

BASIC DESIGN STUDY REPORT
ON
THE COASTAL FISHERIES DEVELOPMENT PROJECT
IN
THE REPUBLIC OF SEYCHELLES

MARCH 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

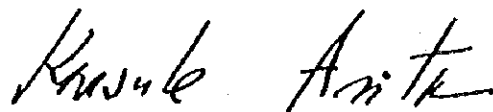
In response to the request of the Government of the Republic of Seychelles the Government of Japan has decided to conduct a basic design study on the Coastal Fisheries Development Project and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Seychelles a study team headed by Mr. Hideki TSUBATA, Fishing Boat Inspector of Fishing Boat Division, Oceanic Fishing Department, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries, from December 8 to 29 1986.

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

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

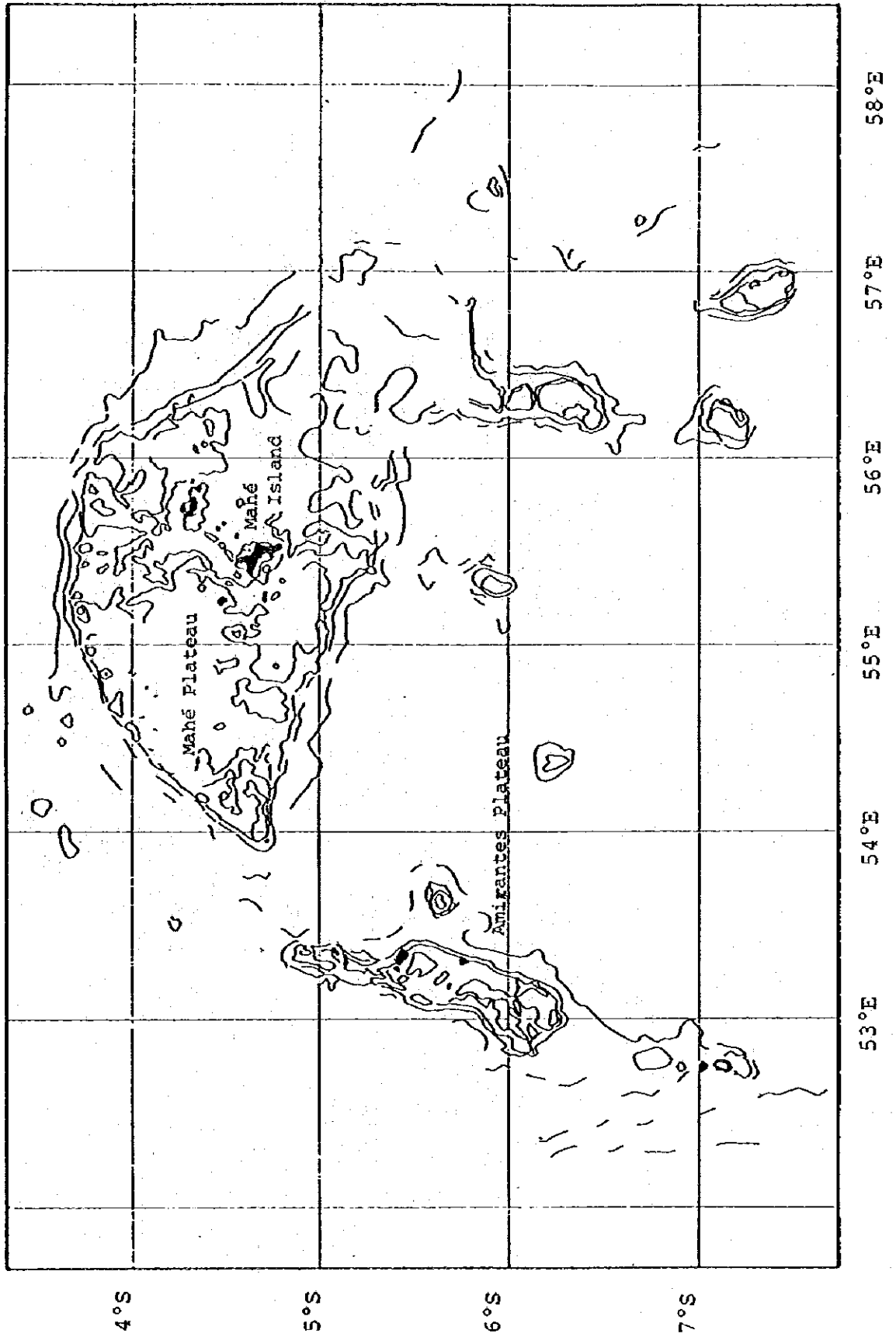
I wish to express my deep appreciation to the officials concerned of the Government of the Republic of Seychelles for their close cooperation extended to the team.

March, 1987

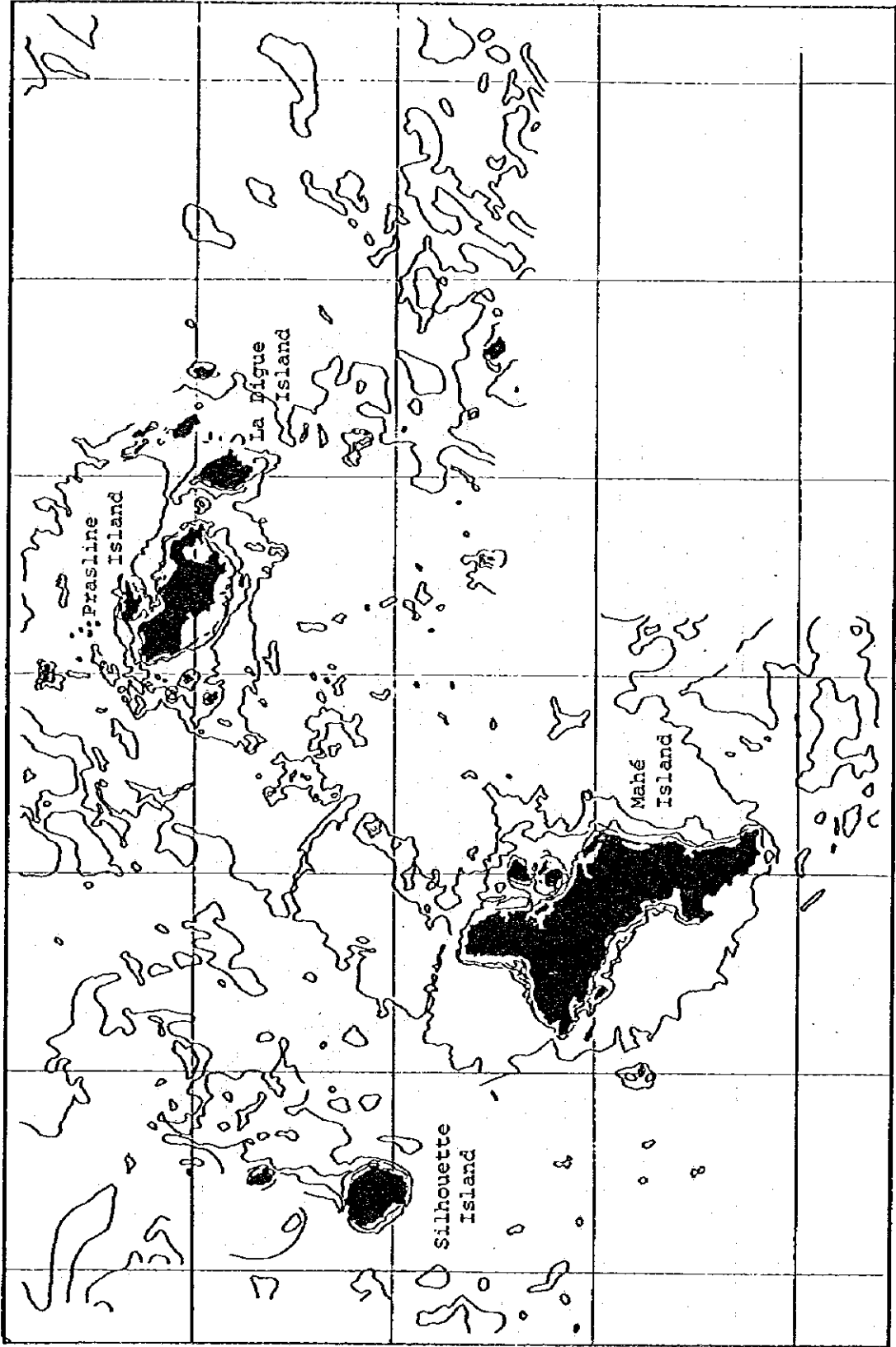


Keisuke Arita
President
Japan International
Cooperation Agency

MAP OF SEYCHELLES (I)



MAP OF SEYCHELLES (II)



55°E

56°E

SUMMARY

An island country situated in the Indian Ocean, the Republic of Seychelles, on becoming independent in 1976, achieved a yearly economic growth rate of 7% by relying on tourism and the country's human resources. The level of tourist activity however, reacts to events occurring in the outside world and development of the industry has been sluggish. Hence the country's growth rate actually turned into a negative figure. Consequently the National Development Plan established in 1984 calls for making greater use of the country's own resources and concentrate attention on the primary sector and the promotion of exports in order to strengthen the economy.

Seychelles is a group of islands of an area of 444 km² and a total population of 65,000 inhabitants. Copra and cinnamon bark are the principal crops grown for export but production capacity is limited. On the other hand, the 42,000 km² sea plateau of a depth of 30 to 50 m that lies within the total Exclusive Economic Zone (approximately 1 million km²) has good fishing grounds, and it counts as one of the best fishing areas in the world for skipjack and tuna. These stocks are already exploited by fishing fleets from France, Spain and South Korea under fishing agreements with Seychelles and some 120,000 tons were transhipped through the port of Victoria last year. Yet Seychellois fishermen directly occupied in coastal and offshore fishing activities have been largely ignored under an economic system that revolves primarily around the tourism industry.

In consideration of the existing conditions, the 1985-1989 National Development Plan (established in 1984), though it still lays major emphasis on developing tourism, aims at lessening its preponderant role in the National Economy.

Through the promotion of local industries and the exploitation of dormant natural resources, it aims at developing a multifaceted economic structure in order to establish a sounder economic base. For this purpose the Seychelles Fishing Authority (SFA) and the Fisheries Division of the Seychelles Marketing Board (SMB) were established, and plans were made for a wider support system for the development of coastal and offshore fisheries.

Fisheries products are an important source of protein for the population of Seychelles, with per capita annual consumption at 55 kg. Fisheries are also becoming a significant resource utilized by the tourist industry. Recently, with the fall in the price of both copra and cinnamon bark on world markets and the development of fishing activities, fish has become the number one export product (making up an estimated 45% of total exports or 550 tons, valued at 7.9 million Rupees).

Under the National Development Plan, the SFA has been activating the stagnating fisheries sector. However, the SFA is of recent origin and its budget cannot be said to be large. At a time when the country's economic growth is in negative figures, this state of affairs is not satisfactory. Accordingly, the government formulated the Coastal Fisheries Development Project in order to raise the efficiency of the fishing industry, and it requested from the Government of Japan the allocation of Grant Aid.

In response to this request the Government of Japan instructed the Japan International Cooperation Agency to conduct a basic design study. A team of experts was dispatched to Seychelles and conducted the study from December 8 to December 29 1986.

Although fisheries production reached a peak in 1978 and began to decline afterwards, the implementation of the projects formulated under the National Plan has offset this trend. The quantity of fish landed amounted to about 4,300 tons in 1985. However the following problems remain and they ought to be solved.

- 1) Aging of the fishing population: it is estimated that 70% of the labour force engaged in fishing activities is over 30 years of age.
- 2) Deterioration of the means of production: fishing gear and fishing boats are becoming increasingly obsolescent.
- 3) Fish catch fluctuations: fish catch size is all the more easily affected by changes in the natural environment when the equipment used is old. Fishing activities are consequently irregular throughout the working year.
- 4) Insufficiency of the support mechanism: the support mechanism set up by the government to activate the development of the fisheries sector is inadequate.

Compared to the conditions prevailing in the tourism industry, these problems create a harsh looking environment which does not entice a young workforce to participate in fishing activities. Accordingly, after analysing the situation outlined above, the SFA designed the Coastal Fisheries Development Project and spelled out the need for the following improvements in the sector of fisheries:

- 1) Research activities for the development of new fishing grounds and fish species: available fisheries resources must be exploited.

- 2) Establishment of new fishing techniques and introduction of new fishing gear and equipment: to raise efficiency.
- 3) Expansion of training and extension activities: in order to raise the effectiveness of the fishing industry and make it more attractive the development activities mentioned above must be diffused throughout the fishing workforce via training.
- 4) Modernization of fishing gear and equipment: to achieve the modernization of the fisheries sector the participation of a younger workforce must be promoted and the working environment improved.
- 5) Establishment of a safe working environment: to ensure safe working conditions the dangers which are associated with fishing activities must be eliminated as much as possible.
- 6) Energy and labour-saving policies: appropriate technology must be introduced in order to improve working conditions.
- 7) Strengthening of the machinery maintenance system: for smooth servicing and repairs.
- 8) Improvement of the fish distribution system: to preserve the freshness of maritime products and expand the market.

The basic design of materials and equipment essential to the implementation of the Project is indicated below.

- 1) Strengthening of research and training activities

A. Small research boat: (about 18m long) 1 unit

to train fishermen and extend the results of work performed mainly in plateau waters on the development of new fishing grounds, fish species and fishing techniques.

B. Research material and equipment: 1 set

to strengthen the SFA's work on developing new fish species and fishing grounds.

C. Training material and equipment: 1 set each for the SFA and the Maritime School

for use by the Polytechnic's Maritime School for the training of those young trainees who may join the industry and by the SFA for the training of fishermen and its extension activities.

D. Prefabricated installation for research and training: 1 installation: 153 m²

the SFA has expanded its activities smoothly since its establishment in 1984 but the scale of its facilities is severely limited. An installation large enough to allow the storing and use of equipment essential to Project implementation is necessary.

2) Modernization of the fishing industry

A. Inboard engines and spare parts: Total 78 units
(12, 27, 37, 56 Hp)

fuel economy, ease of maintenance and the power afforded by these engines which enables the use of electric fishing equipment will promote the SFA's plan for the change to inboard engines.

B. Fishing equipment: 1 set

the change to inboard engines offers the possibility of using modern equipment such as electric fishing reels and fish-finders.

C. Fishing gear: 1 set

fishing gear is necessary to meet the shortage of such equipment in Seychelles.

D. Prototype fishing boat: 2 units

these prototypes will be reproduced in Seychelles and sold to small-scale fishermen as part of the plan for the change to inboard engines.

3) Strengthening of the machinery maintenance system

A. Maintenance and repair equipment: 1 set

this equipment is particularly intended to meet the shortage of hand tools.

