BASIC DESIGN STUDY REPORT
ON
THE PROJECT OF FISHERIES RESOURCES SURVEY
IN
INDIA

FEBRUARY 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of India, the Government of Japan has decided to conduct a basic design study on the Project for the fisheries resources survey in India and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to India a study team headed by Mr. Masahiro Fujimura, Planning Officer, International Affairs Division, Ocean Fisheries Department, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries from October 29th to November 17th, 1987.

The team had discussions on the Project with the officials concerned of the Government of India and conducted a field survey in the Bombay and Cochin areas. After the team returned to Japan, further studies were made, a draft report was prepared and a mission to explain and discuss it was dispatched to India. As a result, 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 countries.

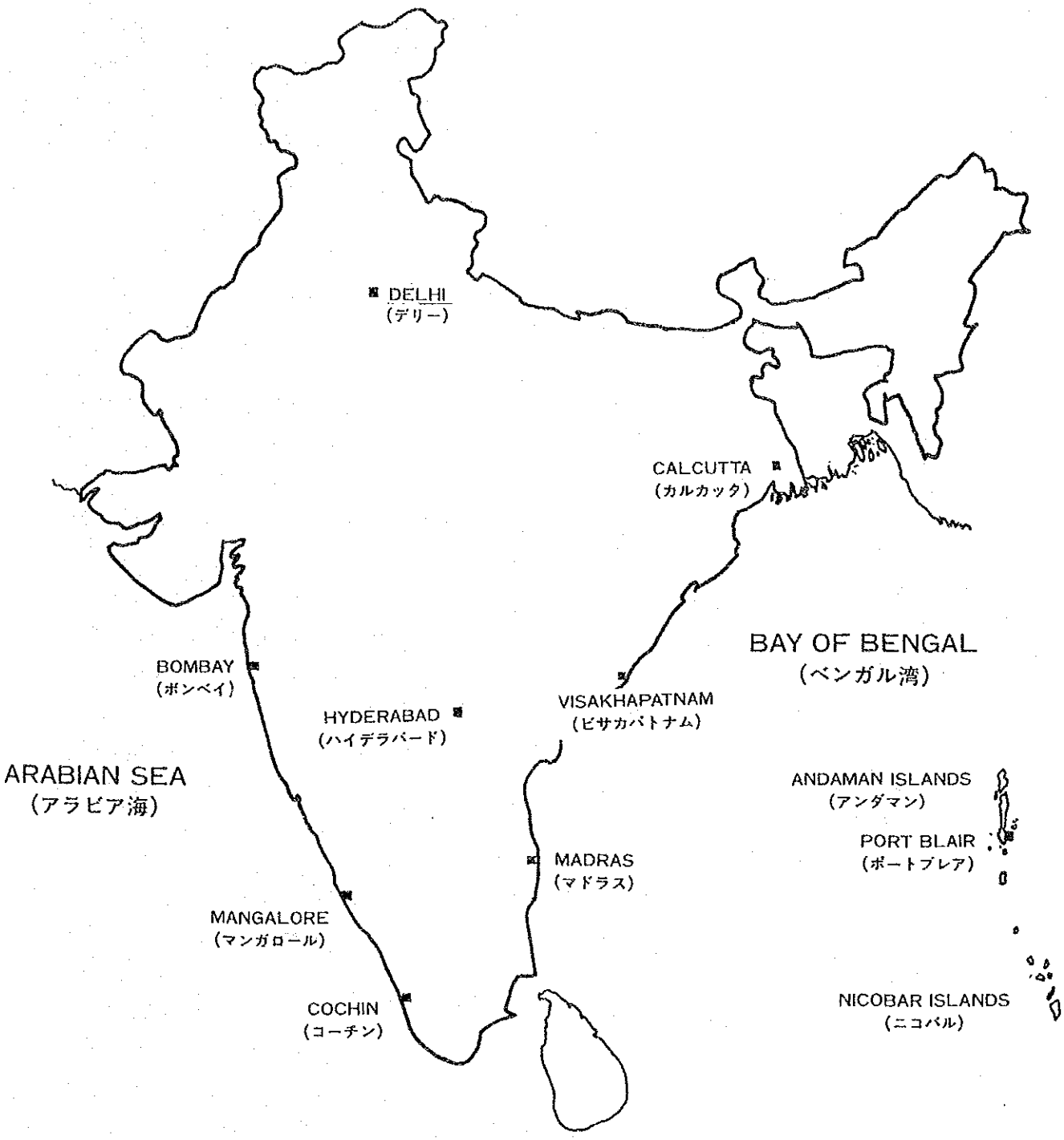
I wish to express my deep appreciation to the officials concerned of the Government of India for their close cooperation with the team.

February, 1988

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International
Cooperation Agency

INDIA
(インド国)


DELHI
(デリー)
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(ニコバル)

SUMMARY

The Seventh Five Year Plan is in progress during the period from 1985 to 1990 in India (hereinafter referred to as "India" or "the Country"). In this plan, the development of fisheries was given a high priority.

The total fisheries catch of India amounted 2,850,000 tons in 1984 and ranked eighth in the world. This amount can be divided into 1,100,000 tons from the inland fisheries and 1,750,000 tons from the marine fisheries.

When analyzing the catches realized in Indian waters, that of prawn and shrimp amounted approximately 200,000 tons, which was equivalent to approximately 7% of the total catch of the country. Indian export value of prawn and shrimp had once ranked first in the world. However, as the production of prawn and shrimp of this country has been stagnant in recent years, in 1986 its exports failed to keep its first position, and lost it to Taiwan. The Government of India considers tuna as a fisheries resource which could be second in importance to prawn and shrimp. Thus it has begun to make more efforts in the development of this resources. In recent years, its catch has been stagnant at between 2,400,000 to 2,800,000 tons. The Government of India provided a target, in its Seventh Five Year Plan, to increase its total catch to 4,000,000 tons by 1990.

Although India borders of the Bay of Bengal and the Arabian Sea where tuna are abundant, the tuna catch is limited to a small quantity due to delay in the modernization of India's tuna fisheries. The statistics of India's tuna catches (FAO) show only about 20,000 tons in 1984, equivalent to less than 1% of the total catch.

In India tunas are fished by artisanal coastal fishermen. Long-lining is practiced by the MATSYA SUGUNDHI (granted by Japan in 1980), which is a survey vessel operated by the Fisheries Survey of India (FSI). It is also practiced by a private fishing boat

based at Mangarole and a few other boats. The MATSYA SUGUNDHI is a dual purpose vessel for tuna fishing and surveying. It is also provided with fishing gear for taking cuttlefish. Tuna fishing with this long-liner has improved every year and reached an annual catch of 188 tons in 1986.

The Government of India considers that only one vessel, the MATSYA SUGUNDHI, is not sufficient for the survey on fisheries resources and stock distribution in both the Bay of Bengal and the Arabian Sea, because those waters are separated by the Indian Subcontinent. This causes a lack of mobility in the survey. Therefore, it is impossible to achieve the targets of the National Development Plan. Accordingly, in order to promote the survey on tuna resources, India made a request for the grant aid from the Government of Japan for two tuna long-liner type survey vessels. It considers that such survey vessels would be modernized versions of the MATSYA SUGUNDHI.

In response to this request, the Government of Japan decided to conduct a basic design study and entrusted the study to JICA. The study was to confirm the contents of the request to evaluate the appropriateness of the Project for Japan's grant aid program and to execute surveys necessary for the basic design.

JICA sent to India a Basic Design Study Team (hereinafter referred to as "the Team"), headed by Mr. Masahiro FUJIMURA, Planning Officer, International Affairs Division, Ocean Fisheries Department, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries from October 29th to November 17th, 1987.

The Team made a series of field surveys on the fisheries situation in India and on the conditions of management and implementation of the MATSYA SUGUNDHI which is presently used by taking into consideration the contents of the request. On the basis of the results of the study, the following contents and scale were considered appropriate for the requested equipment and materials and the basic design was made accordingly.

.Type of vessel : Long poop type tuna long-liner
.Classification : NK
.Size : Overall length : approx. 36 m
Breadth : approx. 7.35 m to 7.40 m
Depth : approx. 3.10 m to 3.20 m
International
Gross Tonnage: approx. 300 GT
Complement : approx. 25 persons
.Fishing gear : Long-line gear : one set
(Main line connected type)
.Survey equipment: Oceanographic survey winch, etc.
one set
.Delivery term : 1989

1. Outline of operation plan

The operation plan of those two vessels (Survey Vessels A and B) is as follows:

1) Survey Vessel A (Survey in the Arabian Sea)

Survey Vessel A will be based at Mormugao for survey of the Arabian Sea for a period of 10 years in a phased manner. Four phases would include a preliminary survey, a detailed survey, a simulated commercial survey and a monitoring of stocks.

2) Survey Vessel B (Survey in the Bay of Bengal)

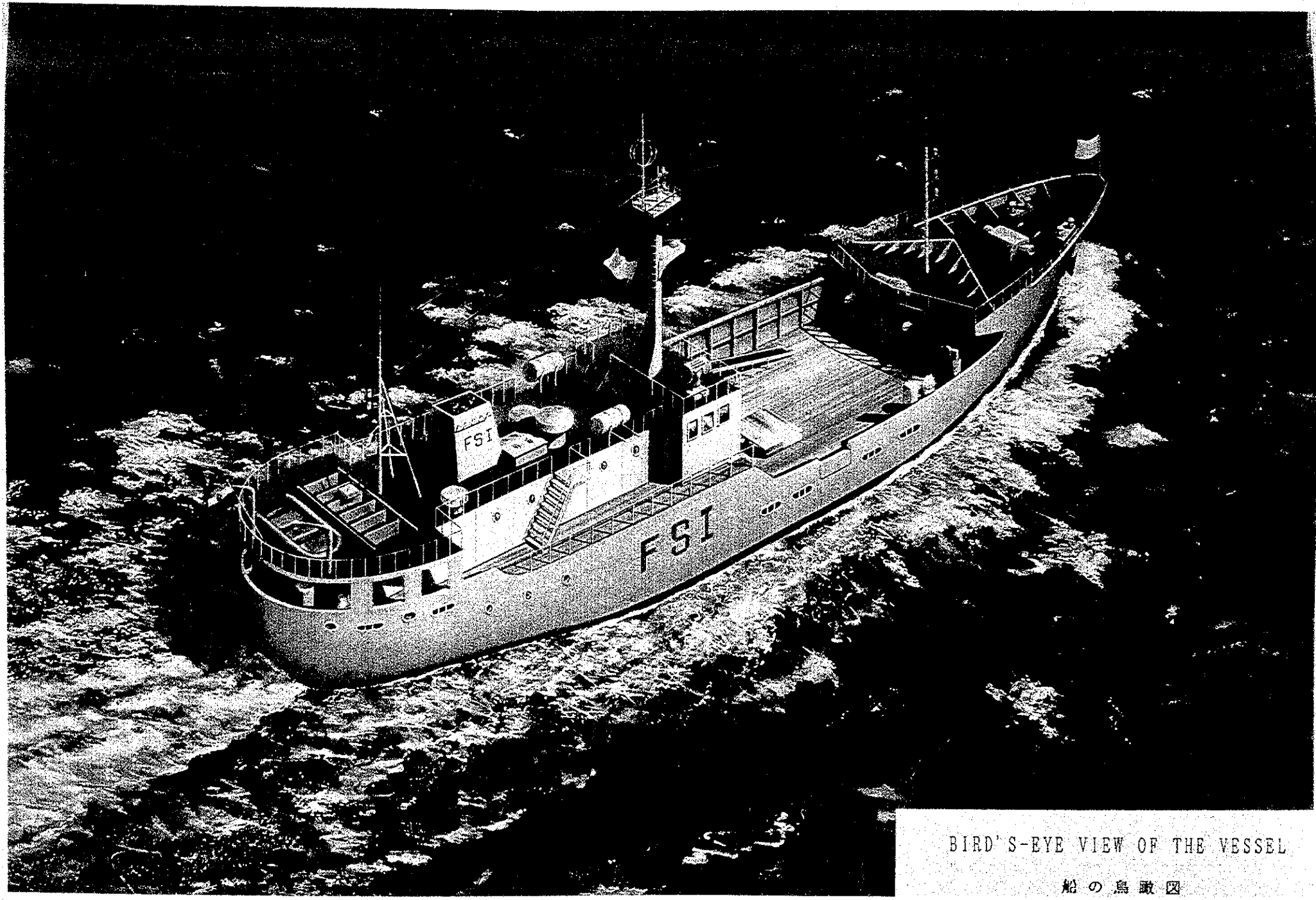
Survey Vessel B will be based at Port Blair for the first half of a period of 10 years for the survey of waters around Andaman and Nicobar Islands. The vessel will subsequently be based at Visakhapatnam for the second half of that period for the survey of the North-west Coast of the Bay of Bengal in a phased manner as in the above case.

2. Implementation system and Management & maintenance system

The Fishery Survey of India (FSI), under the control of the Ministry of Agriculture & Rural Development, is responsible for the management and maintenance of the Survey Vessels. The FSI has its Zonal Bases at Mormugao, Port Blair and Visakhapatnam. Under the Zonal Director of the Zonal Bases, the staff for operation and maintenance of the hull and engines will be assigned for the management and maintenance of the Survey Vessels.

The expenditure for the management and maintenance is received from the National Treasury. A budgetary measure of Rs. 30 crores for 5 years is provided for the operation of the Survey Vessels by the FSI.

The Survey Vessels which are the subject of the Project (hereinafter referred to as "the Survey Vessels") will help to conduct efficiently the survey on fishery resources in the Indian Exclusive Economic Zone (hereinafter referred to as "EEZ"), and will contribute to the development of tuna fishing when the Project is realized. Therefore, the building of the Survey Vessels shall be considered appropriate as an item for the grant aid from the Government of Japan.



BIRD'S-EYE VIEW OF THE VESSEL

船の鳥瞰図

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CHAPTER 1 INTRODUCTION

India recorded an annual fisheries production of 2,850,000 tons in 1984 and ranked eighth in the world. Out of the above production, about 1,750,000 tons was from marine fisheries. About 65% of marine fisheries production was realized with small and unpowered fishing boats and the remaining 35% was achieved mainly with trawlers (motorized boats) as coastal fishing in waters shallower than 50 m. Therefore, very little offshore fishing is practiced in India. The population engaged in fisheries and related industries in India has increased to approximately 4 million at present.

The Seventh Five Year Plan is presently in progress, and the Government of India aims at the development of fisheries as one of the most important economic and social targets in the plan.

The main targets of this plan are as follows:

① to increase both the income of fishermen and employment opportunities for fishermen,

② to supply animal protein to the people,

③ to obtain foreign currencies through export, etc.

