

(4) Gas supply facilities

Gas shall be supplied only to the kitchen in the training building and to the laboratories in the research facilities. Gas cylinders shall be placed outdoors.

(5) Fire prevention facilities

Based on the local law on fire prevention, and suggestion by the Fire Department, fire extinguishing apparatus (hydraulic hose reels or chemical fire extinguishers) shall be installed.

4.3.7 Equipment and apparatus

In the selection and the number of equipments and apparatus, the functions of the three groups: (1) prawn fry production, (2) research on prawn fry production, and (3) training, are considered. Equipments and apparatus installed permanently during the construction are not included here.

Each group has the following characteristics:

(1) Fry production A large quantity of prawn fry shall be produced throughout the year. Larval prawn shall be reared in indoor temperature-controlled ponds. The fry production will be conducted in four separate units for disease prevention.

(2) Research on fry production Research will be focussed on fry production problems to assist practical fry production. Academic and basic researches shall be undertaken at the Fishery Research Institute in Penang.

(3) Technical training Trainees shall be technicians from Department of Fisheries and fishermen engaged in aquaculture. The duration shall be 2-3 weeks for each course and the number of trainees shall reach about 600 persons in a year.

Based on the above situation, the conditions for equipment selection are set up as follows;

(1) Function and scale of the facilities shall be considered in the selection of type and number.

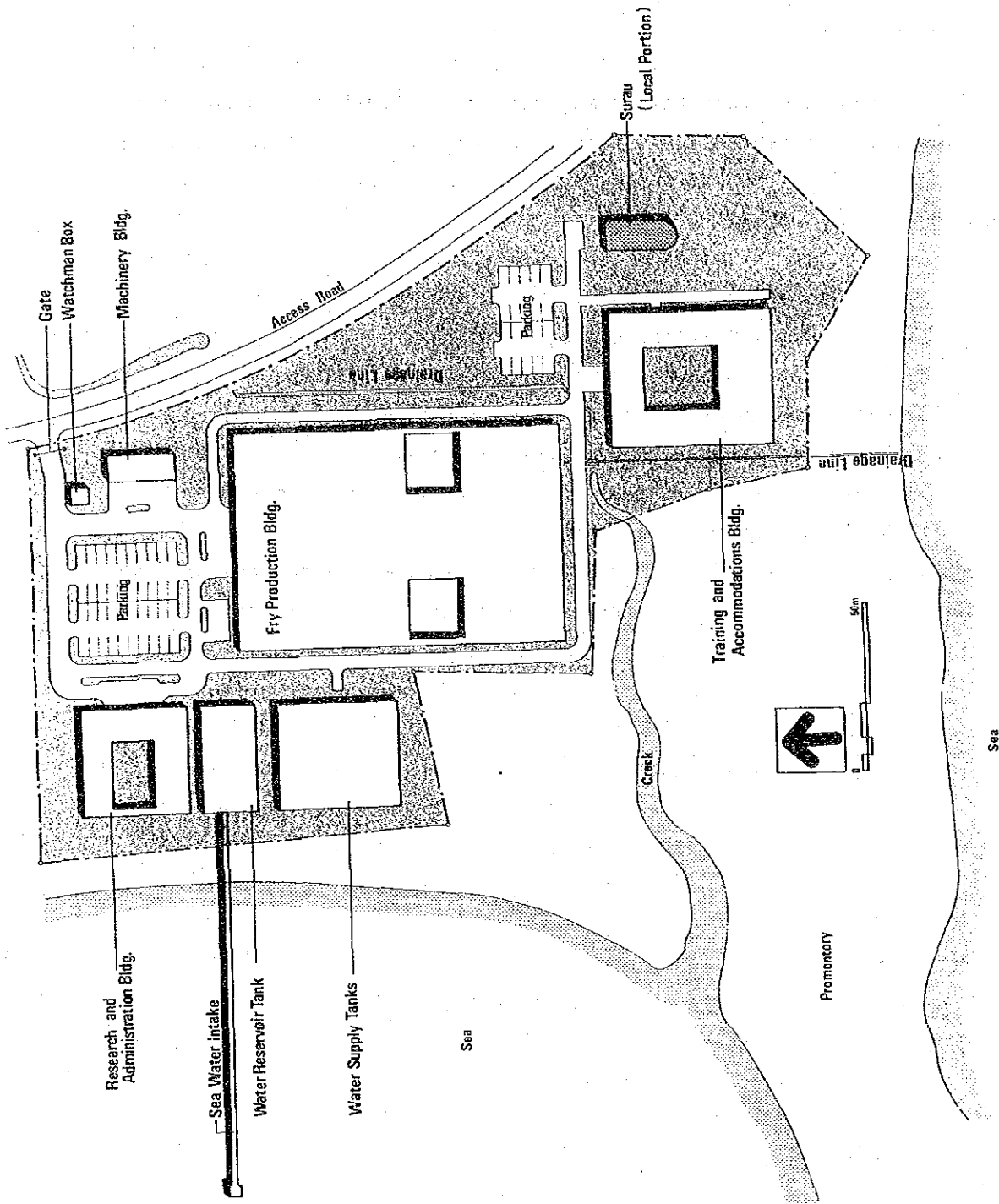
- (2) High quality materials shall also be selected for the increase in production efficiency and technology development.
- (3) Maintenance and repair shall be simple.
- (4) The availability of local supply of spare parts shall be considered.

The list of equipments and apparatus selected based on the above conditions is shown in Table 4.5.

4.4 Basic design drawings

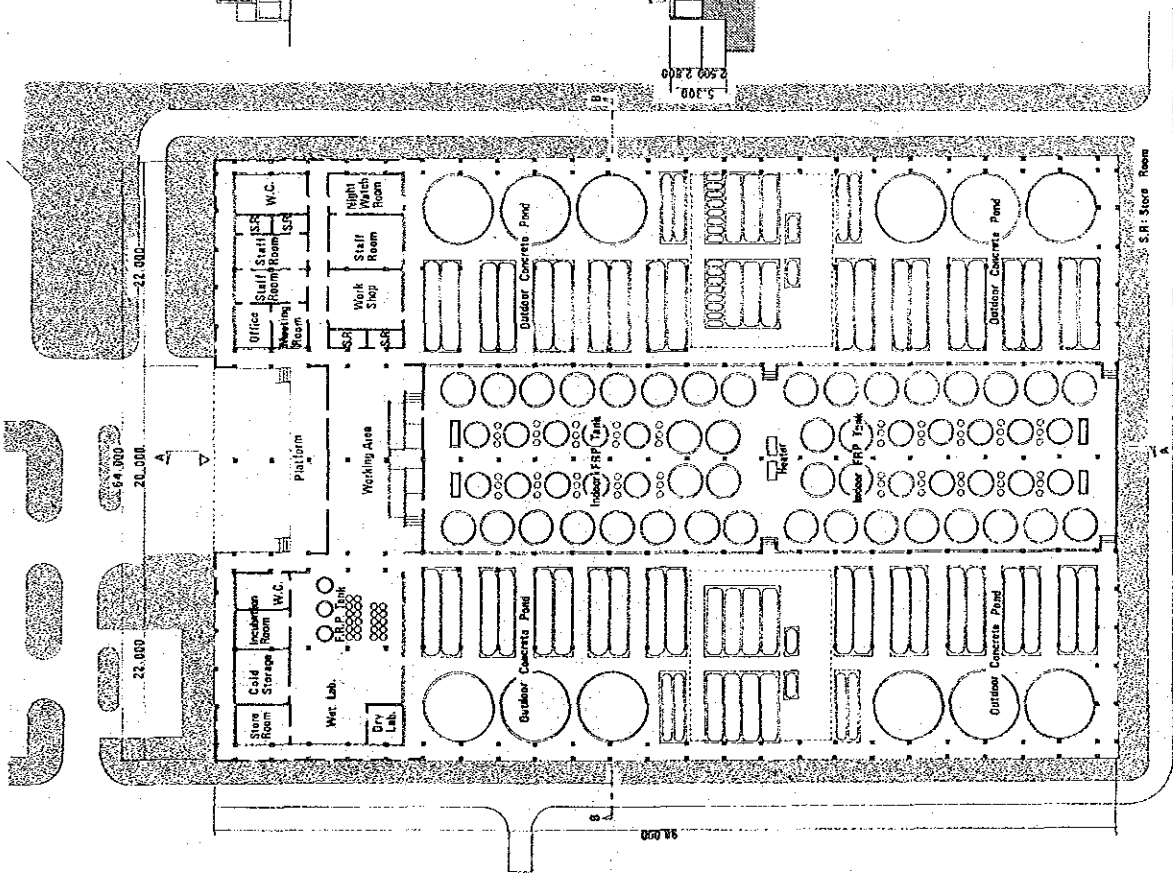
Basic design drawings of NPFPRC are shown in the following order.

- (1) Basic design drawing of layout plan,
- (2) Basic design drawing of fry production building,
- (3) Basic design drawing of sea water intake facilities,
- (4) Basic design drawing of water supply tanks,
- (5) Basic design drawing of water reservoir tanks, machinery building and watchman box,
- (6) Basic design drawing of research and administration building,
- (7) Basic design drawing of training and accommodations building.

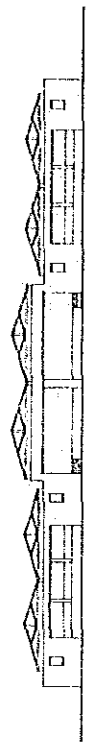


Site Plan

National Prawn Fry Production and Research Centre



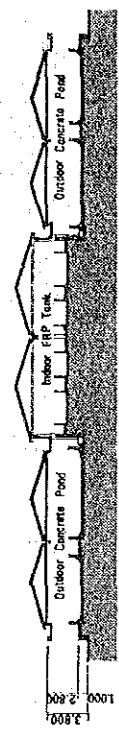
East Elevation



North Elevation



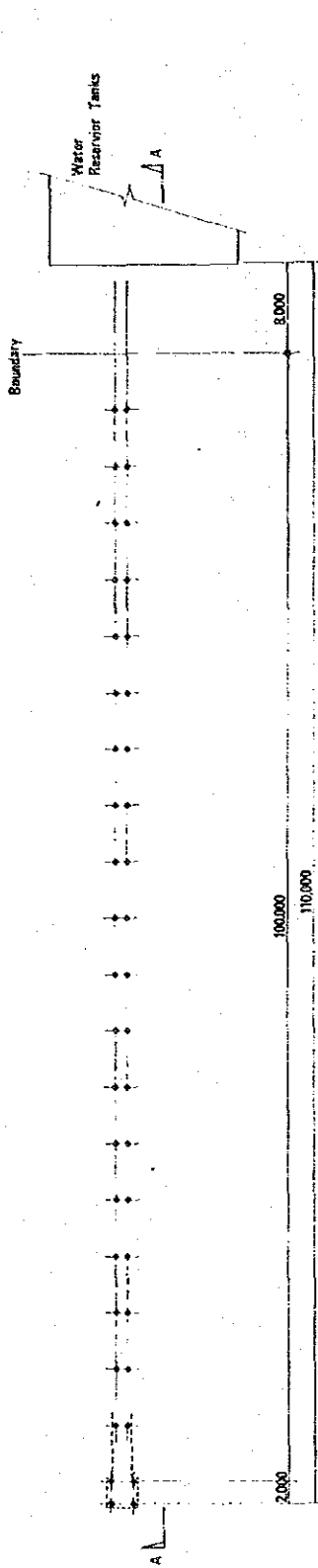
A - A Section



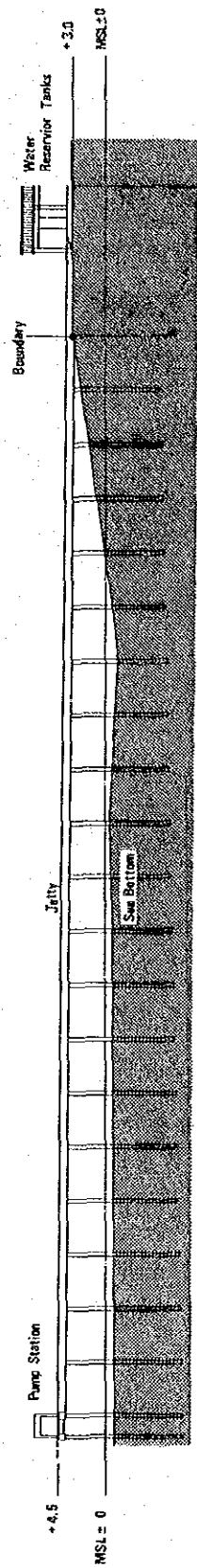
B-B Section

2

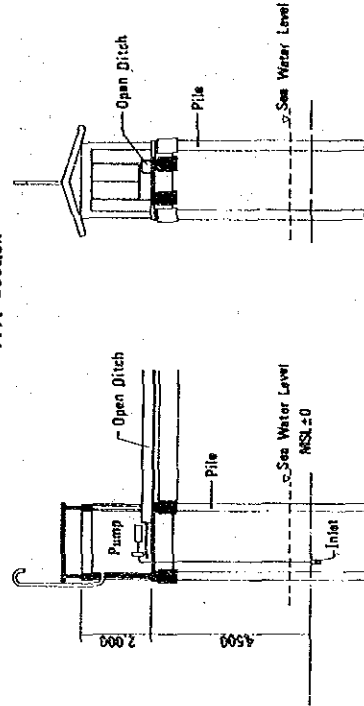
Fry Production Bldg.
National Prawn Fry Production and Research Centre



