REPORT ON THE BASIC DESIGN STUDY ON THE FISHERIES DEVELOPMENT PROJECT IN THE UNITED REPUBLIC OF TANZANIA

NOVEMBER 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

REPORT ON THE BASIC DESIGN STUDY

ON

THE FISHERIES DEVELOPMENT PROJECT

IN THE UNITED REPUBLIC OF TANZANIA

PREFACE

In response to the request of the Government of United Republic of Tanzania, the Government of Japan decided to conduct a Basic Design Study on Fisheries Development Project and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Tanzania a team headed by Mr. Noriharu Nakamura, Chief Fishingboat Inspector, Fisheries Agency, from August 15th to September 1st, 1984.

The team had discussions with the officials concerned of the Government of the United Republic of Tanzania and conducted a field survey. After the team returned to Japan, further studies were made and the present report has been prepared.

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

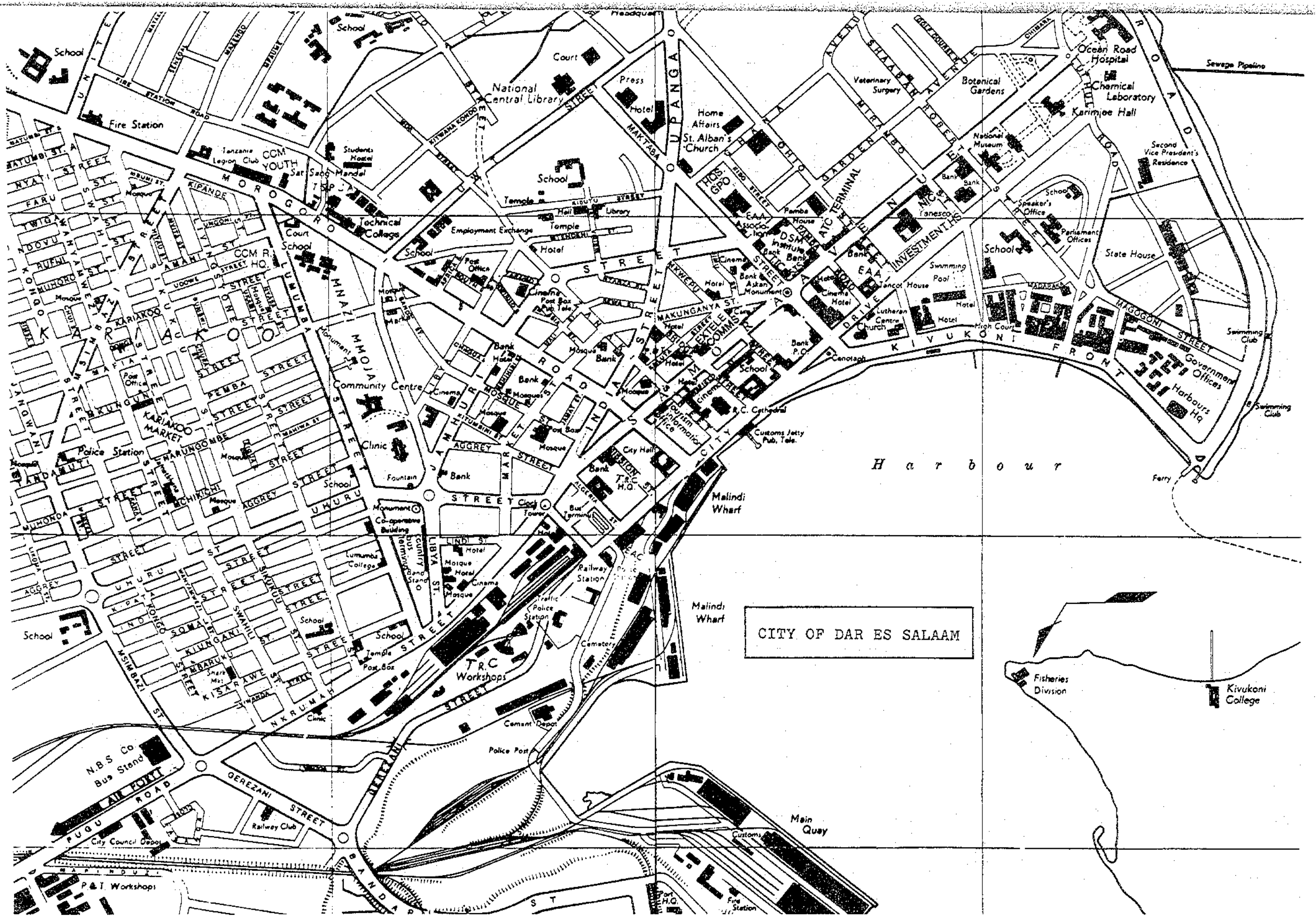
I wish to express my deep appreciation to the officials concerned of the Government of the United Republic of Tanzania for their close cooperation extended to the team.

November, 1984

Keisuke Arita

Keisuke Arita
President
Japan International Cooperation Agency

UNITED REPUBLIC OF TANZANIA


CITY OF DAR ES SALAAM
Harbour
Ocean Road Hospital
Chemical Laboratory
Karimjee Hall
Botanical Gardens
Veterinary Surgery
National Museum
Second Vice President's Residence
State House
Parliament Offices
Speaker's Office
Government Offices
Harbours Hq
Swimming Club
Ferry
Kivukoni College
Fisheries Division
KIVUKONI FRONT
Lutheran Centre Church
Cenotaph
Customs Jetty Pub. Tele.
R.C. Cathedral
Tourism Information Office
City Hall
T.R.C. H.Q.
Malindi Wharf
Main Quay
Customs
Railway Station
T.R.C Workshops
Cement Depot
Police Post
Railway Club
GEREZANI STREET
N.B.S Co. Bus Stand
City Council Depot
P & T. Workshops
PUGU ROAD
Clinic
Community Centre
MNAZI MMOJA
Fountain
Clock Tower
Co-operative Building
Lumumba College
KARIAKOO
KARIAKOO MARKET
Police Station
Fire Station
School
MOROGORO ROAD
CCM YOUTH
Tanzania Legion Club
Technical College
Employment Exchange
Temple
Library
National Central Library
Court
Press
Hotel
MAKTABA
UPANGA
Home Affairs
St. Alban's Church
HQS. GPO
Pemba House
EAA Association
DSM Institute
ATC TERMINAL
INVESTMENT HS
Tanesco
Askari Monument
Cinema
Bank
Mosque
Post Office
UHURU
LIBYA ST.
INDIA STREET
JAMHURI STREET
AGGREY STREET
MAKUNGANYA ST.
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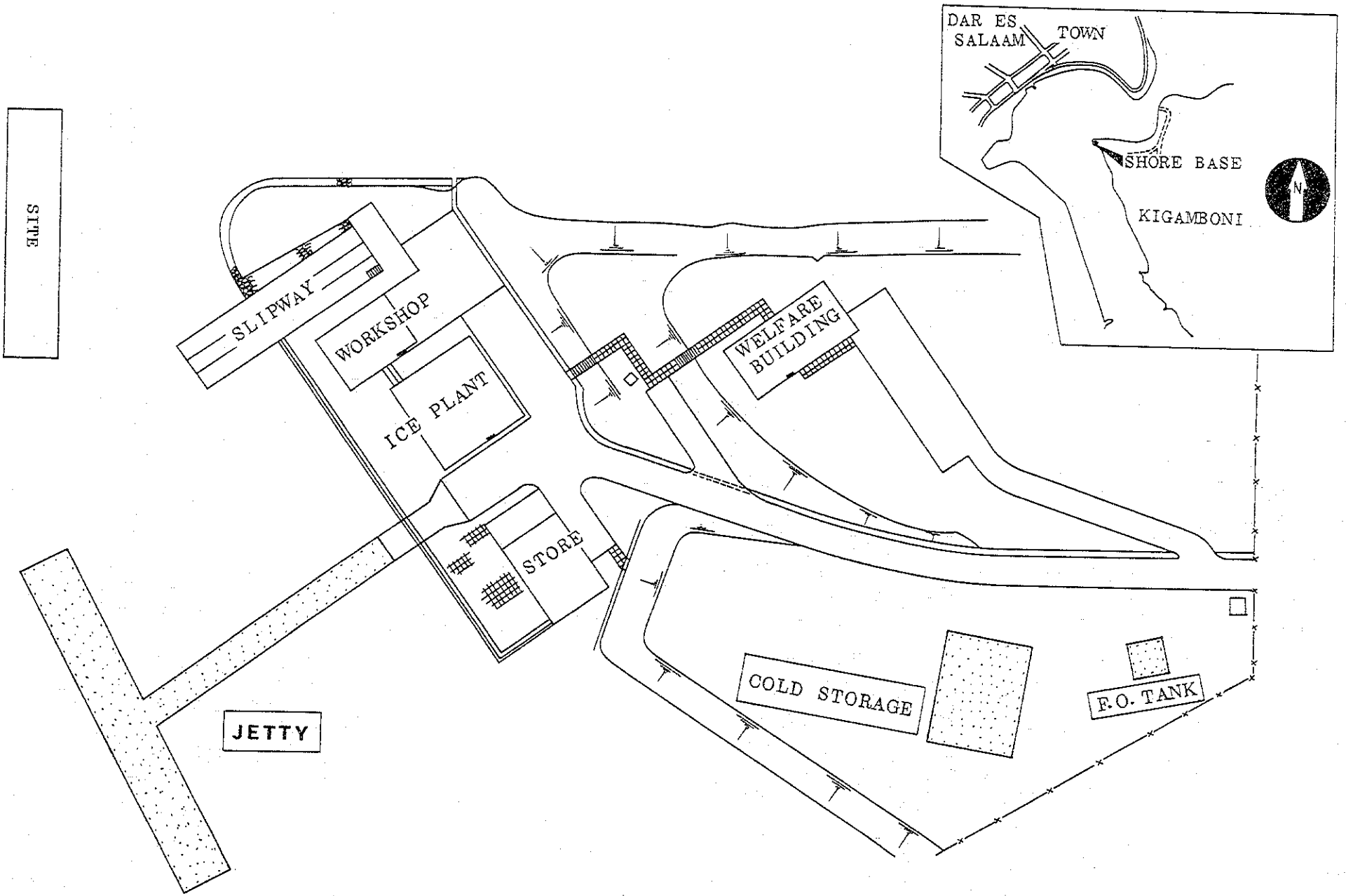
MSIMBAZI ST.
MAGOGONI STREET
Sewage Pipeline


DAR ES SALAAM
TOWN
SHORE BASE
KIGAMBONI
N
SITE
SLIPWAY
WORKSHOP
ICE PLANT
WELFARE BUILDING
STORE
JETTY
COLD STORAGE
F.O. TANK

Contents

SUMMARY

While fresh-water fishery carrys much weight in Tanzania, marine fishery is still at an immatured stage. The Tanzanian marine fishery consists mainly of traditional artisanal fishery. With regard to large scale fishery, TAFICO (Tanzania Fisheries Corporation) carries out its operation with modern fishing methods. In the Tanzanian fishery promotion plan, the Fisheries Division of the Ministry of National Resource and Tourism sets forth its policies and TAFICO is in charge of planning and execution.

The fishery promotion plan includes the boatyard construction project, and the fishing promotion projects which is composed of the prawn trawl fishing promotion project and the fishing company establishment project. Tanzania puts emphasis on the prawn trawl fishing promotion projects and its objectives are to increase the catch of prawn, which is an international commodity, to earn foreign currency through the export of prawns and to increase the supply of animal protein to the nation through production and freezing of the fish caught along with the prawn.

With a view to carry out the prawn fishing promotion project, Tanzania constructs the trawlers through the cooperation of Japan, the United Kingdom, Finland as well as its own funds. The fishing base at Kigamboni in the Ras Mkwavi district of the opposite side of Dar es Salaam is now under construction. TAFICO has sixteen fishing boats, eight of which are moored due to the body damage, engine trouble and shortage of spare parts, etc. However, the MAMATAFICO, double rigger type prawn trawler constructed through the Japanese grant aid in 1982, has been operated with a favorable result, which is not common in the world prawn fishery. The Kigamboni fishing base intends to increase the operational efficiency of the boats belonging to TAFICO by the construction of a slipway, a workshop, etc.,with its own funds. At the base there is a 10 ton/day ice plant utilized effectively which was constructed by the Japanese grant aid.

Tanzania wishes that the increase of a double rigger type prawn trawler in the number will bring about the improvement of TAFICO's

management, the earning of foreign currency through the increase of prawn exports. The supply of animal protein to the nationals through the increase of fish caught along with the prawn. The installation of a jetty, a cold storage, a tank, etc. at the Kigamboni fishing base are also important. Therefore, the country requested the Japanese government to grant double rigger type prawn trawlers, a jetty, a cold storage, a tank, etc. In response to this request, the Japanese Government decided to cooperate with Tanzania in the fishery development plan and Japan International Cooperation Agency sent a basic study team to Tanzania from August 15 to Spetember 4 in 1984.

The study team made a survey of TAFICO, which is an executing body of the Tanzanian modern industrial fishery. TAFICO is also the present and past recipient objected body of the grant aid from the Japanese government. The team conducted also an on-site examination of the MAMATAFICO and the Kigamboni fishing base. The study includes the managerial conditions of TAFICO and the conditions of the fishing boats in their operation, maintenance and servicing , the operational conditions of an ice plant and prawn processing facililies, the Kigamboni fishing facilities which are now being constructed without foreign aid and the confirmation of its construction progress. In the meeings opinions were exchanged with those concerned of the Tanzanian side, especially the responsible staffs of TAFICO.

On the basis of the field survey, the meetings with the persons concerned of TanZania and the implemention of the fishery promotion project, the study team concluded that it is indispensable to construct a jetty, a cold storage, a tank, etc. which should be main facilities of TAFICO's Kigamboni fishing base, to build a prawn trawler, and to supply spare parts and equipments necessary for maintenance and repair of FRP boats granted in the past by the Japanese government. Its contents include the following items.

(1) Double rigger type prawn trawler (approx. 150 international gross tons)x 1
(2) Cold storage (120 ton type, with emergency electric generator) x1
(3) Jetty (PSC floating jetty, with a built-in 120 ton water tank) x1

(4) Fuel oil tank (240 KL) x1

(5) Spare parts and equipments x1

In order to execute this project, it is estimated that Tanzania's share (about 7,000,000 yen) is needed. Also the operation period of 14 months after E/N exchange is required.

The Fisheries Division of the Ministry of Lands, Natural Resources and Tourism is the authority concerned with this project and TAFICO is in charge ofits implementation and administration. With the financial analysis of TAFICO in the basic design study it was confirmed that TAFICO is directed toward the stabilization in management due to a favorable result of the MAMATAFICO and it will improve further with another prawn trawler in operation, and smooth operation of the fishing boats belonging to TAFICO accompanied by the improvement of the fishing base. On the other hand, due to the shortage of foreign currency it was difficult to obtain spare parts necessary for maintaining and repairing the boats and on-shore equipments before adopting the Tanzanian policy which allowed to utilize 15% of the revenue from export of the prawn caught. Furthermore, since the technical experts of the Japan International Cooperation Agency provide with an on-board training in the MAMATAFICO and the crew stick to the job with a high percentag, there is no technical problem in terms of the fishing boat operation. In order to expand the efficiency of this project Tanzania's further efforts to improve the operational rate of the TAFICO's actual fishing boats and other production sections will contribute greatly to the fishery promotion of the country and the TAFICO's financial stabilization.

*1 Double rigger type prawn trawler

This type of trawler was used for the first time in the sourthern part of U.S.A. and now is widely used in many fishery grounds in the world starting from the Latin American countries. The double rigger type extends two rigs on the port and starboard and draws two trawl nets attached to the end of wires which passe the top of the above rigs.

CHAPTER 1 INTRODUCTION

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FAO estimates that among 51 independent countries in the African Continent, 24 of them, approximately a half, are currently facing a serious food crisis. The grain production of these 24 countries in 1983 amounted to 16.2 million tons with 1.9 million tons less compared to the previous year. Tanzania is one of the countries affected by this crisis. The food shortage has reportedly been caused by the drought in the Sahel and its neghboring areas.

The total number of refugees in Africa was reported to be about 3.6 million in 1981, but it increased to an estimated 5 million in early 1983, equivalent to a half of the total number of refugees in the world. This increased refugees are considered to have been caused mainly by farmers who abandoned their land because of drought.

Tanzania's balance of payments has worsened with much deficit from 1974 to 1975. This was, on the one hand, caused by the rise in oil prices which had severe repercussions for all other non-oil producing and developing countries like Tanzania. Another critical factor for it revolved around the import of large quantities of food which came to be needed after the drought at rising international prices. To ameliorate that situation, the Tanzanian government took measures such as raising farm prices, increasing taxes and imposing import restrictions, etc. Efforts were also made to increase aid from other countries and to decrease and compensate for the trade deficit by drawing money from the foreign currency reserve. Owing to the above efforts and the rise in coffee prices, the trade deficit was reduced from 1976 to 1977. Nevertheless, in the years 1978 to 1979, Tanzania suffered from more serious trade deficit than that of 1974 to 1975. Among the chief causes of this were a drop of export goods in price and volume, an outbreak of war against Uganda, the disruption of the East Africa Community, and the decrease in food production due to drought. Also from the above years, farm products, the essential export goods of this country, continued to

be at a lower level in terms of both production and international market prices. The foreign currency reserve of Tanzania has consequently been steadily declining, and the present foreign currency is reportedly equivalent to the value of only its one week export.

