter should be discussed in the future.

• 4 WD car

The insulated van truck to be provided can serve for a 4 WD car.

• Tractor

This was requested to use as power to haul Bakau fishing boats up on the beach and to carry goods within the premises. However, the fishing boats have no strength endurable for beaching using mechanical power, and also there is no urgent necessity to change the current human power method. In substitution for the tractor wheelbarrows are to be supplied.

② Items added to the request

• Insulated van

Instead of the refrigerated truck and insulated van is to be used for transport to other markets.

• Fish box

Some Fish boxes are to be provided for storing and transporting fish

- Weighing machine

  This is necessary to control fish landed at the Bakau base.

(4) Study and examination on requested facilities and equipment

1) Cold room

In order to store and reserve fish landed at Bakau a cold room is necessary for the project. Fish left over at the day's marketing are now used for smoking or drying, but when a cold room is constructed white meat fish, bait for hand-lining, and bonga can be sold at fresh state the following day by storing them in a cold room.

2) Ice plant/ice bin

In order to improve in fish distribution, ice is essential. At the present there is no ice-making facility at fishing bases, including Bakau, on the Atlantic coast at all, and ice is in short supply desperately in the whole country. The processing companies at Banjul, N.P.E. and Pelican, are producing 30 tons and 8 tons of ice a day respectively, but all the products are for their own fishing boats and processing exclusively. Supply to coastal artisanal fisheries is made only when a surplus is produced. Only large hand-line fishing boats are now utilizing ice due to their 3 day fishing trip, and with the production of ice it can be expected that other fishermen will use ice due to higher prices of iced fish. Also the supply of ice to Tanji and Gunjur will become possible.

3) Back up generator

Electricity is supplied at BaKau, but recently power failures and voltage fluctuations is occurring frequently. Considering the importance of stable supply of electricity for the project, a generator facility with necessary apparatuses attached must be supplied.

4) Smoking hut

It is not always necessary to increase the quantity of smoked fish (mainly catfish), but an improvement in quality must be considered.

5) Rack for drying

This is necessary to process shark and ray and its suitable scale is to be established based on the catch at Bakau.

6) Office, store and workshop

The project necessitates these facilities to fulfil its function well. The facilities is to be established based on necessary function, personnel and equipment.

7) Fishermen's lockers

The Fishermen of Bakau have no own store on the beach, and so they must keep their outboard motors, fishing gear and so on at their home 1 to 3 km far away from the beach. The fishermen's locker can afford convenience greatly to them.

8) Shade for fish treating

In front of the ice-making/cold storage facility a space for treating bonga, white meat fish, fish for drying, etc. is to be provided. Treatment of foul water after washing is to be considered.

9) Water tank

Fresh water is chiefly used as raw water of ice and people's refreshment. The scale of tank will be established based on the production of ice and the number of users of the facilities.

10) Fuel tank

Fuel is essential to the project. The capacity of a fuel tank and gasoline tank will be determined based on necessary elements.

11) FRP 13 m type fishing boat

In order to increase fish production fishing boats of this type are to be introduced. The number of boats is to be decided on the fishing situation, including of the number of fishermen of Bakau.

12) Diesel outboard motor

The Department of Fisheries has several mechanics capabling of repairing this type of motor. It is for the fishing boat of item 11.

13) Gasoline outboard motor

These are replacements of the standing outboard motors of the Bakau fishermen.

14) Insulated van

Instead of the requested refrigerated truck, the insulated van is to be supplied for transport of fresh fish as far as more than 200 km in the inland areas.

15) Fishing net

At Bakau undersupply of fishing net always exists. A good supply of fishing net suitable for fishing off Bakau is essential for an increase in fish production.

The project expects that the Bakau fishermen are trained by experts of the Fisheries Department at the training center at Banjul to a level that they can assemble their net for themselves.

16) Fish box

Fish boxes are essential for handling, storing, and transporting fish.

(5) Technical assistance

At the present one Japanese expert in the fishing gear/fishing method sector is training successfully the Gambia fishermen with cooperation of the Fisheries Department.

In connection with the Bakau project, the Government of the Gambia requested one expert in refrigeration technology in a long-term basis. The machinery for the ice plant and cold room of the Bakau project is to be operated and maintained by a mechanic from the Fisheries Department, he is now in charge of the Brikama ice plant, and after his assignment to the Bakau facility he may be sent frequently to Brikama. In order to reap the fruits of the Bakau project, therefore, it is necessary to send one Japanese expert for half a year or a full year for training, technical transfer, and advice on the management.

4-3 Outline of the Project

(1) Executing agency and operational structure

The executing agency of the project is the Fisheries Department of the Ministry of Natural and the Environment. The Fisheries Department plans to organize the Center Management Committee to control and operate the facilities as follows (see Table 14).

Table-16 Center Management Committee

Senior Fisheries Officer	Representative from Village
Fish Processing Specialist	Representative from Fishermen
Fishing Gear Technologist	Representative from Fish-buyer
Outboard Engine Mechanic	Representative from Processor
Refrigeration Technician	
Female Extension Agent	
Male Extension Agent	

Besides the Committee, a sub-committee in charge of the ice-making/cold storage facilities, consisting of staffs of the Department of Fisheries, a refrigerating engineer, and the representatives of the Center Management Committee, is to be established. The sub-committee requires the following staff to operate the facilities daily.

Manager	1
General affairs and accounting	1
Store keeper	2
Worker (ice and shipment)	2
Driver-cum-worker (fuel oil)	2
Guardsman	2
Total	10 persons

An experienced person in the management of an ice-making plant and cold storage facility is to be appointed to an office of manager, and the Government is to appropriate funds for running the project facilities for first 3 months at least.

The Department of Fisheries is to supply the project's fishing gear and materials to the coastal fishermen finished its 6 month training course on preferential basis, placing them under an obligation to use ice and the cold room of the project for preserving fish freshness to maintain the price and preventing fish spoilage. Also the Department is to popularize the idea of the possibility of higher price by adding value through utilization of the project facilities.
These are the ways to put the Bakau facilities on stream economically and financially.

(2) Plan of activity
According to the plan of activity, the basic elements of the Bakau project are as follows.
1) Number of fishing boats
According to the hearing survey at Bakau, 31 fishing boats are based of Bakau as of December 1991. Besides, more than 10 boats are operating at Barra, Banjul, and Old Jeshwang due to no landing facilities at Bakau. Moreover some boats are fishing off Senegal far away. On the other hand ice is always in short supply at Bakau because it has to be carried from Banjul. When the project is completed the fishing fleet of Bakau will be as shown below (Table 17) together with the boats returned from Barra, Banjul, and Old Jeshwang. Moreover fishing boats of Brufut, Tanji, Gunjur, and others will call at Bakau for fuel oil and ice.

Table-17 Number of Fishing Boats after the Project

Type of boat	Present	Comeback	Calling	Provision
Bonga boat (8 ～12m)	1	1	9	2
Bottom gillnetter (8 ～10m)	2	1	5	2
Hand-liner (4 ～ 5m)	28	-	-	-
Large hand-liner (7 ～12m)	-	1	-	-

2) Estimation of catch

① Days at fishing

The fishermen of Bakau are all full-time fishermen, and they fish throughout the year, excepting days below.

Rough seas		20 days/year
Repair and maintenance of net	3 days/month,	36 days/year
Repair and maintenance of boat		21 days/year
Total		77 days/year

Arithmetically the total days at fishing are 365 - 77 =288 days/year, but in consideration of atmospheric phenomena, the number of adopted days is 275.

② Catch of bottom gillnetters

Since no data of Bakau is available, the data of experimental operations performed by the Fisheries Department off Tanji about 20 km away from Bakau was examined.

Table-18 Catch per Day per Bottom Gillnet 1,000 m long off Tanji (kg)

	1988	1989	1990
Month			
1	37	30	29
2	41	46	33
3	68	93	30
4	119	110	26
5	77	120	73
6	85	91	72
7	85	39	60
8	55	40	65
9	50	39	33
10	70	34	40
11	50	20	30
12	30	15	22
Total	767	677	513
Average	64.0/day	56.4/day	42.8/day

At the present the Bakau fishermen are using a net 600 m to 1,000 m long, and the project plans to supply fishing gear to fishermen at a reasonable price and thereby to make it longer up to 1,500 m. Based on the figure above, assuming that the average catch is 43 kg/day and the length of net is 1,500 m,
43 kg $\times$1500/1000 =64.5 $\fallingdotseq$ 64 kg/day can be expected.

③ Catch of hand-liners

No data is available and a catch per day was estimated at about 15 kg through the field survey.

A catch of a large hand-liner making a 3 day trip is a full load of 420 kg.

④ Catch of purse seiners

The current landing at Bakau includes the landing of bonga boats from other areas, and so its figure cannot be applied as the landing of Bakau bonga boats. On the estimation of the catch of Bakau boats therefore the following data of Bakau bonga boats for the period between January and April 1990, collected by the Fisheries Department are to be used.

Table-19 Bonga Catch by Bakau Fishing Boats

(January to April 1990)

(kg)

Month / Date	January	February	March	April
1		1875	1575	1775
2		950	1200	1750
3		1175	980	650
4		1458	1500	2000
5		1200	875	1050
6		800	1200	775
7		25	700	1650
8		1025	1700	175
9		50	—	1200
10		150	1100	1775
11		—	1050	
12		1550	1000	
13		625	175	
14		—	700	
15		1200	1180	Fishing days
16		1275	1500	70 days
17		500	—	
18		810	900	Lowest catch
19		700	450	: 25kg
20		500	980	
21		1900	825	Highest catch
22		500	1500	
23		700	1550	: 2000kg
24		2000	950	
25		25	225	
26	258	1100	1075	
27	208	475	1275	
28	700	775	1500	
29	500		1850	Source :
30	125		300	Fisheries
31	650		—	Department

In order to determine of the tendency of the catch a trip, the frequency distribution of the catch per fishing date is found as shown on the following page based on the data of the table above.

Frq.	Frequency distribution table					
21						
20						
19						
18			800			
17			810			
16		450	825			
15		475	875	1550		
14		500	900	1575		
13		500	950	1500		
12		500	950	1500		
11	25	500	980	1500		
10	25	625	980	1200	2000	
9	50	650	1000	1200	2000	
8	125	650	1025	1550	1900	
7	150	700	1050	1500	1875	
6	175	700	1050	1458	1850	
5	175	700	1075	1275	1775	
4	208	700	1100	1275	1775	
3	225	700	1100	1200	1750	
2	258	775	1175	1200	1700	
1	300	775	1180	1200	1650	
Sect	0-400	400-800	800-1200	1200-1600	1600-以上	Median
Frq.	11	16	18	15	10	980.00

(Source :Fisheries Department)

Fig. 3 Daily Catch by Bakau Bonga Boat (unit: kg)

As shown in the table the maximum catch per day is 2,000 kg, and this figure is the maximum capacity of the boat, and so the boat may return home due to no capacity to fish. The lowest of 25 kg seems to have few chances to fish due to no big school observed until the fuel is consumed. The peak of frequency of the catch is between 800 kg and 1,200 kg, and the median of 980 kg is also in this column. Hence, it will not greatly err to adopt the median of around 980 kg of catch per trip. On the other hand, according to a hearing survey at Bakau, the bonga fishing, without a distinct season, is affected only by a change of a current, and the landing between January and April 1990 is usual throughout the year.

3) Number of boats using the facilities and landing

Assuming that the business days of the facilities are 315 days/year, the number of boats using the facilities are as follows;

Purse seiners

One boat is now fishing, another one is expected to come back, and more 2 boats are to be supplied under the project. Assuming that 30% of 9 boats which are expected to call at Bakau call at actually,

7 boats × 275 days/315 days = 6 boats

Bottom gillnetters

Two boats are now fishing, another one is expected to come back, and more 2 boats are to be supplied under the project. Assuming that 30% of 5 boats which are expected to call at Bakau call at actually,

6 boats × 275 days/315 days = 5 boats

Hand-liners

28 baots× 275 days/315 days =24 boats

Large hand-liner

One boat making 91 trips a year will use the facilities every forth day, and then the number per day is 0.25.

Based on the number of boats as calculated above, the quantity of fish landed per day is as follows;

Purse seiners	980 kg × 6 boats	=	5,880 kg
Bottom gillnetters	64 kg × 5 boats	=	320 kg
Hand-liners	15 kg ×24 boats	=	360 kg
Large hand-liner	420 kg ×0.25	=	105 kg

Total 6,665 kg (of which 785 kg are bottom fishes)

According to 1990 data, the species composition of 785 kg of bottom fishes is as follows (see Appendix 6).

Shark and ray 785 kg× 25.10% ≒ 200 kg

Catfish 785 kg× 12.75% ≒ 100 kg

White meat fish 785 kg× 62.15% ≒ 490 kg

Shark and ray are dried, while catfish smoked. White meat fish are sold at fresh state.

4) Distribution range covered by the project

The distribution range covered by the Bakau project with the facilities running efficiently was determined based on the following factors;

- An area that the Fisheries Department can control.
- An area that has a cold storage facility.
- An area at which people have purchasing power of fresh fish higher in price due to transport expenses added.
- An area at which roads serviceable regardless of rain are running.
- An area that has a proper communications system.
- An area that has a proper credit system.

Hence, the distribution range covered by the project is an area that includes the following 6 districts which have such infrastructure as below.

Table-20 Infrastructure of 6 Districts

	Population	Distance	Road	FB	FM	CS	BY	GT	BK
Banjul	59,653	11.0	paved	exist	exist	exist	77	exist	5
Bakau	9,382	-	paved	nil	exist	nil	28	exist	3
Sere Kunda	20,633	6.0	paved	nil	exist	nil	unknown	exist	2
Brikama	24,333	44.0	paved	exist	exist	exist	unknown	exist	2
Soma	5,940	218.0	paved	exist	exist	nil	unknown	exist	nil
Mansa Konko	6,769	224.0	paved	nil	exist	exist	unknown	exist	nil
Total	26,710								

Note: The population was derived from the statistics of 1990. The distance

shows the one from Bakau.

FB: Branch office of the Fisheries Department

FM: Fish market CS: Cold store BY: Fish broker

GT: Telephone office BK: Bank

(3) Location of situation of the project site

The proposed site is situated on the beach north of Bakau, and the area 50 to 90 m wide between the site and the Atlantic Road is privately owned. The difference of altitude of the proposed construction site is about 5 m, and when high seas occur at the flood tide the sea approaches 3.5 m contour line of the site, when the distance between the edge of the water and the foot of the cliff is about 25 m.

The sea is shallow for some distance from the shore, particularly at one third west of the site, and the surf zone accordingly is fairly wide.

(4) Outline of facilities and equipment

1) Outline of facilities

(A) Shore facilities

- Main building 1 lot
  RC built one story, partly 2-storied (315 ㎡ in total), housing a cold room, ice plan, ice bin, store, generator room, etc.
- Office/repair shop 1 lot
  The building for management of facilities, extension for fishermen, storing fishing materials, and repairing equipment.
  RC built one story (108 ㎡)
- Fishermen's locker and workshop 2 lots
  The building for storing and repairing fishing gear and fishing net.
  Block built one story (108 ㎡ and 190 ㎡)
- Smoking hut 1 lot
  The facility for smoking fish
  RC built one story (74.25 ㎡)
- Toilet 1 lot
  Block built one story (40 ㎡)
- Rack for drying 10 units

(B) Exterior work

- Premises road 1 lot
  Between the Atlantic Road and the main building, berthing and pavement about 105 m
- Main building mound 1 lot
  Berthing work in front of the main building

2) Outline of equipment

- Ice-making machine 1.5 tons/day 2 units
  Crushed ice is used at the facilities.
- Cold room 36 ㎡ 1 lot
- Ice bin 6 ton 1 lot
- Back up generator 70 KVA 2 units
- Water tank 10 ton 1 lot
- Diesel oil tank 10 ton 1 lot
- Gasoline tank 10 ton 1 lot
- Tools for repair shop 1 lot
- Insulated van 3 ton 2 units

3) Outline of materials

Fishing materials are supplied to fishermen of Bakau, Banjul, and Barra who utilize the facilities. On determination of the specifications the following factors are considered.

① Fishing materials are, wherever practicable, to be similar to those in a training course of the Fisheries Department.

② Mending materials are to be available locally.

③ All the materials are to be conformed to Gambia regulations.

The Department of Fisheries is now training coastal fishermen at a 6 month course in bonga purse seine fishing and bottom gillnet fishing, including assembling and mending fishing nets. The equipment and materials supplied under Japan's 1990 aid were given to those finished this training course preferentially under a special credit scheme free of interest, and the specifications recommended by the Department are most suitable for the local conditions.

- FRP 13 m type fishing boat, with 27 HP diesel outboard motor 4 units
- Gasoline outboard motor, 25 HP 10 units
- Spare parts of outboard motor 2 year supply
- Purse seine, complete 2 sets
- Purse seine, mending materials 10 sets
- Bottom gillnet, complete 20 sets
- Materials for cold room 1 lot

  Fish boxes, wheelbarrows, scoops, etc.

(5) Operation and maintenance plan

The operation and maintenance will be conducted by the Centre Management Committee, Which will have a meeting every month and decide the policy to operate and manage the facilities. As occasion demands an ad hoc committee will be held to settle matters. The Committee has to report the activities and financial situation of the facilities to the Fisheries Department once a month. Daily works will be conducted by the technicians, mechanics, and extention agents from the Fisheries Department.

4-4 Technical Cooperation

In connection with the Bakau project, one expert in refrigeration technology was requested by the Government of the Gambia. The machinery for the ice plant and cold room of the project is to be operated and maintained by a mechanic from the Fisheries Department, and, in addition to him, that one Japanese expert is sent for half a year or a full year after the commencement of the operation of the facilities for training and technical transfer will be greatly effective. Having no experience in the ice-making/cold storage facilities, the Department of Fisheries is desirous that the said Japanese expert should have knowledge of the management of such type of facility.

CHAPTER 5 BASIC DESIGN

CHAPTER 5 BASIC DESIGN

5-1 Design Policy

The focus of the basic design of the project was placed on a decrease of costs of all sectors from production to distribution. The facilities are to be not only useful to fishermen of Bakau but also economical, which policy is of importance for the Bakau project.

The reason why decreasing cost is important is, unlike the preceeding fisheries development project implemented at fishing villages on the Atlantic coast, because the Bakau project involves a cold storage facility and ice-making plan to improve quality control of fish. The Government of the Gambia had an eager desire to provide these facilities, and the Basic Design Study Team concluded them to be essential to promote distribution of fish at inlands areas.

To be concrete, the following steps are to be taken to save the costs.

① to decrease the running cost of the equipment;

② to decrease the management and maintenance costs of the facilities;

③ to conduct efficient fishing activities.

The following are the design policy of each facility

5-1-1 Shore Facilities

(1) Buildings

The designed buildings are a main building, an office/repair shop/store, a fishermen's locker/workshop, a smoking hut, and a toilet. With these buildings the Bakau fishing base will function fully as a fishing base from production to distribution. The layout of the buildings is to be functional and to have a good connection each other on the basis of the local custom of the fishing community.

The structure will be a reinforced concrete rigid frame structure with concrete block wall as seen widely in the country. Referring to the local building style, Ventilation as well as solidity will be considered.

(2) Facilities and Equipment

An ice plant/ice bin, a cold room, a back up generator, two fuel tanks, and a

water tank are the facilities and equipment of the project. These are essential to the fishing base, and each one plays an important role. The design policy is as follows;

1) Operation and Maintenance

① Operation and maintenance are to be easy at the local technical level.

② Routine maintenance cost is to be comparatively cheap and spare parts are to be available locally.

③ The layout is to be rational so that each component can fulfill completely its function and daily operation can be conducted easily.

④ Sufficient durability is to be given due to such a local condition as the proximity to sea, much rainfall, hot, and humid.