Especially, the Government of India considers that the presently used survey vessel, the MATSYA SUGUNDHI, is not capable of sufficient study for promoting the future development of tuna fishing in India which is blessed with excellent fishing ground conditions and has great promise. For this reason, the Government of India made a request for grant aid for the construction of new tuna long-liner type survey vessels in order to conduct a full-scale survey on tuna resources.

In response to the request, the Government of Japan, through the Japan International Cooperation Agency, sent to India a Basic Design Study Team, headed by Mr. Masahiro FUJIMURA, Planning Officer, International Affairs Division, Ocean Fisheries Department, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries, from October 29th to November 17th, 1987.

The Team had discussions with the Indian officials concerned in

order to confirm the background of the request and the contents of the Project and in addition conducted the necessary surveys and collected materials and information.

After coming back to Japan, the Team studied and analyzed the survey materials and the contents of discussions, evaluated the effects to be given by the Project to the development of tuna fishing, executed the basic design in scale and contents for the most optimal survey vessels, and prepared the draft final report of the basic design study.

On the basis of the above study, JICA sent a mission, headed by Mr. Masahiro FUJIMURA, Planning Officer, International Affairs Division, Ocean Fisheries Department, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries from January 17th to January 29th, 1988 to India to explain the draft final report.

This report was prepared to contain the most appropriate basic design as considered for the Survey Vessels, the project cost, the evaluation of the Project, recommendations, etc.

Contents and principles of the Project which were confirmed during the field survey by both parties are summarized in the Minutes of Discussions, and a member list of the Study Team, a list of their counterparts in India, and a study schedule are attached to this report as Appendices.

CHAPTER 2 BACKGROUND OF THE PROJECT

2-1 Fisheries Situation in India

2-1-1 Outline

The population engaged in fisheries and related industries in India has become approximately 4 million. The Country attained an annual fisheries production of approximately 2,850,000 tons in 1984 of which about 1,750,000 tons was from marine fisheries. India is the eighth fishing country in the world. Sixty-five percent of the total catch was realized with small non-motorized fishing boats and the remaining 35% was taken with small motorized boats or medium motorized fishing boats engaged in offshore fisheries. Small-scale fishing is mainly practiced as coastal fishing in waters shallower than 50 m deep and by trawling on the seabed.

The potential marine fisheries resources in waters shallower than 50 m are estimated as below according to the Food and Agriculture Organization statistics.

Northwest Coast	500,000 tons
Southwest Coast	700,000 tons
Southeast Coast	550,000 tons
Northeast Coast	500,000 tons
TOTAL	2,250,000 tons

In addition, according to an estimation made by the Government of India, about 4.5 million tons of Maximum Sustainable Yeild is in the Indian EEZ.

When considering the above estimated potential and the actual catch of about 1,750,000 tons,and there should be a great reserve for development.

(1) Catch

1) Catch

The catch in India by year is as follows:

Table 1 Catch by Year

Year	Amount of catch (1,000 tons)	Freshwater fish (1,000 tons)	Seawater fish (1,000 tons)
1975	2,266	784	1,482
1982	2,368	940	1,428
1983	2,506	987	1,519
1984	2,859	1,100	1,759
1989	4,000	1,800	2,200 ... planned amount

(Note) Data for 1984 are from FAO statistics

When comparing the catch of about 2,270,000 tons of 1975 with that of 1984 being about 2,860,000 tons, there is observed an increase of 22% in those 9 years.

The above mentioned catches are landed at approximately 1,300 landing centers. Among these, Veraval in Gujarat, Sassoon dock at Bombay, Cochin in Kerala, and Visakhapatnam in Andhra Pradesh are large fishing ports.

When analyzing the catches shown in Table 1, it should be known that the main species found in the Indian Ocean are prawn, shrimps, sardines, croakers, drums, anchovies, Bombay-duck, sea catfishes, etc. The catch fish species in the past 6 years is as shown in Table 2.

Table 2 Yearly catches by species (Species of catch over 10,000 tons)

Unit: 1,000 tons

	'79	'80	'81	'82	'83	'84
Kelee shad	32.2	24.7	19.9	19.1	24.3	26.5
Flatfishes NEI	10.8	11.3	11.7	17.5	17.3	22.4
Bombay-duck	121.6	116.2	98.6	82.9	91.0	116.4
Sea catfishes	47.1	59.3	55.4	53.2	62.9	70.8
Ponyfishes (=Slipmouths) NEI	34.2	41.0	37.7	48.3	56.6	47.1
Croakers, drums NEI	127.9	124.0	113.5	116.6	91.2	137.5
Jacks, crevalles, carangids NEI	28.3	28.3	23.9	32.5	40.1	41.8
Butterfishes, harvestfishes NEI	42.4	51.5	45.9	42.2	55.0	50.5
Indian oil-sardines	274.4	225.3	310.3	260.1	255.4	291.1
Anchovies	51.0	69.5	62.1	76.7	125.1	118.1
Wolf-herring	15.3	18.2	16.3	12.4	17.2	20.1
Seerfishes NEI	27.4	30.9	25.2	27.7	32.3	34.3
Tunalike fishes NEI	23.0	30.4	14.8	22.6	23.6	21.1
Hairtails, cutlassfishes	72.2	59.5	63.4	61.9	65.3	62.2
Indian mackerel	86.2	58.8	61.1	27.9	32.2	54.6
Sharks, rays, skates, etc	40.9	49.7	50.0	47.8	51.4	54.0
Natantian decapods NEI	183.2	250.3	164.2	209.7	192.9	203.0
Marine crustaceans NEI	17.6	19.0	16.8	18.8	21.8	22.6
Marine molluscs NEI	11.2	12.3	8.9	11.0	9.7	19.8
Others	245.0	275.3	245.2	239.8	253.8	363.2
Total, marine fishes	1,491.9	1,555.5	1,444.9	1,428.7	1,519.1	1,777.1
Total, freshwater fishes NEI	847.6	887.6	999.2	939.6	987.4	1,081.9
TOTAL	2,339.5	2,443.1	2,444.1	2,368.3	2,506.5	2,859.0

(From FAO data)

Remark: NEI: not elsewhere included

The catch by fish species in 1984 can be summarized as follows:

①	Sardines	291,000 tons	10% of total catch
②	Shrimp	203,000 tons	7% of total catch
③	Croakers, drums	137,000 tons	5% of total catch
④	Anchovies	118,000 tons	4% of total catch
⑤	Bombay-duck	116,000 tons	4% of total catch
⑥	Sea catfishes	71,000 tons	2% of total catch

Therefore, two species, sardines and shrimp, represent 17% of the total catch.

The tuna catch which was 30,000 tons in 1980, decreased by a half to 15,000 tons in 1981. Thereafter it has varied; 23,000 tons in 1982, 24,000 tons in 1983, and 21,000 tons in 1984 for about a 20,000 ton level in recent years.

(2) Exports

India's exports of marine products were 33,000 tons in quantity and Rs. 30.5 crores in value in 1970, and 93,000 tons and Rs. 388.6 crores respectively in 1985. Exports of marine products from India have been as follows:

Table 3 Exports of marine products

Year	Quantity (1,000 tons)	Value (Million Rs.)
1970	32.6	305
1981	73.9	2,849
1982	83.3	3,641
1983	85.4	3,959
1984	90.4	3,813
1985	93.4	3,886

When observing the transition of exports in the 15 years up to 1985, it shows a three times increase in quantity and a thirteen times increase in value. In comparing the increase in weight with that in value, the latter is remarkable. This can be explained by noting that exports of high valued prawn and shrimp have increased.

(3) Fishing Boat

It is known that the total number of fishing boats including large vessels and small boats is about 150,000. Previously, most were of about 3 tons or less and unpowered. However, approximately 20,000 motorized boats are now being operated, among these 75 boats are steel vessels over 100 GT amounting to 12,092 GT in total as shown below:

Table 4 Changes in the number of steel vessels larger than 100 GT

Year	Quantity	GT
1976	23	3,428
1981	44	7,740
1982	53	8,788
1983	72	11,345
1984	75	12,092

In order to increase its total catch, the Government of India puts emphasis on increasing the number of fishing boats. In the Seventh Five Year Plan, it plans to increase the number of motorized fishing boats from 20,000 in 1984 to 25,000 in 1989, and those for pelagic fisheries from 75 in 1984 to 350 in 1989 as shown in Table 8.

(4) Fisheries Administration in India

The Ministry of Agriculture of India has three departments; the Department of Agriculture & Cooperation, the Department of Agricultural Research & Development, and the Department of Rural Development. The Fisheries Division is subordinate to the Department of Agriculture & Cooperation and controls fisheries in India. Under it there are organs such as the FSI, the Central Institute of Fisheries Nautical & Engineering Training, the Integrated Fisheries Project, etc. The FSI is responsible for fisheries survey, the CIFNET for fisheries training, and the IFP for marine products processing.

2-1-2 Tuna Fishing

(1) Fishing Conditions

Total world production of tuna was approximately 2.9 million tons in 1985, and this figure represented about 3.8% of the total production of fisheries products.

In the Indian Ocean, the total catch of tuna varied from about 200,000 tons to 270,000 tons up to the year 1981, and this figure was 10% to 11% of the world catch of tuna. The catch was 380,000 tons (13% of total) in 1983, 450,000 tons (16% of total) in 1984, and has become about 460,000 tons (16% of total) in 1985. Thus a slight increasing trend can be observed. Within the total quantity, the catch of skipjack was about 100,000 tons in 1984.

In India, tuna fishing is conducted in the waters around Lakshadweep and the mainland coastal areas with small coastal fishing boats. Fishing methods used by such fishing boats include purse seines, trawling, hand lines, etc. In India, there are only a few medium and large steel tuna long-liners. The existing boats are limited to a few vessels which include a survey vessel belonging to the FSI (Fishery Survey of India), namely the MATSYA SUGUNDHI, and a long-liner based at Mangalore.

The catch of tuna in India varied from around 20,000 tons to several thousand tons over that figure after 1982, and this was 21,000 tons in 1984, which was equivalent to less than 1% of the total catch of India.

(2) Present Operating Condition of the MATSYA SUGUNDHI

As mentioned above, tuna fishing in India is now conducted on a small scale by coastal fishermen. The Government of India emphasizes tuna fishing in the development of its fisheries as one of the important targets of the Seventh Five Year Plan. Therefore, it is expected that long-liner fishing with medium and large vessels will be promoted more and more in the future. At present, the FSI operates a long-liner type survey vessel, the MATSYA SUGUNDHI, which was provided by Japanese grant aid in 1980, as a main means for conducting the fisheries resources survey. Results of the survey are as follows.

Furthermore, there was another vessel granted by Japan in 1980, the PRASHIKSHANI. It is a training boat and is now operated by the CIFNET (The Central Institute of Fisheries Nautical & Engineering Training). As it is mainly for training in trawling, it is omitted as a subject of the present study.

1) Results of the Survey

Although the Indian EEZ is a so-called a treasury of fisheries resources, such as for tuna and marlin, it remains unexploited. Thus India has conducted the resources surveys off the Southwest Coast on the Arabian Sea including the area of Indian EEZ with the MATSYA SUGUNDHI.

The following table shows the results of the operation of the MATSYA SUGUNDHI from 1983 to 1987.

Table 5 Details of the operation of the MATSYA SUGUNDHI by year

Item	Unit	1983	1984	1985	1986	1987
Number of voyages	Time	11	12	11	12	(for 6 M) 6
Days per voyage	Day	206	231	207	244	100
Days per trip	Day	20.5	19.3	18.8	20.3	16.6
Days of operation	Day	149	118	109	123	53
Rate of operation (days of operation/365)	%	40.8	32.3	29.9	33.7	29.4
Total number of hooks used	Pcs	82,381	86,338	73,650	88,200	31,945
Survey area	East of long. 65°E, lat. 5°N to 15°N in the Arabian Sea					
Catch	Ton	57.0	53.4	170.1	188.2	24.4
Hook rate	%	2.23	2.19	7.39	9.18	2.29
Hook rate of YF* only	%	0.6	0.58	5.45	6.76	1.40
Number of fishes						
YF	Pcs	497	506	4,019	4,979	448
Marlin	Pcs	1,348	337	227	341	79
Shark	Pcs		1,089	1,137	1,455	201
Others	Pcs		465	61	22	5

*YF: Yellowfin tuna

The hook rate has been as low as 2% in 1983 and 1984, but it rose to 7% in 1985 and 9% in 1986.
The number of baskets used per day is only 150 on the average. When this fact is taken into consideration, the hook rate is remarkably high. It indicates the abundance of tuna resources.

(Composition of fish species)
According to the catch data in fiscal 1986/87, the catch was broken down as follows:

Catch	188,190 kg
Composition:	
Yellowfin tuna	77.41%
Bigeye tuna	0.30%
Skipjack	0.21%
Striped marlin	2.30%
Sailfish	2.89%
Marlin	0.44%
Shark	16.35%
Others	0.10%
TOTAL	100.00%

Yellowfin tuna, which have a high commercial value, represent 77.4% of the total catch, and shark and marlin follow. The fact that a major part of the catch is represented by yellowfin tuna shows a high economic value of the fishing ground.

2) Processing of Fishery Products
The entire catch of the MATSYA SUGUNDHI is sold at fixed contract prices to the IFP (Integrated Fisheries Project), which is a nationalized processing plant. This distribution system is organized according to the instructions of the

Government of India for the purpose of the development of marine product processing industry and processed products as well as the propagation of marine products in domestic markets.

In 1986, a catch of 188,190 kg was sold to the IFP for at a total value of Rs. 908,162 (average unit price:Rs. 4.8/kg).

3) Expenses

The annual operating expenses of the MATSYA SUGUNDHI in fiscal 1985/86 (from April to March of the following year) are as follows:

Wages	Rs. 420,969
Repair	Rs. 2,500
Stored goods	Rs. 106,950
Fuel oil/Lubricant	Rs. 1,239,450
TOTAL	Rs. 1,769,869

Expenses for fishing gear as well as those for spare parts for repairs, salaries for onshore staff, expenses for repair shop facilities, and general management costs are not included.

4) Preliminary Estimation of Profit and Loss

A budget for direct or indirect expenses for the operation of survey vessels belonging to the FSI is disbursed from the National Treasury. On the other hand, the total amount of money received from sales of the catches shall be paid directly to the National Treasury. This is the system for operation of the Survey Vessels. In other words, the income from sales is not transferred to expenses for operation. Therefore no independent income and expenditures are settled.

In the case of the MATSYA SUGUNDHI, the expenses for

operation in fiscal 1985/86 were approximately Rs. 17.7 lakhs, and the total amount of money received from sales of the catches were approximately Rs. 9.08 lakhs.