Piling Plan

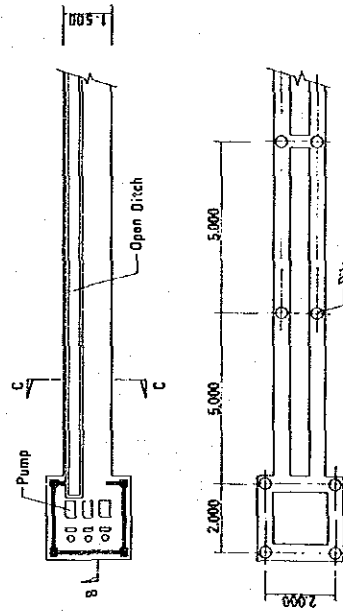


A-A Section

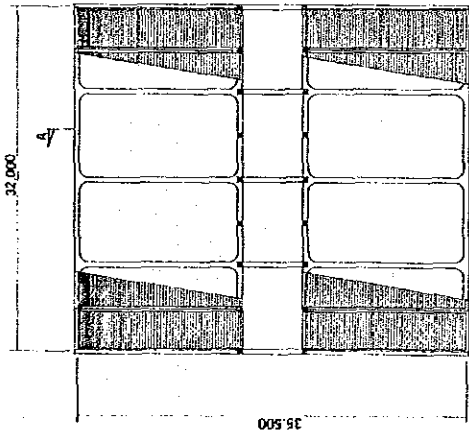


C-C Section

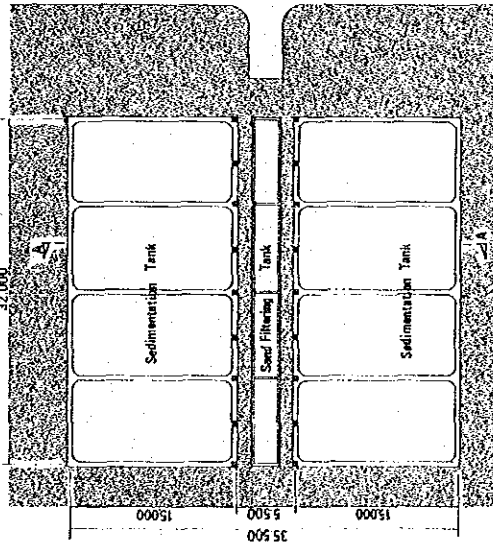
B-B Section



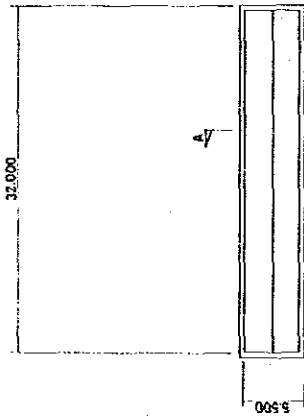
Pump Station Plan



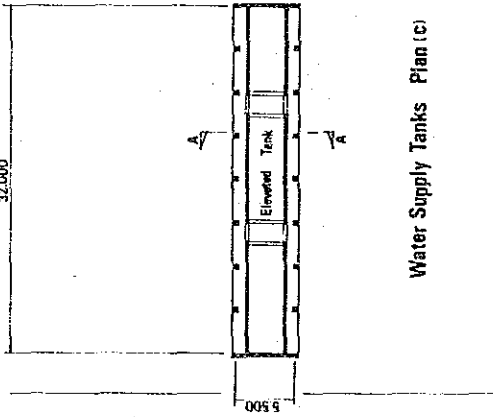
Water Supply Tanks Plan (b)



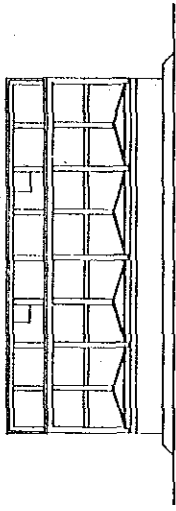
Water Supply Tanks Plan (a)



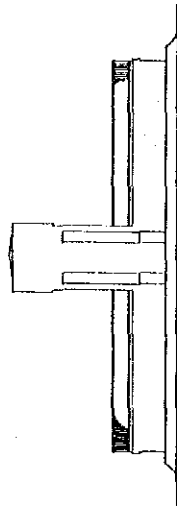
Water Supply Tanks Roof Plan (d)



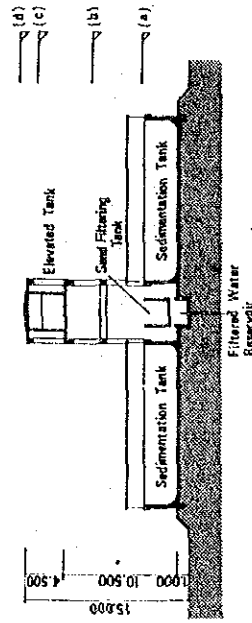
Water Supply Tanks Plan (c)



South Elevation

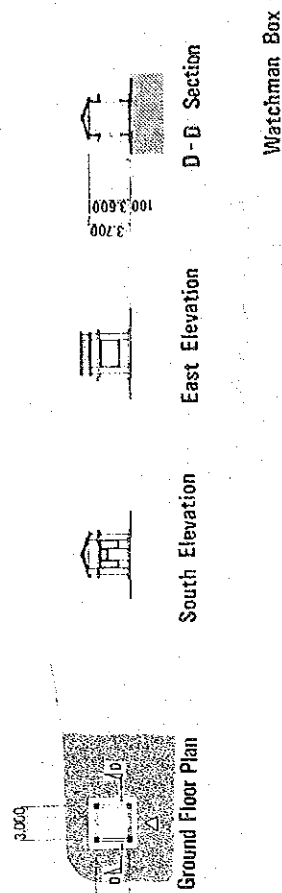
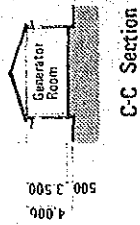
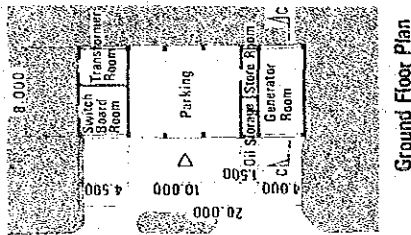
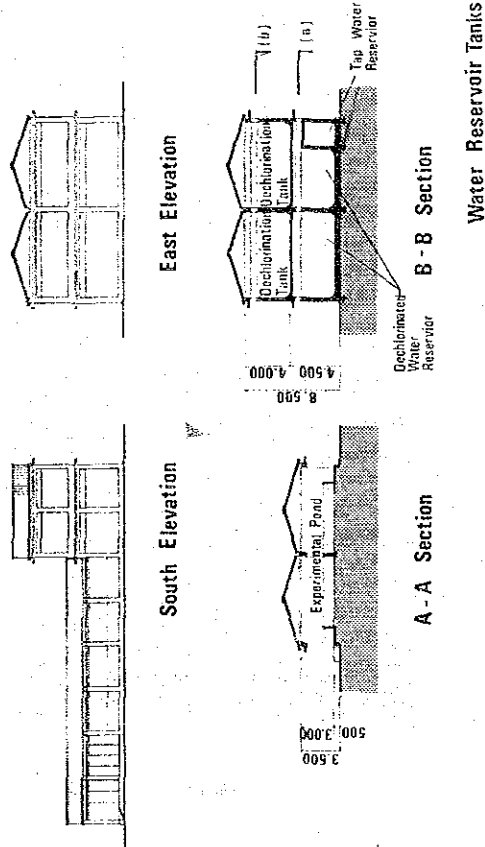
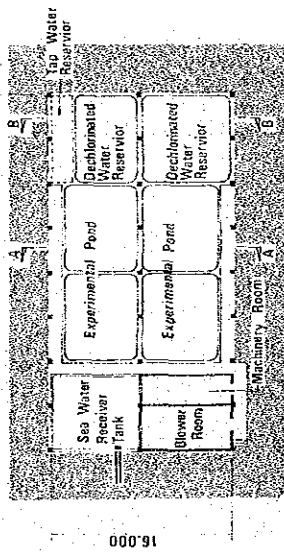
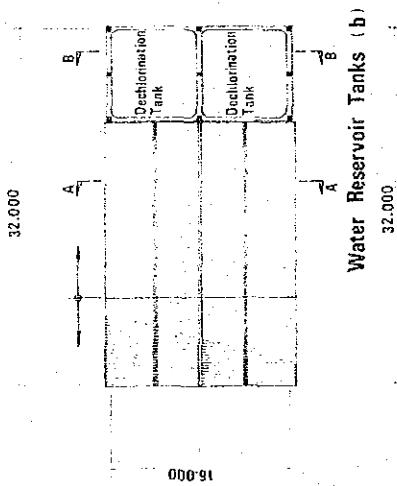


East Elevation

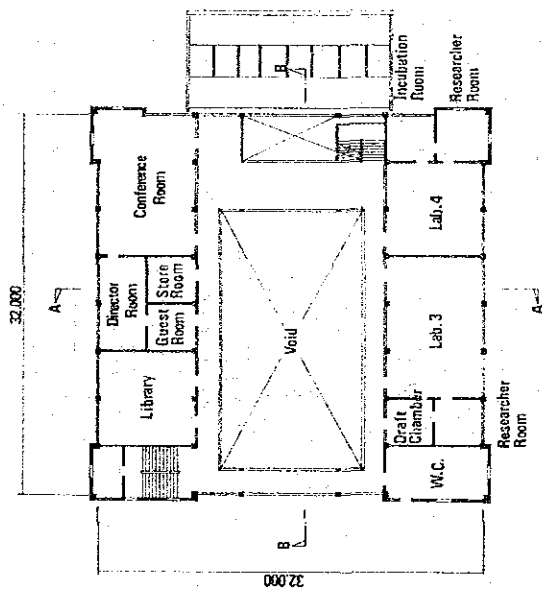


A-A Section

Water Supply Tanks **4**
National Prawn Fry Production and Research Centre



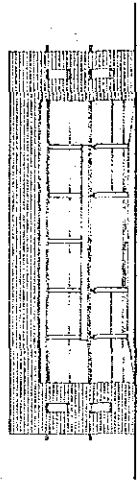
Water Reservoir Tanks, Machinery Bldg., Watchman Box
 National Prawn Fry Production and Research Centre