The lack of foreign currencies has affected every aspect of the people's life. The peole suffer from a shortage of living commodities and the manufacturing industries have lowered their operation rates due to the restrictions on imports of raw material and the lack of spare parts.

In order to get over such a harsh economic condition, the government is striving to improve the management of public corporations, by eliminating unnecessary expenditures, and attempting to raise the level of efficiency in the general administration. Policies have been carried out based on the National Economy Survival Programme (NESP, 1981/1982) and the Structural Adjustment Programme (SAP, 1982/83-1984/85). In addition, the reexamination of the agricultural policy has been undertaken. On the other hand in terms of external policies, the government has made efforts to increase imports by realizing a big low-interest loan. However, in connection with this, the negotiations with the IMF have been rough going. In the economic reconstruction plan, the policies for fishing focus on an increase in volume rather than on the investigation, research, and training of people engaged in the fishing industry.

The Tanzania Fisheries Corporation (TAFICO) was established in 1974 by a law enacted in 1969. The objective of its establishment was that it would be a holding Corporation with a number of subsidiary companies operating in various production activities. However, Tanzania's economic conditions compelled this corporation to aim at the development of marine fishery, the protein supply to the people, and obtaining foreign currency by prawn exports through its direct engagement in production.

According to the economic policies of Tanzania,

fishing boats and on-shore facilities have been granted from other countries. In addition, various facilities and equipments have been constructed through its direct Treasury Investment. Such efforts are now carried out.

At present, the Tanzanian fishing industry is mainly based in the inland waters and its marine fishery is in the beginning stages. Until the present,a few efforts have been directed to the marine resources in coastal waters. Therefore, there is future potential to develop the marine fishery.

MAMATAFICO, constructed by the Japanese grant aid in 1982 operates primarily for prawn catches. Favorable results ensured which are uncommon even in the world prawn fishery. Therefore, it constitutes the main earning in the business of TAFICO and obtains foreign currency by exporting the products to Japan and European countries. In this respect it was necessary for the Tanzanian government to request the aid in the form of grants from the Japanese government for a jetty, a cold storage, etc. This aid would serve to consolidate the TAFICO's fishing base, Ras Mkwavi in the Kigamboni district. It would also ensure better operational efficiency, and increase the foreign currency earnings of TAFICO with more prawn trawlers. In reply to this request, the Japanese government decided to carry out the basic design study. The Japan International Cooperation Agency sent a study team, led by Mr. Noriharu Nakamura, Chief Fishing Boat Inspector, Fishing Boat Division, Fisheries Agency, for a 21-day mission from August 15 to Steptember 4, 1984. The objectives of the study are to discuss with the people concerned of Tanzania and make the field survey on the fishery development plan, the subject of request, so as to elaborate the basic design necessary for the execution of an efficient grant aid concerning prawn trawler, jetty, cold storage, tank, etc. for the development of fishery of the said country.The member, schedule and minutes are described in the annex.

(note) * Angola, Benin, Botswana, Cape Verde, Central Africa, Chad, Ethiopia, Gambia, Ghana, Guinea, Guinea Bissau, Lesotho, Mali, Mauritania, Mozambique, Sao Tome e Principe, Senegal, Somalia, Swaziland, Tanzania, Togo, Upper Volta, Zambia, Zimbabwe

CHAPTER 2 BACKGROUND OF THE PROJECT

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2-1 Natural and economic conditions

(1) Nature

The United Republic of Tanzania is located in the eastern part of the African Continent, south of Kenya, facing the Indian Ocean.

The country consists of the mainland once-called Tanganyika, and islands such as Zanzibar and Pemba which lie about 50 km off the shore. The mainland is made up of plateaus, most of which are more than 300 m above the sea level, except the coastal area along the Indian Ocean. As going to the inside part of country, the altitude rises. The highlands comprise the central part of the country which rise more than 1,000 m above the sea level. Although the country is located almost on the equator, the permanently snow-capped Mt. Kilimanjaro reigns supreme (5,950 m). Two huge dislocations called the Great Rift Valley created by a diastrophism run parallel one to the other from north to south. One of them passes through the central part of the country towards Kenya and the other continues up to Uganda through the Lake Tanganyika. The Lake Victoria, the third largest lake (69,480 km^2) in the world and the Lake Tanganyika ranking seventh (32,890 km^2) lie within the Great Rift Valley. These two famous lakes and other small ones were formed over the years with water which flowed from Mt. Kilimanjaro, Mt. Meru (altitude 4,556 m) and others.

The climate of this country is divided into the following three types: Tropical, tropical savanna and temperate. The coastal zone has a tropical climate with high-humidity and high-temperature. The central highland zone has a tropical savanna climate characterized by the extremes of both rainy and dry seasons. The northern and southern highland areas with altitude 1500 to 3000 m above the sea level have a temperate climate. The heat is moderate from June to September but from December to February, it becomes extremely hot. In the coastal area, it is hot all year round and in the inland plateaus and mountainous areas the daily range of temperature is so wide that it plunges to extremely cold temperature both in the morning and the evening. The lake side climate is hot and humid owing to the effects of lake.

Although the East African Coast Current branches off from the South Equatorial Current and runs off the coast of Tanzania, the plankton breeding is poor in this zone due to insufficient nutrient salts. Tanzania has a coast line of about 800 km with a delta at the mouth of the Rufiji.

(2) Economy

Tanzania is facing an economic crisis due to the aftereffects of the war against Uganda, the drought in the Sahel and surrounding areas, the rise of oil prices and the world recession. The major problems are as follows:

1. Lack of subsistance goods, especially food.

2. In the industrial sector, a low rate of operation due to insufficient fuel, a low level of imported raw materials and lack of spare-parts, etc.

3. In the agricultural sector, insufficient agricultural machinery, fertilizer, etc.

4. Obligation of contracted repayment of loans and lack of foreign currency due to the delay of new loans.

In the budget for the new fiscal year 1984/85, the Tanzanian government sets forth the following policies to obtain foreign currency.

① To give priority to the export foreign currency quota to exporting enterprise, and public corporations under the supervision of the Trade Agency, the Ministry of International Trade and Industry.

② To admit exporting enterprises and public corporations to open foreign currency accounts so as to secure the import of necessary raw materials.

③ To admit enterprises and public corporations which manufacture industrial products to acquire the necessary raw materials by paying a part of the estimated export revenues or through barter trade.

(3) Economic Development Plan

Tanzania's economic development plan began with the first 3 year plan (1961/62-1963/64) established on the basis of fact-finding research taken in 1959 by the World Bank.

The first 3 year plan aimed at building up the economic foundation just after Independence. The first 5 year plan (1964/65-1968/69) had for its objectives the expansion of agricultural production and industrialization. The second 5 year plan (1969/70-1973/74) puts accents on correction of inequality, rural development, generalization of elementary education, and industrialization. Although the goal of the third 5 year plan (1976/77-1980/81) was the same as the former two 5 year plans, it was not achieved due to the rise of oil prices and the drought which occurred in that period. Having, afterward, passed through the NESP (National Economic Survival Programme 1981/82), which aimed at improving the trade balance by increasing the export of farm products and self-supporting food. Currently SAP (Structural Adjustment Programme 1982/83-1984/85) is being carried out. Its main objectives are as follows:

① To promote exports in order to obtain foreign currency.

② To make efficient use of the government budget and to decrease the money supply.

③ To strengthen and promote intra-trade.

④ To promote the realization of plans in each section (administative reforms in public corporations).

2-2 Fishery situation

(1) General Fishery Situation

①. General

The total catches in the world in 1982 was reportedly 75,046,000 tons. That of African nations was 3,073,000 tons (approx. 4.1%) and that of Tanzania, 223,000 tons (approx. 0.3%). According to the statistics published in 1976, even it is too old, among the worldwide catch of 73,500,000 tons, the fresh-water catch was 10,300,000 tons. Asia accounts for 7,500,000 tons and Africa, 1,500,000 tons.

Tanzania may be characterized by its fresh-water fishery. It has Victoria, Tanganyika, Niassa, (Lake Malawi) and rivers running from such as the Rufiji, the Pangani and the Ruvuma. Therefore, among the catch of 223,000 tons (in 1982) freshwater fish made up 199,000 tons (approx. 89%) and saltwater fish was only 24,000 tons (approx. 11%). However, the fresh water fishing grounds are shared with other countries: Lake Victoria with Uganda and Kenya, Lake Tanganyika with Zaire and Zambia, Lake Niassa (Malawi) with Mozambique and Malawi. Therefore, a large increase in production cannot be expected. On the contrary, since marine fishery is a promising field with a fishing ground practically untouched, it is possible to increase the catches in prawn, bottom fish and drift fish in the future.

Table 1 Transition of catches in Tanzania

Unit: 1,000 tons

Category	1978	1979	1980	1981	1982	1983
Fresh-water fishery	164	147	190	186	199	approx. 200
Oceanic fishery	47	33	39	40	24	36
Total	211	180	229	226	223	approx. 236

② Marine fishery

Although Tanzania has a coastline of about 800 km, so far it has not adopted the 200 mile econimic sea zone, rather it has declared a 50-mile territorial zone.

The southwest monsoon season strikes this territorial zone from April to November and the sea often gets stormy with low temperature prevailing. The northeast monsoon season prevails from November to March, and is characterized by high temperature and the calm sea.

Rivers such as the Rufiji, the Pangani and the Ruvuma flow into the sea, carrying with them a lot of mud and organic matter. They characterize the fishing ground. This flow during rainy season towards coastal waters formulates deltas at the mouth of the large rivers. The delta of the Rufiji is especially suitable for the spawning and hatching of prawn. Prawn catch in this delta accounts for more than 80% of the national catch.

Most of the fisheries in Tanzania is done by artisanal fishermen and industrial fishery is carried out by only TAFICO. The artisanal fishery may be divided into the net fishery and the line fishery. The net fishery is operated for horse mackerel, sharks, sardines, ray and bottom fish by using gill net, shark net, drag net and cast net. They catch sardines, employing submarine lights, with scoop net, purse net, and round haul net. Other fishermen operate in the delta of the Rufiji and the Mafia Channel for king, spanish mackerel, tuna and bonito by pole-and-line.

Table 2 Transition of marine fishery in Tanzania

Unit: Number of fisherman: A person, Number of boat: A boat,
Catch: Mill. T., Turnover: Thousand T.Shs

Item	1978	1979	1980	1981	1982	1983
Number of fisherman	9,799	8,120	7,596	12,176	12,752	15,132
Number of boat	4,498	2,906	2,238	3,614	3,280	3,500
Catch	46,707	33,388	39,278	39,576	23,699	35,518
Turnover	267,151	122,466	318,135	224,303	257,560	—

The number of fishermen in Tanzania has been increasing year by year because those who abandoned their farms due to the drought sought fishing business as a new means of livelihood. Fishermen without boats have been increasing. 80% of the fishing boats are not mechanical. The fishing Law of Tanzania provided that all boats with fishing rights should be registered. However, many fishermen don't use their boats owing to the insufficient maintenance faciltities. Consequently the number of fishing boats has not increased since 1981.

③. Freshwater fishery

A: The Lake Victoria

Lying on a highland of more than 1000m, the Lake Victoria is a tray-like lakeforming the boundary of Tanzania with Uganda and Kenya. 85% of the inflowing water to the Lake is produced by rain and the overflow of water runs to the Nile.

In the rainy season,a flooding occurs in the surrounding lowlands. The rising water level makes the Lake rich in nutrient substances as the nutrient salts existing in land soil are fused into the water. Consequently, the Lake has much diatom, blue-green and green algae and rich stock of Tilapia, cichlid mainly Haplochromis, carp, characin and catfish. Lates Nilotica, considered to be the largest fish in Africa, live there, too. In this Lake Haplochromis accounts for about 83% of the stock, followed by catfish, Tilapia,and etc. In regard to the fish value,Tilapia, being valuable, is the most important. Trawl, bottom gill net, longline, dragnet are employed as fishing methods. Haplochromis is consumed in the form of fish meal and the others are eaten raw or processed into fumade. They are consumed in the surrounding cities and some of them are exported to Uganda.

B: The Lake Tanganyika

The Lake Tanganyika, the second largest in Africa, is located on the boundary of Tanzania with Burundi, Zaire and Zambia. The water contains much salt unlike the other lakes, which hinders the movement of creatures in and out of the Lake. As a result it has a number of indigenous species. The water contains a lot of hydrogen sulfide at a depth of less than 200 meters, limiting the benthos to live in the shallower area. More than 300 species of phytoplankton and many species of zooplankton belonging to Copepoda are found in the Lake. Dagaa, a species of small herring, flock together, and Tanganyika perch (a kind of sea bass) chasing after zooplankton get together following these small fishes. They are mostly cichlid of which 134 species are known. The largest cichlid,in the world, Boulengerochromis Microlepis live there, too. Moreover, sponge, freshwater jelly fish, and conchs similar to marine product such as Typhobia and Bythoceras also inhabit the lake.

The main objective fish of catch in the Lake is Dagaa (small fish of herring family) which is abundant as fishing stock. It is fished by using scoop net or dragnet. The fishing season is from June to October. After being sun-dried, the catch is distributed to various localities within the country or it is exported to neighboring states.

C: Others

River fishing is performed in the Malagarsi River and the Rufiji River where Tilapia and catfish are caught to be consumed as fumade and dried fish.

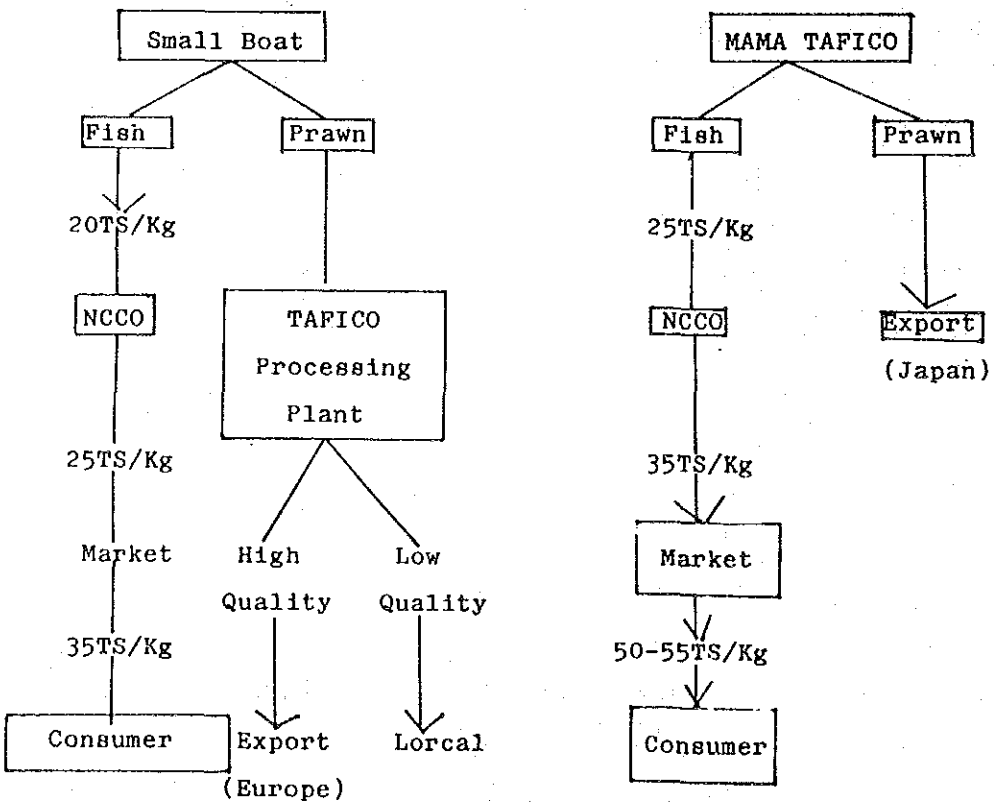
Concerning Tanzanian fish eating habits, the people living near the lakes and rivers like to eat freshwater fish, especially Tilapia and the others take dried or smoked fish as to be preserved and transported to distant places. However, there are some tribes which consider eating fish a taboo and others like the Masai tribe scarcely eat it. Generally speaking, Tanzanian people do not eat baked or raw fish, rather they eat it dried, cooked or fried. In coastal areas, people take not only sea fish but also prawn and cephalopod as food. The government encourages the Tanzanian people to increase fish consumption from 10kg/person year in 1973 to 15kg/person year.

④ Distribution

The landing places of the catch of the coastal fishermen are located in scattered villages which respectively are far from the market. TAFICO's catch is wholesaled to the distributor, NCCO (National Cold Chain Operation). Although NCCO possesses a cold storage in Dar es Salaam, it operates insufficiently due to the lack of spare-parts.

After buying the fish from the producers, the brokers (middlemen) transport them to Dar es Salaam and sell them.

The distribution channel and the price of fish in Tanzania are as follows:



⑤ Fishery education in Tanzania

In Tanzania, there are fisheries colleges at Mgabeni, Kunduchi, and Nyegegi.

Mgabeni Fisheries College has both a 3 and a 2 year course. The carriculum of the 3 year course includes the functions of the captain and crew, the structure of a boat, and the boat operation techniques, while that of the 2 year course holds the fish processing techniques. A certificate for completion is awarded in the both courses. The student enrollment at present is 60. This college was founded in July, 1983 with the aid from the Norwegian government, now it is in the first year of the course.