5) Maintenance and Management

Drydock repairs of the MATSYA SUGUNDHI are made at the Cochin Shipyard. The Cochin Shipyard is technically competent for shipbuilding, dry dock, and underwater repairs. Thus this is considered the most modern shipyard in India.

Maintenance of the main engine, generator, refrigerator and other machinery and equipment on the MATSYA SUGUNDHI is usually directed by experienced crew members. For repairs associated with complicated electronics and electrical work, experts are secured from specialized shops.

From the above mentioned study of the present situation of the MATSYA SUGUNDHI, no problem related to fishing ground conditions, fishery stock, maintenance in relation to operation, etc. even should the number of vessels increase in the future. Similarly, there should be no problem within the implementation of the fisheries resources survey with the Survey Vessels.

2-1-3 Tuna Fishing Problems

"OCEANIC TUNA" - A Feasible Fishery in Indian EEZ (published in October, 1986), edited by CIFNET, analyzes the lag in the development of tuna fishing in India as described below and indicates the following possible causes.

(1) Main Causes of Lag in the Development of Tuna Fishing.

1) Eating Habits

The custom of fish eating is not yet widespread and mainly restricted to the coastal areas, but are slowly spreading.

(Measure: Encouragement to eat fish)

2) Refrigeration Network

Since the refrigeration network in India is still at a primary level of development, the distribution of fresh and frozen fish to the interior of the country is impeded.

(Measure: Arrangement of adequate inland distribution system)

3) Willingness to Invest

Since the people engaged in fisheries are now able to make a living in the fisheries, they are not necessarily interested in taking a risk on unknown offshore tuna fishing.

(Measure: Encouragement of investment by governmental subsidy)

4) Fishing Techniques

Trawling techniques were introduced from abroad in the 1950s and have been adopted in India together with the building technology for small trawlers with the help of a boom in coastal shrimp trawling.

On the other hand, the situation of tuna fishing techniques, introduced in the 1960s, is not the same as that of shrimp trawling. Although long-liner fishing skills have been mastered, shipbuilding technology has not yet come to stay, because it requires larger investment.

(Measure: Governmental subsidy)

(2) Matters to be Improved Pointed out by Experts

Aiming at industrializing, the FSI invited a Japanese expert,

from September, 1963 to February, 1965 and a HongKong expert from October, 1967 to October, 1970 to provide technical assistance for operating the PRATAP and the MEENAPRAYAS with long-liner fishing gear.

Both experts indicated matters to be improved in relation to tuna fishing which were recognized through their experience in India.

- o Increase in number of fishing vessels.
- o Level-up of technology to navigate and operate large sized fishing vessels.
- o Training of skills of crew to maintain and repair engine. Knowledge education of crew about electrical and freezing matters.
- o Consolidation of educational institutions for techniques of long liner fishing and fishing gear operation.
- o Level-up of professional consciousness of crew members.
- o Improvement in investigation of fisheries resources. Knowledge education about market.
- o Consolidation of development of relevant infrastructure.
- o Enlightenment of market knowledge.

The Government of India analyzed the above mentioned matters and concluded that it is more and more important to strengthen the tuna resources survey in the Indian Ocean as one of its main measures. Thus it planned the provision of survey vessels.

2-1-4 Fisheries Resources Survey

The Fisheries Resources Survey in India is conducted under the control of the FSI (described in Chapter 3, 3-4). The FSI now has 10 large and 7 small survey vessels in its possession. Most of them are trawlers.

According to the FSI's survey project, the survey on the development of coastal fishing grounds is scheduled to be

finished in fiscal 1986. Thereafter, the survey will shift its purpose toward a survey of fisheries resources mainly in the Indian EEZ.

This survey in India's EEZ is a survey on tuna resources. The survey on tuna resources has been conducted with the MATSYA SUGUNDHI for about 6 years starting from 1980. This has been conducted mainly in the Arabian Sea in the western area of India.

This survey confirmed that there is a large yellowfin tuna stock in the area from lat. 5° N to lat. 15° N.

However, the existing vessels are insufficient to survey the EEZ covering approximately 2,020,000 km^2. Therefore, India made a grant aid request for two survey vessels.

The Country made the request for two vessels because one is to be in service in the Bay of Bengal, and the other is to be in service in the Arabian Sea.

2-1-5 Outlines of Facilities

(1) Marine Products Processing Facilities

The IFP plant, which is a national corporation located at Cochin, processes yellowfin tuna taken by the MATSYA SUGUNDHI as its main processing material.

They are processed mainly as canned products. Also frozen and dried products are made by the same corporation.

The catches of the Survey Vessels are expected to be processed and distributed to the domestic market in a similar way.

Yellowfin tuna will be processed as canned products and the other species as canned and frozen products. This is the same as with the catch of the MATSYA SUGUNDHI.

1) Outline of the Integrated Fisheries Project

The IFP had initially been founded as a joint project of India and Norway under the guidance of the FAO. In 1952 it was agreed and signed by and between the Government of Norway, the Government of India and the Government of the Province that this project would be carried out for the regional development of the coastal region.

It started business the same year and was provided with various facilities year by year. It is now engaged in a wide range of businesses, such as ice making, ship-building, ship repairing, manufacturing and repairing of fishing gear and product processing. These facilities are efficiently managed for the development of fisheries in India.

2) Processed Products of the IFP

The IFP's yearly development of products such as canned, frozen and dried products, is as follows:

① Canned Products

1978 ... Canned sardines in oil, canned sardines in tomato sauce, canned tuna fillets in oil, canned tuna chunks in oil, canned mackerel fillets in oil

1979 ... Canned crab meat (experimental), canned mussels

1980 ... Canned yellowfin tuna

Canned yellowfin tuna is now still the main product of IFP. Raw material for this product is mainly caught by the MATSYA SUGUNDHI.

1981 ... Oysters in oil stroke brine, marlin fillets in oil, marlin chunks in oil

1982 ... Canned pink perch in oil/tomato sauce

Canned sail fish fillet/chunks in oil

1983 ... Canned dolphin fish fillets/chunks in oil, canned shark

1984 ... Canned priacanthus fillets/chunks in oil, canned cuttlefish

② Frozen Products

1976 ... Seer fish minced meat, anchovy, sardine, mackerel,ribbon fish

1977 ... Catfish fillets, yellowfin tuna

1978 ... Cuttlefish and squid fillets

1980 ... Shark fillets, ray fillets

1981 ... Oyster, catfish, perch, spawn of catfish, shark fin

③ Dried Products

1977 ... Dried perch

1978 ... Sardine

1985 ... Tuna and ribbon fish

④ Hot-air Tunnel Dried Products

1975 ... Prawns, shark, anchovy , catfish

(2) Situation of Ports and Harbor

Outline of the main ports and harbors in India is as follows. Furthermore, three ports, Mormugao, Visakhapatnam and Port Blair are described in more detail in 3-2-3.

1) Port of Bombay

Bombay is a good port having a large water area of approximately 22.5 km from south to north and a width of 6.5 to 8 km. Its anchorage is from 6.7 to 9.6 m deep, the main route is approximately 10 m deep and is available for the entry of 90,000 DWT vessels. This port is completely equipped with all facilities necessary for all port functions.

2) Port of Candla

In this port, there is a jetty 1,125 m long and 9.14 m deep, available for the coming and loading of six cargo ships and bulk carriers at the same time.

3) Port of Madras

Madras is a main trade port on the East Coast of India. It is an artificial port and is a well equipped harbor There is a trawler shipyard on a corner of well arranged fishing harbor.

4) Port of Calcutta

The Port of Calcutta is situated at the mouth of the Hugli River. It can accommodate ships of up to 167 m length, 21 m breadth, and 8 m full draft. There is one major fishing harbor at Roychowk about 30 kilometers downstream.

5) Port of Cochin

It can accommodate ships with a total length 213 m, full draft of 9 m, and 40,000 DWT.

6) Port of New Mangalore

It is a new port located 9 km north of Old Mangalore along the West Coast of India and can accommodate ships of 77,000 DWT.

(3) Conditions of Shipbuilding and Repairing

Facilities for fishing boat building and repairing are necessary for the development of the Indian seawater fisheries. Outline of the Indian shipbuilding and repairing condition through which the Project will be implemented and managed are described below.

The Government of India places emphasis on the development of shipbuilding, and has eight national shipyards. There are more than thirty small private shipyards which build barges, tugboats, and trawlers in the Country.

Some of the main national shipyards are as follows:

1) Hindustan Shipyard Ltd. (HSL) [Visakhapatnam]

This shipyard has the longest history in India. Founded as the Seindia Steam Navigation Co., Ltd. in 1941 it was nationalized in 1952. At present, the number of employees of this corporation is about 8,500 in total.

These personnel are composed of about 500 officers, about 2,000 supervisory and administrative staff and about 6,000 tradesmen and apprentices. It is mainly engaged in the building of large ships, such as cargo ships, iron ore carriers, tankers, etc., but it also conducts various repair services.

It is provided with a cast shop, electrical and mechanical finishing shop and pipe manufacturing shop.

In the event the Survey Vessels of the Project are operated, they will be docked in this shipyard once a year for hull cleaning. There is no problem involving repair facilities in such case.

2) Goa Shipyard Ltd. (GSL) [Mormugao]
This shipyard has the capacity to build ships up to 1,000 DWT and a length of 70 m. It builds dredgers, trawlers, hopper barges, tugboats, etc.
It has delivered in total 27 ships or 5,930 GT, of various types and sizes from 1980 to 1985.
Its production value has also increased from Rs. 8.5 crores in 1981 to Rs. 28.3 crores in 1984. Moreover, it provides repair services for ships for overseas service and ship machinery in Mormugao Port.

3) Alcock Ashdown Ltd. (AAL) [Bhavnagar, Gujarat]
This shipyard built barges and launches in the period from 1980 to 1985. It has begun building fiberglass boats as its regular business.

Principal national and private shipyards in India are as given in the following Table:

Table 6 Principal shipyards

Company	Location	Building slip	Building dock	Repair dock	Slip way	Other
Bharati shipyard Pvt., Ltd.	Bombay	L 80 m x 8				Trawler
East Bengal Engineering Works	Calcutta	L 61 m x 2			L 198 m x 1	
Garden Reach Shipbuilders & Engineers Ltd.	Calcutta		L 180 m x 1	L 186 m x 1 L 212 m x 1	L 225 m x 1 L 195 m x 1 L 98 m x 1	Equipped with fitting jetty
Gladstone Lyall & Co., Ltd.	Hyderabad		Capacity for building 48 small ships/year			Fishing boat
Hindustan Shipyard Ltd.	Visakha-patnam	L size x 4		L 244 m x 1	L size x 4 S size x 1	Equipped with fitting jetty
Hooghly Dock & Port Engineers Ltd.	Calcutta	L 91 m x 4		L 91 m x 1		
Mazagon Dock Ltd.	Bombay	L 147 m x 2 L 191 m x 1		L 151 m x 1 L 130 m x 1 L 457 m x 1	L 87 m x 2	
N.N. Shipbuilders & Engineers Pvt. Ltd.	Bombay	L 60 m to 80 m x 5				Trawler
Shalimar Works Ltd.	Calcutta	Max 5,000 DWT total 9				

2-2 Outlines of Related Plans

2-2-1 National Development Plan

(1) Outline of the Seventh Five Year Economic Development Plan

The First Five Year Economic Development Plan started in 1951, and the Sixth Plan completed its program in 1985. The Seventh Five Year Plan was ratified by the National Development Council of India in November, 1985, and is now in progress. The period of this plan is from 1986 to 1990. The essential features of the Seventh Five Year Plan are as follows:

1) Principal Targets

India is expected to have a population of approximately 970 million by the year 2000. The plan has for its purpose stabilization of national life and the national economy under such circumstances.

It is concluded that the following are necessary for attaining the above purposes:

a) Economic growth and promotion of technical development.
b) Measures for raising the standard of living of the low-income class and those in the poor regions.
c) Improvement and consolidation of education, public health and other social welfare institutions.
d) Control of the population increases.

Therefore, the main targets of the Seventh Five Year Plan are set as follows:

a) Development of agriculture (together with fisheries).
b) Activation of domestic capital.
c) Acceleration of growth in the industrial fields of the domestic economy.

The Seventh Five Year Plan targets the promotion of industries and international trade as shown in Table 7.

Table 7 Target for Economic Growth

Item	7th plan (%)	6th plan (%)
GNP	5.0	5.0
Agriculture	4.0	5.0
Industry	8.0	5.0
Export	6.8	5.0
Import	5.8	-
Domestic gross savings rate	24.9	23.3

2) Investment

Total investment during the period of the Seventh Five Year Plan is set at Rs. 322,360 crores (U.S.$ 256.9 billion). An increase of 56% as compared to the Rs. 206,480 crores in the Sixth Five Year Plan. The above amount is divided into Rs. 154,210 crores for the public sector and Rs. 168,150 crores for the private sector.

2-2-2 Fisheries Development Project

1) Principal Targets

In the Seventh Five Year Plan, the basic thought for fisheries development is described in the agriculture development plan in the following manner:

The development of the fishery division has a great importance for increasing both the national income and employment opportunities.

Moreover, the fishery division is a source for supplying animal protein to Indian people and a potential means for obtaining foreign currencies. Therefore, growth in the fishery division shall contribute much to national life and the economy.

The target value of fishery production is set at six million

tons in the year 2000. Two million tons out of that six million tons is planned to be produced from inland waters. This value will provide a living places for many fishermen and increase the consumption of marine products, which is actually 3.5 kg/person, to 6.0 kg/person in the 21st century. In order to achieve the target, it is necessary to help the people learn advanced techniques for fishing and aquaculture and to develop new fishing grounds and new fishing techniques, especially for tuna.

The Seventh Five Year Plan sets high target figures for all areas of fisheries i.e. catches compared to the results of the Sixth Five Year Plan.

Table 8 Principal Targets of the Seventh Five Year Plan

Item	Unit	Result 1984/85 (a)	Target 1989/90 (b)	Rate (%) b/a
1. Catch				
a. Inland waters	1,000 tons	1,100	1,800	163.6
b. Sea	1,000 tons	1,750	2,200	125.7
Total	1,000 tons	2,850	4,000	140.4
2. Motorized boats		20,000	25,000	125.0
3. Pelagic fishing boats		75	350	466.7
4. Port/ landing center		86	140	162.8
5. Seed production	Million	5,639	12,000	212.8
6. Modernized culturing reservoirs	1,000 ha	101	300	297.0
7. BWFDA		147	400	272.1

Note) Fiscal year begins in April and terminates in March of the following year.