B. Prefabricated installation:

for equipment maintenance: 1 installation: 250 m²

it is difficult to maintain and control the equipment supplied under the Project in the SFA's present facilities. Under these conditions, a maintenance installation

comprising a storeroom for spare parts and a storeroom for keeping and fabricating fishing gear is necessary.

4) Improvement of the fish distribution system

- A. Polystyrene box moulding machine to make containers for the transportation of fish: 1 unit

these boxes are needed to transport chilled fish overseas as well as to maintain the freshness of fish caught.

- B. Prefabricated installation for the box moulding machine: 1 installation: 80 m²

to accomodate the box moulding machine.

When drawing up the basic design, close attention was paid to the technical knowhow and the economic conditions of fishermen in order for Project equipment to be fully used. Fishing gear and equipment and inboard engines supplied for the purpose of modernizing fisheries will be sold to fishermen by the SFA. After reporting to the Japanese government on its use, the SFA will then proceed to use the collected funds to further the Coastal Fisheries Development Project. In addition the SFA needs to execute foundation work related to the prefabricated installations before Project execution.

The cost of the Project borne by the Government of Seychelles is estimated at about 248,000 Rupees. Further, the time schedule for the work is set by the Exchange of Notes signed by the two countries' governments. Detailed design will take 2 months, tender activities 1.5 month, procurement and manufacture of the equipment 6 months, transportation 1.5 month, and installation 2.5 months. Though some activities do overlap, total Project duration is 12 months.

The Project aims at modernizing the operations of coastal fishermen. Moreover, the revolving fund which shall be created from the proceeds of fishing equipment sales should be of great benefit to other fishermen who are not included in the Project. The SFA is of recent origin but it should be able to expand the system embracing the Project's facilities and establish a smooth support mechanism vis-à-vis the development of coastal and offshore fisheries. Considering its abundant fisheries resources, Seychelles' potential for assuming the role of leader among other Indian Ocean countries in the realm of fisheries is high.

In this respect, the granting of aid concerning the Coastal Fisheries Development Project will contribute to the development of fisheries and it is regarded as highly significant and meaningful.

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MAPS OF SEYCHELLES

SUMMARY

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CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

The Republic of Seychelles joined the Commonwealth as an independent nation in 1976 and in the following year the country turned to Socialism. Seychelles is a granitic island country of a gross area of 444 km² and a population of some 65,000 inhabitants but its geographical features have not endowed it with either agricultural or mineral resources. Yet the natural beauty of the country and the character of its population are such that, based on these assets, the growth of the tourism industry enabled Seychelles to embark on a smooth development programme. However, foreign exchange earned by tourism has to this day failed to exceed the 1979 peak of 79,000 tourist arrivals. The economic structure of Seychelles is heavily dependent on tourism and direct foreign exchange earnings make up approximately 47% of Gross Domestic Product.

The 1984 National Development Plan (1985-1989) was formulated against this background. Though it still focusses on developing tourism, the Government of Seychelles decided to reduce the country's dependency on the latter and promote local industries presenting a good potential for growth by establishing more stable economic policies.

The sea area around Mahé Island has good fishing grounds and it offers excellent potential for the development of coastal and offshore fisheries. The scale of present day activities is very small however and existing fisheries natural resources are largely unexploited. It is with such considerations in mind that the Government of Seychelles presented a request to the Government of Japan for the allocation of Grant Aid under the latter's Grant Aid Programme, with a view to the implementation of the Coastal Fisheries Development Project.

The Government of Japan transmitted the application for Grant Aid to the Japan International Cooperation Agency and from December 8 to December 29 1986 a Team headed by Mr. Hideki TSUBATA, an inspector of the Fishing Boat Department of the Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries, was dispatched to Seychelles to effect a basic design study. The team visited the three main islands of Mahé, Praslin and La Digue and surveyed the state of coastal and offshore fisheries together with the activities of the various institutions related to the industry. Talks were held with officials from the executing agency, the SFA, over details concerning the Project's budget, personnel and management. Following the Team's survey and those talks, the SFA, the Planning and Economic Cooperation Division of the Department of Planning and External Relations of Seychelles and the Team arrived at a mutual understanding over the supply of equipment and materials necessary to the implementation of the Project. The proposition concerning Project equipment was incorporated into the Minutes of Agreements signed by the parties concerned. The composition of the Team, the list of the officials interviewed, the survey schedule, the Minutes of Discussions and other attachments are appended at the back of the report.

This report is based on the Team's findings in the field. It contains the results of an analysis conducted in Japan, a description of the Project and its rationale, and it defines the most appropriate scope and scale of the materials and equipment necessary for the implementation of the Project.

CHAPTER 2

PROJECT BACKGROUND

CHAPTER 2 PROJECT BACKGROUND

2-1 Overview of Seychelles

The Republic of Seychelles consists of a group of 92 granitic islands of a land area of 444 km² situated in the Indian Ocean, 1,600 km away from Kenya. The vast 200 mile Exclusive Economic Zone of about 1 million km² that lies around the islands is rich in fisheries resources to be exploited by the country's coastal and offshore fisheries. The potential for the development of tuna fisheries is considerable.

Tourism is the main industry and it accounts for a large part of the Gross National Product, which stood at 11 million Rupees in 1985 (approx. US\$2 million). At present tourist arrivals number about 70,000 per annum (the average length of stay is 11 days). Income from activities directly related to tourism, such as aviation, bus and taxi services, the hotel business and restaurants make up 45% of Gross Domestic Product. In addition, the indirect effects of the tourism industry and its contribution to the National Economy are seen to be even more considerable when one considers its impact on the production of primary commodities. Given its overall importance the young's hopes of finding employment in this industry are therefore high.

As mentioned above, agriculture and fisheries also help in the earning of foreign exchange. Exports of fish account for the greater part of total exports (estimated at 48% in 1985), followed by copra (35%) and cinnamon bark (11%). These exports enable the country to pay for imports of food and other products necessary to daily life. The size of the country however, restricts development in the field of agriculture. Both the country and its population are young, 60% of the latter

being under 25 years of age. The education system of Seychelles is highly developed and much is expected from it. Children receive 9 years of schooling from the age of 6, followed by 2 years of National Youth services totalling 11 years of compulsory schooling. Those wishing to further their studies after high school have the opportunity to go to the Polytechnic. In addition a programme has been established whereby 250 students are able to pursue their studies abroad every year. Accordingly both the technical level and the ethical sense of the population are high. The education system is not only national in its coverage but also free, with no expenses charged for either dormitory accomodation or food.

2-1-1 National Development Plan

Under the 1985-1989 National Development Plan established in 1984, positive action towards the country's development is urged through the following four policies.

- 1) Employment creation: to reduce the current 14.8% unemployment rate and create new jobs for the young. Employment creation will be given priority and training is of prime importance in this respect.
- 2) Trade improvements: imports must be reduced and exports of primary products increased. The role of the Seyshelles Marketing Board, which is charged with the control of exports and imports, is therefore particularly important.
- 3) Return to economic growth: Gross National Product grew at a rate of 7% between 1976 and 1980.

Since then however, the stagnation of tourism has severely affected the rest of the economy and economic activity indicates negative figures. Production is to be increased and the deficiency of tourism supplied.

4) Export promotion:

Seychelles is to develop the production of exportable goods. In particular much importance is attached to the development of fisheries resources within the 200 mile Exclusive Economic Zone.

In addition large scale construction works for the East Coast Development Project of Victoria will be in progress from the time of the Plan's effectuation onwards.

2-2 Overview of the Fisheries Sector

In the 1985-1989 National Development Plan the high potential for the development of the fishing industry is particularly emphasized. The total Exclusive Economic Zone (EEZ, approximately 100,000 km²), including the 30 to 50 m deep Mahé and Amirantes plateaus (gross area 42,000 km²), offers promising opportunities for coastal and offshore fishing.

Yet the size of the fishing industry is small and the fisheries resources that abound are unexploited. Those employed in fishing activities number 1,300, or a mere 4.5% of the total working population. One possible explanation lies in the fact that, in comparison with the tourist industry, fishing is both harsh and dangerous an occupation. Young people are not attracted and the subsequent aging of the labour force

constitutes a factor preventing the development of that industry (50% of the total working population of Seychelles is under 30 years of age but 30% only of those occupied in fishing activities are under that age).

Fishing activities in Seychelles can be conveniently classified into coastal and offshore fishing. Coastal fishing is effected primarily by small open-deck boats powered by outboard engines (these range between 5 and 8m; however with the decline in wood resources and the ease of maintenance of FRP boats, they are being increasingly replaced by the latter) and open-deck whalers powered by inboard engines (which range between 7 and 9 m and resemble American whale catcher boats). These boats operate within a radius of 10 to 30 miles from the main island, over the rough and uneven Mahé Plateau. Fishing gear consists of handlines (60%) and fish-traps (35%), besides gillnets and beach-seine nets. Coastal fishing accounts for two thirds of total fish production and the main species caught includes trevally (Carangidae, which makes up 26% of coastal fish catch), red snapper (*Lutjanus sebae*, *L. cosineus*), blue snapper (*Aprion vivescens*), grouper (*Epinephelus* spp) and striped mackerel (*Rastrelliger karnagurta*). Other species caught are listed in Appendix VI.

The remainder of fish caught originates from offshore activities. As compared with coastal fishing, offshore fishing is conducted with larger boats (9 to 12 m in length) powered by inboard engines. These boats are in the main decked whalers and schooners which can operate for up to ten days in the distant waters of the plateaus' peripheral area. On average crews number 4 to 6 men and 1 or 2 tons of ice can be kept in the fish hold. Fishing gear consists of handlines, which are used to catch demersal fish such as red snapper. Table 1 indicates the number and type of boats used for coastal and offshore fishing activities.

Table 1. Boats per fishing activity

| Year | Coastal Fisheries | | | Offshore Fisheries | | |
|------|-------------------|-----------|-------|--------------------|-----------|-------|
| | Wooden-hull boats | FRP boats | Total | Whalers | Schooners | Total |
| 1977 | 273 | - | 273 | 48 | 27 | 75 |
| 1982 | 175 | 97 | 272 | 48 | 40 | 88 |
| 1985 | 55 | 143 | 198 | 40 | 21 | 61 |

Table 2 below indicates total coastal and offshore fish landings over several years.

Table 2. Fish Catch (m.t)

| Year | 1977 | 1978 | 1979 | 1980 | 1981 |
|------------------|-------|-------|-------|-------|-------|
| Total Fish Catch | 4,600 | 5,400 | 4,908 | 4,377 | 4,444 |
| Year | 1982 | 1983 | 1984 | 1985 | |
| Total Fish Catch | 3,897 | 3,750 | 4,021 | 4,381 | |

After reaching a peak in 1978 total fish production decreased steadily, until implementation of projects introduced in National Development Plans began to have a slight impact. Nevertheless, various problem areas pertaining to the development of coastal and offshore fisheries remain and the following issues require attention.

- 1) Aging of the fishing population: it is estimated that 70% of the labour force engaged in fishing activities is over 30 years of age.
- 2) Deterioration of the means of production: the size of crews is limited and safety precautions are insufficient. In addition, acquisition of new gear is difficult while existing equipment is obsolescent.

- 3) Fish catch fluctuations: small fishing boats are affected by the south easterly monsoon, which influences fishing activities and causes fluctuations in fish production indicated by peak and lean seasons.
- 4) Insufficiency of the support system: the support mechanism provided by the Government for the purpose of activating fisheries is insufficient.

The conditions outlined above, if contrasted to those of the hotel business, do not encourage a younger workforce to enter the fishing industry. The current system of boat ownership is pre-modern and the government has tried to change it to an owner-skipper system. At present one half of all boats are not owned by fishermen but by small businessmen. From among these, one third of revenue from fishing activities is taken by the owner, who is responsible for paying all the necessary expenses. Another third is shared by the crew on equal terms and the remainder is reserved to pay back the loan made to cover costs incurred during equipment investment (including the cost of the fishing boat).

The Seychellois are traditionally fond of fresh fish and in recent years frozen fish has been consumed by the military forces, in schools, hotels etc. In 1978, at the peak of fish production, per capita fish consumption was estimated at 85 kg. This subsequently fell to 55 kg, because of a decrease in fish production and an increase in fish exports. With a view to improving the distribution of fish products, the Seychelles Marketing Board's Fisheries Division was established in 1984. The Division purchases and then sells fish from the three principal islands of Mahé, Praslin and La Digue and is currently handling 30 % of total fish production. In Victoria the SMB owns a 893 m³ cold store (-20°C), a 405 m³ insulated store (0°C), two 18 ton blast freezers, a 20 ton/day ice-making machine, ten refrigerated transport vehicles and two insulated

transport vehicles with which it can manage the fish products it handles. In addition there are two fish collection centers situated on both Mahé and Praslin and these allow for expedient collection of fish products bought from fishermen. In future the SMB plans to establish 11 collection centers on these islands to help control and manage total fish distribution in the country. There are currently three ways in which fishermen can sell their catch. They can take it to the SMB, entrust middlemen (collecting agents) with its sale, or sell it directly on the market place. There are in addition two fish processing factories operating, one for the fileting of red snapper and the other is a smokehouse for sailfish.

Seychelles has been exporting fish since the mid-1970s. Over the last few years however the prices of copra and cinnamon have slumped on world markets, while exports of fish have increased, following growth in the fishing industry. As a result fisheries have become the second foreign exchange earner after tourism. Red snapper, grouper, skipjack and tuna make up the greater part of fish caught and in 1985 approximately 550 tons of fish were exported. This amounted to 7.9 million Rupees in foreign exchange earnings. 65 % of the exports went to the Reunion, 20 % to France while Britain is another market.

As mentioned above, fishing activities engaged in by the Seychellois are categorized as coastal and offshore. Abundant stocks of tuna are available in the surrounding waters off the plateaus. These are currently exploited by purse-seiners from the E.C. (France and Spain) and Mauritius and by long liners from Korea. The fish caught by these foreign fleets is transhipped through the port of Victoria (120 thousand tons; 1985) and the employment creation opportunities and transfer of technology that have resulted from the situation have given an added stimulus to the local fishing industry. Further, direct income raised from transhipping activities amounted to 4 million Rupees while indirect income earned by various suppliers is estimated at 9 million Rupees.

2-3 Development of the Fishing Industry

Following the decision to reduce the country's dependence on tourism, the National Development Plan that was elaborated in 1984 spelled out the need for exploiting existing natural resources and fostering the establishment of institutions to perform this. Accordingly, the development of a fishing industry able to exploit the abundant resources available becomes a necessity.

The Seychelles Fishing Authority (SFA) was created for this purpose and charged with responsibility over all matters related to the development of fisheries. The main development effort with regards to fisheries is aimed at improving transshipment facilities in the port of Victoria and the current Development Plan is benefiting from financial help from the African Development Bank and the Koweiti Fund.