Kunduchi Fisheries College is a 2 year technical college with student enrollment of 25. The completion of 4 year junior high school is required for admission. A certificate for completion is awarded at graduation.

Nyegegi Fisheries College adopts a 2 year school system, teaching fresh-water fishery. It receives thirty 4-year junior high school graduates and awards the certificate to those finish the course. All 28 people who passed the graduation examination in the 1983 school year were sent to villages involved in the project in order to spread their knowledge of fishing techniques.

(2) Fishery restrictions

The Fisheries Division of the Ministry of Land, Natural Resources and Tourism is in charge of fishery administration and control. The Fishing Law enacted in 1970 obliges all fishing boats with fishing rights to be registered in the fishing boat ledger of the Fisheries Division and its renewal after a certain period. The registration fee and the renewal charge for fishing rights, which the fishermen shall pay, are determined depending on the size of boat.

The 1982 amendments of fishery restrictions prohibited the use of the explosives and poisons.

The Fisheries Division is in charge of administration and control of inland-water fishery. The restrictions are as follows:

a) to protect the spawning and feeding grounds of useful species which indicate a sign of extinction due to overfishing

b) to limit the mesh of fishing nets to be used in some fishing grounds

c) to prohibit the fishing methods using dynamite and poison

d) to enforce the restrictions in relation to trawling, especially to ban trawling nets at less than 20 meters in Lake Victoria. Because in this area the growing condition and feeding grounds of fish are damaged

e) to prohibit environmental pollution threatening the growth of aquatic plants

(3) Resource

The basic study team obtained the operation record of MAMATAFICO, Which is a double rigger type prawn trawler constructed in 1982 by the grant aid of the Japanese government. By analyzing the record, the team estimated the national resource of bottom fish and prawn to be as follows:

① Bottom fish resource

In terms of the fish resource and the M.S.Y. in Tanzanian waters, the team calculated them with the data from the operation record of the MAMATAFICO in the following way. However, as a double rigger type prawn trawler operates for the prawn living mainly on the sea bottom, their nets are designed with a very small distance from sea bottom to net head to avoid catching other types of fish. Moreover, the bottom fish may be broken down into two categories, one living primarily on the sea bottom such as halibut, ray, and croaker, the other living in waters of varying depth depending on the time or season such as sea bream, butter fish and horse mackerel, etc.

1 Opening distance between two wings

19.7m + 19.7m = 39.4m

2 Distance from sea bottom to dragnet head

1.5m

3 Net drawing distance

(2.8Kt x 2.5h x 1852m) 13.0Km

4 Net passing water quantity

$39.4m \times 1.5m \times 13,000m = 768,300m^3$

5 Average catch per net drawing

75kg

6 Net catching rate (Catch/total stock)

10% (*1)

7 Amount of bottom fish resource per 1000 m^3

75kg ÷68.3000m^3 x 100/10 = 0.976kg/1000m^3

8 Bottom area (except coral reef and mangorve)

15,505km^2 (*2)

9 Living depth of bottom fish

5m (*3)

10 Amount of water in which bottom fishes live

15,505km^2 x 5m x (1,000m x 1,000m) = 77,525,000,000 m^3

11 Resource

0.976kg x 77,525,000,000m^3 = 75,664,4000,000kg = 75,664.4t

12 Maximum Sustainable Yield

75,664t x 0.1 = 7,566t/year (*4)

(Note 1) The estimated net catching rate of prawn is 20 % and that of other fish is 10%, as fish have stronger swimming power than prawn.

(Note 2) The Tanzanian continental shelf area is referred to in the data of FAO.

Coral reef	2,183km^2
Mangrove	820km^2
Ordinary sea bottom	15,505km^2
Total	18,508km^2

(Note 3) The living depth of bottom fish is estimated at 5 m. Because the distance from sea bottom to net head of the bottom fish trawling net varies from 3 m to 7 m, though it depends on the size of the boat.

(Note 4) 10% is employed, while it is usually used to calculate the M.S.Y. of bottom fish.

2. Prawn resource

The amount of prawn resource and the M.S.Y. in Tanzanian territorial waters are calculated from the operation records of MAMATAFICO.

Opening distance between two wings: 19.7m + 19.7m = 39.4m

Net drawing distance: (2.8Kt x 2.5h x 1852m) 13.0km

Sea bottom sweeping area:(0.0394km x 13.0km) 0.512km^2/net

Net catching rate (Catch/total stock): 20% (*1)

Average prawn catch per net: 106.8kg

Production= 72.8kg (with head 30%, without head 70%)

With head= 72.8kg x 30% = 21.8kg

Without head= 51.0kg ÷60% = 85.0kg

Converted to without head 21.8kg + 85.0kg = 106.8kg

The area for prawn inhabiting waters along the coast (Fishable area)

Width 5.4km x length 324.4km = 1,751km^2

Prawn stock per 1 km^2 1,043kg (106.8kg ÷0.512 x 100/20)

Prawn resource in that sea zone 1,043kg x 1,751km^2 = 1,826t

M.S.Y. 1,826t x 0.4 = 730.4ton/year (*2)

(Note 1) As prawns have less swimming power, the net catching rate (catch/inhabiting amount) is estimated at 20%

(Note 2) The value 0.4 was employed, while it is usually used to calculate the M.S.Y. of one year old squid and prawn.

The above result gives us reason to believe that some additional double riggers will not affect the resouces, though the prawn resources of Tanzania cannot be considered to be very big.

(4) Fishery promotion project

The Fisheries Division of the Ministry of Lands, Natural Resources and Tourism is to set out the policies for the fishing promotion project of Tanzania, while TAFICO is to make plans and implement them.
The policies in the fishery field of the third 5-year plan are as follows:

① Increase in nationwide fish production

② Expansion of domestic fish consumption

③ Increase in fishermen's income

④ Generation of foreign currencies by means of increasing exports.

To complement these policies, TAFICO is planning and implementing the fishery development and shipyard construction plan. The fishery development project is divided into the prawn trawling project and the fishing company project. The prawn trawling project aims to provide trawlers with the aids and loans from foreign countries, to develop the prawn stock along the coast, to acquire foreign currencies, and also to supply the products to the nation.

A slipway (under construction), a workshop (only the building is completed), an ice plant (the grant from Japan in 1980 & 1982), a jetty, a cold storage, and tanks are planned to be constructed at Ras Mkwavi as the on-shore base for the smooth operation of boats.

In the fisheries company project, the commercial fishing centers are to be established under the joint ownership of TAFICO and Local Development Corporation with the view to develop the ocean and fresh-water fishery. One will be at Kigoma by the Lake Tanganyika for fresh-water fishing and three at Bagamoyo, Nyamisata and Mikindani along the coast of the Indian Ocean for the marine fishery. At present, TAFICO participates financially in those 4 companies but is not involved in their management.

By considering that the construction and repair of fishing boats are important for increasing the catch, in terms of the shipyard project, the modernization of the Mikindani shipyard (completed in 1979), new construction work at the Kigoma shipyard (completed in 1979) are executed, and the Pasiansi steel vessel shipyard is currently under construction. However, the order receiving of these shipyard is low because of their high shipbuilding cost and the long period for building compared to foreign or private shipyards.

Although the 4th 5-year plan (1981/82 - 1985/86) was established, the policies relating the fishery are still the same with the 3rd 5-year plan, and futhermore, the 4th plan itself has not been carried out due to the severe economic situation. The fishery policies in NESP (1981/82) and SAP(1982/83 - 1984/85) established to substitute the above mentioned plan are as follows:

① to obtain fishing boats, nets and gears necessary for smooth opertion

② to obtain fishery infrastructure facilities and distribution-related facilities and equipments

③ to improve fishing techniques and administrative ability

④ to introduce a fishing incentive pay system

2-3 Tanzania Fisheries Corporation (TAFICO)

(1) Establishment

TAFICO was established in 1974 on the basis of the Public Corporation Act enacted in 1969, inheriting a number of assets from the private enterprise, "Mwananchi Ocean Products", and from the Fisheries Division of the Ministry of Natural Resources and Tourism including the Ras Mkwavi base for fishing operations, Mikindani, Mwanza and Itungi boatyards.
The intention, at the establishment of TAFICO was that it would be a holding corporation with a number of subsidiary companies operating in the various fishery and fishery-related production activities. It would play a key role in monitoring and controlling the subsidiary companies in order to accomplish the development project in the fishery field. However, adding to the above role, TAFICO is, at present, performing its own operations in its sections of fishing, shipbuilding and repairing, ice-making and fishery products sales.
It is a parastatal corporation imposed a self-accountability.

The Public Corporation Act enacted in 1969 provides the following 11 functions of TAFICO.

1) to promote the fisheries development

2) to buy, sell, export and import all types of marine products

3) to participate in and sponsor both national and international joint ventures with the object of improving and expanding country's fishery industries.

4) to participate in and sponsor the establishment of enterprises indispensable for the development of the fishing industry including the construction of fishing boats and the manufacture of fishing nets.

⑤ to participate in and sponsor any fishing related enterprises on the commercial basis.

⑥ to carry out ans sponsor the research in any fields of the fishing industries and the marketing of marine products.

⑦ to manage any corporation and companies transferred to TAFICO by this Act

⑧ to implements the projects both in the contry and abroad in cooperation with other corporation or by single, or as the main contractor

⑨ participate in the local fishing controlling organization and in the fishing of cooperation.

⑩ to take any necessary measures for keeping the trust of the corporation, assuring reliability and minimizing any loss.

⑪ to undertake any transaction for assuring adequate execution of the objectives and the activities of TAFICO provided by this Act under the direction of the board of directors.

TAFICO was established as the center of fishery development in Tanzania including the boat building, net manufacturing and other fishery related industries. TAFICO is under the supervision of the Ministry of Lands, Natural Resources and Tourism.

(2) Economic activities of TAFICO

① Fishery development project

The policies of Tanzania in the fishery field provided in the third 5 year plan (1976/77 - 1980/81) are as follows:

1) increase in nationwide fish production

2) expansion of domestic fish consumption

3) increase of fishermen's income

4) generation of foreign currency by means of increasing exports

On the basis of the above objectives, TAFICO planned and implemented two development projects, fishing project and boatyard project.
The fishing project has for the objectives the protein supply to the nation through the increase of fish production and the promotion of selling, the increase of fishermen's income earning, and the obtaining of foreign currency. This project can be divided into the prawn trawling project and the fisheries company project.

In the prawn trawling project, it is aimed to develop the fish and prawn fishing by using 9 trawlers, two purchased from Australia in 1976, Juhudi, Tumaini (now only Tumaini is in operation), 4 granted from Finland, Hongwi, Lengo, Jihihada, Maendeleo (now only Maendeleo is in operation), three granted from U.K.,Kamba, Kambakochi, Tasi (now Kambakochi and Tasi are in service). This project also includes the construction of a slipway, a workshop, a jetty, a cold storage, a tank, etc. At Ras Mkwavi (Dar es Salaam) as the fishing base of trawler.
(At present, a slipway, workshop, fishing gear warehouse ae under construction.)

In the fisheries company project, the commercial fishing centers will be established at 4 places, Bagamoyo, Mikindani, Nyamisata on the coast of the Indian Ocean and Kigoma on the Tanganyika lake side by the funds of the World Bank signed in 1976, and the company aiming the development of the coastal fishing in cooperation of TAFICO and the Local Development Corporation.TAFICO takes the loans of the government funds and participates financially into Uvuvi Kigoma, Bagamoyo Fishing Company, Mikindani Fishing Comapany, Nyamisati Fishing Company but not involved in their management.

② Boatyard project

The boatyard project has for the objectives the construction and repair of the fishing boats directly connected with the increase of the fish production. TAFICO modernized the Mikindani boatyard which it inherited from the Ministry of Lands, Natural Resources and Tourism (completed in 1979), constructed a new boatyard at Kigoma on the side of the Lake Tanganyika (completed in 1979), and now constructs the Pasiasi steel vessel building yard which was commenced in the fiscal 1979/1980 at Mwansa on the Victoria Lake side.

TAFICO succeeded the boat building section from the Ministry of Lands, Natural Resources and Trourism in 1974. This section has never marked a profit. It is scheduled to be separated from TAFICO in the fiscal 1984/85. However, it is actually constructing the Kigamboni fishing base which still lacks some necessary facilities such as a jetty, a slipway, a cold storage, etc.In addition, the boat building and repairing section has a certain number of problems such as the defectiveness of proper facilities, the lack of maintenance and repairing materials and spare parts, the low level of techniques and the work efficiency of employees. Therefore, the building time for boats constructed in these boatyards is longer than that of those in the local or foreign boatyards, and the unit cost is higher. These factors have resulted few orders to the boatyard and created an economic stress for TAFICO.

(3) Present fishery situation of TAFICO

SAP (Structural Adjustment Programme) has for the objectives the activation of existing projects, the revival of the national economy and the industrializaion of the country for exports. Its targets in the fishing field are as follows:

① Acquisition of necessary fishing nets and parts and fishing boats

② Consolidation of fishing infrastructure facilities and distribution-related facilities and equipment

③ Improvement of fishing techniques and managing ability

④ Introduction of a fishing incentive pay system

On the basis of the fishing promotion project, 6 vessels furnished in the first grant aid from Japan in 1980 Kisiju, Nangara, Shangara, Muchungu, Pangani and Shangani (now 3 boats, Shangara, Muchungu and Pangani are in operation) and a boat furnished in the second grant aid from Japan in 1982 the MAMATAFICO (actually in operation) was added to the fleets of TAFICO.

Especially, the foreign currency obtained from the export of prawn caught by the MAMATAFICO was an excellent achievement of the national fishery in the country (US 514,000$ earned in the fiscal 1983/84). Moreover, from February 1984 TAFICO has been admitted to keep an accout in foreign currency of an amount equivalent to 10% of the total income from the prawn exports. This enabled TAFICO to stop a vicious cycle of the lack of foreign currency, difficulty in obtaining necessary spare parts and lowering of operation.

The actual operation condition of fishing boats is as follows:

Name of country which supplied boats	In operation	Out of service	total
Australia	1	1	2
Finland	1	3	4
U.K.	2	1	3
Japan	4	3	7
Total	8	8	16

(4) Other business of TAFICO

① Ice making section

The ice produced by a 2 ton/day ice machine (granted from Japan in 1980) and a 10 ton/day ice machine (granted from Japan in 1982) are supplied in broken ice to the ships owned by TAFICO. Otherwise, the ice is sold to luxury hotels in Dar es Salaam, to the Tanzania Railway Union and to private fishermen.
The ice making section earning a profit along with the fishing section.

② Purchase and sales section of fishery products

The cold-storage car acquired through the grant aid from Japan in 1980 serves for purchasing prawn and lobster by making the rounds of scattered fishing villages along the coast. A special exchange is placed at Kanda ya Puwani in order to purchase cowries produced along the coast. Moreover, TAFICO manages and administers the fish markets of Dar es Salaam (located at Krasini district and Kigamboni district). On the nameof TAFICO, this section is acting for the management and control of the above fish markets. It is alos executing its proper transaction of fishery production in those markets.

(5) Business policies of TAFICO in the fiscal 1984/85

The directions of the Ministry of Lands, Natural Resources and Tourism to TAFICO given in June 1984 for the fiscal 1984/85 are as follows:

① To reduce the number of sections (According to this direction, TAFICO reduced its sections from 7 to 3.)

② The Ministry of Lands, Natural Resources and Tourism decides the priority in regard to the government financial assistance to TAFICO's projects by examining the capital structure of TAFICO.

③ TAFICO has to elaborate its budget.

④ TAFICO shall make plans for the proper workshop and other shipyard-related facilities and determine the items of equipments necessary for the repair of fishing boats. However, the shipyard section will be transferred to the Ministry of Lands, Natural Resources and Trourism.

⑤ To make every effort for the production of fish and prawn.

⑥ TAFICO has to promote further the joint ventures for enlarging fishing industries.

⑦ TAFICO shall make policies enabling the fishermen to obtain fishing nets and gears.

⑧ TAFICO shall succeed NCCO, the selling company.

According to the above mentioned directions, TAFICO has already reformed its organization and made its budget and is making efforts for the following targets as the most important tasks of TAFICO:

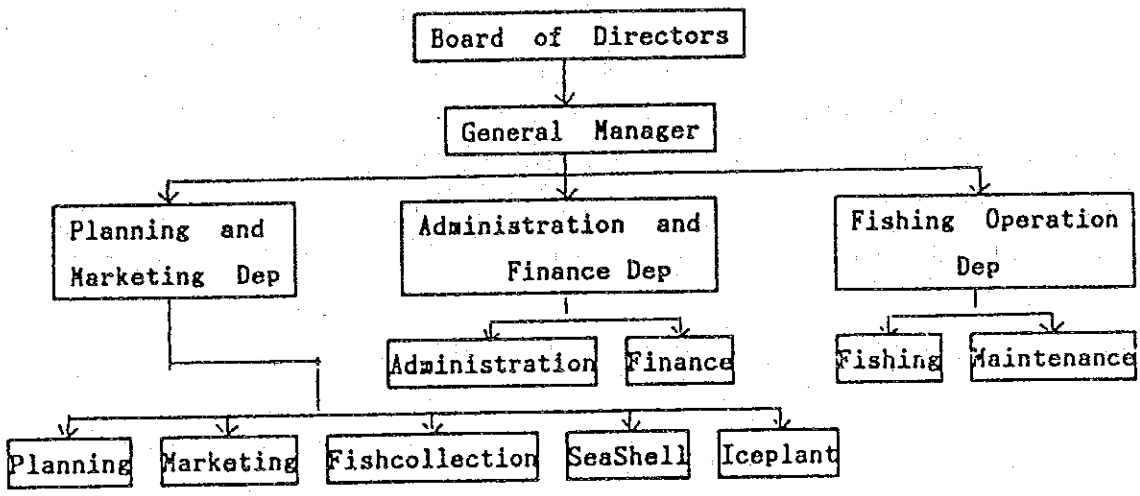
① to upgrade the fishery activities to be at a commercial base

② to obtain foreign currency by industrial fisheries

③ to improve fishing gears of small scale fishermen

(6) Organization of TAFICO

In conformity with the directions of the Ministry of Lands, Natural Resources and Tourism, since August 1984, the managements of TAFICO are controlled by the General Manager according to the decision of the Board of Directors. All the works of TAFICO are executed by about 200 employees in a three section system, Planning and Marketing Dep., Administration and Finance Dep. and Fishing Operation Dep. The newly instituted organization of TAFICO is shown in the following chart.