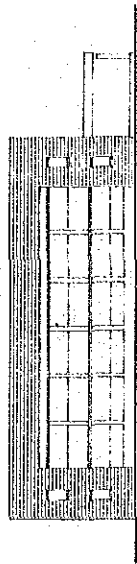
First Floor Plan



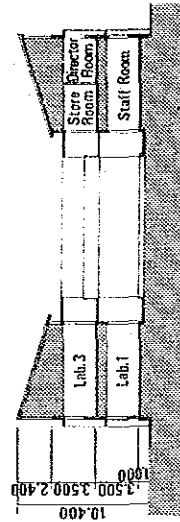
Ground Floor Plan



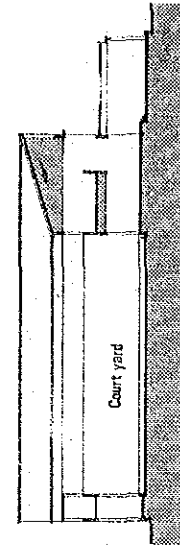
East Elevation



South Elevation

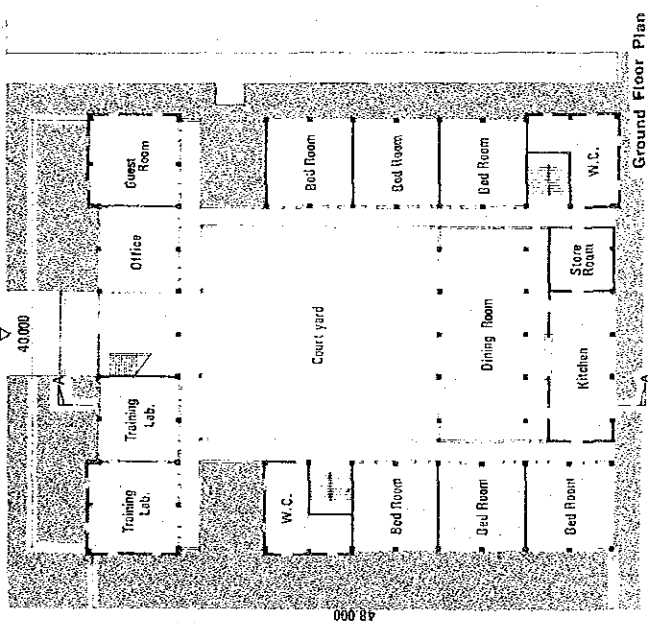
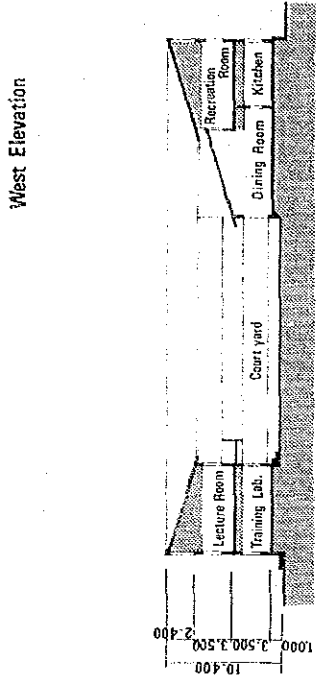
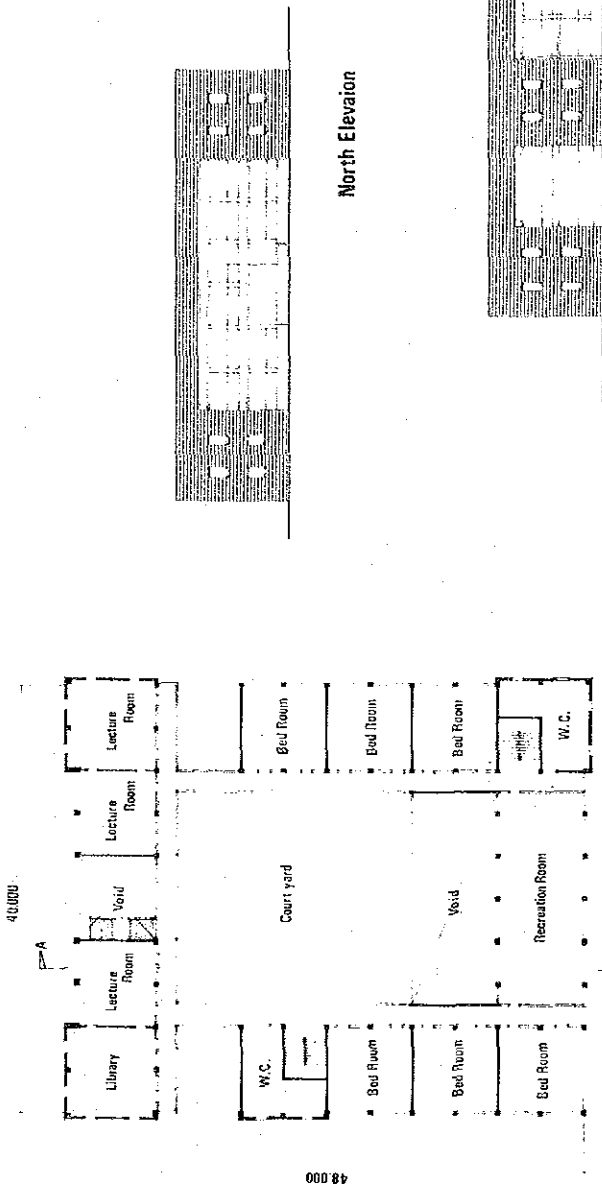


A-A Section



B-B Section

Research and Administration Bldg. **6**
National Prawns Fry Production and Research Centre



Training and Accommodations Bldg.
Accommodations Bldg.
7
National Prawn Fry Production and Research Centre

4.5 Undertakings and portions of construction cost

4.5.1 Undertakings of both governments

The following preparatory and construction works for NPFPRC are to be undertaken by the Governments of Japan and Malaysia under the conditions agreed for the implementation of the Japan's Grant Aid. The items to be undertaken are listed below.

| No. | Item | Japanese side | Malaysian side |
|-----|---------------------------------------------------------------------------------------------------------------------|---------------|----------------|
| 1. | To secure land | | 0 |
| 2. | To clear, level and reclaim the site | | 0 |
| 3. | To construct the gate and fence in and around the site | | 0 |
| 4. | To construct the parking lot | 0 | |
| 5. | To construct the road | | |
| | 1) Within the site | 0 | |
| | 2) Outside the site | | 0 |
| 6. | To construct the building | | |
| | 1) Water intake facilities | 0 | |
| | 2) Water reservoir | 0 | |
| | 3) Water elevated tank | 0 | |
| | 4) Fry production facilities | 0 | |
| | 5) Research/administration facilities | 0 | |
| | 6) Training facilities | 0 | |
| | 7) Machinery facilities | 0 | |
| | 8) Watchman box | 0 | |
| | 9) Surau (place for worship) | | 0 |
| 10) | To provide space for temporary office, construction materials, and working area | | 0 |
| 7. | To provide facilities for distribution of electricity, water supply, drainage and other incidental facilities | | |
| | 1) Electricity | | |
| | a. The distribution line to the site | | 0 |

| No. | Item | Japanese side | Malaysian side |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------|
| | b. The drop wiring and internal wiring within the site | 0 | |
| | c. The main circuit breaker and transformer | 0 | |
| 2) | Water supply | | |
| | a. The city water distribution main to the site | | 0 |
| | b. The supply system within the site | 0 | |
| 3) | Drainage | | |
| | The drainage system within the site | 0 | |
| 4) | Telephone system | | |
| | a. The telephone trunk line to the main distribution frame/panel (MDF) of the building | | 0 |
| | b. The MDF and the extension after the frame/panel | 0 | |
| 5) | Furniture and equipment | | |
| | a. Project equipment (fry production, research and administration, training) | 0 | |
| | b. Furniture (tables, chairs, beds) | 0 | |
| | c. Other furniture (carpets, curtains, etc.) | | 0 |
| 8. | To bear the following commissions to the Japanese foreign exchange bank for the banking services based upon the B/A (Banking arrangement) | | |
| 1) | Advising commission of A/P (Authorization to pay) | | 0 |
| 2) | Payment commission | | 0 |

| No. | Item | Japanese side | Malaysian side |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------------|
| 9. | To ensure unloading and custom clearance at port of disembarkation in Malaysia | | |
| | 1) Sea and air transportation of the products from Japan to Malaysia | 0 | |
| | 2) Tax exemption and custom clearance of the products at the port of disembarkation | | 0 |
| | 3) Internal transportation from the port of disembarkation to the project site | 0 | |
| 10. | To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into Malaysia and stay therein for the performance of their work | | 0 |
| 11. | To maintain and use properly and effectively that the facilities constructed and equipment purchased under the Grant | | 0 |
| 12. | To bear all the expenses other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and the installation of the equipment | | 0 |
| 13. | To proceed for planning and building approval | | 0 |

4.5.2 Portion of construction cost of Malaysian Government

The estimated portion of construction cost of the Malaysian Government is shown below.

| Item | M\$ |
|--------------------------|-----------|
| 1. Land aquisition | 900,000 |
| 2. Building construction | 134,400 |
| 3. Building equipment | 26,880 |
| 4. Landscaping | 400,609 |
| 5. Temporary work, etc. | 104,815 |
| 6. Physical contingency | 56,550 |
| Total | 1,623,254 |

5. PROJECT ORGANIZATION

5. Project organization

5.1 Department responsible for implementation

The Department of Fisheries, Ministry of Agriculture of Malaysia, shall be responsible for the implementation of this project.

5.2 Plan for the implementation of construction works

The works are mainly consisted of construction work of the three facilities, and civil work of the water supply and drainage facilities.

Following notices shall be taken into consideration in detail design and implementation.

5.2.1 Civil works

Civil works mainly involve water intake and drainage facilities. As mentioned above, the civil works shall be done in the initial implementation stage. Attention shall be paid for the implementation schedule between civil works and building works.

5.2.2 Building works

A large quantity of reinforced concrete and pipes shall be used for the buildings and the ponds. Effective plans to supply, transport and store of materials shall be considered.

5.2.3 Others

The execution plan, and the arrangement of labourers and engineers shall be made by keeping a close and smooth relationship between a Japanese construction firm (contractor) and local construction companies (subcontractors).

5.3 Supervision

For smooth implementation of the works, the Japanese consultants shall be required to cooperate with Department of Fisheries, Economic Planning Unit and other Malaysian government agencies concerned from the detail design phase.

During the supervision, a registered architect will be dispatched to arrange and coordinate schedules and procedures with the Department of Fisheries. Further, he shall supervise quality control and the

progress schedule for the construction. He shall be adequately assisted by other professionals hired locally and dispatched from Japan.

High precision is required in water intake facilities, rearing ponds, and water supply and drainage systems. An engineering expert shall be dispatched, if necessary. Imported materials from Japan shall be checked for their quality, if necessary.

5.4 Construction schedule

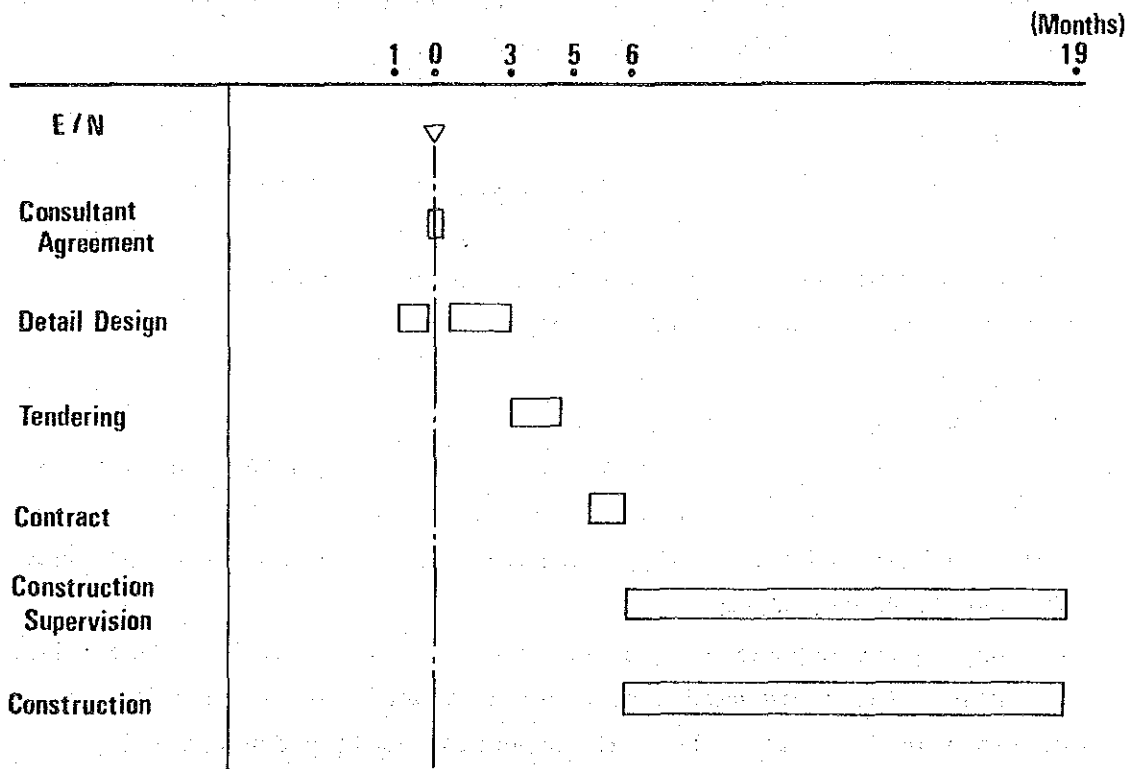
Schedule for design and construction is shown in the following figure.

5.5 Procurement

5.5.1 Procurement of local materials

Almost all construction materials can be procured locally. They are cement, steel bars, timber, plywood panels, concrete blocks and asbestos. Some equipment such as tables, chairs, beds shall be procured locally.

Schedule for Design and Construction



5.5.2 Procurement of imported materials

Almost all equipments and apparatus for prawn fry production, research and training shall be imported from Japan. It may take about one month for transportation from Japan to Butterworth and for custom clearance at Butterworth. Special attention should be paid for the transportation programmes.

5.6 Operation and management

5.6.1 Operation

The Research Branch of DOF is responsible for the operation of NPFPRC and the Extension Branch shall support the operation in the technical training. The organization chart of DOF is shown in Fig. 5.1. The main activity of the Research Branch is undertaken by FRI, which plays an important role in organizing and coordinating the activities with other relevant institutes on planning and development of basic and practical techniques. The FRI is staffed with about 250 persons, of which 82 persons are in the Aquaculture Section. The Aquaculture Section is actively conducting research on the artificial breeding of giant prawn, tiger prawn, marine fishes such as sea bass, and freshwater fishes.

The Aquaculture Section shall be responsible for the operation of NPFPRC, including the selection of NPFPRC personnel, dispatch of FRC staff to NPFPRC, fry production work and research work. The FRI staff shall be able to supervise the NPFPRC activities at all times because it takes only an hour and half by car from FRI to NPFPRC using the ferry boat between Penang and Butterworth which is available every five minutes.

The chief fisheries engineer of NPFPRC shall be selected from the Research Branch of DOF. Other workers (skilled or unskilled) and clerks shall be newly appointed. The employment of staff from the peripheral area would not be difficult but they should be carefully selected. NPFPRC shall require good organization and cooperation among the workers for mass production of prawn fry. Recruitment of suitable staff through tests and interviews should be considered.