⑤ The measures against power failure and suspension of water supply, both frequently at the site, are to be made in order not to disturb the operation and maintenance.

⑥ Accidents and disasters are to be prevented in accordance with the regulations of Japan if no regulation in the country.

2) Execution Works

① Taking easiness of maintenance into consideration, locally available materials are used when they meet the qualitative and quantitative requirements of the specifications.

② Not sophisticated construction method is applied so that local technical experts can be employed.

③ Execution works are done in accordance with the national related-regulations and customs.

(3) Exterior Work

1) Premises Road

The difference of elevation between the site and the Atlantic Road is about 9.5 m, and a premises road including a temporary road is essential to access to the site from the outside.

Since almost all parts of the roadbed will be banking, the road is to be maintained carefully as a temporary road until the top becomes stable. Pavement will be done lastly. Drainage and protection of normal sides are to be executed completely to construct a permanent road.

2) Main Building Mound

The mean high water level is 1.87 m at Bakau, and the highest tide level is 2.30 m, when the surf line is at 3 m line (about twice a year). In order to make the activities in the site safe the ground level around the main building is to be raised to 4 m. Earth, therefore, will be laid on the ground seaward and cut off from the ground landward.

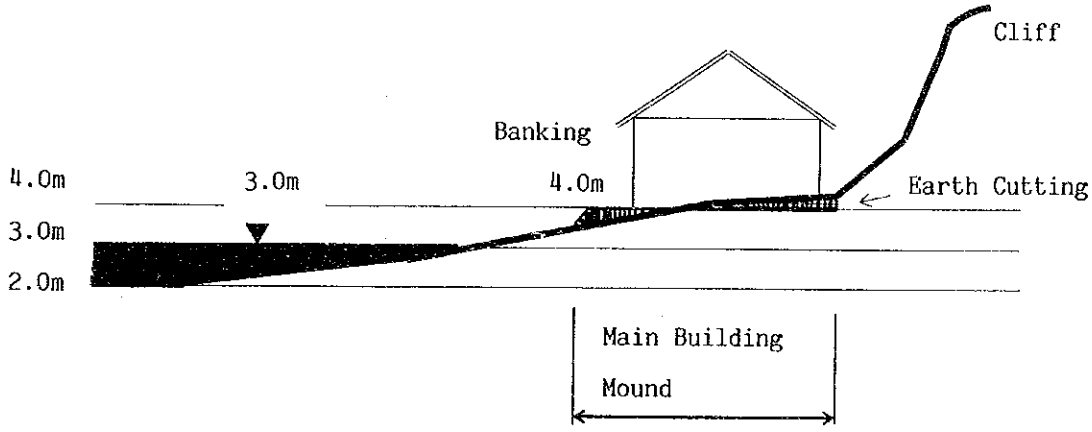


Fig. 4 Main Building Mound

5-1-2 Other Equipment and Materials

Other equipment and materials are divided broadly into 3 categories;① those for production such as fishing boats, fishing net, and outboard motors, ② those for distribution such as insulated vans, fish boxes, and wheelbarrows, and ③ those to help the facilities to fulfill their function, such as tools for maintenance and weighing machines. The following are the main policies to be taken to design the equipment and materials.

- Selection of the equipment and materials familiar to the Gambia fishermen;
- Easy maintenance and local availability;
- Contribution to increasing production;
- Low operation and maintenance costs;
- Safety and efficiency;
- Useful to maintain freshness of fish;
- Essential to operate the facilities.

5-2 Basic Design

5-2-1 Site and Layout Plan

On the center of the beltlike site on the beach the main building is to be constructed, because the fishing boats after landing every day are beached on the entire sand beach at Bakau, so the most suitable location of the main building to fulfil the most important function is the center of the beach.
Placing the main building on the center, on the west side is the office/repair shop/store building and on the east side one water tank and two fuel tanks.
The smoking hut is to be constructed at the higher western part of the site to minimize public nuisance caused by smoke and malodor.
Fishermen's lockers/workshop buildings are to be placed separately on the both sides of the main building. Because the fishing boats are beached on almost entire sand beach of the site.
The premises road connecting with the Atlantic Road is to be extended to the east of main building.
The toilet building is to be placed near the public sewerage so that people can gain easy access on foot.

5-2-2 Shore Facilities

(1) Design elements

A. Main building (ice plant/ice bin, cold room, generator room, etc.)

1) Ice Plant/Ice Bin

Ice produced at the Bakau project is sold for keeping freshness of fish to the fishermen and distributors (fish retailers and fish brokers) of Bakau and fish brokers of other fishing bases such as Gunjur which have a great demand for ice. Usually three types of ice, block ice, plate ice, and flake ice, are distributed, but, from the viewpoint of the quality control purpose of ice, easiness of operation and maintenance of ice-making plant, and easy handling of ice, it was judged that plate ice is the most suitable to the project.

Furthermore, taking easiness of maintenance, economical aspect, and decreasing demand during the season off into consideration, the capacity of ice-making machine is to be divided into two.

① Required quantities of ice

• for fishing boats

The fishing boats required ice are large hand-lining boats harvesting white meat fish for export or hotel and bottom gillnetter. Small hand-liners need not ice because they are too small to carry ice and their fishing hours are short.

The fishing boats required ice are as follows;

Table-21 Ice-carrying Fishing Boats and Their Catch

Type	Number	Fishing days	Catch
Bottom gillnetter	5	1 day/trip	64 kg/trip
Large hand-liner	1	3 days/trip	420 kg/trip

Considering rather big size of fish and rather fast melting rate of ice due to a wooden ice box without heat insulation, an ice/fish ratio was established at 1:

1. Hence the required quantities of ice for fishing boats are
(64 kg/trip ×5 boats ÷1 day/trip) +(420 kg/trip ×1 boat÷3 days/trip)
= 460 kg/day

• for distribution

The quantities of bonga caught and landed in largest quantities are about 5,880 kg a day, of which about 500 kg are sold directly during the day and some are dumped due to deterioration, and thus the quantities of bonga to be stored in the cold room is about 5,200 kg. If such a great deal of fish is stored directly in a cold room, a larger cooling unit and thus a larger generator unit will be needed due to its larger thermal load, resulting in an increase of operation and maintenance costs. In addition, almost of the fish are put out the cold room the following day for marketing. Bonga landed therefore are to be covered with ice after washing and packing in fish boxes, and then put in the cold room. The required quantities for this purpose are calculated on the following conditions;

Quantities stored:	about 5,200 kg
Temperature of a fish body:	initial +30℃, final +10℃
Specific heat of a fish body:	before cooling 0.85 kcal/kg℃
Freezing point:	-3.5℃

Thermal load: 5200 kg/day×(30-10) ℃× 0.85 kcal/kg ℃= 88,400 kcal/day

Hence the required quantities are

88,400 kcal/day ÷ 80 kcal/kg ≒1,105 kg/day

• for other fishing bases

The current situation of 5 fishing bases south of Bakau is shown on Table-22. Having no ice plant, brokers at these fishing bases must go up as far as Banjul or Brikama to buy ice if need, and also fishermen suffer from a lowered price due to deteriorated fish (a price of D25 per bucket slumps to the D15 level), especially in the rainy season. According to the interview surveys and the field surveys, several 1 or 2 ton trucks are carrying some 70 to 140 bucketfuls of bonga in bulk on their beds to the interior from the landing spots. Since no ice is used in this process, fishes in the lower layer become stale, and at each destination it is found that 8 to 10 fishes on an average out of 50 fishes of a bucketful of fish is unmarketable. It is estimated therefore that about

20% of fish is spoiled due to no use of ice during transporting to the inland areas. Out of part of the current shipment from Gunjur, Tanji and so on, 12 tons/day ×365 days×20% = 876 tons are estimated to be a spoilage loss, and the utilization of ice will save about 75% of the spoilage, some 650 tons of fish.

In order to improve these situations it is of urgent necessity for the Government of the Gambia to supply ice to fish brokers, at least, of Tanji and Gunjur from which they can go to Bakau and come back by car in terms of the time required.

Table-22 Current Situation of 5 Fishing Bases

	Brufut	Tanji	Snyang	Gunjur	Kartong	total
Population	6,247	1,991	3,702	8,577	2,549	23,066
Fishermen	278	251	102	588	59	1,278
Brokers	53	89	15	121	30	308
Paved road	non	non	non	non	non	
Distance to Banjul (km)	27.0	31.5	43.5	53.5	63.5	
Electricity	non	non	non	non	non	
Communication	VHF	VHF	VHF	VHF	VHF	
Ice plant	non	non	non	out of order	non	
Cold room	non	non	non	out of order	non	

Assuming that the number of brokers who buy ice at Bakau is 5% of the brokers of both Tanji and Gunjur, they are (89+121)× 0.05 = 11 persons. The brokers are usually using a one ton truck to carry fish, and in Africa an ice/fish ratio in truck transport is usually 1 : 0.1. Hence

Required quantities of ice = 11 × 1000 kg× 0.1 = 1,100 kg.

Hence, considering a reserve of 10%, the required quantities of ice is

(465 kg +1,105 kg+1,100 kg) × 1.1 = 2,932 kg/day ≒ 3,000 kg/day,

and 2 units of 1.5 ton type ice plant will be required.

② Capacity of the ice bin

An ice plant cannot produce ice beyond its capacity, and stocked ice, together with producing ice, must satisfy an increasing demand. This is a reason why a ice bin is needed. In order to maintain a stable supply of ice the capacity of ice bin is to be for a two day stock, that is, 3 tons × 2 days = 6 tons.

The specifications are as follows;

Design conditions

• Ambient temperature:	+ 35℃
• Ambient humidity:	85%
• Defrost:	Hot gas system or electric heater method
• Power source:	Public utility or back up generator
	3 ϕ, 4 w, 60 Hz, 415/220 ACV
• Refrigerant	R-22 or R-12
• Water	Public water supply, +28℃
• Capacity & kind of ice	3 tons/day of plate ice
• Capacity of ice bin	6 tons
• Storing temperature	- 10℃

a. Ice-making plant

• Number of ice plant:	1.5 ton type 2 units	
• Type:	Outdoor type, automatic ice-making machine	
• Refrigerating machine:	Open type or semi-closed type	
	reciprocating compressor	7.50 KW
• Condenser:	Air-cooled condenser	0.45 KW
• Pumps:	Circulating pump and water pump	1.20 KW
• Crusher:		0.75 KW
• Accessories:	Ice chute, defrost tank, bin leveler, etc.	

b. Ice bin

• Refrigerating machine:	Open type or semi-closed type	
	reciprocating compressor	2.20 KW
• Number of the above:	1 unit	
• Condenser:	Air-cooled condenser	0.20 KW
• Cooler:	Ceiling-hanging, forced ventilation type	
• Accessory:	Thermometer 1 unit	

c. Control panel: Stand type or wall-hanging type 1 unit

with operation indication lamp, alarm light and bell indicator, push button switch, temperature regulator

2) Cold Room

Major goods to be stored in the cold room is fresh bonga and white meat fish, with rather short storing hours, and hence, the keeping temperature is -5 ℃.

① Capacity

The proposed storing quantities are 5,200 kg of bonga plus 490 kg of white meat fish, but the latter is eliminated on the examination of the capacity of the cold room since a former/latter ratio is 10:1. Hence the white meat fish is to be omitted in the calculation of the capacity of the cold room.

The basic conditions on the examination are as follows;

- The business days of the proposed facility are 315 days in the year.
- One piece of bonga weighs 250 g at average.
- The data concerning shipment, fluctuation of shipment, destination, etc. are not available at all, and hence, the quantities of the daily shipment of the proposed facility are established at 500 kg, a current daily turnover of fresh fish at Bakau.
- In order not to disturb the existing fish brokers' activities, the target population of the proposed facility is established at a half of the population of the 6 areas; Banjul (59,653), Bakau (9,382), Sere Kunda (20,633), Brikama (24,333), Soma (5,940), and Mansa Konko (6,769), totalling 63,355 people.

Number of fish to be delivered is 500 kg/day÷250 g/piece=2,000 pieces/day

Assuming that the population of 9,382 of Bakau consume this fish

9,382 ÷ 2,000=4.691 days, that is, the fish are consumed completely and people can eat fish every 4 or 5 days. Similarly, in the case of the target population

63,355 ÷ 4.691≒ 13,505 pieces/day, that is

13,505 pieces/day × 250 g/piece = 3,376.25 kg in weight.

Besides, adding the supplies to tiny villages (population of about 4,300 of 6 villages) on the way, the total daily shipment will be 4 tons.

Base on the results above a shipment schedule is established as follows;

- for the Bakau market: 500 kg a day
- for neighboring markets (Banjul, Sere Kunda, and Brikama): 4,000 kg a day
- for distant markets (Soma and Mansa Konko): 2,100 kg every 3 days

Table-23 shows the shipment schedule of the week (figures in kg).

Table-23 Weekly Shipment Schedule

	Mon	Tue	Wed	Thu	Fri	Sat
Shipment						
to Bakau on the day	500	500	500	500	500	500
to Bakau on the following day	500	500	500	500	500	500
to neighboring markets	4000	4000	4000	4000	4000	4000
to distant markets	2100	-	-	2100	-	-
Storing						
shipment on the following day	4500	4500	4500	4500	4500	4500
shipment for distant markets	700	1400	2100	700	1400	2100
Total of storing	5200	5900	6600	5200	5900	6600

② Storing method

As shown in the above table, the maximum quantities to be stored are 6,600 kg. To make handling of fish easy in shipment, transport, marketing, fish are to be packed in a fish box accommodating 24 kg. The dimensions of the box are

outside 858 (L)× 521 (W)× 207 (H) mm

inside 790 (L)× 480 (W)× 196 (H) mm

Fish boxes are to be handled manually, and assuming that the maximum stacking height is 1.5 m for safety,

- the number of the required boxes is 6600 kg ÷24 kg = 275 boxes,
- the number of boxes stacked in one column is 1,500÷207= 7 boxes, and
- the number of boxes placed on one step is 275 ÷7 ≒ 40 boxes.

To make handling of the box easy, a space of 20 cm wide is needed for grips. Hence, the required area for 40 boxes is

$40 \times \{(0.858+0.2)\times 0.521\} = 22.028 \fallingdotseq 23\,m^2$

Considering a space necessary for circulation of cooled air in the cold room, an area 6 m by 6 m, that is, 36 ㎡ will be required.

Fish boxes are to be stored as the sketch below, that is, the number of the fish

boxes is {(6×4)+(4×4)} ×7 steps = 280 boxes, and hence,
the cold room will be capable of accommodating 6,720 kg (280 boxes×24 kg).
On the other hand, the daily quantities of white meat fish to be stored are 490 kg, and its number of boxes is 490 kg ÷ 24 kg/box=21 boxes. There is the remaining space of 1 ×4 ×7 steps=28 boxes enough to accommodate 21 boxes.
All the fish boxes are covered with ice.
The following is a rough plan of the cold room.

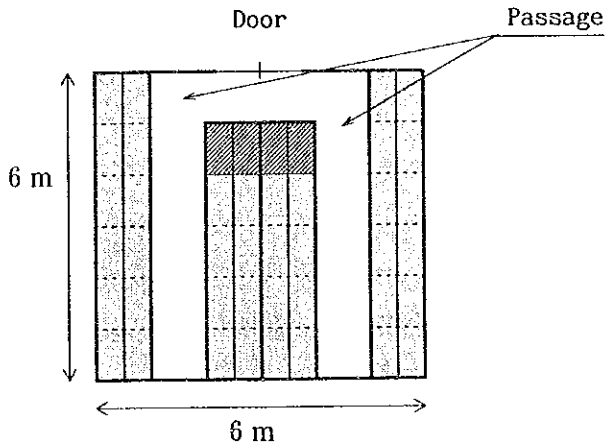


Fig. 5 Storage Plan

③ Others
The cooling unit is to be of the ceiling hanging, forced air cooling type, and 2 units are to be installed due to easy maintenance, cost deduction, etc. Proper marks are to be printed on the floor to make various works in the cold room easy and efficient.

The design conditions and specification of the cooling system are as follows;
- Ambient temperature: + 35℃
- Ambient humidity: 85%
- Defrost: Hot gas or electric heater
- Power source: Public utility or back up generator

3 ϕ, 4 w, 60 Hz, 415/220 ACV

- Refrigerant: R-22 or R-12
- Storing temperature: - 5℃ below
- Temperature of incoming goods: +28℃
- Number of cooling system: 2 units
- Refrigerating machine: Open type or semi-closed type 7.50 KW
- Condenser: Air-cooled condenser
- Cooler: Ceiling-hanging, forced ventilation type 1.2 kw
- Accessory: Thermometer 1
- Control panel: Stand type or wall-hanging type 1 unit
  with operation indication lamp, alarm light and bell indicator, push button switch, temperature regulator

3) Back up generator

Bakau at which the project site is located has a rather improved electricity network, but recently voltage fluctuations and power failures take place frequently because of inadequate capacity. Hospitals and hotels are provided with an independent power plant, while each household are using incandescent lamps to minimize accident and burning out of electric apparatuses due to fluctuations of power.

For the project to operate and maintain a cold storage facility aiming at the improvement of fresh fish distribution in the country a stable supply of electricity is essential, and for this purpose an emergency power plant with a voltage regulator must be provided.

① Capacity of the generator

The electric apparatuses required by the project are not so many in number and need not so much capacity, and, when each apparatus has an independent controlling circuit, an electric trip of the generator will rarely take place when starting.

The major electric apparatuses and their capacity are shown in Table-24 on the following page.

Table-24 Electric Apparatuses of the Project

1.5 ton ice plant	2 units	18.0 KW
Cooling machine for ice bin	2 units	3.5 KW
Refrigerating machine	2 units	7.0 KW
Fuel transfer pump	2 units	1.5 KW
Fresh water transfer pump	1 unit	1.0 KW
Lighting at the main building	1 lot	2.0 KW
Lighting other buildings	1 lot	5.0 KW
Total		38.0 KW (47.5 KVA)

The required capacity of the generator is calculated as follows.

$PG_1 = \sqrt{3}\ VI \times 10^{-3} \fallingdotseq$ load output $\div$ (load efficiency $\times$ load power factor)

$= 38.0 \div (0.70 \times 0.80) = 67.86$ KVA (54.29 KW)

$PG_2 = \{Xd(1-\triangle E) \div \triangle E)\} \times P_m \cdot B \cdot C$

$= \{0.21(1-0.3) \div 0.3\} \times 9 \times 7.2 \times 0.67 = 21.27$ KVA (17.02 KW)

$PG_3 = \{(PL - Pn) \div \eta L + P_s + Pn_s \cdot C \cdot PF_s\} \times 1/\cos\theta$

$= \{(38.0 - 9)/0.85) + 7 + 14.4 \times 0.4\} \times 1/0.85$

$= 55.15$ KVA (44.12 KW)

Where, PG_1: a required power at the rated running.

PG_2: a required power when the voltage drops.

PG_3: a required power endurable for a short time.

Hence, the required power of the generator is 67.86 KVA (54.29 KW), and a 70-75 KVA (56-60 KW) generator available on the market is fit for the purpose.

The generator to be supplied to the project is to be of salt resistance and soundproofing type because of the proximity to the sea and a medical facility. Also, for the energy-saving purpose, a variable voltage starter is to be attached to such the ice-making machine and the cooling machine as need a higher starting power. The voltage drop is frequent at Bakau; the standard voltage of 220 v drops often to 140 v, a dropping rate of 36%. A voltage stabilizer will be necessary to minimize damage caused by a voltage fluctuation. A generator is usually overhauled three times a year (each 3,000 hour running), and thus two generators must be supplied so the facility can be operated even

when one unit is under repair.

The following are the major design conditions and specifications of the back up generator.