The major tasks of the above mentioned three sections are as follows:

Planning and Marketing Dep.

The major business of this section is involved in the companywide planning and sales.

① companywide planning

② sales of fish and prawn in the domestic and overseas market

③ purchase of prawn from fishing villages and their processing and selling

④ purchase and selling of shell fish

⑤ ice making and selling

⑥ products freezing

⑦ companywide control of vehicles

⑧ financial and legal procedures

It may be said that the Planning and Marketing Dep. is in charge of the sales of fish products which are transported to the coast.

Administration and Finance Dep.

The major business of this section is involved in the total administration and finance of TAFICO.
The business which belonged to the former Material Department and that relating to the internal audit was transferred to this department.

Fishing Operation Dep.

The major business of this section is involved in the fishing operation of TAFICO.

1 operation control of fishing and boats

2 control of workshop

3 control of fishing nets and gears

4 control of maintenance of vessels

This section is responsible until the fish products are transported to the coast.

(7) Financial condition of TAFICO

Tanzania established the fishing promotion plan to increase export, obtain foreign currency and supply animal protein for the people through the development of fishery industries. For the implementation of this plan, a prawn trawler namely the MAMATAFICO was furnished from Japan. And this boat showed an excellent result of fish catches and foreign currency earnings. On the basis of such result, a facilities consolidation plan was established for strengthening further TAFICO which is the administrative and controlling part of fishery industries. In this plan, acquisition of prawn trawlers, arrangement of fishing base (Kigamboni), construction of a jetty, a cold storage, a fresh water tank, a fuel tank, a workshop, a slipway, etc. are included. Presenly, a part of this plan was subjected to the request of grant aid to the Japanese government.

The fiscal year of TAFICO, which is a counter body of this aid, is from July 1 to June 30 of next year. Its sections which are subject to the profit and loss parts are:

Head Office

Fishing Operation

Boatyard

TAFICO has not published its financial statements since the fiscal year 1979/80. As the original materials obtained during the study period have much fluctuation in data, this analysis was made by examining them and correcting some of data. The analyzing results of TAFICO, mainly the fishing operation department, are shown below.

The transition of profit and loss of the fishing operation section except boatyard is as follows:

Table 3 Profit and loss statement

Unit:1,000 T.Shs

Item		1980	1981	1982	1983	1984
Fishing operation section	Sales	3,854	3,823	3,304	6,039	20,644
	Production cost	10,003	9,487	9,947	11,572	13,718
	Gross profit on sale	-6,149	-5,664	-6,643	-5,533	6,926
	Section cost	3,406	5,664	2,576	865	6,926
	Profit of term	-9,555	-9,948	-9,219	-6,398	77
Administration cost		3,581	2,709	3,759	2,855	5,878
Net profit(loss) of term		-13,136	-12,657	-12,978	-9,253	-5,801
Accumulated P/L		-34,864	-47,521	-60,499	-69,752	-75,553

The sound management of TAFICO depends on the business of the fishing operation. From its establishment in March 1974 until the fiscal year 1983, the fishing operation section showed a large deficit in the profit and loss account of the term. But in the fiscal year 1984, the account in their term became into the black as the results of full operation of the MAMATAFICO granted from Japan in 1982 and the rehabilitation of small fishing boats with the funds by the governmental loans. However, this is not yet enough to cover the administration expenditures of TAFICO.

Details of profit and loss by section in the fiscal year 1983/84

Table 4 Profit and loss by section in 1983/84

Unit: 1,000 T.Shs

Item		Total	MAMATAFICO	Small Fishing boat	Others
Fishing operation section	Sales	20,644	9,238	9,264	2,142
	Production cost	13,718	5,509	6,867	1,342
	Gross profit on sale	6,926	3,729	2,397	800
	Section cost	6,849	3,014	3,023	812
	Profit of term	77	715	-626	-12
Administration cost		5,878	2,361	2,942	575
Net profit (loss) or term		-5,801	-1,646	-3,568	-587

The fishing boats which operated in the fiscal year 1983/84 are total 9 in number, a boat from Australia, a boat from Finland, 2 boats from U.K. and 5 boats from Japan.

The MAMATAFICO summed up the sales of 9,238,000 T.Shs which can be divided into prawn 105 tons (6,608,000 T.Shs) and fish 86 tons (2,630,000 T.Shs). This resulted a profit of 715,000 T.shs before counting the administration expenditures and a deficit of 1,646,000 T.Shs after counting that in the account of the term.

Small fishing boats produced 420 tons of fish (Sales 9,264,000 T.Shs). It resulted a deficit of 626,000 T.Shs before counting the adminstration expenditure of TAFICO and a deficit of 3,568,000 T.Shs after counting that in the account of the term.

Other business sections like ice making showed a deficit of 587,000 T.Shs after counting the administration expenditures of TAFICO in the account of the term.

(8) Management condition of TAFICO

Until present, TAFICO has had a large non-production means unproportional to its production means. (Otherwise said, the production means was weak compared to the non-production means.) Therefore, as the biggest production means, the MAMATAFICO, was added to the operation, the accounts of TAFICO was ameliorated. Moreover, since a new double rigger will be added to its operation and the biggest non-producing means, shipyard, is separated from TAFICO, much amelioration of accounts will be expected.

As above mentioned, the accounts of TAFICO has been ameliorated by the outside factors, but there are still many internal factors to be improved. Through the improvement of such internal factors by its own efforts, the stable management of TAFICO may be achieved.

There are the following problems to be resolved by TAFICO.

① A half of owned boats (8/16) are not in service. As the primary precondition for the stable management of TAFICO is the reinforcement of its production means, it is urgently required to raise the rate of operation of the owned boats.

② Too much administrative expenditures caused the worsenning balance of TAFICO. It is due to the delay of making efforts for reducing the administrative expenditures.

③ The lack of various kinds of spare parts necessary for the boats owned by TAFICO is striking, It is due to the insufficient foreign currency to purchase spare parts, however, it is equally due to a poor inventory taking. Thererfore, it is unknown what spare parts lack and what spare parts exist in excess.

④ A list of fixed assets is not well arranged. No profit and loss statement by each boat was made. For the managment purpose, those statements are to be well issued.

⑤ At present, TAFICO has many non-operating boats. It is seemingly necessary to abandon boats which cannot be used. The managerial structure of TAFICO shall as quickly as possible be ameliorated to be sound by aiming the increase in income.

⑥ As pointed out by the National Audit Corporation of Tanzania, TAFICO makes a diminishing balance depreciation by using the rate of straight line depreciation. Since it is not sufficintly depreciated, it is required to resolve this problem.

2-4 Background of request

(1) Background of request

Tanzania made a request to the Government of Japan in 1979 for the grant aid for five 14m type FRP trawlers, one 16m type FRP purse seiner, ice plant, etc. in order to assure animal protein for people, promote exportation, obtain foreign currencies and increase opportunities of employment. The Government of Japan executed the grant aid for the above.

However, these fishing boats had the following problems which hindered to bring about the desired goals.

- ⓞ Having no freezing equipment, it could hardly keep the fish procudts fresh.

- ⓞ Because of the long distance between the base and the fishing grounds,the vessels were compelled to come back to port frequently in order to prevent the freshness fault due to the ice storage of prawns, thus the rate of operation is low.

Therefore, Tanzania made a request for the grant aid from the Government of Japan in 1981 for double rigger type prawn trawler enabling to collect the products caught by the above mentioned small fishing boats on the sea and freeze them on board as well as the self fishing, two ice making machines of capacity 5 tons/day and ice storage.
The Government of Japan granted them.

At present, the annual product of TAFICO is about 120 tons of prawn and about 510 tons of fish. The double rigger type prawn boat named the MAMATAFICO performs almost no mother boat operations but produces 114 tons of white and tiger shrimp and about 87 tons of fish per year as a single ship operation.

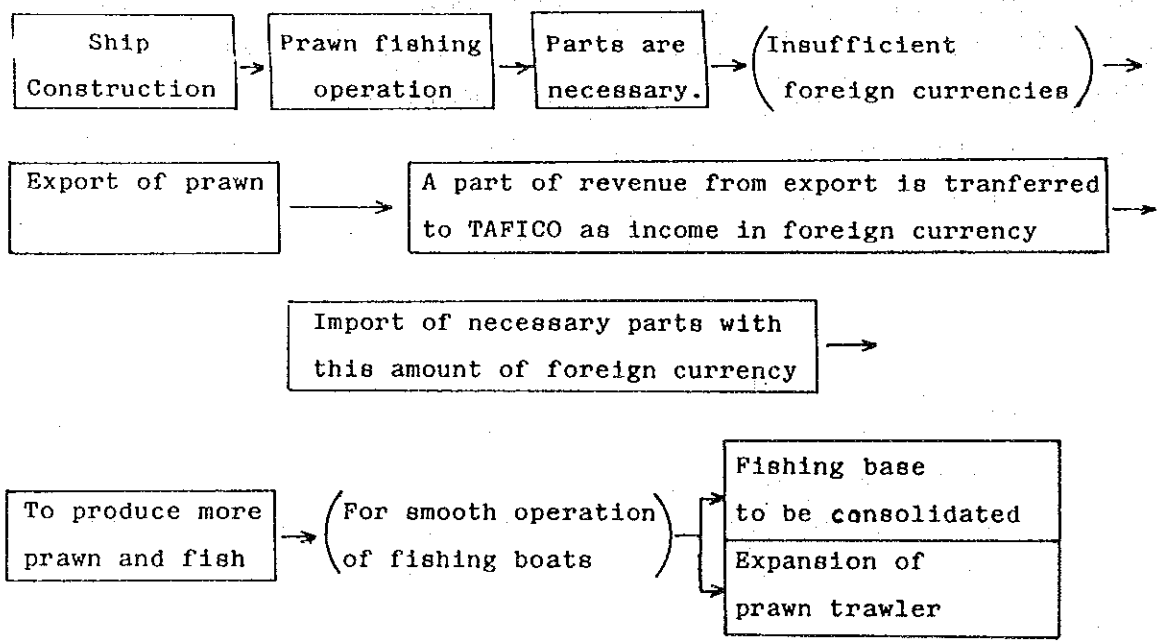
Further, the ice making equipments were installed on the opposite bank of the town of Dar es Salaam, Ras Mkwavi. However, as there is no jetty on the site, the ice produced there is transported to the city of Dar es Salaam by the truck and the ferryboat. It is then loaded on fishing boats being alongside of the jetty of that city.
For that reason, TAFICO considers that a jetty is necessary at the site.

Moreover, since there is insufficient cold storage in the Dar es Salaam Port, the frozen products made by the MAMATAFICO are transshiped to the reefer carrier being alongside of the carrier. The operation schedule of the MAMATAFICO which is compelled to be made corresponding to the entry into port of the reefer carrier has bad effect on the rate of operation.

With the view of enhancing further the favorable results of this double rigger through increasing the boats and reinforcing the related facilities, presently Tanzania made a request for the jetty to serve prawn trawlers and boats and a cold storage to keep frozen prawn and fish.

(2) Aims of the present project

Tanzania set out a fishing promotion project aiming at the acquisition of foreign currencies through expanding exports and supplying people with more animal protein by reinforcing the marine fishery.
Then, the country established the prawn trawl fishing project for increasing the export of the above which is the international seller and the fish production developing project for assuring more supply of animal protein to people. For the above aims, Tanzania expects the grant aids from foreign countries including Japan.
The causal relation of this project may be charted as follows:



(3) Outlines of the project

① Objectives

The prawn trawl fishery project, a part of the fishery promotion plan of Tanzania, aims to increase fish production as well as to develop the prawn stock and export the catches of prawn at Bagamoyo and at the Rufiji River mouth for obtaining foreign currencies. The above mentioned plan includes both the fishing boat building project, and a construction project of jetty, fresh water tank, fuel tank, slipway, workshop, cold storage, fishing gear storehouse, and ice making facilities at Ras Mkwavi (the on-shore base).

② Project site

The site will be on the opposite bank of Dar es Salaam Port, Ras Mkwavi.

③ Control and administration orgnization of the Project

TAFICO founded in 1974 for industrial fisheries and fishery related industries of Tanzani will be in charge.

④ Concrete contents of request

In the concerned project, ice making facilities were constructed by the grant aids from Japan in 1980 and 1982. The slipway, workshop and fishing gears storehouse are now under construction by the national investment of Tanzania.

The facilities and equipments subjected to the request of this time to Japan for the grant aid are as follows:

a) Initial request to Japan contained:

o Motherboat type double rigger (total length 24.5m) x 2

- o Floating jetty (Pontoon type) x 1
- o Cold storage (200 tons) x 1

b) Request made at opportunity of basic design study contained:

- o Double rigger x 2
- o Jetty (Floating jetty or pile base jetty) x 1
- o Cold storage (about 100 tons) x 1
- o Ferryboat (30 seats) x 1
- o Water carrying boat x 1
- o Water tank (1000 tons) x 1
- o Fuel tank (460 tons) x 1
- o Generator plant for emergency case (for use of all on-shore facilities) x 1 set
- o Spare parts (for use of existing FRP fishing boat) x 1 set
- o Repairing machine and tools for workshop x 1 set
- o Payao (with one patrol boat and one fishing boat) x 1 set

CHAPTER 3 OUTLINE OF PLANNED SITE

CHAPTER 3 OUTLINE OF PLANNED SITE

3-1 Natural conditions

(1) Precipitation

Table 5 Precipitation of Dar es Salaam

Observation place: Dar es Salaam Airport

Unit: m/m

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1979	201.7	142.8	80.0	187.7	395.6	91.3	15.1	18.6	26.3	24.9	41.8	85.4	1315.2
1980	58.8	61.6	102.1	143.6	89.0	NIL	19.2	34.1	2.4	66.1	238.1	98.5	913.4
1981	40.5	8.3	188.2	171.3	191.0	18.7	2.8	56.1	23.0	75.1	54.4	219.2	1048.6
1982	13.8	1.7	58.9	200.9	237.4	138.9	50.3	20.0	18.5	181.2	264.1	238.3	1424.0
1983	87.2	61.9	27.2	224.0	405.6	39.4	46.1	13.9	6.8	70.0	15.8	67.2	2065.1

The annual range of fluctuation in precipitation by month is very wide, and there are two rainy seasons, from March to May and from November to December. Also the diference between the maximum precipitation 1,424 m/m and the minimum 913.4 m/m is 510.6 m/m based on the past 5 years. This indicates a big change from year to year. The rainy seasons should be taken into account in the site work.

(2) Cyclones

In Tanzania tropical cyclones seldom occur. The following statistical report forecasts the frequency.

