DEPT. OF STATE FOR PRESIDENTIAL AFFAIRS.
FISHERIES & NATURAL RESOURCES
THE REPUBLIC OF THE GAMBIA

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR IMPROVEMENT OF FISHING AND PRESERVATION FACILITIES FOR INLAND FISH DISTRIBUTION
IN
THE REPUBLIC OF THE GAMBIA

MARCH 1999

JAPAN INTERNATIONAL COOPERATION AGENCY
CRC OVERSEAS COOPERATION Inc.

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PREFACE

In response to a request from the Government of The Gambia the Government of Japan decided to conduct a basic design study on The Project for Improvement of Fishing and Preservation Facilities for Inland Fish Distribution in the Republic of The Gambia and entrusted the study to the Japan International Cooperation Agency (JICA).

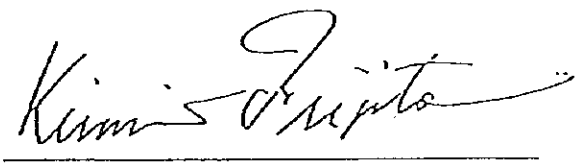
JICA sent to The Gambia a study team from October 28, 1998 to November 22, 1998.

The team held discussions 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 basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

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

March, 1999



Kimio Fujita
President
Japan International Cooperation Agency

March, 1999

LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on The Project for Improvement of Fishing and Preservation Facilities for Inland Fish Distribution in the Republic of The Gambia.

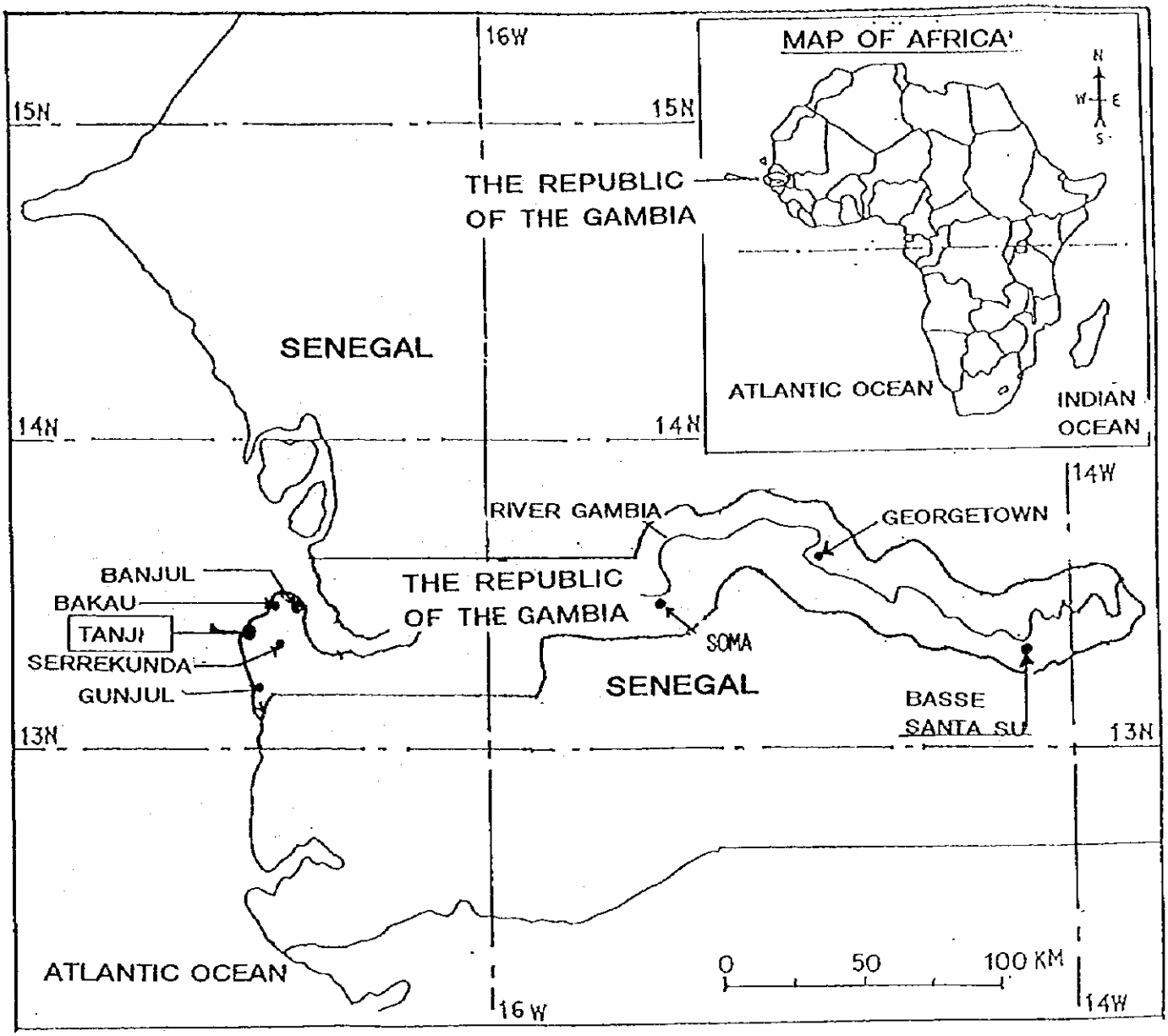
This study was conducted by CRC Overseas Cooperation Inc., under a contract to JICA, during the period from October 20, 1998 to March 8, 1999. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of The Gambia and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

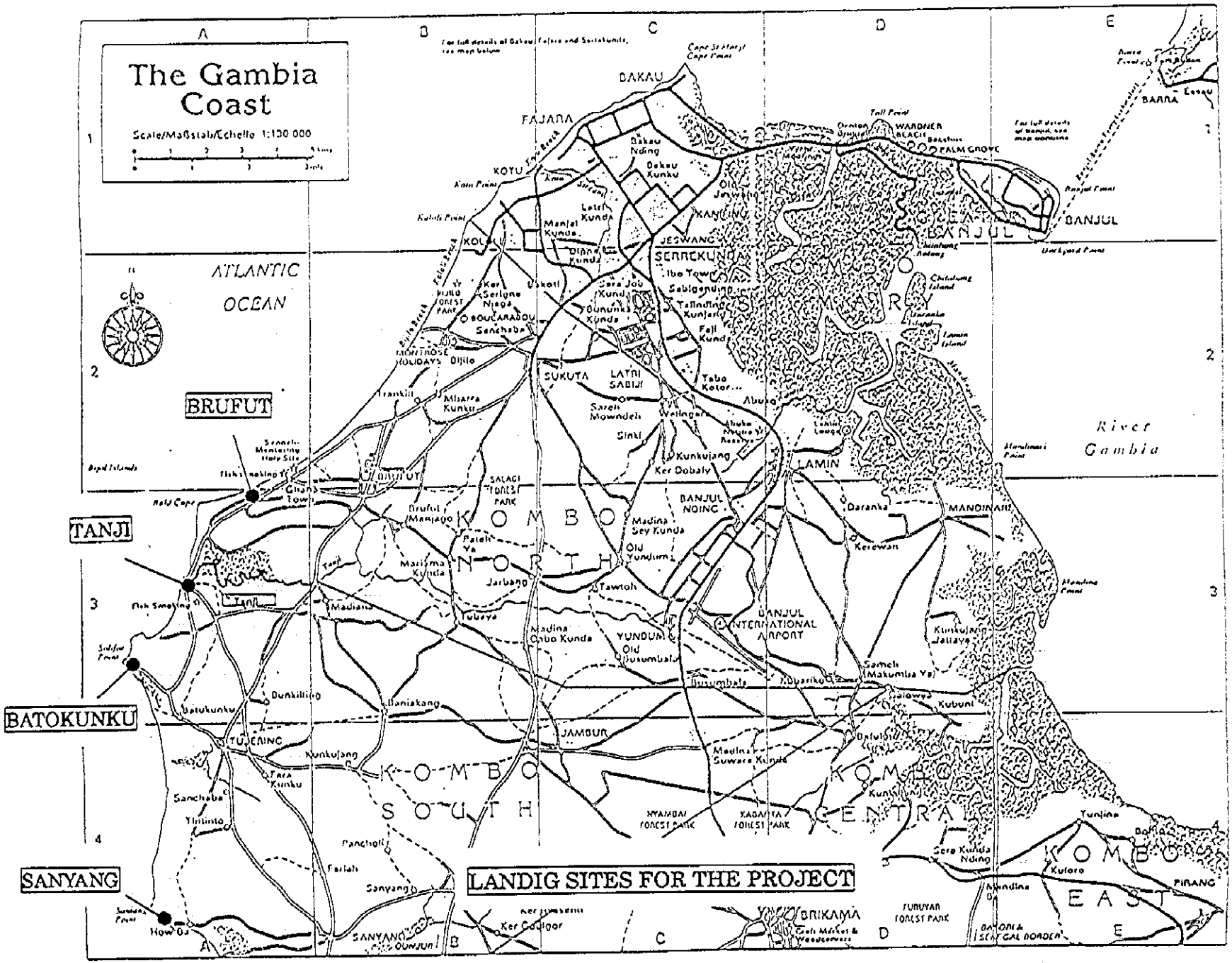
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Kohsuke SHIMAZU
Project Manager
Basic Design Study Team on
The Project for Improvement of Fishing and
Preservation Facilities for Inland Fish
Distribution in The Republic of The Gambia
CRC Overseas Cooperation Inc.

LOCATION MAP OF THE REPUBLIC OF THE GAMBIA




The Gambia Coast
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BRUFUT
TANJI
BATOKUNKU
SANYANG
LANDIG SITES FOR THE PROJECT
BANJUL
KOMBO NORTH
KOMBO SOUTH
KOMBO CENTRAL
KOMBO EAST
KANIFING MUNICIPALITY
River Gambia
DAKAU
FAJARA
KOTU
SERREKUNDA
BRIKAMA
LAMIN
BANJUL INTERNATIONAL AIRPORT
SUKUTA
LATRI SABIJI
JAMBUR
YUNDUM
TUJERING
SANYANG
BARRA
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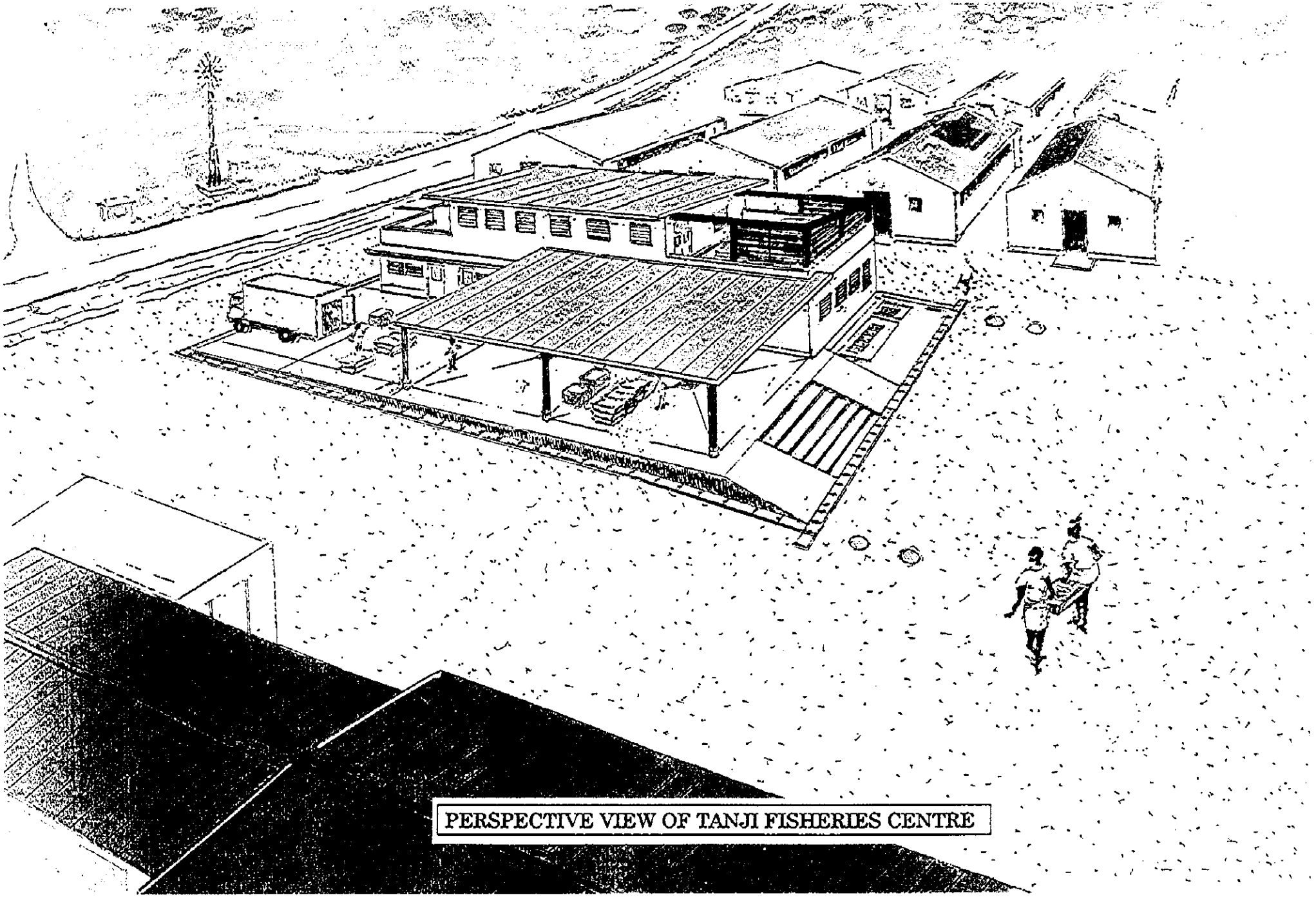
GAMBIA/SENEGAL BORDER



PERSPECTIVE VIEW OF TANJI FISHERIES CENTRE

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Chapter 4 Project Evaluation and Recommendations

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Chapter 1

Background of the Project

Chapter 1. Background of the Project

1-1 Background

Republic of The Gambia is located at the western end of the continent of Africa along almost 13 deg. N latitude, being bordered by Senegal except the coastline. The country is long and slender in shape along the Gambia River, about 300 km east and west and 30 to 50 km north and south. The land area is 11,300 square km, of which about 2,000 square km is included in swampy land along the Gambia River. The country belongs to the tropical savanna climate with the dry season (November to May) having no rainfall and the rainy season (June to October). The total population is 1,205 thousand (1996), which consists of 6 tribes, and more than 80% are Mandingo. Most of the fishermen belong to the Wolof tribe. The principal religious groups are Moslem (90%) and Christian (9%). English is the official language and languages of main tribes are also spoken widely. The immigrant fishermen from Senegal speak French. The Gambia has been a UK colony since 1882 and declared independence as Republic in February 1965 and became a member of the commonwealth.

The state economy relies heavily upon agriculture, fisheries, and tourism. The 1995 GDP was $ 384 million and GNP per capita was $ 320. The economic growth rate was 1.6% for the past four years. Economical activities are slack as a whole because the country's main production of peanut is unstable due to drought and famine and its international price is declining. The soil of the banks of the Gambia River is not arable due to salinity caused by a flood seawater going up the River, often more than 100 km from the mouth, by the tides. This is a serious difficulty to agriculture development. The tourism depends mainly upon visitors from Europe wintering by charter flight. Visitors have increased to about 90,000 in 1993 compared with 50,000 in 1980s, but was halved in 1994 due to a military coup. The revival of tourism can be expected as the political situation becomes stable, but will not make up for depressed agricultural production. The Government is striving to activate the economy by diversification of agricultural products, but the effects are not seen due to declining prices in worldwide depression. A rise in prices also bears heavily on household economy, while wages of civil service are

pegged. The state economy is still slack as a whole.

Following the first National Development Plan (1976-1980) aiming at social development, the second National Development Plan (1981-1985) placed emphasis on agriculture, the Economic Recovery Programme in 1985 aiming at a long-term economic growth through increasing public investment and encouraging private investment, were formulated. Then the 2nd Economic Recovery Programme (1988-1990) was succeeded to the Programme for Sustained Development placing emphasis on agriculture, fisheries, stock-farming, and tourism, which was implemented from 1991. In 1996 Vision 2020 was announced, in which the development of agriculture, fisheries, and natural resources sector, diversification of products, and tourism development were stressed again as the urgent policies. The fisheries sector contributes 1.9% (1995) to GDP, but accounts for 6.5% of total export, next to peanut production and stock farming. Fisheries are very important for the economy of The Gambia because it has no other promising resources.

The coastal waters of The Gambia form good fishing grounds due to an inflow of nutrients and a wide continental shelf extending more than 30 km offshore. According to FAO reports the Maximum Sustainable Yield (MSY) of pelagic fish such as Bonga and sardine is 65 to 75 thousand tons a year and the one of demersal fish of grouper and bream is 15 to 17 thousand tons.