BWFDA: Blakish Water Fishing Development Agency

2) Concrete Measures in the Fishery Division in the Seventh Five Year Plan.

In the Seventh Five Year Plan, it is noted that India has its EEZ of 2,020,000 km^2, coastal line of 7,517 km in length, rivers of 29,000 km in total length, ponds of 1.7 million ha, seawater marsh of 900,000 ha, and lakes of 750,000 ha. Then the Country has a large potential for the development of fisheries resources.

Therefore, the following projects are now in progress.

a) Marine Fisheries

- o Development of fisheries resources in the EEZ, especially in waters deeper than 72 m, by the encouragement of investment.
- o Increase of income of coastal fishermen through diversification of fishing methods of coastal fisheries by the introduction of modernized motorized fishing boats.
- o Progressing from wood shipbuilding by the introduction of shipbuilding technologies using FRP, ferrocement, etc. and the reduction of building costs.
- o Severe enforcement of the Maritime Zones of India (regulation of fishing by foreign vessels) Act of 1981 and the rules framed in 1982 for the prevention of conflicts between capitalized fishermen and coastal fishermen.
- o Construction and consolidation of ports and harbors for catch landing and mooring of pelagic fishing boats.
- o Construction of catch landing centers for coastal fishing boats which number up to 154,000 and account for 2/3 of the total catch.
- o Introduction of an insurance system for fishing boats, fishing gear, and fishermen's lives and the establishment of welfare services.

- o Improvement of distribution system (commercialization of fish species not presently used, consolidation of domestic and international marketing, quality maintenance of products during seasons with big catches, consolidation and strengthening of infra-structure for product sorting and processing, and improvement of distribution system to inland areas.)
- o Consolidation of distribution system and organization of fishermen's cooperatives for increasing the fishermen's incomes and supply products to consumers at stable prices.
- o Organization of a marine complex by unifying fishing villages which number 2,447.
- o Manpower cultivation by strengthening research and training institutions like the FSI, the CIFNET, the CICEF (The Central Institute of Coastal Engineering for Fisheries), etc.

b) Inland Water Fisheries

- o Increase of cultured prawn bred in seawater by BWFDA (Blackish Water Fishing Development Agency).
- o Establishment of a cooperative administration system of reservoirs and lakes for aquaculture and training of fisheries related people.
- o Study of pond aquaculture, aquaculture of air breathing fish, aquaculture in Bheeles and Mans reclaimed land areas.
- o Support of the Province Government for the National Fishes Seed Project for the promotion of hatching for seed production. (Self-sufficiency in seeds for aquaculture in each Province, like West Bengal)
- o Research for the protection of inland fisheries resources.
- o Manpower development.

2-3 History and Contents of the Request

(1) History of the Request

The FSI initially requested three survey vessels to the Ministry of Agriculture & Rural Development of India, a tuna long-liner type with an overall length of 35 to 40 m, a tuna long-liner type with an overall length of 32 to 35 m, and a skipjack pole-and-liner type with an overall length of 30 to 35 m.

As a result of a study of the proposals for the survey vessels the Ministry of Agriculture made a request in March 1987, to the Government of Japan for the provision of one grant aid tuna long-liner and one skipjack pole-and-liner.

Since there is a problem in assuring a supply of live bait throughout the year for the skipjack pole-and-liner, and since India has not sufficient experience in such fishing, Japan has recommended that the tuna long-liner is more appropriate for India. Therefore, the Government of India withdrew the request for a skipjack pole-and-liner and altered the request to two tuna long liners in June 1987.

When the Team had discussions with the Indian side such matters for confirming the contents of the request, the Indian side noted that the tuna and marlin resources survey is necessary; that India requires two vessels for such survey; and that it needs two vessels of the same type with a length of approximately 40 m.

As a result of the discussions held between the Team and the Government of India, both parties have agreed to two tuna long-liners of the same type with a length of approximately 36 m.

(2) Contents of the Request and Minutes

Contents of the Request and Minutes are as follows:

Table 9 Contents of the Request and Minutes

	Content of Request	Content of Minutes
Length overall	40 m	approx. 36 m
Breadth	6.35 m	approx. 7.35 - 7.40 m
Depth	3.10 m	approx. 3.10 - 3.20 m
GRT	approx. 350 GT	(Not described in Minutes, but approx. 300 GT)
Voyage days	45 days	-
Endurance	7000 nautical miles	approx. 7000 nautical miles
Number of beds	25	approx. 25
Main engine	800BHP * 375RPM	approx. 800PS
Cruising speed	10 - 12 knots	approx. 10 - 11 knots
Tank capacity		
(a) Fish hold	-30°c 90 m^3	approx. 100 - 110 m^3
(b) Fresh water tank	70 m^3	approx. 50 - 60 m^3
Freezing capacity	-65°C 3 mT per day	4mT per day (The temperatures of the freezing room and fish hold, -55°C and -50°C were requested, respectively.)

* BHP is the English unit of shaft power and 550 ft-lb/sec is equivalent to 745.7 W.
PS is a unit of power in the metric system, and 75 kg-m/sec = 735.5 W. Therefore, the English power unit is bigger by 1.4%, as 800HP = 811PS. This difference is understood by the Government of India.

CHAPTER 3 CONTENTS OF THE PROJECT

3-1 Objective

The objective of the Project is to provide two tuna resources survey vessels so as to improve the effectiveness and level of the tuna resources survey to be undertaken mainly for yellowfin tuna, in the sea zones of the Bay of Bengal and the Arabian Sea. The Project is expected to contribute to fisheries development, which is an important target of India's national development.

3-2 Necessity of the Project

(1) There is a necessity for the development and enlargement of tuna fishing.

As previously described, tuna fishing has recently been attracting a good deal of attention as the type of fishing coming second to shrimp fishing according to the Fisheries Development Plan.

The basis for tuna fishing in India was formed by two training and survey vessels granted by Japan in 1980. However, these two vessels are dual-purpose vessels for the early stage of resources early development; therefore, specialized survey vessels are now required for more a functional survey.

(2) The survey area is immense and divided into two zones.

The sea area belonging to India is divided into two zones; one is the Bay of Bengal with its center in the Andaman and Nicobar Islands; the other is the Arabian Sea with its center at Lakshados. Taking into consideration such geographical conditions, two survey vessels are necessary for the development of tuna fishing.

(3) It is necessary to promote employment opportunities.
The promotion of tuna fishing, which has a great potential for future development and expansion, will lead to the creation of new employment opportunities for fishermen. These new employment opportunities will be created not only directly by the processing of fish, including frozen fish, the building of fishing boats, and the development of fishing gear, but also indirectly by the expansion of businesses related to fish exporting.

(4) It is necessary to train fishermen.
The training of crew members (fishermen) is presently conducted with the existing two vessels. It is indispensable to conduct it at a higher level with modernized vessels for the development of tuna fishing in India.

3-3 Outline of the Project

3-3-1 Fisheries Resources Survey Project

The Government of India plans, in the Seventh Five Year Plan (1985 to 1990), to develop fisheries for the purposes of securing foodstuffs, increasing employment opportunities for fishermen, and obtaining foreign currencies through exports. However, the India's fishery activities are mainly concentrated on freshwater fisheries, especially aquaculture. The main marine fisheries are coastal fisheries in waters shallower than 50 m. Tuna are abundant in the Indian EEZ. But the fisheries resources survey on fishing grounds is not sufficiently carried out because of the shortage of medium and large fishing boats and/or vessels. Therefore, there remains many matters unknown such as stock distribution and the seasonal migrating patterns of tunas.

On the other hand, India has been conducting the resources

survey within the 200 mile EEZ with a training vessel, the PRASHIKSHANI, and a survey vessel, the MATSYA SUGUNDHI. They were supplied by grant aid from the Government of Japan in 1980. These two vessels are insufficient for the survey of India's EEZ which covers 2,020,000 km^2.

Therefore, India has made a request for the grant aid of two tuna long-liner survey vessels, and expects to promote the survey on tuna resources.

The survey schedule prepared by the Government of India is given below.

1) Fish species targeted for survey

   Yellowfin tuna, bigeye tuna, skipjack, long tail, marlin, etc.

2) Survey areas

   Arabian Sea : North of lat. 15° N in the Arabian Sea offshore area

   Bay of Bengal : The sea around Andaman and Nicobar Islands and the Northwest Bay of Bengal

(1) Plan for survey navigation

Concerning the use of the Survey Vessels for the Project, the FSI will divide the survey area into two zones and will send one vessel to the Arabian Sea and the other to the Bay of Bengal.

1) Survey in the Arabian Sea

   In the Arabian Sea, the base of the survey will be at the Port of Mormugao in Goa. The survey will be carried on in a phased manner as follows:

   Preliminary Survey, Detailed Survey, Simulated and Commercial Fishing Survey, and Monitoring of Stocks.

Survey Plan for the Arabian Sea

Base	Nature of Survey	Fish species	89	90	91	92	93	94	95	96	97	98
Mormugao	Preliminary Survey	Yellowfin Skipjack Bigeye Long tail Billfishes										
ditto	Detailed Survey	ditto										
ditto	Simulated Commercial Survey	ditto										
ditto	Monitoring of stocks	ditto										

2) Survey in the Bay of Bengal

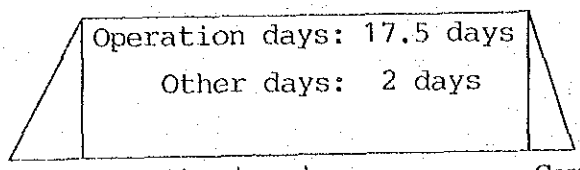
In the Bay of Bengal, the survey area is divided into two zones. One of these survey zones will be located near the Andaman and Nicobar Islands and have a base at Port Blair; the other will be the northwest part of the Bay of Bengal with a base at Visakhapatnam port. This survey will also be conducted in 4 phases.

Survey Plan for the Bay of Bengal

Base	Sea area	Nature of the survey	Fish species	89	90	91	92	93	94	95	96	97	98
Port Blair	Andaman Nicobar Islands	Preliminary Survey	Yellow fin Skipjack Bigeye *Long tail* Billfishes										
ditto	ditto	Detailed Survey	ditto										
ditto	ditto	Simulated Commercial Survey	ditto										
ditto	ditto	Monitoring of Stocks	ditto										
Visakha patnam	Northeast Coast of the Bay of Bengal	Preliminary Survey	ditto										
ditto	ditto	Detailed Survey	ditto										
ditto	ditto	Simulated Commercial Survey	ditto										
ditto	ditto	Monitoring of Stocks	ditto										

(2) Annual operation plan

The Survey Vessels are planned to make 10 voyages in a year. And the breakdown of days per average voyage is as follows:



Going to fishing ground	Staying in fishing ground	Coming back from fishing ground
(1.5 days)	(19.5 days)	(1 day)

As mentioned above, the total number of days spent on the fishing grounds per year is 220, mooring days, including those spent at dockside, and on stand-by are 145, and the rate of operation is 47%.

(3) Annual fishing plan

Number of baskets for operation	200 per day
Number of hooks	5 per basket
Operation days	175 days
Hook rate	10% (all species included)
Average weight	30 kg per piece

200 baskets x 5 hooks x 175 days x 0.10 x 30 kg = 525,000 kg

Note) The annual operation plan and the annual fishing plan may be changed slightly depending on future investigations.

Fishing plan by fish species for each vessel

Species	kg	Comp. %
Yellowfin tuna	329,166	62.7
Bigeye tuna	14,709	2.8
Marlin	39,375	7.5
Shark	140,700	26.8
Others	1,050	0.2
TOTAL	525,000	100

Note) Composition is according to the data of the MATSYA SUGUNDHI.

(4) Fuel consumption plan

1) Annual consumption for each vessel

Days in a year		Consumption/day	Consumption kl
Days of operation	175	2.2	385.0
Other days	20	3.3	66.0
Navigating days	25	3.3	82.5
Mooring days/dock	145	0.5	72.5
TOTAL	365	1.66	606.0

2) Consumption for one voyage for each vessel

Consumption for one voyage		Consumption/day	Consumption kl
Days for operation	17.5	2.2	38.5
Other days	2	3.3	6.6
Navigation days	2.5	3.3	8.3
Mooring days	10	0.5	5.0
TOTAL	32	1.84	58.4

Note) Consumption during mooring days does not include that used while at dockside.

Average fuel consumption for one voyage is approximately 59 kl, therefore, the necessary capacity for the fuel tank for such consumption is approximately 66 m^3.

(5) Fresh water consumption plan

At sea	1 pers. 80 lit. x 25 pers. x 22 days =	44 tons
Mooring	1 pers. 80 lit. x 25 pers. x 10 days =	20 tons
TOTAL		64 tons

If fresh water is supplied every time as quickly as possible after the return of the vessels to port, the required capacity of the fresh water tank is approximately 45 m^3. If fresh water is supplied prior to the departure of the Vessel after consuming the reserved water during mooring, required capacity is approximately 65 m^3.
Generally it is considered that the consumption of fresh water per day and per person is approximately 50 l. This project provides a fresh water tank of capacity increased by about 60%.

3-3-2 Outlines of Survey Vessels

(1) Main Particulars

Length Overall:	approx.	36.0 m
L pp:	approx.	31.0 m
Breadth (molded):	approx.	7.35 to 7.40 m
Depth (molded):	approx.	3.10 to 3.20 m
Main Engine Power:	approx.	800 PS
Cruising Speed:	approx.	10 to 11 knots
Endurance:	approx.	7,000 nautical miles
Fish Hold Capacity:	approx.	100 to 110 m^3
Fresh Water Tank Capacity:	approx.	50 to 60 m^3
Fuel Oil Tank Capacity:	approx.	120 m^3
Freezing Space:	approx.	2 tons x 2 sets

(2) Complement and cabins

Skipper. Captain:	1 room	2 beds
Chief engineer:	1 room	1 bed
Scientist:	1 room	2 beds
Engineer:	1 room	2 beds
Bos'n and second bos'n:	1 room	2 beds
Mate:	1 room	2 beds
Crew:	4 rooms	14 beds
Total	10 rooms	25 beds

(3) Main facilities

Line hauler:	1 set
Line throwing machine and others:	1 set
Gyro Compass:	1 set
Radar:	1 set
Direction Finder:	1 set
SSB Radio Telephone:	1 set
Satellite Navigator:	1 set
Fish Finder:	1 set
Oceanographic Survey Equipment:	1 set

3-3-3 Bases for the Survey Vessels

Three ports are assigned by the Indian counterparts as the base ports for operation of the Survey Vessels. Mormugao on the Arabian Sea, Visakhapatnam and Port Blair on the Bay of Bengal. Outlines of the facilities provided in those three ports are as follows.