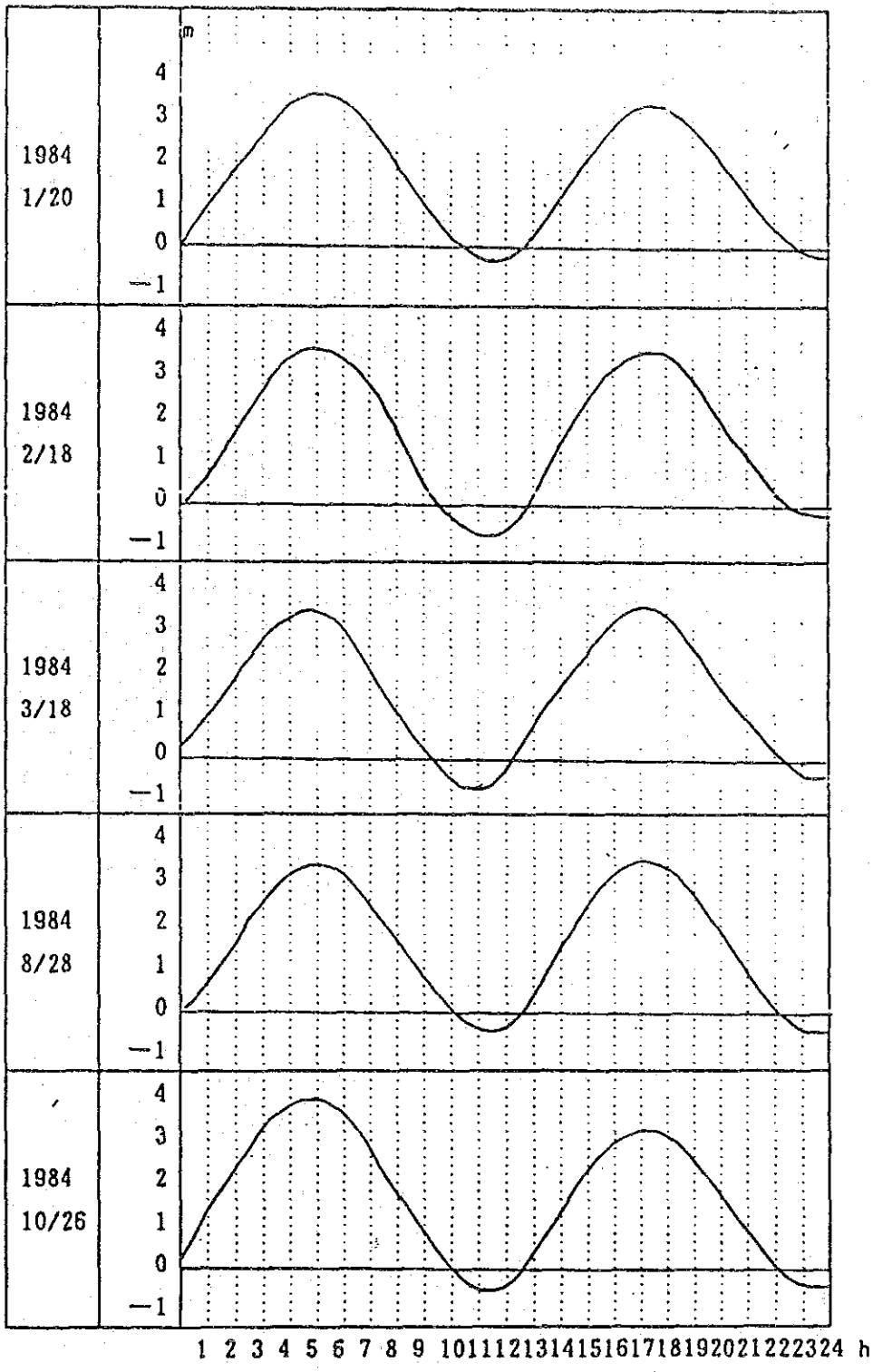
From 4° S Lat. to 6° S Lat.: Once in 100 years
From 6° S Lat. to 8° S Lat.: Once in 60 years
From 8° S Lat. to 10° S Lat.: Once in 20 years
From 10° S Lat. to 11° S Lat.: Once in 10 years

As Dar es Salaam is situated at 6° 50' S Lat., statistically, a cyclone occurs once in 60 years.

(3) Geological features and earthquakes

There have been relatively few earthquakes recorded in the city of Dar es Salaam. However, 15 active volcanoes exist along the African Great Rift Valley which runs on the eastern part of Africa including Tanzania.
The earthquakes and the volcanic activities still continue.
(The rift valley means the subsided and depressed areas between two dislocations caused by a diastrophism. Eastern rift valley and western rift valley run along the eastern part of Africa.)
An earthquake of the 8th degree on the seismic scale was recorded in May, 1964 at Babati, 90 km south-east off from Lake Eyashi within the eastern rift valley.
At that time, the 1st degree on the scale was registered at Dar es Salaam (It is 300 miles away from Babati). Although the city is quite far away from the earthquake zone with few earthquake records, in case of structural design, the seismic coefficient of 0.05 should be taken in account.

(4) Tide of Dar es Salaam Port



3-2 Outline of planned construction site and its surrounding area

(1) Planned construction site

TAFICO's Kigamboni fishing base assigned for the site of the objective facilities lies at Ras Mkwavi in the Kigamboni district, the opposite side of Dar es Salaam, the capital of Tanzania. It is located at the tip of the Dar es Salaam Port.

The total area of premises is about 28,000 m^2, allotted on the basis of the government plan. The soil preparation of the site is almost completed except for a small part, and the principal roads (6m wide) in the premises are already paved.

The base is divided into three large plots. In the northwest section of the lowland, a fishing net storehouse and an ice plant (with grant aid from Japan) are completed, while a workshop and a slipway are now under construction. The intended jetty is to be attached to this section. Preparation of the north* plot of the highland is already completed, and facilities such as dining room, dressing room are now being constructed. The TAFICO's office is to be built here though as yet no construction is under way.

Preliminary grading has been completed in the south plot (approx, 9 to 10m above the sea level).
This area is planned to be the site for the expansion of facilities. The requested cold storage and tank facilities are to be built in this plot.

(2) Neighboring areas

Two sides of the Kigamboni base face the Dar es Salaam Port and beyond the other side is farm land and a waste land. The educational institutes of the Revolution Party (Chamacha Mapinduzi), between the principal road and the base, and some private houses are the only buildings found near the base.

Dar es Salaam Port is a good natural harbor and calm inside. Due to the well equipped facilities and smooth cargo work, there is no such problem as demurrage. It is one of the most important trading ports in East Africa. Furthermore, the 4m range of tide purifies naturally the sea water inside the port assuring water of good quality.

As described above, the population in the hinterland is so small that there seems to be no trouble with the neighboring residents even if the base activities come into operation with the progress of tune-up.

Viewed at this angle, although the base lacks traffic, water and communication facilities due to the long distance from the city, it may be said that the selection of the site is appropriate, provided it is fully equipped with the infrastructure in the future.

3-3 Infrastructure situation

(1) Power supply

The power supply facilities were established by the 2nd grant aid from Japan in 1982.
First, the electricity is conducted from the power source in the city to the site by an overhead power transmission line. After passing through a transformer set in the site, it is transmitted through an underground cable to a load-dispatching board installed in the fishing gears storehouse.
The transformer capacity is 11KV/400V, 500KVA, capable of covering the electric demand for the construction of a cold storage, jetty illuminations and a feed pump as well as for the repairing facilities planned by TAFICO.
It is reported that the electric power supply is often stopped.

(2) Water supply

Although the urban service water pipe is laid to a water repository for ice making, the water is not conducted due to insufficient water pressure. Therefore, at present, the water is supplied by a 40 ton water carrier barge from Dar es Salaam, on the opposite shore of the base.
The water is supplied in the city by means of a submarine pipe from Krasini, on the opposite shore, to Kigamboni and through the booster pump installed on Kigamboni side. At the time of this study, an electric motor of one booster pump out of two was not functioning, and the pump was out of service due to the burn-out of fuses in the distribution panel.
According to the statistics of 1983, the population of Kigamboni was about 22,000. Since the city water supply is not reliable, those residents depend on wells. At the time of this study, wells were being drilled in several places. Water is indispensable for a fishing base. Although the water shortage was known when the ice plant was constructed, no essentially remedial measures have been taken yet.

(3) Ferryboat

The ferryboat is an essential means of transportation connecting the fishing base and Dar es Salaam. There are two ferryboats, a big and small one, however only the larger one is in operation. This is a 14 year old vessel which was made in West Germany in 1970, and of which the deadweight tonnage is 180. It is capable of carrying six 25 ton trucks and 200 passengers.

Its principal specifications are as follows:

Type:	Fore and aft same hull form shallow draft
Total Length:	55.0 m
Length between perpendiculars:	41.0 m
Total width:	10.0 m
Depth:	2.4 m
Design draft:	approx. 1.3 m
Main engine:	2 x 170 Ps
Height from upper deck to bridge:	approx. 4.5 m

In the present project, it is crucial to transport the frozen products from the Ras Mkwavi fishing base. From this point of view, the ferryboat plays an essential role.

Although the usable ferryboat has no problem in transportng refrigerator cars in relation to the deadwight tonnage and effective height, a movable bridge on one side of the vessel is out of order. Through measures for maintenance and repair shall be taken by Tanzania in the future.

(4) Fuel oil, lubricating oil

The fuel oil supply to fishing boats cannot be considered stable, as it was once suspended for one month owing to the unstable foreign currency supply. Oil is supplied by means of a 9 ton tank lorry.
All the lubricating oil is imported so that its brands often change. Therefore, the quality of oil to be used in the boat is preferred to be that admitting the mixing with the others.

(5) Ship repair facilities

There is a ship repair shop at Dar es Salaam, where there is a slipway shipyard owned by the Tanzania Harbor Authorities (THA).
It is located at the southern side of the Oil Berth.
However, it is unable to repair TAFICO's boats, because it is in full operation repairing THA's boats (Tugboats and steel barges).
The Tanzania Navy Base has another slipway repair shop exclusively used for the navy. Therefore, TAFICO performs necessary painting and repairing, by lifting the steel ships except the MAMATAFICO on the jetty of Dar es Salaam by crane. For the FRP boats, the same method is employed or stranding the boats on the shore with the help of high tide is used for making necessary repairs.
TAFICO asks the Mombasa shipyard in Kenya, a neighboring country, to repair the ships which cannot be repaired in Dar es Salaam. The MAMATFICO was repaired at the end of last year. The skill of the Mombasa shipyard is reportedly reliable but the repairing cost is high. The repairs of the MAMAFICO cost about 37,000 US$ at that time.

Under such circumstances of the ship repairing, TAFICO planned to construct ship repairing facilities in the Ras Mkwavi fishing base with a loan from the Tanzanian government. The repairing facilities now under

construction consist of a slipway and a repair shop.
Only the building of that repair shop has been completed, while no work relating to the illumination, power wiring or machinery installation has been made. A part of the machinery for the repair shop already imported from the U.K. is still stored as packed in the TAFICO's warehouse at Krasini.

The construction of the slipway is left unfinished and appurtenant work relating to winch and crane has not been started.
Consequently, it will take a while until this repair shop begins to operate. The outline of the repair facilities under construction is as follows:

1 Slipway

Length	40 m
Width	10 m
Admissible load	approx. 200 tons

2 Workshop

Structure	Reinforced concrete construction, single-story slate roofed, a single building	
Total area	Approx. 500 m^2	
Plant	o Iron work shop	approx. 232 m^2
	o Finishing shop	approx. 72 m^2
	o Machining shop	approx. 99 m^2
	o Carpenter shop	approx. 70 m^2
	o Paint store	approx. 18 m^2
	o Electric store	approx. 9 m^2

Major machines	o	Press	1	Iron working plant
	o	Forging press	1	"
	o	Drill machine	1	"
	o	Grinder	1	"
	o	Air compressor	1	"
	o	Hoist	1	Finishing plant
	o	Lathe	2	"
	o	Pipe bender	1	"
	o	Milling machine	1	"
	o	Metal sawing machine	1	"
	o	Grinder	1	"
	o	Drill machine	1	
	o	Wood sawing machine	2	Wood working plant
	o	Wood planing machine	1	
	o	Grinder	1	
	o	Wood lathe	1	
	o	Derrick crane	1	Slipway
	o	Air compressor	1	Finishing plant

When observing the above list, it may be understood that little attention was paid to electric repair facilities and machinery for onboard work. As a result TAFICO would be compelled to entrust the motor rewinding and the repair of navigation and radio equipments to the repair service shop in town, unless TAFICO prepares those facilities and machinery itself.

3-4 Construction

(1) General condition

Tanzania is faced with a grave problem for carrying out a construction project because of the recent slump in the construction business caused by insufficient foreign capital and the chronic shortage of construction materials and equipments incidental thereto. Especially, the shortage of construction materials such as cement, steel materials, asphalt materials, tire, other materials, fuel, etc. is so serious that it often results in the postponement or delay in the construction period.

(2) Laws and regulations relating to construction

The government sets the laws and regulations relating to construction in accordance with the British Standard. However, these laws and regulations are not necessarily applied in a practical design. In the case of the projects assisted by foreign states, the standards of the granting country are mainly applied.

(3) Construction materials

① Cement

There are three cement plants:

Tanzania Portland Cement Factory Co., Ltd. (Production capacity: 600,000tons/year) in Wazo Hill, in the suburbs of Dar es Salaam

Tanga Cement Factory Co., Ltd. (Production capacity: 500,000 tons/year) in Tanga

Mbeya Cement Factory Co., Ltd. (Production capacity: 250,000 tons/year) in Mbeya which started to operate in April, 1983

In spite of the above mentioned capacity, the real capacity is said to be approximately 30% of the design capacity due to the shortage of spare parts of machines and facilities as well as fuel shortage.

For this reason, the cement shortage is on going in Tanzania.

② Aggregate

Sand: It is gathered from a river 10 miles away from the city. There is no problem in quality or quantity.

Rough aggregate: Brown macadam is generally used but it is rather weak. Black granitic high-power macadam is gathered from a quarry 70 miles away from the city.

③ Reinforcement

Extraordinary form round bars are not available in this country. Ordinary form round bars of 6 to 10 mm in diameter are imported and those of 12 to 25 mm are locally produced. However, they are sometimes not available.

④ Steel materials

Although there are Steel Rolling Mills in Tanga, the production does not meet the demand. Steel materials are sold in order of applications received and no spare material is seemingly obtainable.

(4) Constructors

Since Tanzania adopts a registration system for constructors which are classified into A to H by industrial type, the constructor not registrered cannot execute the works. Moreover, those registrants in each industrial type are classified again into Class 1 to Class 6 by the charge per construction at which they can afford to undertake. Among Class 1, the major constructors are many foreign companies as well as the representative Tanzanian constructors. Mwananchi Engineering and Construction Co., Ltd. (MECCD), and United Construction are examples of local companies.

CHAPTER 4 CONTENTS OF THE PROJECT

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4-1 Objective of the project

Tanzania planned to acquire foreign currency by developing its prawn resources and exporting them. A second goal was to supply animal protein to the people by catching fish. For the above reasons, TAFICO worked out the prawn trawling project. At the same time, TAFICO realized the necessity of obtaining fishing boats and constructing an on-shore base to assure the smooth operation of such boats.

Tanzania received an ice machine and a boat ,the MAMATAFICO ,from Japan and fishing boats from U.K. and Finland for that project. Moreover, other fishing boats were constructed in Australia with the loan from the Tanzania Investment Bank. At present, TAFICO itself is building a slipway, a workshop and a warehouse at the Ras Mkwavi fishing base.

The MAMATAFICO furnished from Japan contributes greatly to the improvement in TAFICO's accounts. Therefore, the corporation intended to further improve the accounts with more double riggers. At this time a request for a third grant from the Japanese government was made. At the same time, the project has for its objective the increase of the operation rate of fishing boats belonging to TAFICO and the completion of the Ras Mkwavi fishing base in the Kigamboni district.

4-2 Survey of facilities and equipments of TAFICO

At the site of the present project, Ras Mkwavi in the Kigamboni district, there are three types of facilities: boats, facilities and equipments granted from Japan; boats granted or purchased from the U.K., the Netherlands and Finland; facilities and equipments constructed or under construction by Tanzania itself. Here some problems are drawn out from the present conditions to be studied and evaluated so that the results can contribute to the present and future projects of facilities and equipments.

(1) Grant aid from Japan

① FRP boat (Furnished in 1980)

(Present conditions)

One of five FRP trawlers granted by Japan was completely destroyed in 1981 due to being stranded. Repairs were impossible. The other one was damaged on its outer board of port side by a crash against a tugboat and is now moored. However, all the instruments and parts including nautical instruments, the main engine cylinder covers, axial generators, etc. are being used in the other boats. Three boats other than the above mentioned ones are operating up to present and are involved in fishing for bottom fish. The 16m type FRP round haul net boat is now moored because of a crew problem (a local chief fisherman has left the boat). The fish-luring lamp of a skiff boat cannot be repaired due to the lack of parts. However it is said that it will restart operations before long. Regarding the 12 skiffs granted at the same time, four are now moored owing to insufficient parts, but the other eight are used as auxiliary boats (to the FRP round haul net boat) and as ferryboats.

(Problems)

A The pricipal problem of the 14m FRP fishing boat is that no freezing facilities are provided. The protease existing in the digestive organs of prawn to digest intaken planktons is so active that the prawn digests itself if the digestive organ is damaged on catching time and this protease flows out. Such self-digestion may damage extremely the quality of product for the market.

Ice storage of prawns on a FRP prawn trawler is a dilemma; that is, in order to make good products, the vessel is compelled to go back frequently to the port, and if the fishing efficiency is sought, the quality of products drops. As proof of this, the products of this boat are not suitable for the Japanese market, where much importance is attached to appearance and quality. As a result, they are allocated to European markets or destined for internal consumption.

B Concerning the maintenance problems, no available repair facilities, techniques, or equipments for FRP vessels in the country makes the repair possible. Furthermore, the parts provided through foreign aid have already been used up, and fishermen manage their boats with the instruments and parts of idle boats. However, in such way, the boats will be obliged to be moored out of service due to the lack of parts before long.

From now on, with respects to the full use of such vessels, it is necessary to provide the parts and the repair tools and equipments, the repair materials for FRP bodies. Training in repair techniques is essential also for the local tradesmen.

2 Ice plant (Furnished in 1980 and 1982)

(Present conditions)

Two ice machines of capacity 1 ton/day furnished have been installed at the TAFICO Krasini plant in Dar es Salaam. Only one is in operation, while the other one has a trouble of cooling fan. The other two machines of 5 tons/day capacity provided by the second grant aid have been set at Ras Mkwavi in the Kigamboni district and operating smoothly.

(Problems)

A 1 ton/day machine is out of order due to lack of necessary part for the cooling fan.

B The water for two 5 tons/day machines is not conducted because of the pressure problem even though the piping for urban water service is in order. For this reason, the barges transport the water twice a week according to an agreement concluded with the Harbour Cooperative Association of Dar es Salaam. Moreover, since the ice plant has a 50 ton water tank, it is able to operate for up to 5 days even if the service of the barge is suspended for some reason.