The Gambia fisheries are divided into two categories; the industrial fisheries and artisanal coastal fisheries. Average total production for 3 years from 1995 to 1997 is 34,840 tons, of which about 7,800 tons (22.4%) came from the industrial fisheries and the rest (about 27,000ton, 77.6%) came from the artisanal fisheries. The former consists of modern large trawlers, and most of their catches are frozen onboard and directly exported. Only three trawlers belonging to Gambia companies land their catches locally, which are processed and exported as well. Thus more than 95% of industrial fisheries production are exported, resulting in little contribution to domestic consumption.

As for the artisanal fisheries, the number of fishermen is some 3,000; about 500 registered fishermen plus 2,500 onboard assistant fishermen. There are eleven landing sites along the coast and the fishing fleet consists of 500 fishing boats, 430 powered boats and 60 non-powered boats, operating circle gillnetting, drift

gillnetting, long-lining, and hand-lining. The production has been less than the one of industrial fisheries until 1991, but since 1992 the former has exceeded the later due to a Government's improvement plan of the artisanal fisheries and decreasing production of the industrial fisheries. Main catches are Bonga (a kind of herring) (78%) and demersal fish (22%) such as grouper and bream. Some 85% of Bonga are marketed domestically in fresh or as smoked state, and the rest is exported to neighboring countries after smoke processing. Some 35% of demersal fish are consumed locally and the rest 65% are exported as fresh or frozen products by fisheries companies or salted/dried products by artisanal fishfolk. On the other hand, import of fish products is little, only 140 tons of canned fish. Thus the domestic demand for fish is supplied by the production of the artisanal fisheries.

People have a strong preference for fish, and an annual per capita consumption of fish is estimated at 20 kg. However, it is estimated at 28 kg in the urban area, while in the interior area it is only 13 kg due to poor distribution resulting from lack of transportation methods. The Fisheries Department plans to raise these figures, to 40 kg in the urban area and to 26 kg in the inland respectively, by five years later through improving the distribution system.

A fishery centre constructed at Bakau in March 1994 by Japan's Grant Aid improved the distribution of fisheries products in the area. With the introduction of an ice-making plant, a chilled room, and FRP fishing boats, the production was increased from 450 tons in 1994 to 3,700 tons in 1997 and the number of fishery-related people was also increased from 145 to 280, while the post-harvest-loss were decreased rapidly from 30% of the catch to less than 1%. The management of the Project is going well, generating a profit of D 200 to D 400 thousand a year, totaling D one million in 3 years, and the half of the profits were reserved as a surplus. This fact shows the direction of further development of artisanal fisheries in other landing sites as well as attracts attention of neighboring countries as a successful example in West Africa.

Besides Bakau, there are 10 landing sites, where lack of preservation/distribution facilities make it impossible to effective utilization of valuable resources due to lots of post-harvest-loss. In The Gambia 70% of distribution are consumed in the densely populated area around Bunjul, the capital, while 30% are sold in the inland and rural area. The main cause of lots of post-harvest-loss is spoilage of perishable

Bonga during longer transportation to the inland. Demersal fish is also losing exporting opportunities or forced to sell at lower prices due to deteriorated quality. In order to solve these problems, ice-making plants, hygienic facilities for fish preservation, refrigeration trucks, and insulated boxes must be introduced to activate fish distribution as well as supply fresh fish protein to inland people.
At Tanji, the next largest landing site in the country, in particular, more than 25 tons fish, mainly Bonga, beyond selling and processing capacity, are landed a day during the high season, and as a result the following problems are taking place.

a) lots of post-harvest-loss due to difficulty in obtaining ice for preservation and lack of cold storage facilities.

b) Loss of selling opportunities of demersal fish lack of cold storage facilities.

c) Difficulty of wooden fishing boat construction due to difficulty in obtaining timber.

d) Exhaustion of forest resources due to mass consumption of firewood for smoke processing.

Furthermore, at Brufut, Batokunku, and Sanyang, landing sites of demersal fish near Tanji, the following problems are taking place due to lack of preservation-related infrastructure.

a) decreasing fish price due to shortage of ice for preservation.

b) Quality fish is forced to sell at lower prices due to deterioration of freshness.

Under these conditions, improving the cold storage/distribution facilities at Tanji, where popular fish of Bonga, a source of fish protein to the people, are landed, will be effectual for distribution not only at Tanji but also at such surrounding fishing villages as Brufut and Sanyang. It is judged thus that this project should be given higher priority among the improvement projects of fisheries-related infrastructure in The Gambia, and Tanji should be placed priority before Gunjur which is 20 km south of Tanji and the largest landing site in the country, because of easier management and maintenance due to its closer proximity to Banjul than the later.

In The Gambia, traditional fishing boats are made of wood, but good timber is

becoming difficult to obtain and substitution of good timber with wood of mango family is making a service life of boats shorter. This is another problem of artisanal fisheries to be solved in the future. Some 30% of Bonga and all of catfish catches are traditionally processed by smoking by burning timber for one to four days. The method for fish preservation is consuming lots of timber, which is endangering the forest resources in the country. Hence formulation of a policy on the forest preservation has become a pressing issue. In view of this situation introduction of FRP fishing boats as implemented in the Bukau Project as alternative boats, and reduction of processed products by improving the distribution system became an important problem.

Under the above background, the Government of The Gambia formulated a project titled "Improvement of Fishing and Preservation facilities for Inland Fish Distribution and Equipment Supply" and requested Japan to assist the implementation of the Project. The Project aims at reduction of post-harvest-loss by construction of fish preservation facilities at Tanji and provision of distribution equipment such as refrigeration trucks, as well as forest preservation through decreasing timber consumption by introduction of FRP fishing boats and promotion of fresh fish consumption instead of wood-consuming smoked products. On this request the Government of Japan decided to conduct a preliminary survey and sent a survey team to The Gambia between July 22 and August 12, 1998 through Japan International Cooperation Agency (JICA). In the preliminary survey the fisheries situation and distribution system in The Gambia were confirmed and the appropriateness of the proposed project site and the necessity of the project as Japan's Grant Aid were investigated. As a result the appropriateness of the project was proved and the Basic Design Study was carried out.

1-2 Contents of the Request and its main Components

1-2-1 Outline of the Request

The contents of the request is to construct preservation facilities including an ice-making plant and a cold storage room and provide fresh fish distribution equipment as well. Its main objective is to reduce post-harvest-loss and increase a supply of fish protein in the inland area in tandem. Also an increase of fish export and improvement of fish quality in Tanji and neighbouring fishing villages through supply of ice are included. Furthermore introduction of FRP fishing boats and promotion of fresh fish consumption will contribute to the preservation of forest resources..

1-2-2 Main Components

The main facilities and equipment requested initially are as follows. The contents of the components were partly changed at the preliminary and Basic Design Study.

Table 1-2-1 Main Components of requested project

Contents	Specifications and quantity
Tanji fish landing site	
Fish market	340 ㎡
Ice-making/ ice storage facilities	ice-making 20 ton, ice storage 10 ton
Chilled room	25 ton
Generator	135 KVA×3 sets
Fuel oil tank	10,000 l
Water tank	30 m^3
Septic tank	Complete
Generator hut	40 ㎡
Deep well and pumping system	Complete
Workshop	30 ㎡

Contents	Specifications and quantity
Equipment	
Refrigerated Vehicles	5 t×2 units
Delivery Boat with Insulated Fish Hold	Boat with 15 t for Fish hold
Fish Boxes	25L type×50 units
Insulated Containers	500L type×10 units
	1,000Ltype×5units
FRP Fishing Boats	40ft Canoe×16 boats
Outboard Engines	Outboard Gas engine×49units
	Outboard diesel×25units
Fishing Gear	for FRP Fishing Boat
Maintenance Tool for Workshop	Complete
Base in Soma	
Fish Market Building	260 ㎡
Chilled Storage	25 t×1 unit
Generator	20 KVA×2units
Oil Tank	1,500L×1unit
Generator Shed	30 ㎡
Drying Shelf & Car Park	140 ㎡

Chapter 2

Contents of the Project

Chapter 2 Contents of the Project

2-1 Objectives of the Project

Tanji, the centre of the proposed sites of the Project, is an inshore landing place of Bonga, a kind of herring harvested in large quantity, and is one of the major fish landing places of the artisanl fishery. Also it is the largest smoking and processing site of Bonga in the country. Some 50 fishing canoes are operating from the beach of Tanji and their total catches are some 7,000 tons annually (1995-1997 average). About 54% of landed Bonga are marketed in fresh state to the metropolitan and inland areas, while the rest is allocated to processing purposes such as smoking and drying.

The beach of Tanji shows activity all day long with some 1,000 people coming and going, including 500 fishermen, 300 processors, many fish landing workers and some vendors. All these people are making livelihood by working on the beach and supporting more than 5,000 dependent family members as well.

The following problems are becoming serious at Tanji fish landing site.

(A) Lots of post-harvest-loss due to poor availability of ice for preservation and lack of cold storage facility.

(B) Loss of selling opportunities of demersal fish due to lack of cold storage.

(C) Difficulty in building boats due to poor availability of timber.

(D) Exhaustion of forest resources due to mass consumption of firewood for smoke processing.

(A) Lots of post-harvest-loss due to poor availability of ice for preservation and lack of cold storage.

There is a private ice plant with indicated capacity of 6 ton/day (substantial capacity of 2 ton in view of the capacity of ice bin), which stopped its operation for the year because of problems of maintenance, and prospect of resumption is not expected as yet. Thus the transporters must go to Sere Kunda, more than

one-hour-drive distant, to buy necessary ice. But ice carried in jute bag melts with heat, losing cooling efficiency promptly. On the other hand, fishermen do not use ice because they have no transport methods.

Post-harvest-loss occurs from spoilage of fish which failed to be shipped during the day due to late evening landing, and spoilage caused during transportation to the inland area. No data about post-harvest-loss are available, but according to an interview survey at the landing site on Bonga which is a herring family with soft fish meat, about 30 % of marketed Bonga except those for smoke-processing or drying was estimated lost. At Tanji, during the low fishing season, post-harvest-loss does not occur at the beach but takes place during the 2 days of transportation to the inland areas. On the other hand, during the high season, the surplus fish beyond distribution and processing capacity must be dumped due to spoilage, whose volume is estimated at some 1,200 tons a year.

At Bakau, the situation was similar before a Japan's Aid project was implemented, but the project including ice-making, cold storage facility, and refrigeration trucks, reduced the spoilage of 30% to less than 5%. Hence, when the Project is implemented at Tanji, the above losses will be reduced to about 200 tons.

(B) Loss of selling opportunities of dermeral fish due to lack of cold storage facility

Demersal fish caught by Bonga boat as by-catch at Tanji are unknown statistically. In the site survey it was observed that about 5% of the total landings were demersal fish. Presently these fish are consumed privately by fishermen or processed into dried products. But the price of demersal fish attains more than 5 times a Bonga at the regular selling route. It is expected to earn more incomes by selling this by-catch in bulk by proper preservation.

(C) Difficulty in building boats due to poor availability of timber

Presently 34 fishing canoes made of wood are operating at Tanji. The service life of a wooden boat is usually 10 years, but some canoes are now shortening their service life to 5 years due to poor materials. The forest resources of the country are exhausting due to consumption of firewood; the decreasing rate of

the forest area of The Gambia is threefold of the World average. The Government announced the "Environmental Activities Plan" in 1993 to regulate the forest resources. Also, Senegal which is a exporter of hard wood of mahogany, keel construction material, is going to regulate timber export. Hence the availability of good boat building materials became an important problem. With the successful introduction of FRP fishing boat in the Bakau project, fishermen of Tanji are desirous of the introduction of FRP fishing boats.

(D) Exhaustion of forest resources due to mass consumption of firewood for smoke processing

At Tanji there are 20 smoking huts, which are processing some 8 tons of Bonga, 40% of landings, into smoking products every day. The smoking method of Gambia, burning to dry, requires lots of firewood, continuing to burn Bonga on a grid for one to four days. How to preserve the forest resources in Gambia having little rainfall is a pressing problem to be solved. It will be necessary to reduce gradually smoke processing with a consumption of fish in fresh state increasing.

On the other hand, other three proposed sites, Brufut, Batokunku and Sanyang, 3 km, 5 km and 10 km distant from Tanji respectively, are different from Tanji in that they have no landing Bonga. Fishermen in these sites are mainly catching demersal fish, and thus require small fishing vessels. The number of vessels, varying monthly on immigrant fishermen from Senegal, are some 150 in Brufut, 10 (local boats only) in Batokunku and some 100 in Sanyang.

Annual catches (1995-1997 average) are 1,970 tons in Brufut, 100 tons in Batokunko and 470 tons in Sanyang.

Landings of good quality (about 50% of the total) are bought by fish processing companies in Banjul as materials for frozen fish products for export, while the rest is processed for salt products on the beach.

There are the following problems here.

(A) Decreasing selling price due to shortage of ice for preservation.

(B) Shortage of ice and insulated boxes compels fishermen to sell quality fish for processing.

(A) Decreasing selling price due to shortage of ice for preservation

Presently ice for preservation is supplied by fishing companies carrying it from Banjul with one hour drive. Thus ice has little cooling efficiency as well as not obtainable at any time necessary. Sole and cuttlefish at the first grade are sold at D 14/kg, and grouper and snapper D 7/kg. However, once they lost freshness the prices drop to less than half.

(B) Shortage of ice and insulated boxes compels fishermen to sell quality fish for processing.

Fish for export are preserved in insulated boxes of middlemen, but more than half of these boxes are less efficient because they are obsolete ex-home refrigerators. Deterioration progresses for longer time, and the quality sometime drops to under the 2nd grade. Fishing companies do not purchase deteriorated products under the 2nd grade which are compelled to be sold for processing at a price of only 1/5-1/10 of the one of fish in fresh state resulting in decreasing incomes of fishermen.

The Project was formulated to deal with these conditions. Based on the fisheries development plan of Gambia, the Project intends to provide a preservation facilities including an ice-making plant, a cold storage space, and the distribution equipment so that the post-harvest-loss may minimized, fish protein supply in the inland area may be increase, and fish export may be increased and the fish quality may be improved at fishing villages near Tanji. Furthermore with the introduction of FRP fishing boats and increasing consumption of fish in fresh state, preservation of forest resources is intended.

2-2 Basic Concept of the Project

2-2-1 Contents of the Request

(1) The initial request of the Gambia, the request on a preliminary survey in July 1998, and the request on the basic design study in October 1998 are shown in Table 2-2-1(1/2)/(2/2) below.

Table 2-2-1 Contents of the Request (1/2)

Initial request (July 1996)	Request on preliminary survey (July 1998)	Request on contents on basic design study (Oct. 1998)	Changes and process
A. Implementing Agency Fisheries Department, Ministry of Agriculture & Natural Resources	A. Implementing Agency Fisheries Department, Dept. of State for Presidential Affairs, Fisheries & Natural Resources	A. Implementing Agency Fisheries Department, Dept. of State for Presidential Affairs, Fisheries & Natural Resources	Change of title due to reorganization
B. Project site Tanji & Soma	B. Project site Tanji	B. Project site Tanji	Soma was cancelled.
C. Management of Project Fisheries Department, Ministry of Agriculture & Natural resources, and Tanji Management Committee	C. Management of Project Fisheries Department and Tanji Management Committee	C. Management of Project Fisheries Department and Tanji Management Committee	Change of title due to reorganization

Table 2-2-1 Contents of the Request (2/2)

Initial request (July 1996)	Request on preliminary survey (July 1998)	Request on basic design study (Oct. 1998)	Changes and process
D. Equipment and materials			
1. Fishery Centre			
Fish market building Ice making plant Ice bin Chilled storage Generator Fuel oil tank Well & pump Water tank Septic tank Workshop and Tools	Fish market building Ice making plant Ice bin Chilled storage Generator Fuel oil tank Nil Water tank Septic tank Workshop and Tools	Fish market building Ice making plant Ice bin Chilled storage Generator Fuel oil tank Nil Water tank Septic tank Workshop and Tools	No changes: Though no request concerning a well was made, it was judged that a well is necessary for the Project. Construction of a well was incorporated in the Project component.
2. Vehicle & boat			
Refrigerated truck Delivery boat	Refrigerated truck Nil	Refrigerated truck Nil	Delivery boat was cancelled.
3. Materials			
Insulated boxes FRP boats Fishing gear	Insulated boxes Fish boxes FRP boats Fishing gear	Insulated boxes Fish boxes FRP boat Fishing gear	Fish boxes were added.

For improvement of the fresh fish distribution system, which is a main objective of the Project, it was recommended that development of Tanji landing is necessary at the first stage, and development of inland area comes next after full operation of the facilities in Tanji is confirmed, and costs for fresh fish distribution are reviewed. As the result, construction of facilities and procurement of a transport vessel have been postponed at Soma.

2-2-2 Concept of the Project

Based on the contents of above-mentioned requests, the following facility, equipment and materials was determined to involve in the Project component to be examined.

The necessity of each component and the basic principle on determining its design and scale are as follows.