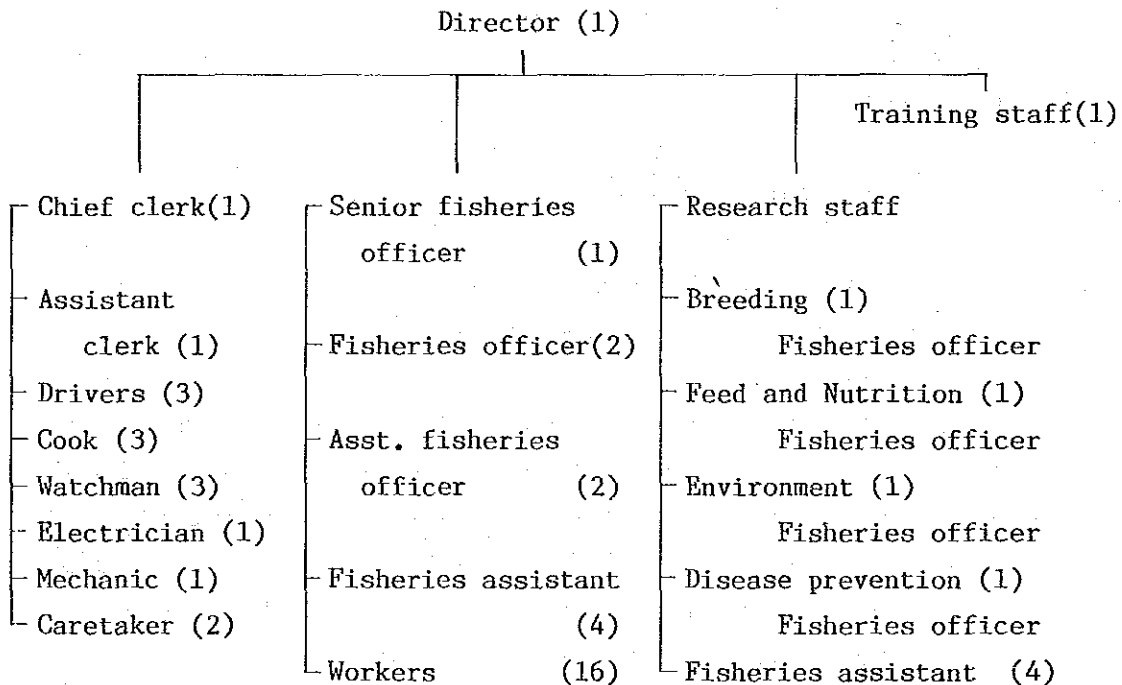
The technology in the laboratory level is highly appreciated at the Research Branch of DOF, especially the Aquaculture Section of FRI. However their experience in operation for mass production at the practical level is limited. Accordingly, technical assistance from

elsewhere shall contribute to the smooth operation at the initial stage.

5.6.2 Personnel

(1) Personnel composition

Personnel for NPFPRC are divided into two groups: (1) technical staff and workers for fry production, research works and technical training, and (2) administrative staff and clerks for administration, maintenance and operation of the facilities. Personnel composition is shown in the following chart.



Number of staff shall be 50 persons in total.

(2) Duty of staff

1) Director

He shall be a person equivalent to the chief manager of Aquaculture Section of FRI. His responsibility includes not only all matters pertaining to general administration, budgetary subjects and other duties for the smooth operation of NPFPRC through contact with other institutions, but also coordination and controlling all activities at NPFPRC, and giving suitable technical advice about works and instruction for the proper maintenance and operation of NPFPRC.

2) Staff of fry production section

The chief staff of this section shall have extensive practical experience of about 10 years in prawn fry production, and shall be responsible for this section. This section shall be divided into five groups: four for prawn fry production, and one for food organisms. The former comprises 20 persons, of which four shall be leaders of each group. Each group shall take care of each rearing unit of 46 tanks (475 m² in total) and brood stock tanks, hatching tanks, etc. and work 5-6 hours/day for the operation. This section shall be responsible for the stocking of brood, spawning, hatching, rearing of larvae and postlarvae, and shipment of prawn fry. The group for food organisms (4 persons) shall be responsible for plankton and Artemia cultures corresponding to production schedule. 16 staff out of 25 shall be unskilled, but desirably should be interested in biology or have some experience in fisheries.

3) Staff of research section

This section is divided into 4 laboratories. The staff should have at least 5 years of research experience in their fields. They shall have 4 assistants, conduct research works on prawn fry production and keep close contact with the chief of the fry production section which is under the guidance of the director. They shall also conduct some lectures at technical training courses, and also assist and cooperate with other laboratories.

4) Administration section

a) Chief clerk

He shall be responsible for this section, and control the whole administrative work under the guidance of the director.

b) Assistant clerk

He (or she) shall assist the chief clerk including typing work.

c) Driver

They shall drive four vehicles (one 4-ton insulated truck, one 750-kg pickup, one 20-passenger bus, and one four-wheel-drive car).

d) Cook

The cook shall prepare meals only for the trainees but he may

prepare for NPFPRC staff if necessary.

e) Watchman

They shall work in two shifts of 12 hours, and rotate the shift of work (daytime and overnight) and dayoff at 10 day intervals.

f) Electrician

He shall maintain and control the electric system of NPFPRC.

g) Mechanic

He shall maintain and control the machinery and other facilities and shall work closely with the electrician.

h) Caretaker

They shall clean the facilities, mow the lawn, make purchases and tentatively assist other sections.

Estimate of personnel expenses

| | Item | Number | Wage(a) | Wage(b) |
|---|------------------------------|--------|---------|---------|
| A | 1. Director | 1 | 4,300 | 51,600 |
| | 2. Senior fisheries officer | 1 | 4,000 | 48,000 |
| | 3. Fisheries officer | 2 | 2,400 | 57,600 |
| | 4. Assist. fisheries officer | 2 | 1,500 | 36,000 |
| | 5. Fisheries assistant | 4 | 800 | 38,400 |
| | 6. Unskilled worker | 16 | 450 | 86,400 |
| | 7. Researcher | 4 | 2,400 | 115,200 |
| | 8. Assistant researcher | 4 | 800 | 38,400 |
| | 9. Coordinator | 1 | 1,200 | 14,400 |
| B | 1. Chief clerk | 1 | 1,400 | 16,800 |
| | 2. Assistant clerk | 1 | 750 | 9,000 |
| | 3. Driver | 3 | 450 | 16,200 |
| | 4. Cook | 3 | 800 | 28,800 |
| | 5. Watchman | 3 | 450 | 16,200 |
| | 6. Electrician | 1 | 650 | 7,800 |
| | 7. Mechanic | 1 | 650 | 7,800 |
| | 8. Caretaker | 2 | 400 | 9,600 |
| | Total | 50 | -- | 598,200 |

A: Technical staff and workers,

B: Administrative staff and clerks

Wage (a): M\$/person/month, Wage (b): M\$/year.

5.6.3 Operation and maintenance cost

Items for operation and maintenance are listed below.

- 1) Personnel expenses
- 2) Food expenses for fry production
- 3) Expenses for purchase of mother prawns
- 4) Expenses for purchase of chemicals
- 5) Water, telephone, fuel and light expenses
- 6) Maintenance and repair expenses
- 7) Training expenses

The Extension Branch of DOF shall have a budget for training and therefore the training expenses are not included here.

(1) Personnel expenses

Personnel expenses are tabulated in the previous page. Standard wages are shown in Table 5.1.

(2) Food expenses for fry production

Quantity and cost of food for the production of 60 million fry in a year are listed below.

Food expenses for fry production

| Item | Quantity (kg/year) | Unit price (M\$/kg) | Total (M\$/year) |
|-------------------------------------|-----------------------|------------------------|---------------------|
| a) Fertilizer for diatom culture | --- | 16.7/1 mil. PL20 | 919 |
| b) Artemia | 800 | 82.2 | 69,870 |
| c) Clam meat | 4,875 | 3.0 | 29,250 |
| d) Formulated feed | 975 | 3.2 | 3,120 |
| Total | --- | --- | 103,159 |

(3) Expenses for purchase of mother prawns

Number and cost of mother prawns of the tiger prawn and the giant prawn for the production of 60 million fry in a year are listed in the next page.

Purchase of mother prawn

| Species | Number (prawn/year) | Unit price (M\$/prawn) | Total (M\$/year) |
|----------------|------------------------|---------------------------|---------------------|
| a) Tiger prawn | 2,200 | 100* | 220,000 |
| b) Giant prawn | 4,120 | 1 | 4,120 |
| Total | 6,320 | --- | 224,120 |

*: After ban of export of the mother tiger prawn, the price dropped to about M\$50/prawn. However, this price is reasonable for stable supply.

(4) Expenses for purchase of chemicals

Expenses for the purchase of chemicals used in research and experiments are estimated at M\$ 30,000/year which is 0.3% of the total amount of the equipment and apparatus for research works.

(5) Water, telephone, fuel and light expenses

Water, telephone, fuel and light expenses

| Item | Basic charge | Consumption charge | Total |
|---------------------------|------------------------------------|-----------------------------------------------|---------|
| a) Water | M\$1.6/month x 12 = 19.2 | M\$0.77/ton x 24,465 m3/year = 18,838 | 18,857 |
| b) Telephone (2 lines) | M\$5,000/year x 2 = 10,000 | M\$600/month x 2 lines x 12 month = 14,400 | 24,400 |
| c) Electricity | M\$12/KW x 338 KW x 12 = 48,672 | M\$0.19/KW X 588,530 KW/year = 111,821 | 160,493 |
| d) LPG | ----- | M\$2.0/kg X 5,400 kg /year = 10,800 | 10,800 |
| e) Heavy oil | ----- | M\$0.6/lit. X 25,294 lit/year = 15,176 | 15,176 |
| f) Gasoline | | M\$1.2/lit. X 1,920 lit/year = 2,304 | 2,304 |
| Total | ----- | ----- | 232,030 |

(6) Maintenance and repair expenses

Regular inspection shall be conducted for smooth and efficient operation and damage prevention. Water supply and aeration system shall be inspected after every fry production cycle. The estimates for maintenance and repair expenses are shown in the next page.

1) Facilities

Maintenance and repair expenses for some facilities are expected every year and at certain intervals in others. M\$ 55,723/year is counted up for the total maintenance and repair expenses.

2) Equipment

M\$ 11,389/year is counted up for the maintenance and repair expenses.

The total cost of operation and maintenance is summarized in the table below.

Estimates of total operation and maintenance

| Item | Cost (M\$/year) |
|----------------------------------------|-----------------|
| (1) Personnel expenses | 598,200 |
| (2) Food expenses for fry production | 103,159 |
| (3) Expenses for purchase mother prawn | 244,120 |
| (4) Expenses for purchase of chemicals | 30,000 |
| (5) Water, telephone, fuel and light | 232,030 |
| (6) Maintenance and repair expenses | 67,112 |
| Total | 1,274,621 |

6. EVALUATION OF THE PROJECT

6. Evaluation of the project

After the construction of NPFPRC, DOF which is within the jurisdiction of MOA will be responsible for the operation using its budget and manpower.

The prawn fry produced by NPFPRC will be distributed without charge to small-scale fish farmers only once in the first year operation of ponds. The mass production of prawn fry will be technically innovated through the research work at NPFPRC. NPFPRC will also provide training courses on prawn fry production and other related aquaculture technology not only for small-scale fish farmers but also for technical staff of DOF and private investors. This function is provided with aim to initiate the participation of private sector in the development of prawn culture.

Consequently, it is apparent that the operation of NPFPRC itself is financially not viable. In this study, the project is evaluated from financial viewpoint of prawn culture by small-scale fish farmers on the assumption that they will purchase and use the prawn fry at estimated production cost produced by NPFPRC.

6.1 Production cost of prawn fry

The production cost of prawn fry at NPFPRC is consisted of the following two items:

6.1.1 Operation and maintenance cost

As clarified in 5.6.3, the operation cost of NPFPRC for production of 60 million prawn fry is as follows:

| Item | cost(M\$/year) |
|-----------------------------------|----------------|
| (1) Salary | 598,200 |
| (2) Feed | 103,159 |
| (3) Mother prawn | 244,120 |
| (4) Fertilizers and chemicals | 30,000 |
| (5) Electricity, water, oil, etc. | 232,030 |
| (6) Maintenance | 67,112 |
| Total | 1,274,621 |

6.1.2 Depreciation of buildings and facilities

The life span of RC buildings and facilities of NPFPRC is based on the relevant data issued by the Ministry of Finance of the Japanese government. The buildings and facilities of NPFPRC are roughly divided into four categories. The life span of these categories is shown below.

Life span

| Category | Specification | Life span (year) |
|------------------------------|---------------------------------------------------------|------------------|
| (1) RC buildings | Fish market or livestock | 45 |
| (2) RC jetty | Jetty, stairway | 50 |
| (3) Other RC structures | Reservoirs, ponds | 40 |
| (4) Equipment and facilities | Machinery for feed industry, engines, fishing equipment | 8 |

Annual depreciation cost of the buildings and facilities of NPFPRC is estimated at an annual interest rate of 10 % based on the life span, and is listed below.

Annual depreciation cost

Unit:M\$/year

| Category | Depreciation |
|------------------------------|--------------|
| (1) RC buildings | 432,524 |
| (2) RC jetty | 41,145 |
| (3) Other RC structures | 121,334 |
| (4) Equipment and facilities | 365,581 |
| Total | 960,584 |

The annual production cost of 60 million prawn fry at NPFPRC is at M\$2,235,205 which is the sum of the operation and maintenance cost and depreciation cost. Accordingly, the production cost per prawn fry is equivalent to M\$ 0.037, which is much cheaper compared with the retail price of M\$ 0.05 per prawn fry produced by private hatcheries.