- Ambient temperature: + 35℃
- Ambient humidity: 85%
- Despite an emergency purpose, the generator can be operated for more than 7 successive days from the viewpoint of the electric situation of Bakau. The electric apparatuses can also be switched to the public power.
- Capacity: 70 KVA, 3 ϕ, 4 w, 60 Hz, 415/220 ACV
- Fuel oil: Diesel oil

a. Generator engine

- Type: 6 cylinder, 4 cycle direct injection type
  87 PS rated output at 1,500 rpm
- Cooling method: Water cooling method
- Starting method: Electric method
- Oiling method: Automatic oiling method
- Accessories: Complete

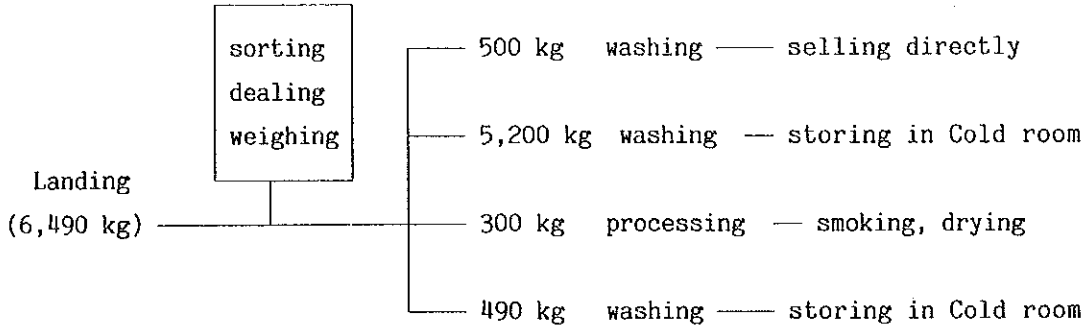
b. Generator

- Type: Automatic oiling type 56 KW
- Exciting method: Brushless method
- Insulation: F class
- Accessories: Inverse power protection system, Wattmeter, Switchboard, distribution panel, etc.

c. Control panel: Stand type 1 unit
with operation indication lamp, alarm light and bell indicator, push button switch, temperature regulator distribution panel, power selector board, etc.

4) Shade for fish treating

Fish landed will be carried to the main building and handled as follows;



① Sorting, dealing, and weighing corner

About 80% of fish landed at Bakau will be concentrated in 2 hours, one hour before and after 16:00, and its quantities are

6,490 kg× 0.8/2 hours = 2,596 kg/hour

Since the quantities put in a fish box are 24 kg the number of fish boxes will be 108, and when stacking 4 boxes to handle them a space of 27 boxes will be required. The base area of a box is about 0.5㎡, and hence the required space for all boxes is

27 boxes× 0.5㎡/box = 13 ㎡

A space without any partition, washable with water, is to be provided as this corner.

② Washing corner

The quantities to be washed a day are 500 kg of bonga sold directly, 5,200 kg of bonga stored in the cold room, plus 490 kg of white meat fish, totalling 6,190 kg. Hence the quantities to be washed an hour are

6,190 kg× 0.8/2 hours = 2,476 kg/hour, that is, 2,476 kg ÷24 kg= 103 boxes.

Assuming that the washing work requires 2.5 minute a fish box, it will take 257 minutes (103 × 2.5) to wash out 106 boxes, and hence to finish in an hour a washing corner with 4 booths (257 ÷60) is required.

Assuming that the required quantities of water are as same as those of fish, 2,476 ℓ /hour of water at the peak, 6,190 ℓ a day, will be needed.

③ Processing corner

Fish for smoking and drying are 300 kg a day. Prior to smoking or drying fish must be washed, gutted, and filleted. For this purpose a processing corner equipped with sinks and working tables is provided. The quantities at the peak is 300 kg× 0.8/2 hours =120 kg/hour

Since the working efficiency is normally 10 kg/10 minutes, that is 60 kg/hour,

120 kg÷ 60 kg= 2 lines will be needed at the processing corner.

But, many processors are working at Bakau and they are likely to crowd the corner at the same time, and hence, it will be reasonable to treble the above figures of the booth.

5) Job office

A guardhouse for 3 persons, including a driver, in charge of selling ice and supervising movements in and out of the cold room is to be placed in the main building. The required space will be 1.5㎡ ×3 = 4.5 ㎡ , and a counter and chairs will be provided.

6) Store

A store covering an area of about 35㎡ is to be placed to keep wheelbarrows, fish boxes, dusting things, working cloths and so on.

7) Ice Plant

Two sets of 1.5 tons/day plate ice-making machine with the dimensions of

3.0 m (L) ×1.5 m (W) ×3.0 m (H)

are to be installed on the upper storey over the ice bin as the sketch below. To place the 1.5 m wide maintenance passage an area of 5.0 m ×7.0 m =35.0 ㎡ will be required. Since each machine weighs about 2 tons, the floor load of 4 tons×1.2 = 4.8 tons must be considered. Louvers and fans for ventilation are to be installed

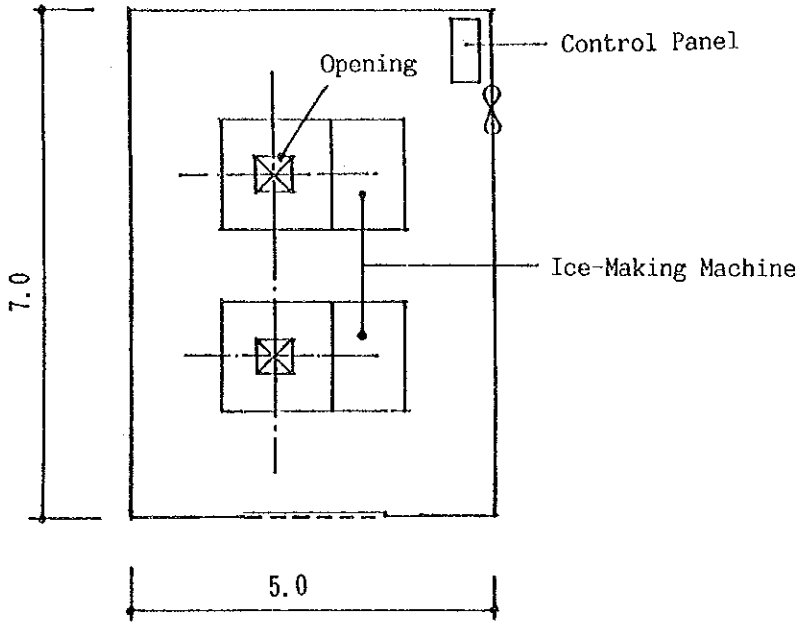


Fig. 6 Ice Plant

8) Generator Room

Two sets of 70 KVA generator unit the dimensions of 2m(L) ×1 m(W)×2.2 m(H) are to be installed in the generator room with an incoming panel and a distribution panel. Taking the 1.5 m wide maintenance passage, an area of 5.0 m ×7.0 m =35.0 m² will be required. In order to supply enough air an enforced fan shall be installed.

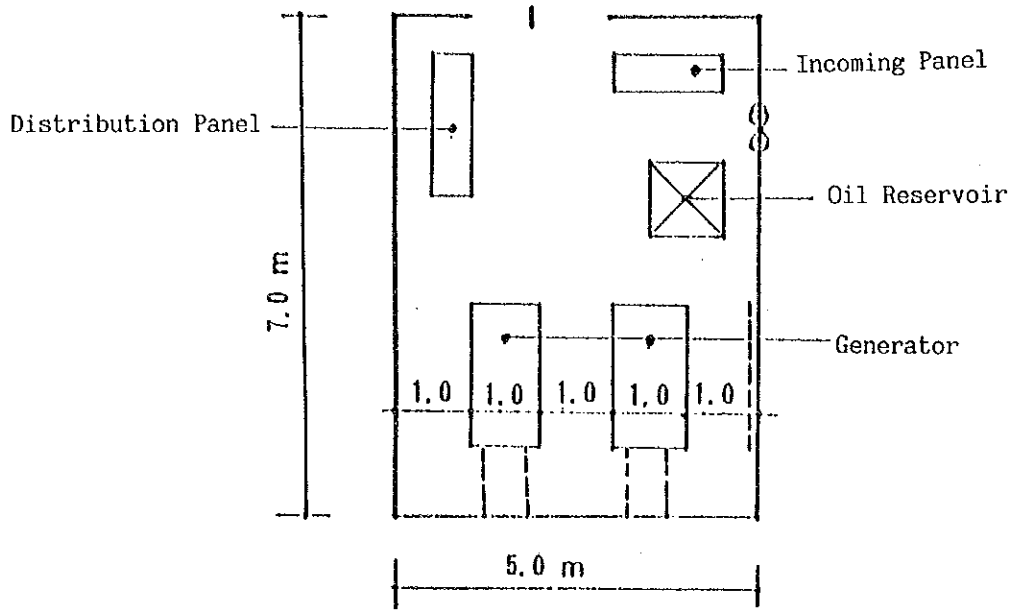


Fig. 7 Generator Room

B. Office/Repair Shop/Store Building

The office/repair shop/store building is to be constructed adjacent to the main building. The three components of the building are placed in a line with the store as the center, the office being placed on one side and the repair shop being on the other side, considering working requirements of each component.

1) Office

Among 11 members of the Central Management Committee, 7 from the Government and 4 from the industry, responsible for the management of the project, 3 persons, one extension officer and two officers in charge of shipment and accounting, will be permanently stationed in the fishing base. Placing a multipurpose corner for a conference and others as the sketch below, an area of 36㎡ (6 m × 6 m) will be required.

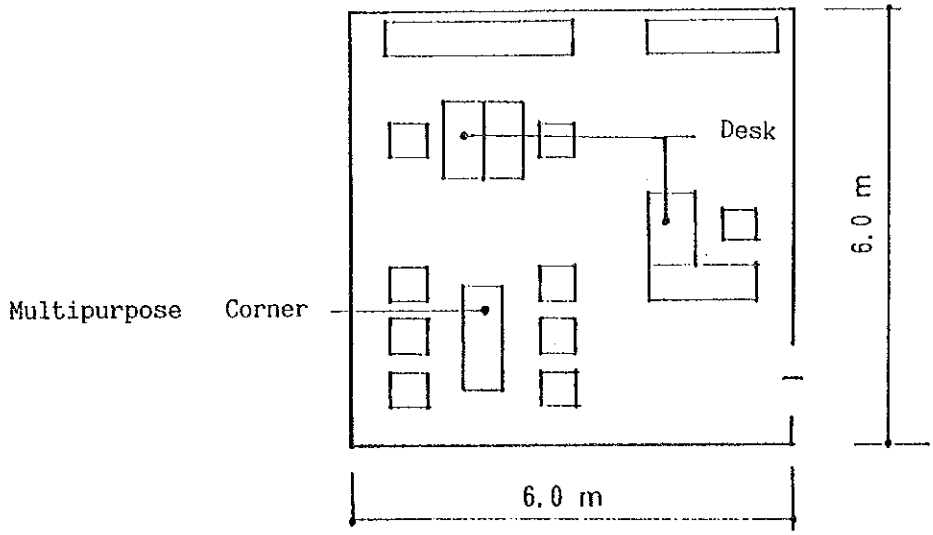


Fig. 8 Office

2) Repair Shop

Work to be done in the repair shop includes repairs of outboard motors, inboard engines, ice-making machinery, generators, and vehicles. For this purpose engine racks, a test tank, working stands, a spare parts shelf, working counter and so on. Arranging these apparatuses as the sketch on the following page, an area of 6 m $\times$6 m = 36㎡ will be required

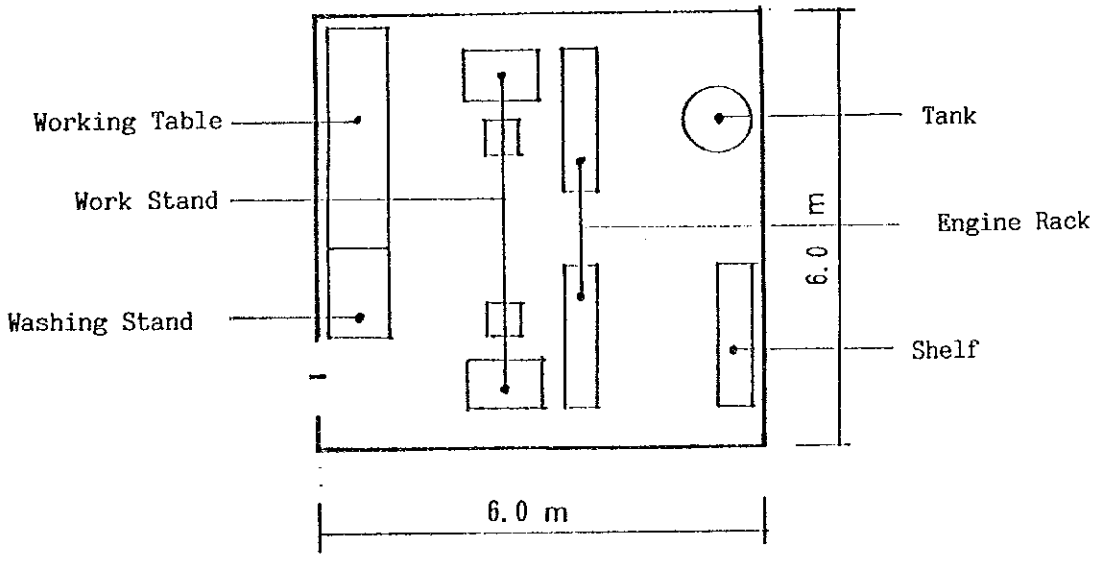


Fig. 9 Repair Shop

3) Store

A store covering an area of about 36㎡ will be required to keep spare parts of outboard motors, outboard motors in reserve, fishing gear, fishing nets, etc.

C. Fishermen's Locker and Workshop

1) Fishermen's Locker

Fishermen's lockers for 42 (plus 2 for reserve) fishing boats including 13 m type fishing boats to be provided by the project. Articles and goods to be stored are fishing gear, outboard motors, maintenance tools, etc., and hence, an area of 5 ㎡ (2m×2.5m) for each locker with a 3 m high ceiling will be enough. Security and ventilation are to be considered.

2) Workshop

A space roofed with bamboo is to be placed outdoor as a workshop for mending of fishing net. A fishing net hanger is to be attached.

D. Smoking Hut

About 100 kg of fish must be smoked a day, and it will take 3 day to smoke the quantities of fish with kilns, covering a space of about 0.05㎡ per 1 kg. Hence, required space of kilns

100 kg/day×0.05㎡/kg ×3 days= 15㎡

Five kilns, 0.9 m(L)×1.1 m(B)×1.0 m(H) each, are to be installed, and a space of about 25 ㎡ is to be attached as a firewood yard.

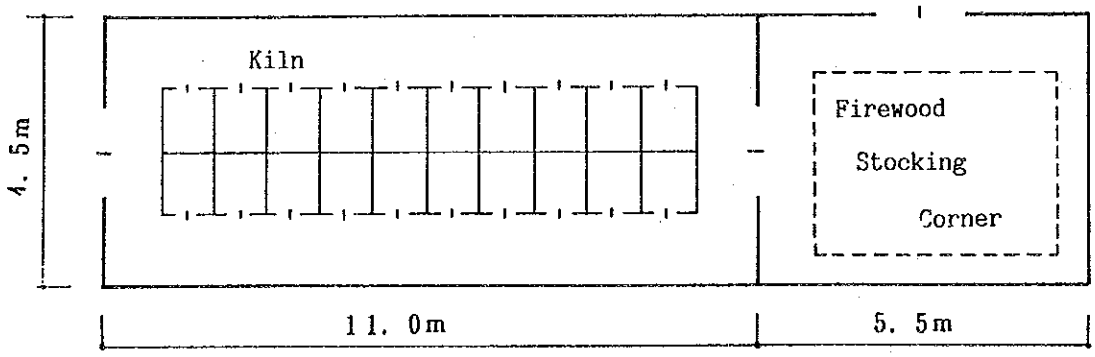


Fig.10 Smoking Hut

E. Toilet

A toilet should be constructed for officials, workers, fishermen, processors. The number of fishing boats with a crew of 2.5 persons is 44, and at the peak of 2 hours, 1 hour each before and after 4 p.m.

44 boats×2.5 persons/boat×0.8/2 hours = 44 persons plus about 10 processors and 11 officials of the facilities, totalling 65 persons, will crowd at the site. Assuming that a male/female ratio is 7:3, among them the male are 45 and the female are 20. Installing two stools and two bowls for the male and two stools for the female, separating fishermen from others, as shown in the sketch of the following page, the required area of the toilet building is about 25 ㎡.

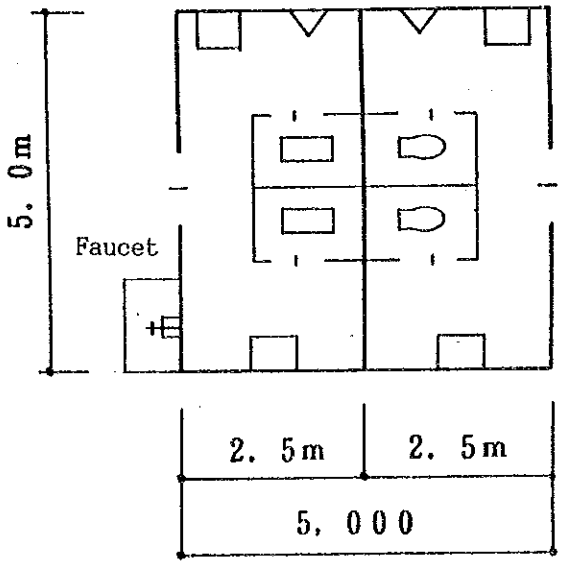


Fig.11 Toilet

(F) Other facilities and equipment

1) Rack for drying

Shark and ray are processed to steaklike pieces, about 25 cm by 25 cm by 1 cm thick, weighing some 200 g each, which are arranged on a rack. About 200 kg of shark and ray is landed a day, and after deheading and gutting a 60% of the landed quantities will be dried. Hence, the number to be dried a day

200 kg × 60% ÷ 0.2 kg = 600 pieces

Placing a gap of about 5 cm between steaklike pieces, an area to be covered by a piece is 0.3 m ×0.3 m, and so the required area for 600 pieces is

0.3 m ×0.3 m ×600 = 54㎡

Since it takes usually 3 days to dried up, a total area required is the treble of 54㎡. Considering the work easiness, 10 units of the 1.6 m by 10 m rack are to be provided.

2) Fuel tank

Gasoline and diesel oil are used at the project; the former is for the fishing fleet and the latter is for the insulated vans and generator engines besides the fishing fleet. Estimated consumption based on actual results is given as Table-25 below. Among them the figure of the back up generator is derived from a maker's catalog because despite its name the back up generator must be used regularly due to the current electric condition of the site.