In addition, an agreement with the European Community allows French and Spanish fleets to operate within the Seychelles EEZ. One of the covenants of this agreement is the provision of technical cooperation to promote the development of coastal and offshore fisheries.

2-4 Organization of the Fisheries Sector

The Seychelles Fishing Authority was established in 1984 to take charge of all fishing development. It has been allocated a budget and has been engaged in expanding the fisheries workforce in the most favorable conditions. The SFA is administered by a Board of Directors headed by a Managing Director and operated by some 50 employees. The main functions, roles and responsibilities of the SFA are:

- 1) to compile statistics on the fisheries industry;
- 2) to conduct surveys to monitor and administer fishing fleets and to estimate the fishing fee in accordance with fish catches by foreign fleets;

- 3) to promote coastal fishing through the development of fishing gear and the search for new fishing grounds;
- 4) fishery resources management;
- 5) the establishment of legislation;
- 6) to provide training for the fishing workforce;
- 7) to conduct sale and maintenance of fishing equipment.

The Fish Marketing Division of the SMB is the governmental institution charged with organizing the distribution and sale of fish products. In order to enhance the fish distribution system, it maintains inland facilities and handles some 30% of total fish catch. It is also fostering exports of chilled and frozen fish to the Reunion and Britain (approximately 550 tons) and this is making a significant contribution to the National Economy.

2-5 Contents of the Request for the Project

The National Development Plan of Seychelles advocates a reduction of the National Economy's dependence on tourism and the development of existing natural resources. The fishing industry is eager to make an increased use of Seychelles' vast maritime resources and central to the SFA is the intention to develop the fisheries sector. Having determined to promote the development of coastal fisheries, Seychelles formulated the "Coastal Fisheries Development Project" and then requested Grant Aid from Japan for its implementation. A request for the following equipment and materials has been made.

- 1) Research boat
- 2) Research and training equipment and a prefabricated installation in which to house it
- 3) Inboard engines and spare parts
- 4) Fishing gear and equipment
- 5) Equipment for communication and safety
- 6) Prototype fishing boats

- 7) A prefabricated installation for engine repair and maintenance equipment
- 8) A machine for the moulding of polystyrene boxes for the handling and transportation of fish and a prefabricated installation in which to house and operate it

CHAPTER 3

CONTENTS OF PROJECT

CHAPTER 3 CONTENTS OF THE PROJECT

3-1 Objectives of the Project

Having laid emphasis on the promotion of fisheries in its National Development Plan, the Government of Seychelles established the Seychelles Fishing Authority (SFA) and charged it with implementing the various aspects of all fisheries development. Prominent among these is the Coastal Fisheries Development Project and its demand for the active participation of the Seychellois. The current stagnation of the coastal and offshore fishing industries is by and large caused by such factors as the aging of the labour force and the obsolescence of the fishing gear and equipment. Under the Project these industries will be modernized and their efficiency raised. Young people should be attracted by a renewed industry and their participation shall be encouraged. To achieve these objectives, the implementation of the following policies has been urged:

- 1) Research activities for the development of new fishing grounds and fish species: untapped fisheries resources will be exploited at the same time as research work to monitor the natural resources situation is effected
- 2) Establishment of new fishing methods and introduction of new fishing gear and equipment: in order to raise efficiency
- 3) Expansion of training and extension works: the above-mentioned development activities, such as the search for new fish species and fishing grounds, the introduction of new fishing gear and fishing techniques, must be extended throughout the fishing population in order to raise efficiency and make the fishing industry more attractive

- 4) Modernization of fishing gear and equipment: the image of jobs related to the fisheries sector must be improved and the participation of young people encouraged.
- 5) Establishment of a safe working environment: the dangers associated with fishing activities must be eliminated and safe working conditions established
- 6) Energy and labour-saving policies: appropriate technology must be introduced in order to improve working conditions

The improvement of the fish distribution system and the strengthening of the machinery maintenance system can be considered to be prerequisites to any attempt at achieving the above objectives.

3-2 Examination of the Contents of the Request

After reviewing the new course of action that is elaborated in the National Development Plan and the natural resources with which Seychelles is endowed it appears that the need to promote fisheries is considerable. The existence of vast stocks of tuna in the offshore sea is known and about 120,000 tons were transhipped in Victoria last year. Nevertheless, from Seychelles' point of view, this state of affairs can be questioned. Seychelles' participation in the production of tuna is crucial and the necessity for creating a skilled workforce will soon become of grave importance. The solving of the problems that hamper the development of the coastal and offshore fishing industries must be solved urgently and this stands as the country's first priority.

After surveying the conditions of the fishing industry, the activities of those organizations charged with implementing the Project and examining the contents of the

request for Grant Aid, the following conclusions have been drawn.

- 1) Strengthening of research and training activities:
 - A. research boat
 - B. research material and equipment
 - C. training material and equipment
 - D. prefabricated installation for research and training activities
- 2) Modernization of the fishing industry:
 - A. inboard engines and spare parts
 - B. fishing equipment
 - C. fishing gear
 - D. communication and safety equipment
 - E. prototype fishing boats
 - F. prefabricated installation
- 3) Strengthening of the machinery maintenance system
 - A. maintenance and repair equipment
 - B. prefabricated installation for maintenance works
- 4) Improvement of the fish distribution system
 - A. polystyrene box moulding machine for the handling and transportation of fish
 - B. prefabricated installation for the moulding machine

Each of the above points is examined below.

1) Strengthening of research and training activities.

- A. Research boat: the Seychelles Fishing Authority currently has a 15 G/T survey ship (length 9.5 m, width 3 m), the SCYLLARUS, which is normally engaged in research and training activities such as the testing of fishing equipment and the search for new fishing grounds. This boat was built in

1966 however and it does not have the right configuration to undertake modern surveying. The problems inherent to the actual ship are the following. 1) due to mechanical deterioration of the vessel, about 3 months of repairs are required to keep it in operation 2) accomodation space is insufficient 3) there is no fish hold 4) there is no space for fishing equipment. Because of the above the existing boat is insufficient to conduct effective research works offshore.

In order to resolve the problems listed above, the use of a survey ship, as requested under the Project, that would enable the intensification of research and training activities seems appropriate. However, although the articles of the National Development Plan allow for an increase in the budget of the SFA, it is thought preferable to avoid any increase in the cost of running such a ship. For this reason we may assume the scale of the new survey ship to be identical to that of the SCYLLARUS.

- B. Research material and equipment: based on an agreement with France, Seychelles is currently engaged in joint research activities with the state-related French institute ORSTOM. Negotiations were concluded last year with the E.C. with the result that fleets from France and Spain are now allowed to operate in Seychelles waters. As part of this agreement, economic assistance worth \$250,000 a year is to be paid by the E.C. for the SFA's research work. However, it is not possible for each research project to be implemented on a par with the increasing need for research. Accordingly the use of specific research

equipment to promote the development of coastal and offshore fishing, as set forth in the Project, is deemed to be appropriate. However, the SFA's staff is currently engaged in various research programs and the introduction of research equipment should not go beyond the scope of these programs.

C. Training material and equipment: in Seychelles training in the field of fisheries is conducted at the Maritime School of the Polytechnic. Entry into the Maritime School depends upon one having completed two years of National Youth services, as explained above. Training takes a further two years, the first of which is spent studying coastal fisheries, while the second is made up by a course on industrial fisheries. A boat building course is also conducted at the school. The Polytechnic's Maritime School was built with French help and the majority of teachers are French. There is however little equipment and materials for practical training. With the establishment of the SFA, some training activities have been undertaken for fishermen. Again therefore the use of simple equipment to be used at the Maritime School and by the SFA for the training of fishermen is considered to be necessary younger people and appropriate.

D. Prefabricated installation: the SFA is currently employing some 50 persons. Office space however does not exceed 200 m² and there has been little room in which to conduct research and training. Consequently 15 employees from the research division are currently undertaking research works in the field or renting facilities belonging to ORSTOM. The request for a house in which to

conduct training and research works seems necessary in order to enable the SFA to intensify such activities.

2) Modernization of the Fishing Industry

A. Inboard Engines and Spare Parts: coastal fishermen are well acquainted with the use of outboard engines and maintenance is thus not thought to be a source of problems. However, trouble occurring during the performance of fishing activities and high fuel costs are becoming a major problem area. In response to this, the SFA is now emphasizing energy conservation and is urging the adoption and increased use of inboard engines. Fishermen wishing to install such engines in their fishing boats now have access to loans and they have been treated favourably. Fishermen having switched to inboard engines will have the opportunity to use such fishing equipment as electric fishing reels or fish-finders. Since the SFA has secured technicians capable of maintaining such engines, the perspective for a smooth change to the latter type is thus comparatively good. Consequently the Project's call for an increased use of inboard engines matched with the Boat Construction Programme is deemed to be appropriate.

B. Fishing Equipment: accompanying the change to inboard engines is the increased opportunity for using fishing equipment. The presence of vast stocks of fish in the area surrounding the plateau is well known but at present these resources are largely untapped. Accordingly, after due research by the SFA's research boat as to opportunities, fishing at depths of 200 m to 300 m with an

electric fishing reel should be appropriate and efficient. In addition should bigger fish be caught in shallow waters the use of an electric fishing reel will also be effective and labour saving. Finally, in plateau areas where rock formations are to be found the use of an echo sounder or a fish-finder will prove most useful to detect fish schools.

Although they cannot be called fishing equipment per se, nautical instruments such as magnetic compasses also help in finding fishing grounds. Those of the afore-mentioned instruments that have already been introduced to Seychellois fishermen have met with no problems of maintenance.

- C. Fishing Gear: the acquisition of fishing gear by fishing equipment dealers does not reflect the views of the Seychelles' government on fisheries development as expressed in the National Development Plan. As a result, there is a dire lack of fishing gear. Coastal fishing in present day Seychelles is usually effected by handline but beach-seine and various types of mackerel driftnets are also used. Trap fishing is also effected. These methods were evolved in accordance with the technical level of the fishing population and the fishing environment. According to the Project however, troll fishing and modern techniques using gear such as handline, vertical longline, various types of mackerel driftnets and beach-seine can be used to improve fishing methods. There seems to be no problem related to the extension of these technologies and to their intensification. In particular, sports fishing is already conducted and equipment such as troll

lines or vertical longlines are already used in Seychelles. However the current shortage of fishing gear makes the diffusion of such techniques considerably difficult. At present Fish Aggregating Devices (FAD) have been laid in five different areas of the plateau and these have produced very satisfactory results. Accordingly, the inclusion of FADs, as advocated by the Project, and their use in the development of coastal fisheries is regarded as appropriate and efficient.

D. Communication and safety equipment: the dangers that are associated with the fishing profession constitute an explanation for the lack of participation of the young in the fishing industry. With a view to reducing the incidence of accidents, the SFA pledged itself to establishing adequate codes of conduct and promoting the diffusion of communication and safety equipment, in order to give the industry a more attractive image. In future, safety laws and regulation as well as operational procedures will be worked out. As a first step, the Project plans to introduce safety equipment on inboard engine boats and communication and safety equipment in larger boats operating on high seas.

E. Prototype fishing boats: there are two constructors of wooden-hull boats and three constructors of FRP boats in Seychelles at the moment and the demand for medium-size wooden-hull schooners, whalers and cargo boats is high. In the case of small-size boats, however, a decline in the availability of wood and the ease with which FRP boats can be maintained have led to a change

in favour of the latter type. Materials are imported from South Africa and the technical skill of the builders is considerable. The small-size boat used for coastal fishing is called the MINIMAHE. It resembles leisure type boats and is not appropriate for fishing purposes.

SFA has developed a 6.5 meter prototype with an inboard engine (the LEKONOMI) and it has been recommending its adoption by fishermen. The LEKONOMI type of fishing boat is appropriate for handline fishing in plateau waters and it is fulfilling its role as the major force in the development of the coastal fisheries industry. Nevertheless, the rather large size of the LEKONOMI, as compared to the MINIMAHE, makes it expensive and not all fishermen can afford to purchase one. The SFA has for some time been developing a prototype similar to the MINIMAHE and, in order for it to be appropriate to artisanal fishermen, it is being targeted as a cheap, light and energy-saving boat. In the Project a request for a similar boat has been presented. If the current leisure boat type is used, then prospects for the development of coastal fisheries do not appear to be bright. The use of a small boat more suited to fishing activities is regarded as appropriate for the Project and, consequently, the development and introduction in Seychelles of a prototype fishing boat and its mould of a size equal to that of the MINIMAHE is advocated in the Project.

- F. Prefabricated installation: storing space for fishing gear essential to the modernization of the fishing industry is currently unavailable in the

SFA's restricted facilities. Accordingly, the creation of minimum space in which fishing gear could be housed and fabricated is considered to be of absolute necessity in the Project. The inclusion of a prefabricated installation is hereupon considered to be appropriate.

3) Strengthening of the Machinery Maintenance System

A. Maintenance and repair equipment: while promoting the change to inboard engines, the SFA is securing the necessary back-up force for the maintenance and support of inboard engines. It is also effecting the maintenance of engines through one of its subsidiary company: Indian Ocean Marine, Ltd. However, maintenance and repair equipment is clearly insufficient and cannot be supplied in quantities necessary for the implementation of the Project. On the other hand recruitment of necessary manpower is not problematic, as mentioned above. Consequently, the request for maintenance and repair equipment, particularly for small hand tools, seems appropriate.

B. Prefabricated installation for mechanical maintenance: space in the present SFA buildings is very limited so that repairs are effected in a workshop located in a disused room. Because of the poor location of the existing workshop, moving equipment is very difficult. Space in the storehouse for spare parts is equally restricted. In such conditions, maintenance of Project equipment such as inboard engines and the management of spare parts is foreseen to become extremely difficult. Accordingly, the creation of

minimum space in which the repair, maintenance and housing of equipment and spare parts can be performed is judged to be appropriate to the Project.

4) Improvement of the fish distribution system

A. Polystyrene box moulding machine to make containers for the transportation and handling of fish: the Fisheries Division of the SMB is charged with exporting fish products and with the promotion of these exports. In recent years the export of chilled fish, which brings higher profits as compared to frozen fish, has met with little competition from other countries. The demand for such products in Europe is considerable and against such a background the SMB signed an agreement with air freight companies, with a view to the promotion of exports of chilled fish (in polystyrene boxes filled with ice). Recently, the quantity exported has reached a level of over 100 tons (4,000 boxes) per annum and the perspective seems good, with opportunities for expansion. For this purpose, the SMB has been importing polystyrene boxes at a cost of 20 Rupees (500 yen) per unit in order to export fish. If it were possible to avoid the import of such voluminous boxes by manufacturing them in Seychelles instead, the reduction of the cost in foreign exchange would be sizeable. A further problem is raised by the fact that small boat fishermen do not use ice since their boats are not equipped with insulated fish holds. If a polystyrene box moulding machine were available polystyrene boxes would be sold and distributed to fishermen at a low price. These could be reinforced with wooden planks on their outside and then used with reasonable

effectiveness as insulated boxes for containing ice. The fish distribution system stretching from the producer to the SMB would be greatly improved as a result. Consequently it is judged that a simple polystyrene box moulding plant, as requested in the Project, would be appropriate.