(1) Facility component

(A) Fishery Centre facility

a. Ice making machine

Utilization of ice on the post-harvest stage and distribution stages is indispensable to reduce post-harvest-loss, which reduction is the major objective of the Project. It can be said that this is the principal facility of the Project. Tanji has a private ice-plant with the nominal capacity of 6 ton/day (indicated capacity of 2 ton in view of the capacity of ice bin), which has been broken for more than half a year. Now ice is supplied from Serekunda, more than 20 km distant, by insulated truck carrying 1,200 kg of ice in jute bag. These trucks are delivering 3 ton of Bonga to the inland area, but ice is melting rapidly with less efficiency. Also 20 – 30 kg of ice packed in 1 kg vinyl bag each are sold every day, and some traders by bicycle buy this ice by 2-3 kg and use it for some 30 kg of Bonga; too less ice for the volume of fish results in a lot of spoilage loss during transportation and distribution.

Also since there is no supply of ice for demersal fish, by-product of Bonga fishing, this quality fish accounting for 5% of total catch of Bonga boat loses a selling opportunity to fishing companies.

Constant supply of ice will make it possible to keep freshness of Bonga as well as demersal fish. In particular, perishable Bonga must be iced just after landing to keep its quality, and ice must be added to Bonga in carrying by truck to reduce spoilage losses during transportation.

At inland area, Bonga is marketable at a price more than 10 times as higher as the one at the landing site. Reduction of spoilage losses benefits traders by

truck. Fishermen can sell their demersal fish at proper price. Hence, they are looking forward to introduction of ice-making machine.
An ice making machine with the capacity matching the volume of landing/distribution of fish shall be installed. Therefore, this should be taken into consideration in installing ice-making machine in Tanji.

Brufut, Batokunku and Sanyang are three landing sites lose to Tanji and at these 3 sites targeted fish is demersal fish. Ice is delivered by fishing companies from Banjul and Serekunda, 20 to 30 km distant. Middlemen add ice to fish bought from fishing boats in insulated boxes, and sell them to fishing companies. Marketable fish for fishing companies is 50% of total landings on an average, and the remaining is used for processing (mainly salt/dry processing). Although middlemen wish one ton ice to one ton fish, ice brought by companies is less than half of required volume and also its quality is poor due to long transportation.
Estimated change of utilization of ice at 3 landing sites caused by production of ice in Tanji
The fishery company, purchaser of demersal fish, has so far bought ice from Banjul or Sere Kunda which are more than 20km away from them. When the ice plant is constructed in Tanji, they will use quality ice of the plant as it is quite advantageous for them to get it at Tanji, considering loss of time and melting ice.
For such reasons, ice supply at Tanji is quite important and installation of ice-making machine is planned, whose scale is appropriate to the total volume of fishery landings at Tanji and neighboring landings; and volume of fresh fish distribution.

b. Ice bin

An appropriate ice bin is necessary to control shipment of ice produced regularly by the ice making machine. The scale of the ice bin will be matched the capacity of the ice making machine.

c. Chilled storage space

At Tanji a day catch must be shipped on that day due to lack of preservation facility. Less than 20 ton fish can be sold on that day, but surplus fish for processing or landings after 5 o'clock in the afternoon are allocated for the next day shipment, of which about one third are often discarded because of deterioration. Furthermore spoilage losses always occur during transportation, and thus the total post-harvest-loss are estimated at some 30% of total catch annually.

It is necessary to preserve Bonga landed on late evening and various demersal fish collected from Bonga boats in a chilled store until the next morning for shipment. A chilled storage is provided so that fish may be stowed in boxes to make loading to trucks easy.

d. Generator

Tanji site has no electric utility. A generator system shall be introduced to operate the ice making machine, refrigerating machine, pumps and so on.

e. Maintenance room/store

This facility is necessary to maintain the machinery for day and night as well as to keep spare parts.

f. Toilet/shower

This toilet/shower facility is for the staff of the Fishery Centre.

g. Working space

A working space for washing fish, stowing fish in boxes, loading fish on trucks, selling ice, adding ice on fish boxes, etc. shall be provided.

h. Fishery Centre building

The building shall be constructed to house all of above-mentioned machinery and spaces and to avoid exposure of the working space to weather.

(B) Attached facility

i. Fuel oil tank

A fuel oil tank is necessary to store the generator oil carried from Banjul by tank lorry. Another oil tank to keep outboard motor oil for fishermen is also necessary. Both tank facilities are planned.

j. Water tank and pumping system

A water tank is planned to keep water drawn regularly from a well and a pumping system necessary for distribution of water to the Centre shall be provided.

k. Well, pumping system and initial water tank

Ice to be used for ice-making must satisfy the hygiene standard of the country. For this purpose it is planned to dig a well on an area without contamination. Also a pumping system to draw water from this well is planned. By the side of the well an initial gravity tank is introduced to impound drawn water from the tank and then deliver to a reservoir water tank in the Project site. This tank shall have a function of settling tank.

l. Hut for pump/control panel

A hut shall be installed to protect the control panel for the pumping system. Also another hut is planned for the pumping system of the water tank.

m. Septic tank

A simple septic tank is placed so that waste water in the Centre may penetrate into the soil after treatment.

(C) Exterior work

n. Placement of side ditches and gabions

Necessary gabions shall be placed around the premises of the centre and also side ditches at the east, west and central side of the Centre to protect the facilities against erosion by downpours of rain or stormy heavy waves.

(2) Equipment and materials component

(A) Equipment and materials

a. Refrigeration truck

To decrease post-harvest loss and increase transport volume of fresh fish to inland, which is the main objective of the Project, another truck for Tanji Management Committee is necessary in addition to the currently used private one. The truck is a refrigeration type with a cooling machine loaded on the bed to prevent rise in temperature and melting of ice as much as possible during transportation. The target area for the truck service is located mostly along the Gambia River, away from a highway and any regular transport services are provided by a private company.

b. Insulated box

Insulated boxes are to be introduced to settle these problems by using them as "simple preservation equipment" to allow freshness of fish to be kept for 2 days at least.

Insulated boxes with ice are now being used at the landing places of demersal fish such as Burfut to shipment them to fishing companies. More than half of them, however, are substituted with obsolete household refrigerators for temporary use. These must be replaced.

Also another usage is planned; new boxes will be kept at inland consumption areas to preserve Bonga carried from landing places until selling. Necessary number for this purpose shall be calculated.

c. Fish box

Bonga landed late evening must be stowed in this box and kept in the chilled store until the following day shipment. Also a small quantity of demersal fish landed by each Bonga boat must be gathered by stowing in this box to reach a marketable quantity.

Also at Tanji by-products of demersal fish shall be conveyed by these boxes between fishing canoes and the chilled store.

Necessary number for these purposes shall be calculated.

d. Maintenance tools

Maintenance and inspection of all the machinery including ice-making machine, ice storage unit, generator, outboard engine, etc. require various tools.

e. FRP Fishing boat & gear

To implement the Project as a model case of conversion of building material for fishing boat from timber and improvement of safe fishing, FRP fishing boats are introduced. Fishing gear which is necessary for their operation is also introduced.

2-3 Basic Design

2-3-1 Design Concept

The basic design concept of the proposed facilities consists of five components; that is, Management Plan, Layout Plan, Facility Plan, Implementation Plan, and Local Conditions.

(1) Management Plan

The responsible agency is the Fisheries Department, Dept. of State for Presidential Affairs. Fisheries & Natural Resources, which will lease the Project facility (the Fishery Centre) to the Tanji Management Committee operating presently the existing facilities. The Management Plan of the Fishery Centre will be carried out by the Management Committee under supervision of the Fisheries Department. The existing facilities, constructed by Italian Fund with EU financial assistance, consist of a fish market, fish handling space, fish smoking space, locker room, office, and water supplying system of groundwater by windmill.

For the management of the new facility of the Centre to be provided by Japan's Grant Aid maintenance technology of the refrigerating machinery and electric devices which will be newly introduced is indispensable. Regarding with this, the Fisheries Department intends to backup the Management Committee with engineers educated in Bakau, while requesting technical assistance to Japan.

The basic frame of the Management Plan is to maintain the Centre with proceeds of ice, charges of chilled store, and rental fee of refrigerated truck as well as to contribute the development of fisheries and the improvement of fish distribution.

The running cost of the Centre is expected to be high due to lack of public utility including electricity and water supply, and hence saving energy/labor in the Facility Plan will be a key point to the success. It is most important to establish a sound management system with a financially viable Management Plan.

(2) Layout Plan

The site survey confirmed that the proposed Project site, a vacant lot between the existing fish market and the smoking space, 37m wide at minimum, an area of about 2,500 square meter, is proper and suitable for the Project.

There is a road project with assistance from Kuwait near the Project site. The front road of the site is to be modified its shape and height and paved by July 2000. Negotiation with the Gambia side will be necessary to allow easy access to the Project site.

The followings are the main points to be cared about in preparing the Layout Plan.

- To protect the Centre from salt damage caused by the direct sea breeze.
- To place the Centre on the line of landing activity as well as to minimize the lines of receiving/forwarding activities.
- To secure a passage to the Centre from the state road to not hinder the current activities in the existing facilities.
- To keep sufficient distance from the existing facilities to prevent the spread of fire.
- To separate the facilities concerning ice-making, refrigeration and handling from the facilities to perform backup.
- To take the existing drainage system into consideration to prevent damage by a flood.

(3) Facility Plan

The newly constructed Centre shall not hinder the activities in the existing facilities.

The handling space and generator room shall be provided on the front of the ice bin and chilled store, and the maintenance room shall be adjoined to allow it to give support to activities in the Centre easily.

The automatic ice-making machine is planned to be installed on the ice bin. To prevent the machinery from salt damage, the facility shall be a one-story steel construction with partly two-storied RC structure.

The ice-making machine, refrigeration unit, and the generator shall be of energy saving type, and the exchangeability of parts with the existing Bakau facility shall be considered as well.

Construction materials are procured locally to the utmost.

(4) Implementation Plan

Preparation of the Implementation Plan requires all-out co-operation of the Gambia side. For instance, securing a lot for temporary works at the neighboring area of the Project site is absolutely necessary, and in order to continue the construction work not to hinder the current activities a full co-operation of fishery-related persons is important. Also leveling the ground, removing existing structures, and relocation of vendors will be not able to achieve without co-operation of the Gambia side.

Almost all construction materials and heavy machinery are available in Banjul, but, the road condition between Banjul and Tanji is so poor that a careful transportation plan must be prepared during the rainy season.

(5) Local Conditions (Natural condition, social circumstances, construction condition)

1) Natural condition

(A) Special care shall be taken in ventilation and lighting from the weather standpoint of high temperature and humidity.

(B) The whole neighborhood of the site, facing the Atlantic, is a flat land with gentle rise and fall. The annual rainfall is as comparatively less as 1,300 mm, but downpours of rain sometimes take place during the rainy season, causing a flood towards the sea side on the east side of the site. The Centre shall be of anticorrosion structure.

(C) Since the site facing the sea is subject to salt damage, salt-resistant building materials and equipment shall be applied.

(D) The sea in front of the site is open but comparatively calm. A careful measure to prevent pollution on the coast by drainage and waste from the Centre shall be planned.

2) Social circumstances

(A) The Project site is situated in the existing Tanji fish landing site, and the utilization rate of land is high with a heavy density of building. A brisk activity during landing is a matter of concern. Since the proposed Centre is constructed in almost the centre in such area, the Layout Plan must be prepared to not hinder the current activities, and a safety supervision measure shall be taken during construction.

(B) Material, color, and shape of the Center building shall be matched with the surrounding environment.

(C) In arranging the buildings the road condition shall be fully considered.

3) Construction condition

(A) The Gambia has the regulations and standards concerning construction and design of structure, and the structural standards not stipulated in these regulations and standards are in conformity with the UK standard,

(B) The Gambia has a few construction engineers as well as refrigeration engineers essential for the Project. In the past, necessary engineers have often be invited from Senegal. Since such kind of machinery of the Project has common specifications to the machinery used in Bakau, some engineers to be sent from Japan will be able to cope with the situation, but the machinery with type and design operable by local engineer must be selected.

(C) Sand, cement, steel piping, and part of electric materials are available locally, while steel bar and special electric materials depending on import are scanty in stock. Although locally available materials shall be used as much as

possible, materials which are difficult to obtain within the country will be brought Japan or the third countries by comparison of necessary cost.

(D) Utilization of local firms

There are five or six local construction firms working in various public works in the Gambia. They will be useful as subcontractors of the Project.

2-3-2 Precondition for Establishment of Scale

(1) Fisheries Distribution Plan in The Gambia

Due to poor fisheries infrastructure, currently some 30% of catches are lost in spoilage on the distribution stage in the Gambia. Also cutting timber necessary for boats building and smoking process of Bonga and demersal fish is causing serious environmental disruption.

Fisheries Department drafted a fish distribution plan to promote increasing fresh fish distribution as well as decreasing the rate of smoking fish as shown in Table 2-3-1.

Table 2-3-1 Prospect of catch, etc

	1998	1999	2000	2001	2002	2003	2004
Catch (t)	7,210	7,500	8,250	9,900	10,890	12,000	12,500
Sales (t)	3,605	4,125	4,538	5,940	7,079	8,400	9,375
Spoilage loss (t)	1,154	1,238	1,135	891	354	252	225
Loss rate (%)	32	30	25	15	5	3	2.4
Fresh fish distribution (%)	50	55	55	60	65	70	75
Distribution of smoked fish	40	40	40	35	30	25	20
Distribution of salt/dry fish	10	5	5	5	5	5	5

Source: Fisheries Dept. statistics

(2) Precondition for establishment of scale

1) Distribution situation of fisheries in Tanji district is examined on 1997 statistics and the results of site survey.

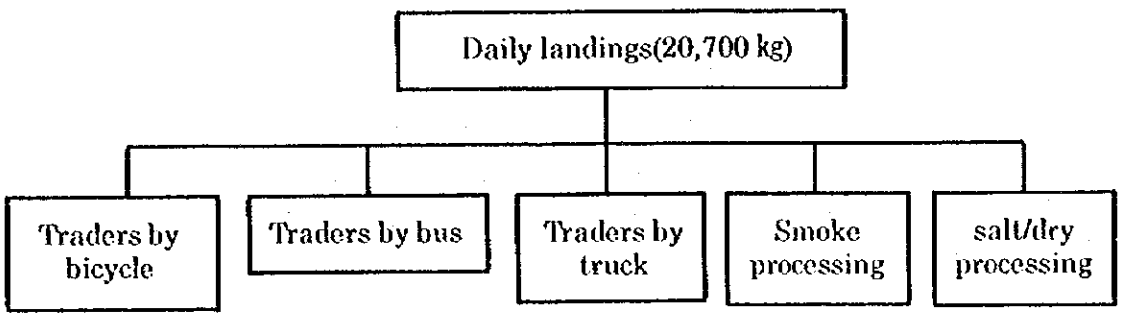
- Annual catch: 7,377 ton
- Fishing days in year: 335 days (30 days off due to storm)
- Catch per day: 7,377÷335=22.02=22 ton
- Distribution by type: Page 2-19 Figure 2-3-1

2) The Project aims to reduce spoilage loss to less than 5% of landings, expecting an increasing fresh fish distribution of some 12 t/day.

3) Catch is assumed on reliable 1995-1997 statistics (see Table 2-3-2).

4) As for the number of middlemen and traders in Tanji, the one obtained from the results of interview survey at the site survey is used (Figure 2-3-1).

Figure 2-3-1 Utilization of landings (November 1998 Site Survey)



	Traders by bicycle	Traders by bus	Traders by truck	Smoke processing	salt/dry processing
Number	50	20	1	12	25
Purchase (kg/p)	90	200	3,000	660	51.2
Demand/day	4,500	4,000	3,000	7,920	1,280

Note 1: Every day three 5 ton refrigerating trucks come to Tanji and each truck buys 3 ton of fish, but the basic figure of purchase per truck per day in the Basic Design is determined to be 3 tons because of 3 days trip going to inland and back.

Note 2: Included spoilage loss.

5) The landing sites of Burufut, Sanyang and Batokunk which are close to Tanji (3km, 5km and 10km from Tanji, respectively) are also targets of examination for ice demand. At those landings, demersal fishing is prevalent including quality grouper and sea bream. To ship them to a fishery company for export, ice is essential to preserve their freshness. However, it is currently brought from Banjul or Serrekunda, 20-30km away from the landings because there is no ice plant in their neighborhood. In the circumstances, ice is not freely

available in terms of time and quantity. Also, rise in temperature while fish is transported makes it difficult to preserve their freshness. According to the results of the hearing survey, fishermen at the landings anxiously expect to get quality ice at Tanji, which is within 10 minutes' ride. Taking the situation and expectation of the fishermen into account, those neighboring villages are examined as target of ice supply.