6.2 Financial balance of prawn culture

Case studies on financial balance of small-scale culture of the tiger prawn and the freshwater giant prawn provided by DOF are shown in Table 6.1 and 6.2. Based on culture indices shown in the tables, financial conditions of prawn culture in case of using prawn fry produced by NPFPRC was evaluated as shown in Table 6.3. It is clarified that annual benefit of prawn culture using the prawn fry produced by NPFPRC amounted to M\$ 3,420,000. Consequently, it is apparent that prawn culture has the potential to earn foreign exchange through export.

6.3 Justification of the project

The annual O/M cost of NPFPRC would be about M\$ 1.27 million. However, the budget requirement for NPFPRC is to be authorized by the government during 1985 based on following facts:

(1) Budget trend of fisheries industry during 2MP, 3MP and 4MP shows a rapid increase of its share in the total agriculture budget.

(2) Budget of aquaculture development during 4MP amounted to about M\$ 50 millions, of which M\$ 15 millions were allotted for seed production, aquaculture research and aquaculture training.

(3) Aquaculture development, especially prawn culture development is authorized in NAP. Accordingly, the share of aquaculture development would be increased in 5MP.

(4) Development techniques on prawn fry production by DOF have already been established at research level, and resources of manpower is also sufficient for further aquaculture development.

(5) Development of 10% of the total mangrove area for aquaculture was authorized by the government and the share would be increased to 20% which is equivalent to 114,000 ha of aquaculture pond. Based on these facts, it can be inferred that the Malaysian government can properly and efficiently operate the NPFPRC to achieve the target of the project.

7. CONCLUSIONS AND RECOMMENDATIONS

7. Conclusions and recommendations

7.1 Conclusions

DOF has been developing the aquaculture in the 3MP and 4MP. Aquaculture industry, in particular the prawn culture, is strongly emphasized in NAP which was newly formulated in 1984. Through prawn culture development, the government aims to provide new jobs to small-scale fish farmers and fishermen and to improve their standard of living. One of the important policies of DOF is to establish the technology for the mass production of prawn fry. Under this circumstance, the basic design study was carried out by the study team to establish NPFPRC at Pulau Sayak in Kedah State, and to provide necessary equipment and facility for NPFPRC. It was recognized through the study that NPFPRC would play an important role in the development of prawn culture in Malaysia and would encourage the national economy.

There are no problems in the infrastructural conditions of the proposed site for the construction. However, the sea bed off the proposed site is shallow and silty up to 3-5 km from the shore, with the water depth ranging 1.4-3.3 m at spring tide. The salinity of sea water around the project site becomes low after heavy rain influenced by the discharged freshwater from the Merbok river located near the site. It was found that the rainfall over 10 mm per day will not occur for more than three days continuously according to the meteorological data. Consequently, it was inferred that the sea water near the shore can be used for fry production by storing sufficient sea water for 3-4 days consumption at NPFPRC.

The annual production cost of NPFPRC is estimated at M\$ 2,235,205 and the price is calculated to be M\$ 0.037 per prawn fry. This price is much cheaper than the retail price of prawn fry produced by private hatcheries (M\$ 0.05/fry).

The staff of NPFPRC shall be mainly assigned from the Fisheries Research Institute under the Research Branch of DOF. The NPFPRC staff for training course shall be assigned from the Extension Branch. Accordingly, NPFPRC shall be operated by qualified and experienced personnel.

The operation of NPFPRC is not viable financially because the prawn fry produced by NPFPRC is planned to be distributed without

charge to newly organized small-scale fish farmers in their first year of operation. However, it is considered that the culture of prawns using prawn fry produced by NPFPRC would increase the incomes of small-scale fish farmers and thereby improve their standard of living.

From these points of view, the Grant Aid of the Japanese government for this project shall greatly contribute to the aquaculture development in Malaysia. Consequently, it is advisable that the project be proceeded to the implementation phase.

7.2 Recommendations

DOF has been actively involved in various research works on aquaculture and has established several small-scale hatcheries for freshwater fishes/prawn. However, the production scale of NPFPRC is much greater and its operation schedule is also very tight. In any aquaculture, it will not bear fruit unless 24 hour management system is devoted by experienced and dedicated staff and workers. In this regard, DOF does not have much experience. Hence, there is a need to acquire aquaculture operation system from aquaculturally developed countries.

For the effective operation of NPFPRC, it is recommended that NPFPRC use technical cooperation system by Japanese experts on aquaculture and/or technical training provided by JICA.

TABLES AND FIGURES

TABLE 1.1 COMPARISON OF CONTENTS OF GRANT REQUEST CONFINED BETWEEN BY THE PRELIMINARY MISSION AND BY THE BASIC DESIGN STUDY TEAM

| Contents of grant request confirmed | |
|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Item | Basic Design Study Team |
| | Preliminary Mission |
| 1. Name of proposed centre | National Prawn Fry Production and Research Centre |
| 2. Objective | Supply of marine animal protein and development of aquaculture |
| 3. Location of the site | Glugor, Penang |
| 4. Function of the centre | (i) Production of prawn fry to meet the increasing demand of aquaculture farmers in Malaysia (ii) To conduct basic and applied research on prawn fry production (iii) To conduct training for Malaysian personnel concerned in the field of prawn fry production (iv) Other related aquaculture activities than prawn |
| 5. Executing body | DOF |

TABLE 2.1 POPULATION DISTRIBUTION BETWEEN URBAN AND RURAL BY ETHNIC GROUP IN PENINSULAR MALAYSIA

Unit:1,000

| Ethnic group | 1970 | | 1980 | | Average annual growth rate of Urban population(%) |
|--------------|--------------|--------------|--------------|--------------|---------------------------------------------------|
| | Urban | Rural | Urban | Rural | |
| Malay | 713 | 4,109 | 1,359 | 5,025 | 6.7 |
| Chinese | 1,557 | 1,717 | 2,234 | 1,902 | 3.7 |
| Indian | 338 | 640 | 508 | 731 | 4.2 |
| Others | 30 | 43 | 47 | 43 | 4.6 |
| Total | 2,638 | 6,509 | 4,148 | 7,701 | 4.6 |

Source: Fourth Malaysia Plan, 1981-1985

TABLE 2.2 GDP, GRP, PER CAPITA GDP AND PER CAPITA GRP IN 1980

| Region | GDP or GRP | | Per capita GDP or per capita GRP | |
|--------------|--------------------------|-------------------|----------------------------------|-------------------|
| | Amount* (M\$ 100,000) | Growth rate (%)** | Amount* (M\$) | Growth rate (%)** |
| Malaysia | 25,376 | 8.1 | 1,779 | 5.1 |
| Perlis/Kedah | 1,422 | 6.5 | 1,069 | 4.7 |
| P. Pinang | 2,221 | 11.6 | 2,290 | 9.6 |

*: at factor cost in 1970 constant price

** : during 1971-1980 period

Source: Fourth Malaysia Plan, 1981-1985

TABLE 2.3 GDP AND GRP BY SECTOR IN 1980

Unit: M\$ 1,000,000

| Sector | Kedah/Perlis | P. Pinang | Malaysia |
|----------------------------------------|--------------|--------------|---------------|
| Agriculture, forestry and fisheries | 666 (46.9) | 130 (5.9) | 5,809 (22.9) |
| Mining and quarrying | 4.5 (0.3) | 0.5 (0.0) | 1,214 (4.8) |
| Manufacturing | 110 (7.7) | 825 (37.1) | 5,374 (21.2) |
| Construction | 25 (1.8) | 84 (3.8) | 1,186 (4.7) |
| Services | 616 (43.3) | 1,181(53.2) | 11,793 (46.5) |
| Total | 1,421.5(100) | 2,220.5(100) | 25,376 (100) |

Remarks: In 1980 constant price at factor cost. Figures in parentheses signify the percentage share of each sector in the GDP or GRP.

Source: Fourth Malaysia Plan, 1981-1985.

TABLE 2.4 ESTIMATED TOTAL AQUACULTURE PRODUCTION IN MALAYSIA, 1979

| Item | Ton | % |
|--------------------------------------------------------|--------|-------|
| Cockle | 63,412 | 86.26 |
| Freshwater fish | 9,500 | 12.92 |
| Others (marine prawn, marine fish, crab, oyster) | 600 | 0.82 |
| Total | 73,512 | 100 |

Source: Aquaculture Development in Malaysia in 1980's. DOF (1983).

TABLE 2.5 TREND OF MARINE FISH PRODUCTION
(1972-1984) unit:1,000 MT

| Year | Peninsular Malaysia | | | East Malaysia | | Total |
|------|---------------------|------------|-----------|---------------|---------|---------|
| | West Coast | East Coast | Sub-total | Sabah | Sarawak | |
| 1972 | 227.0 | 79.3 | 306.3 | 28.1 | 16.5 | 350.9 |
| 1973 | 276.3 | 89.2 | 365.5 | 32.2 | 48.4 | 446.1 |
| 1974 | 317.8 | 121.6 | 439.4 | 33.3 | 51.9 | 524.6 |
| 1975 | 270.3 | 104.6 | 374.9 | 33.5 | 63.9 | 472.3 |
| 1976 | 294.6 | 116.4 | 411.0 | 31.6 | 73.2 | 515.8 |
| 1977 | 377.9 | 120.1 | 617.5 | 36.2 | 83.3 | 737.0 |
| 1978 | 410.8 | 154.1 | 683.8 | 41.6 | 77.5 | 802.9 |
| 1979 | 432.3 | 138.6 | 695.1 | 41.9 | 82.3 | 819.3 |
| 1980 | 493.5 | 130.4 | 735.5 | 34.5 | 77.4 | 847.1 |
| 1981 | 433.4 | 215.9 | 757.3 | 40.0 | 68.0 | 865.3 |
| 1982 | -- | -- | (740.0) | (36.0) | (85.0) | (861.0) |
| 1983 | -- | -- | -- | -- | -- | (719.6) |
| 1984 | -- | -- | (617.4) | (40.3) | (69.0) | (726.7) |

Source: Annual fisheries Statistics, 1973-1981, Malaysia

Remarks: Figures in parenthesis are referred to Economic Report, Vol. 11 and 13.

Inland fish production in 1981, 1983 and 1984 was (9,200, 12,300 and 14,800 tons, respectively.

TABLE 2.6 NUMBER OF FISHING BOATS LICENSED AND NUMBER OF FISHERMEN OPERATING LICENSED BOATS, 1962-1981

| Tahun Year | Bilangan Bot-bot Yang Dilesenkan Number of Fishing Boats Licensed | | | | Bilangan Nelayan-nelayan Number of Fishermen | | | | |
|---------------|----------------------------------------------------------------------|--------------------------------|---------------------------------|--------------|-------------------------------------------------|-----------------|-----------------|---------------------|--------------|
| | Berjentera Dalam Inboard | Berjentera Sangkut Outboard | Tidak Berjentera Non-powered | Jumlah Total | Melayu Malay | Cina Chinese | India Indian | Lain-Lain Others | Jumlah Total |
| 1962 | 5,468 | 4,377 | 12,338 | 22,183 | 35,750 | 19,246 | 421 | 93 | 55,510 |
| 1963 | 6,426 | 4,057 | 12,271 | 22,754 | 36,199 | 22,874 | 252 | 124 | 59,449 |
| 1964 | 6,983 | 3,744 | 10,903 | 21,630 | 37,075 | 23,732 | 217 | 441 | 61,465 |
| 1965 | 8,374 | 3,908 | 10,182 | 22,464 | 40,548 | 27,155 | 153 | 332 | 68,188 |
| 1966 | 9,298 | 3,237 | 8,371 | 20,906 | 36,508 | 25,252 | 215 | 482 | 62,457 |
| 1967 | 10,145 | 2,887 | 7,204 | 20,236 | 34,833 | 26,402 | 212 | 706 | 62,153 |
| 1968 | 10,629 | 2,531 | 6,293 | 19,453 | 34,414 | 26,398 | 195 | 494 | 61,501 |
| 1969 | 11,399 | 2,177 | 5,608 | 19,184 | 34,845 | 28,258 | 160 | 351 | 63,614 |
| 1970 | 12,865 | 2,164 | 5,277 | 20,306 | 36,472 | 31,078 | 253 | 351 | 68,154 |
| 1971 | 14,284 | 2,036 | 4,821 | 21,141 | 36,295 | 31,096 | 256 | 314 | 67,961 |
| 1972 | 14,945 | 2,009 | 4,665 | 21,619 | 38,589 | 29,892 | 310 | 461 | 69,252 |
| 1973 | 15,596 | 2,004 | 4,567 | 22,167 | 38,048 | 29,192 | 342 | 726 | 68,308 |
| 1974 | 16,205 | 2,100 | 4,072 | 22,377 | 38,973 | 30,619 | 424 | 789 | 70,805 |
| 1975 | 16,081 | 2,138 | 3,928 | 22,147 | 40,335 | 31,992 | 452 | 525 | 73,304 |
| 1976 | 16,142 | 2,342 | 4,151 | 22,635 | 41,997 | 30,479 | 450 | 610 | 73,536 |
| 1977 | 16,977 | 2,775 | 4,329 | 24,081 | 44,373 | 30,131 | 541 | 600 | 75,645 |
| 1978 | 17,775 | 3,684 | 6,038 | 27,497 | 51,265 | 30,980 | 637 | 812 | 83,694 |
| 1979 | 17,741 | 5,156 | 6,256 | 29,153 | 50,816 | 30,323 | 528 | 1,259 | 82,926 |
| 1980 | 18,433 | 6,585 | 5,502 | 30,520 | 55,008 | 31,802 | 410 | 1,752 | 88,972 |
| 1981 | 18,585 | 7,368 | 4,437 | 30,390 | 54,538 | 30,084 | 609 | 1,694 | 86,925 |

Source: Annual Fisheries Statistics, 1981, DOF.