- B. Prefabricated installation for the polystyrene box moulding plant: the box moulding machine and other equipment take little room but the operation of the moulding machine requires vertical space (about 4 m). A prefabricated installation in which to house the plant is then requested under the Project.

3-3 Outline of the Project

3-3-1 Outline of the Project

After a survey of Seychelles' economy, the fisheries industry's conditions, the activities of institutions such as the SFA related to the development of the fisheries industry and after conducting a detailed examination of the contents of the request for Grant Aid regarding the Project, the following items of the Coastal Fisheries Development Project are deemed to be suitable for inclusion into the Project.

- 1) Strengthening of research and training activities
 - A. supply of a small-size research boat
 - B. provision of essential research materials and equipment
 - C. provision of training equipment at the Maritime School and the SFA
 - D. prefabricated installation for research and training activities

2) Modernization of the fishing industry

- A. supply of inboard engines and spare parts
- B. supply of fishing gear and equipment
- C. supply of communication and safety equipment
- D. small prototype fishing boats
- E. prefabricated installation
(a storeroom for fishing gear and a fishing gear assembly room are included in the installation for machinery maintenance)

3) Strengthening of the machinery maintenance system

- A. supply of necessary small hand tools and a vehicle
- B. prefabricated installation for machinery

4) Improvement of the fish distribution system

- A. Polystyrene box moulding machine for the handling and transportation of fish and a prefabricated installation (box moulding machine room).

3-3-2 Executing Agency

The executing agency is the Seychelles Fishing Authority (SFA). The SFA was established in 1984 for the purpose of developing fisheries. Since then it has been engaged in this task, using an expanding budget and personnel. Based on a smooth rapport with the Department of External Relations and the Ministry of National Development, cooperation with the SMB, the Polytechnic and the Maritime School is essential with regards to the Project's implementation (see Appendix VII).

3-3-3 Budgeting Plan

Since the establishment in 1984 of the Seychelles Fishing Authority the outlook for the development of coastal fisheries has taken a turn for the better and development activities have been expanded. Consequently, the 1987 Budget of 6.5 million Rupees exceeds the 1986 Budget (4.5 million

Rupees) by some 40%, indicating a significant increase. In addition, besides the budget allocated by the government, the agreement with the European Community regarding tuna fishing allows the use of US\$250,000 for research activities (60% of which will serve to pay the E.C. expert).

3-3-4 Personnel Plan

At present the SFA employs 52 persons and another 4 persons who are currently on study leave will return by the time of Project implementation. With regards to the Project's survey ship, the present vessel can be scrapped and its crew can be used to man the new boat. As far as other matters are concerned, the number of employees seems to be sufficient but a larger number of employees at the maintenance and repairs workshop will become necessary in order to manage the large quantities of equipment that will be supplied.

3-3-5 Project Site

This Project requires the erection of 3 prefabricated installations. These will be situated on government-owned land located in the M Block (35,684 m²) of the new fishing port area (see Appendix V). The research and training installation will be situated on a ground contiguous to the SFA's main office building. A new installation, for maintenance and repair work and a storeroom for fishing gear will be raised over the current repairs room which will be abandoned. The installation for the polystyrene box moulding machine will be erected in SMB grounds, which are currently being prepared. Ground clearing, foundation, electricity and water installation works will be implemented by the Government of Seychelles.

3-3-6 Project Management Plan

Excepting equipment listed under the section on the modernization of the fishing industry, equipment provided under

the Project will be used for strengthening the activities of the SFA, the SMB and the Maritime School. Fishing gear and equipment provided under the section mentioned above will be sold to coastal fishermen through Indian Ocean Marine, Ltd., the SFA's subsidiary. However, it will be necessary for the SFA to screen fishermen prior to selling the equipment, and it might be convenient to give priority to those fishermen who have in the past sold their catch to the SMB (this is advantageous for money collecting purposes). Those fishermen's collaterals will be guaranteed by the SFA and they will subsequently receive a loan from the Seychelles Development Bank, which shall enable them to pay for equipment needed. The accumulated money will be a revolving fund for the Project. After reporting to the Japanese government on its usage, the fund can be used again for the purpose of developing coastal fisheries. The Seychelles Development Bank will receive a 3% commission. The Seychelles government does not have a financial policy for setting up subsidies, so that fishing equipment is not sold on a subsidy basis. However, in order to help diffuse new fishing gear and safety equipment provided under the Project, the latter will be sold in such a way. The sale of fishing boats constructed from the prototypes cannot be effected directly. In addition the two boats supplied to the SFA for the modernization of the fishing industry will be used for trial operations or the training of fishermen. After receiving confirmation as to their proper use these can then be copied and identical boats built at the two boat yards for subsequent use and diffusion.

CHAPTER 4

BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4-1 Design Policy

The design policy of the Project is based on the development strategy exposed in the National Development Plan of Seychelles. For the design of equipment and materials, full consideration must be given to local conditions such as climate and the state of the fishing industry, in order to make efficient use of the equipment and thereby contribute to the development of the fishing industry to the fullest extent. In particular, the Project being to a large extent concerned with the supply of equipment, it is important to pay sufficient attention to the technical level of the coastal fisheries industry. With regards to the selection of the type and size of Project equipment and materials, the following points must be given thoughtful consideration.

- 1) **Duration of the Project:** the Project period is set at two years from the beginning of its execution. The lifespan of some of the spare parts provided will consequently be of 2 years, under normal maintenance conditions. The aim of the Project is to promote coastal and offshore fisheries over this period.
- 2) **Project Management:** in order to avoid excess costs, economic conditions must be studied and forecasts made as regards the beneficiaries, together with the setting of budgets for the executing agency.
- 3) **Technical Level:** after surveying the current fishing activities and conditions relating to the use of the equipment, it is assumed that the level of technical skill necessary to utilize the equipment will be reached by the time the two-year period that follows

Project implementation is over. It is also important for the level of technology required to use new equipment to be within the reach of fishermen and attention should be focused on this matter.

- 4) **Manning Plan:** it is important for the management system of the executing agency to be able to cope with the scale and size of the equipment and materials.
- 5) **Mechanical Maintenance System:** the mechanical maintenance system for the equipment and spare parts which will be acquired must be sufficiently considered. It is essential to include a sufficient supply of spare parts and necessary tools, to allow for the proper maintenance of Project equipment and materials.
- 6) **Sales Plan:** project equipment allocated for the modernization of the fishing industry is to be sold to coastal and offshore fishermen. The degree of skill required to handle such equipment must therefore be assessed, along with the purchasing power of the fishermen and the uses to which purchased equipment and materials will be put. With regards to purchasing power, it is important to select equipment the cost of which is within the economic range of fishermen. For equipment which fishermen cannot hope to buy, such as new fishing gear and safety equipment, subsidized prices must be set from the first in order to ensure diffusion of the equipment.

4-2 Examination of the Scale of Facilities and Equipment

The scale of Project equipment and materials was determined in accordance with the design policy.

4-2-1 Strengthening of Research and Training Activities

- A. Small-size research boat. The research boat currently owned by the SFA was built 20 years ago and its replacement has been programmed under the Project. In addition to its budget, the SFA receives US\$250,000 for research expenses under an agreement with the E.C. over fishing rights. 40% of that sum (US\$100,000 or approximately ¥16 million) is used to cover actual research costs. The present boat effects 30 to 36 trips of 2 to 3 days each per year. However, the age of the boat necessitates 2 or 3 months of dry docking every year for maintenance work and the resulting period of inactivity cannot be avoided. One consequence of this is an inability to use up the research budget, so that the amount left over has to be returned to the National Treasury. Thus, while the research boat's operating expenses are covered, the new boat should not exceed the operating expenses budget of the older one. The cost of running the research room supplied under the Project must also be borne.

Accordingly, the main engines horsepower of the new research boat should be identical to that of the old one, or 125 Hp. The latter is operated by a crew of four men that includes the skipper, who is a qualified coxswain, the chief engineer (2nd class) and two deck-hands, and this crew can man the new ship if it is supplied. Further, and with a view to the research and training plan of the SFA, two researchers or two to ten fishermen could be taken on board. This will vary according to the length of the trip: 2 fishermen for a long trip and up to 10 for a one or two day trip. The area in which the research boat will operate is within a 150 mile radius from Mahé Island. The research boat is not of the trawler type but, as serves the purposes of such a boat, it is suited to handline fishing. See figure 1.

Research and Training Plan

- 1) Development of new fishing grounds: the survey for new fishing grounds will cover Mahé and the Amirantes Plateau, and in particular the waters of the peripheral region.
- 2) Development of new fishing gear: this will be effected over the same area.
- 3) Training of fishermen, and extension of fishing gear: fishermen shall be informed of new fishing grounds and instructed in how to use new fishing gear. In particular, schooner fishermen shall be allowed onboard the survey ship to perfect their training.

B. Research Equipment. The research division of the SFA numbers 15 employees, 8 of whom are researchers, 4 crew members and another 3 are acting as observers on board foreign fleets catching tuna. In addition, another 4 staff members are currently conducting research in France, Cuba and the Soviet Union and are due to return in time for Project implementation to participate in research activities.

Until now, the research division has been using three computers to assist in the collection of data on fish production, the compilation of statistics and the assessment and supervision of tuna catches made by foreign fleets. Among other tasks performed by the research division of the SFA is the development of new fishing grounds and fishing gear and the extension of information and new technology. During Project implementation the above mentioned activities will be expanded together with the surveying of demersal fish resources in plateau waters. Such a survey has not been undertaken since 1980, the year in which the SFA's forerunner, FIDECO, conducted

research in cooperation with the FAO. The 1980 survey however indicated that the stocks of large demersal fish such as red snapper and grouper were decreasing.

It will therefore be necessary to keep this information in mind, when implementing the Coastal Fisheries Development Project, in order not to exhaust such resources. The SFA is presently establishing a research program in order to fully understand facts concerning the fish population. Information such as body length and fish age is being collected and fish gonad index analysis is being conducted over the main species of fish caught. While paying attention to the preservation of mangrove areas and their natural resources, the SFA has begun conducting basic research on the culture of the formerly widespread mangrove crab. It is for the performance of such activities that the inclusion of testing equipment in the Project was stressed. To perform such research activities, the SFA disposes of 7 researchers (4 of whom are currently doing research overseas) - the scale of the equipment has been targeted to meet the needs of 6 researchers, excluding the director - and 5 field researchers (who are employed in collecting fish production data in various regions).

Having been established recently, the SFA is affected by a lack of equipment and adequate facilities. The setting up of the Project has highlighted the urgent need for the creation of a research programme. Consequently, and based on the request for research equipment as formulated under the Project, the scope of the following equipment is regarded as appropriate.

a. precision scales

Precision scales accurate to 0.1 mg are necessary to conduct such research work as the manipulation of chemicals or plankton or the study of otoliths and dehydrated fish gonads.

b. weighing scales

The five field workers currently occupied in collecting statistics on fish catch lack appropriate scales and the collection of statistics is understandably difficult to perform. Such equipment will also be necessary for the SFA's laboratory room activities and the fishing gear assembly room. Consequently the inclusion in the Project of the following types of scales is appropriate.

0-100 g: (for weighing the internal organs of fish or the weighing of angling lines)

| | |
|-------------------------------|---------------------------|
| laboratory room | 3 units (1 for 2 persons) |
| for fishing gear assembly use | 2 units (1 is spare) |

0-1000 g: (for weighing fishing lines, small fish and pre-assembly nets)

| | |
|-------------------------------|--------------------|
| laboratory room | 3 units (as above) |
| for fishing gear assembly use | 2 units (as above) |

0-3 kg : (for weighing large fish and fishing gear)

| | |
|----------------------------------|----------------------|
| laboratory room | 3 units (as above) |
| for fishing gear assembly use | 2 units (as above) |
| for use by the field researchers | 5 units (1 for each) |

0-50 kg : (for weighing large numbers of fish and fishing gear)

| | |
|----------------------------------|----------------------|
| laboratory room | 3 units (as above) |
| for fishing gear assembly use | 2 units (as above) |
| for use by the field researchers | 5 units (1 for each) |

0-100 kg: (for weighing large numbers of fish
and fishing gear)

laboratory room 3 units (as above)

for fishing gear
assembly use 2 units (as above)

c. copier

The SFA currently employs 50 persons but there is only one photocopier. In order to expand research activities and assist in the compilation of statistics or report writing a copier is necessary.

d. desk-top calculators

11 calculators able to perform the various algebraic functions are necessary to assist in the performance of fisheries resources analysis and computations (one for each researcher and field researcher).

e. P.H. meters

2 meters (including a spare) are necessary in view of checking environmental factors in mangrove areas.

f. self-registering thermographs

2 thermographs are necessary for work in mangrove areas.

g. electric thermometers

2 thermometers (including a spare) are necessary for work on board the research boat over fishing grounds.

h. circular cutter for otolith analysis

Among the research activities of the SFA in coastal waters, the age determination of fish from

important species is of prime importance. A circular cutter (abrasive drill) is necessary to enable the counting of the rings in the otolith.

i. scalimeter

A universal projector is necessary to study fish scale rings and determine fish age.

j. refrigerator for storing specimens

A freezer is necessary to preserve natural specimens. For the purpose of natural resources surveys at least one hundred samples must be taken and measured. The average length of fish being of 30 cm, 100 fish will occupy a volume of approximately 150 l. If the actual volume of fish inside the freezer is 0.4 (occupancy rate) a 350 l refrigerator is needed.

k. refrigerator for storing chemicals

A conventional household use refrigerator is necessary to store such substances as decarbonated otoliths.

l. underwater camera

Because of the nature of the country, underwater equipment is widely available and the SFA has in the past performed underwater surveys with regards to FADs. Nevertheless the SFA's equipment is rented from ORSTOM and with a view to pursue future research and training activities to the fullest extent a small underwater camera is needed.

m. dehydrating oven

A small dehydrating oven (pyrostat) is necessary to obtain information about the dehydrated weight of various fish organs.

n. draught chamber

The installation of a small draught chamber is necessary in order to control the emanation of toxic or irritating gasses such as formalin and other chemical reagents.

o. binocular microscope (for dissections)

A low magnification microscope is necessary in order to perform research on natural resources, plankton, fish organs or the degree of maturity of fish gonads.

p. microscope equipped with a camera

A trinocular microscope of low magnifying power equipped with a camera is also necessary in order to pursue the activities mentioned above.

q. conductivity meters

To successfully expand research activities, the measurement of a primary factor, salinity, is necessary. It is essential to obtain data on the salinity of sea water in order to perform experimental aquaculture in mangrove areas, and effect research on board the research boat and in the laboratory room. In consequence a total of 6 meters is needed (2 per area of research).

r. microwave oven

A microwave oven is necessary to sterilize dissection equipment and samples in the course of experimental aquaculture. At the moment, a conventional electric oven belonging to ORSTOM is used for such purposes and consequently a similar oven is necessary under the Project.

s. scuba diving equipment

2 sets of equipment are necessary in order to perform such work as the inspection and management of Fish Aggregating Devices (FADs).

t. measuring boards

2 measuring boards (for the research boat and the laboratory room) are necessary to assess the length of fish specimens.

u. calipers

10 calipers are used for measuring fish length in the laboratory room and during field research (5 to each activity).

v. current meters

Equipment for plotting sea currents and tidal flows is necessary to conduct such work as the search for new fishing grounds, the development of fishing gear or the laying of FADs. Accordingly, the inclusion of 2 current meters amongst equipment on board the research boat is appropriate.

w. anemometers

Anemometers are necessary to assist in research boat navigation. 2 units (including a spare) shall therefore be necessary.

x. plastic sheets

500 m² of plastic sheets are necessary to construct simple ponds and conduct experimental aquaculture in mangrove areas.

y. dissection kit

2 sets are necessary to perform dissecting work on fish organs, gonads or extract otoliths.

z. glass utensils

Appropriate quantities of glass utensils, such as beakers, flasks, burettes, pipettes, regulating valves, sampling bottles, blood cell counters, funnels and pétri dishes are necessary to implement the afore-mentioned research activities.