Table 2-3-2 Transition of Monthly Catches of Planed Sites (1991--1997)

1. Tanji (ton/Month)

Year \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year/ catches
1991	88	516	659	691	477	60	70	508	267	112		951	
1992	739	958	128			35	726			817	961	534	
1993		848	862	81		196	645	220					
1994	175	532	197	432		430	597	519		1,098	672	589	
1995	374	129	331	362	388	485	300	407	351	590	393	463	4,573
1996	411	378	444	418	324	392	774	1,261	1,333	1,404	1,455	464	9,059
1997	741	531	658	539	886	247	472	157	853	1,044	520	731	7,378
Average Monthly Catches	509	346	478	440	533	375	515	608	846	1,013	789	553	

2. Brufut (ton/Month)

Year \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year/ catches
1991	58	269	110		190	67	181	57			29	130	
1992	89	33	113	137		37	85	63		117	90	59	
1993	43		53	53	164	22	53	49	339			351	
1994	80	85	64	58	71	46	73	42	37	85	96	65	801
1995	101	122	147	130	160	150	182	144	247	218	207	259	2,067
1996	380	455	530	347	143	195	189	220	200	112	108	84	2,962
1997	119	139	86	18	74	203	1,540	549	383	424	436	259	4,232
Average Monthly Catches	200	239	254	165	126	183	637	304	277	251	250	201	

3. Batokunku (ton/Month)

Year \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year/ catches
1991	2	1	2	22	9	7	3	2	3	3	2	2	55
1992	5		4	3	4	4	2						
1993	1		1	4				1					
1994	1		1	2	2	6	4	4	4	4	3	2	
1995	6	3	8	8	7	5	5		58	10	4	4	117
1996	7	11	8	7	10	20	11	5	4	4	7	6	100
1997	4	5	3	13	11	13	5	5	2	6	30	1	97
Average Monthly Catches	6	6	6	9	9	12	7	3	21	7	14	3	

4. Sanyang (ton/Month)

Year \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year/ catches
1991													
1992													
1993	56		13	2	3		4	15					
1994	56		13	2	3		4	15					
1995	25	18	30	44	25	21	15	93		62	75	114	521
1996	163	40	34	25	24	32	18	34	34	49	30	34	518
1997	24	30	31	26	43	37	27	23	28	23	33	39	365
Average Monthly Catches	71	29	32	32	31	30	20	50	21	44	46	62	

Sources : Statistics Division of Fisheries Department
Note 1 : Black ; No Data available
2 : Refferred Avarage Monthly Catches from Reliable Date for 3 Year (1995-1997)

Table 2-3-3 Summary of results of Site Survey

A site survey was conducted to determine uncertain date in the statistics. The results are summarized as follows;

(A) Fishing force by district

District	Tanji	Brufut	Batokunk
Fishing boat	34	101	9
Full time fishermen	34	111	9
Fishery-related people	341	453	82
Catch (t/y)	9,059	2,962	97
Catch (t/boat)	266	29	10.8
Fishery-related people per boat	11	5.6	10.1

Source: Fisheries Dept. statistics 1997

(B) Fishery-related infrastructure

District	Tanji	Brufut	Batokunk
Smoking lot	19	2	1
Salting/drying shelf	76	98	0
Insulated box	12	13	4
Fishermen's locker	38	60	12

Source: Site survey result

(C) Distribution-related persons (Tanji)

Item	Quantity	Remark
Middleman	90	People engaging in purchasing fish from fishing boat
Carrier	150	People carrying fish to processing lot
Trader by bicycle	50	Buying 90 kg/day average
Trader by bus	20	Buying 200 kg/day average
Trader by truck	3	Buying 3 ton average twice a week
Smoking processor	12	
Purchase of raw fish for smoking (p/day)	660 kg	30 kg/basket×22 basket
Salting/drying processor	25	
Purchase of raw fish for salting (p/day)	51.2 kg	
Helper of processing	293	
Cooperative-related persons	20	
Total	663	

Source: Site survey result

(3) Results of Natural Condition Surveys

1) Topography

The site, Tanji Beach, is consists of 1) sand dune formed by sediments transported from sea current and Tanji River flow and 2) terrace which includes sea cliff and a lateritic reef. Figure 1 indicates the topography around the site. As shown in the figure, the sand covers the shore with a width about 50m from the shoreline. Inland further than 50m from the shoreline is a terrace of quite low height.

An unpaved road is paralleled to the shore line at a distance about 100m inland. The inclination of the ground surface between the road and shoreline is about 1:20 (vertical : horizontal).

End of the terrace has gullies at several locations, probably due to flood water at rainy season which flows over and cuts the ground surface.

The shoreline is said to be being eroded every year and occasionally the lower end of the terrace is washed by sea waves at high tide.

Assuming that the height of the existing road is 0.0m, the ground elevation at the lower end of terrace becomes –4.5m according to ground level survey and the mean shoreline is –6.0m due to the maximum tidal range of 3m and the height of the terrace end is equal to the highest elevation of tide.

Measures against the possibility for the erosion of foundation soil by flooded water at rainy season must be taken. One measure is to protect the site by setting gabions around the foundation of the Fisherie Centre building.

2) Geology

Terrace is of highly weathered soft rock (like hard cemented clay) and is very stable as foundation ground.

A trial excavation and a plate loading test showed that, the ground consists of hard clay to the depth of 1.7m from ground surface. Below 1.7m the ground is so hard that it is very difficulty to dig by hand.

The maximum load applied to the ground while testing is 30 t/m^2, and ground settlement by it was 1mm only, which indicates the ground has changed into very hard crust.

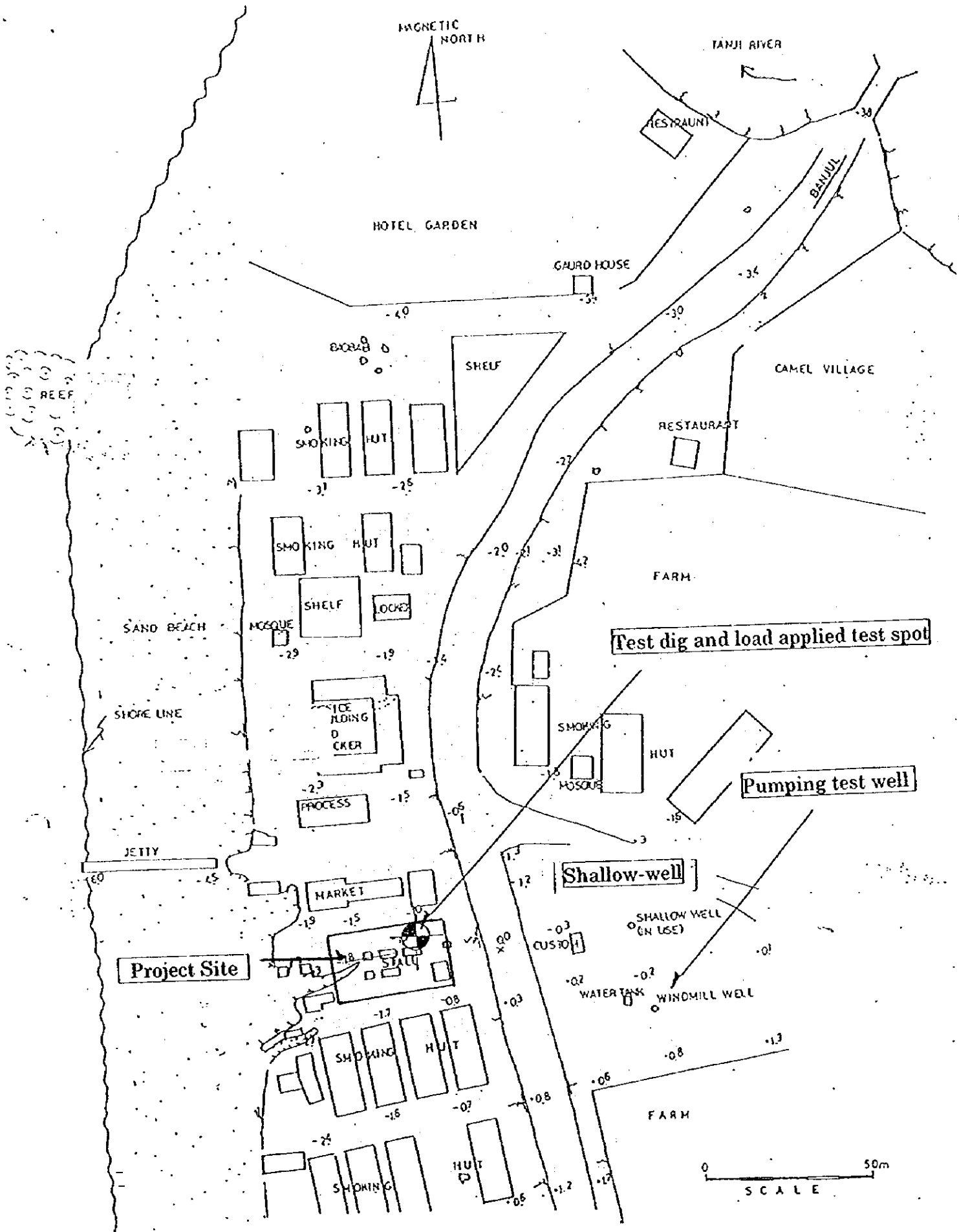


Fig. N-1 TOPOGRAPHY OF TANJI

At the beach, fine sand covers most area and the bearing capacity of the ground seemed to be not enough.

However, original ground has enough bearing capacity for proposed structures. Fill should be properly compacted to avoid possible subsidence at rainy season.

3) Pumping Rate of Groundwater

Table 1 summarizes the results of pumping tests at the wells around the site. As shown in Table, pumping rate 10 m^3/hr of groundwater can be easily obtained at any deep-well.

The pumping test at the shallow-well with windmill at Tanji, constant pumping rate 1.5m^3/hr was confirmed. Also observed was that the groundwater level at another shallow well located 20m away from the pumping test well did not change at all while testing, which situation indicates that each well is located on a separate water vein.

Table 2-3-4 Results of Pumping Test

Location	Tanji			Sanyang	Batokunku
Type of Well	Shallow-well w/wind mill	Shallow-well at Ice-making plant	Deep-well	Deep-well	Deep-well
Ground Surface Mean sea level, m	6	11	12	12	12
Ground water Mean sea level, m	±0	+1	±0	+1	+3
Lowered by pumping, m	0.5 ~1.5	?	1.0	3.4	2.2
Pumping Rate confirmed m^3/hr	1.5~4	< 1	12	32	12
Tested by	Consultant team	Hearing only	Water resource department		

The shallow well for ice-making plant is located about 500m south of the site and is elevated about 10m above mean sea level on the sea cliff. The pumping rate was unknown. However, comparison of ground conditions revealed by test excavation and outcropped at nearby cliff of ice-making plant indicates that the ground conditions are same. It is therefore estimated that the same pumping rate of 1m3/hr is obtained around the ice-making plant.

Followings are proposed to obtain required amount of groundwater;

(A) To utilize existing shallow well with windmill

A pumping rate of 1.5~4 m^3/hr was confirmed at the well. Also the utilization of the well for ice-making seems to not affects the present use by fishermen because 1) lowering of groundwater level by pumping of 1.5 m^3/hr is only 0.5m when total depth of ground water in the well is affordable 2.3m, 2) amount of present use by fishers is very small and 3) another well which has different aquifer is available.

(B) To utilize the existing deep well inside Tanji Village

Though the pumping rate has no problem, a water pipe, 1km long, must be provided from the village to the site.

(C) To excavate another well

【Shallow well】

Another well will be excavated near the ice-making plant to avoid influence on users. The planned area is uninhabited and free from coliform pollution. The water is almost neutral with pH=6.4. As the surface of ground water is above the sea level, the problem of salinization of groundwater will be prevented by careful water pumping. In that case, the location should be about 400m from the centre.

【Deep well】

In dry seasons deep wells are advantageous to get constant volume of water. The wells should be about 50m deep. To avoid possibly coliform-polluted groundwater in a shallow stratum, a strainer will be placed in the depth of a well and the upper part will be sealed with bentonite. To prevent salinization of groundwater, as the water is pumped up from the depth of the ground, over pumping should be avoided.

4) Quality of Groundwater

The quality of groundwater investigated in wells at the fish landing sites along shoreline are shown in Table 2 (Page A-45). Followings are notes for the table;

(A) Coliform was confirmed in all wells except well of Tanji ice-making plant, Brufut and Sanyang. Fecal coliform was also detected with quite high concentration which indicates that the contamination of groundwater has been caused by output from human/domestic animals.

(B) Although the number of test samples was limited, concentration of nitrite, NO_2 was very less and risk to health can be neglected.

(C) Generally, pH is rather low but there is no problem for the villagers in Tanji who use the water for their drinking every day, and hence this water can be utilized for ice-making.

(D) There is no problem about taste since the iron content, hardness and dissolved solid are very less. Colour is also accepted.

Taking an example of the wells with windmill at Tanji, the followings were examined with respect to the quality of groundwater. The primary problem is high concentration of coliform in the water. The water is currently used untreated by people to drink and any trouble is yet to come out. However, it is not suitable for making ice for fresh fish because its quality deterioration is expected. To prevent coliform-pollution as much as possible, it is recommended to excavate a deep well in an area away from living spaces of the villagers and livestock, as the case of the ice-making plant, so that possibly polluted groundwater in a shallow stratum may be avoided.

Secondly, pH of the groundwater is low. Based on not WHO but the Japan's standards for drinking water which is pH=5.8-8.6, it was revealed all the wells in Tanji showed under pH5.5 except the one in the ice plant.

Although the groundwater showed lower pH than the Japan's standards, it will cause no problem practically for ice making, taking it into account that there is no current problem in the villagers' use of groundwater to drink and that pH will not worsen while water is kept in store.

As a result of the investigation, the following comparative study should be examined in deciding type of wells for pumping water at Tanji under the Project.

Table 2-3-5 Comparative study on type of well

	Existing well		Projected well	
	Well w/windmill	Well in ice plant	Deep well	Shallow well (near ice plant)
Volume of water	○	△	○	△
Coliform	×	○	○	○
Others Except water quality	△	○	○	○
Cost	○	○	△	△
Owner	Village	Private	Centre	Centre
Total evaluation	×	×	○	△

When pumping water is necessary for the Project, it is recommended to excavate another deep wells in Tanji to get constant volume of water, which is most important and also quality of water is expected to be suitable for ice-making.

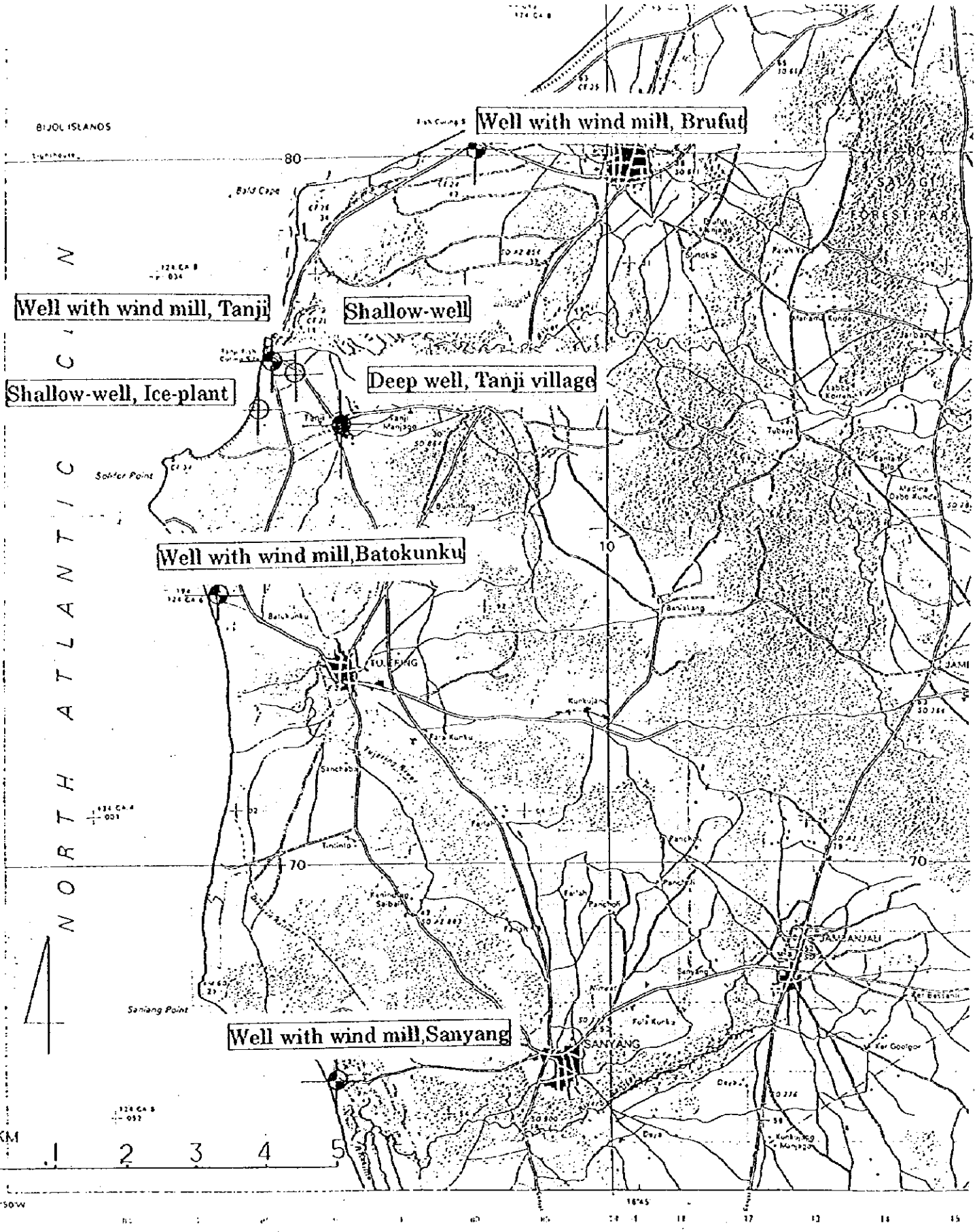


Fig. N-2 WELLS AROUND TANJI

2-3-3 Basic Design

(1) Layout Plan

The existing Tanji Fish Market yard is fully utilized. New Fishery Centre, which is given consideration on efficient traffic lines, will be arranged between the existing smoking huts and the building for market and shops. Water tank and fuel tank will be arranged at the eastern side of the building.