Table-25 Fuel Consumption of the Fleet

	Days at operation	Number of units	Consumption
Gasoline			
Bottom gillnetter	275 days/year	8	25 ℓ/day
Bonga boat	275 days/year	11	40 ℓ/day
Large hand-liner	90 days/year	1	90 ℓ/day
Diesel oil			
Bottom gillnetter	275 days/year	2	12.5 ℓ/day
Bonga boat	275 days/year	2	20 ℓ/day
Insulated van	315 days/year	2	25 ℓ/day
Back up generator	315 days/year	1	480 ℓ/day

Assuming that 2 days reserve is to be left in the fuel tank which is supplied every two weeks to fill up, the required capacity of the fuel tank is obtained as below;

(a) Gasoline

Bottom gillnetter	8 × 25 ℓ/day×275 days/year =	55,000 ℓ/year
Bonga boat	11 × 40 ℓ/day×275 days/year =	121,000 ℓ/year
Large hand-liner	1 × 90 ℓ/day× 91 days/year =	8,190 ℓ/year
Total		184,190 ℓ/year

Consumption a day: 184,190 ℓ/year ÷315 days = 584.7 ℓ

Reserve: 584.7 ℓ × 2 days = 1169.4 ℓ

Hence the required capacity of the gasoline tank is

584.7 ℓ ×14 days +1169.4 ℓ = 9355 ≒10,000 ℓ

(b) Diesel oil

Bottom gillnetter	2 ×12.5 ℓ/day×275 days/year =	6,875 ℓ/year
Bonga boat	2 × 20 ℓ/day×275 days/year =	11,000 ℓ/year
Insulated van	2 × 25 ℓ/day×315 days/year =	15,750 ℓ/year
Back up generator	1 ×480 ℓ/day×315 days/year =	151,200 ℓ/year
Total		184,825 ℓ/year

Consumption a day: 184,825 ℓ/year ÷315 days = 586.7 ℓ

Reserve: 586.7 ℓ × 2 days = 1173.4 ℓ

Hence the required capacity of the gasoline tank is

586.7 ℓ ×14 days +1173.4 ℓ = 9387.2 ≒10,000 ℓ

Both tanks, 10,000 ℓ capacity each, are to be laid under the ground for the safety purpose, and their major specifications are as follows;

Dimensions:	φ1,600 × 5,200 mm
Thickness:	9 mm
Material:	SS 41
Painting:	Epoxy resins 2 coats
Accessories:	Feeding hole, supplying hole, oil gage, air pipe, etc.

3) Water tank

Water is used to produce ice and wash fish. Also it serves as daily use of people working at the facility and refreshment for fishermen.

(a) For washing fish

The quantity of water as same as that of fish landed a day, that is 6,190 ℓ, is to be required to wash them. Usage of water will concentrate from 15:00 to 19:00 after landing.

(b) For ice production

Usually plate ice requires raw water 1.15 to 1.25 times the quantity of produced ice. At this project a coefficient of 1.20 is to be applied.

Hence, 1,500 kg/day ×2 units ×1.20 = 3,600 ℓ is required.

(c) People's daily use and refreshment

As no data is available the required quantity of water for this purpose is to be established with reference to the FAO's recommendation to the effect that in artisanal fisheries 100 ℓ of water for each person a day, if necessary plus 15%, be secured. People who will use the facility and the quantity of water necessary for them are estimated as follows.

Table-26 Water Consumption

	No. of persons	Time and hour	Q'ty/person	Q'ty required
Facility staff	7	08-1700 9 hrs	100 ℓ	700 ℓ
Mechanics	3	08-1700 9 hrs	100 ℓ	300 ℓ
Workers	10	08-1700 9 hrs	150 ℓ	1,500 ℓ
Processors	10	08-1700 9 hrs	20 ℓ	200 ℓ
Brokers	10	08-1800 10 hrs	20 ℓ	200 ℓ
fishermen	40	15-1900 4 hrs	150 ℓ	6,000 ℓ
Total	80			8,900 ℓ

Hence, the required quantity of water a day is

6,190 ℓ + 3,600 ℓ + 8,900 ℓ = 18,690 ℓ and the quantity an hour is

18,690 ℓ ÷ 24 hours = 778.75 ℓ ≒ 780 ℓ

However, the usage of water is not even through the day, but the peak, 4 hours from 15:00 to 19:00, occurs. Since the processors and brokers are irregular uses, they can be neglected on calculation. Hence the quantity an hour at the peak is

(6,190÷4)+(6,000÷4)+ {(700+300 +1500) ÷9 } = 3,325 ℓ ≒ 3,300 ℓ

Hence, a tank of about 10 ton capacity is required to meet the requirement of

the peak for 4 hours.

The water tank is to be a FRP exterior reinforcement tank with necessary accessories such as a feeding hole, supplying hole, drain hole, inspection hole, air pipe, electrodes, ladders, etc. attached, and its dimensions is to be 3,000 (L) ×2,000 (W) × 2,000 (H) mm

(G) Exterior work

1) Premises road

In order to connect the project site with the Atlantic Road an exterior road is to be constructed at a passage between higher grounds at the east part of the site. The road consists of a 5 m flat top plus a 100 m ramp and has a longitudinal slope of about 9%. On each side of the road a side-ditch is to be constructed for drainage. The breadth of the road is to be 6 m to allow construction machinery to pass.

Another 6 m wide road is to be constructed toward the main building.

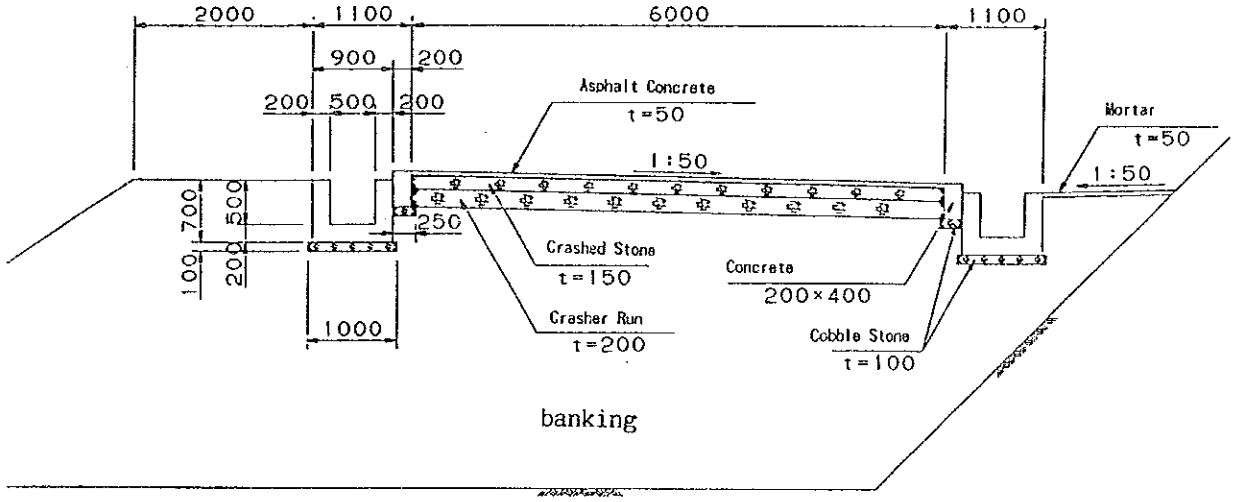


Fig. 12 Typical Section of Access Road

2) Main building mound

The mound for the main building is to be prepared at the level of +4.0 m since the mean high water at the spring is +2.14 m and the run-up of wave is about 3.0 m at the site. Some portion at the onshore side will be cut and other portion will be banked.

The slope of the mound is to be protected with rubble stones (5 to 10 kg), whose protection is 50 cm wide at the top and has a grade of 1:1.5. The seaward foot of the slope of the mound is also to be protected with similar stones 30 cm thick to prevent scouring. A synthetic fiber sheet is to be installed at the boundary between the rubble stone layer and banking to prevent sucking out.

3) Pavement

Asphalt pavement is to be made on the premises road including an access road as shown in Fig. 11. Required paved area is as follows;

Access road	630㎡
Other road	324㎡
Total	954㎡

(2) Architectural Plan

A. Main Building

① Plan/section plan

Fish landed will be first carried to the shade for fish treating of the main building, and then sorted. The shade for fish treating houses a sorting corner, dealing corner, and weighing corner, and behind it is a cold room, ice bin, store, and generator room. A job office is placed at the seaward center of the shade for fish treating, allowing the staff in charge of selling ice and controlling goods to monitor activities at the shore and the main building.

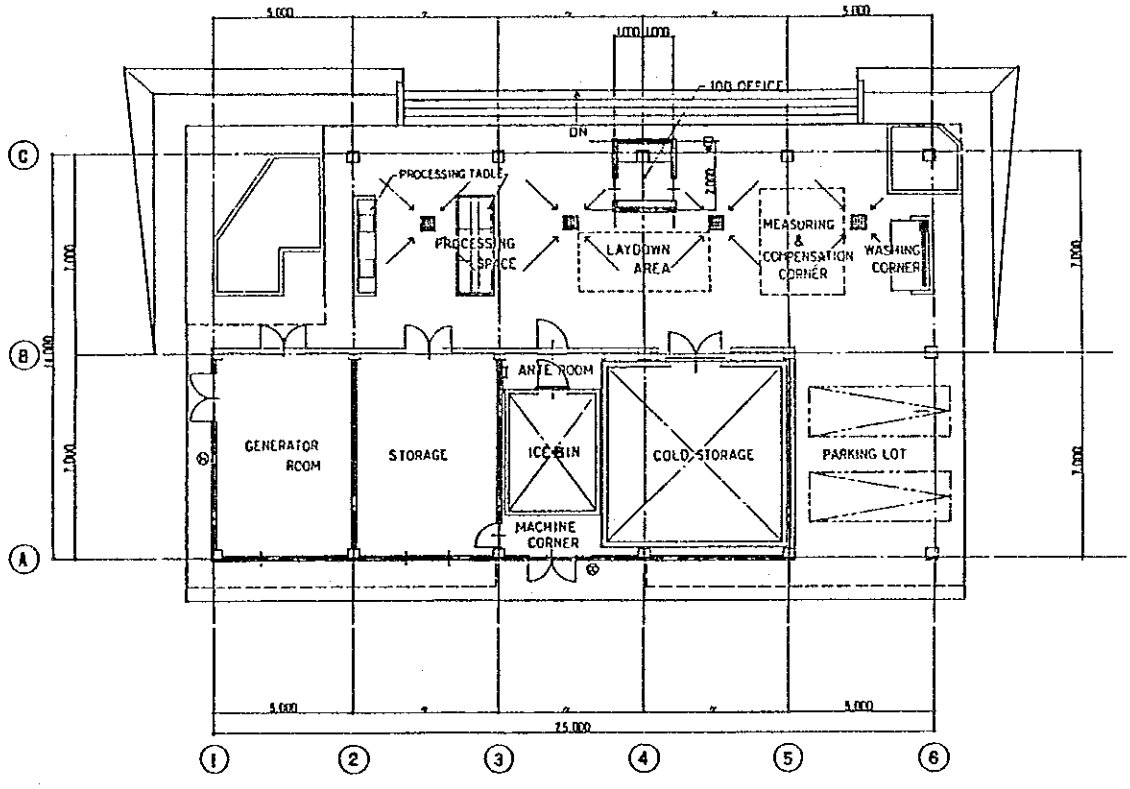


Fig. 13 Main Building: Plan

In order to install the ice-making machine on the ice bin, only the building of the ice plant is two storied. To allow the panel ice room and ice bin to be housed under the beam the ceiling height of the ground floor is 3.5 m, and the ceiling height of the second floor is also 3.5 m to house the ice-making machine.

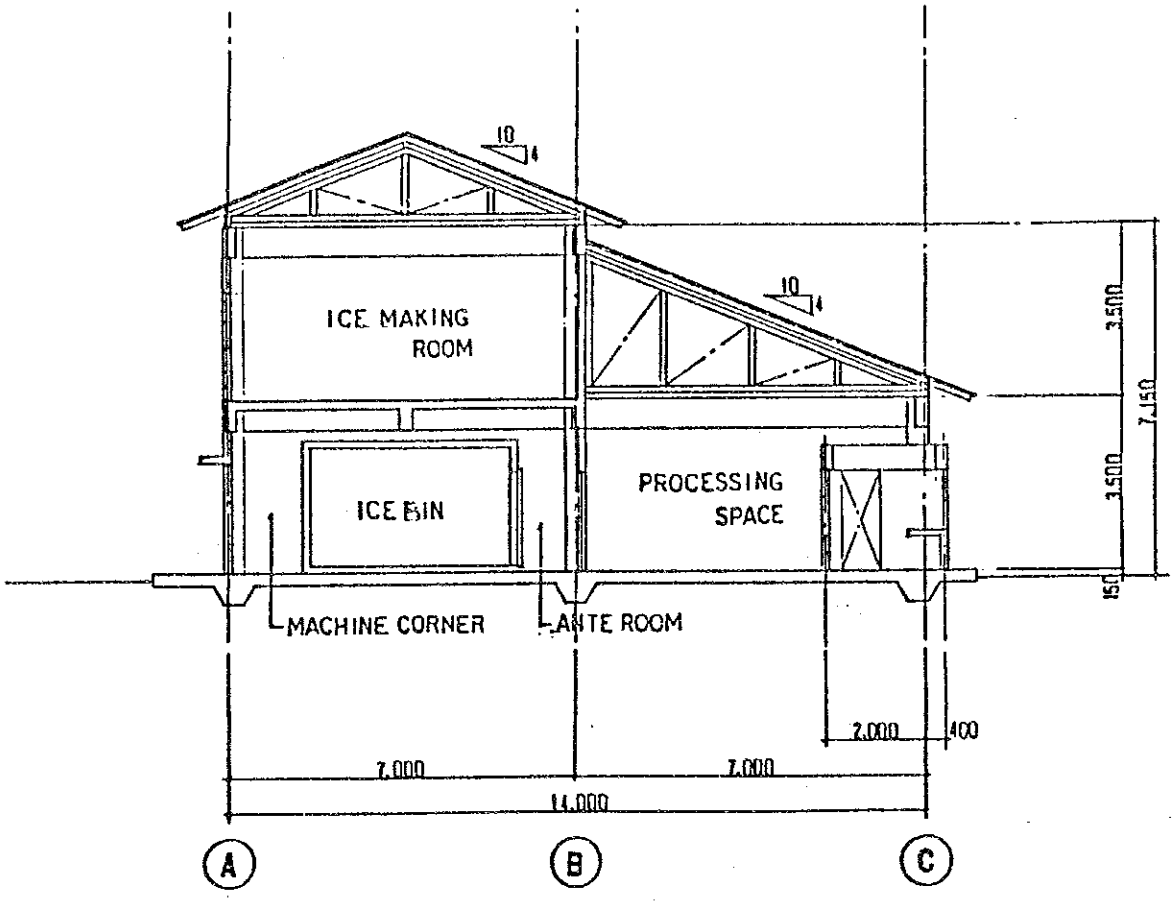


Fig. 14 Main Building: Section

② Structural design

The soil of the site records N value of 40 to 50 at 10 to 12 m below the ground surface with a layer mixed with clay and gravel lying. The bearing capacity of the ground surface is 5 ton/m², which is sufficient for the horizontal load of the main building of 3.5 ton/m².

In order to prevent uneven sinking of the building the RC direct foundation is applied. The framework is RC construction and the wall is of block. This type

type of structure is common in the country and will be endurable to injury from salt. The roof truss and gable roof are to be applied.

③ Part design

Roof:	Plywood bed, colonial roof tile
Exterior wall:	Plaster finish on both RC and block
Opening:	Aluminum window, aluminum door, and aluminum louver
Floor:	Troweled concrete, wear resistance resin finish
Ceiling:	timber bed, plywood sheathing, paint finish

B. Office/Repair Shop/Store

① Plan/section plan

The store is common to the office and the repair shop, and the space in front of the counter in the store is the common entrance hall of all the three room. An enough window area is given to the office due to ventilation and lighting and sight. A double-leafed hinged door is placed on each side of the store to allow engines and motors to put in and out the store.

In order to secure the ceiling height of 2.8 m in both the office and repair shop, the eaves height is 3.5 m. No ceiling is provided to the store.

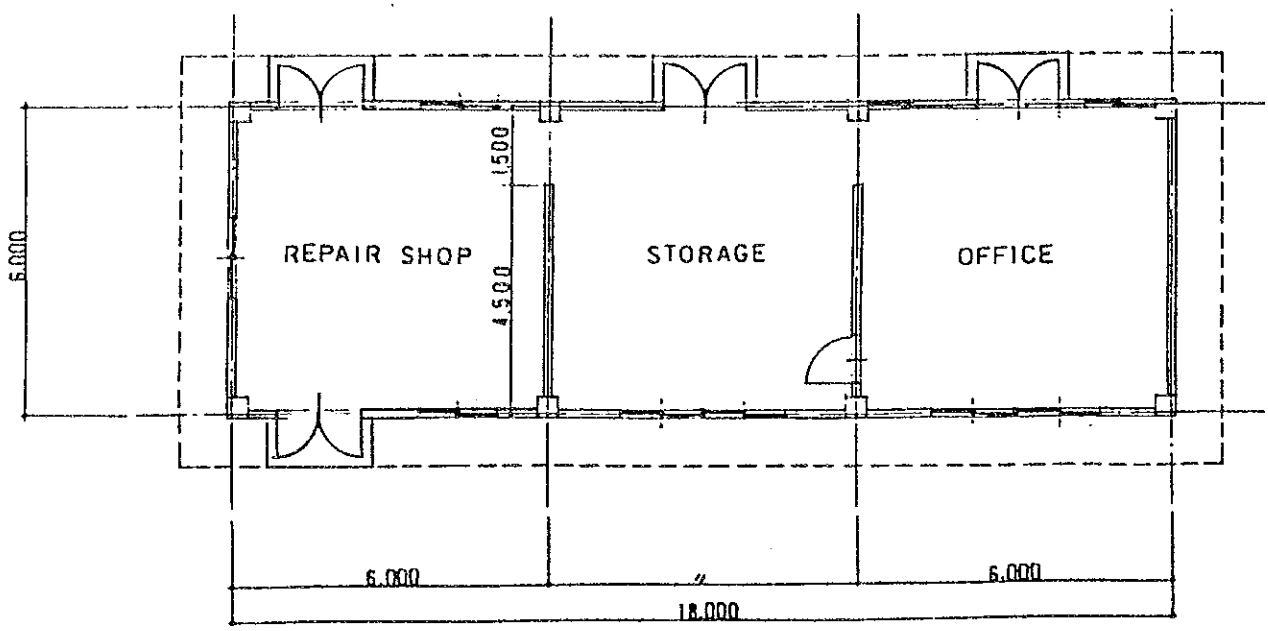


Fig. 15 Office/Repair Shop/Store: Plan

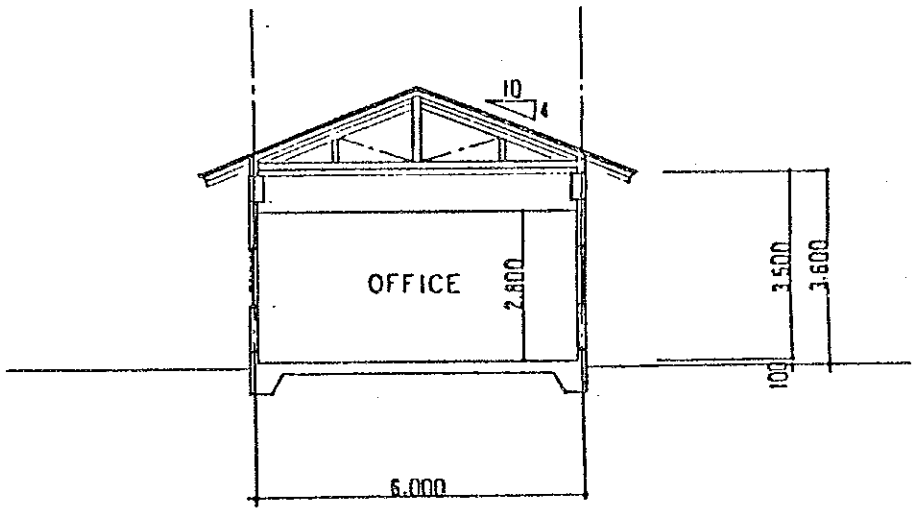


Fig. 16 Office/Repair Shop/Store: Section

② Structural design

The RC framework with block wall structure is to be constructed on the RC direct foundation.