- C. Training Material and Equipment: training equipment will be supplied to two institutions. Essential equipment such as fishing nets, hand tools and basic materials for the building of FRP boats will be necessary, with a view to the two-year practical training programme at the Polytechnic's Maritime School for the young trainees who will enter the fishing industry.

The SFA envisaged from the first the development of fish resources and fishing grounds situated in the peripheral regions of the plateaus, with an eye to their economic and resource aspects. The development of these resources is one of the core objectives of the Project. After receiving training and guidance from the SFA, some 120 fishermen are currently in a position to operate schooners in outer region waters (21 boats x average crew size of 6 men = 126 fishermen). In future, the SFA will select two or more fishermen from among those 126 to receive on board training at every trip (for short trips of one or two days it will be possible to accomodate 10 fishermen). In addition, some 330 fishermen will be supplied with inboard engine or perhaps fishing boats under the Project's plan for the modernization of the fishing industry (see below). Accordingly, training of fishermen in the use and maintenance of equipment is indispensable to the smooth management of the Project.

In the Project, some 450 fishermen (120 + 330) will be the object of training. However, training does not simply consist of practical work on board the research boat (see

above). Training and education based on the use of audio-visual equipment and materials will be conducted on land. The equipment listed below is appropriate to such training and its scale was chosen with due regards to the request made by the Seychelles government.

1) For use by the SFA

a. Overhead projector

An overhead projector is necessary in order to help explain gear assembly, illustrate fishing grounds, fish migration, etc.

b. Slide projector

Since not all fishermen will be able to go on board the research boat, a slide projector will be necessary to illustrate fishing conditions in the outer region of the plateau and the use of FADs (including underwater pictures).

c. Video set

A video set is necessary to promote and raise the efficiency of fishing operations in the peripheral waters of the plateaus. The equipment will serve to increase the rate of extension of new fishing equipment used in these waters by illustrating fishing conditions, etc.

2) For use by the Maritime School

a. Fishing gear and equipment

Though there are over 50 persons enrolled in the course on coastal fisheries and just under 20 following the course on industrial fisheries, none of the indispensable equipment is available. Similarly, fishing gear with which to catch the bait that is indispensable to the development of

handline fishing is unavailable. Basic materials needed during the two-year course at the Maritime school are necessary. Such fishing gear includes purse-seine nets, bouke nets, trawl nets to exploit pelagic fish and handlines. In consequence, minimum appropriate equipment for use at the school has been set as follows: small purse-seine nets; 1 set, basic materials for handlines; 70 sets, small bouke nets; 1 set, driftnets (30 units); 1 set.

b. Maintenance tools

There is an acute shortage of much-needed hand tools for instruction in repairs and maintenance (at present there are only 5 units per set of equipment). Such equipment is necessary and accordingly, if 1 set is allocated for 2 persons, $70 \div 2 = 35$ sets of basic hand tools will be provided.

c. Basic materials for FRP building

A course in boat building is offered at the Maritime School. Yet essential materials are unavailable and students are unable to do practical work in boat building. In recent years however, the demand for FRP boats has risen and consequently basic materials to begin practical work with regards to the latter type of boat have become necessary. Nevertheless, since the lifespan of the equipment is limited, materials for the building of one small fishing boat (5m) only will be provided under the Project.

D. Research and Training Installation

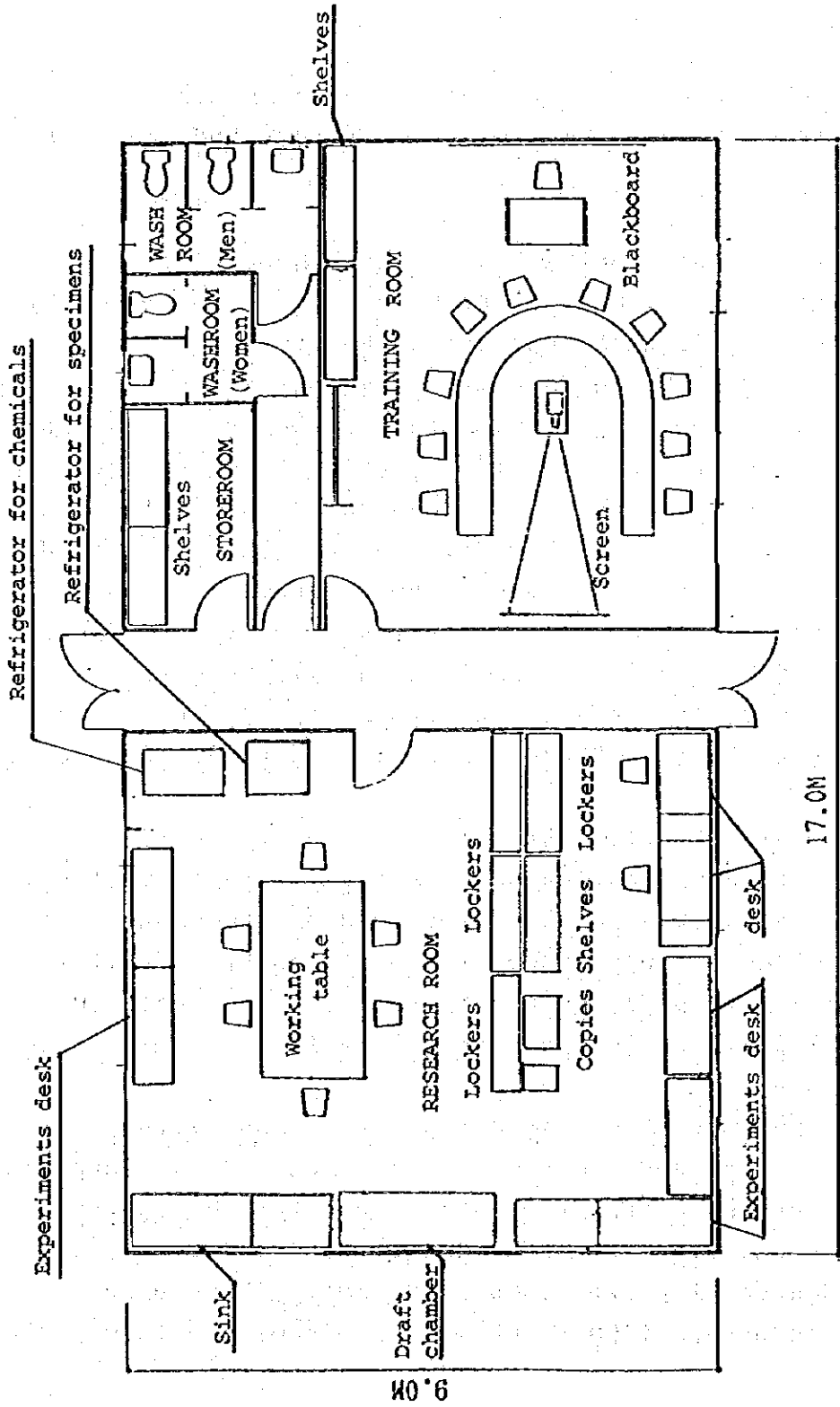
In order to ease the constraints in working space which affect the SFA and enable it to perform research and

training activities smoothly, the inclusion into the Project of a prefabricated installation is necessary. With an eye to the activities that will be undertaken, this installation shall be made of heat insulating material. The design and scale of this installation is as follows:

The research and training installation comprises a research room, a training room, a storeroom and communal space.

- 1) Research room: during Project implementation, the current number of 8 researchers will be increased by another 4. As explained above the activities that will be undertaken do not simply consist of laboratory work. For this reason, working space has been allocated for 6 persons, or half of the total number of researchers and this seems appropriate enough (the head of the division and the five field researchers are excluded). The research room is divided into a wet zone (for the treatment of fish) and a dry zone (for analytical work). Below is a break down of the space available for research work and the storing of necessary equipment. See Figure 2.
 - a. working table; a table will be provided for dissecting and measuring fish. The table will be large enough to allow for work on specimens collected for natural resources analysis (3.1 x 1.5 m). Space for chairs (0.7 m) and access (0.6 m) is taken into account, totalling 1.3 m.
 - b. experimental desks; desks are necessary for research and experiments equipment. Such equipment includes a circular cutter for otolith analysis (650 x 650 mm), a scalimeter (650 x 700 mm), a dehydrating oven (500 x 500 mm), a binocular microscope (300 x 200 mm), a microscope (300 x 300

Figure 2 RESEARCH AND TRAINING INSTALLATION



mm), a microwave oven (500 x 400 mm), a measuring board (800 x 300 mm), a precision scales (500 x 500 mm) and a conductivity meter (650 x 500 mm). The desks are ready-made and measure 650 mm by 1,800 mm or 650 mm by 1,200 mm respectively.

| | | No. of desks |
|------------|--------------------------------------|--------------|
| Large desk | circular cutter | 1 |
| | scalimeter | 1 |
| | microscope (2) | 1 |
| | dehydrating oven + microwave oven | 1 |
| | conductivity meter | 1 |
| Small desk | precision scales | 1 |
| | measuring board | 1 |
| Total | | 7 |

The desks will be aligned against the wall with sufficient elbowroom.

- c. research desk; a desk is supplied to allow two researchers to write reports, make calculations and analyse the results of experiments. With reference to data collected by the Japanese Association of Architects, the size of the desk was established at 4 m² per person, totalling 8 m².
- d. draught chamber; with a view to its maintenance there shall be a 0.2 m space on both sides of the chamber.
- e. refrigerator for storing chemicals; space allocation is effected with due consideration for radiant heat.
- f. refrigerator for storing specimens; space allocation is effected with due consideration for radiant heat.

g. copier; will be positioned with due consideration for the space needed for maintenance, operation and radiant heat. Further, extra space must be available at the front of the machine for the supply of paper.

h. shelves; shelves and lockers are necessary. These consist of ready-made materials, 1,800 x 450 mm. Numbers are indicated below:

| | Units |
|------------------------|----------|
| for storing: chemicals | 1 |
| glassware | 1 |
| experimental equipment | 2 |
| <u>files and data</u> | <u>1</u> |
| Total | 5 |

Access to these shelves is accounted for.

i. sink; a sink equipped with a sieve is necessary for experimental work.

Below is a break down of space available for each item.

| Item | Actual space | Access space | Total space |
|----------------------------|--------------|--------------|-------------------|
| Working table | 4.5 | 18.5 | 23 |
| Experiments desk | 7.41 | 5.59 | 13 |
| Research desk | 2.16 | 5.84 | 8 |
| Draught chamber | 2.3 | 2.7 | 5 |
| Refrigerator for chemicals | 1.2 | 1.4 | 2.6 |
| Refrigerator for specimens | 1.0 | 1.9 | 2.9 |
| Copier | 0.96 | 2.04 | 3 |
| Shelves | 4.05 | 6.45 | 10.5 |
| Sink | 1.8 | 2.2 | 4 |
| Total | 25.38 | 46.62 | 72 m ² |

- 2) Training room: the SFA plans to organize two training sessions per month over the two-year period of the Project. Training will focus on equipment usage and maintenance and the fishing techniques to be used in grounds outside the plateau. Thus, 450 fishermen + 24 months + 2 sessions per month = 10 men. A room able to accommodate 10 fishermen is therefore necessary. This room will be equipped with audiovisual equipment such as a slide projector and a video. The screen and the blackboard shall both be placed at a minimum distance of 2 m from the trainees. In the main room shall be 2 shelves for video cassettes and slides and a mobile board (white) shall also be provided. Japanese standards for the construction of video rooms of 40 to 50 persons are available ($2.5 - 3.5 \text{ m}^2/\text{person}$). For rooms of a smaller number of persons, 150 % of the above standard is employed and thus 3 m^2 per person $\times 1.5 \times 10 = 45 \text{ m}^2$. A surface area of 45 m^2 is necessary.
- 3) Storeroom; is required to house the spare parts of equipment on board the research boat (2.0 m^3), the scuba diving set (0.5 m^3), pipe chairs and such like (0.3 m^3). The occupancy rate of shelves in the room and the storing rate of the shelves are assumed to be 0.4 each. The total volume required is thus $2.8 \text{ m}^3 + 0.4 + 0.4 = 3.6 \text{ m}^3$. The height of the room being of 2.5 m, the necessary surface area becomes $3.6 + 2.5 = 7 \text{ m}^2$.
- 4) Communal space; 2 toilets are available for men and 1 for women. A washroom is available for each. Communal space also includes corridors and space interposing the research and training rooms.

Total space is indicated below. See Figure 2.

| | |
|----------------|--------------------|
| Research room | 72 |
| Training room | 45 |
| Storeroom | 7 |
| Communal space | 29 |
| <hr/> | |
| Total | 153 m ² |

4-2-2 Modernization of the Fishing Industry

A. Inboard engines and spare parts. Under the Project the SFA strongly urges modernization of the fishing boats' engines through the change to inboard engines, which it believes to be of crucial importance. The following effects are expected to take place.