TABLE 2.7 BALANCE OF IMPORT AND EXPORT OF FISHERY PRODUCT (1970-1983)

| Year | Import | | Export | |
|------|----------|---------------|---------|---------------|
| | 1,000 MT | M\$ 1 million | 1,000MT | M\$ 1 million |
| 1970 | 71 | 58 | 109 | 96 |
| 1971 | 59 | 52 | 109 | 119 |
| 1972 | 68 | 50 | 116 | 143 |
| 1973 | 73 | 58 | 125 | 176 |
| 1974 | 75 | 68 | 107 | 159 |
| 1975 | 93 | 79 | 93 | 166 |
| 1976 | 114 | 88 | 107 | 238 |
| 1977 | 119 | 95 | 108 | 160 |
| 1978 | 150 | 110 | 124 | 200 |
| 1979 | 158 | 131 | 126 | 310 |
| 1980 | 140 | 130 | 115 | 243 |
| 1981 | 142 | 155 | 123 | 255 |
| 1982 | 169 | 196 | 132 | 225 |
| 1983 | 162 | 206 | 117 | 243 |

Source: Annual Fisheries Statistics, 1970-1983, DOF.

TABLE 2.8 MALAYSIA: PUBLIC DEVELOPMENT EXPENDITURE FOR AGRICULTURAL PROGRAMMES, 1971-85
(\$ million)

| | Revised SMP allocation, 1971-75 | Actual expenditure, 1971-75 | Achievement, % | Revised TMP allocation, 1976-80 | Estimated expenditure, 1976-80 | Achievement, % | FMP allocation, 1981-85 |
|---------------------------------------------------------------------|---------------------------------|-----------------------------|----------------|---------------------------------|--------------------------------|----------------|-------------------------|
| <i>Agriculture:</i> | | | | | | | |
| Integrated agricultural development project .. | — | — | — | 254.70 | 198.23 | 77.8 | 892.00 |
| Pineapple replanting | 4.76 | 4.09 | 85.9 | 23.13 | 12.39 | 53.6 | 20.00 |
| Coconut replanting | 33.63 | 28.02 | 83.3 | 62.30 | 31.20 | 50.1 | 49.83 |
| Diversification of crops | 24.48 | 24.48 | 100.0 | 66.97 | 54.71 | 81.7 | 64.46 |
| Extension and other services | 39.71 | 39.71 | 100.0 | 62.88 | 20.95 | 33.3 | 79.92 |
| Other programmes associated with agricultural development (DOA) | — | — | — | 156.10 | 92.42 | 59.2 | 189.39 |
| Input subsidies | — | — | — | 300.00 | 101.80 | 33.9 | 500.00 |
| KADA | 0.30 | — | — | 12.09 | 7.36 | 50.9 | 28.00 |
| MADA | 0.40 | 0.40 | 100.0 | 5.75 | 5.72 | 99.5 | 33.00 |
| <i>Rubber replanting</i> | <i>170.46</i> | <i>145.62</i> | <i>85.4</i> | <i>262.83</i> | <i>198.23</i> | <i>75.4</i> | <i>316.66</i> |
| <i>Land and regional development:</i> | | | | | | | |
| FELDA | 898.60 | 678.41 | 75.5 | 2,014.70 | 1,732.71 | 86.0 | 2,040.96 |
| FELCRA | 63.68 | 50.96 | 80.0 | 209.98 | 192.80 | 91.8 | 472.08 |
| Public Estates | — | — | — | 5.42 | 5.42 | 100.0 | 274.50 |
| State Land development boards | 196.70 | 170.06 | 86.5 | 207.25 | 109.97 | 53.1 | 143.50 |
| DARA | 105.75 | 37.80 | 35.7 | 458.78 | 371.54 | 81.0 | 313.00 |
| KETENGAH | 7.11 | 2.80 | 39.4 | 163.76 | 111.84 | 68.1 | 250.00 |
| KEJORA | 77.33 | 48.15 | 62.3 | 239.92 | 195.67 | 81.6 | 209.03 |
| KESEDAR | — | — | — | 115.60 | 24.70 | 21.4 | 250.00 |
| Bigatula Development Authority | — | — | — | — | — | — | 26.00 |
| Kedah Regional Development Authority | — | — | — | — | — | — | 3.00 |
| <i>Drainage and irrigation</i> | <i>257.43</i> | <i>217.81</i> | <i>84.6</i> | <i>778.61</i> | <i>554.84</i> | <i>71.3</i> | <i>860.33</i> |
| <i>Forestry</i> | <i>12.79</i> | <i>8.85</i> | <i>69.2</i> | <i>39.64</i> | <i>25.61</i> | <i>64.6</i> | <i>63.00</i> |
| <i>Livestock</i> | <i>61.77</i> | <i>57.04</i> | <i>92.3</i> | <i>168.75</i> | <i>127.22</i> | <i>75.4</i> | <i>241.00</i> |
| <i>Fisheries</i> | <i>39.05</i> | <i>31.78</i> | <i>81.4</i> | <i>322.63</i> | <i>105.84</i> | <i>46.8</i> | <i>434.62</i> |
| <i>Agricultural research</i> | <i>27.90</i> | <i>25.07</i> | <i>89.9</i> | <i>89.54</i> | <i>69.33</i> | <i>77.4</i> | <i>93.00</i> |
| <i>Agricultural credit, marketing, processing and cooperatives:</i> | | | | | | | |
| Bank Pertanian | 50.00 | 50.00 | 100.0 | 105.77 | 37.50 | 35.5 | 167.00 |
| FOA | 22.00 | 20.94 | 95.2 | 120.51 | 117.49 | 97.5 | 247.40 |
| Cooperative development | 0.38 | 0.09 | 23.7 | 25.62 | 9.99 | 39.0 | 50.00 |
| FAMA | 31.11 | 31.11 | 100.0 | 81.50 | 39.64 | 48.6 | 165.00 |
| National Padi and Rice Authority | 70.00 | 36.32 | 51.9 | 73.80 | 49.54 | 67.1 | 118.92 |
| National Tobacco Board | 0.54 | 0.54 | 100.00 | 18.67 | 15.52 | 83.2 | 13.00 |
| <i>Others</i> | <i>83.48</i> | <i>83.48</i> | <i>100.0</i> | <i>1.02</i> | <i>1.02</i> | <i>100.00</i> | <i>—</i> |
| TOTAL | 2,279.36 | 1,793.53 | | 6,448.25 | 4,666.20 | | 8,608.60 |

Source: Fourth Malaysia Plan, 1981-1985.

Remarks: Public estates allocation for the SMP was provided under Others.

TABLE 2.9 AQUACULTURE DEVELOPMENT PLAN BASED ON NAP (1986-2000)

| Species | Fifth Malaysia Plan | | | | | | Subtotal 1991- 2000 | Grand total 1986- 2000 |
|--------------------------------------------------------|---------------------|------|-------|-------|-------|-----------------------|---------------------------|---------------------------------|
| | 1986 | 1987 | 1988 | 1989 | 1990 | Subtotal 1986-1990 | | |
| | | | | | | | | |
| 1. Tiger prawn (ha) | | | | | | | | |
| a. government | 300 | 300 | 300 | 300 | 300 | 1,500 | 9,000 | |
| b. private | 700 | 900 | 1,140 | 1,428 | 1,774 | 5,942 | 12,000 | |
| 2. Sea bass (rakit) | | | | | | | | |
| a. government | 400 | 400 | 400 | 400 | 400 | 2,000 | 4,500 | |
| b. private | 150 | 150 | 150 | 150 | 150 | 750 | 3,750 | |
| 3. Mussel (rakit) | | | | | | | | |
| a. government | 200 | 200 | 200 | 200 | 200 | 1,000 | 6,500 | |
| b. private | 300 | 300 | 300 | 300 | 300 | 1,500 | 3,500 | |
| 4. cockle (ha) | | | | | | | | |
| a. government | 80 | 80 | 80 | 80 | 80 | 400 | 960 | |
| b. private | 100 | 100 | 100 | 100 | 100 | 500 | 1,000 | |
| 5. Freshwater fishes/giant prawn in culture ponds (ha) | | | | | | | | |
| a. government | 20 | 20 | 20 | 20 | 20 | 100 | 300 | |
| b. private | 180 | 180 | 180 | 180 | 180 | 900 | 2,700 | |
| 6. Freshwater fishes in abandoned mining pools (ha) | | | | | | | | |
| a. government | 100 | 100 | 100 | 100 | 100 | 500 | 1,500 | |
| b. private | 100 | 100 | 100 | 100 | 100 | 500 | 1,500 | |
| 7. Freshwater fishes in cage culture (rakit) | | | | | | | | |
| a. government | 200 | 200 | 200 | 200 | 200 | 1,000 | 3,000 | |
| b. private | -- | -- | -- | -- | -- | -- | -- | |
| 8. Freshwater fishes in reservoirs (rakit) | | | | | | | | |
| a. government | 200 | 200 | 200 | 200 | 200 | 1,000 | 3,000 | |
| b. private | 800 | 800 | 800 | 800 | 800 | 4,000 | 12,000 | |

Source: NAP, Strategies and Programmes for Agriculture, DOF (1984)

TABLE 3.1 FREQUENCY OF CONTINUOUS RAINFALL OVER 10 MM/DAY

unit: frequency=time/month

| Location | Period of continuous rainfall | Month | | | | | | | | | | | |
|------------|-------------------------------|-------|---|---|---|---|---|---|---|---|---|---|---|
| | | J | F | M | A | M | J | J | A | S | O | N | D |
| P. Penang | 2 days | - | - | - | 1 | 1 | 1 | - | 1 | 1 | 2 | - | 1 |
| | 3 | - | - | - | - | - | - | - | - | 1 | - | - | - |
| | 4 | - | - | - | - | - | - | - | - | - | - | - | - |
| | 5 | - | - | - | - | - | - | 1 | - | - | - | - | - |
| Alor Setar | 2 | - | - | - | - | 1 | 1 | 1 | 2 | 1 | - | 1 | 1 |
| | 3 | - | - | 1 | - | - | - | - | 1 | 1 | 1 | 1 | - |
| | 4 | - | - | - | - | - | - | 1 | - | - | - | - | - |
| | 5 | - | - | - | - | - | - | - | - | - | - | - | - |

Source: Meteorological data at P. Penang International Airport and Alor Setar Airport in 1983.

Remarks: Mean daily rainfall by month ranged 0.07-13.8 mm/day in P. Penang and 0.2-13.8 mm/day in Alor Setar in 1983.

TABLE 3.2 SALINITY OF SEA WATER OFF THE PROPOSED SITE

unit: %

| Sampling point | Sampling time | | | |
|----------------|---------------|--------|---------|--------|
| | 10 am | | 2 pm | |
| | Surface | Bottom | Surface | Bottom |
| A | 3.10 | 3.10 | 3.20 | 3.20 |
| B | 3.10 | 3.20 | 3.15 | 3.30 |
| C | 3.15 | 3.20 | 3.15 | 3.30 |
| D | 3.15 | 3.20 | 3.20 | 3.30 |
| E | 3.15 | 3.20 | 3.20 | 3.30 |
| F | 3.15 | 3.15 | 3.20 | 3.20 |
| G | 3.15 | 3.10 | 3.15 | 3.15 |
| H | 3.15 | 3.15 | 3.15 | 3.20 |
| I | 3.00 | 3.20 | 3.15 | 3.20 |

Remarks: The salinity was checked by the survey team on Nov. 3, 1984.