As a result, existing traffic line for landing and shipping will not be spoiled but arranged much more convenient for access to the Fishery Centre since they are placed right on the line.

At least a distance of 8m will be taken between the smoking huts and the new facilities, which will be spacious enough for prevention of a fire spread, or serve as a passage from the road in time of heavy rains.

Wells for pumping water and a shed for well will be arranged 150m southwards from the Site, considering necessary conditions for obtaining quality water and volume of water.

(2) Facility Plan

1) Facility Plan for the Fishery Centre

Ice-making/storage facilities, refrigerator, work space, maintenance room and machine room should be gathered in a building so that their functions may be effectively linked, and short and hygienic fish flow can be made.

As for a ground plan, refrigerator, ice-storage, generator room, maintenance room, warehouse and toilet/shower room will be arranged around the work space.

As the ice-making/storage system will become automatic and multi-leveled, a second floor girder will be placed over the ice storage to make it machine room in which ice-making machine is installed. In the machine room, cooling equipment for refrigerator and a distributor for electricity transmitted from the generator will be installed.

Supplemental equipment for the above equipment will be stored over the refrigerator, which will be protected from salt damages and intended for long

life by building a oceanic wind shield, and necessary measures will be taken for effective ventilation as well.

The scale of the Facility Component and Material Component of the proposed Fishery Centre is established as follows;

(3) Facility Component

1) Fishery Centre

a Ice-making machine

(A) Required quantity of ice

Required quantity of ice for Tanji, Project Site, as well as neighbouring Brufut, Batokunku and Sanyang is estimated.

(a) Ice for initial cooling (Tanji)

Since higher bodily heat of Bonga just after catching is the prime cause of deterioration, some 12 ton (See Page 2-19) fresh fish for distribution to the interior shall be covered with ice.

- Initial bodily temperature: 32℃ (average measurement of 30 Bongas just catching)
- Specific heat of fish body: 0.9 kcal/kg℃
- Final bodily temperature: 5℃
- Latent heat of ice: 80 kcal/kg
- Required cooling volume: 50 kg/case
- Loss of ice during transportation: 10%
- Required volume : $(32-5)\times0.9\times50/80 = 15.187 = 15$ kg/case
- Required ice for cooling 12 ton fish: $(12,000/50)\times15\times1.1 = 3,960$ kg≒4.0 ton/day...(A)

(b) Required volume of ice during transportation (Tanji)

Presently an insulated truck of private fisheries company needs 2 days to carry fish to the inland area, loading 1.2 ton ice for 3 ton fish. The rising air

temperature in the truck without a cooling system causes heavy spoilage losses. A volume of ice required to prevent air temperature from rising is established conditioned that after completion of the facilities ice for truck is totally supplied by the Fishery Centre. (Page 2-8)

Based on the above data, raising temperature caused by changing heat in a parking truck loading fresh fish at 5℃ in the ambient air at 32℃ during 24 hours is calculated as follow;

Table 2-3-4 Radiation test on an insulated truck

Time elapsed	Inside Temp (℃)	Top (℃)	3rd stack (℃)	Floor (℃)
0.0	0.0	5.0	5.0	5.0
1.0	10.0	5.61	5.41	5.17
2.0	10.0	5.85	5.66	5.41
3.0	10.0	6.06	5.88	5.64
4.0	10.0	6.26	6.09	5.86
5.0	10.0	6.45	6.29	6.08
6.0	11.0	6.78	6.56	6.31
7.0	11.0	6.98	6.79	6.55
8.0	11.0	7.18	7.01	6.77
9.0	11.0	7.38	7.21	6.99
10.0	11.0	7.56	7.40	7.19
11.0	12.0	7.86	7.67	7.42
12.0	12.0	8.07	7.89	7.65
13.0	12.0	8.27	8.10	7.87
14.0	12.0	8.46	8.30	8.08
15.0	12.0	8.64	8.49	8.28
16.0	13.0	8.94	8.75	8.51
17.0	13.0	9.15	8.97	8.74
18.0	13.0	9.34	9.18	8.95
19.0	13.0	9.53	9.37	9.16
20.0	13.0	9.71	9.56	9.35
21.0	14.0	10.00	9.81	9.57
22.0	14.0	10.20	10.03	9.80
23.0	14.0	10.40	10.23	10.01
24.0	14.0	10.58	10.43	10.22
25.0	14.0	10.75	10.61	10.41

Source: Test result of an insulated box maker

According to the table above, the bodily temperature of fish rises by 6°C, from 5°C to 11°C. Actually, the truck will shake, doors will repeat opening and shutting as loading/ unloading work is done, and hence radiation of heat will be doubled, melting ice will become rapid, and the bodily temperature of fish will be as high as some 25°C. This higher temperature will accelerate spoilage. Volume of ice required to prevent this is calculated as follows;

Total heat load: $3,000 \text{ kg} \times (25-5) \times 1.1 = 66,000$ kcal

Required volume of ice: $I = 66,000/80 = 825$ kg . . . (B)

Hence, about 1 ton of ice guarantees freshness of fish during transportation. The figure is the required volume of ice to keep low air temperature.

One ton ice costs about D 800, that is, D 13.3 per 50 kg pan. When Bonga at D 1/kg on the beach can be sold at D 5-10/kg in inland area, the cost of ice is only D 0.5 per kg. The expenses of ice will be trifling in comparison with expected profits from selling some 30% of fish once discarded.

(c) Ice for insulated box (Brufut, Batokunko, Sanyang)

In addition to above mentioned "Precondition of design determination" on page 2-18, the following data are added to establish the finally required volume of ice.

- In view of the prime objective of utilization of ice, reduction of post-harvest loss, volume of ice necessary to be calculated is for average catch for 6 months in the highest fishing season, based on the past 3 years fishery statistics.
- The situation of insulated boxes in each landing site is taken into account.
- Shipment to fishing companies is established to be 60% of landings.
- Ice is used for fish at the one-one ratio in weight.

The result of calculation is shown in the Table below. As shown in it, volume of ice necessary for demersal fish at these 3 sites is 5.3 ton per day.....(C)

Table 2-3-5 Situation of demersal fish catch, insulated box, and ice required

Landing site	Brufut	Sanyang	Batokunko	Total
Shipment for 6 months in high season Average catch/ day	3.6~5.1t	0.7~1.5t	0.2~0.5t	
Insulated box	16	8	4	
Necessary volume of ice per box estimated on current fishing condition	250 kg	125 kg	75 kg	
Necessary volume of ice per day	4t	1t	0.3t	5.3t

(d) Necessary volume of ice in total

Ice for initial cooling (Tanji)	4.0 t/day
Ice for transportation (Tanji)	1.0 t/day
Other 3 sites	5.3 t/day
Total	10.3 t/day

Necessary volume of ice is estimated at 10.3 tons a day, and it does not include the figure of existing ice plant at Tanji as it is not currently operating and its future operation is not assured. For that reason, the volume of ice is planned for approximate 10-ton production and two units of 5-ton ice-making machine are planned. Also, kind of ice should be plate ice which is not of easy melting and allows easier maintenance of the machine.

Details of ice-making machine is as follows:

- Kind of ice: Plate ice (crashed ice)
- Outputs: 10 tons/day
- Number of unit: 2 each of 5-ton type
- Control system: Full automatic
- Refrigerant: Freon 22

b. Ice bin

Ice production can be controlled by the number of ice-making machines, and one machine can only produce a certain volume of ice. Ice storage capacity is established to match 2 days production so that the following situations may be dealt with.

(A) High demand

The high fishing season (more than 15 ton/day ice are necessary), good catch, and simultaneous sortie of fishing boats for fishing after stormy weather present a high demand of ice.

(B) Concentration of demand

In the artisanal fishery for the single species of Bonga, ice demand is concentrated in a particular time zone in a day.

(C) Maintenance period

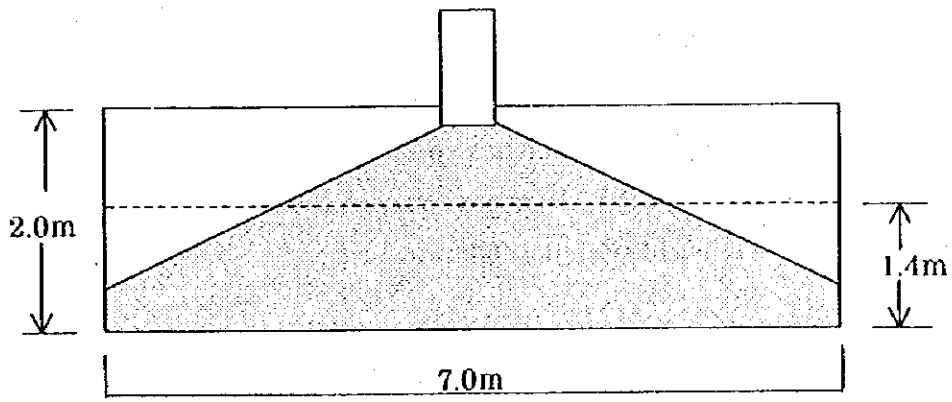
Even when such machinery as ice-making machine, generator, well pump, are put in maintenance, a stable supply of ice must be secured.

(a) Required volume of ice bin

Volume of ice bin = Weight of ice/weight per volume

Hence, Volume(V) = 20,000 kg ÷ 400 (kg/m^3) = 50 m^3

An ice bin, 7 m(L)×5 m(W)×2 m (H) (effective height is 1.4 m), is planned.



Similarly, the ice bin, 5.4m×5.4m, shall be of prefabricated unit panel with a high insulation effect from the standpoint of allowing a shorter construction period. The floor has a wooden board all over. The space for the ice bin panel

requires 6m×7m = 42 ㎡ including three passage ways for maintenance and inspection.

Details of ice bin are as follows:

- Capacity: 20 tons
- Number of unit: one
- Cooling system: forced draft system, hanging cooler
- Defrosting system: electric heat or hot gas
- Control system: full automatic

c. Chilled storage

When a chilled store is provided, the surplus fish for processing, landings late evening, and demersal fish (by-catch of Bonga boat) can be preserved.

It was observed at the site survey that the volume of Bonga to be allocated for the next day shipment is estimated at about 3 ton in normal fishing situation. Also about 5% of total landings of Bonga boats, 5 pans per 100 pans, was their by-catch of demersal fish. Presently this quality fish are shipped in small volume by bus, allocated for smoking, or consumed by fishermen. By-catch of Bonga boats is of good quality due to their short fishing hour and can be sold at a price 10 times as high as Bonga. By selling collected and preserved demersal fish in the chilled store on that day to fishing companies on the next day some cash incomes can be expected.

Taking the situation above into consideration, the necessary volume of the chilled store is calculated as follows;

Bonga late landed	3,000 kg
By-catch of demersal fish	1,000 kg
Total	4,000 kg

Hence, the capacity of the chilled storage is established to be 4,000 kg. The fish boxes generally used in the area are 85cm(L)×52cm(W)×20cm(D). As each box has the capacity of 50kg of fish, 80 boxes are needed for 4,000kg of

fish, and the maximum height of stacked boxes is 1m. Its dimensions are 5.4 m by 5.4 m from a viewpoint of stacking. The Figure below shows a stacking method of fish boxes which requires labor of two persons for carrying. A working space for two persons must be placed in the centre of the storage.

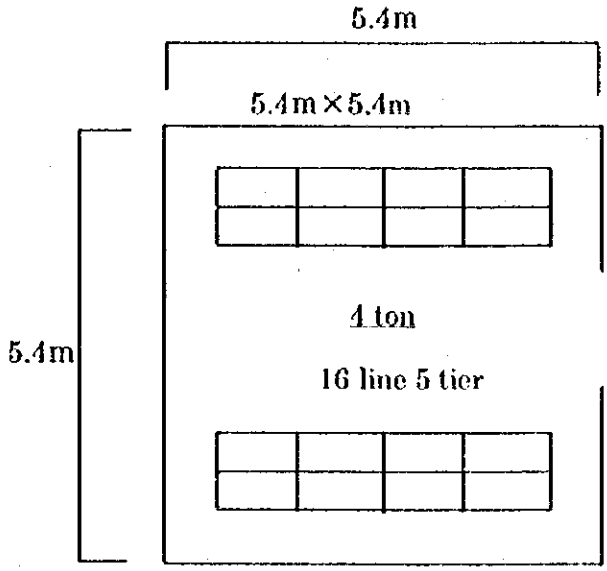


Figure 2-3-2 Stacking Method of Fish Boxes in Ice Storage

A chilled storage, 5.4 m by 5.4m, shall be of prefabricated unit panel with a good insulation effect type from the standpoint of allowing a shorter construction period. The floor shall be of mortar finish on washable heat insulation material, and a drainage system shall be installed. The floor shall be covered with wooden board al over.

The space for a the chilled storage panel requires 6m×7m = 42 ㎡ including tree passage ways for maintenance and inspection.

Details of ice storage are as follows:

- Capacity : 4 tons
- Number of unit : one
- Storage item : fresh fish (mostly Bonga)
- Storage temperature : +32℃ (process: store fish covered with ice right after landing)

- Methods of storage : pile up in fish boxes
- Cooling system : forced draft system, hanging cooler
- Defrosting system : electric heat or hot gas
- Control system : full automatic

d. Generator

The total load of the facility is estimated to be 76 KVA ice-making machine, 18 KVA chilled store/ice bin plus 17 KVA other equipment, and 2 sets of 75 KVA generator will be cover necessary load.

However, since presently there is no plan to introduce electric utility in Tanji, three sets including one set of spare, similar to the Bakau Project, is planned so that a stable operation of the Centre can be maintained.

One emergency and two working generators are installed in parallel and surrounded by a maintain/inspection passage. The space requires 6m × 7m =42 ㎡, including a space for a service tank and a switchboard. Walls shall be of porous concrete block due to exhaust ducts and air intake ducts. Openings of exhaust and intake shall leave enough space to prevent short circuit of them. The foundation of generator shall be independent to prevent vibration from transmitting to the building as well as to reduce floor load. Soundproofing materials shall be sprayed on the ceiling.

Specifics of the generator is as follows:

- Generator

  Engine: Water-cooled 4-cycle direct-jet type

  (fixed number of revolution: 1,500/minute

  Fuel oil: Light oil or heavy oil A

  Generator: Rotary open-magnet type generator

  (with brushless/automatic voltage regulator)

  Power circuit: $3\phi 4\omega$, 50Hz, 380ACV

  Illumination circuit: $1\phi 2\omega$, 50Hz, 220ACV(w/Scott-transformer)

e. Maintenance room and storage

To control and maintain all of the machinery of the Centre, the following maintain room/store is planned.

Space for storage of tools and spare parts	4 m × 3 m = 12 ㎡
Space for disassembling/assembling work	4 m × 3 m = 12 ㎡
Total	24 ㎡

f. Toilet/shower

One toilet/shower room, 3 m×2.5 m = 7.5 ㎡, centering a washing recess, one local type toilet booth and one shower booth with a wardrobe being installed on both sides, is planned.

g. Working space

A space for packing work, loading work, and work for selling and handling ice is planned. Its area is calculated based on 90 boxes to be handled for storage in the chilled store.

0.5 ㎡ / line x×90 lines = 45 ㎡

(size of fish box: 0.45 m(L)×0.9 m(W) ≒ 0.5 ㎡)

By adding a 45 ㎡ working space the floor area is determined to be 90 ㎡.

The floor shall be of concrete trowel finish from the viewpoint of hygiene, durability, and washability. A gradient towards the centre between the pillars is installed, and dust boxes are placed on each side.

h. Fishery Centre building

Total floor area of the centre building including the following rooms is 347 ㎡.

Ground floor:	Ice storage unit:	42 ㎡
	Refrigeration unit:	42 ㎡
	Generator room:	42 ㎡
	Maintenance/storage	24 ㎡
	Work space	90 ㎡
	Toilet/shower	7.5 ㎡
	Surrounding area	15.5 ㎡
	Ground floor	263 ㎡

2nd floor:

Machine room(1)	42 m²
Machine room(2)	42 m²
2nd floor	84 m²

2) Attached facility

a Fuel oil tank

There are only two oil companies in the Gambia; SHELL and ELF. According to ELF, the tank lorry capacity is 12 kl at maximum, transportation is made every 2 weeks as a rule. ELF advised also that 10 kl type tank should be constructed instead of 5kl type from an economical point of view. A regulation concerning fuel oil tank is not enacted yet.

(A) Generator oil tank

The consumption of fuel oil for two 75 KVA generators is about 500 l per 24 hours.

- A tank with an enough reserve must be prepared due to unreliable oil transportation.
- It is much better to reduce the number of supplying oil to the tank in order to avoid giving damage to neighboring smoke processing lot.
- It is desirous to allow to run the generator system without caring about supplying oil due to lack of public power supply and poor telephone communication.
- It is desirous to prepare oil for fishermen's daily life.