- 1) The majority of the fishing population will stop using inappropriate small-size boats equipped with outboard engines such as pleasure boats which make fishing difficult and are not safe in rough seas.
- 2) The electrical system of outboard engines often fails in the course of fishing activities and this can be dangerous. Fuel costs and other operating costs are also high. In comparison, inboard engines have relatively few problems with regards to maintenance and fuel costs are low.
- 3) The electric power drive supplied by inboard engines allows the use of electric fishing reels, safety equipment, fish-finders and other equipment. Besides being labour-saving, such engines have a high utility factor and are comparatively safe. The SFA's policy for the shift to inboard engines is linked to the government's financial assistance plan for boat building. See table below.

Table 3. Boat Construction Programme

| Type of boat | 1987 | 1988 | 1989 | 1990 | Total |
|--|--------------|--------------|--------------|--------------|----------------|
| Minimahé (outboard engine) *1 | (4) | (2) | (1) | - | (7) |
| Prototype boat (12 Hp engine) | - | 6 | 10 | 10 | 26 |
| Lekonomi (12 Hp engine) | 17 | 15 | 12 | 6 | 50 |
| Whaler (27 Hp engine) | 8 | 8 | 7 | 3 | 26 |
| Schooner (small) (37 Hp engine) | 5 | 6 | 5 | 5 | 21 |
| Schooner (large) (56 Hp engine) | 1 | 2 | 3 | - | 6 |
| AfDB boat (medium) (100 Hp + engine) *2 | (2) | (1) | - | (1) | (4) |
| Total | 31(6) | 37(3) | 37(2) | 24(1) | 129(11) |

*1 Except in areas where it cannot be dispensed with (such as coral reefs), the SFA does not intend to encourage the use of this type of boat for fishing purposes. Fishermen using it do not feature as one of the groups targeted under the Project. This is due to the fact that the scale of operations of these fishermen and the potential for modernization of this way of fishing are very small.

*2 The African Development Bank's Victoria Fishing Port Development Plan includes the building of medium-size fishing boats. Fishermen participating in this plan are not considered under the Project, since they already derive benefits from the Bank.

Excepting the medium-size fishing boats which are financed by the African Development Bank however, there is no financial assistance plan to facilitate the purchase of inboard engines. Consequently, the supply of the necessary engines and basic materials for boats constructed in 1987 and 1988 is appropriate in order to implement the Boat Construction Programme. With regards to the inboard engines of boats similar to the Minimahé (called 'prototype boat' under the Project), the delivery of these prototypes and their moulds is likely to take place in early 1988. The boats built in 1988 and 1989 will therefore be the object of this assistance. The size and number of inboard engines provided under the Project is indicated below:

| | <u>Units</u> | <u>Recipient Boats</u> |
|--------------|---------------|--------------------------------------|
| 12 Hp engine | 48 (16+32) | Prototype and Lekonomi type boats |
| 27 Hp engine | 16 | Whalers |
| 37 Hp engine | 11 | Schooners (small) |
| 56 Hp engine | 3 | Schooners (large) |
| <hr/> | | |
| Total | 78 | |

Spare parts for inboard engines will be supplied for a period of two years and larger spare parts will be supplied in adequate numbers. Equipment for the stern assembly of the ship and outfittings essential for boat building shall also be provided.

In Seychelles, 90% of fishing boats are powered by engines. Of these 28% are powered by inboard engines and this proportion will rise to 43% under the Project. From the point of view of the diffusion of these engines, the Project can be considered to be of immense value.

B. Fishing Gear and Equipment. In addition to the inboard engines mentioned above, fishing gear and equipment shall be supplied under the Fishing Industry Modernization programme. The boats and fishermen covered by the programme are the following:

| Type of boat | Number of boats | Average crew size | Total workforce |
|---------------------|-----------------|-------------------|-----------------|
| Prototype boat | 16 | 2 | 32 |
| Lekonomi | 32 | 3 | 96 |
| Whaler | 16 | 5 | 80 |
| Schooner (small) | 11 | 6 | 66 |
| Large-size schooner | 3 | 6 | 18 |
| Total | 78 | | 332 |

a. Fish-finders: besides enabling fishermen to directly detect fish in the uneven plateau waters and at the bottom of coral reefs, fish-finders also help in acquiring knowledge of the configuration of the seabed and detecting fish schools. The demand for these fish-finders is high, since a few boats are already equipped with small ones and some fishermen are therefore acquainted with their use. Under the Project 46 newly-built boats will be supplied with such equipment, with the exception of Lekonomi class boats, which cannot accommodate such equipment for lack of space.

b. Electric fishing reels: the seabed of the peripheral plateau region, whose resource exploitation the SFA is promoting, slants steeply towards the deep. These waters are rich in fish resources and their exploitation has become a matter of great concern. However fish is found at depths of about 200 m so that exploitation using the current handlines is

difficult. By using the electric power drive supplied by the new inboard engines, fishing with the reels provided under the Project should prove labour-saving and efficient. In addition, the proportion of large fish caught in coastal waters being high, the use of electric reels in plateau waters should also be beneficial and labour-saving. However, the use of such reels in waters which are not rich in fish resources is not advisable, since this is likely to prove uneconomical. Consequently, the boats to be supplied with such equipment under the Project are large-size schooners, which are capable of fishing in the peripheral plateau waters. For maximum efficiency in catching fish, fishing lines are usually set at intervals of at least 3 m over the ship's boardside. This offers the possibility of setting up 4 reels on a small schooner and 5 on a large one. This gives a total of 11 boats x 4 reels + 3 boats x 5 reels = 59 reels to be supplied under the Project.

- c. **Small Magnetic Compasses:** although they are not strictly speaking fishing equipment, small compasses are requested under the Project. A number of large fishing boats (schooners) are equipped with compasses but small fishing boats are actually conducting navigation without such equipment and they find fishing grounds by relying on experience. The SFA has in recent times been promoting the use of Fish Aggregating Devices (FAD) and fishing in their vicinity necessarily requires a certain control over direction. For this purpose, the Project has planned the equipping with small compasses of the fishing boats concerned. This amounts to 78 small magnetic compasses.
- d. **Fishing Gear:** the total number of professional Seychellois fishermen operating in coastal and

offshore areas amounts to 1,300. The following indicates the class of boats used and the number of fishermen operating them (Table 4).

Table 4 Coastal and offshore fishing population (1986)

| Type of boat | Numbers fishing without boat #1 | Small fishing boats | | | Large fishing boats | | |
|-------------------|---------------------------------|---------------------|----------------------|-----|---------------------|-----------|-------------|
| | | without engine #2 | with wooden hulls #2 | FRP | Whalers | Schooners | Large boats |
| Number of boats | | 32 | 55 | 121 | 45 | 24 | 2 |
| Average crew size | | 1 | 4 | 3 | 5 | 6 | 10 |
| Total work-force | Approx. 300 | 32 | 220 | 363 | 225 | 144 | 20 |
| | | | | | | Total | 1,304 |

*1: Although there are no reliable statistics available, approximately 300 fishermen operate from the shoreline with handlines, collect sea shells from coral reefs or dive to catch octopuss, etc.

*2: These figures are as of 1985.

The stagnation of Seychelles' fishing industry is commonly explained in terms of the aging of the labour force and the obsolescence of the equipment. In reality, however, another factor is at work, namely the shortage of equipment in Victoria's fishing gear shops. With the recent stagnation of the tourist industry and the resulting stringency of the foreign exchange market, fishing equipment dealers have favoured investment into high-profit fishing cruises for tourists and into trolling. In addition, because the effects of projects implemented under the latest National Development Plan are not yet fully felt, the development of fisheries is not thoroughly under way and imported fishing gear and equipment are consequently unavailable. Fishermen are currently using old equipment that needs constant repairs and is inadequate for the purposes of the Coastal Fisheries Development Project. Though there is every reason to expect an improvement, the Project may run into difficulties under such circumstances. Consequently, the inclusion of fishing gear into Project equipment should prove efficient. Based on its experience in selling and distributing fishing gear, the SFA wishes to be supplied with unassembled materials (with the exception of demonstration equipment) for the following three reasons:

- 1) the equipment can be sold to fishermen at a cheaper price.
- 2) characteristically, fishermen have been known to turn down new equipment.
- 3) materials supplied unassembled can be combined with others or converted to other uses.

Fishermen operating without fishing boats basically do not require fishing equipment and they are therefore excluded

from the number of fishermen benefiting from the Project. Approximately 1,000 fishermen own boats and under the Project a further 332 will be supplied with inboard engines. Equipment provided under the Project will therefore be targeted at 1,332 fishermen, and the quantity of equipment is decided accordingly.

Fishing line equipment:

in Seychelles fishing with lines is the most common method. Among such gear handlines are used because of their simplicity. Though the use of troll lines and vertical longlines is not widespread, the advent of sports fishing has incited their inclusion into gear and equipment requested under the Project. In consequence, these three kinds of fishing gear will be supplied. Fishermen commonly utilize three different types of handline and troll line to adjust to varying fishing conditions. The expected life span of this gear being of 6 months, 4 sets of replacements will be needed to cover the two-year period of the Project. Accordingly, fishing line gear will be supplied in the following quantities.

For boats being supplied with inboard engines;

| | |
|--------------------|---------|
| handlines | 3 types |
| troll lines | 3 types |
| vertical longlines | 1 type |

| |
|------------------------|
| 7 types |
| x 4 replacements |
| <u>x 332 fishermen</u> |
| 9,296 sets |

For the remaining 1,000 fishermen;
(handline fishing being the most common activity)

handlines

1 type

x 4 replacements

x 1000 fishermen

4000 sets

=====

Total 13,296 sets

Fishing nets:

gillnet for trevally (mesh size 70 mm); though approximately 10% of whalers use gillnets to catch trevally, these nets are in poor condition. Of the total number of whalers (45 whalers + 16 whalers to be equipped with inboard engines = 61 boats) 10%, or 6 boats, will therefore be supplied with the necessary quantity of gillnets.

Beach-seine nets; beach-seine is the main fishing technique used in Seychelles' coastal waters and it allows fishermen to secure the bait for handlines. However, since the area in which beach-seine nets can be used is limited by the highly extended coral reefs around the islands, 7 nets will be supplied for use in the 7 main fishing grounds suited to such fishing techniques.

Mackerel gillnets (mesh size 45 mm); out of the 208 small fishing boats, some 10% are catching striped mackerel with mackerel gillnets. Consequently 10%, or 20 boats, will be equipped with such gillnets.

Shark gillnets (mesh size 180 mm); the abundance of sharks in Seychelles waters is well known. Nonetheless, the market for sharks is comparatively small and a mere 2% of the small boats catch such fish by using comparatively old equipment. Consequently 2%, or 4 boats, will be supplied with such nets.

In addition to the fishing gear that will be sold to fishermen, the SFA plans to set up Fish Aggregating Devices. The current 5 FADs have proved to be effective and the supply of a further 5 FADs seems appropriate. These will be composed of materials such as metal wiring.

Below is a summary of fishing gear to be supplied under the Project.

| | |
|-----------------------|------------|
| Handlines | 7,984 sets |
| Trawl lines | 3,984 sets |
| Vertical longlines | 1,328 sets |
| Gillnets for trevally | 6 sets |
| Beach-seine nets | 7 sets |
| Mackerel gillnets | 20 sets |
| Shark gillnets | 4 sets |
| FADs | 5 sets |

- C. Communication and Safety Equipment. This equipment is included in the Project in order to promote safety conditions in the fishing industry.

Communication equipment; such equipment is of great value in the performance of fishing activities or perhaps in times of emergency and its inclusion in the Project should be beneficial. Although a number of large schooners are equipped with Single Side Band radio-telephones (SSB), the high cost of such equipment prevents it from becoming widely used. The cheaper VHF equipment, on the other hand, does not allow for communication from the outer plateau areas. Under the Project, 3 large schooners equipped with 56 Hp inboard engines and able to operate in fishing grounds situated in the outer region of the plateau will be provided with SSB systems (3 sets). At present, maritime communications are handled by the Telecommunications Authority, which transmits messages to the receivers by telephone.

Safety equipment; disasters at sea have become fewer. However, in order to promote the development of coastal fisheries and the participation of the young, it is important to establish a system to uphold safety and foster the creation of a better image for the fishing industry. It is usually necessary to coerce fishermen into equipping their boats with safety equipment and, accordingly, the SFA is currently preparing legislation to oblige fishermen to do so. Under the Project, the following shall be sold under the heading of engine spare parts at discount prices as a first step.

- (1) life buoys; in view of the space available for equipment, 2 will be distributed to each of the 14 schooners who engage in fishing activities in distant areas.
- (2) flares; for the same reason 2 will be distributed to each of the 14 schooners.
- (3) life jackets; in view of the fact that they are relatively cheap and take up little space, each crew member of the boats being equipped with a new inboard engine under the Project will receive a life jacket.

D. Prototype Fishing Boat. To assist in the change to inboard engines, the SFA was developing an inboard engine fishing boat identical to the Minimahé in large numbers. From the point of view of low price and light weight, however, it was not able to achieve this. Though the technical skill required to build FRP boats exists in Seychelles, no staff is available to lay out a plan. Accordingly, the request for the introduction into Seychelles of a prototype boat is included in the Project. The boat shall be under 6 m in overall length, weigh under 400 kg (because the cost of building boats at the local yards stands at 75 rupees/kg

for FRP boats the aim is to build a boat whose cost will not exceed 30,000 Rupees - approximately ¥800,000; the selling price of the Lekonomi is 60,000 Rupees) and be powered by a 12 Hp engine in order to comply with the request. After delivery and confirmation as to its effectiveness, the SFA will order its construction at the two FRP boat yards operating in Mahé and its subsequent distribution and diffusion to fishermen. Accordingly, two prototype boats and two moulds are requested in the Project. See figure 3.

- E. Prefabricated Installation. An installation in which to use and store the fishing gear supplied under the Project is necessary. The function and scale of the maintenance room and its adjacent space is discussed below.