③ Part design

Roof:	Plywood bed, colonial roof tile
Exterior wall:	Plaster finish on both RC and block
Opening:	Aluminum interior furniture and exterior furniture
Floor:	Troweled concrete, wearing resistance resin finish
Ceiling:	Timber bed, plywood sheathing, paint finish (except the store)

C. Fishermen's Locker/Work Shop

① Plan/section plan

The locker units, 2 m by 2.5 m each, being arranged back to back are to be placed separately at 2 spots, totalling 44 units. With priority to security, ventilation is to be given through only the openworks of the upper and lower parts of the door. Between the locker units a roof is placed for the workshop. The ceiling (wire net) height of the locker is 3 m, so the eaves height is 3 m.

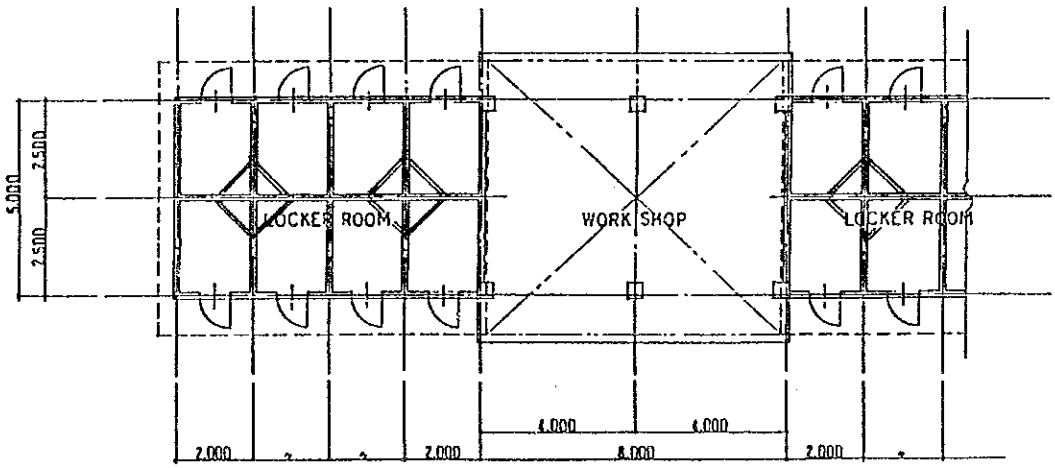


Fig. 17 Fishermen's Locker/Work Shop: Plan

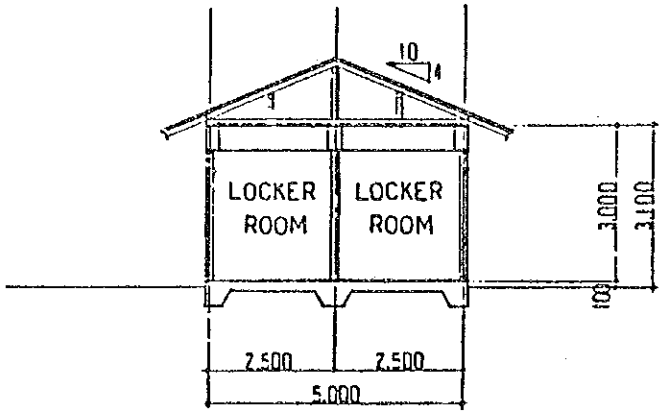


Fig. 18 Fishermen's Locker/Work Shop: Section

② Structural design

Since a single unit of locker is not so large, the wall volume a unit area suffices the standard of block structure, and hence, the block structure on the RC direct foundation and the roof truss and gable roof are to be applied.

The workshop is to be of pipe construction.

③ Part design

Roof:	Plywood bed, colonial roof tile
Exterior wall:	Plaster finish on both RC and block (the interior without coating)
Opening:	Aluminum single swing door with a padlock
Floor:	Troweled concrete
Ceiling:	Wire netted
Workshop roof:	Braided bamboo, locally made

D. Smoking Hut

① Plan/section plan

The smoking hut houses 20 smoking tables, 0.9 m(W)× 1.1 m (D)×1.0 m (H) each, and a firewood store as shown in the sketch, and hence its dimensions are 4.5 m

by 16.5 m, and the eaves height of 3.5 m. The sixth block line below the beam is to be of perforated blocks for lighting and ventilation. Louvers are to be installed on the roof for more ventilation.

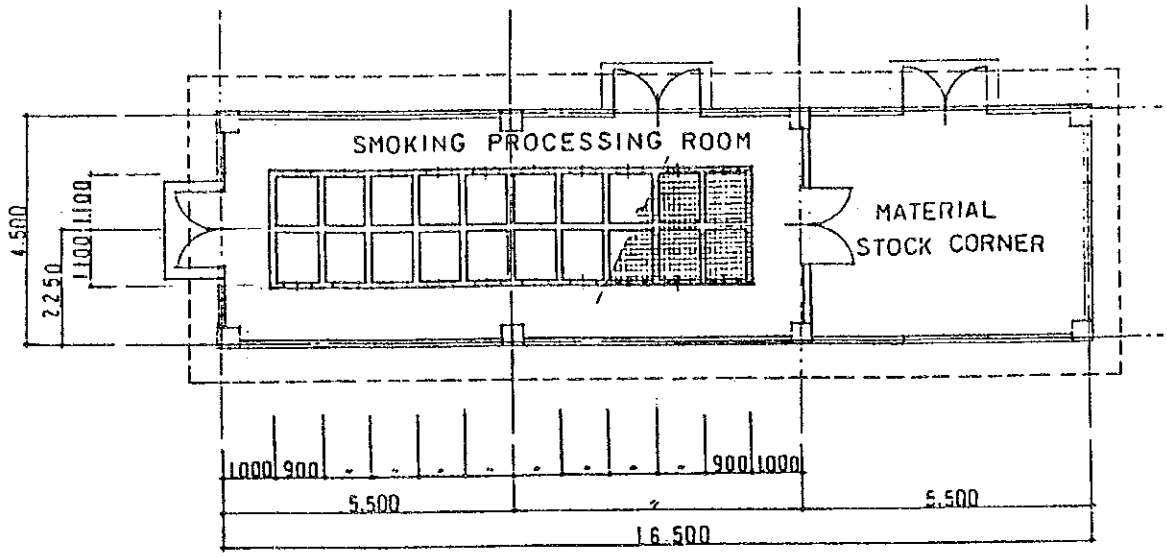


Fig. 19 Smoking Hut: Plan

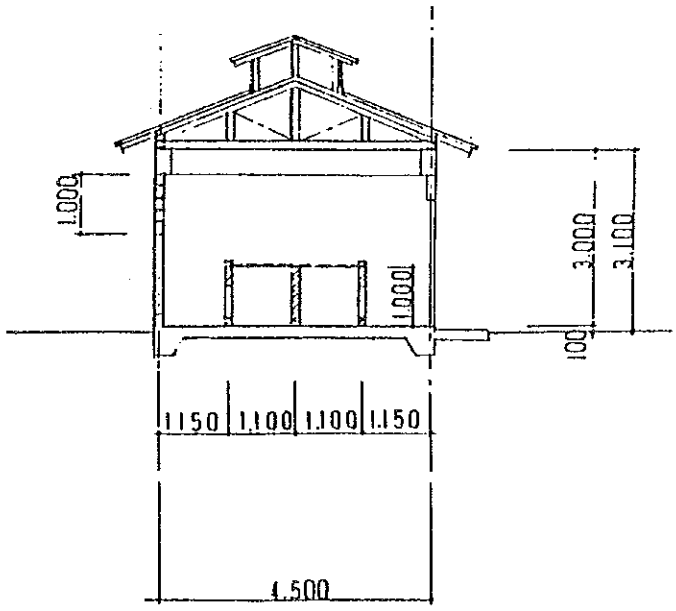


Fig. 20 Smoking Hut: Section

② Structural design

The RC framework with block wall structure is to be constructed on the RC direct foundation. The roof truss and gable roof are to be applied.

③ Part design

Roof:	Plywood bed, colonial roof tile
Exterior wall:	Plaster finish on both RC and block
	(partly perforated blocks applied emulsion paint)
Opening:	door
Floor:	Troweled concrete
Ceiling:	No coating

E. Toilet

① Plan/section plan

The toilet for each sex is arranged symmetrically. The floor, double slab, is to be 300 mm high from the ground level, allowing inspection to be made easily.

The height from the floor to the eaves is to be 2.5 m, and no ceiling is boarded.

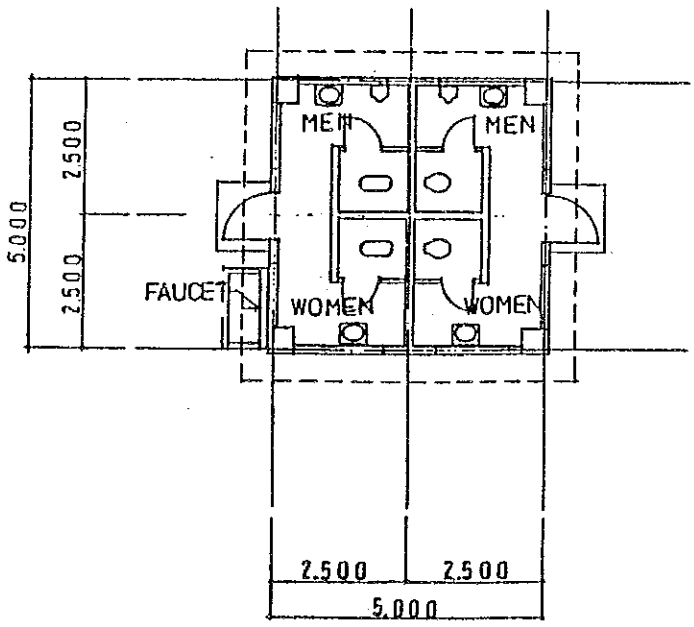


Fig. 21 Toilet : Plan

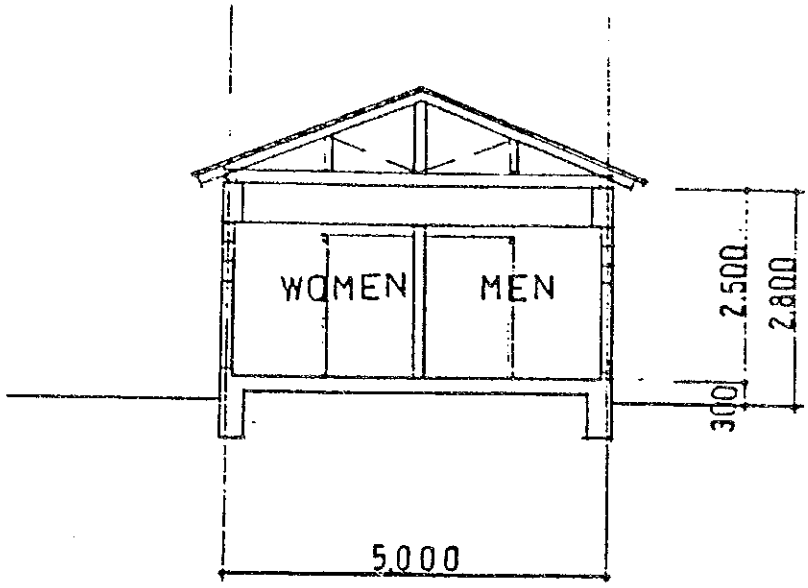


Fig. 22 Toilet : Section

② Structural design

The RC framework with block wall structure is to be constructed on the RC direct foundation. The roof truss and gable roof are to be applied.

③ Part design

Roof:	Plywood bed, colonial roof tile
Exterior wall:	Plaster finish on both RC and block (partly perforated blocks, shower booth, and lining blocks applied emulsion paint)
Opening:	Aluminum door
Floor:	50 mm by 50 mm tessellated tile
Ceiling:	Natural surface (back of ceiling)

F. Other facility

The specifications of the rack for drying is as follows.

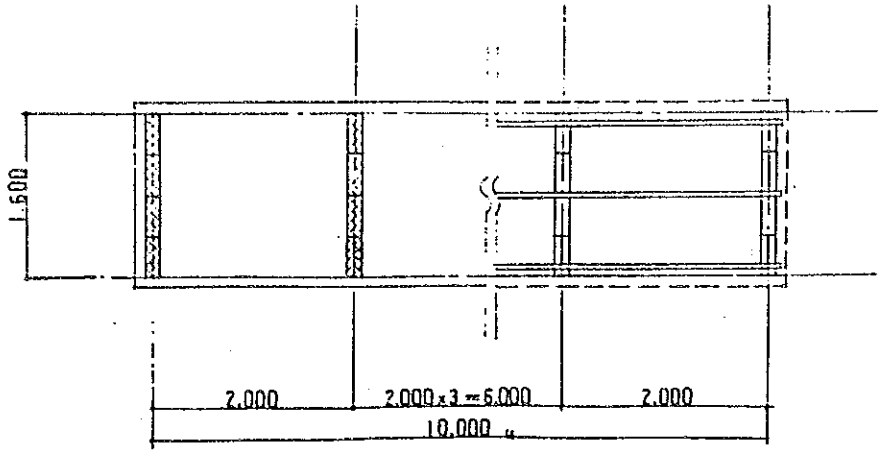


Fig. 23 Rack for Fish Drying: Plan

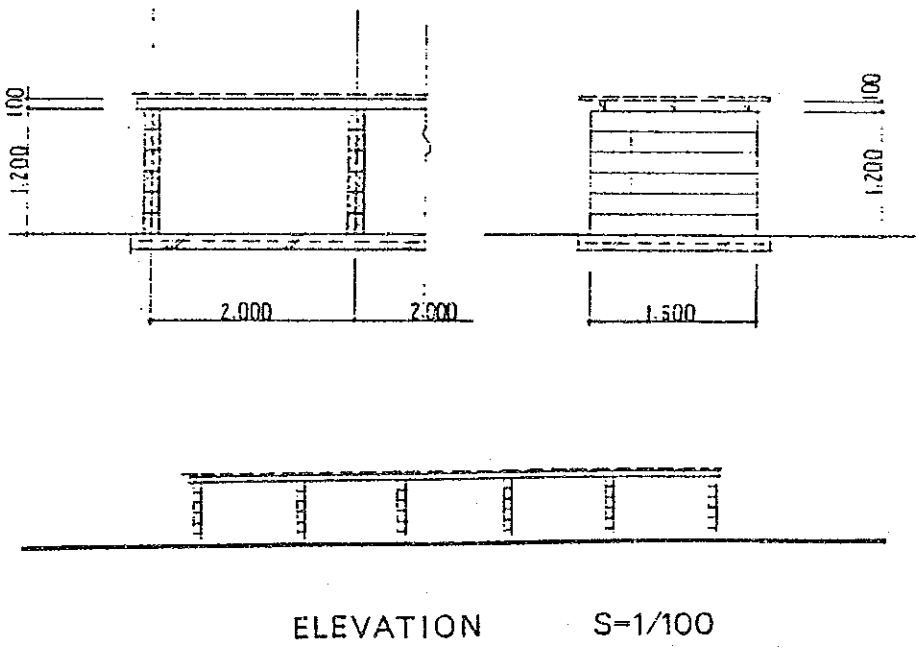


Fig. 23 Rack for Fish Drying: Section

(3) Materials Plan

① FRP canoe type fishing boat 4 units

In the Gambia the overexploitaion of forestry resources has made it difficult for fishermen to get timber to built his canoe. If available, transporting expenses are very high. In addition, the wooden canoe requires maintenance such as painting at least once a year to prevent deterioration, resulting in high expenses. A FRP-made boat settles most of these problems. The projected canoes, 2 for bonga fishing and 2 for bottom gillnetting, will be used by trained fishermen jointly. The major particulars are as follows;

Length over all	about 13 m
Breadth over all	about 2 m
Depth	about 1 m
Insulated box	about 1 m^3
Diesel outboard engine	27 HP 1 unit
Engine spare parts	20% of engine FOB price
Sail and mast	1 lot
Anchor Danforth type	15 kg 1 piece
Anchor rope ϕ 16 mm	60 m

② Gasoline outboard motor 25 HP 10 units

A diesel outboard motor is more economical in the terms of running cost than a gasoline outboard motor, but the former, weighing about 70 kg, is heavier 2 times than the latter and too heavy to be installed on a 8 to 12 m long canoe.

This type of gasoline outboard motor is widely used by Gambia fishermen engaging in purse seining and bottom gillnet fishing, and also a teaching material of a coastal fishermen training course of the Fisheries Department. Thus almost all of Gambia fishermen are familiar with this type of outboard motor. Projected outboard motors are to be exchanged with the fishermen's worn-out motors. The major particulars are as follows;

Two-cycle gasoline outboard motor maximum output 25 HP over

Shaft length	about 600 mm
Cooling system	seawater direct cooling
Fixing method to hull	Clamp screwing method
Accessory	20 ℓ gasoline tank with connecting pipe
Tools for maintenance	plug extractor, screwdriver(+)(-), wrench

Spare parts gasket complete, 20% of FOB price for body assembly, shaft system, and propeller driving system.

③ Equipment and materials for the repair shop

These are for the routine maintenance and minor repairs of outboard motors, ice-making machines, etc. Major repairs will be done at the workshop of the Fisheries Department. Major equipment and materials are as follows;

Special tools for diesel outboard motor	1 set
Special tools for gasoline outboard motor	1 set
Electric welder 14 KVA	1 unit
Welding rod for above and face mask	1 set
Thermometer for fish body +50 to -50	1 unit
Electric tester	1 unit
Bench grinder	1 unit
Current meter AC 300 A, DC 100 A	1 unit
Electric drill	1 unit
Insulated resistance meter	1 unit
Electric cord reel 20 m	2 units
Clearance gauge inner scale 10-200 mm	1 unit
Clearance gauge outside scale 300 mm	1 unit
Clearance gauge 0.03-3.0 mm	1 unit
Socket wrench 8,10,12,13,14,17 19,21,22,23,24,26, 27,29,30	1 set
Outside clearance pass max.100 mm	1 unit
Outside clearance pass max.400 mm	1 unit
Inside clearance pass max.100 mm	1 unit
Inside clearance pass max.300 mm	1 unit
Pipe wrench 200,450,900 mm	1 unit each
Plier 165,300 mm	1 unit each
Water pump plier 180,250 mm	1 unit each
Dial gauge with stand	1 unit each
Electric work nipper	1 unit
Ring spanner 8-10,10-12, 11-13,12-14, 11-13,	1 piece each

(45 ° angle)	12-14,17-19,19-21,23-26,24-26	
Nipper		1 piece
Radio plier	1.25-8.0 mm	1 piece
	0.8-38 mm	1 piece
Screw driver	with check bulb 6 pieces in a set	1 set
Chisel	9 X 9 X140	1 piece
	16 X19 X190	1 piece
Screw driver	(+) 100,200. (-) 75. 150. 250.	1 piece each
Punch	3,4,5,6,8,10,12,14,15,18,20	1 piece each
	22,24,26,28,30	
Solder iron	30w, 100w	1 unit each
Solder	1 kg plate type	1 unit
	1 kg coil type	1 coil
Paste	500 g/tin	1 tin
Marking off compasses		1 pair
Hexagonal wrench set		1 set
Needle file	10 pieces in a set	1 set
Vice	400 type	1 unit
Taper gauge	1-15 mm, 15-30mm	1 piece each
Surface plate	300X300X95	1 unit
Hammer	250g ,750g	1 unit each
Single hand Hammer	450g ,550g	1 unit each
Rubber Hammer	450g	1 piece
Lead Hammer	550g	1 piece
Double ended wrench	8-10,10-12,12-14	1 piece each
	13-17,19-21,22-24,	
	24-27,26-32,30-34,	
	36-41	
Drill bit	2.5,3.0,3.5,3.7,4.0,4.5,	5 pieces each
	5,5.0,5.5,6.0,7.0,7.5,8.0,	
	7.0,7.5,8.0,9.0,10.0,10.5,	
	12.0,12.5,	
Hand tap	3.0,4.0,5.0,	5 pieces each
	6.0, 8.0,10.0	
Tap holder	Max. 12 mm	2 pieces

Torque wrench	460 kg/f	1 unit
Hand tap	3.0,4.0,5.0,6.0,	2 pieces each
Pipe bender with pipe cutter	3-30mm	2 units
Hacksaw		1 unit
Hacksaw blade	14,18,24,	50 pieces each
Compound A alundum	#120,280,1000	2 boxes each
Tool box	535L,215W,190H	2 boxes
Metal saw	55 type	1 unit
Torch lamp	1 ℓ	1 unit
Oiler	200 cc	3 units
Grease gun	350 cc, 500 cc	1 unit each
Parts box	315L,200W,80H	2 boxes
Tool & parts shelf	2400L,600W,1800H	2 units
Freon gas leak checker		1 unit
Outboard motor repairing table		2 units
Outboard motor testing tank		1 unit

④ Fishing net

The specifications of the proposed fishing nets are to be similar to those of fishing nets that are now used as teaching materials of a training course of the Fisheries Department and that are widespread among the fishermen of the country.

a. Purse seining net complete 2 lots

This net will be used with the 13 m type canoe to be supplied from the project. To prevent penetration to the net of fish, its mesh is to be 5 - 6 cm, about 60% of the height of target fish bonga, about 10 cm high, 1.5 cm wide, and 25 cm long in average size. A longer net is welcome due to a comparatively high swimming speed of bonga, but, with a limited loading capacity of the boat the length of the net will be limited to 200 m in complete, 2 m^3 in volume. A knotless net is desirous due to its fast sinking speed, but its netting for repair is not available in the country, and a knot net made of twine as thin as possible therefore is to be provided. Since fishing is done on a rather shallow fishing ground about 10 to 15 m deep, the depth of the net of about 9 m will be suitable, considering a behavior of net at purse-ring seining.