TABLE 3.3 RATES OF LABOURER AND MATERIALS

| Description | Unit | Rate (M\$) |
|-------------------------------------------------------------------------------|----------------|------------|
| (1) Excavating (by hand) | m ³ | 5.90 |
| (2) 12" x 12" Precast Concrete Pile (20' long) | m | 26.95 |
| (3) Handle, Transport and Pitch 12' x 12" Precast Concrete Pile (20' long) | No. | 29.00 |
| (4) Drive 12" x 12" Precast Concrete Pile (20' long) | m | 16.90 |
| (5) Cement Concrete (3/4" gauge lime stone) | m ³ | 170.00 |
| (6) *5/8"- 1" Diameter Mild Steel Bar | ton | 1,350.00 |
| (7) Wood Form | m ² | 17.90 |
| (8) Precast Cement and Sand Hollow Block in 4-1/2" thick walling | m ² | 14.75 |
| (9) Asbestos Cement Roof Sheeting | m ² | 14.00 |
| (10) Roof Truss | m ³ | 660.80 |
| (11) *1/4" Plywood Panel | m ² | 13.50 |
| (12) Waterproof 3/4" Thick Cement and Sand | m ² | 10.20 |
| (13) *1/4" Tinted Glass | m ² | 72.15 |

Source: Schedule of rates, JKR, 1984

Remark: *: including material cost and wage

TABLE 3.4 CHANGE RATE OF "RATE OF SCHEDULE" FROM 1982 TO 1984

| Change rate | Work item |
|---------------|------------------------------------------------------------------------------------|
| +21 --- +30 % | Turfing |
| +11 --- +20 % | Ironmongery, plaster works, plumbing works |
| +6 --- +10 % | Reinforcement steel works |
| +2 --- +5 % | Precast concrete piling, carpentry and joinery, steel and ironworks, glasing works |
| -1 --- +1 % | Excavating, roofing works |
| -2 --- -5 % | Concrete works, brick and masonry works, painting works. |
| -6 --- -10 % | Road works |

Remarks: The Rate of Schedule was fixed by JKR in 1982. The change rate is an index to apply them in 1984 by JKR. These rates are ones in Sg. Petani City.

TABLE 3.5 WAGE LEVEL FOR CONSTRUCTION LABOURER

| Profession | unit: M\$ wage/day |
|-------------------------------|-----------------------|
| 1. General labourer (male) | 25.8 |
| 2. General labourer (female) | 23.0 |
| 3. Concrete leveller | 35.0 |
| 4. Mason | 39.0 |
| 5. Carpenter and Joiner | 43.0 |
| 6. Steel bar bender and fixer | 43.0 |
| 7. Welder | 43.0 |
| 8. Plumber | 40.0 |
| 9. Painter | 35.8 |
| 10. Glazier | 34.0 |
| 11. Plasterer | 45.0 |
| 12. Tile fixer | 45.0 |

Remarks: These figures are effective till the end of 1984. These wages are effective only in case that the Rate of Schedule is not applied. A 15 % extra charge to these wages are usually paid to contractors.

TABLE 4.1 LIST OF JUSTIFICATION ITEMS FOR APPRAISAL OF THE REQUESTS
(1/2)

| Function of NPFPRC on request | Study item | Tiger prawn | Giant prawn | Other prawns | Justifi- cation |
|------------------------------------------------------------------------------------|------------------------------------------------------------------------|----------------|----------------|-----------------|--------------------|
| 1) Prawn fry pro- duction (mainly tiger prawn, partially, giant prawn) | 1) No. of existing facilities | 0 | 6 | 0 | |
| | 2) Demand of fry (present) | + | + | - | |
| | 3) Demand of fry (future) | ++ | + | +/- | |
| | 4) Collection of mother prawn | + | + | ? | |
| | 5) Fry production techniques at laboratory level | + | + | + | |
| | 6) Fry production techniques at mass production level | +/- | +/- | - | |
| | 7) Employment of technical staff at the mass production stage | + | + | +/- | |
| | 8) Propriety of the proposed site | | | | |
| ° To secure the land | + | + | + | | |
| ° Area, and topo- graphic condition | + | + | + | | |
| ° Infrastructure | + | + | + | | |
| ° Water quality | + | + | + | | |
| ° Temperature | + | + | + | | |

+

Remarks: ++: strongly positive, +: positive, +/-: weakly positive,
-: negative, ?: unknown.

TABLE 4.1 LIST OF JUSTIFICATION ITEMS FOR APPRAISAL OF THE REQUESTS
(2/2)

| Function of NPFPRC on request | Study item | Tiger prawn | Giant prawn | Other prawns | Justifi- cation |
|------------------------------------------------------------------------------------------------------|---------------------------------------------------|----------------|----------------|-----------------|--------------------|
| 2) Research on breeding and mass production of fry, and other related aquaculture method | 1) Research level | | | | |
| | °Fry production by wild mother prawn | + | + | + | |
| | °Induced matura- tion by eye stalk abrasion | +/- | - | - | |
| | °Induced matura- tion by other methods | - | - | - | |
| | °Suitable rearing environment | +/- | +/- | ? | |
| | °Feed and nutri- tion | +/- | +/- | - | |
| | °Disease preven- tion | +/- | +/- | - | |
| | 2) Employment of research staff | + | + | + | |
| | | | | | + |
| 3) Technical train- ing on prawn breeding and other related aquacul- ture methods | 1) Past records to receive trainees | + | + | - | |
| | 2) Government budget | + | + | - | |
| | 3) Temporary train- ing facilities | + | + | + | |
| | 4) Permanent train- ing facilities | - | - | - | |
| | 5) Employment of lecturers | + | + | +/- | |
| | 6) Potential trainees | + | + | ? | |
| | | | | | + |

Remarks: ++: strongly positive, +: positive, +/-: weakly positive,
-: negative, ?: unknown.

TABLE 4.2 CONTENTS OF TRAINING TEXTBOOK FOR BRACKISH WATER AQUACULTURE

| Brackish Water Fish And Shrimp Culture in Pond | |
|------------------------------------------------|---------|
| Contents | Page |
| 1. Introduction | 1-5 |
| 2. Site selection | 6-35 |
| 3. Species selection | 37-82 |
| 4. Seed supply | 83-88 |
| 5. Pond design | 89-109 |
| 6. Pond construction | 110-124 |
| 7. Pond management | 125-154 |
| 8. Feed and nutrition | 155-185 |
| 9. Fish health | 186-203 |
| 10. Harvesting and marketing | 204-212 |
| 11. Aquaculture economics | 213-241 |

Source: Department of Fisheries, Malaysia

TABLE 4.3 LIVE LOAD

| | KN/m ² | Kg/m ² |
|-------------------|-------------------|-------------------|
| Roof | 0.25 | 26 |
| Office | 2.5 | 255 |
| Laboratory | 3.0 | 306 |
| lecture Room | 3.0 | 306 |
| Lodgin | 1.5 | 153 |
| Corridor, Balcony | 3.0 | 306 |

Source: Uniform Building, Drainage, Sanitation and Street By-Law, 1973 (as on 15 May 1984)

TABLE 4.4 WEIGHT OF MATERIALS

| No. | Item | kN/m ³ | kgf/m ³ | lbf/ft ³ |
|-----|---------------------------------------------------------------------------|-------------------|--------------------|---------------------|
| 1. | Earth (in natural state or rammed) | 17 | 1,734 | 108 |
| 2. | Sand (Wet) | 20 | 2,039 | 127 |
| 3. | Gravel | 19 | 1,937 | 121 |
| 4. | Aluminum and Alloys | 27 | 2,720 | 170 |
| 5. | Steel | 77 | 7,850 | 490 |
| 6. | Brickwork | 19 | 1,920 | 120 |
| 7. | Concrete: (a) Unreinforced | 23 | 2,310 | 144 |
| 8. | Concrete: (b) Reinforced | 24 | 2,400 | 150 |
| 9. | Granite and Marble | 26 | 2,690 | 168 |
| 10. | Limestone | 25 | 2,500 | 156 |
| 11. | Sandstone | 23 | 2,310 | 144 |
| 12. | Timber | 8-11 | 800-1,120 | 50-70 |
| | | N/m ² | kgf/m ² | b/ft ² |
| 13. | Plaster on brick work, blocks or concrete per inch (25.4 mm) thickness | 480 | 49 | 10 |
| 14. | Suspended metal lath and plaster | 380 | 39 | 8 |
| 15. | Roof Tiles: | | | |
| | (a) Terra-cotta (French pattern) | 580 | 59 | 12 |
| | (b) Concrete | 530 | 54 | 11 |
| 16. | Glass per 1/4 inch (6.35 mm) thickness | 170 | 17 | 3.5 |
| 17. | Asbestos cement: | | | |
| | (a) 1/4 inch (6.35 mm) plain | 160 | 16 | 3.25 |
| | (b) Corrugated | 100-170 | 10-17 | 2-3.5 |
| 18. | Galvanised Iron, 24 gauge, 3 inch (76.2 mm) corrugation | 84 | 9 | 1.75 |
| 19. | Brickwork per inch (25.4 mm) thickness | 480 | 49 | 10 |
| 20. | Cement mortar finish per inch (25.4 mm) thickness | 580 | 59 | 12 |

Source: Uniform Building, Drainage, Sanitation and Street By-Law, 1973
(as on 15 May 1984)

TABLE 4.5 (1). LIST OF EQUIPMENTS AND APPARATUS (1)

| NO. | ITEM | Q'TY |
|---------------------------------------------------|-----------------------------------|------|
| I. FRY PRODUCTION FACILITIES | | |
| I-1. Equipments of Physical and Chemical Study | | |
| 1) | Thermometer, alcohol | 22 |
| 2) | Thermo-hydrograph | 1 |
| 3) | Portable DO meter | 2 |
| 4) | A. Portable water quality checker | 1 |
| | B. Water tester set (HACH) | 1 |
| 5) | A. Electric top balance | 1 |
| | B. Top pan balance | 3 |
| | C. Platform balance | 1 |
| 6) | Lux meter | 1 |
| 7) | Portable pH meter | 1 |
| 8) | Laboratory wares (Refer to V) | |
| 9) | Salinity refractometer | 5 |
| 10) | Water sampler | 1 |
| 11) | Incubator | 1 |
| 12) | Refrigerated show case | 1 |
| I-2. Optical Equipments and Electrical Appliances | | |
| 1) | Biocular microscope | 1 |
| 2) | Waterproof flash light | 2 |
| 3) | Underwater flash light | 2 |
| 4) | Mechanical typewriter | 1 |
| I-3. Other Equipments | | |
| 1) | High pressure washer | 2 |
| 2) | Portable water pump | 4 |
| 3) | Aero-hydraulic gun | 29 |
| 4) | Aeration system | |
| | A. Regulator | 300 |
| | B. Diffuser (5 cm) | 1300 |
| | C. Diffuser (17 cm) | 100 |
| 5) | Altemia incubation tank | 2 |
| 6) | Diatom incubation tank | 2 |

TABLE 4.5 (2). LIST OF EQUIPMENTS AND APPARATUS (2)

| NO. | ITEM | Q'TY |
|-----|------------------------------------|--------------|
| 7) | Water circulation pump | 2 |
| 8) | Polyethylene screen | 6 rolls |
| 9) | Nylon bolting cloth | 4 rolls |
| 10) | Vinyl hose | 1,000 m |
| 11) | Scoop net | 120 |
| 12) | Artificial weed | 100 |
| 13) | Feed blender | 1 |
| 14) | Crusher | 1 |
| 15) | Grinder | 1 |
| 16) | Meat chopper | 1 |
| 17) | Pelletizer | 1 set |
| 18) | Rice cooker | 2 |
| 19) | Tool set | 1 set |
| 20) | Pick-up truck | 1 |
| 21) | Insulated truck | 1 |
| 22) | FRP Small boat with inboard engine | 1 |
| 23) | Formulated food | for 0.5 year |
| 24) | Oxygen cylinder | 2 |
| 25) | Electric heater | 1 |
| 26) | Handy water pump | 10 |

II. RESEARCH FACILITIES

II-1. Equipments of Physical and Chemical Study

| | | |
|-----|----------------------------------------------|-------|
| 1) | Automatic high speed refrigerated centrifuge | 1 |
| 2) | Centrifuge | 2 |
| 3) | Cellulose acetate electrophoresis | 1 set |
| 4) | Spectrophotometer | 1 |
| 5) | Sugar polarimeter | 1 |
| 6) | Kjeldahl apparatus | 1 |
| 7) | Fat extraction apparatus | 1 |
| 8) | Electric crusher | 1 |
| 9) | Distiller | 2 |
| 10) | Drying oven | 1 |
| 11) | Incubator | 2 |

TABLE 4.5 (3). LIST OF EQUIPMENTS AND APPARATUS (3)

| NO. | ITEM | Q'TY |
|-----|------------------------------------|------|
| 12) | Electric furnace,muffle | 1 |
| 13) | Infrared moisture meter | 1 |
| 14) | Drying sterilizer | 2 |
| 15) | Autoclave | 1 |
| 16) | Water bath incubator,shaking | 1 |
| 17) | Hot plate and magnetic stirrer | 1 |
| 18) | Tissue floating bath | 1 |
| 19) | Paraffin spreading apparatus | 1 |
| 20) | Minot type microtome | 1 |
| 21) | Microtome sharpener | 1 |
| 22) | Blender | 1 |
| 23) | Homogenizer | 1 |
| 24) | Analytical balance | 1 |
| 25) | Electric top balance | 2 |
| 26) | Top balance | 2 |
| 27) | Millipore filtering apparatus | 1 |
| 28) | Regnault's calorimeter | 1 |
| 29) | Aseptic box | 2 |
| 30) | Rotary evaporater | 1 |
| 31) | Lux meter | 1 |
| 32) | pH meter | 1 |
| 33) | Oxdation-reduction potential meter | 1 |
| 34) | Water tester set (HACH) | 1 |
| 35) | Thermometer, mercury | 20 |
| 36) | Hemacytometer | 4 |
| 37) | Sediwich-rafter counter | 1 |
| 38) | Portable DO meter | 1 |
| 39) | Freeze drying apparatus | 1 |
| 40) | Spray dryer | 1 |
| 41) | Mechanical shaker and seive | 1 |
| 42) | Portable mixer | 2 |
| 43) | Hair dryer | 1 |
| 44) | Mantle heater | 3 |
| 45) | Fiber test system | 1 |