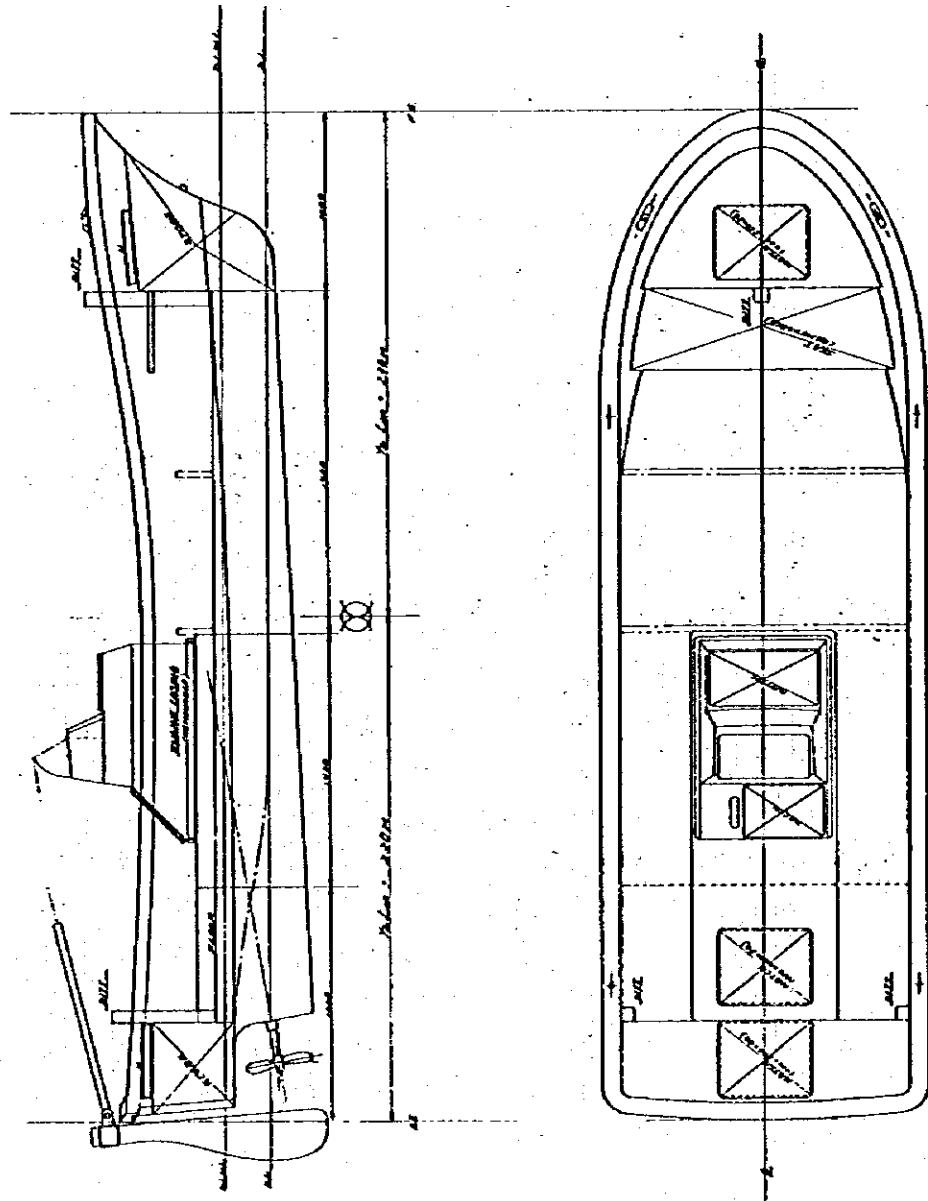
4-2-3 Strengthening of the Machinery Maintenance System

- A. Essential hand tools and vehicle. Tools are requested in the Project, in order to complement the system under which the servicing and maintenance of the inboard engines that form the core of the equipment supply is effected. The SFA is currently using a disused room as a maintenance workshop and essential equipment such as an electric lathe is available.

After assessing the request for Grant Aid, the inclusion in the Project of hand tools and repairs equipment is judged to be appropriate. Under the SFA's organization, work on inboard engines is currently performed in the room mentioned above and, in order to move equipment in or out, a fork lift is rented from the SMB. With the delivery of the 78 inboard engines, however, repairs and maintenance of the equipment is certain to become very difficult. With a view to avoiding such problems, a truck equipped with a crane is necessary in order for equipment to be handled and repaired smoothly.

Figure 3 PROTOTYPE FISHING BOAT

- DIMENSIONAL PARTICULARS —
- LENGTH OVER ALL — 52.0 —
- BREADTH MAX — 12.0 —
- DEPTH — 0.70 —
- DRAUGHT — 0.15 —
- DISPLACEMENT IN TONS APPROX — 2.15 —
- MAIN ENGINE — 9 P.S. —
- SERVICE SPEED — 4 KNOTS —
- COMPLEMENT — 2 —
- F.O.T. CAPACITY — 20 L —
- GROSS TONNAGE (NET) — 0.7 —



— 5.6 METERS ENGINE ROOM FOR 2 PERSONS —

— SCALE: 1/20 —

Type and number of necessary equipment.

- a. hand tools; set of Allen keys, set of tap and dice, set of ratchet-spanners, drill set, hand tools set, bearing puller, punching machine for packing, grease gun, electric drill, ignition checker, etc: 1 set.
 - b. other tools; welding machine, working table, electric cutter, multi-purpose water pump.
 - c. truck equipped with a crane.
- B. Equipment Maintenance Complex. The SFA has expanded rapidly following its establishment and it now numbers 50 employees. The main office building is as yet unbuilt and equipment maintenance is consequently difficult. For this reason, a prefabricated installation is requested in the Project, which will include a maintenance room, a store room for spare parts, a store room for fishing gear and a room for the maintenance and assembly of fishing gear. These are all necessary for the smooth implementation of the support and maintenance system.

Scope: the following facilities are necessary for the maintenance complex.

1. maintenance room
 2. storeroom for spare parts
 3. storeroom for fishing gear
 4. fishing gear assembly room
 5. communal space
1. Maintenance room; moving machinery in and out of the disused room which serves as the SFA's maintenance room is bothersome, since there is no road access to

it. Difficulties are therefore bound to arise when the large quantities of material and equipment supplied are delivered. In view of this, the inclusion of minimum space maintenance facilities in the Project is necessary. The scale of this room is computed so as to allow maintenance of the Project's inboard engines and other equipment as well as the outboard engines which the SFA has been repairing up to this day. The electric lathe, injection tester, vice and its base, electric drill and compressor which are currently kept in the disused room will be moved. In addition, a 1 ton crane for the moving of equipment around the workshop shall be affixed to the ceiling.

Work to be performed in the maintenance room is listed below.

- a. overhaul of inboard engines
- b. maintenance of outboard engines
- c. maintenance of propellers and stern assembly parts
- d. cleaning of inboard engines

a. Overhaul of inboard engines

78 inboard engines will be supplied under the Project and these have to be overhauled once every three years. A complete overhaul is effected in 2 weeks, so that the total number of days of work per year is the following:

$$78 \text{ engines} + 3 \times 14 \text{ days} = 364 \text{ engine/days per annum}$$

Taking the number of working days per annum to be 200 days:

$$364 \text{ engine/days} + 200 \text{ days} = 1.8 \text{ engines per day}$$

Space is required for the dismantling of the small inboard engines (12-56 Hp) supplied under the Project. Approximately $2.5 \times 3.5 \text{ m} = 8.75 \text{ m}^2$ are required per engine.

Consequently: $1.8 \text{ engine/days} \times 8.75 \text{ m}^2 \div 15\text{m}^2$ are necessary for overhaul activities.

b. Maintenance of outboard engines

The SFA has been performing maintenance work on outboard engines in its present facilities. There are some 200 of these engines and small maintenance work is required every year. The average time necessary to perform this work is 3 days per engine, so that:

$$200 \text{ engines} \times 3 \text{ days} \div 200 \text{ days (average working days per annum)} = 3 \text{ engines per day}$$

Space required for the performance of such work is:

$$3.3 \text{ m}^2 \times 3 \text{ engines per day} = 9.9 \text{ m}^2 \div 10 \text{ m}^2$$

c. Maintenance of propellers and stern assembly parts

Stern assembly parts must receive a complete check every five years, and this usually takes two weeks. With regards to the 78 engines supplied:

$$78 \text{ engines} \div 5 \text{ years} \times 14 \text{ days} \div 200 \text{ days} = 1.0 \text{ engine per day.}$$

Space required for overhaul and adjustments is the following (for the propeller, shaft and other parts):

$$3.0 \times 1.5 = 4.5 \text{ m}^2. \text{ Consequently a total space of: } 4.5 \text{ m}^2 \times 1 \text{ engine per day} = 4.5 \text{ m}^2.$$

d. Cleaning of inboard engines

Small work on engines such as simple repairs and the overhaul of small parts must be effected at least once a year. Work can be performed in 1.5 days so that $78 \text{ engines} \times 1.5 \text{ days} \div 200 \text{ days} = 0.6 \text{ engines per day}$ space required is the following: $1.8 \times 1.8 = 3.24 \text{ m}^2$, and total space required will be: $3.24 \times 0.6 = 2 \text{ m}^2$.

Besides the functional space mentioned above the following space is also necessary.

- e. Space for moving equipment and tools
- f. access space

e. Space for moving equipment and tools

Space in the maintenance room for using the battery charger, the electric welder and other implements is necessary. In this case the battery charger will occupy 0.5 m^2 , the welder 0.3 m^2 and other tools 0.2 m^2 , totalling 1.0 m^2 .

f. Access space

Access space allowing each function to be performed is required. A hoist will be affixed to the ceiling, so that transporting heavy equipment will not be necessary. Access way of a width of 1 m should therefore be sufficient.

Space requirements

| | |
|---------------------|---------------------|
| engine overhaul | 15 |
| maintenance | 10 |
| stern assembly work | 4.5 |
| small repairs work | 2 |
| moving implements | 1 |
| | <hr/> |
| | 32.5 m ² |

Listed above is the net space for the performance of various tasks. Access space is also necessary. In the case of an installation such as the maintenance room, net space of 80% is required so that $32.5 \times 0.8 = 26 \text{ m}^2$. The surface of total working space is thus: $32.5 + 26 = 58.5 \text{ m}^2$.

Existing equipment will be transferred from the present room to the new maintenance room. Additional space is therefore necessary.

- 1) Electric lathe: the dimensions of the lathe are 0.6 x 1 m space between the lathe and the wall and for maintenance amounts to 0.4 m. In addition, the propellor shafts of engines supplied under the Project measure 4 m, and a 5 m leeway is necessary on the side of the lathe from which materials are introduced. Accordingly a surface of 10.5 m² is necessary for operating the lathe.
- 2) Working tables: total space being limited, tables of 0.7 x 1.5 m will be installed on which to perform small work and place small tools. The main working table will be constituted of 2 of these tables and 'island space' around it totals 11.9 m². The two other tables require a 5.25 m² space each.
- 3) Bench drill: the present drill measures 0.6 x 0.5 m. For performing work, space of 0.8 m on both sides of the drill is necessary. A total working space of 3.3 m² is required.
- 4) Vice: the present drill which shall be moved to the new room, measuring 1.0 x 1.0 m. A 6.0 m² working space is required.
- 5) Other equipment transferred: a compressor, battery charger, welder and injection tester will be kept in the maintenance room. Necessary adjacent space is the following:

| | | |
|------------------|-------------|--------------------|
| Compressor | 1.7 x 0.8 | 1.36 |
| Battery charger | 1.0 x 0.8 | 0.8 |
| Welder | 0.6 x 0.9 | 0.54 |
| Injection tester | 1.0 x 1.0 m | 1.0 m ² |
| <hr/> | | |
| Total | | 3.7 m ² |

Accordingly total space required for equipment transferred is as follows:

| | |
|-----------------|-------------------------|
| Lathe | 10.5 |
| Working tables | 27.65 (5.25 x 3 + 11.9) |
| Bench drill | 3.3 |
| Vice | 6.0 |
| Other equipment | 3.7 |

| | |
|-------|----------------------|
| Total | 51.15 m ² |
|-------|----------------------|

Additional space of $2 \times 2.5 = 5 \text{ m}^2$ is required for storing steel pipes, L or H shaped steel bars, etc.

Accordingly total space required in the maintenance

| Space Name | | Total Space (m ²) |
|-----------------------|--------------------|-------------------------------|
| Working space | Real working space | 32.5 |
| | Access Space | 26.0 |
| Equipment transferred | | 51.5 |
| For storing materials | | 5.0 |
| Total | | 114.65 |

2. Storeroom for spare parts; until now the SFA has effected the sale to fishermen of fishing gear and engine spare parts through its subsidiary, Indian Ocean Marine, Ltd. This company owns a storeroom for spare parts with an 88.36 m² surface area, a 94 m² shop, and it has been storing equipment and distributing it from these facilities. There is no space however for storing Project spare parts. To get round this problem, it might be helpful to keep large Project equipment and inboard engines in the crates in which they will have been packed in Japan and use these containers as makeshift stores until the time

of the sale of this equipment. If small equipment and spare parts are not controlled and regulated, the sale is unlikely to occur. The following space will be needed for housing and controlling equipment under the Project.

| Equipment | Units | Volume | Total Volume (m3) |
|-------------------------|-------|--------|-------------------|
| Fishing reel | 59 | 0.1 | 5.9 |
| Fish-finder | 46 | 0.06 | 2.76 |
| Battery | 14 | 0.04 | 0.56 |
| Electric generator | 14 | 0.04 | 0.56 |
| Communication equipment | 3 | 0.08 | 0.24 |
| Tool spares | 1 | 0.8 | 0.8 |
| Compass | 78 | 0.008 | 0.6 |
| Life jacket | 332 | 0.03 | 10.6 |
| 12 Hp engine | 48 | 0.6 | 28.6 |
| 27 Hp " | 16 | 1.0 | 16.0 |
| 37 Hp " | 11 | 1.3 | 14.3 |
| 56 Hp " | 3 | 1.6 | 4.8 |
| Engine spare parts | | | 12.7 |
| | | | 98.42 m3 |

Some of the equipment listed above can be kept in the containers in which it was delivered. However, other equipment such as fish-finders, batteries, generators, tool spares, compasses, engine spare parts and communication equipment must be stored properly. The volume necessary for this is of 18.22 m³. If stored on the shelves that are situated in the storeroom, we may assume an occupancy rate of 0.4. Further, the height of the shelves being of 2.4 m and their width being of 0.6 m, we obtain:

$$18.19 \div 0.4 \div 2.4 \div 0.6 = 31.6 \text{ m}$$

Accordingly, shelves of a length superior to 31.6 m are necessary. In addition, a 1 m elbowroom is allocated for the 2 types of shelves as follows.

$$1.5 (x 2.4 x 0.6) x 14 = 21$$

$$1.8 (x 2.4 x 0.6) x 7 = 12.6$$

$$33.6 \text{ m}$$

Accordingly, storeroom space occupied by shelves is $33.6 \text{ m} \times 0.6 \text{ m} = 20.16 \text{ m}^2$, access space is 29.84 (46% of the shelves) and total space is 50 m^2 .

3. Storeroom for fishing gear; as explained above, Indian Ocean Marine, Ltd. does not possess facilities in which to store fishing gear and equipment. Nevertheless, fishing equipment supplied under the Project must be stored, in order to avoid being damaged by humidity or rats. Since there is little space available, nets and other equipment can be stored in the containers in which they were delivered. Yet at the time and place of selling, great care will have to be exercised and small gear closely controlled. Further amongst the 72 m^3 of fishing tackle supplied under the Project are smaller parts such as fish hooks and lines which have to be stored adequately. This small gear makes up 15% of the fishing tackle and, accordingly, a volume of 10.8 m^3 must be stored on shelves. Space occupancy being of 0.4, a shelf space of 27 m^3 is necessary. These shelves are 2.4 m high and 0.5 m wide.