C Power failures sometime occur at the site. Since there is no independent electric power generator, the operation is stopped in the event of a power failure.

Broken into rubbles, the ice thus produced is not only provided to the fishing boats belonging to TAFICO but it is also sold to the private fishing boats. Furthermore, it is sold to hotels in Dar es Salaam and to the Tanzania Railways Union. This is profitable and is highly valued by the customers.

3 Cold-storage car (Furnished in 1980)

(Present conditions)

The cold-storage car and truck for cargo transport (to which the financial cooperation was executed in 1980) are used to discharge the fresh and frozen fish from the TAFICO boat at the entry to the port as well as to purchase fish from the above mentioned fishermen along the coast.

(Problems)

A Some cars were not able to operate for a while because of a shortage of tires and gasoline. Presently all of them are operating.

B Since the road conditions for the purchase are bad, there are a lot of mechanical troubles of vehicles. The repair should be made in private repair shops (ex. Cooper Motors and T.D. Dolby Co., Ltd. etc.) because the repair shop attached to the base has insufficient parts. Therefore, the expenses incidental to the maintenance and repair are rather substantial.

(Conclusion)

The furnished vehicles contribute to the various activities of TAFICO. They are highly appreciated in view of the appropriateness of the grant aid and the utilization rate.

4 MAMATAFICO

(Present conditions)

The MAMATAFICO operates 239 days a year, producing approx. 105 tons of frozen prawn products and 86 tons of frozen fish products. This boat was initially designed as a mother boat as well as an operation boat. However, at present, it does not perform the mother boat function but operate as a single boat.

(Problems)

A The first problem concerning the design is that a fishing boat cannot serve as a mother boat. Serving both as a fishing boat and mother boat means a lot of restrictions in terms of its self-operation, if a mother boat operation is required. For example, a fishing zone for a mother boat is obviously different from that of a small boat, so that either or both have to stop operation and run in order to meet the other. For the unloading and loading of catches (transferring the catch, suppying the fuel oil and water, transferring the materials) at the meeting point of the two boats, the mother boat casts an anchor (drifts if in the offing), and lowers a fender. Then the small vessel arrives at the side of the mother boat. Both mother and small boats lose much time in the fixing of a small boat with forcers and spring ropes, the fine adjustment of the relative positions of two boats to fit the cargo entrance, the preparation of cargo work (hose setting), the cargo work, the boat separation etc.

B The output of the main engine during the net drawing analyzed from the MAMATAFICO's engine operation record is 290 Ps to 310 Ps at the net drawing speed of 3.0kt. Since this is equivalent to 58% to 62% of the rated output of the main engine 500 Ps, the engine operates at a rather low output compared to the ordinary trawlers. It means that there is still a reserve for expansion of the net resistance, in other words, net size.

(Conclusion)

The mother boat operation is not actually performed owing to economic problems. However, this boat reveals its true function as a single fishing boat in spite of some problems such as tank capacity and the varying number of crew members. However, there is still room for improvement of net size, etc. Incidentally, the boat is in extremely good condition.

(2) Construction condition of TAFICO's base

① Slipway

(Present conditions)

A slipway is under construction with TAFICO's funds in Ras Mkwavi, the fishing base. At present, only the concrete foundation of an on-shore part (width 10m, length 40m) is completed, and the remaining work is suspended due to the lack of funds.

(Problems)

A Although the slip way was scheduled to be completed at the end of 1982, the slope of submerged parts, rail, winch for pulling up the body, trolly, crane, water pump for cleaning the body electric power facilities are not yet constructed up to now.

B Since SAP (Structural Adjustment Programme) now in application was planned on a tight budget, thus is is not known definitely when the funds for constructing a slipway will be raised.

C The design of the slipway has some problems (Basic structure design, operability, etc.).

(Conclusion)

Even though TAFICO has the intention to construct the slipway by itself, which should be duly appreciated, it is regrettable that the completion of work has not been determinated because of no raising the funds due to severe economic conditions of that country.

② Workshop

(Present conditions)

In connection with the slipway, the construction of a workshop was planned so as to repair the fishing boats and various piece of machinery in the fishing base. At present, the building (reinforced concrete construction one-story building, slated roof, approx. 500m^2 of floor area) is almost completed except for fishing.

(Problems)

Presently, there are only two welding machines and one tester in the building. A machine tool imported from the U.K. is stored as packed in the warehouse of TAFICO at Krashini. If it is left in this way, it may be spoiled by rust.

(Conclusion)

As the workshop is indispensable for a fishing base, the will to construct it can be appreciated, but it is hard to assess the present workshop without repair equipments.

③ Miscellaneous

A Warehouse for fishing nets and gears

The building (reinforced concrete construction one-story building, slated roof, 288m^2 of floor area) has been constructed at Ras Mkwavi, and a part of it is actually used as a warehouse for the fishing gears of fishing boats owned by TAFICO.

Apart from this, in the city of Dar es Salaam, there is a TAFICO's warehouse, where fishing gears and parts are stored. However, it also is scheduled to be moved to the Ras Mkwavi warehouse before long.

B Living facilities for employees

The building (reinforced concrete construction one-story building, slated roof, 288m^2 of floor area) has been constructed at Ras Mkwavi, and work on the interior is now under way. This has been designed as a dining and dressing room for TAFICO's employees.

C TAFICO office

Presently, the TAFICO office is in Dar es Salaam, but in the future a new office is expected to be constructed at the Ras Mkwavi fishing base.

(3) Assistance from other countries

Four trawlers were granted through the assistance of the Finnish government. Powered by 270 H.P. Caterpillar engines the vessels were expected to be overhauled on arrival at Dar es Salaam from Helsinki. However, the facilities were not in Tanzania and they were allowed to opperate as they were. Therefore, engine troubles occurred one after another and now only the MAENDELEO is in operation. Two out of the other three are now waiting for repairs and the other one is moored waiting for parts.

Three small trawlers were constructed through the assistance of the U.K. At present, the TASI and the KAMBAKOCHI are in operation but the other is moored due to lack of parts.

TAFICO constructed two trawlers in Australia using a loan from the Tanzania Investment Bank. At present, only the TUMAINI is in operation. The damage to the engine of the other boat was so severe that it is laid up. The operation is impossible before changing that engine.

4-3 Study of fishing base project

(1) Analysis

In order to study the present contents of the request, problems have been selected by comparing the most suitable requisites to scheme the request and TAFICO's fishing base project.

Item	Optimal requisites to be fulfilled	TAFICO's fishing base project
(Facilities)		
Port	A safe place where the boats may anchor without any disturbance from and waves	Since the Dar es Salaam port has a bottle-like shape, wind, waves and swells will have little effect on the boats.
Berth, jetty	The port is to have a berth where stevedoring, embarking and desembarking are done safely.	At present there are project no berth on jetty, but they will be provided through the present aid.
Repair facilities	There should be facilities and equipments with which the repair of the hull, engine, instruments of the boats can be done quickly and perfectly.	At present a slipway and a workshop are now under construction, but there are some problems concerning the date of completion and the repair techniques of the installed equipments.

Cold storage	Near the berthing place there should be a cold storage where the products are stored. Near the cold storage, there should be a berth for the cold storage boat, where the shipment of the products can be made.	AT present, there is none, but it will be provided through the present aid. At the jetty of this project large cold storage boats cannot be berther. Therefore, the products should be transported from the cold storage to the berth of Dar es Salaam by cold storage car, using a ferryboat.
Warehouse	There shall be a warehouse for its exclusive use near the berthing place.	There is one constructed be TAFICO.
Repair of fishing	Usually, the crew of the trawlers repair the fishing nets and gears, but a roofed repair shop is needed during rainy season.	The warehouse of fishing nets and gears constructed by TAFICO is available.
(Supply)		
Fuel oil	The fuel oil should be supplied at the berthing place.	The fuel oil supply at the berthing place is possible providing the fuel oil tank is granted this time.
Water	Water should be supplied at the berthing place.	If this grant is realized, the water supply at the berthing place is possible. There are some problems on using water barges to transport water to to the site.

Articles for boats	Near the berthing place, there should be a warehouse, where various mateirals ordered on board are stored and they are shipped before sailing	The materials can be stored in TAFICO's warehouse for its exclusive use, and can be loaded on its trucks.
Food	Near the berthing place, there should be a cold storage and a warehouse, where the food is stored.	The cold storage scheduled to be granted this time and the warehouse for TAFICO's exclusive use are available.

(2) Policies for design

A jetty, a cold storage and a fuel oil tank requested by Tanzania this time will meet a part of the requirements of the fishing base of TAFICO. FRP fishing boats, constructed with the aid of Japan, will operate again through the supply of repair tools and parts. Moreover, the cooperation in constructing a prawn trawler will double the prawn export of TAFICO, which will bring about the improvement of TAFICO's business. In view of the results of this basic study, 15% of the revenue from exports may be used for the import of parts. Therefore, the improvement in the operation rate of the boats can be expected.

In order to realize the above mentioned objectives, the bacic policies regarding the present grant aid are as follows:

① Double rigger type prawn trawler

Taking the foreign money situation of the coutry in consideration, the project shall seek energy saving as much as possible and a stock of running spare parts for three years shall be provided. The double rigger shall prefarably be equipped with the instruments made by the same manufacturer as the MAMATAFICO for the common use of parts in both vessels. The fishing nets and gears shuld be so designed that they have a resistance index corresponding to the main engine propulsion.

2 Cold storage

After the study of production capacity of fishing boats, transport plan of the products from the fishing to the port, and the shipment plan from the cold strage, the size of the cold storage will be determined in due consideration of the future increase of fishing boats. The freezer is preferably to be made by the same manufacturer as in the past for the common use of parts. As this cold storage is destined to conserve prawns of high value, it shall be so designed so that the products donot deteriorate. An independent electric power plant shall be installed against the suspention of service and due consideration should be taken for its starting.

③ Jetty

The type of jetty shall be decided by taking into consideration the construction period, cost, nesessity of maintenance, safety, using conditions, etc. If a floating jetty is adopted, the installation of a water tank in the pontoon shall be examined instead of the on-shore water tank for total cost reduction. If the investigation of the reefer carrier now in service gives the conclusion that the vessel can barge to the shore, the fact should be considered in the design of the jetty.

④ Others

Repair tools must be chosen to assure the least necessary work in the workshop. The kind and quantity of parts for the FRP boats already furnished shall be determined so as to permit operation for three years.

CHAPTER 5 BASIC DESIGN

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5-1 Basic policy

Upon effectuating the basic design of the boats,facilities,equipments, and meterials planned to be granted this time, the basic policy is set as follows;

① to examine fully the contents of the request of Tanzania and to make an appropriate design for the objective, function and capacity of the request

② to minimize the administration expenses as much as possible

③ to save energy by taking the situation of balance of payment into consideration

④ to assure as much as possible the compatibility with the instruments granted by Japan in the past for choosing the instruments and epuipments

⑤ to seek the maximum performance with the least cost

⑥ to design in conformity with the local laws, customs, fishing conditions, marine and weather conditions, etc.

5-2 Basic design

5-2-1 Double rigger type prawn trawler cnstruction project

(1) Basic policy

① Operation type of prawn trawlers

The MAMATAFICO which was constructed through the grant aid from Japan in 1982 has been operating for the past 2 years and its results are better than expected. The MAMATAFICO was initially designed as a mother boat in the original plan. The mother boat was to collect and freeze the products caught by small cold storage trawlers belonging to TAFICO.
However, the results of the practical operation pointed out the following problems.

A The prawn collection and the supply of oil and water on board are strongly influenced by the weather and marine conditions.

B Since raw prawns in the small boats are preserved in ice, the operating ground shall depend on how long the ice on board can last.

C The operation of the MAMATAFICO as a single boat is more profitable than as a mother boat.

For the above mentioned reasons, the new boat is to be designed as a single operation boat.

2 Measures for energy saving and labor saving

Upon constructing and designing the prawn trawl boat, the following measures for energy saving and labor saving should be taken.

A Main engine

The MAMATAFICO is equipped with the main engine of 500 PS. As the result of its operational conditions, the power necessary for drawing nets is approx. 60% of the rated power of the main engine, approx. 70% less than the normal prawn trawl boat. Accordingly, energy saving will be performed by designing the main engine of the new boat at 450 PS.

B Electric generator

The new boat does not perform the mother ship operation. Providing the power of the electric generation is lowered from 100KVA x 2 of the MAMATAFICO to 90 KVA x 2 of the new boat, 10 % of the energy will be saved by lowering the freezing capacity of the new boat.

C Propeller

The new boat should be equipped with the nozzle propeller of the large caliber in order to increase the propulsion efficiency.
The propeller of the MAMATAFICO is of 1,500 mm, while that of the new boat, 1,650 mm in order to enhance the propeller efficiency.
Consequently energy will be saved.

D The MAMATAFICO has a split type trawl winch in the portside and starboard, and two people are necessary to operate it. Energy should be saved by adopting the integral trawl winch for the new boat sho that only one operator is necessary.

③ Performance of the prawn trawlers

The new boat will play a leading role along with the MAMATAFICO in the business of TAFICO. Upon designing the boat, labor and energy saving must be duly considered so as to attain economical efficiency.
A large part of the fishing grounds along the coast of Tanzania are narrow and surrounded by reefs, and also good fishing places depend on the season and natural conditions. Therefore, the boats should have good performance for turning while drawing the net, and shall be able to cut the net casting time of the trawl winch.
Moreover, the layout and the performance of the sorting machine and the freezer must be fully considered so that the prawn products can be processed in the shortest time. (Long processing time of prawns turns them black due to chemical reactions and in turn decreases their value.)

The nautical instruments, especially radars and fish-finders, are indispensable for securing the fishing position and finding the fishing grounds. Also from the view point of safety in sailing, the istruments should be highly efficient and easy to maintain. Above all, two fish-finders are necessary because they are essential for the operation in narrow grounds.
In the bridge, the necessary instruments should be operated by the centralized control system so that the captain can control them alone upon navigation and operation.

As nobody in TAFICO is qualified to navigate a ship more than 150 GT according to the Tanzanian internal laws, the gross tonnage has to be less than 150 international tons. This is based on the Oslo treaty of 1965.

④ Estimation of the catch

The catch of a prawn trawler is estimated to be the same as that of the MAMATAFICO. In any case, the catch of the new boat cannot be less than that of the MAMAFICO. Because, the MAMATAFICO has already operated in the past 2 years. For this reason, facilities for production and space for storage shall be enough to cover easily such catch.

The results of operation of the MAMATAFICO in 1983/84 are as follows:

TAble 6 Operation record of the MAMATAFICO in 1983/84 (July to June)

Item	1983 Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	1984 Jan.	Feb.	Mar.	Apr.	May	Jun.	Total
No. of operating day	24	23	22	22	18	4	23	21	22	18	20	22	239
No. of navigating day	2	2	1	2	2	4	2	1	2	3	2	1	24
No. of mooring day	5	6	7	7	10	23	6	7	7	9	9	7	103
Total	31	31	30	31	30	31	31	29	31	30	31	30	366
Catch prawn (t)	10.8	8.4	8.3	8.2	7.6	2.2	15.5	9.0	9.7	9.0	12.8	12.8	114.3
fish (t)	7.7	7.1	6.6	9.2	6.7	1.1	7.0	5.4	11.4	7.0	9.2	9.2	87.6
Total (t)	18.5	15.5	14.9	17.4	14.3	3.3	22.5	14.4	21.1	16.0	22.0	22.0	201.9
Catch per day prawn (kg)	450	365	377	372	422	550	674	429	441	500	640	582	478
fish (kg)	321	309	300	418	372	275	304	257	518	389	460	418	367
Total (kg)	771	674	677	790	794	825	978	686	959	889	1,100	1,000	845

Table 7 Summary of the MAMATAFICO's record (1983/7-1984/6)

Number of day per year	Number of operating day 239 days total 366 days	Number of sailing day 24 days	Number of anchoring day 103 days
Number of day per voyage	Number of operating day 20 days total 31 days	Number of sailing day 2 days	Number of anchoring day 9 days
Number of voyage per year	12 voyages		
Catch per year	Prawn 114,344 kg, Fish 87,630 kg, Total 201,974 kg		
Catch per voyage	Prawn 9,529 kg, Fish 7,302 kg, Total 16,831 kg		
Catch per operation day	Prawn 478 kg, Fish 367 kg, Total 845 kg		

5 Basic boat type

The new vessel is to be double rigger type, long forecastle single deck trawler, and to be designed as a single operation boat.

6 Standard of new boat project

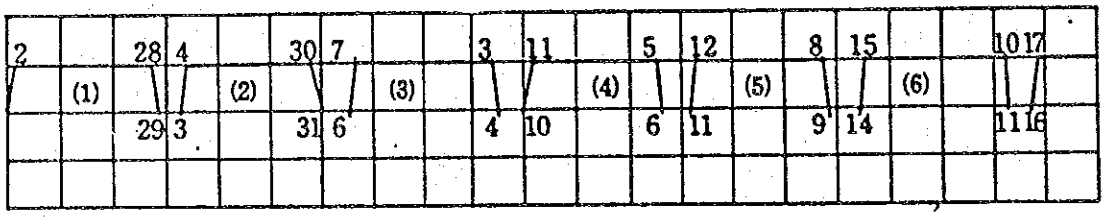
The followings were estimated for a new boat project on the basis of the MAMATAFICO's record. Such data were required so as to set the main equipments sucn as main and auxiliary engines and to determine various capacities.