Hence, about 200 m float line of 12 mm in diameter, 210 D/18 50 mm main net about 9 m deep are the main specifications of the net.

b. Netting

Netting for bonga fishing is to be 90 mm in mesh, based on the typical size of the target fish.

There are 2 types of netting for bottom gillnetting, one is for larger fish off shore and the other is for small fish around shoals. The former includes cassava fish, cat fish, and croakers, 40 to 80 cm long each, plus sometimes shark, and hence its netting is to be nylon multifilament 210 D/27, 120 mm mesh. The depth of the net is to be 3 m at finish due to the target fish's behavior range of 2 - 3 m. The netting of the latter, usually less than 40 cm long, is to be 210 D/12, about 100 mm mesh.

Such accessories as rope, float, sinker, are to be similar to those the Gambia fishermen are now using, and their quantities are to be enough to make complete nets. The major specifications are as follows;

Net	210D/ 9 3L 90mm str. 140 mesh depth 100m length	100 pcs.
	210D/12 3L 100mm str. 30 mesh depth 100m length	100 pcs.
	210D/27 3L 120mm str. 30 mesh depth 100m length	100 pcs.
Rope	3L Left 200m Dia.8mm 200m length	200 coils
Float	Cylinder type buoyancy 130g	10,000 pcs.
	Foot ball type buoyancy 100g	10,000 pcs.
Lead	75g	50,000 pcs.
Maker float	300mm	90 pcs.
Sinker	10kg	40 pcs.
Net needle	# 7	100 pcs.
	#10	100 pcs.
Twine	210D/ 9 3L 500g/coil	100 pcs.
	210D/12 3L 500g/coil	100 pcs.
	210D/27 3L 500g/coil	100 pcs.
	210D/36 3L 500g/coil	100 pcs.

⑤ Materials for the cold room

a. Fish box

Fish boxes are used for storage, transportation and so on. The quantities to be carried to the Bakau base are 5,880 kg of bonga and 790 kg of white meat fish, totalling 6,670 kg. Since bonga dominate the quantities of fish, the specifications of the fish box are to be based on the following criteria;

- The box have an enough space capable of arranging bonga, 10 cm high, 1.5 cm wide, and 25 cm long in standard size.
- The box with fish can be carried manually.
- When being stacked in the cold room, there are proper gaps for circulation of cooled air.
- Arranged fish can be covered with ice.

Hence, the required dimensions are as follows;

Outside	about 860 ×520 ×260 mm
Inside	about 790 ×480 ×196 mm

This type of fish box can accommodate 96 pieces of bonga, 3 lines of 32 pieces. As one bonga weighs about 250 g, the weight of the box with fish is

250 g × 96 = 24 kg

Hence the required number of boxes is

For the Bakau market

1000 kg ÷ 24 kg = 41 boxes plus other 41 boxes for rotational use.

For storage to the cold room

6600 kg ÷ 24 kg = 275 boxes

For truck transport

2100 kg ÷ 24 kg×2 trucks = 180 boxes

Thus the total number of boxes is 754, and, when a 15% is added the required number is 754×1.2 = 867, that is, 870 boxes are required.

b. Miscellaneous

For various works in the cold room and the ice plant some scoops and wheelbarrows are to be supplied.

⑥ Insulated van truck

The insulated van truck is used for transport fish and ice. Assuming that a service schedule is as follows, two trucks will suffice (see Table-27).

Transport of ice: once a day

Transport of fish to the capital region: once a day

Transport of fish to the inland aras: Monday and Thursday

Table-27 Transport Service Schedule

	Mon		Tue		Wed		Thu		Fri		Sat	
No.1 van	○	□	○	□	○	-	■	■	-	□	-	○
No.2 van	■	■	-	○	-	□	○	□	○	-	○	□

Note; ○: Transport of fish to the capital region

■: Transport of fish to the inland areas

□: Transport of ice

- : Reserve and servicing

The maximum quantities to be carried are 2,100 kg for the inland ares. To meet the requirement the number of boxes to be loaded in the van, inside dimensions of 4255(L) ×1735(W) ×1830(H) mm, will be calculated as follows.

As the inside height of the van is 1,830 mm, the maximum height of stacked boxes is established at 1,500 mm for safety and working efficiency, the number of boxes of one column is 1,500 mm÷260 mm(outside height of the box)=5.77≒6, and, according to the dimensions of the van and the box

4,255 mm÷520 mm = 8.2≒8

1,735 mm÷860 mm = 2.1≒2

Hence, the number of fish boxes is 96 boxes (6×8 ×2) at maximum.

5-2-3 Financial Prospect of the Project

(1) Fishing boat and fishing gear

By the provision of these equipment and materials, the Fisheries Department can expect an increase of fish production, an increase of earnings of fishermen, and creation of employment opportunities.

1) 13 m type fishing boat with diesel outboard motor 2 units

① Bonga fishing

Preconditions

Bonga producer's price	D 0.70/kg	
Landing of bonga a day	950 kg out of a catch of 980 kg a trip	
Days at fishing	275 days	
Crew	8 persons	
Fishing boat value	D 100,000	5 year loan
Outboard motor value	D 22,000	3 year loan
Fishing gear value	D 22,000	2 year loan
Diesel oil price	D 4.00/ℓ	

Income

950 kg/day × 275 days × D 0.70 = D 182,875 /year

Expenditure

Fuel oil cost	20 ℓ /day × 275 days × D 4.00/ℓ	= D 22,000/year
Provisions	D 20 × 275 days	= D 5,500/year
Repair of fishing gear	D 22,000 × 0.1	= D 2,200/year
Repayment of fishing gear	D 22,000 × 1/2	= D 11,000/year
Repair of outboard motor	D 22,000 × 0.2	= D 4,400/year
Repayment of outboard motor	D 22,000 × 1/3	= D 7,333/year
Repayment of fishing boat	D100,000 × 1/5	= D 20,000/year
Wages	D700 × 12 months × 8 persons	= D 67,200/year
Total		D139,633/year

Hence, D 182,875 /year − D139,633/year = D 43,242

Employment opportunities of 16 persons (with incomes of D8,400 a year) and an increase of production by about 50 tons a year can be expected.

On the other hand, in the case where the price of bonga declines by 20% (to D 0.56/kg), while the price of diesel oil rises by 30% (to D 5.20/ℓ),

income =950 kg/day × 275 days × D 0.56 = D 146,300 /year and the expenditure

increases by D 6,600 (=20 ℓ /day × 275 days × D 1.20/ ℓ), reaching D 146,233, resulting in a loss.

② Bottom gillnetting

Preconditions

Bottom fish producer's price	D 7.00/kg	
Landing of bottom fish	64 kg/day	
Days at fishing	275 days	
Crew	4 persons	
Fishing boat value	D 100,000	5 year loan
Outboard motor value	D 22,000	3 year loan
Fishing gear value	D 22,000	2 year loan
Diesel oil price	D 4.00/ ℓ	

Income

64 kg/day × 275 days × D 7.00 = D 123,200 /year

Expenditure

Fuel oil cost 12.5 ℓ /day × 275 days × D 4.00/ ℓ		= D 13,750/year
Provisions	D 10 × 275 days	= D 2,750/year
Repair of fishing gear	D 22,000 × 0.1	= D 2,200/year
Repayment of fishing gear	D 22,000 × 1/2	= D 11,000/year
Repair of outboard motor	D 22,000 × 0.2	= D 4,400/year
Repayment of outboard motor	D 22,000 × 1/3	= D 7,333/year
Repayment of fishing boat	D100,000 × 1/5	= D 20,000/year
Wages	D700 × 12 months × 4 persons	= D 33,600/year
Total		D 95,033/year

Hence, D 123,200 /year − D 95,033/year = D 28,167

Employment opportunities of 8 persons (with incomes of D8,400 a year) and an increase of production by about 17 tons a year can be expected.

On the other hand, in the case where the price of bottom fish declines by 20% (to D 5.60/kg), while the price of diesel oil rises by 30% (to D 5.20/ ℓ), income =64 kg/day × 275 days × D 5.60 = D 98.560/year and the expenditure increases by D 4,125 (=12.5 ℓ /day × 275 days × D 1.20/ ℓ), reaching D 99,233, resulting in a loss of D 598.

(2) Shore facilities

The facilities will be operated by the Committee, and the Fisheries Department will dispatch necessary engineers to run the machinery.

1) Expenditure

① Wages

Based on the current wage schedule the following wages are established.

General manager	1 person ×D1000/month × 12 months =	D12,000/year
Accountant	1 person ×D 800/month × 12 months =	D 9,600/year
Store keepers	2 persons×D 500/month × 12 months =	D12,000/year
Workers	2 persons×D 500/month × 12 months =	D12,000/year
Drivers	2 persons×D 600/month × 12 months =	D14,000/year
Guardsmen	2 persons×D 400/month × 12 months =	D 9,600/year
Total		D69,600/year

② Electric charges

The electricity of the facilities is consumed as follows;

• Ice plant	18.0 KW ×21 hrs/day× 315 days =	119,070 KW/year
• Ice bin	3.5 KW ×24 hrs/day× 365 days =	30,660 KW/year
• Cold room	7.0 KW ×80% ×21 hrs/day× 365 days =	42,942 KW/year
• Pumps		
Fuel transfer pump	1.5 KW×2 units ×3 hrs/day ×365 days=	2,835 KW/year
Fresh water pump	1.0 KW×1 unit ×3 hrs/day ×365 days=	945 KW/year
• Lighting	2.0 KW× 6 hrs/day× 315 days =	3,780 KW/year
	5.0 KW× 6 hrs/day× 315 days =	9,450 KW/year
Total		209,664 KW/year

A unit charge of electricity is D 1.85/KW, and hence, the electric charges a year are as follows;

209,664 KW/year ×D 1.85/KW = D 387,874.00

However, at the present the public power utility of Bakau gets frequently out of order, so the back up generator will have to be operated regularly. In this case, electricity of the project will be as follows, which result is to be used on the project evaluation.

Since the fuel consumption of the generator is 20.0 ℓ/hour,

20.0 ℓ/hour × D 3.75/ ℓ × 24 hours × 315 days = D 567,000.00

③ Water charges

A unit charge of water is D 4.10/1,000 ℓ .

Water for fish washing	6,190 ℓ ×315 days	= 1,949,850 ℓ
Raw water for ice	1,800 ℓ ×2 units ×315 days	= 1,134,000 ℓ
Water for facilities	6,190 ℓ ×315 days	= 2,614,500 ℓ
Total		5,698,350 ℓ

Hence the water charges of the project is

5,698,350 ℓ × D 4.10/1,000 ℓ = D 23,363.24

④ Fuel of insulated vans

25 ℓ /day×315 days× D.3.75/ ℓ ×2 units = D 59,063

⑤ Maintenance cost

Ice plant	D 6,670.00
Cold room	D 3,300.00
Generator	D 6,670.00
Building	D 6,670.00
Insulated van	D 3,300.00
Total	D26,610.00

2) Income

① Fuel proceeds

(a) Gasoline

• Bottom gillnetter	8 units× 25 ℓ × 275 days	= 55,000 ℓ
• Bonga boat	11 units× 40 ℓ × 275 days	=121,000 ℓ
• Large hand-liner	1 unit × 90 ℓ × 91 trips	= 8,190 ℓ
Total		184,190 ℓ

Buying price of gasoline D 5.25/ ℓ

Selling price of gasoline D 5.50/ ℓ

(for reference, market price is D 7.50/ ℓ .)

Hence the gasoline proceeds a year are

184,190 ℓ ×(D 5.50/ ℓ −D 5.25/ ℓ) = D 46,047.50/year

(b) Diesel oil

• Bottom gillnetter	2 units× 14 ℓ × 275 days	= 7,700 ℓ

• Bonga boat	2 units × 20 ℓ × 275 days	= 11,000 ℓ
• Large hand-liner	2 units × 40 ℓ × 315 days	= 25,200 ℓ
Total		43,900 ℓ

Buying price of gasoline D 3.75/ ℓ

Selling price of gasoline D 4.00/ ℓ

(for reference, market price is D 5.00/ ℓ .)

Hence the diesel oil proceeds a year are

43,900 ℓ × (D 4.00/ ℓ − D 3.75/ ℓ) = D 10,975 /year

② Ice proceeds

(a) Ice for white meat fish

490 kg/day × 315 days = 154,350 kg/year

(b) Ice for storage

In order to store 5,200 kg of fish, as mentioned above, 1,105 kg/day of ice is required.

1,105 kg/day × 315 days = 348,075 kg/year

(c) Ice for transport to other fishing bases

1,100 kg/day × 315 days = 346,500 kg/year

Hence the proceeds of ice are

(154,350 kg + 348,075 kg + 346,500 kg) × D 0.70 = D 594,247.50/year

③ Storage fee

The storage fee a 24 kg fish box a day is established at D 1.00, and the number of fish boxes for storage and transport is to be 217 boxes (5,200 kg of fish), and hence the storage fee is

217 boxes × D 1.00/day × 315 days = D 68,355.00/year

④ Rental fee of fish drying rack

10 racks × D 50.00/month × 12 months = D 6,000.00/year

⑤ Rental fee of smoking hut

1 hut × D 100.00/month × 12 months = D 1,200.00/year

⑥ Rental fee of fishermen's locker

44 lockers × D 25.00 /month × 12 months = D 13,200.00/year

⑦ Freight of insulated van

The freight of fish a 24 kg box is established at D 5.0 for long distance, D 2.0 for coastal area, and D 1.0 for short distance. Hence

Freight earned by long distance transport

D 5.0 ×88 boxes ×2 times/week×365/7 week = D 45,885.71

Freight earned by transport to coastal areas

D 2.0 ×50 boxes ×6 times/week×365/7 week = D 31,285.71

Freight earned by long distance transport

D 1.0 ×217 boxes ×6 times/week×365/7 week = D 67,890.00

Total D145,061.42

3) Balance

Base on the figures above, the balance of the shore facilities is estimated as follows. It is concluded that the facilities will be viable financially.

Table-28 Estimate Balance of Shore Facilities

Income (D)		Expenditure (D)	
1) Fuel proceeds		1) Wages	69,600.00
Gasoline	46,047.50	2) Fuel for generator	567,000.00
Diesel oil	10,975.00	3) Water charges	23,363.24
2) Ice proceeds	594,247.00	4) Fuel for van	59,063.00
3) Storage fee	68,355.00	5) Maintenance cost	
4) Rack for drying	6,000.00	Ice plant	6,670.00
5) Smoking hut	1,200.00	Cold room	3,300.00
6) Fishermen's locker	13,200.00	Generator	6,670.00
Freight	145,061.42	Building	6,670.00
		Van truck	3,300.00
Total	885,086.42	Total	745,636.24

Hence, the balance of the facilities is

D 885,086.42 − D 745,636.24 = D 139,450.18/year

On the other hand, in the case where the price of fuel oil rises an increased diesel oil price affects the expenditure of the facilities. Assuming that the price rises by 20 %, the price of diesel oil is D3.75/ℓ ×1.2=D4.50/ℓ, resulting in an increase of the expenditure as follows;

Generator: 20 ℓ/h×(D4.50-D3.75) ×24 h×315 days= D 113,400/year

Van truck: 25 ℓ/day×(D4.50-D3.75) ×315 days×2 units= D 11,812/year

In this case the total expenditure is

D 113,400+ D 11,812 +D 745,636.24=D 870,848.24, and a slight profit can be obtained. However, in case of a rise more than 25% will make the balance worse, if there is no rise of fish price, ice price, and storage fee.

4) Fluctuation of the price of bonga

At the present the producer's price of bonga is D 0.70 per kg. With the facilities operating the following costs will occur.

- Storage fee

  The storage fee a box of 24 kg is D 1.00, so it is D 1.00 ÷ 24 = D 0.05.

- Cost of ice

  The quantity of ice necessary to cover 5,200 kg of fish is 1,105 kg, so the required quantity of ice for kg of fish is 1,105 ÷5,200=0.21 kg.

  The price of ice is D 0.7/kg, so the cost of ice for 1 kg of fish is

  0.21 kg ×D 0.7/kg = D 0.147≒ D 0.15

Hence, the cost necessary to store 1 kg of fish is

D 0.05 + D 0.15 = D 0.20

- Freight

  The freight of D 5.0 is needed to carry a 24 kg boxful of fish to Mansa Konko or Soma by insulated van, that is, D 0.21 per kg.

  In the case where the destination of shipment is Banjul or Sere Kunda, the freight per kg is D 1.0÷24 kg = D 0.05.

Hence, adding the costs above to the producer's price

The broker's purchasing price at Mansa Konko is

D 0.70+0.20+0.21 = D 1.11/kg and

The broker's purchasing price at Banjul or Sere Kunda is

D 0.70+0.20+0.05 = D 0.95/kg

At the present the consumer's price of bonga at Banjul and Mansa Konko is D 1.50/kg and D 2.50/kg respectively. In comparison with these current prices the

prices, D 1.11/kg and D 0.95/kg, are completely competitive.
In addition, the successful quality control throughout the distribution will make it possible to minimize waste of fish.