(1) Mormugao

1) Location

Mormugao is located at lat. 15°25' N and long. 73°47' E midway between Bombay and Cochin on the West Coast of India. Mormugao is also famous as the loading port of the Goa iron ore.

2) Quay, wharf, jetty

The jetty is 167.6 m long and 8.53 m deep. It is able to accommodate 4 ships at a time. The commercial berth is 11 m deep and 250 m long. It is also used by survey vessels of the FSI.

3) Water supply

It is possible to supply water to vessels at the quay or with a barge. The capacity of water supply is 20 tons/h at the quay and 30 tons/h with a barge.

4) Fuel supply

As there is a fuel tank of the nationalized Indian Oil Corporation, it is possible to conduct fueling by announcing the fact 48 hours before the fueling.

5) Repair

Goa Shipyard Ltd. is a shipyard belonging to the Indian Navy. Its employees amount to about 2,000. It has slip ways which allow the repair of ships up to 40 m long and 250 GT in weight.

6) Others

- o There are two warehouses on two sites with a total capacity of 30,000 tons.
- o This port is provided with cranes and other facilities for loading/unloading.

(2) Visakhapatnam

1) Location

Visakhapatnam is at lat. 17°41' N and long. 83°18' E on the Coromandel Coast. It has a berth specifically for iron ore loading in the outer harbor. The fishery facilities in the fishing harbor are of the largest scale among all Indian fishing ports. It is the best arranged port in India which is used by many trawlers and small fishing boats.

2) Quay, wharf, jetty

The fishing harbor was expanded to accommodate 15 trawlers and 150 small fishing boats in the first stage of the improvement work. After the end of the second period of the improvement work, 56 trawlers and 300 small fishing boats can be accommodated in the fishing harbor.
There are three comb-shaped jetties of 5 to 6 m deep. Therefore, ships with an overall length of 40 to 50 m may be accommodated without problem. Thus this port is adequate to serve as the base port for the Survey Vessels.

3) Water supply

It is possible to supply water to vessels at the quay or with a barge.

4) Fuel supply

Fuel is supplied from two public sector corporations: Indian Oil Corporation and Hindustan Petroleum Corporation.

5) Repair

It is possible to repair both decks and engines.

6) Dry docks, slip way

- Hindustan Shipyard Ltd. is equipped with a dry dock 137.2 m long and 18.4 m wide.

o The fishing harbor is equipped with a slip way for receiving 6 trawlers and 12 small fishing boats at one time.

(3) Port Blair

1) Location

The Andaman and Nicobar Islands, which consist of 533 islands, occupy important positions in the east sea zone of India from a military viewpoint. Most of those islands are not inhabited. A population of 250,000 is living on 20 islands. Port Blair (located at lat. 11°41' N and long. 92°43' E) is the center of this region.

2) Quay, wharf, jetty

The main berths and jetties are:

Haddo Wharf	Depth	35 m
Chatham Wharf	Depth	20 m
Marine Jetty	Depth	5 m
Junglighat Jetty	Depth	6 m
Bamboo Flat Jetty	Depth	5 m

There are also a berth 300 m long and 6 m deep for 10 small boats at one time and a berth specifically for large vessel that can accommodate 5 large vessels at one time.

The Survey Vessel is planned to come alongside the fisheries jetty of Phoenix Bay. The jetty is sufficient in scale and water depth.

3) Fuel supply, water supply

This port is fully equipped with facilities for fuel supply and water supply.

4) Repairs

Tow companies, the Marine Department and the CIWTC have facilities for repair.

5) Dry docks, slip way

This port is equipped with two dry docks of 90 m x 20 m x 4 m. It is also provided with a slip way for 5 vessels of 350 GT.

Drawings of these three ports are given in the Appendices.

3-3-4 Implementation Organization and Management Organizations

The implementation organization of the Project is the FSI (Fishery Survey of India). It is in charge of the planning and the implementation of the seawater fisheries resources survey. And it is responsible for the operation of the Survey Vessels and for their management and control.

Outline of the FSI is as follows.

(1) Works of the FSI

The FSI is under the direct control of the Ministry of Agriculture of India. It has its Headquarters in Bombay and has Zonal Bases in 6 locations.

The FSI was founded in 1946. It began survey work in 1947 with a small staff and using the Port of Bombay as its base by having a mine sweeper reconstructed as a trawler. The FSI constructed a steel stern trawler (56.8 GT. L:17.5 m. BHT:200HP) in India in 1968 and has been engaged in the resources survey of coastal trawl fishing until now.

In 1982, the FSI possessed 28 survey vessels and fishing boats and had 865 staff members engaged in surveys at 12 survey bases. Presently, it conducts the resources survey from 6 Zonal Bases with 10 large and 7 small fishing vessels granted by Norway, the Netherlands, Denmark and Japan. The outlines of these 10 large vessels are as follows:

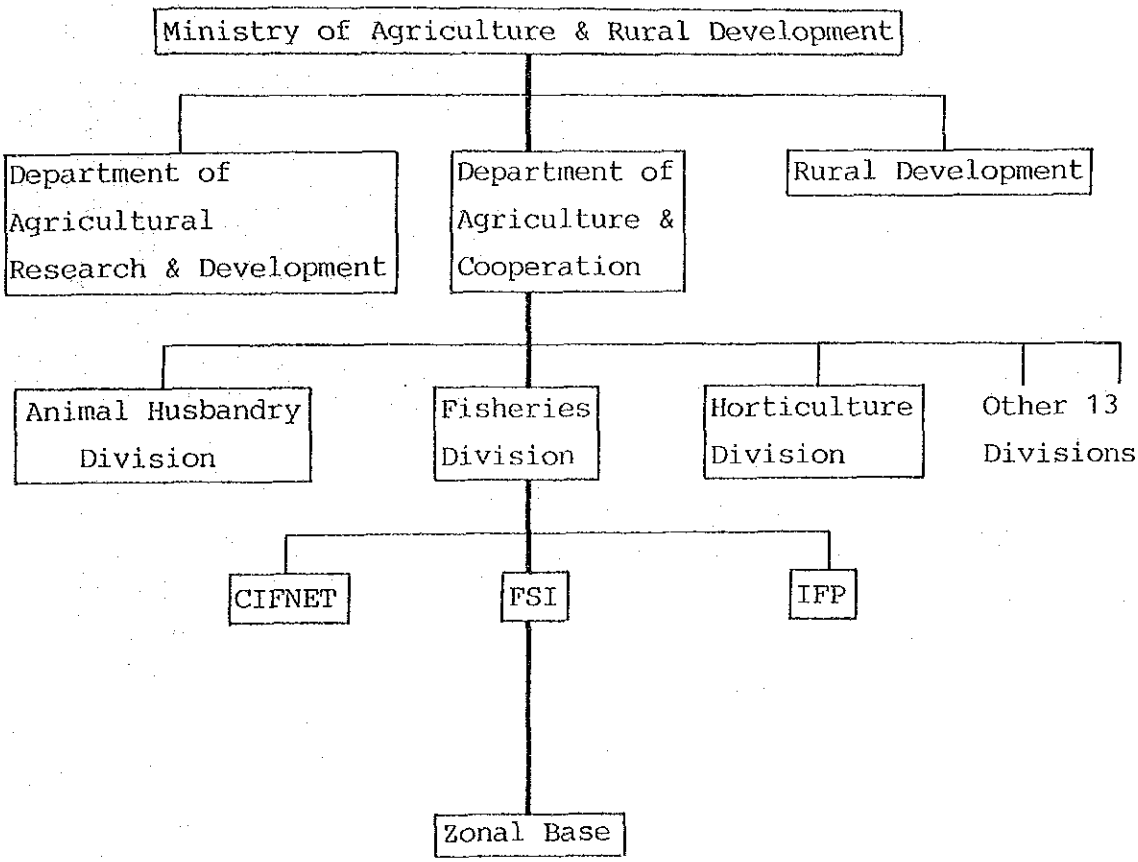
Table 10 Large vessels belonging to the FSI

Name of ship	Fishing method	GT	Length (m)	M.E.H.P. (HP)	Granted by, Year
MATSYA NIREEKSHANI	Survey vessel (Trawler)	329.26	40.5	2,030	Netherlands 1979
MATSYA SHIKARI	Survey vessel (Trawler)	352.00	39.5	1,740	Netherlands 1979
MATSYA SUGUNDHI	Survey vessel (Tuna long-liner cum Squid Jigger)	245.80	31.5	650	Japan 1980
MATSYA VARSHINI	Survey vessel (Par seiner cum Trawler)	268.80	36.5	1,160	Denmark 1980
MATSYA DARSHINI	Survey vessel (Tuna long-liner cum Par seiner)	268.80	36.5	1,160	Denmark 1980
MATSYA HARINI	Survey vessel (Trawler)	257.95	32.5	750	Norway 1980 Constructed in India
MATSYA JEEVAN	Survey vessel (Trawler)	327.18	36.5	825	Norway 1982 Constructed in India
MATSYA SHAKTHI	Survey vessel (Trawler)	327.18	36.5	825	Norway 1982 Constructed in India
MATSYA VISHWA	Survey vessel (Trawler)	327.18	36.5	825	Norway 1982 Constructed in India
MATSYA MOHINI	Survey vessel (Trawler)	345.00	42.5	1,100	1987

All of the above mentioned ten vessels are under 10 years old and in good condition. The skills of crew members are improving. The resources survey of coastal fishing grounds was completed in fiscal 1986. The FSI is now transferring its objective to the resources survey in the Indian EEZ.

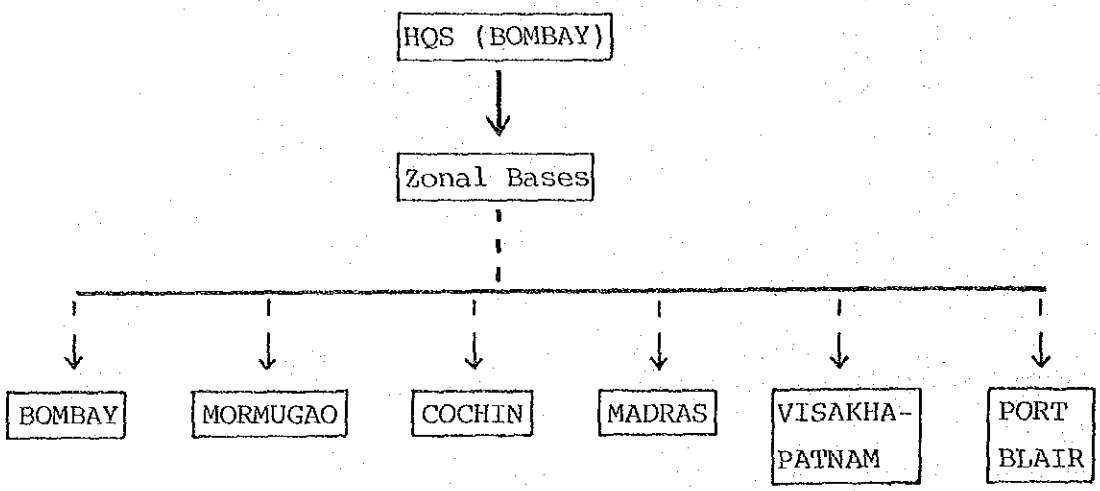
(2) Organization of the FSI

1) Position of the FSI in the Ministry of Agriculture.



2) Zonal Bases of the FSI

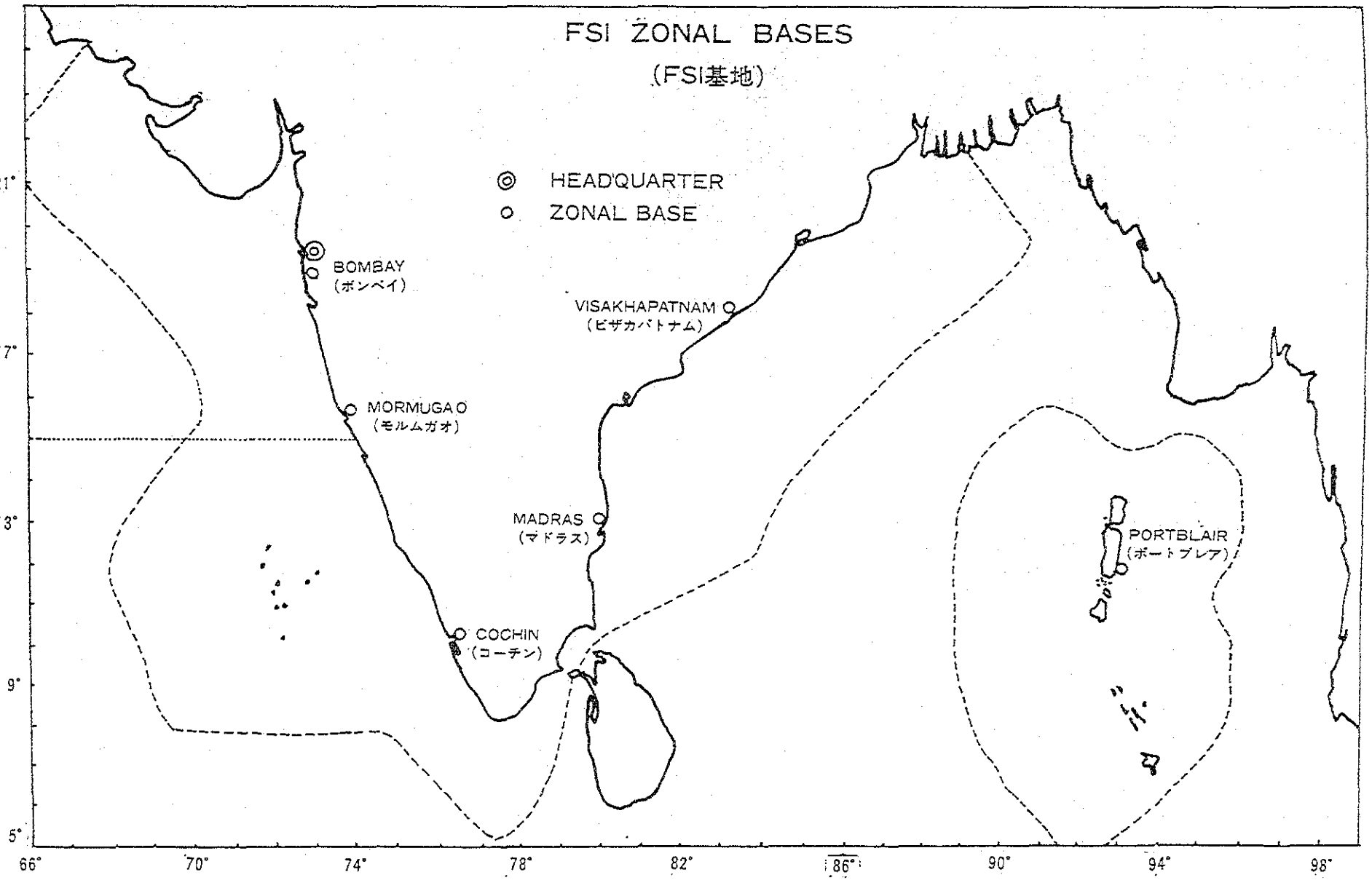
The FSI Headquarter is located at Bombay and has the following 6 Zonal Bases. In each Zonal Base, staff is assigned to carry out the work.