Essentially, 500 l/day × 14 days = 7 kl is necessary. Taking the above situation into consideration, a tank of 10 kl is planned.
The tank shall be laid under the ground, a gauge installed.

(B) Gasoline (for out-board motors) tank

A Bonga boat spends 30 l gasoline a day. Since a tax exemption measure is applied, fishermen can buy gasoline everywhere. In the Project, required

volume of gasoline can be calculated as follows;

Fishing fleet:	34 fishing canoes in Tanji
Operating canoes:	70%
Usage of gasoline:	30 l/day (data from hearing surveys)
Gasoline consumption:	34×0.7×30=714 l/day

The volume required for 2 weeks is 714×14 = 10.0 kl. Reserve can be neglected because gasoline is not vital for the management of the Centre. The tank shall be laid under the ground, a dispenser for selling installed.

b. Water tank and pumping system

The following water is required for daily operation of the Centre.

For ice-making	10.0 ton
For washing	4.5 ton
For toilet/shower	0.5 ton
Total	15.0 ton

A stable supply of water is indispensable to the Centre equipped with the ice-making facility. The water tank capacity is planned to be 15 ton meeting daily requirements in view of the water source being a shallow well and the lack of public power utility. The tank shall be of unit panel type made of salt-resistant and maintenance-easy stainless steel type, and be installed on the ground. A small pump for distribution of water to the facilities is planned.

c. Deep well, pumping system, and initial water tank

In excavating a deep well, the following conditions must be investigated.

- The well is located on a proper water vein
- No colon bacilli
- Low salinity
- Being drinkable

The Centre requires some 15 ton of water, 10 ton for ice-making plus some 5 ton for fish handling and toilet/shower. As a result of the survey on natural conditions a well will be established near the site.

Location of the well is in an uninhabited area and about 150m south wards from the site, and 150m from the beach as well. An underwater pump is set in the well to pump up water. It is stored in first water tank to remove sand, and sent by natural gravity to the water tank in the site. Location of the well is shown in Figure (P2-51)

d. Pumping system and control panel hut

A hut, 3m×4m= 12 ㎡ in area, shall be installed beside the well to house a control panel for an underground pump to be installed in the well. In parallel the water tank, a hut, 2m by 2m, housing the pressure pump and its control panel shall be constructed.

e. Water supply, drainage, and sanitation

Water is supplied with 50mm-pipe laid from a water tank, which is installed adjacent to the eastern side of the existing market and booths, to the centre. Service pipe is extended to the ice-making machine on the second floor, work space on the ground floor, and toilet/shower room. Rain water is directly discharged to the sea through U-ditches and water catchment tank. Waste water from fish handling and floor washing at the work space is filtered by a stainless waste-catch basket which is set in the water catchment tank. Then it is treated in a septic tank, and permeated into soil by a permeate-tank. Waste water from toilet/shower room and others will also be pooled in the septic tank to permeate. For sanitation, local-type water closet, hand washer, shower unit will be installed.

Daily washing water of 4.5 ton being used in the Centre contains grease and some blood due to washing fish and floors, which filth water is not allowed to discharge to the sea directly. The waste water, together with 0.5 ton dirty water from the toilet/shower room, shall be seeped into the ground after the

treatment with a natural bleaching and 36 hour staying type septic tank.

The septic tank to be laid under the ground shall be of multistage filtration type reinforced concrete construction with a dimensions of 4m(H)×1.5m(W) and 1.5m(H).

3) Exterior

a. Placement of side ditches and gabions

Side ditches and gabions are placed to protect the Centre building when the site is washed by heavy rainfalls or stormy waves. Side ditches are arranged all around the building. Gabions, 600mm square each, are placed along the berm of the building in two- row/two-layer .

Side ditches are placed as Figure 2-3-3.

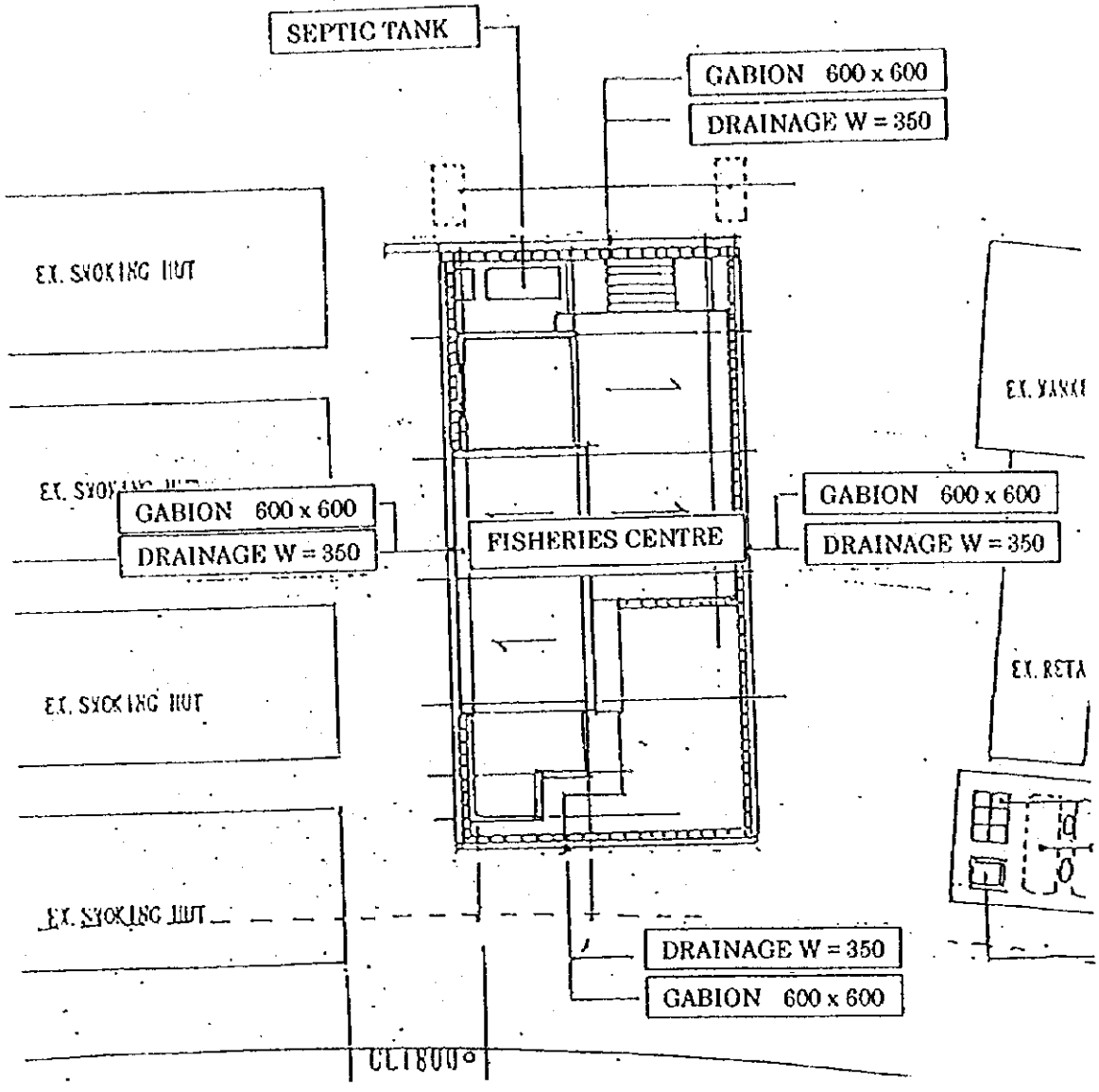


Figure 2-3-3 Layout of Site Ditches & Gabions

4) Structural Plan

In planning structure of the facilities, measures against water damages should be taken for any part of the facilities. Southern part where the equipment is concentrated due to its durability for heavy equipment should be of RC Rahmen structure and of 7.5×7.5-grid steel structure which will economically create wide spaces among pillars around the work space of the ground floor.

a. Building standards and Regulations

As for regulations and standards concerning building design, The Gambia has building standards. Cases which are not applicable to the standards should abide by those of the United Kingdom. Construction of Project facilities will be designed according to the above standards and regulations.

b. Outline of Structure

Facilities	Main structure	Foundation
Fishery Centre	Main structure: R.C Rahmen Structure (A part of 2nd Floor) Steel structure (A part of single floor)	Continuous footing W/ Rain-forced concrete
A shed for well	Main structure: R.C concrete block structure Roof: Wooden Framed structure	Continuous footing W/ Rain-forced concrete
A shed for pressure pump	Main structure: R.C concrete block structure Roof: Wooden Framed structure	Continuous footing W/ Rain-forced concrete

c. Design Load

(A) Fixed load

Weight of structural materials, finish materials, and equipment will be calculated separately. Unit weight of basic materials for main structure is as follows:

Concrete	2.3 ton/m^3
Ferroconcrete	2.4 ton/m^3
Mortar	2.0 ton/m^3
Concrete block	300 kg/m^3

Live load	Slub・Beam	Column・Gurder・Foundation	Earthquake
Roof	30	100	0
Machine-RM	500	5,000	180

(B) Wind load

Wind load shall be designed as 60m/sec(225:kg/㎡)

(C) Earthquake load

There is not any record on earth quake in Gambia. And any anti earthquake regulation on the structural design document is required. But in this project a coefficient of earthquake Co=0.1 shall be adopted.

(D) Concerning anti-corrosive structural material

A special quality control shall be done on Aggregate product of Gambian coast to certify the anti-corrosion for the concrete structure.

A content of alkali-silica shall be less than 300g/ m^3. A covering thickness for steel bar on rain-forced concrete shall be more than a regulation.

Anti-corrosive paint or zinc-chromate gilt shall be treated properly on steel structure material against salty wind on Gambian coast.

5) Facility Plan

a. Special facility

Special facilities which include cooling equipment (ice-making machine, ice storage, refrigerator) and generator will be planned based on the following conditions.

(A) Temperature standards

Place	Open air	Natural water	Machine room	Inside of ice storage	Refrigerator
Temperature:℃	+35	+35	+35	-7.0	-7.0
Corresponding humidity(RH): 85% (excluding natural water)					

(B) Related regulations

As the Gambia has no systematized standards for special facilities, those of Japan will be applied.

- Japan Industrial Standards	: Standards for quality of Japanese industrial products
- High Pressure-gas Regulations	: Regulations for design, manufacturing, installation, and inspection of equipment and machinery
- Container Safety Standards	: Standards for material selection, manufacturing and inspection of containers for equipment
- Food Hygiene Regulations	: Regulations for storage and load hygiene
- Standards for electric equipment	: Standards for methods/specifications of electric power, and illumination and other electric appliances.

Also, regulations for dangerous objects and standards of Japanese Electric Industry Association are applied.

(C) Special conditions

- All the facilities and equipment should be of tropical salt-proof. Particularly, the Project site is always under the influence of sea breeze. Therefore, all the special facilities should be taken the best possible measures against salt damages for their materials and functions.
- Pure water should be pH5.2
- Refrigerator to be used for each cooling equipment will be open and multi-cylinder type. Compressor will be of air-cooled type, and radiator will be of copper-alloy.
- Electric service will not be provided at the Project Site for the time being. Therefore, the power generator should be durable and economical, and designed for easy handling.
- Control panel and electric facilities should be given consideration on said damages/radiation, and easiness of handling/procurement, etc. As a result,

usage of IC board will be avoided as much as possible. When no substitution is available, it should be coated or molded.

b. Electric facility

Electricity is supplied to a switchboard installed in the generator room, and converted to appropriate voltage for use in the Centre.

Electricity is transmitted among buildings through underground cables/wires and if necessary, handholes will be set. It is also supplied through cables/wires inside of the buildings and a rack for cables will be set according to demands.

Electric light, outlet, illumination equipment are designed to coordinate natural light and energy-saving as much as possible.

As source of light, fluorescent lamp is used for interior and mercury-vapor lamp is used for exterior.

Outlets and lighting equipment are efficiently salt-resistant and vapor-proof.

6) Material Plan

As procurement of construction materials is limited in the Republic of Gambia in terms of both variety and quantity, most of them should be imported. However, utmost procurement in the field is planned.

(A) Exterior finish

- Roof : Shingled with color asphalt, water-proof plywood
- Outer wall : Mortar steel trowel and plastic emulsion paint

(B) Interior Finish

	Floor	Wall	Ceiling
Work space	Mortar brush finish	Plastic emulsion paint w/mortar steel trowel	Bottom roof: Plastic emulsion paint
Cold storage/ Ice storage	Mortar steel trowel	Prefabricated Insulation panel	Prefabricated Insulation panel
Generator room	Mortar steel trowel	Plastic emulsion paint w/mortar steel trowel	Glass wool w/concrete Exposed
Maintenance & Storage	Mortar steel trowel	Plastic emulsion paint w/mortar steel trowel	Plastic emulsion paint w/plywood
Toilet/shower room	50mm mosaic tile w/concrete steel trowel	50mm mosic tile w/mortar steel trowel	Plastic emulsion paint w/plywood
Machine room	Mortar steel trowel	Plastic emulsion paint w/mortar steel trowel	Concrete exposed

(4) Equipment and materials component

a. Refrigeration truck

Since no data on insulated truck transportation is available, a daily transportation volume was estimated based on the following conditions.

- The target population is the one of towns/villages which unloading is made.
- Value of the Consumption target and others are according to the data from Fisheries Development Plan to be achieved by 2004.
- It is estimated that the fresh fish distribution program covers 50 % of consumption to be increased at Serekunda and Brikama being supplied fresh fish directly from production sites and all of the targeted consumption in the interior land having a strong demand and no other trucks are intended for distribute for this area.

Table 2-3-6 Fresh fish distribution program (1/2)

Unloading site	Serekunda	Brikama	Barokunda	Kundang
Population of target site	18,900	41,760	3,380	4,620
Middlemen	Coming from various places		Unknown	Unknown
Consumption target (1)	40 kg/ year.person	40 kg/ year.person	26 kg/ year.person	26 kg/ year.person
Consumption actual (2)	28 kg/ year.person	28 kg/ year.person	13 kg/ year.person	13 kg/ year.person
Consumption to increase (3)=(1)--(2)	12 kg/ year.person	12 kg/ year.person	13 kg/ year.person	13 kg/ year.person
Target rate of The Project(4)	1/2	1/2	1	1
Applied consumption (5)=(3)×(4)	6 kg/ year.person	6 kg/ year.person	13 kg/ year.person	13 kg/ year.person
Target supply	133.5 ton/year	251 ton/year	44 ton/year	60 ton/year
Target supply a day	404 kg/day	893 kg/day	157 kg/day	213 kg/day

Table 2-3-6 Fresh fish distribution program (2/2)

Unloading site	Bansang	Basse	Total	Remarks
Population of target site	17,400	25,450	111,510	
Middlemen	12	12	32+α	
Consumption target (1)	26 kg/ year.person	26 kg/ year.person		National average 33
Consumption actual (2)	13 kg/ year.person	13 kg/ year.person		
Consumption to increase (3)=(1)−(2)	13 kg/ year.person	13 kg/ year.person		
Target rate of The Project(4)	1	1		
Applied consumption (5)=(3)×(4)	13 kg/ year.person	13 kg/ year.person		
Target supply	226 ton/year	331 ton/year	1,025 ton/year	
Target supply a day	804 kg/day	1,178 kg/day	3,649 kg/day	Converted to for 281 days

Hence, daily transportation in the Program fresh fish 3,649 kg (73 boxes)

Daily required ice for transportation 1,095 ton

Total transportation 4,744 kg ≒ 5.0 ton

The refrigeration truck is planned to be a 5 ton truck.

(C) Number of trucks

Transportation between Tanji and Basse requires 3 days. A service schedule of one shift of 4 days including maintenance time is shown in following Figure 2-3-4.

Figure 2-3-4 Refrigeration truck operation service

day elapsed	1	2	3	4	5	6	7	8	9	10
day of the week	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed
No. 1 truck	■■■■■■			◎	■■■■■■			◎	■■■■	
No. 2 truck		■■■■■■		◎		■■■■■■		◎		■■
No. 3 truck			■■■■■■			◎	■■■■■■			◎

■ Operation service ◎ Maintenance

The schedule above is for an operation by 3 trucks. Number of operations is 7 per month, the transportation volume is 25.5 ton/month, and number of operations a year is 84.

The number of the refrigeration trucks of the Project is planned to be 3 so that a stable supply may be achieved by one operation a day on an average through the year.

b. Insulated box

(a) For production sites

The number of unusable boxes to be replaced plus the number of boxes necessary for current fishing situation are determind based on the result of the site survey as follows:

Table 2-3-7 Provision of insulated boxes (for landing sites)

Landing site	Brufut	Sanyang	Batokunko	Total
Average demersal fish catch (ton/day) for 6 months in high season	3.6~5.1	0.7~1.5	0.2~0.5	
Existing boxes	16	8	4	
Number of boxes to be newly provided (unusable boxes to be replaced)	7	4	1	12

Hence, 12 new insulated boxes are planned to be provided.