5-2-4 Basic Design Plans

The following are the basic design plans;

① Plot Plan

② Main Building (Plan)

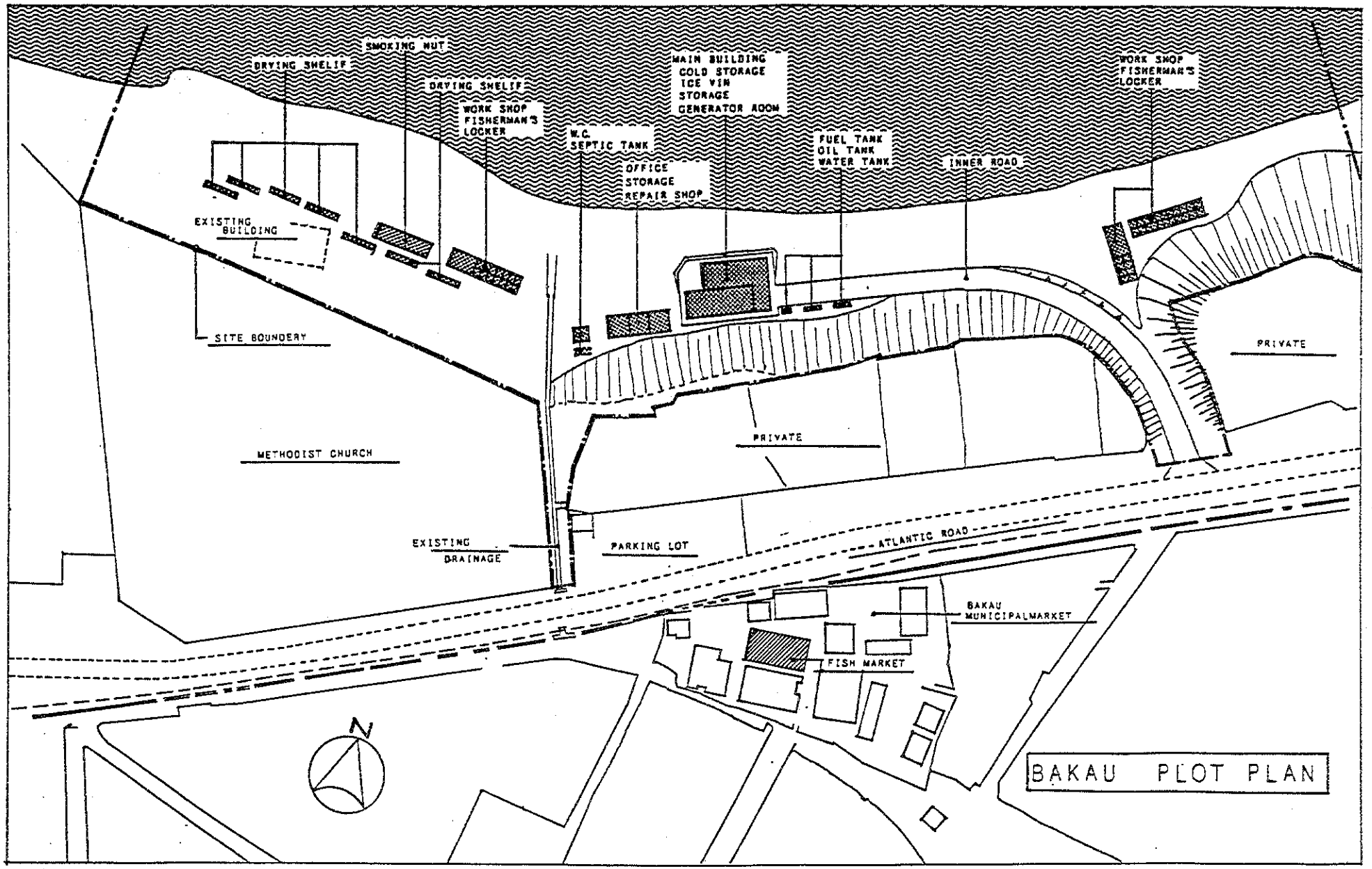
③ Main Building (Section)

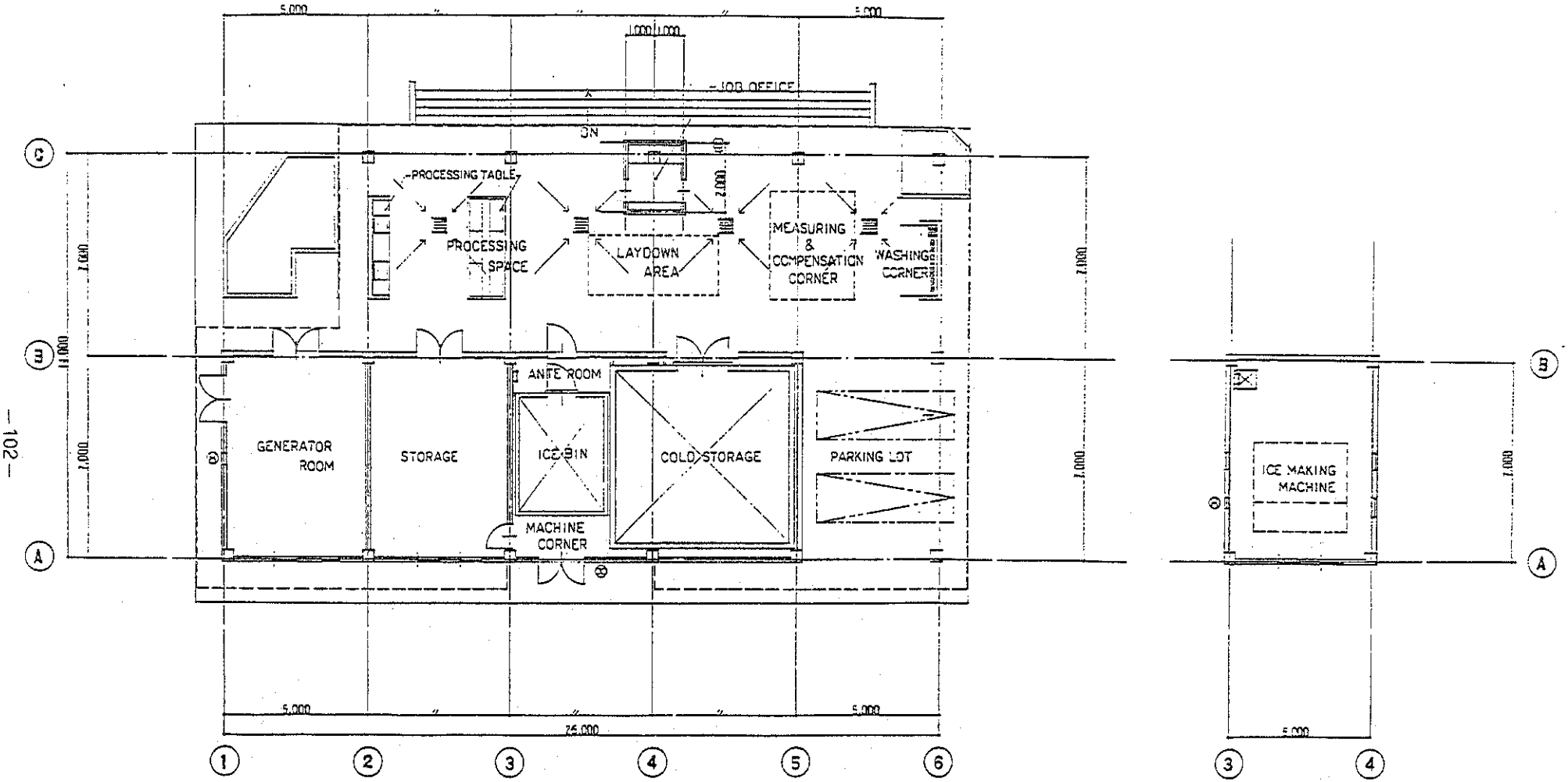
④ Main Building (Elevation)

⑤ Office/Repair Shop/Store
(Elevation, Plan, and Section)

⑥ Locker Room/Workshop
(Elevation, Plan, and Section)
Toilet Building
(Elevation, Plan, and Section)

⑦ Smoking Hut
(Elevation, Plan, and Section)
Drying Shelf
(Elevation, Plan, and Section)

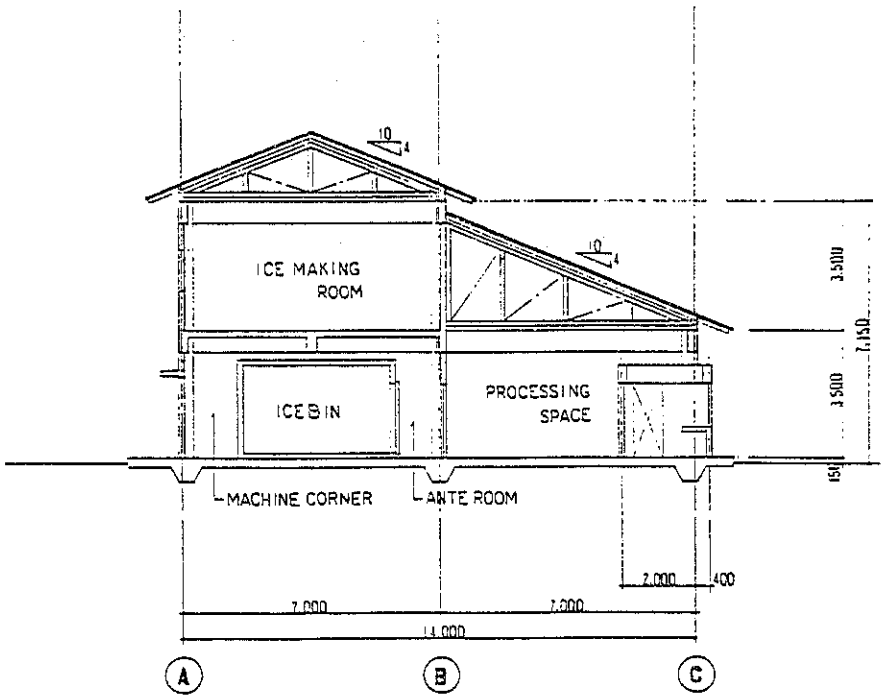

DRYING SHELIF
SMOKING HUT
DRYING SHELIF
WORK SHOP
FISHERMAN'S
LOCKER
MAIN BUILDING
COLD STORAGE
ICE VIN
STORAGE
GENERATOR ROOM
W.C.
SEPTIC TANK
OFFICE
STORAGE
REPAIR SHOP
FUEL TANK
OIL TANK
WATER TANK
INNER ROAD
WORK SHOP
FISHERMAN'S
LOCKER
EXISTING
BUILDING
SITE BOUNDERY
METHODIST CHURCH
PRIVATE
PRIVATE
EXISTING
DRAINAGE
PARKING LOT
ATLANTIC ROAD
BAKAU
MUNICIPALMARKET
FISH MARKET
N
BAKAU PLOT PLAN



1F PLAN S-1/100

2F PLAN

MAIN BUILDING



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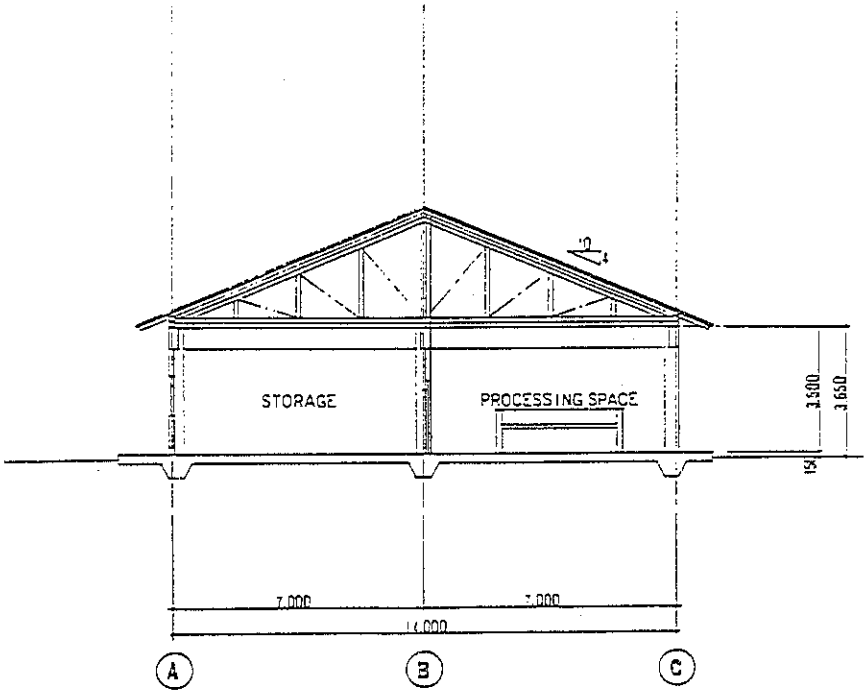

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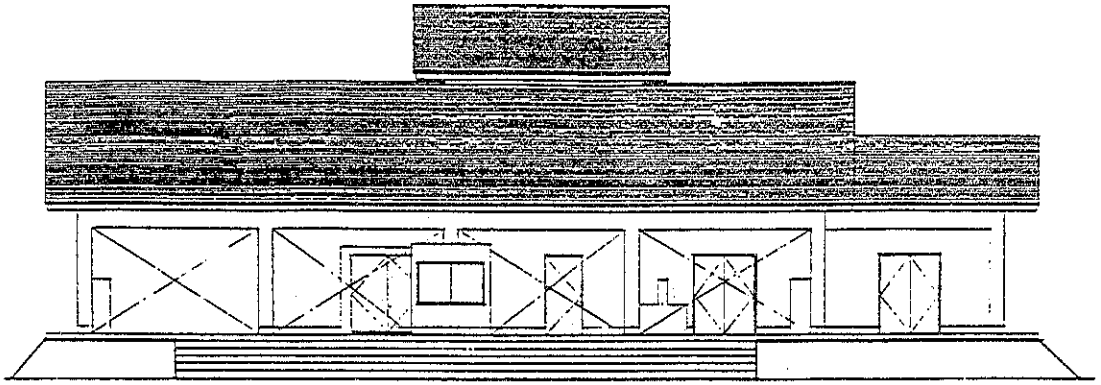
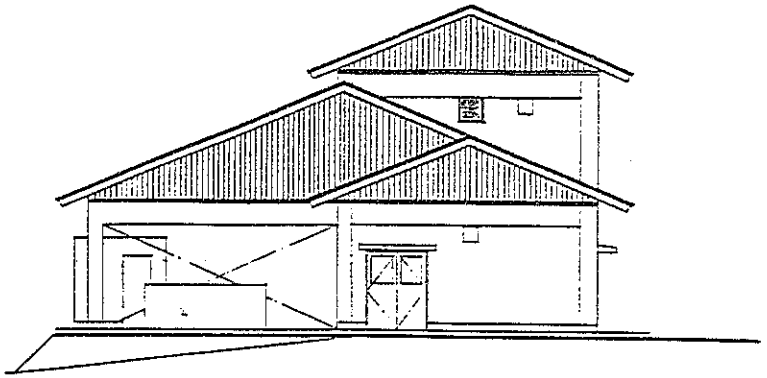
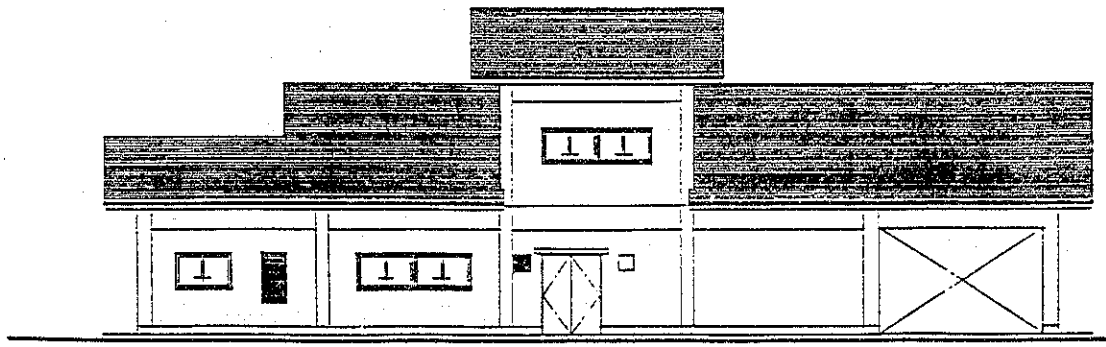
MAIN BUILDING



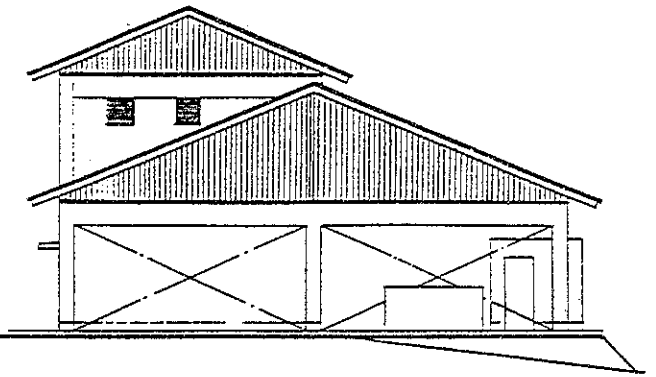
NORTH ELEVATION S=1/100



WEST ELEVATION

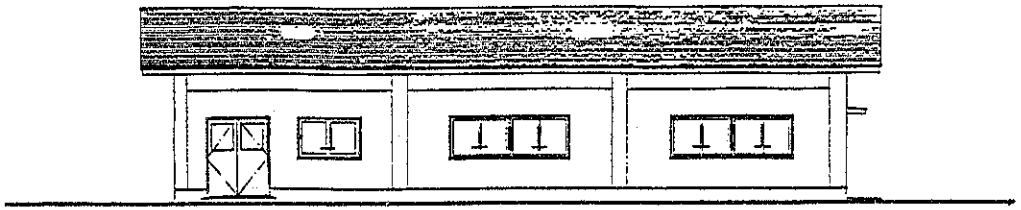


SOUTH ELEVATION

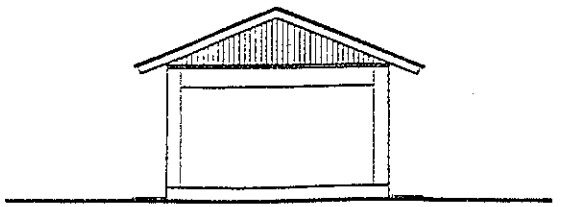


EAST ELEVATION

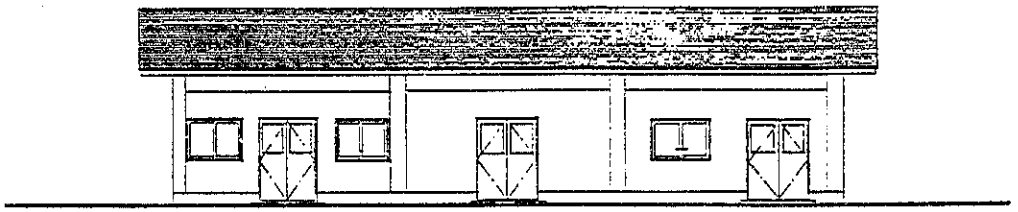
MAIN BUILDING



SOUTH ELEVATION



EAST ELEVATION



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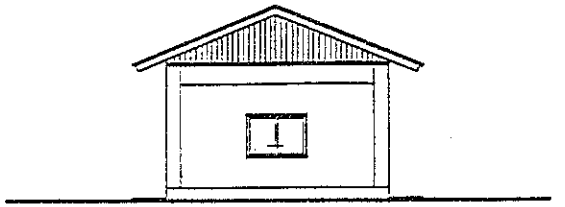

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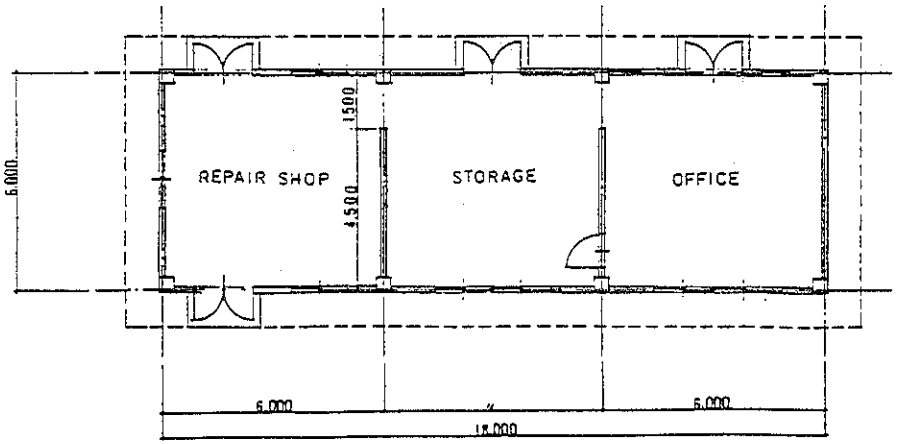