The Zonal Base in COCHIN is in charge of the management and control of the MATSYA SUGUNDHI.

The Deputy Director General of HQS in BOMBAY is the responsible person of the Project, and HQS will be in charge of the operation of the Survey Vessels in the event they are granted.

A map of India is given on the next page for indicating the locations of the 6 Zonal Bases.


FSI ZONAL BASES
(FSI基地)
HEADQUARTER
ZONAL BASE
BOMBAY
(ボンベイ)
MORMUGAO
(モルムガオ)
COCHIN
(コーチン)
MADRAS
(マドラス)
VISAKHAPATNAM
(ビザカパトナム)
PORTBLAIR
(ポートブレア)
21°
17°
13°
9°
5°
66°
70°
74°
78°
82°
86°
90°
94°
98°

3-3-5 Personnel Plan

Presently, the FSI operates a tuna long-liner type survey vessel, the MATSYA SUGUNDHI. Crew members of that vessel show little tendency to leave their job and about a half of them were trained in the CIFNET and by the expert, Mr. Haruta sent by JICA (actually performing on job training for cattlefish fishing). Therefore, they are skilled. These skilled crew members will be assigned to the vessels included in the Project. Working arrangements for officers and crew members on the Project will be as follows:

Table 11 Number of Crew (per vessel and per year)

Position	Project Vessel	MATSYA SUGUNDHI
Captain, Skipper	1	1
Chief Engineer	1	1
Scientist	2	2
Mate	1	1
Engineer	2	2
Boatswain	2	2
Sailor and Oiler	16	16
TOTAL	25	25

Japanese vessels are highly labor saving. 19 to 20 crew members are assigned to a Japanese tuna long-liner of the same size as the Vessels included in the Project. However, in India where labor costs are comparatively low, 23 crew members (excluding scientists) is considered appropriate. This number is also from the point of creating employment opportunities.

CHAPTER 4 BASIC DESIGN

4-1 Principles for the Basic Design

The Team determined the following as the principles for the basic design of the two Survey Vessels, materials and equipment.

(1) Study sufficiently the contents of the request from India. Make a basic design based on the results obtained through the basic design study. In this way the vessels will be suitable for the intended objectives and will demonstrate maximum performance.

(2) Take the principles that the vessels must display optimum qualities of safety and seaworthiness. Take into equally consideration energy saving, lobor saving and maintenance costs saving for ther fisheries resources survey vessles. The vessels will be provided with the most appropriate survey facilities and fishing gear for the Project.

(3) Adopt design principles to reduce the management and implementation costs of the Survey Vessels which will be charged to the implementing organization, the FSI.

(4) In selecting equipment and facilities, stress simplicity and durability as much as possible and ease of procurement of spare parts.

(5) Take care so that the Vessels will display the maximum performance for the minimum cost.

(6) Establish design principles by taking into consideration the laws and regulations, customs, fisheries conditions, conditions of fishing grounds (survey areas), sea weather, weather, etc.

of India.

(7) Take into special consideration provisions to combat rust and contamination to improve the durability of the Vessels, as the Survey Vessels will be operated in tropical regions.

4-2 Conditions for the Basic Design

(1) Vessel type

The MATSYA SUGUNDHI and the PRASHIKSHANI granted by Japan in 1980 are survey vessels of dual-purpose type. They are provided with the equipment for two different fishing methods. However, the Vessels which will be granted this time aim specifically at the tuna resource survey by long-lining. In order to enable an efficient survey, they will be vessels of the same type as a Japanese survey vessel of the tuna long-liner type, and of the same specifications for both vessels.

(2) Classification

In order to assure the quality of the vessels and their maintenance, the vessels will obtain the classification of NK (Nihon Kaijikyokai). As NK has an exclusive surveyer and an office in Bombay and a non-exclusive surveyer in Cochin, Goa, Visakhapatnam, Mangalore, Jamnagar, Madras and Calcutta (in December, 1987), there will be no future problems to maintain the classification.

(3) Applicable regulations and reference regulations

As a result of the discussions with the Indian side, the following should be applied.

a) The Japanese Government's Inspection Rules for Export Vessels

b) The International Convention for the Prevention of Collisions at Sea, 1972

c) The International Regulation for Tonnage Measurement of Ships, 1969

Moreover, the following should be referred to as applicable.

d) IMO Intact Stability, Recommendations for Fishing Vessel. (IMO. A-168 paragraph V)

e) Maritime Regulations of India framed under the Indian Merchant Shipping Act (1958) and The Rules made thereunder

(4) Fishing machinery

a) The Survey Vessel shall be equipped with the fishing machinery necessary and sufficient for the tuna resource survey. In selecting the machinery, the fact that the tuna is a migrant fish living in the Indian EEZ shall be taken into consideration.

b) As for the improvement of survey efficiency and for the introduction of up-to-date techniques, the taking in of main and branch lines and line throwing will be automated.

c) Although it is planned that 200 baskets be used ordinarily, the capacity of the fishing gear hold will be 300 baskets taking a future increase of operation baskets into consideration.

(5) Oceanographic survey equipment

The vessel will be equipped with an oceanographic survey winch for oceanographic surveys. Furthermore, it will have have a laboratory as large as possible so as to allow the sufficient on-board investigation, analysis, dissection, etc. However, a scientific fish-finder will not be installed.

4-3 Basic Design

4-3-1 Outline

Originally, the request for the grant aid of the Indian side was for two tuna long-liner type survey vessels of an overall length of 40 m.

The specifications for the requested vessels are:

Length overall:	40 m
Breadth:	6.35 m
Depth:	3.10 m
Fish hold:	90 m^3
Fresh water tank:	70 m^3
Endurance:	7,000 miles

and others.

After the discussions held in India, the following principal particulars were determined for the Survey Vessels:

Length Overall	approx.	36.0 m
L pp	approx.	31.0 m
Breadth (molded)	approx.	7.35 to 7.40 m
Depth (molded)	approx.	3.10 to 3.20 m
Main Engine Power	approx.	800 PS
Cruising Speed	approx.	10 to 11 knots
Endurance	approx.	7,000 nautical miles
Fish Hold Capacity	approx.	100 to 110 m^3
Fresh Water Tank Capacity	approx.	50 to 60 m^3
Fuel Oil Tank Capacity	approx.	120 m^3
Freezing Space	approx.	2 ton x 2 sets

The primarily requested type of vessel was relatively long, but the breadth was small and the depth was also comparatively large. Therefore, there was a stability problem in designing a Japanese type tuna fishing boat. Because the Vessels of the Project will serve also as survey vessels, the following are required:

- o Laboratory
- o Complement of 25 members including two scientists
- o Necessary to reserve a place for a survey winch
- o Quick freezing room with a capacity for a catch of 4 tons, at the same time

In this case, the primarily requested breadth cannot provide sufficient stability and the necessary space.

The Team then determined to increase the breadth to assure the stability and shorten the overall length so that the total size of the vessel will remain nearly equal.

Cubic number (CN) is obtained by multiplying the length, the breadth, and the depth and is an index of vessel size used in ship design. Using this (CN), the requested vessel type is CN = 787. The planned vessel type of which the size is given in the Minutes as is CN = 815 to 852, and is bigger by 3 to 8 % than the requested vessel type. However, in this case the length of the vessel type is not Lpp which is generally used in ship building, but Loa. The reason why the Loa length is used is that the Lpp of the requested vessel type is unknown.

Also for the fish hold, the planned vessel's capacity is provided more than 100 m^3, compared with the originally requested area of 90 m^3. The size of the Survey Vessel type was determined to satisfy the various the demands of the FSI to some extent and to maintain good balance.

The freezing temperature the requested of the FSI was - 65°C for quick freezing and - 30°C for the fish hold and a freezing capacity of 6 tons a day. However, the capacity of 6 tons a day is disproportionately large considering the size of the

Survey Vessel type. Such large equipment might cause safety and/or work procedure problems and even fail during practical use. It has been decided to provide a freezing machine proportional with the size of the vessels.

During the season of high catches the vessel is estimated that there would be catches over 6 tons a day. However, it is impossible to have freezers in the vessel to hold such a large quantity on the vessels for the above mentioned reason. If a freezing room is installed under the decks, the fish hold will become smaller in that proportion and the freezing work would become inefficient. Therefore, it was determined to have a quick freezer of 4 tons on both sides on the deck of the vessel.

Regarding the scientific fishfinder, the FSI had initially considered that it could be used for the tuna resource survey. But the Team decided not to provide it, because there is actually no Scientific Echo Sounder which is effective for such a purpose and there is a little possibility of utilization of an Echo Sounder on vessels emphasizing practical fishing operations.

Regarding the fish hold capacity, the possibility of having a hold with a capacity of 150 tons was raised during the discussion. In this case, assuming a storage factor of 0.6, it would be $150^{t}/0.6^{t}/m^{3} = 250\ m^{3}$. This is too far from the 90 m^{3} which was the figure for the vessel originally requested by India.

While studying the results of the MATSYA SUGUNDHI during the four years from 1983 to 1986, the average duration of one voyage was established at 19.3 days. For the present design the period in which the vessel is offshore is assumed to be about 3 weeks (21 days).

Therefore, the Team assumed a voyage of 22 days with 17.5 operation days. The estimated average catch is 3 tons/day (200 baskets x 5 hooks x 10% x 30 kg/piece). Therefore, the

estimated catch per voyage is 52.5 tons (3 tons/day x 17.5 days). In order to store this quantity, a fish hold of approximately 105 m^3 is required by assuming the storage factor to be 0.5 (2 m^3/1 MTON).

The main requirements for a survey vessel are hereby described. In order to fulfill such requirements and to sufficiently function, the vessel type and size should be at least

Loa : approximately 36 m,
B : approximately 7.40 m, and
D : approximately 3.10 m

as described in the Appendix.

This type of vessel would be approximately 300 tons according to the international gross tonnage measurement and approximately 185 GT according to the Japanese gross tonnage measurement of the Fishing Boat Standard.

4-3-2 Facilities of the Vessels

(1) Fuel oil tank

If the number of days for a voyage are designed with the assumption that it lasts until the fish hold becomes full, the number varies too much because of the variation of catches each day even from 10 to 50 days. Even though the quantity of necessary fuel for a voyage depends on the load on the main engine and the auxiliary engine, it will vary from 30 to 150 m^3 given only the above variation in voyage days.

The working plan estimated a required fuel quantity for a voyage as 58.4 kl. In order to contain approximately 59 kl or fuel, a tank of 66 m^3 will be sufficient. However, a fuel tank of approximately 120 m^3 is designed in order to cope with an endurance of 7,000 nautical miles which was required by the Indian side.

(2) Freezing equipment and precooling room

The MATSYA SUGUNDHI is presently operating with 150 baskets per day. Compared to the expected size of its catches, the vessel is provided with a freezing capacity of only 3 tons/day. Therefore, in the event of good catches, it is obliged to delay work for 1 or 2 days on freezing. As the Survey Vessel of the Project will be provided with one set of 200 to 240 baskets for the experimental survey of commercial fisheries, the catch is expected to be greater than that of the MATSYA SUGUNDHI. Therefore, if only seasons of good catches are considered, it will be necessary to have a capacity of 6 tons/day. However, in other seasons, as described elsewhere, such large catches will not be realized. Consequently the vessels are designed to have a freezing space capacity of 2 tons x 2 sets (4 tons) as a rational size.

1) The capacity of 6 tons/day is disproportionately large for the size of the vessels and the capacity of their fish holds.

2) It is not economical to determine the freezing capacity to cope with temporary maximum catches from the stand point of the initial cost and the maintenance costs.

3) It is extremely difficult to provide a freezing room with a capacity of 6 tons/day on the vessels in consideration of space and stability. Even if it was possible, the arrangement of other facilities would be affected would cause many disadvantages.

Moreover, the Survey Vessel will be provided with a precooling room of - 15°C for holding the catch before freezing to eliminate quality damage in case of a large catches.

(3) Fresh water tank capacity

The consumption of fresh water is generally 50 l/day/pers. However, as the Indian fishermen use much more fresh water than in ordinary cases, consumption was calculated at 80 l/day/pers. According to the working plan, the capacity was determined to be 44 tons. (80 l/day/pers. x 25 pers. x 22 days = 44 tons) And with a certain reserve provided, it was determined to be 50 to 60 m^3.

When the endurance is extended to 7,000 nautical miles, the total duration of a voyage would be approximately 29 days. In this case, the fresh water consumption per person should be decreased to approximately 65 l per day.

(4) Loading/unloading equipment

The Survey Vessel will be equipped with hoists, cargo blocks and eye plates at the necessary points for moving fish from the fish hold and landing them to shore facilities.

(5) Living facilities

. Air conditioners will be installed in the captain's room, scientists' room, chief engineer's room, steering room, laboratory and mess room.
. Sizes of the beds will be a little bigger and the clearance height of the living area will be a little higher than that of the Japanese tuna long-liner. Special care will be taken on the officers' room.
. Pilot chair will be provided in wheel house.
. Rotary antenna for a TV will be installed.
. Bathrooms will be provided only with showers without a bath tub according to Indian customs.
. Water closet will be:
  European style for officers
  Indian style or Japanese style for crew members.
. As for galley equipment, the cooker will be an electric type

and the other facilities will be the same level as those of the Japanese vessels.

. Chief engineer's room will be provided with a space or shelves for retaining machinery manuals, drawings and valuable spare parts.

. Room arrangement for officers and crew members is as follows:

1)	Captain: Skipper	1 room	2 beds (a bed is folding type)
2)	Chief engineer	1 room	1 bed
3)	Scientist	1 room	2 beds
4)	Mate	1 room	2 beds (a bed is folding type)
5)	Engineer	1 room	2 beds
6)	Bos'n and second bos'n	1 room	2 beds
7)	Crew	2 rooms	6 beds
8)	Crew	2 rooms	8 beds
	TOTAL	10 rooms	25 beds

(6) Store

Lockable stores will be installed in necessary places in the living area. A small store for parts will also be installed in the engine room.