A middleman can deal with 300 kg fish at maximum. To handle this quantity of fish the plastic box of 1.1m(L) × 1.0m(W) × 0.5m(H) = 0.55m^3 (inside dimensions) is planned.

(b) For consumption places

The following boxes shall be placed at each place where the refrigeration truck unloads its load. Data used for calculation of necessary number were quoted from Table 7. Since no boxes are used these places, all of boxes must be newly provided. Box, similar to production site in size, 500 l type, is planned.

Table 2-3-8 Provision of insulated boxes (for distribution centres) 1/2

Places to be provided	Serekunda	Brikama	Barokunda	Kundang
Population of target site	18,900	41,760	3,380	4,620
Target supply	133.5 ton/year	251 ton/year	44 ton/year	70 ton/year
Target supply a day	404 kg/day	893 kg/day	157 kg/day	250 kg/day
Number of boxes to be provided	2	4	1	1

Table 2-3-8 Provision of insulated boxes (for distribution centres) 2/2

Place to be provides	Bansang	Basse	Total	Remarks
Population of target site	17,400	25,450	111,510	
Target supply a day	804 kg/day	1,178 kg/day	3,649 kg/day	Converted to for 281 days
Number of boxes to be provided	3	5	16	300 kg at maximum

Hence, the number of insulated boxes is established as follows;

(a)	For production sites	12 boxes
(b)	For consumption places	16 boxes
	Total	28 boxes

c. Fish box

Fish boxes are necessary for transportation by truck, preservation in the chilled store, and landing work at the beach. Its size shall be similar to existing boxes called "blue box" holding 50 kg Bonga, 0.9m(L)×0.55m(W)×0.2m(H) ≒ $0.1m^3$ Material is plastics.

(a) For refrigeration truck (3 trucks)

Daily transportation 3,649 kg/day/507 = 4.4 ≒ 75 boxes

For 3 trucks 75×3 = 225 boxes. ..... (A)

(b) For chilled store

For storing 4 ton 4,000 kg/50 kg = 80 boxes ..... (B)

(c) For landing work at beach

Used to carry large demersal fish at beach 1,000 kg/20 kg = 50 boxes...(C)

(d) Spare boxes

About 10% reservation is planned 45 boxes ..... (D)

Hence, 225+80+50+45 = 400 boxes shall be provided.

d. Maintenance tools

Tools necessary for maintenance and inspection of the machinery are planned. In general, an electric welding machine, gas cutting machine, vice, sander, etc. are included. Special tools for maintenance of ice-maker/storage, generator and outboard engine are also provided. (details are given on attached sheet Page A-46～49)

e. FRP Fishing Boat & Gear

In recent years, nations in Western Africa are establishing laws for protection of environment and the Republic of Gumbia is no exception. As a result, the following issues are arising concerning building and repair of fishing boats.

- Long waiting period is needed to procure suitable material wood for new boats or substituting boats, causing problems on operation plans.
- Quality timber for building and repair of fishing boats is decreasing, causing problems of durability and safety of boats.

The situation will definitely worsen in the future and material for hull should be changed. Timber may be substituted generally with steel and FRP(glass fiber). FRP fishing boat which has light weight and easily maintained is suitable for Tanji for the following reasons.

- As most of the fishery catches are caught in mass and need hands for landing, fishing boats should be moored on the beach.
- As Bonga fishing is operated in shallow sea area, light and shallow draft boats are suitable.
- There is no shipyard in the neighborhood and the fishermen themselves have to do maintenance and repair. Also, accidents during operation by wooden boats are at high rate. Introduction of FRP fishing boats is desirable for safe operation. In the circumstances, to promote introduction of FRP fishing boats in the neighborhood of Tanji, they are provided as a model case of the Project. They are 40ft canoes, suitable for Bonga fishing, and loaded with 40hp outboard engine which is generally used in the area.

The year of construction of the 34 wooden boats currently operating in Tanji and the number of boats built in each year are given below.

Built Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Total
No. of boats	4	7	3	4	1	1	3	3	1	5	2	34

Among the 34 boats, 14 of those built during 1988 and 1990 and used for ten years or more are becoming decrepit making it difficult to be repaired and dangerous to be used any longer. It is the time, therefore, for building new boats.

- According to the site survey, 9 boats are scheduled to be substituted and 5 boats are unable to be built due to difficulty of procurement of quality timber. To meet the above conditions, 5 FRP fishing boats are provided in substitution of the decrepit boats. There will be no increase in fishery catches nor volume of ice demand as they are just substituted.

- Details of fishing lines used in the area are as given below. Fishing gear corresponding to the above is procured with FRP fishing boats. Items of fishing gear are determined. (1 unit of Bonga surrounding gill net)

  - Main net : 210d/12×85mm×140MD; 1,200m (stretch) 1set
  - Material/color : Nylon, multi-filament, white
  - Sinker : 75g, 1,500 pieces
  - Float : buoyancy 132g, 1,500 pieces
  - Rope : PE 8mm 1,200mm
  - Netting twine : 4kg (210d/30, 500g roll)
  - Mending twine : 210d/12, 10kg (210d/12, 500g roll)

f. Spare Parts

In the Republic of Gambia, ice-making/ice storage equipment provided by Japan's Grant Aid is efficiently utilized. However, procurement of spare parts is often difficult and takes time. Considering the above situation, spare parts of ice-making machine, ice storage, generator and outboard engine are provided for use of 2 years.

(a) Spare parts for ice-making machine and ice storage

Main component : frozen gas, freezer oil, spare parts for compressor and controller

(b) Generator

Main component : Packing for overhaul of engine, electrode for starter, oil filter, fuel filter, etc.

(c) Outboard engine:

Main component : spark plug, gasket kit, bearings, piston ring, oil seal, etc.

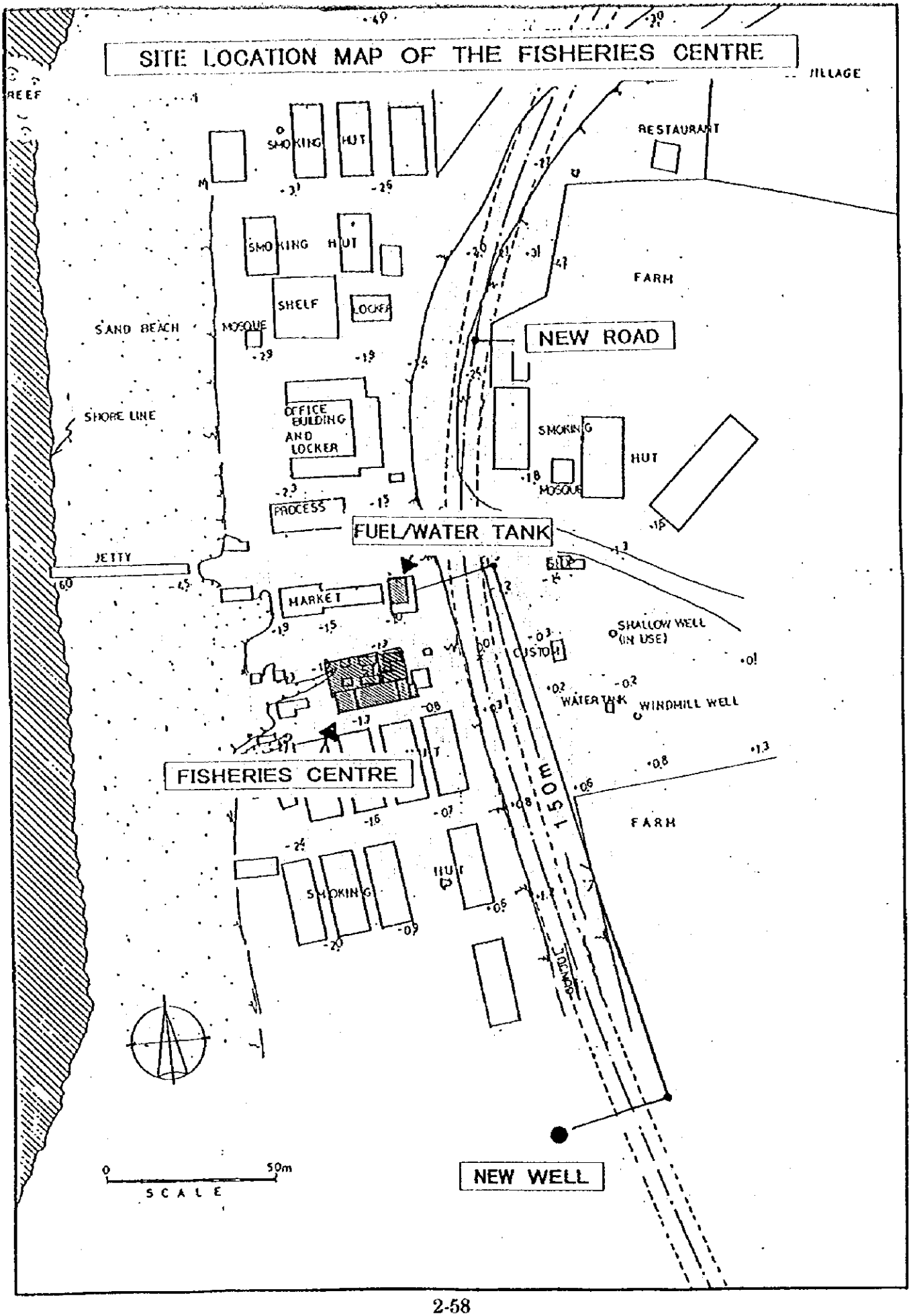
2-3-4 Summary of the Basic Design

The followings are result of the basic design study of the Project.

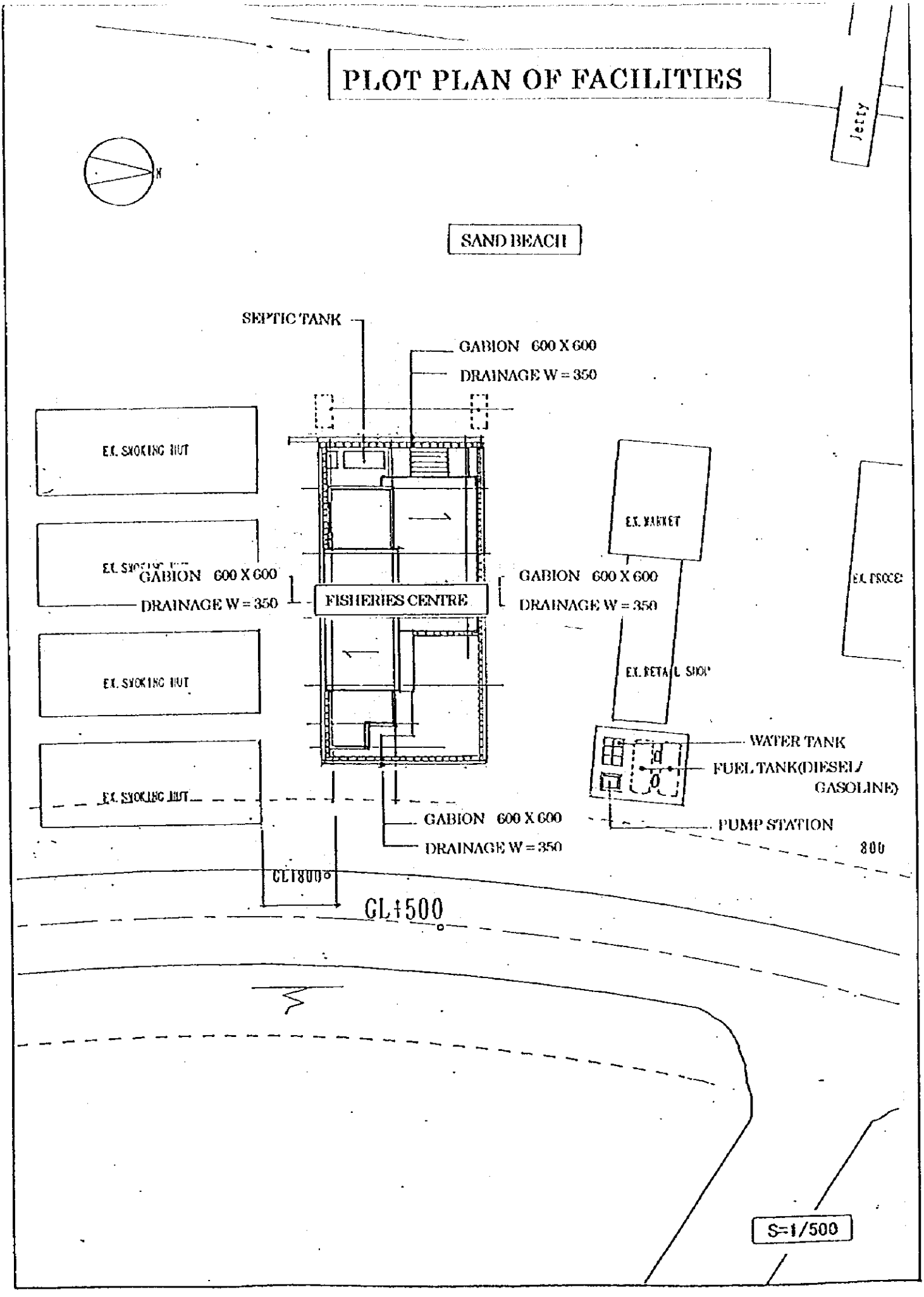
Table 2-3-9 Summary of the Basic Design

Name	Description	Quantity
1. Facility component		
1) Fishery Centre		
· Ice-making machine	5 ton/day, plate ice	2 units
· Ice bin	7m×2m, 20 ton	1 unit
· Chilled room	5.4m×5.4m	1 unit
· Generator	75 KVA	3 sets
· Maintenance room/store	4m×6m	complete
· Toilet/shower		complete
· Working space	90 ㎡	complete
· Centre building	350m, RC, partly 2-storied	1 building
2) Attached facility		
· Fuel oil tank	diesel oil, 10 kl, underground	1 unit
	gasoline, 10 kl underground	1 unit
· Water tank & pumping system	15 ton tank	complete
· Well, pump, initial water tank	well: 50m deep underwater pump, 5 ton tank	complete
· Pump/control panel hut		2 buildings
· Septic tank	simple type	1 unit
3) Exterior work		
· Place of the side ditches	All surroundings	1 unit
· Placement of gabions	All surroundings	1 unit
2. Equipment & materials		
· Refrigeration truck	5 ton capacity	3 units
· Insulated box	FRP, 500 l, with lid	28 boxes
· Fish box	plasties, 50 l, with handle	400 boxes
· Maintenance tools	for generator, ice-making machine, etc.	Complete
FRP Fishing Canoe	40ft, with 40hp O.B.E	5 boats
Fishing gear	Materials for surrounding gill net	for 5 boats

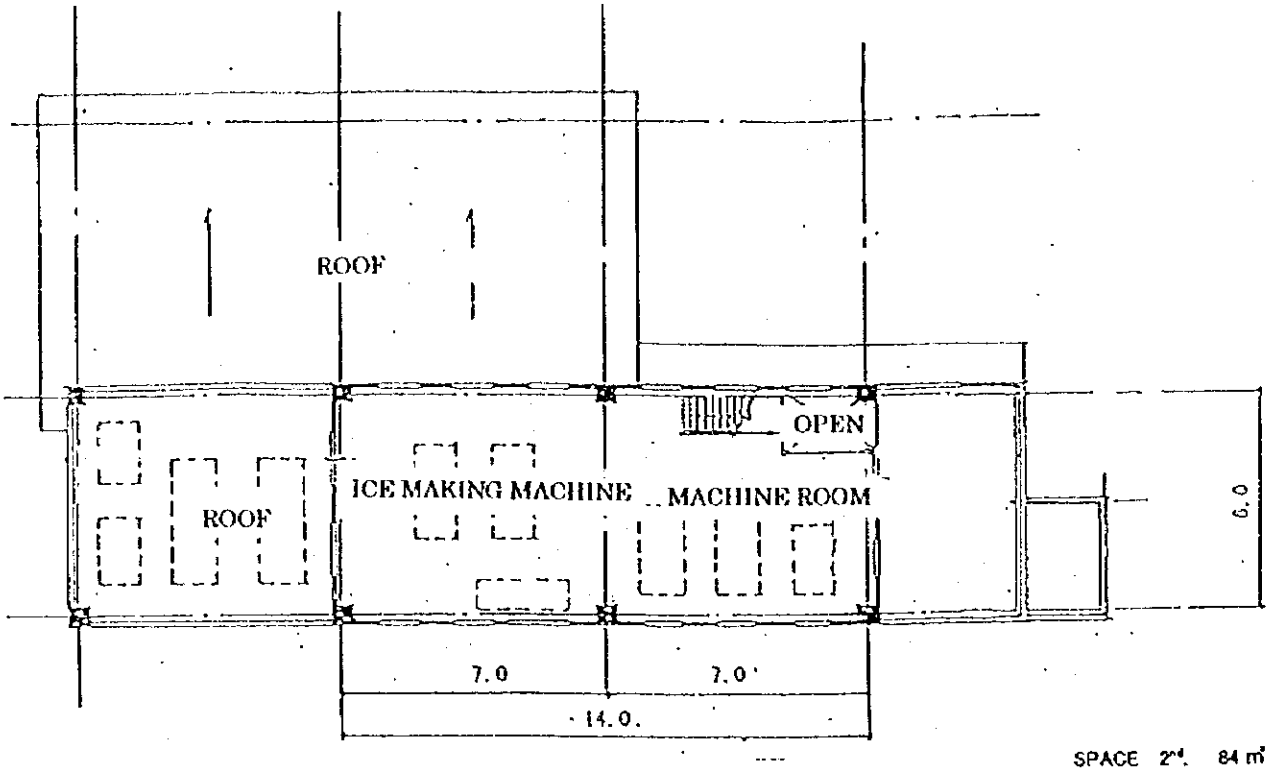
Arrangement of facilities, ground plan, sectional plan, elevation plan and plan of FRP fishing boat are forwarded to following pages.