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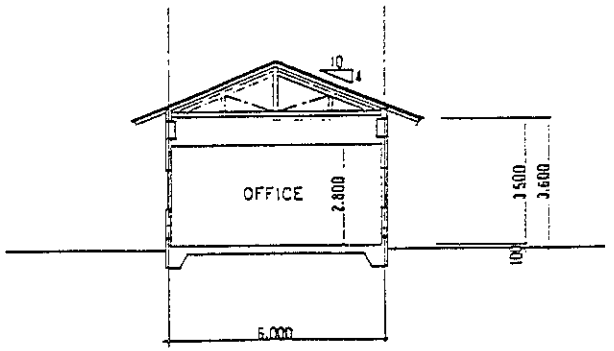
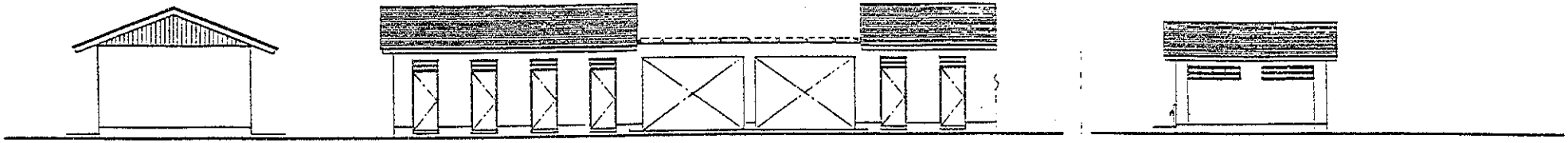


SECTION S=1/100

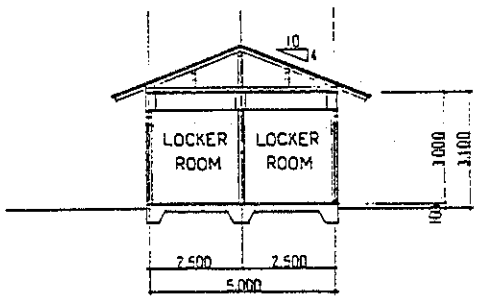
OFFICE・STORAGE・REPAIR SHOP



WEST ELEVATION

NORTH ELEVATION S=1/100

SOUTH ELEVATION



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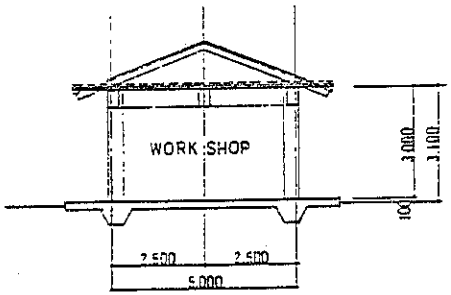
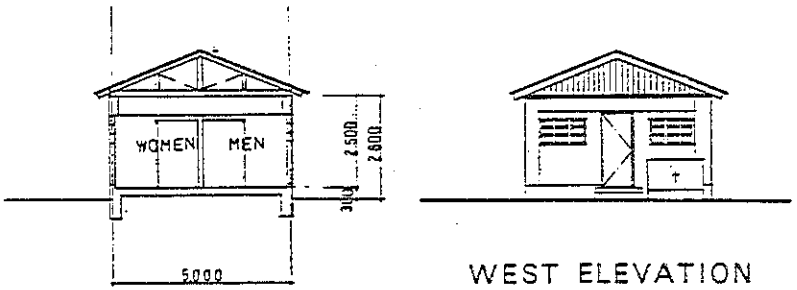


SECTION



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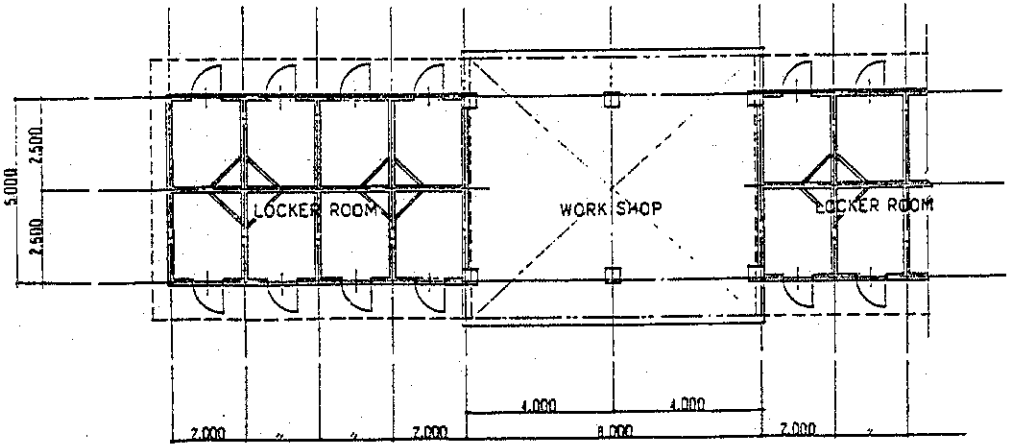
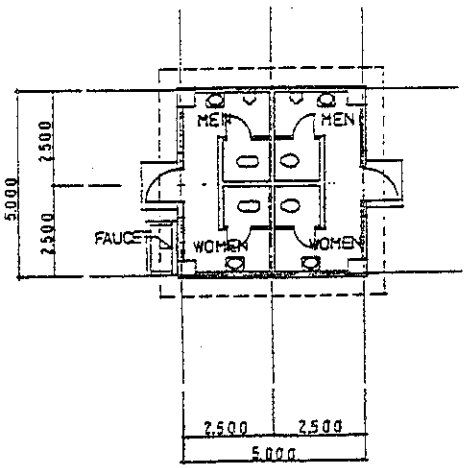


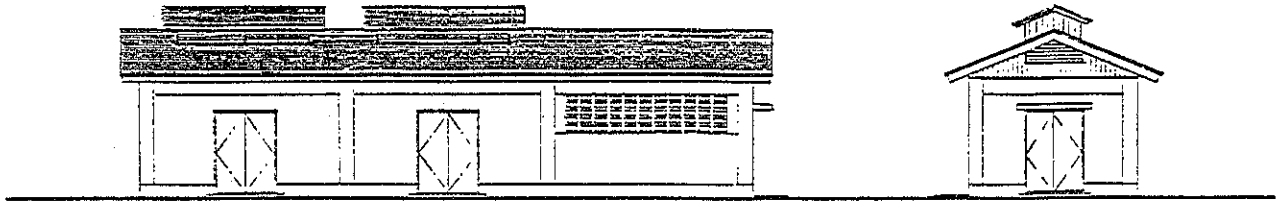
PLAN S=1/100

LOCKER ROOM-WORK SHOP



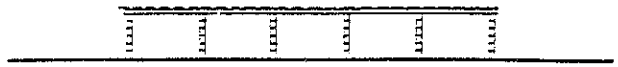
PLAN S=1/100

TOILET BUILDING

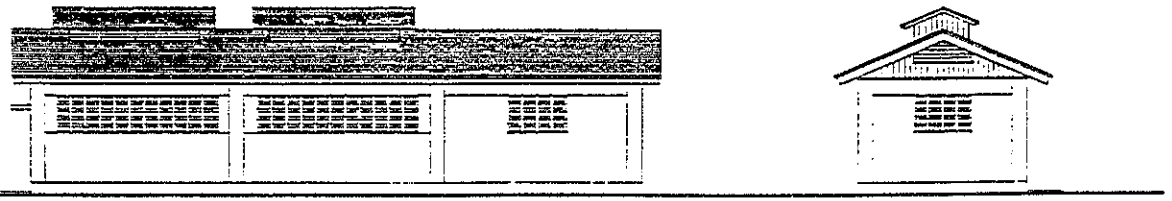


NORTH ELEVATION

WEST ELEVATION

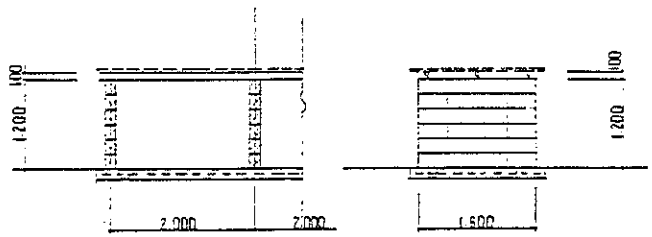


ELEVATION S=1/100



SOUTH ELEVATION

EAST ELEVATION



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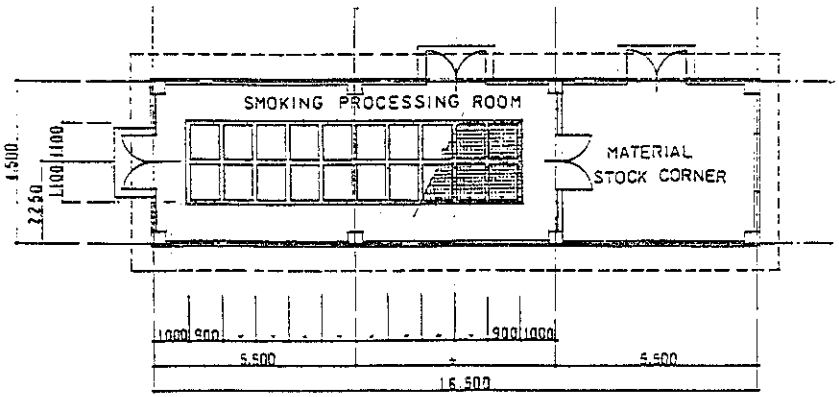

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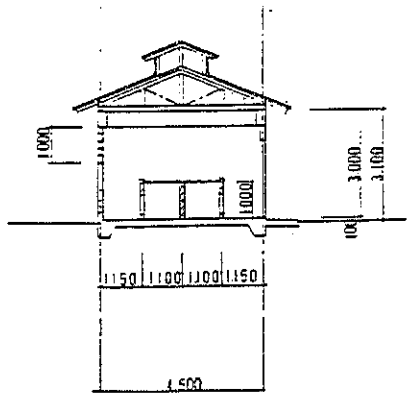
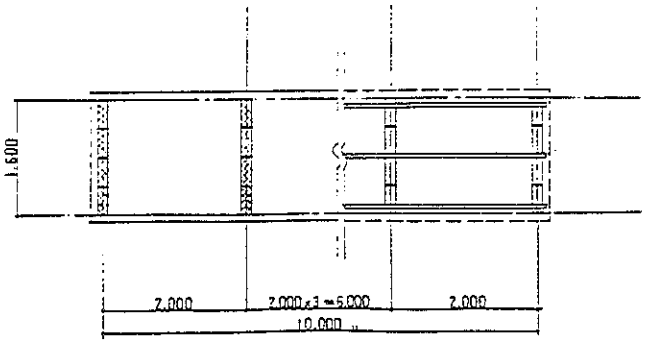


SECTION

SMOKING HUT



PLAN S=1/50

DRYING SHELF

5-3 Implementation Plan

(1) Implementation Policy

The major components of the project are as follows;

- Shore facilities:

Main building	RC one-story building (partly two-storied)	315	㎡
Office/repair shop/store	RC one-story building	108	㎡
Fishermen's locker	Block one-story building ×2	220	㎡
Smoking hut		74.25	㎡
Toilet		20	㎡
Rack for drying		10	unit
Exterior work	A Premises road	1	lot
	B Main building mound	1	lot

Labor force will be available locally due to a normal construction method, but electric engineers and refrigeration engineers must be sent from Japan due to the lack of technology in the country.

(2) Local Construction Conditions

Among the construction materials of the project, those not available locally are to be imported from other countries. Locally available construction materials are only soil, sand, concrete blocks, timber, and so on, and even gravel and crushed stone are imported from Senegal. Since the shore facilities of the project are mainly of RC block construction, cement, sand, gravel are available locally in due consideration of stock.

Equipment and apparatuses are to be procured in Japan.

(3) Scope of Work

The work executed under Japan's grant aid is as follows;

- Construction of the main building, office/repair shop/store building, fishermen's locker/work shop building, smoking hut, toilet, and attached facilities.
- Construction of the premises road and main building mound
- Provision of fishing materials and equipment necessary for the management of the Bakau fishing base.
- Service concerning the implementation of the above-mentioned work.

1) Work borne by the Japanese side

- Expenses for the construction of the facilities and manufacturing of equipment and materials.
- Sea and inland transportation of equipment and materials with insurance.
- Consulting services concerning tender, execution, supervision, etc.

2) Work borne by the Gambia side

- Prompt unloading, tax exemption, and customs clearance of the equipment and materials of the project at the port of disembarkation in the Gambia.
- Security of the project site, removal of the obstacles from the project site, and supply of water, power, and telephone necessary to the project.
- Tax exemption to Japanese nationals whose services are required in connection with the supply of products and services under the verified contract.
- Expenses necessary for effective management and maintenance the project and provision of necessary apparatuses, fixtures, and furniture.

(4) Supervisory Plan

After the conclusion of a contract between the Government of the Gambia and a Japanese contractor, a consulting firm will check all the drawings and plans concerning equipment and materials manufactured and procured in Japan. Also the consultant firm will be present at necessary tests and inspections.

On the commencement of the work at the project site, the consultant firm will coordinate and supervise the conformity of construction method, work progress, and detail arrangement with the requirements of the specifications, keeping in close contact with the Government of the Gambia.

Prior the completion of the project, the consultant firm will perform necessary tests and inspections, and then will be in present at the delivery of the project to the Government of the Gambia.

(5) Implementation Schedule

In the implementation schedule of the project the construction of the premises road will be given priority over all other works, because only this road will give construction machinery access to the project site. Soil and gravel necessary for the construction of the premises road will be available in the

country or by import from Senegal.
Equipment and materials for the building work, and machinery and apparatuses for refrigeration and so on are to be procured in Japan, and these are to be shipped in good time due to a rather long transport time (about two and a half months).
On the completion of the premises road, all the facility buildings are to be constructed simultaneously. It is estimated that it will take about 7 months to complete the project after the conclusion of the contractor's contract.

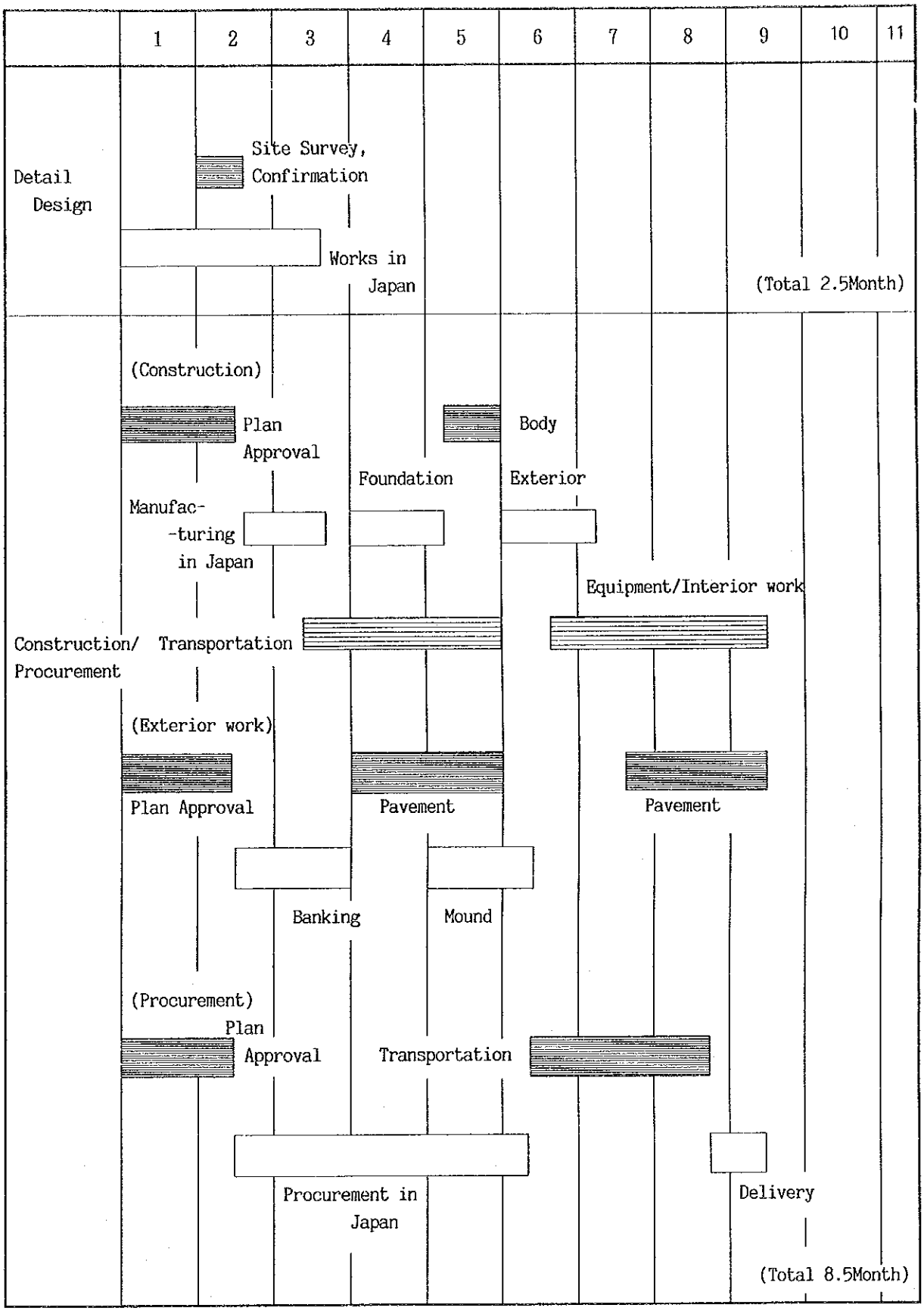
A project schedule is shown in the following page.

(6) Estimated cost to be borne by the Gambia side
Cost to be borne by the Gambia side is estimated at about D 120,000 and its breakdown is given as follows. The details are shown in Appendix I - ⑦.

①	Site clearance	complete	D 10,000
②	Fence	complete	D 30,000
③	Provision of power, water, and telephone		D 80,000
	Total		D 120,000

(about ¥ 1.8 mn at a rate of US$= ¥134, D= ¥14.67 as of December 1991)

P R O J E C T S C H E D U L E



CHAPTER 6

PROJECT EVALUATION AND CONCLUSION

CHAPTER 6 PROJECT EVALUATION AND CONCLUSION

Although its shoreline is rather short, about 57 km, the Gambia has a continental shelf which is part of the world best fishing ground off the western Africa, having estimated 75,000 tons of the maximum sustainable yield (MSY). However, the fish production of the country has been 20,000 to 30,000 tons for the past decade, without a full exploitation of the marine resources.

The fish production is supplying about 90% of animal protein to the people who have a strong preference for fish. The nation's animal protein intake has varied in proportion to the fish production, and so the increased fish production and an improved fish distribution system are sure to contribute greatly to improve the nutrition of the people. Although the offshore resources are being exploited by the industrial fisheries and foreign fishing vessels, the coastal fisheries by artisanal fishermen are less developed due to poor fishery-related infrastructure.

In an attempt to solve these problems the project aims to provide fishery-related infrastructure at a traditional landing spot on the Atlantic coast of Bakau, neighboring on Bunjul, the capital, and consisting of "Greater Bunjul" together with Sere Kunda.

6-1 Project Effects

6-1-1 Increase of fish production

On the implementation of the project, an increase of some 1,700 tons of fish production can be expected through the newly-provided fishing boats and the Bakau fishing boats returned from fishing away from home due to an improvement of shore facilities.

6-1-2 Improvement in quality

Utilization of ice and storing in the cold room will make it possible to distribute at fresh state about 650 tons out of about 870 tons of fish dumped due to spoilage every year.