(7) Foods storage and bait hold

The Survey Vessel will be provided with a small bait hold (about 5 m^3) for taking out only enough bait for the day in order to maintain the freshness of the bait. This small bait hold will be installed around the steering room together with the refrigerator for food.

In addition, the bait loaded on departure will be put in the fish hold and the portion to be used each day will be shifted to this small bait hold.

Further, the Vessels will be provided with the following

provision storage for dried foods, meat, vegetable, etc.

1) Bait hold : - 15°C to - 20°C about 5 m^3
2) Dried provision store: + 0°C
3) Meat store : - 15°C
4) Vegetable store : + 0°C

(8) Painting and deck covering

In order to withstand the severe conditions of India, such as high temperatures, change in the weather from the rainy season to the dry season and vice versa, special care will be taken while painting, especially concerning the foundation.
Also special attention will be paid in choosing the material and method of fitting of the deck covering for the protection of the steel plates against rust and erosion.

(9) Life saving equipment

According to the Indian Merchant Ship Rule in effect, the vessel is required to have a lifeboat. However, it is difficult to provide a lifeboat on board due to the space restrictions as a result of the arrangement of the fishing gear based on the Japanese type tuna long-liner.
Therefore, the vessels will hold only six-man rescue boat which are only required for a vessel over 24 meters in length under Indian rules. Inflatable life rafts to accommodate 100% of the crew members will be fitted on both sides of the vessel.

(10) Applicable tonnage and rules

The tonnage certificate for the vessel will be issued by an authority in accordance with the International Tonnage Measurement Rule. Rules and regulations to be applied as described in 4-2-3 of this report. The regulations of the International Convention of Safety on Fishing Vessel will only be referred to as applicable but regulation 28 on the stability

for the fishing vessels will be respected in the design of the vessels.

4-3-3 Mechanical Equipment

(1) Main engine

Considering the data of vessels of this class, the maximum continuous output of the main engine was determined to be 800 PS. This capacity allows a service speed of 10 to 11 knots in calm seas. However, considering the length of the Survey Vessels, it is economical to navigate at a speed around 9 knots.
The starting system of the main engine will be a compressed air type. An auxiliary air compressor with a hand start internal-combustion engine will be provided in case of trouble with the main air compressor.

(2) Lubricating oil

The lubricating oils presently used by the MATSYA SUGUNDHI of the FSI are as follows and the Survey Vessel is designed to use the following oils or their equivalent.

Main Engine, Auxiliary Engine :	Servo, Super 30° to 40°
Freezing Machine:	Servo, Fridge F66

(3) Propeller

The clutch of the previous MATSYA SUGUNDHI showed a great deal of damage. Therefore, the Indian side requested of a controllable pitch propeller (CPP) for the new Survey Vessels to avoid similar difficulties. However, because the CPP is rarely used in actual Japanese tuna fishing boats and because of the risk of winding lines around the propeller, it was decided to design the Survey Vessel with a fixed pitch propeller (FPP).
Although the causes of the clutch troubles that occurred in the previously granted vessel are not known, the Team will carry

out the design of the Survey Vessels by using clutches of different experienced manufacturer. It should be noted that other ordinary tuna long liner are operating without any problems with multi-disk wet type clutches. Furthermore, it could be recommended that a propeller of a large diameter be used from the viewpoint of fuel conservation, but in order to respond to the demand for less hull vibration, a smaller diameter propeller should be used to reduce vibration by avoiding a too large diameter.
Moreover, the semi-skewed propeller will be adopted to reduce the vibration generating force, which is a cause of stern vibration.

(4) Auxiliary engine, electric generator
The Survey Vessels will be provided with auxiliary engines which drive a electric generator of a sufficient capacity for the main electric power consumption in the vessels such as the freezing machines and others. These generators will have enough capacity to cope with the current load during compressor at starting. There will be two engines and generators of the same type to facilitate the interchangeability of parts and load distribution.
Both electric generators will be driven by two auxiliary engines. There will be no additional generator of main engine driven considering the fact that the main engine drives the fixed pitch propeller and the repair facility in India.

(5) Freezing equipment
The basic design will be completed with the particulars:
Freezing temperature: - 55°C
Cold storage temperature in fish hold: - 50°C
Refrigerant will be R-22.
The freezing room will have space for 2 tons x 2 sets (4 tons), as previously mentioned.

However, that does not mean freezing capacity. Freezing capacity is determined by the displacement, revolution, and suction gas density (according to the relative temperature of evaporation) of the compressor, seawater temperature, air temperature, heat insulation, surface area and material of cooling coil, fan capacity, pulp temperature of fish, time for one freezing cycle, etc.
By taking into general consideration and all the above conditions, the Survey Vessels will be provided with two identical compressors of a two-stage compression for both the freezing room and the fish hold.

(6) Electric power shore connection
The power supply of the berth of Cochin where the MATSYA SUGUNDHI is based is presently 440 V and 50 Hz which is same as all other ports in India. Therefore, the voltage and frequency of the onshore electric power supply box will be 445 V and 50 Hz, and the voltage will be dropped down to 225 V used inside the vessel by a transformer. The power supply will be sufficient for the use of the vessel air conditioning, cold store, lighting, etc.

(7) Pumps
The Team will select the pumps from manufacturers with experience and those using high quality materials for wearable parts, such as the shaft, sleeve, impeller, etc. The bilge pump will be separated from the general service pump so that each pump can be used separately.

(8) Ventilator
The capacity of the mechanical ventilator to be installed in the engine room and living area should be sufficient.

(9) Measures for fresh water conservation

A Spring Loaded Tap will be set on the fresh water cock in order to use it economically.

(10) Welder

As a welder and its accessories are basic tools to be provided, one set of a 20KVA electric welder or the equivalent will be provided.

4-3-4 Fishing Method and Related Fishing Gear

The Survey Vessel will be designed so as to allow it to operate in slightly stormy weather. As tuna long liners usually receive the wind and the waves on the port bow at 30° during line hauling, the forecastle deck will be extended to make an additional awning deck to prevent shipping water on board around the line hauler so as to increase the vessels' seaworthiness.

As it usually receives the wind and waves on its starboard quarter at 30° during line throwing, the poop deck will be raised to prevent waves intruding in and around the line throwing machine. The capacity of the line hauler will be greater than that of the MATSYA SUGUNDHI so as to increase the number of baskets within a certain period of labor time. The line hauler will be of an electric and hydraulic drive type to facilitate speed control and to assure sufficient speed and power.

The capacity of the line haulers of the proposed Survey Vessels and the MATSYA SUGUNDHI are compared in the table below.

	H.P.	Motor output	Hauling speed (m/min)	Basket/hour
MATSYA SUGUNDHI	10 HP	7.5 KW	150	30
The Survey Vessel	25 HP	* 19 KW	approx. 264	45

(* also for windlass)

It took 6 hours 40 minutes to haul 200 baskets (60,000 m) in the case of the MATSYA SUGUNDHI, and it will take only 4 hours and 30 minutes to haul the same in the case of the Survey Vessels.

As for the line storing method, it will be changed to the box method (one-line system) from the basket method of the MATSYA SUGUNDHI. The reason why the box method is to be adopted is: it allows omission of the following four processes when compared with the conventional basket method.

On line hauling :(1) Coiling branch lines and float lines by hand

(2) Coiling float lines by hand and in collecting polyethylene floats

(3) Storing lines by collecting them in a basket

On line throwing:(4) Releasing collected lines and connecting main lines with one another

Moreover, the vessel will be equipped with a branch line reel for further labor saving.

Scale of fishing gear and spare gear

According to the operation results of the MATSYA SUGUNDHI by fiscal year;

Av. operation days	Av. No. of baskets used	Total No. of baskets used	No. of main lines used
121	131	117,960	470

For the Survey Vessel, the number of baskets to be used will be increased by 20 in the second fiscal year and by an other 20 in the third fiscal year.

	Operation days	Av. No. of baskets used	Total No. of baskets used	No. of main lines used
First year	175	200	35,000	
Second "	175	220	38,500	
Third "	175	240	42,000	
Total	525	(220)	115,500	460

The number of main lines used on the Survey Vessels for the three years will be:

115,500 x 470/117,960 = 460 baskets, but including
20 baskets of spare main lines:

460 + 20 = 480 baskets

480 x 2 vessels = 960 baskets (in total for 2 vessels)

This will be in accordance with the number required (480 baskets) by the FSI.

As for the fishing gear other than main lines, the proper quantity will be calculated based on the number of operation days and on the number of baskets used. The specifications, standard and quality of gear will be at the same level or equivalent to those used in Japanese tuna long-liners.

The Survey Vessels will be equipped with the following gear and equipment:

a)	Line hauler	1 set
b)	Line storage machine and line storage box(es)	1 set
c)	Line throwing machine	1 set
d)	Branch line reel	1 set
e)	Belt conveyor	1 set
f)	Guide roller, guide fittings, and guide pipes	1 set
g)	Hoist	1 set
h)	Others	

4-3-5 Oceanographic Survey Equipment

(1) Oceanographic survey equipment

The following equipment will be provided.

a)	Oceanographic survey winch	1 set
b)	Nansen bottle (including Reversing Thermometer)	5 sets
c)	Anemoscope/anemometer	1 set
d)	Dissection set	1 set
e)	Rack for Nansen bottles	1 set
f)	Flow meter	3 sets
g)	Plankton net	3 sets
h)	Meter for Measuring cable angle	1 set
i)	Water color set	1 set
j)	Visibility Disc	1 set
k)	Salinity, Temperature and Depth Recorder	1 set
l)	Salinometer	1 set
m)	Doppler Sonar Current Indicator	1 set
n)	Platform scale	1 set

(2) Laboratory

If two laboratories, one for oceanographic survey and the other for biology, could be installed, it would be very useful. However, this is impossible due to space restrictions. So only one laboratory will be installed. The laboratory will be provided with tables, chairs, electric power outlets, fresh

water, seawater, etc.

4-3-6 Electronic Equipment for Navigation, Communications and Fishing

The above mentioned up-to-date equipment will be provided. Moreover, the assurance of spare parts for a period will be an important factor in selecting the equipment.
The following equipment will be provided.

a) Gyro Compass with Auto Pilot System	1 set
b) Radar	1 set
c) Direction Finder	1 set
d) SSB Radiotelephone	1 set
e) Satellite Navigator (NNSS)	1 set
f) Public Address System	1 set
g) International VHF Radiotelephone	1 set
h) Search Light	1 set
i) Fish Finder	1 set
j) Weather Facsimile Receiver	1 set
k) Magnetic Compass	1 set
l) SOS Buoy	1 set
m) Thermometer for Fish hold	1 set
n) Thermometer for Sea Water	1 set
o) Others	

* Scientific Fish Finder will not be installed.

4-3-7 Spare Fishing Gear and Spare Parts

The Survey Vessels will be provided with spare fishing gear for three years. Table A shows the parts for three years of operation. The vessels will also be provided with spare parts for operations for three years.

TABLE - A

Fishing gear (including spare parts) 1

	Good	Standard	Quantity
1	Tuna Long-Line Complete Set		
	Dyed Black Resin		
	One Set Description		960 sets
	(1) Main Line	Tetron 6.7 ø x 50m x 6PCS	
	(2) Branch Line	Tetron 4.5 ø x 20m x 5PCS	
	(3) Box Swivel	Stainless steel No.9 x 5PCS	
	(4) Sekiyama	No.30 x 4 x 3, 12m x 5PCS	
	(5) Armour for above	10PCS	
	(6) Toyo Lock for above	No. 4 10PCS	
	(7) Wire Leader	No.30 x 4 x 3, 2.5m x 5PCS	
	(8) Armour Spring for above	5PCS	
	(9) Kanseki Spring for above	5PCS	
	(10) Toyo Lock for above	No. 2 10PCS	
	(11) Tuna Hook	3.6 Sun with ring x 5PCS	
	(12) Float Line	24m x 1PCS	
	(13) Snap	L type x 5PCS	
	(14) Polyethylene Float	300 o with net & snap x 1 set	
2	Main Line	Tetron 6.7 ø 500m/coil	
3	Branch Line	Tetron 4.5 ø 500m/coil	40 coils
*4	Sekiyama	No.28 x 4 x 3 400m/coil	50 coils
*	ditto	No.30 x 4 x 3 400m/coil	50 coils
5	Wire Leader	No.30 x 4 x 3 400m/coil	450 coils

TABLE - A

Fishing gear (including spare parts) 2

	Good	Standard	Quantity
6	Box Swivel	Stainless steel No.9	1,500 P
7	Tuna Hook	3.6 sun with ring	6,000 P
8	Hand Pressor with Tip		20 sets
9	Toyo Lock for Wire	No.2	8,600 P
10	Snap	L type	1,000 P
11	Polyethylene Float	300 ø with net	500 P
12	Light Buoy		18 P
13	Battery for above	Dry type	45 P
14	Bulb, Packing, Cord for above		45 sets
15	Kanseki Spring for Wire		27,000 P
16	Armour Spring for Wire		27,000 P
17	Toyo lock for Sekiyama	No.4	67,000 P
18	Armour Spring for Sekiyama		67,000 P
19	Cotton Twine for Sekiyama	No.5	10 kg
20	Luminous Plate		900 P
21	Rope for Light Buoy		16 coils
22	Wire Cutter (L)		6 P
23	Hayasuke Hook		10 P
24	Harpoon Head		16 P
25	Morisaki Kanagu		6 P

TABLE - A

Fishing gear (including spare parts) 3

	Good	Standard	Quantity
26	Morisaki FRP 4m Pole		4 P
27	Hand Hook (Long)		60 P
28	Pincers		60 P
29	Wire Cutter		60 P
30	Scissors for cutting line		60 P
31	Spike		10 P
32	Spike for fish killing		8 P
33	Wooden hammer		4 P
34	Kakeya		16 P
35	Handle for above		16 P
36	Subaru (S)		2 P
37	Subaru (L)		2 P
38	Shark ring		8 P
39	Shark hook with swivel		8 P
40	File		16 P
41	Plastic basket	# 250	6 P
42	Rubber band for Line Hauler		500 P
43	Rubber roller for Line Hauler		50 P
44	Rubber band for Line Thrower		500 P
45	Rubber roller for Line Thrower		50 P

TABLE - A

Fishing gear (including spare parts) 4

	Good	Standard	Quantity
46	Rubber ring for Line Thrower		500 P
47	Vinyl basket	595 x 435 x 305	80 P
48	Bamboo pole		2 P
49	Bamboo pole		2 P
50	Bamboo pole		20 P
51	Hook for hauling		40 P
52	Sekiyama Stretcher	7 roller	8 P
53	Radio buoy	3 W	4 sets
54	Battery for above		10 P
55	Bulb for above		10 P
56	Packing for above		10 P

*(Note) On the explanation of the Draft Final Report, the Indian side requested an increase in the quantity of spare parts of both Sekiyama #28 and #30 from 50 coils to 100 coils. 100 coils are equivalent to 3,200 lines. On the Draft Final Report, 5 lines of Sekiyama are provided for each of the 960 main line, in total 4,800 lines. Therefore, the Team decided not to increase the quantity of Sekiyama. So the quantity of Sekiyama remains at 50 coils as initially described in the Draft Final Report.