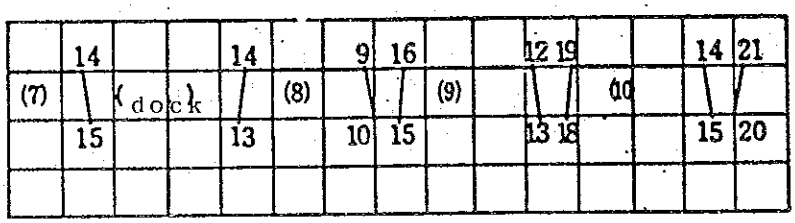
Table 8 Operation project of new boat

Number of day per year	Number of operating day 266 days	Number of sailing day 20 days	Number of anchoring day 79 days
	total 365 days		
Number of day per voyage	Number of operting day 27 days	Number of sailing day 2 days	Number of anchoring day 8 days
	total 37 days		
Number of voyage per year	10 voyages		
Catch per year	Prawn 127,270 kg, Fish 93,960 kg, Total 221,130 kg		
Catch per voyage	Prawn 12,717 kg, Fish 9,396 kg, Total 22,113 kg		
Catch per operation day	Prawn 478 kg, Fish 353 kg, Total 831 kg		

7 New boat project

Table 9 New boat operation project (corresponding to TAFICO's business year)
(July 1-June 30 the following year)





Number of year	Period	The number of operating day	catch standard	catch praw (kg)	catch fish(kg	total (kg)
1	July	27 days	prawn478kg fish 353	12,906	9,531	22,437
2	August	"	prawn478 fish 353	"	"	"
3	September-October	"	prawn478 fish 353	"	"	"
4	October-November	"	prawn478 fish 353	"	"	"
5	November-December	"	prawn478 fish 353	"	"	"
6	December-January	"	prawn478 fish 353	"	"	"
7	January-February	26 days	prawn478 fish 353	12,428	9,178	21,606
8	March-April	"	prawn478 fih 353	"	"	"
9	April-May	"	prawn478 fish 353	"	"	"
10	May-June	"	prawn478 fish 353	"	"	"
	TOTAL	266 days		127,170	93,960	221,130

(2) Study on boat scale

1 Main engine, mchines, horse power

A main engine

Design point should be placed on the net pulling power in designing the main engine horse power of a prawn trawler. Especially, when the distance between the base and the fishing grounds is short like in this project, the sailing speed is of secondary importance.
The net pulling speed for prawns is 2.5 kt to 3.5 kt.
Since the fishing boat of this type and size is of 3.5 kt, approx. 4 tons of resistance is appropriate. In this project the vessel is scheduled to be equipped with a nozzel propeller. In this case, according to the calculation the horse power of approx. 300 PS corresponds to the net pulling power of 4 tons at the net drawing speed of 3.5 kt on the calm sea. Estimating a researve in load at 70%.

300 x 1/0.7=429 PS

On the other hand, providing the sailing speed of this boat is set at 8.5 kt like in the MAMATAFICO's project, the required horse power is estimated as follows:
Required horse power = $(\text{displacement})^{2/3}$ x (speed) 3/Admiral coefficient
Displacement = approx. 310 tons
Speed = 8.5 knots
Admiral coefficient = 72
Required horse power = $310^{2/3}$ x 8.5^{3} x /72 = 390 PS
Estimating the load factor at 85%

390 x 1/0.85 = 459 PS

Therefore, the required horse power will be approx. 460 PS.
As stated above, if the main stress is placed on the net pulling power in designing, the horse power of 450 PS will be enough and the sailing speed of approx. 8.5kt will be secured.

B Electric generator

According to the calculation of the electric power consumption, a maximum electric power consumption will be approx. 56 kw. Therefore, the required auxiliary engine capacity will be calculated as follows.
Providing the power factor of the electric generator capacity is estimated at 80% and the load factor at 20%

56 kw x 1/0.8 x 1.2 = 84 KVA

the value of approx. 90 KVA is obtained.
Accordingly, the horse power of the electric generator is to be

90 KVA x 1.2 = 108 PS

It may be taken as approx. 110PS. The electric generator should have the same function as that of the MAMATAFICO and a spare generator should be installed.

2 Study on various capacities

A Fuel tank

On the basis of the above mentioned operation project, the amount of fuel consumption per sailing of this boat is calculated as follows.

a) Main engine

Main engine horse power: 450 PS

Running hour: Sailing 2 days (24 hours/day): Load factor 0.85%

Operation 27 days (18 hours/day): Load factor 0.80%

Fuel consumption rate: 168gr/ps hr

Specific gravity of fuel oil:0.84gr/cc

Amount of fuel consumption:

under way 450 x 0.85 x 0.168 x 1/0.84 x 24 x 2 = 3,672L

in operation 450 x 0.80 x 0.168 x 1/0.84 x 18 x 27 = 34,992L

Main engine total 38,664L

b) auxiliary engine

According to the calculation, the electric power consumption will be 37 KW under way, 56 kw in opertion, and 25 kw at anchor.

Running hour: Sailing: 2 days

Operation: 27 days

Anchorage: 3 days

Fuel consumption: 0.318 gr/kw/hr

Specific gravity of fuel oil: 0.84 gr/cc

Amount of fuel consumption

Under way 37 kw x 0.318 x 1/0.84 x 24 x 2 = 672L

In operation 56 kw x 0.318 x 1/0.84 x 24 x 27 = 13,738L

At anchorage 25 kw x 0.318 x 1/0.84 x 24 x 8 = 1,817L

Auxiliary engine total 16,227 L

Main and auxiliary engine total 54,891L

Therefore, providing the tank storage factor and the expansion rate is 0.85 and the reserve of fuel oil of 20%, required capacity for fuel oil is to be

(54.891 x 1.20) x 1/0.85 = 77,493L

approx. 80.M^3

B Lubricating oil tank

When estimating the lubricating oil consumption of both main and auxiliary engines at 1% of fuel consumption, the consumption rate of lubricating oil per voyage is to be

53,755L x 0.01 = 538L

Therefore, estimating the tank storage factor at 0.95 and lubricating oil reserve at 20%, required capacity for lubricating oil will be

(538 x 1.2) x 1/0.95 = 680L

approximately 700L

C Water tank

The amount of water consumption per voyage is calculated as follows.

Drinking and nondrinking water:	50L/person/day x 29 x 17	=	24,650
Glaze water for prawn:	Catch 13,500 kg x 1/2	=	6,750
Engine cooling water:	100L/day	=	100
	total		31,500

The water quality of Dar es Salaam is far inferior to that of the fresh water generator. It is desirable to use water processed by the fresh water generator. The capacity of water generation utilizing waste heat depends on the load of main engine and operation rate. In the case of this boat, average 0.7 ton/day can be expected during voyage and operation. Therefore, quantity of required pure water will be

31,500 - (700 x 29) = 11,200L

Consequently, estimating the tank storage factor at 0.95 and the reserve at 15%, the required capacity for pure water will be

$$11,200 \times 1/0.95 \times 1.15 = 13,558L$$

approximately $15M^3$.

D Fish hold

The amount of products to be held during a voyage is 13.5 tons prawns and 11.5 tons fish, totaling to 25.0 tons. In addition, the fish hold should be clearly divided into the prawns and fish sections. Also the working space for storing the products is needed. If the storage factor is set at 0.4 by taking into consideration the above mentioned dead space,

$$25.0 \times 1/0.4 = 62.5$$

Estimating the reserve rate at 15%, required capacity for fish hold is to be

$$62.5 \times 1.15 = 71.9M^3$$

approximately $75M^3$

3 Freezing equipment

The basic method of freezing is the same as that of the MAMATAFICO.

A Prawns are to be contact-frozen in ice.

B Fish is to be frozen slowly in the fish hold

According to the results of the MAMATAFICO the prawn production is about 700 kg/day. As the daily freezing capacity is set at 1,200 kg with a little leeway. All the products may be processed within a day in two operation cycles.

Therefore, there should be one set of flat tank with a capacity of 600 kg. The R-22 direct expansion system is adopted in freezing as well as in keeping the products cool. The compressor with two stage compression is used and also a spare machine should be installed.

4 Prawn grading machine

The prawn grading machines contribute to manpower-saving. On the other hand, they may cause some inconveniences in operation on the deck, if the number of grade is too much and also require expenses in maintenance in the future.
Generally, almost all the prawn trawlers are not equipped with grading machines because that the experienced man power is more reliable.
Since the crew of this boat outnumbers that of ordinary prawn trawlers, the increase in efficiency of the operation on deck and the energe saving of the trawl winch operation should be aimed, and the number of grade is to be reduced to 5, though that of the MAMATAFICO was 10.
Therefore, the capacity of prawn grading machine will be 200 to 300 kg/hour.
A set of 5 grades will be installed.

5 Number of crew member

In view of the MAMATAFICO 's records and the improvement in skill of the crew, the regular complement of the boat will be 17 crewmen, reducing 3 from 20, the MAMATAFICO's crew, including 2 Japanese trainers.

6 Design of fishing nets and gears to be used for double rigger type prawn trawler

When designing the fishing nets and gears, attentions should be paid to the performance and function of the boat as well as the natural conditions of the fishing grounds and the prawn's behavior. Furthermore, the important things are to design them so that they would fit best for those factors. The process of the study is described as follows.

Main items of the prawn trawler

Main engine: 450 HP (300 HP are given during net drawing)
Propeller: Nozzel propeller
Rigging: Double rigger type (twin trawl fishing)

On the basis of these three items the fishing gears were examined.

A Operation method

The double rigger type and twin trawl fishing method. One boat draws 2 fishing gears at the same time.

B Estimated pulling power

The net pulling power of a boat depends on the ship hull form and the propeller design.
In this project, the load of the main engine is calculated at 300 HP, net pulling speed at 3.5 kt and the net pulling power at approx.4,000 kg.

C Determination of fishing gear scale

Generally, the net pulling speed of a prawn trawler is set at 2.5 to 3.5 kt. In this case, in view of the expansion of the net drawing area, the maximum speed is set at 3.5 kt. At this time the fishing gear scale is designed so that the fishing gear resistance corresponds to 4,000 kg, the net pulling power of the item B.

D Net type

Since the white and tiger prawns are the targets, high nets are not necessary. Among various types of prawn nets, flat type should be chosen. Because its cutting is easy and the net shape (during net drawing) is good.

E Design

As mentioned in the item D, net type, it is not necessary to pay attention to the height of net head. The target of net and otter board design, as shown in attached figures, is to fully open the distance between wings while keeping a necessary minimum height and to have a wide sea bottom sweeping area by enabling net pulling at a maximum speed of 3.5 knots.

F Resistance

The resistance of the trawl fishing gear is obtained by adding the resistance of trawl net, otter board and warp. However, in case of the operation in a shallow sea like a trawling for prawns, the resistance of a short warp is negligibly small. Consequently, the total resistance of a trawl net and otter boards shall correspond to the net pulling power of the fishing boat.

G Resistance of the otter board

$$ROB = CD \times 1/2 \times \rho \times S \times V^2$$

ROB	= Resistance of otter board	(kg)
CD	= Resistance coefficient of otter board	(0.35-0.4)
ρ	= Density of sea water	(104.5kg sec/m^4)
S	= Area of otter board	(m^2)
V	= Net speed against water	(m^2/sec)

Setting an otter board area at 5 m from experience by considering the net spreading power and the facility for handling, the otter board resistance at each boat speed will be:

Where: V=2.5 kt

ROB=0.35 x 1/2 x 104.5 x 5 x 1.65 = 151 kg

Where: V=3.0 kt

ROB=0.35 x 1/2 x 104.5 x 5 x 2.37 = 217 kg

Where: V=3.5 kt

ROB=0.35 x 1/2 x 104.5 x 5 x 3.24 = 296 kg

H Net resistance

Since the net drawing power at the ships' speed of 3.5 kt in this project is estimated at 4,000 kg, the net resistance will be as follows:

RN=4,000-ROB

RN=Net resistance (kg)

ROB=Otter board resistance (kg)

RN=4,000-296=3,704 kg

Generally, the net resistance may be calculated from the following

$$RN=C \times V^{1.5}$$

RN=Net resistance kg

V=Speed against water m/sec.

C=Resistance coefficient

On the basis of the above formula the net resistance and resistance coefficient at each boat speed (speed against water) are given as follows.

Boat velocity (velocity against water)		ROB	RN	ROB+RN	C
Kt	m / sec	(Kg)	(Kg)	(kg)	
3.5	1.80	296	3,704	4,000	1,540
3.0	1.54	217	2,943	3,160	1,540
2.5	1.29	151	2,256	2,407	1,540

I Scale of fishing gears

The above is the formula for an ordinary trawl net at a speed against water. It requires revision for a prawn net. In addtion, taking a reserve against an adverse current into consideration, the net scale will be determined from experience as follows:

Prawn net resistance unit:kg

Boat speed	ROB	RN	ROB+RN
3.5 Kt	296	3,313	3,609
3.0 Kt	217	2,510	2,727
2.5 Kt	151	1,807	1,958

(3) General layout and main specifications

The boat type is determined to be long forecastle single deck double rigger trawler from the view point of convenience in steering and fishing. Under the upper deck are installed a forepeak, a chain locker, a fuel oil tank, a fish hold, an engine room, a fresh water tank, a steering room and an afterpeak from bow in order. Under the fish hold and the engine room are installed a double-bottomed fuel oil and a lubricating oil tank. In the long forecastle of the upper deck are allotted a deckhouse, a store, living quaters, a dining room, a gallely, a provision store, a freezing room a lavatory and a washroom from bow in order.
A steering house is installed on the long forecastle and also a cargo hatch and a trawl winch are installed in the aft wheel room. A radar mast is set up in the upperwheel house.
In the aft part of the upper forecastle of the upper deck are installed a gate type derrick post. A set of rigger and a boom for cargo are disposed on each of board. In addition, a hatch for cargo, a trawl winch for prawn selector, an engine hatchway and a wheel room trunk are disposed in the upper deck from bow in order. The following is the main specifications of this boat. The figures listed in the specification are rough values and there may be some revisions in the execution design.

Principal Particulars

Boat type	Long forecastle single deck double rigger trawler
Regulations to be applied	JG export inspection N.K.
Length (total length)	approx. 28.0 m
Length (between perpendicular)	approx. 24.0 m
Breadth	approx. 7.2 m
Depth	approx. 3.2 m
Design draft	approx. 2.8 m
Gross tonnage	approx. 150 tons (based on the international gross tonnage)
Fuel oil tank capacity	approx. 80 m^3
Pure water tank capacity	approx. 15 m^3
Lubricating oil tank capacity	approx. 1 m^3
Fish hold capacity	approx. 75 m^3
Cruising speed	approx. 75 m^3
Complement	approx. 17 persons

Engine Section

Main engine	approx. 450 ps	x 1
Auxiliary engine	approx. 110 ps	x 2
Fresh water generator		x 1
Various auxiliary machines		x 1

Electric section and wireless equipments

Electric generator	3, AC 220V, 50 Hz approx. 90 KVA	x 2

Electric equipment and facilities

Radio equipments	SSB and VHF	x1 of each
	SOS buoy	x 1

Deck machinery

Trawl winch		x 1
Trynet winch		x 1
Windlass		x 1
Hoist for loading/unloading		x 2
Automatic prawn grader		x 1

Nautical instruments

Steering gears		x 1
Magnetic compas		x 1
Radar		x 1
Fish finder		x 2
Sea water thermometer		x 1

Freezing and air conditioning system

Refrigerant	R-22	x 1
Compressor		x 2
Contact freezer	0.6 tonx/8 hr	x 1
Fish hold cooling equipment		x 1
Provision store cooling equipment		x 1
Living quaters air conditioning equipment		x 1
Appurterances		x 1
Electric fan (Engine room, galley, and ohters)		x 1

Fishing net and gears

Fishing net and gears		x 1

5-2-2 Cold storage design

(1) Basic design policy

The cold storage shall be designed by taking into consideration the construction related conditions such as climate, labor, machinery, and available materials at the site. Also the attention should be paid to the general local conditions and operation techniques in selecting the construction method and materials.

(2) Study of scale

1 Cold storage capacity

The cold storage is divided into the prawn storage and fish storage. The amount of storage of each item is as follows.

A Amount of prawn storage

The collected prawns are stored until they are sent off by cold storage carriers which are assigned once a two months. The prawn products of the MAMATAFICO at the best season is set at 13.5 tons/month on the basis of its record. And the products collected from the local boats are approximately 1.5 tons/month. Providing the amount of products of the new boat is the same as the MAMATAFICO's, the storage capacity for two months will be

(13.5 tons/month x 2 boats x 2 months) + (1.5 tons/month x 2 months)

= 57 tons

B Amount of fish storage

As frozen fish is for the domestic market, there is no restriction in relation with the reefer carriers, etc. However, a minimum capacity for storing a product of both the MAMATAFICO and the new boat from a voyage is necessary.

The MAMATAFICO has a maximum product of 11.5 tons/voyage. Supposing the new boat has the same amount, the product of these tow boats from a voyage will be

11.5 tons/voyage x 2 boats = 23 tons/voyage

A and B amount to

57 tons + 23 tons = 80 tons

Along with the above mentioned value, estimating the increase reserve of the capacity coming from the future expansion of the catch at 50%

80 tons x 1.5 = 120

Therefore, a 120 ton cold storage will be needed.

2 Cold storage

The capacity of the cold storage is set at 120 tons. Taking the work space of the cold storage and duct space into consideration, the storage factor per m^3 is 0.33 ton.