Thus $27 \text{ m}^3 \div 2.4 \text{ m} \div 0.5 \text{ m} = 22.5 \text{ m}$. This is the total length required for the shelves. Taking 1.8 m to be an adequate length for shelves we obtain $22.5 \div 1.8 = 12.5$. 12 shelves shall therefore be required in the room. Adding a 1 meter elbowroom all round we obtain a total surface area of 25 m^2 (10.8 m^2 of shelves and 14.2 m^2 of access space).

4. Fishing gear assembly room; fishing gear provided under the Project will be sold to fishermen through Indian Ocean Marine, Ltd. On the basis of past experience, a request was made for unassembled fishing gear (with the exception of demonstration equipment). Accordingly, the fishing gear assembly

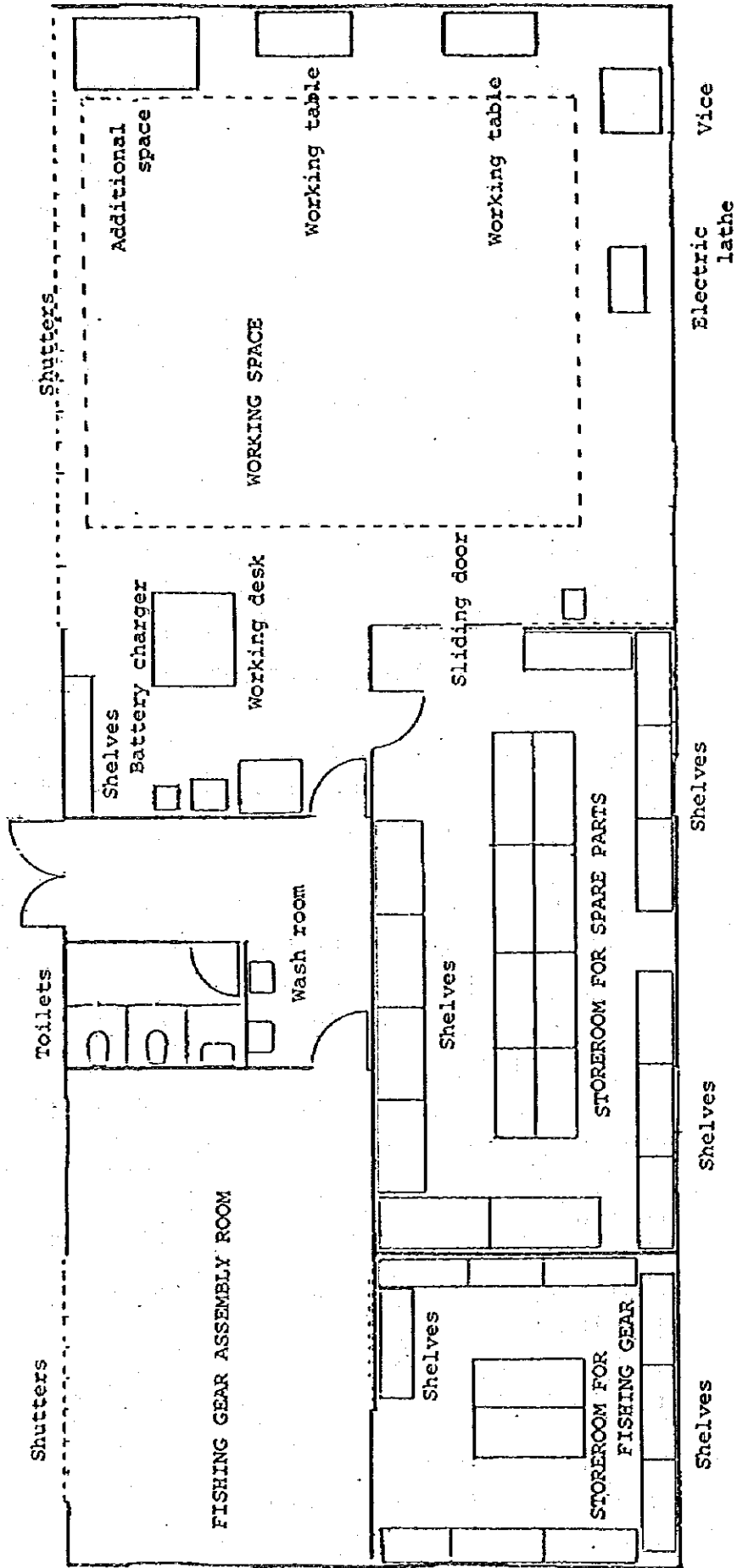
room shall be contiguous to the storeroom and guidance over the use and assembly of fishing gear can be given there. Further, the SFA's fishing gear research activities have so far been conducted in the maintenance room for lack of adequate facilities. However, this room is scheduled to be evacuated under implementation of the Project and, with the delivery of a new research boat with which to conduct research activities, a more suitable assembly room has become necessary.

Consequently, space allowing the repair of nets is required. Among the nets to be sold to fishermen are gillnets (50 m x 30 units = 1,500 m) of a height of 4 m. Accordingly, the dimensions of the assembly room will be the following. A minimum of 5 m is required for the width (4 + 1.0). Folding the nets when repairing can be done but a length twice that of the width is still necessary. Therefore, the assembly room will measure 5 m x 8 m = 40 m².

5. Communal space; for entrance, toilets and washing room, space amounting to 20 m² is necessary. The total area of the complex for the maintenance of fishing gear is as follows. See figure 4.

| Room | Size | |
|------------------------------|-------|--|
| Maintenance Room | 115 m | Height 4 m, movable crane fixed to ceiling |
| Storeroom (spare parts) | 50 m | Height 3 m, shelves available |
| Store room (fishing gear) | 25 m | Height 3 m, shelves available |
| Assembly room (fishing gear) | 40 m | Height 3 m, waist high outside wall |
| Communal space | 20 m | |
| Total area | 250 m | |

Figure 4 EQUIPMENT MAINTENANCE COMPLEX



4-2-4 Improvement of the fish distribution system

- A. Polystyrene box moulding machine for the transportation and handling of fish. Under the Project the supply of a moulding machine is necessary for the manufacture in Seychelles of polystyrene boxes. These boxes are used for the preservation of fish as well as for transportation during the export of chilled fish. Polystyrene beads, the raw materials, can be imported from South Africa. The amount of foreign exchanges saved by not having to import such boxes should be substantial.

The SMB is currently exporting 100 tons of chilled fish every year. For transportation purposes 4,000 boxes are imported. Exports have recently risen by 25% (1983-1985), so that the number of boxes required for the transportation of fish during the Project will increase by 1,000 to 5,000: $[(100 \text{ tons} + 25 \text{ tons}) + 25 \text{ kg per box}]$. Under the Project 332 fishermen will be supplied with 3 boxes each. The total production capacity of the moulding machine is 6,000 boxes per annum. The equipment consists of the two parts of the machine (for the lid and main body of the box), the boiler, pre-foaming machine, treatment tank, compressor, etc.

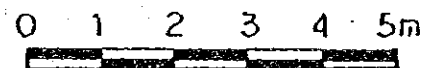
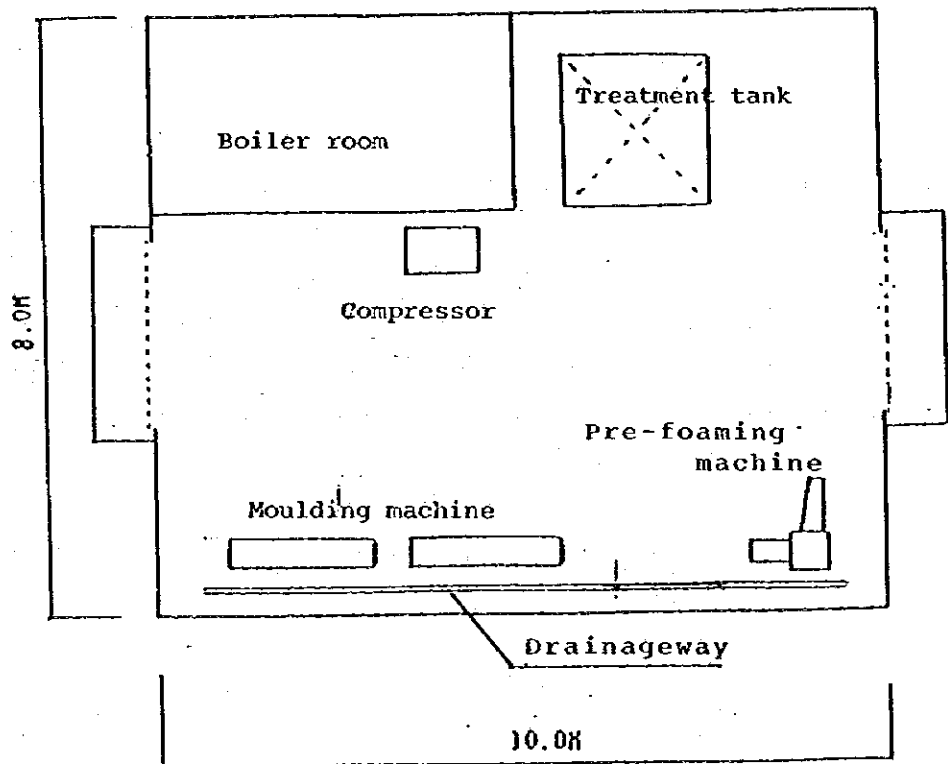
- B. Installation for the moulding machine

A boiler room is incorporated into the room for the box moulding machine (See Figure 5). The dimensions of both rooms are computed according to the following space requirements:

- 1) Boiler room; the boiler room is used for the heating of the polystyrene beads. The equipment consists of the boiler itself (2.5 x 1.2), a water tank (0.8 x 0.8) and a steam header (0.3 x 1.0). The boiler room can reach high temperatures and as such its equipment must be frequently inspected and maintained. For

Figure 5

INSTALLATION FOR THE BOX-MOULDING MACHINE



this purpose a minimum space of 0.7 m is necessary in between each machine, so that a total area of 15 m² is required. The walls shall be made of heat-insulating material.

- 2) Moulding machine room; the equipment installed in this room consists of the treatment tank, the pre-foaming machine and the moulding machine itself.
 - a. Treatment tank; pre-foamed materials are stored in the tank. Room to walk around the tank is necessary. Space required is of 3.4 x 3.4 = 12 m².
 - b. Pre-foaming machine; it is essential to pre-foam materials prior to inserting them into the moulding machine. Required space amounts to 2.6 x 2.6 = 7 m², including 0.7 m of walking space.
 - c. Moulding machine; two separate parts make up the machine (organ type). 4 m in vertical space are required to operate the machine. The box itself and its cover are made separately by using the two units of the machine. Space required by the machine (2 x 0.6 m) and working space amount to 8m².
 - d. Working space; space of 25 m² is necessary to perform work around the pre-foaming machine, the treatment tank, the moulding machine, and other works such as the handling of completed products, cleaning and temporary storage.
 - e. Other equipment; an air compressor and a high pressure tank are needed and space of 1.5 x 3.2 = 5 m² is required.

f. storeroom; a storeroom is not included under the Project for the storing of completed polystyrene boxes and basic materials. However, the following storing space is necessary:

- * for temporary storage of boxes; lasting at least a day (32 boxes). One box occupies a space of 0.3 x 0.4 x 0.6 m, so that $0.07 \times 32 = 1.7 \text{ m}^3$ with a height of 2.5 m necessary space amounts to 0.8 m^2 .

- * for storing materials; one day's supply of basic materials must be kept in this room. The materials are stored in drums (cans) measuring $1.5 \times 1.5 = 2.20 \text{ m}^2$, which is the necessary space.

g. drainageways; large quantities of water are needed in the course of the moulding machine's operations. Covered drains required to evacuate used water occupy an area of 5 m^2 .

To sum up, the following indicates the space requirements per working function and total space required by the box moulding machine room: 80 m^2 . See figure 5.

| <u>Space for</u> | <u>Space required (m²)</u> |
|---------------------|---------------------------------------|
| boiler room | 15 |
| treatment tank | 12 |
| pre-foaming machine | 7 |
| moulding machine | 8 |
| working space | 25 |
| other equipment | 5 |
| storeroom | 3 |
| drainageways | 5 |
| | ===== |
| | 80m ² |

4-3 Installation Plan

The three installations supplied under the Project necessitate the performance of certain works by the government of Seychelles. These include the selection of sites (these are already being prepared by the Seychelles government), foundation works, evacuation of unused houses and other works such as the provision of electricity and water supply facilities up to the installations. The materials for the installations, whose scope and scale are established under the Project, will have to be transported to the sites selected and erected above the foundations by a Japanese contractor. Works to be performed at that time are the following.

| Installation | Room | Works To Be Performed (with regards to equipment supplied) |
|------------------------------------|------------------------------|--|
| Research and Training Installation | Research room | air conditioning system, draft chamber, ventilation system, electric wiring, water supply, drainage work |
| | Training room | air conditioning system, electric wiring |
| | Store room | ventilation system, electric wiring |
| | Communal space | sanitary facilities, electric wiring, water works, drainage system |
| Maintenance Complex | Maintenance room | ventilation system, electric wiring (including 3 phases), ceiling crane installation, water works, drainage system |
| | Storeroom (spare parts) | ventilation system, electric wiring |
| | Storeroom (fishing gear) | ventilation system, electric wiring |
| | Assembly room (fishing gear) | electric wiring, water works, drainage system |
| | Communal space | sanitary facilities, electric wiring, water works, drainage system |
| Box Moulding Machine Room | | electric wiring (including 3 phases), water/drainage works |

4-4 Basic Design

The scale of necessary equipment is as indicated below.

4-4-1 Strengthening of training and research activities

A. Small research boat:

Small research boat (FRP type)

| | |
|--------------------------|---|
| Overall length | : about 18 m |
| Main engines horse power | : 125 Hp |
| Cruising range | : 600 miles |
| Crew size | : 6 |
| Fishing gear | : handline, longline, traps, trolling, gillnets, etc. |
| Inboard equipment | : radar, fish-finder, NNSS, SSB, electric thermometer, emergency radio beacon, etc. |

B. Research equipment:

precision scales, weighing scales, desk-top calculator, Ph meter, thermograph, circular saw, refrigerator for storing specimens, refrigerator for storing chemicals, underwater camera, dehydrating oven, draft chamber, binocular microscope, conductivity meter, microwave oven, current meter, etc.

C. Training equipment:

For SFA use : overhead projector, video equipment, etc.