SITE LOCATION MAP OF THE FISHERIES CENTRE
REEF
VILLAGE
SMOKING HUT
RESTAURANT
SMOKING HUT
SHELF
LOCKER
SAND BEACH
MOSQUE
FARM
NEW ROAD
SHORE LINE
OFFICE BUILDING AND LOCKER
SMOKING
HUT
MOSQUE
PROCESS
FUEL/WATER TANK
JETTY
MARKET
SHALLOW WELL (IN USE)
CUSTOM
WATER TANK
WINDMILL WELL
FISHERIES CENTRE
FARM
SMOKING
HUT
150M
NEW WELL
0
50m
SCALE

PLOT PLAN OF FACILITIES

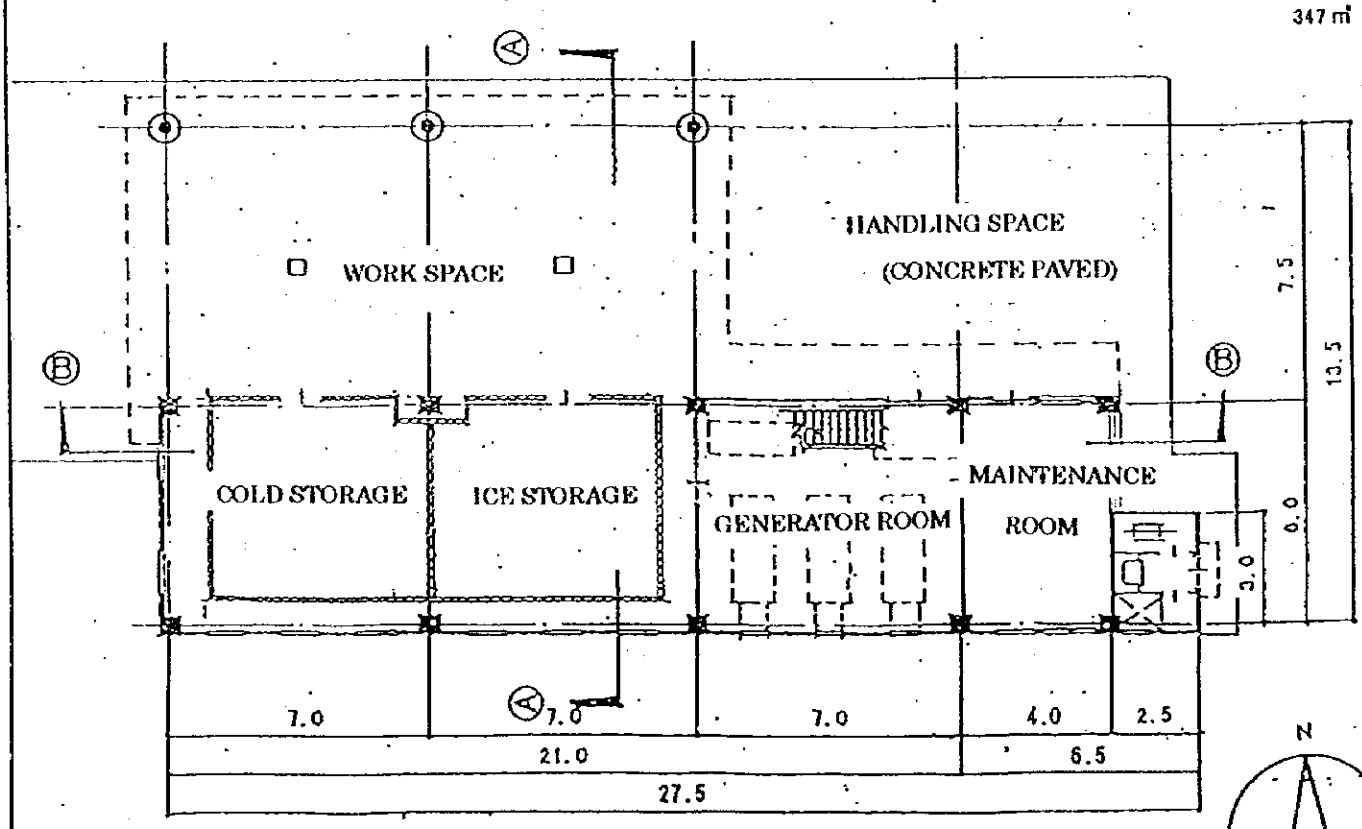


FISHERIES CENTRE PLAN ① S=1/200



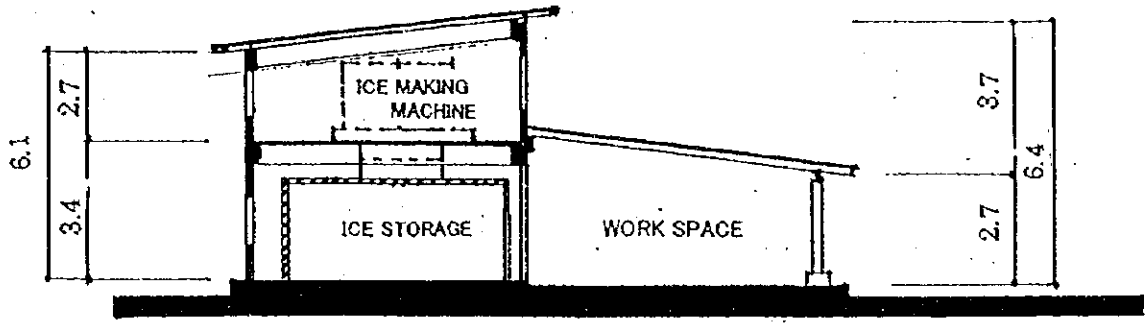
SPACE 2nd. 84 m²
1st. 263 m²
347 m²

2nd FLOOR PLAN

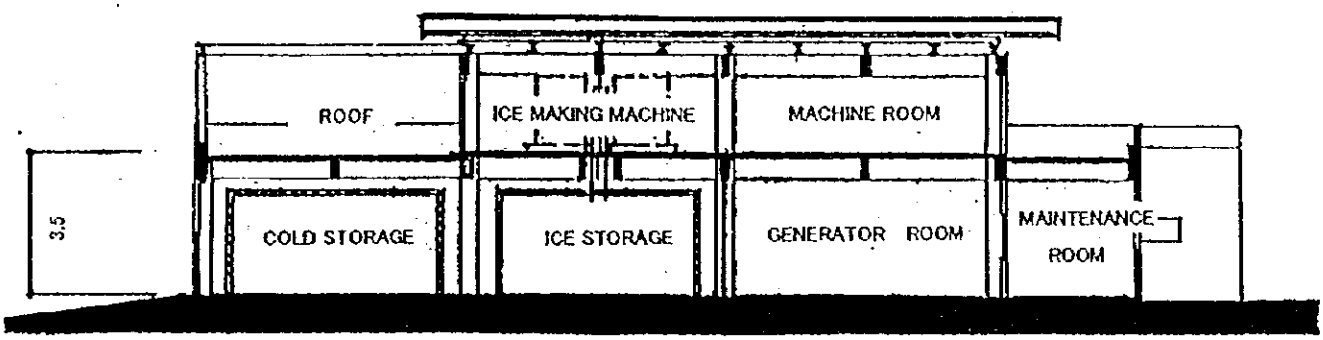


1st FLOOR PLAN

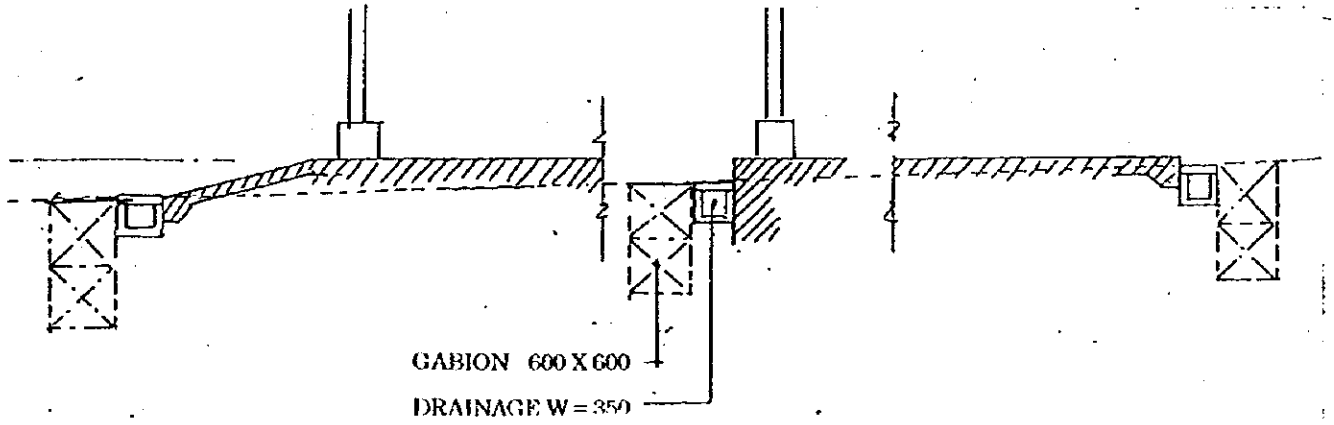
FISHERIES CENTRE SECTION ② S=1/200



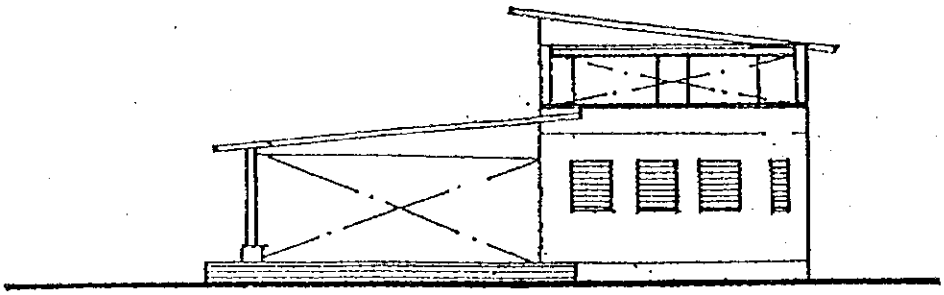
Ⓐ—Ⓐ SECTION



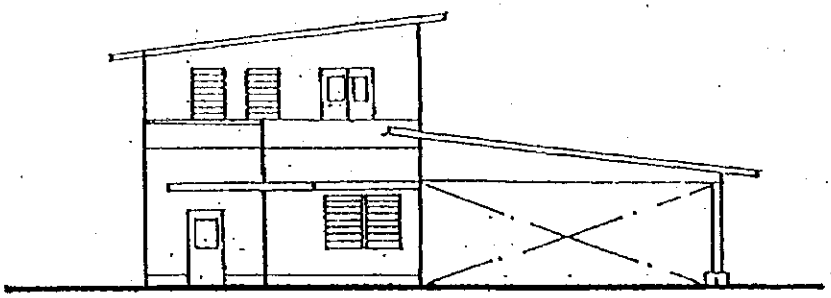
Ⓑ—Ⓑ SECTION



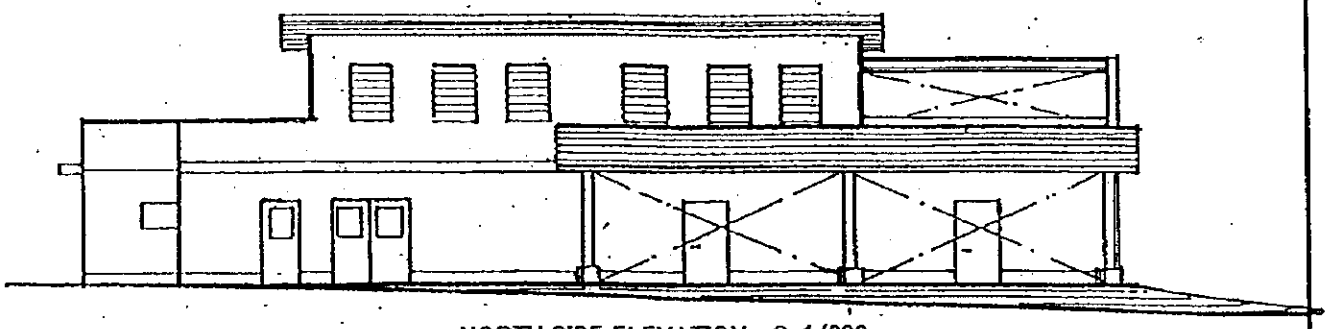
FISHERIES CENTRE ELEVATION ③ S=1/200



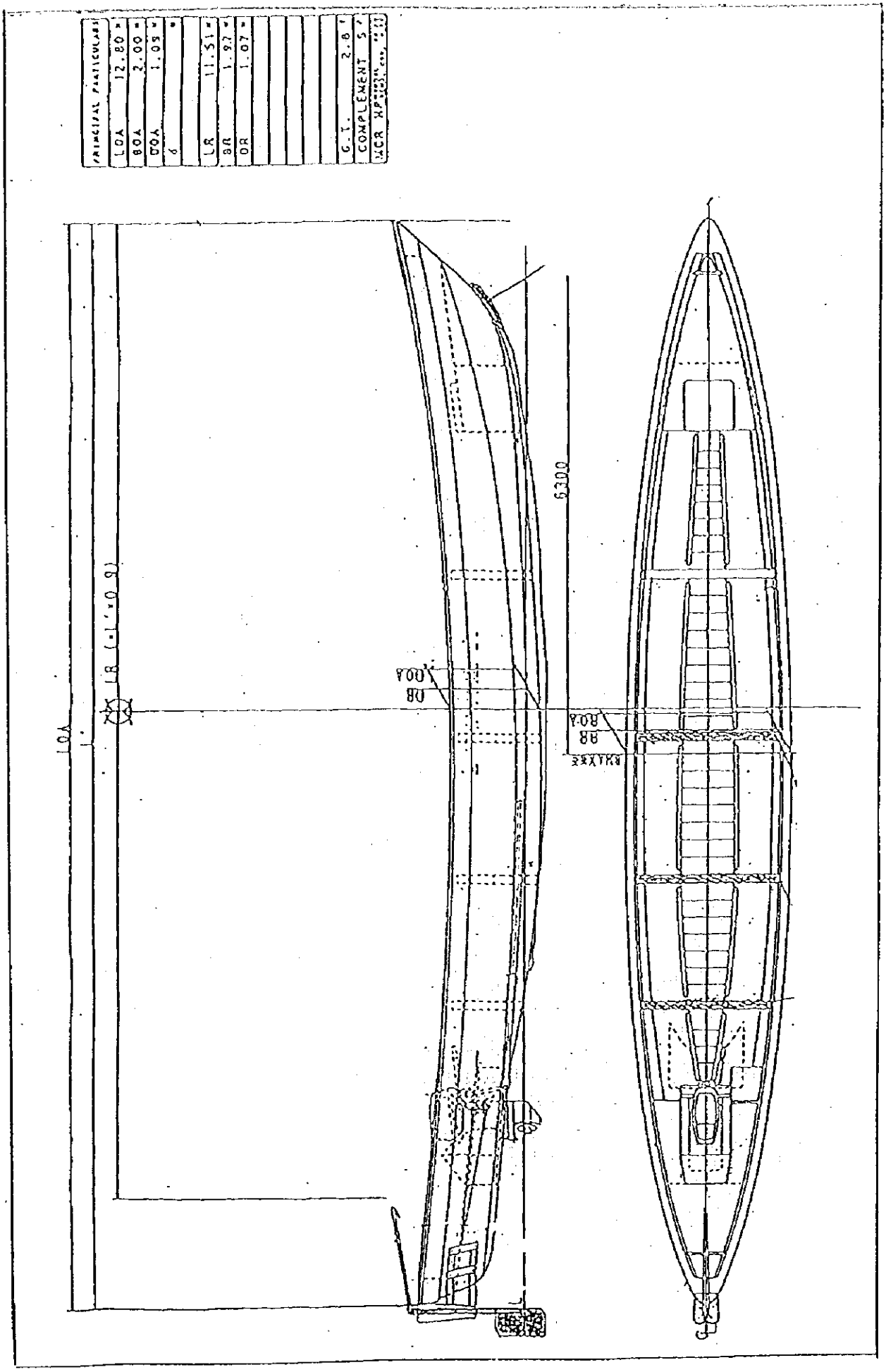
WEST SIDE ELEVATION S=1/200



EAST SIDE ELEVATION S=1/200



NORTH SIDE ELEVATION S=1/200



40ft FRP CANOE