120 x 1/0.33 = 363.6 m^3

Therefore, the capacity will be set at 360 m^3.

When the possible loading height by man power is estimated at 2.4 m and the area necessary for machine room and platform is added, the following floor area will be needed.

Cold storage	150 M^2
Machine room	50 M^2
Platform	110 M^2
Total	310 M^2

3 Cold storage system

A Refrigerating capacity

1) Refrigerating load

The refrigerating load designing conditions are determined as follows for the calculation.

Outside temperature	+ 32° C	Keeping inside temperature	-25° C
Temperature of frozen product	- 15° C	Temperature of chilled product	+10°C

Total heat tranfer coefficient ceiling and wall K1=0.15kcal/m^2,hr,°C

floor K2=0.19kcal/m^2,hr,°C

Amount of frozen products in storage 25 tons/day

Amount of chilled products in storage 3 tons/day (bonitos, etc. by payao)

2) Heat transmitting load

	M^2	K1	delta T	
Ceiling, wall	270 x	0.15 x	57 =	2,309
Floor	150 x	0.19 x	45 =	1,282
			total	3,591

delta T:Temperature difference

3) Cooling down load (ccoling for 24 hours)

	hour	kg	Specific heat	delta T	
Frozen products	1/24 x	25,000 x	0.41 x	10 =	4,270

	Cooling time	kg	Specific heat	delta T	
Chilled products	1/24 x	3,000 x	110 =		13,750
			total	13,020	18,020

4) Cooling fan motor and lighting load

kcal/kw.hr	kw		
860 x	2.5 =	2,150kcal/hr	2,150

5) Air exchange load (Cooling the amount of air equivalent to 3 times of cold storage volume for 24 hours)

Cooling time		M^3		Entropy		Air exchange frequency		
1/24	x	360	x	43	x	1,935		1,935

6) Human body load (3 person x 3 hours/day)

Cooling time		Generated heat		Person		Hour		
1/24	x	300	x	3	x	3 = 112		112
							total	25,808

Providing the reserve is estimated at 15%

25,808 x 1.15 = 29,679 kcal/hr

Therefore, the compressor capacity of about 30,000 kcal/hr will be needed.

B Freezer

The door of the fish cold storage is frequently opened. In order to avoid the influence of opening the door of fish cold storage to the prawns storage temperature, two freezers should be installed, one for fishs and the other prawns.

C Emergency electric generator

As the emergency electric source for cold storages at the event that the power is suspended the capacity of emergency electric generator is as follows:

	Output	Unit	Input	Load factor	Required electric power (KW)
Compressor	17.2	2	34.4	0.80	27.5
Cooling Ventilator	0.55	4	2.2	0.85	1.9
Condensor ventilator	0.45	4	1.8	0.85	1.5
Illumination inside the cold storage	0.6	-	0.6	1.0	0.6
Illumination in the machine room	0.3	-	0.3	1.0	0.3
Power Door	0.4	-	0.4	1.0	0.4
				total	32.2

Providing the reserve rate is estimated at 10%

32.2 KW x 1.1 = 35 KW

Therefore, the capacity of the electric generator is set at 40 KW, and the electric generating machine set is as follows:

70 PS, 50 KVA, AC 220V, 50 HZ x 1 set

(3) Construction design

① Building construction

The cold storage will be of pre-fabricated method. It will be composed of heat proof pannels (outer wall t=125^{mm}, partition wall t=40^{mm})made from colored steel plate insulated with polyurethane form.

Racks, footings and drain boards in the cold storage are to be all made of wood. The building is to be of steel frame construction. Outer walls (color steel plate or painted plate) and roofs are to be slated. The structure of the office will be the same except that the heat proof design is applied to the inner walls. At the doorway of the cold storage, a platform (GL approx. 1.0m) corresponding to the height of the bed of the wagon will be installed in order to facilitate the cargo work.

② Machinery

Since the frequency of the door opening varies depending on the products, the cold storage is to be divided into two chambers, one for prawns (80m) and the other for fish (70m). The freezer of the direct expansion system using the refregerant R-22 (Freon gas) will be installed

in each chamber. The cold storage is to be so designed that the inside temperature is kept at -25°C (at the temperature of the outside air + 32°C). The air curtains shall be installed in each door in order to prevent the cold air escaping at the time of opening. The cold storage will have electric powered doors. An electric generator (50 KVA) as emergency power source should be installed in the machine room so as to secure the operation of the above mentioned machinery at the time of power failure, and as its refueling facilities an oil service tank (for 80L) should be installed.

5-2-3 Jetty construction design

(1) Basic design conditions

① Using condition

Objective boat 150 G.TON trawler

Berth approach speed 0.3 m/sec

Design load Uniform load 0.5 ton/m^2

Live load Usually, live load is 3-ton truck. However, 16 ton crane truck should be able to work.

② Natural conditions

Waves wave height 1m, cycle 3 seconds

Wind wind velocity 15m/sec

Current 2 knots
(The direction is parallel to the cost line)

Nature of the soil	Soil of 2m from sea bottom surface is sandy silt. Deeper Zone is sand. However, near coast line is fine sand from surface.	
Designed seismic intensity		
	Seismic intensity coefficient	Kh=0.05 Kv=0
Tide level	H.H.W.L	C.D.+3.5m
	L.L.W.L	C.D.-0.5m

(2) Basic design policy

①Various factors of the jetty:

The jetty should be so constructed that both the MAMATAFICO and the trawler to be granted this time can be moored at the same time, and also it should be long enough to be able to moor the other TAFICO's fishing boats directly or indirectly. In regard to the jetty width 3 ton trucks shall be able to run safely and can make a U-turn with a few wheel manipulations and 16 ton truck crane to work safely on the jetty. Taking the above points into consideration, various factors of the jetty are established as follows.

Length of jetty	70m
Width of jetty	10m
Depth of water in front of jetty	C.D.-4m
Width of gangway	6m
Length of gangway	about 55m

② Comparative study of jetty type

There are four jetty types.

A Gravity-type quay wall (block, caisson)

B Pile jetty

C Floating jetty

D Combination of the above jetties

As the result of the on-site investigation, the gravity type quay wall is not appropriate from the technical and economical point of views because the geographical feature of the seabed in the marine zone, where the jetty is scheduled to be constructed, is distinguished by steep slope. Therefore, a pile jetty and a floating jetty are subject to be studied as the main parts of the jetty. In the comparative study, the following is the important points to be regarded.

A Unloading and loading work should be performed in a safe and efficient way.

B The jetty is to cope with the tide range of 4m without any problem.

C The jetty shall be able to be used for a long time (strong durability) with little maintenance.

D The construction period and charge shall be appropriate.

For the pile jetty, the steel pipe pile which is heavily coated for corrosion resistance (plastic coating), and for the floating jetty, the steel made jetty or PC made jetty shall respectively be subject to study.

Comparative list of jetty

	Pile jetty	Floating jetty(steel)	Floating jetty(PC)
Structure	Steel pipe pile (heavy coating) jetty and gangway	. Steel pontoon . Movable bridge . Gangway	. PC pontoon . Movable bridge . Gangway
Geographical figure of seabed	Affects the size and allotment of the pile	. No influence	. Same as the left
Nature of the soil in seabed	Affects	. Affects scarcely	. Same as the left
Marine weather conditions	Not affects in designing	. Affects, but negligible in practical use	. Same as the left
Tide range of 4m	Affects relatively much	. Affects the movable parts, but negligible in practical use	. Same as the left
Cargo work	Work is safe on the jetty, but seen from boats this jetty has some inconvenience	. There are some rockings by waves, but so small in quantity that it is negligible in practical use	. Same as the left

Maintenance	. Almost maintenance free	. Necessary, but it is not available on the site	. Almost maintenance free
Seen from the approaching boat	. It is necessary to adjust the length of rope according to the water level	. No such problem	. No such problem
Construction period	. Approx. 10 to 12 months after signing a contract	. Approx. 8 to 9 months after signing a contract	. Same as the left

In the preceding list, we made comparisons on the advantages and disadvantages in each item of three types of jetties. The following study was added.

As described above, the safety in work and the maintenance of the jetty were marked as decisive factors upon choosing the jetty type. There is no problem of safety in work on the pile jetty. On the other hand, the results of careful study have revealed that even on the floating jetty the rockings which may affect the safety in work will not occur under the scale of the jetty presently planned and the natural conditions in this marine zone. For example, a floating material is subject to a rolling of about 1 degree caused by the waves of which height and period are 1m and 4 seconds (actually 2 to 3 seconds) respectively, which will not influence the work on the jetty. The steel made one will cause some problems of maintenance but prestressed concrete seldom requires maintenance.

In case of the fixed style, in other words, the pile jetty, a tide range of 4m will inconvenience the derrick work on a small boat of less than 150 GT tons at low tide. Also the adjustment of the length of rope corresponding to the change of water level is required and a pile jetty will present some inconveniences to the embarkation and disembarkation of the crew as well as to transportation. Furthermore, in terms of the construction period and cost, the floating jetty is more advantageous.

Since there is no problem in practical use of rolling, which was once considered to be the fundamental defect in the floating jetty, the result of the study indicates that a floating jetty is more advantageous than a pile jetty because the floating one is not subject to the influence of the geographical figure and nature of the soil in seabed and it can cope with the tide range.

(3) Basic plan

1 plane layout

The plane layout of the jetty is shown in the figure 7. The field survey revealed that the contour line is not parallel to the retaining wall in the coastal area of the base. Therefore, the jetty is not parallel to the retaining wall, but it lies with an angle of some degrees. The movable bridge is approx. 33m long and an angle of inclination is less than 6 degrees at low tide of C.D-0.5m. The fixed gangway part of the jetty is to be approx. 22m long. Its maximum height of shall be C.D+4.5m. The attached road from gangway to the existing road should be paved with concrete after laying gravel. (The construction of the attached road is charged to the Tanzanian government.)

2 Basic structure, design plan

A Prestressed concrete jett

The outer surface dhould be made of prestressed concrete and the intetior partition wall should be of the steel made hybrid structure. On the flanks (before and behind, right and left) of the jetty, there shall be a rubber fender for mooring boats. On its back, ladders for embarkation and disembarkation for small boats shall be installed in four places. On the jetty deck the mooring post, vehicle stopper, illumination, hydrants (in two places), oil feeding posts (in two places) will be needed. 120 ton water tank is to be set up in the jetty.

That will be equipped with two pumps of 10 tons/hour x 10m lift (one for spare) for pressure circulation. Water supply pipe is connected to the jetty and to the water tank attached to the ice plant. In view of the corrosion allowance of 30mm, the chain for mooring the jetty is of 70 . The jetty itself should be strong enough to be towed by tug boats from Japan.

B Movable bridge

Movable bridge should be made of steel plate girders of approx. 33m long and 6m wide. Upon designing the matenial of the load supporting shoe, the abrasion should be taken into consideration. Excellent in durability, cement or resin heavy coating type should be used as painting.

C Gangway

It should be approx. 22m long and 6m wide and painted with concrete on the surface.

D Attached road (under the control of Tanzanian government)

After the gravel is laid and the roadbed is formed, it is paved with concrete. The gravel-laid slope should be protected by stone adhering so that it cannot be broken by the waves or tide. The attached road is from a bridge base to the existing paved road, 18m long and 6m wide.

5-2-4 Construction design of tank and accessories

(1) Fresh water tank

1 Basic design policy

The design is carried out in view of the supply conditions of fresh water or the conditions about labor, materials and equipments. The facilities shall have a structure, where a part of PC pontoon planned to be a jetty serves as a fresh water tank.

2 Study of scale

The tank shall be provided against the accidental stop of fresh water supply and its reserve is to be for a week.
The fresh water demand for a week is scheduled as follows.

A Ice machine and nondrinking water:
15 tons/day x 7 days=105 tons/week

B Fishing boats

Name	Water tank Number of boat total	30/sailing day	pure water ton/month	ton/week
TUMAINI	3.0 x 1 = 3.0	30/8	11.25	2.8
MAENDELEO	6.0 x 1 = 6.0	30/8	22.5	5.6
KAMBAKOCHI and one other	1.5 x 2 = 3.0	30/6	15.0	3.8
SANGARA and three others	1.5 x 4 = 6.0	30/6	30.0	7.5
SANGANI	1.5 x 1 = 1.5	30/20	2.3	1.5
MAMATAFICO	36.0 x 1 = 36.0	1	-	18.0
New boat	15.0 x 1 = 15.0	1	-	7.5
			total	46.7

In the above list, the MAMATAFICO and the new boat have water generator in itself. Providing a supply of water is a half the tank capacity, a reserve for one week, accorking to the list, will be:

105 tons + 46.7 tons = 151.7 tons

Since the capacity of the existing tank of ice machine is approx. 50 tons,

151.7 tons - 50 tons = 101.7 tons

Estimating the reserve at 13%

101.7 x 1.13 = 115 tons

Therefore, 120 ton tank will be required.

3 Construction design

In view of the maintenance free of the painted surface the fresh water tank shall have a concrete inner surface finished with mortar. The fresh water shall be supplied to the tank by the power of water barge which berthes at the new jetty to be constructed. Water is conducted to the existing 50 ton water tank for ice making by the water supply pump installed inside the pontoon, and then is sent to the shore and fishing boats by the existing water supply pump for ice making by passing through the strainer. Also piping arrangement is made so that the direct supply to the fishing boats by the newly established pump is made possible. The supply pump has a capacity of 10 tons/hour, the same as the water barge. The supply should be made to two fishing boats at the same time. The flexible coupling is used as piping joint before and after the movable bridge.

(2) Fuel oil tank

1 Basic design policy

Upon designing the geographical features, fuel oil supply method, labor conditions, materials and equipments avoilability, maintenance and marine transportation cost should be taken into account.

2 Study of scale

In order to prevent some operational loss caused by eventual oil supply stop, an oil tank with one month reserve will be installed. It is appropriate to decide the oil tank capacity by calculating the fuel oil consumption of boats. The result of the calculation is as follows.

Name	Main engine horse power	Number of boats	Fuel oil consumption Kl/day	Sailing days	Lay days	Kl/month
TUMAINI	365	1	1.212	7	1	31.8
MAENDELEO	270	1	0.923	7	1	24.0
KAMBAKOCHI and one other	89	2	0.434	5	1	22.0
SANGARA and three others	120	4	0.470	5	1	47.0
SANGANI	120	1	0.402	5	2	11.0
MAMATAFICO	500	1	1.6	22	9	37.0
New boat	450	1	1.6	29	8	48.0
					Total	200.8

Consequently, in view of the heat expansion an approx. 240kl fuel oil tank will be required. The most economical and efficient number of tanks shall be decided on the basis of the above mentiond basic design policy.

3 Constuction design

The fuel oil tank shall be of the structure of pre-fabricated iron pannel or of steel plate welding. The foundation shall be concrete. Inner surface shall be oiled and the outer surface is to be finished in decoration paint over anti-rust painting.
The fuel oil will be transported to the tank by tank lorry. It is also supplied to the fishing boats by power through the pipe connecting the tank to jetty and emergency electric generator.
In order to prevent unforeseen accidents due to the leakage, the branching valve and supply valve to the fishing boats in flexible coupling is to be set before and after the movable bridge.
A fuel oil tank storage measuring instrument should be of floating type.

5-2-5 Design of materials and equipments

(1) Basic policy

The design of materials and equipments is divided into two parts.

1) Materials and equipments of FRP boats furnished by 1980's grant aid.

2) Repairing instruments and tools

The basic policy is described as follows.

1 Existing FRP boat

The top priority is to be given to the rehabilitation of the Kisiju which is now laid up because of partial damage in the hull as a result of the shipwreck. Through the materials and ports supply to the rehabilitation of this boat, its reengagement in the fishing operation will be aimed. Its rejoining to the Tanzanian fishing fleet will contribute to the increase in catch.
Also for the other boats, a necessary quantity of equipments and parts are to be calculated by considering their aging conditions.

2 Repairing instruments and tools for boats

Large machinery for repairing boats is alreday purchased by TAFICO. Practical repairing instruments and tools necessary for small repairs are to be chosen.

(2) Study of scale

1 Materials and equipments for FRP boats

Main materials and equipments necessary for the rehabilitation of the KISIJI are as follows.

Item	Quantity	Note	Present condition
1.Radio instruments for navigation			
Radar	to be in order 1		divertid to the other boats
Fish-finder	to be in order 1		"
SSB transmitter receiver	" 1		"
Magnetic compass	" 1		"
Motor siren	" 1		"
Nautical light pannel	" 1		unrepairable
2.Deck instruments			
Ventilator for living quarters	to be in order 1	broken completely	

3.Main engine			
Cylinder hed	to be in order 4	diverted to the other boats	packing
Locker arm	" each 4	"	Both parts for air supply and exhaustion
Fuel oil oump	" 1	"	
Starting morter	" 1	"	
T joint for power take off	" 1	broken	only rubber missing
4.Hull repairing instruments			
Glass fiber	approx.2m^{2}minutes	fender beams shall be provided in the site	broken,bent
Gell coat			worn-out
Resin	1	including key	

When the life of the parts for the other boats was calculated from the annual operating hours of equipments, it was estimated that those for 3 years are necessary to be furnished. Furthermore, since the MAMATAFICO and the new boat are compelled to operate in narrow marine zones, a radar and a fish-finder are indispensable for the safety. In addition, a radar and a fish-finder should be supplied as spare instruments.