TABLE - A

Fishing disposition (including spare parts) 1

	Good	Standard	Quantity
1	Bar type thermometer		20 P
2	Fish body thermometer		20 P
3	Electric drill		6 P
4	Gimlet for above		20 P
5	Nose saw		40 P
6	One sided blade (L)		10 P
7	One sided blade (N)		80 P
8	Tuna tool		20 P
9	Line for above		60 P
10	Deck stone (rough)		60 P
11	Deck stone (blue)		20 P
12	Hatchet (S)		20 P
13	Handle for above		20 P
14	Scissors for fish fins		12 P
15	Fish hook sus	short	60 P
16	Fish cleaning brush		20 P
17	Wire fish brush		20 P
18	Winter outfit (Coat)		16 P
19	Winter outfit (Trousers)		16 P
20	Winter underwear (Turtle neck)		16 P

TABLE - A

Fishing disposition (including spare parts) 2

	Good	Standard	Quantity
21	Winter underwear (Trousers)		16 P
22	Winter Cap		16 P
23	Winter rubber boots		8 pairs
24	Winter boots - 60°C		16 pairs
25	Winter socks		16 pairs
26	Felt for boots		16 pairs
27	Winter glove		24 pairs
28	Winter canvas (Coat)		8 P
29	Winter canvas (Trousers)		8 P
30	Platform scale	150 kg	2 P
31	Rubber gloves		20 pairs
32	Plastic bucket		10 P
33	Dipper		20 P
34	Rubber apron		12 P
35	Freezing pan		20 P
36	Bamboo broom		60 P
37	Vinyl broom		60 P
38	Iron bar		6 P
39	Square shovel		20 P

4-4 Determination of Outline Size

(1) The size of the vessels is determined by the following factors:

a) Requested size of fish hold

b) Volume of tanks

c) Volume of engine room which is determined by the capacity, model and number of the main engine and auxiliary engines

d) Living facilities and others

The procedure for determining the size is as follows. First of all, the necessary space for the fish hold is calculated.

The ratio of the inner volume of steel plates which construct the fish hold and the actual fish hold space for holding frozen fish varies depending on the size of the fishing vessel and the steel structure, such as stringers, strong frames, depth of frames and beams, shape of brackets, etc., especially on the thickness of heat insulating materials. The inner volume made by the heat insulating materials is generally called the grain volume. While considering the grain volume, the hold volume includes a space made between the cooling coils and the inside sparring plates which line the inside surface of the cooling coils.

As the above space cannot be used when frozen fish or cartons are stored in the fish hold, the inside volume of the inside sparring plates is important. It is called Bale volume.

The volume of the fish hold given to us for consideration is this Bale volume. Therefore, in order to calculate the size of a vessel from the volume of the fish hold, it is necessary to study the ratio of the above mentioned real volume of the fish hold and the inside volume made by the steel plates.

The ratio (inside volume made by cooling coil inside lining plates/inside volume made by steel plates) is referred to as the insulation ratio. This ratio is larger as the vessel size is larger and the fish hold size is larger. It is understandable when considering that even if the fish hold size

becomes double, the thickness loss due to heat insulation and cooling piping does not become double.
This ratio varies from approximately 0.50 on small shrimp trawlers to approximately 0.85 on large reefer cargo vessels. In this case, assuming this ratio as 0.62, and the inside volume made by the steel plates so as to reserve a fish hold volume of 105 m^3 is calculated from the following formula:

$$105/0.62 = 169 \ m^3$$

This value is represented by V_S.

(2) Adding to the above, the vessels shall reserve for a fuel oil tank (FOT) of 120 m^3, a fresh water tank (FWT) of 60 m^3 and a forepeak tank (FPT) of 10 m^3 and others. As for FOT and FWT, the inside volume made by the steel plates is calculated directly as the tank volume, when adding all of the above volumes:

$$V_S + FOT + FWT + FPT \text{ and others}$$
$$= 169 + 120 + 60 + 10$$
$$= 359 \ m^3$$

This value is represented by V_{HT}.
Further, as the engine room is located under the upper deck, it is necessary to also add this volume. This volume shall be 0.31 of the whole volume under the upper deck in vessels of this size.
Therefore, assuming that the inside volume of the engine room is 31% of the volume under the upper deck (V_U),

$$V_D = 0.31 \ V_D + V_{HT}$$
$$\therefore 0.69 \ V_D = V_{HT} = 359$$
$$\therefore V_D = 520$$

(3) The length between perpendiculars (L_{pp}), the breadth (B) and the depth (D) of the vessel shall be obtained from the above. First of all, the ratio of breadth and depth that determines the stability of the vessel shall be assumed. As the length of the vessel (L_{pp}) is presumed to be 30 to 35 m, this ratio is assumed to be 2.35, equal to the value of the Japanese tuna long-liner of 36 m L_{pp} class.

As there are few data of vessels of smaller L_{pp} than 36 m, it is assumed provisionally to be 2.35; if the length is shorter or the depth smaller, that value will be bigger. Main specifications of Japanese tuna long-liners are given in the attached table.

The length of the vessel is generally a little under 5 times (about 4.8 times) the breadth in an ordinary tuna long-liner of 199 GT. However, as the said vessel is smaller than that, it is assumed that the length will be 4.2 times the breadth.

Where $L = L_{pp}$,

$\therefore L/B = 4.2$ $\quad B/D = 2.35$

$L = 4.2\ B$ $\quad B = 2.35\ D$ $\quad \therefore L = 4.2 \times 2.35\ D$

CN (Cubic number) $= L \times B \times D$

$= 4.2 \times 2.35\ D \times 2.35\ D \times D = 23.1945\ D^3$

(4) On the other hand, the whole volume under the deck V_D shall be:

$V_D = L \times B \times D \times Cb \times \alpha$

In this case, Cb is called the block coefficient, and it can be obtained by dividing the displacement volume under the waterline by L x B x d.

Here, d is called the mold draft which represents the vertical distance between the top of the keel to the waterline. When the volume under the deck is calculated from L x B x D, the depth of vessel D will be used instead of the draft.

In other words,

$$\frac{V}{L \times B \times D} = Cb$$

It is estimated that Cb is about 0.655 at the loaded draft, Cb is presumed to be about 0.682 at the depth up to the upper deck.

Cb = 0.682 at D = 3.15

α represents the compensation for the sheer and the camber which cause the increase of volume under deck over the waterline which passes through the deck side line at the midship, and it is a coefficient determined after the shear and the camber are determined.

However, here it is assumed to be 1.06 from some data of existing vessels.

Therefore,

$V_D = L \times B \times D \times 0.682 \times 1.06$

Substitute

$V_D = 520$ $\quad L \times B \times D = 23.1945\ D^3$ for the above

$520 = 23.1945\ D^3 \times 0.682 \times 1.06$

From the above,

$D^3 = 31.012$ $\quad D = 3.142 \fallingdotseq 3.14$

$\therefore B = 7.383 \fallingdotseq 7.38$ $\quad L = 31.01 \fallingdotseq 31.0$

For obtaining the overall length of the Vessel Loa, as the ratio Loa/Lpp is generally about 1.16 in the Japanese tuna long liners.

Loa = 31 x 1.16 = 35.96 $\fallingdotseq$ 36.00 m

(5) Therefore, the above calculation was made only for information in order to obtain the approximate size of the vessels.
As given in the table, in the case of the Japanese tuna long-liner, in the vessel of L_{pp}, approximately 31 m L/B is around 4.5 and it is more fine that the above mentioned vessels.
Further, B/D is mostly 2.40 to 2.60 at around 31 m long.

Therefore, assuming that:

$L/B = 4.5$ $\quad B/D = 2.50$

$L = 4.5\ B \quad B = 2.5\ D \quad \therefore L = 11.25\ D$

$\therefore L \times B \times D = 28.125\ D^3$

When assuming that Cb in full load departure condition is 0.655 same as before, then Cb on the upper deck level is 0.682

$$V_D = L \times B \times D \times 0.682 \times 1.06$$
$$= 28.125\ D^3 \times 0.682 \times 1.06$$

Where: $V_D = 520$

$D^3 = 25.575 \quad D = 2.946 \doteqdot 2.95$ m

$\therefore B = 7.366 \doteqdot 7.40$ m $\quad L = 33.15 \doteqdot 33.0$ m

These days there is a tendency that a relatively fine hull form is adopted with a large diameter propeller for energy saving. Therefore, making Cb more, the following two calculations have been examined:

Where: $L/B = 4.2 \quad B/D = 2.35$ and

Where: $L/B = 4.5 \quad B/D = 2.50$

When assuming Cb at 0.9 D as 0.645 and 0.635, Cb on the upper deck level shall be estimated as follows:

Cb at 0.9 D	Cb at D
0.645	0.672
0.635	0.661

When substituting the above values for the said formula to calculate L, B and D, the values in the table below are obtained.

α is always 1.06.

No.	1	2	3	4	5	6
L/B	4.2	4.5	4.2	4.5	4.2	4.5
B/D	2.35	2.5	2.35	2.5	2.35	2.5
Cb (0.9D)	0.655	0.655	0.645	0.645	0.635	0.635
Cb (D)	0.682	0.682	0.672	0.672	0.661	0.661
Cal. L	31.01	33.15	31.16	33.31	31.33	33.49
Cal. B	7.383	7.366	7.419	7.402	7.461	7.443
Cal. D	3.142	2.946	3.157	2.961	3.175	2.977
Cal. CN	719	719	730	730	742	742
Round L	31.00	33.00	31.00	33.50	31.50	33.50
Round B	7.40	7.40	7.40	7.40	7.50	7.45
Round D	3.15	2.95	3.15	2.95	3.20	3.00
Round CN	723	720	723	731	756	749
Round L/B	4.19	4.46	4.19	4.53	4.20	4.50
Round B/D	2.35	2.51	2.35	2.51	2.34	2.48

As the Cal. L, B, D and others are unnecessarily detailed for entering them in the specifications, the values are rounded to adequate decimals as shown by Round L, B, D and others.

(6) As described in the other part of the report, the center of gravity of the Survey Vessels tends to be at a higher position because of the many rooms to be placed on the deck. On the other hand, as the fishing gear on the vessel is less than that of the Japanese vessels, this will lower the center of gravity. However, although the overall length of the vessels is smaller in comparison with the bigger 199 GT class Japanese tuna long-liner, the length of poop and forecastle will not be smaller in proportion to the above. Therefore, the center of gravity tends to rise in comparison with the 199 GT class vessel. Then, it may be required to widen the breadth of the vessel. In such a case, as the GM (the height from the center of

gravity to the metacenter, which directly indicates the stability of the vessel) rises by 50% of the breadth under a full load conditions, if the breadth will be 7.50 m, the metacenter rises by 5 cm in comparison with the breadth of 7.40 m.

In a case where the depth of the vessel is decreased, the center of gravity further lowers so that the metacenter rises more. In the case of a tuna long-liner of this class, the height of the center of gravity over the keel under light load conditions is almost equal to the depth of the vessel. Then if the depth varies, the center of gravity alters proportionately. However, under some load conditions, the variation becomes small.

Therefore, the height of the metacenter of the vessel of No. 6 in the above table is higher by 2.5 cm under full load conditions compared to that of No. 1 of the above table and the center of gravity lowers by 15 cm under light load conditions. Then GM increases by about 10 cm, which is about a half of the sum of both of the above values when under normal operating conditions. As GM of the vessel is approximately 70 to 80 cm under full load departure conditions, the stability is improved by 15%. At present, the raise of the center of gravity is considered to be sufficiently compensated for by the above. However, the ratio of the breadth and the depth shall be determined later by making a trim stability calculation during the progress of the design.

From the above, the main particulars of the Survey Vessel are as follows:

Length overall	approx.	36.0 m
L pp	approx.	31.0 m
Breadth (molded)	approx.	7.35 to 7.4 m
Depth (molded)	approx.	3.10 to 3.20 m
Main Engine Power	approx.	800 PS
Cruising Speed	approx.	10 to 11 knots

Endurance	approx.	7,000 nautical miles
Fish Hold Capacity	approx.	100 to 110 m^3
Fresh Water Tank Capacity	approx.	50 to 60 m^3
Fuel Oil Tank Capacity	approx.	120 m^3
Freezing space	approx.	2 tons x 2 sets

Drawings and tables relating to the Survey Vessels are attached hereto.

General Arrangement

Tuna Long Line Arrangement

Table of Typical Japanese Tuna Long Liner's Principal Particulars

CHAPTER 5 BUILDING PLAN

5-1 Principles for Building

The Survey Vessel is a semicommercial tuna long liner. The Survey Vessel has two purposes;one, tuna resource surveying; two, crew training.
These two same specification vessels should be built at the same time and at the same shipyard. This is advantageous in order for the shipyard to improve building techniques, reduce costs and construction time and to eliminate differences in detailed fittings between the two vessels.
First of all, the shipyard should have extensive experience in the building of tuna long-liners, it would also be preferable if the shipyard to have experience in the building of the training vessels, survey vessels and export vessels. In addition it should have sufficient design capability and understand the maritime rules and regulations of the Government of India. However, in the case of a severe time constraint, it would be better to contract two shipyards simultaneously in order to shorten the building term.

Order Method

All submitted bids will include vessels, fishing gear, spare parts for three years and survey equipment comprehensively in order to improve efficiency.
Also it is better that the shipyard will be responsible for the navigation of the vessels to India after the completion of the vessels in Japan.
The navigation will be from Japan to Bombay, a distance of approx. 5,600 nautical miles, and will take about 27 days.

5-2 Building Process

The outline of the building process is as follows:

Building Process (Proposal)

Period (Month)	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
E/N		▲														
Consultation Contract		--														
Verification of the Government of Japan		----														
Detailed design			--													
Approval of the Government of India			----													
Tender				------	---▲	(P/Q Publication, estimation)										
Evaluation					---											
Contract with successful tender						-										
Verification of the Government of Japan						-----										
Approval of Drawings							------	--	--	--	--	--				
Supervision of Construction and Work							---	------	------	------	------	------	-			
Keel Laying							▲									
Launching									▲							
Tests												---	-			
Completion of building													▲			
Navigation													----			
Delivery														▲		