TABLE 4.5 (4). LIST OF EQUIPMENTS AND APPARATUS (4)

| NO. | ITEM | Q'TY |
|--------------------------------------------------|-------------------------------------------------|-------|
| 46) | Laboratory mixer | 1 |
| 47) | Salinity refractometer | 1 |
| 48) | Glasswares (Refer to V) | |
| 49) | Chemicals (Refer to V) | |
| II-2. Optical Equipments and Electric Appliances | | |
| 1) | Dissecting microscope | 1 |
| 2) | Trinocular microscope (phase contrast) | 1 |
| 3) | Binocular microscope | 3 |
| 4) | Photographic apparatus for microscope | 1 |
| 5) | Still camera, 35mm reflex type, with macro lens | 1 |
| 6) | Micro-computer system | 1 set |
| 7) | Waterproof flash light | 1 |
| 8) | Photo processing apparatus | 1 set |
| 9) | Electric typewriter | 1 |
| 10) | Table calculator | 5 |
| 11) | Copying machine | 1 |
| II-3. Other Equipments | | |
| 1) | Experiment table, center | 4 |
| 2) | Experiment table, side | 1 |
| 3) | Table lamp | 8 |
| 4) | Push cart | 4 |
| 5) | Refrigerator | 4 |
| 6) | Deep freezer | 1 |
| 7) | Ice making machine | 1 |
| 8) | Dissecting apparatus set | 2 |
| 9) | Dial caliper | 1 |
| 10) | Vacuum pump | 1 |
| 11) | Thermostatic water tank | 2 |
| 12) | Compact draft | 1 |

TABLE 4.5 (5). LIST OF EQUIPMENTS AND APPARATUS (5)

| NO. | ITEM | Q'TY |
|-----------------------------------------------------|-------------------------|---------|
| III. TRAINING FACILITIES | | |
| III-1. Equipments of Physical and Chemical Study | | |
| 1) | Salinity refractometer | 5 |
| 2) | Top balance | 1 |
| 3) | Portable DO meter | 1 |
| 4) | Thermometer, alcohol | 10 |
| 5) | Grasswares (Refer to V) | |
| 6) | Dissecting apparatus | 20 sets |
| III-2. Optical Equipment and Electrical Appliances | | |
| 1) | Biological microscope | 20 |
| 2) | Video cassette TV set | 1 |
| 3) | Slide projector | 1 set |
| 4) | Overhead projector | 1 |
| 5) | Screen for projector | 1 |
| III-2. Other Equipments | | |
| 1) | Altemia incubation tank | 1 |
| 2) | Diatom incubation tank | 1 |
| 3) | Rearing tank | 4 |
| 4) | Mini aeration pump | 1 |
| 5) | Mechanical typewriter | 1 |
| 6) | Gas burner | 5 |
| 7) | Grasswares (Refer to V) | |
| 8) | Small-size bus | 1 |
| 9) | Offset machine | 1 |
| IV. ADMINISTRATION FACILITIES | | |
| IV-1. Equipment of Physical and Chemical Study | | |
| 1) | Electric heater | 1 |
| IV-2. Optical equipments and Electrical Applicances | | |
| 1) | Electric typewriter | 1 |
| 2) | Table calculator | 1 |

TABLE 4.6 (6) LIST OF EQUIPMENTS AND APPARATUS (6)

| No. | ITEM | Q'TY |
|-------------------------------------------|---------------------------------|-------|
| IV-3. Other equipments | | |
| 1) | Lawn mower with engine | 1 |
| 2) | Waterproof flash light | 2 |
| 3) | Repairing tools | 1 set |
| 4) | Electric repairing tools | 1 set |
| 5) | Station wagon | 1 |
| V. Glass and plastic wares, and chemicals | | |
| 1) | A. Beaker (Pyrex) 30 ml | 50 |
| | B. Beaker (Pyrex) 50 ml | 50 |
| | C. Beaker (Pyrex) 100 ml | 120 |
| | D. Beaker (Pyrex) 250 ml | 100 |
| | E. Beaker (Pyrex) 500 ml | 120 |
| | F. Beaker (Pyrex) 1,000 ml | 60 |
| | G. Beaker (Pyrex) 2,000 ml | 50 |
| 2) | A. Beaker (P.P) 30 ml | 50 |
| | B. Beaker (P.P) 50 ml | 50 |
| | C. Beaker (P.P) 100 ml | 120 |
| | D. Beaker (P.P) 250 ml | 100 |
| | E. Beaker (P.P) 500 ml | 120 |
| | F. Beaker (P.P) 1,000 ml | 150 |
| | G. Beaker (P.P) 2,000 ml | 50 |
| 3) | A. Flask, round bottom 25 ml | 10 |
| | B. Flask, round bottom 50 ml | 10 |
| | C. Flask, round bottom 100 ml | 10 |
| | D. Flask, round bottom 250 ml | 10 |
| | E. Flask, round bottom 500 ml | 10 |
| | F. Flask, round bottom 1,000 ml | 10 |
| 4) | A. Flask, flat bottom 25 ml | 10 |
| | B. Flask, flat bottom 50 ml | 10 |
| | C. Flask, flat bottom 100 ml | 30 |
| | D. Flask, flat bottom 250 ml | 30 |
| | E. Flask, flat bottom 500 ml | 30 |
| | F. Flask, flat bottom 1,000 ml | 40 |

TABLE 4.5 (7). LIST OF EQUIPMENTS AND APPARATUS (7)

| No. | ITEM | Q'TY |
|-----|----------------------------------------|------|
| 5) | A. Flask, Erlenmeyer 25 ml | 50 |
| | B. Flask, Erlenmeyer 50 ml | 50 |
| | C. Flask, Erlenmeyer 100 ml | 100 |
| | D. Flask, Erlenmeyer 250 ml | 100 |
| | E. Flask, Erlenmeyer 500 ml | 100 |
| | F. Flask, Erlenmeyer 1,000 ml | 60 |
| 6) | A. Volumetric flask 25 ml | 50 |
| | B. Volumetric flask 50 ml | 50 |
| | C. Volumetric flask 100 ml | 50 |
| | D. Volumetric flask 250 ml | 50 |
| | E. Volumetric flask 500 ml | 50 |
| | F. Volumetric flask 1,000 ml | 50 |
| 7) | A. Graduated cylinder (Pyrex) 5 ml | 25 |
| | B. Graduated cylinder (Pyrex) 10 ml | 25 |
| | C. Graduated cylinder (Pyrex) 25 ml | 25 |
| | D. Graduated cylinder (Pyrex) 50 ml | 25 |
| | E. Graduated cylinder (Pyrex) 100 ml | 25 |
| | F. Graduated cylinder (Pyrex) 250 ml | 25 |
| | G. Graduated cylinder (Pyrex) 500 ml | 25 |
| | H. Graduated cylinder (Pyrex) 1,000 ml | 25 |
| 8) | A. Graduated cylinder (P.P) 5 ml | 25 |
| | B. Graduated cylinder (P.P) 10 ml | 25 |
| | C. Graduated cylinder (P.P) 25 ml | 25 |
| | D. Graduated cylinder (P.P) 50 ml | 20 |
| | E. Graduated cylinder (P.P) 100 ml | 24 |
| | F. Graduated cylinder (P.P) 250 ml | 20 |
| | G. Graduated cylinder (P.P) 500 ml | 20 |
| | H. Graduated cylinder (P.P) 1,000 ml | 24 |
| 9) | A. Volumetric pipette 0.1 ml | 25 |
| | B. Volumetric pipette 1 ml | 25 |
| | C. Volumetric pipette 5 ml | 25 |
| | D. Volumetric pipette 10 ml | 25 |
| | E. Volumetric pipette 20 ml | 25 |
| | F. Volumetric pipette 50 ml | 25 |

TABLE 4.5 (8). LIST OF EQUIPMENTS AND APPARATUS (8)

| No. | ITEM | Q'TY |
|-----|------------------------------------------------|------|
| 10) | A. Mohr pipette 1 ml | 60 |
| | B. Mohr pipette 10 ml | 80 |
| 11) | A. Bulbed pipette 1 ml | 20 |
| | B. Bulbed pipette 2 ml | 20 |
| | C. Bulbed pipette 5 ml | 20 |
| | D. Bulbed pipette 10 ml | 50 |
| 12) | A. Funnel (Glass) 5 cm | 14 |
| | B. Funnel (Glass) 10 cm | 14 |
| 13) | A. Funnel (P.E) 5 cm | 14 |
| | B. Funnel (P.E) 10 cm | 18 |
| 14) | A. Buchner funnel 5 cm | 7 |
| | B. Buchner funnel 10 cm | 7 |
| 15) | A. Separatory funnel 50 ml | 7 |
| | B. Separatory funnel 100 ml | 7 |
| | C. Separatory funnel 200 ml | 7 |
| | D. Separatory funnel 500 ml | 7 |
| 16) | A. Tunneltop buret with teflon stopcock 50 ml | 10 |
| | B. Tunneltop buret with teflon stopcock 100 ml | 10 |
| 17) | A. Automatic buret, with reagent bottle 25 ml | 10 |
| | B. Automatic buret, with reagent bottle 50 ml | 10 |
| 18) | Culture flask 5,000 ml | 20 |
| 19) | Petri dish | 200 |
| 20) | Test tube | 500 |
| 21) | Watch dish | 60 |
| 22) | A. Reagent bottle (plain) 250 ml | 50 |
| | B. Reagent bottle (plain) 500 ml | 50 |
| | C. Reagent bottle (plain) 1,000 ml | 25 |
| 23) | A. Reagent bottle (amber) 250 ml | 50 |
| | B. Reagent bottle (amber) 500 ml | 50 |
| | C. Reagent bottle (amber) 1,000 ml | 25 |
| 24) | A. Vial specimen bottle 30 ml | 150 |
| | B. Vial specimen bottle 500 ml | 50 |
| 25) | A. Filtering bottle 3,000 ml | 5 |
| | B. Filtering bottle 5,000 ml | 5 |

TABLE 4.5 (9). LIST OF EQUIPMENTS AND APPARATUS (9)

| No. | ITEM | Q'TY |
|-----|---------------------------------------------|-------|
| 26) | Graham condenser | 5 |
| 27) | A. Slide glass (plain) | 1,500 |
| | B. Slide glass (frost) | 1,500 |
| | C. Cover glass | 6,000 |
| 28) | Holed slide glass | 1,000 |
| 29) | Staining dish (for slide) | 5 |
| 30) | A. Glass tube 5 mm X 1.2 m | 50 |
| | B. Glass rod 5 mm X 1.2 m | 30 |
| 31) | A. Tuberculin syringe 0.25 ml | 10 |
| | B. Needle for syringe | 120 |
| 32) | A. P.E bottle (narrow mouth) 250 ml | 40 |
| | B. P.E bottle (narrow mouth) 500 ml | 25 |
| | C. P.E bottle (narrow mouth) 1,000 ml | 25 |
| | D. P.E bottle (narrow mouth) 2,000 ml | 17 |
| | E. P.E bottle (narrow mouth) 5,000 ml | 9 |
| 33) | A. P.E bottle (wide mouth) 500 ml | 10 |
| | B. P.E bottle (wide mouth) 1,000 ml | 10 |
| 34) | Plastic spoon | 70 |
| 35) | A. Plastic bucket 20 liter | 30 |
| | B. Plastic bucket 60 liter | 10 |
| 36) | A. Constainer (PVC) (with caster) 80 liter | 15 |
| | B. Constainer (PVC) (with caster) 400 liter | 10 |
| 37) | A. P.E bottles with stopcock 10 liter | 6 |
| | B. P.E bottles with stopcock 20 liter | 6 |
| 38) | A. Rubber bulb for bulbed pipette 1 ml | 80 |
| | B. Rubber bulb for bulbed pipette 2 ml | 80 |
| | C. Rubber bulb for bulbed pipette 5 ml | 80 |
| | D. Rubber bulb for bulbed pipette 10 ml | 200 |
| 39) | Rubber bulb for buret | 8 |
| 40) | Crucible, lidded 100 ml | 20 |
| 41) | Needle holder (long arm) | 20 |
| 42) | Forceps set | 17 |
| 43) | Spatula | 18 |
| 44) | Needle holder (short arm) | 30 |

TABLE 4.5 (10). LIST OF EQUIPMENTS AND APPARATUS (10)

| No. | ITEM | Q'TY |
|-----|------------------------------------------|-------|
| 45) | Washing bottle 300 ml | 24 |
| 46) | Desiccator 30 cm | 6 |
| 47) | Slide glass box (100 sheets) | 5 |
| 48) | Pipette box (8 drawers) | 2 |
| 49) | A. Rubber tube for glass tube | 40 m |
| | B. Vinyl tube for faucet | 150 m |
| | C. Vinyl tube for aeration | 150 m |
| | D. Rubber tube for gas | 50 m |
| 50) | Pipette washer | 5 |
| 51) | Rubber stopper | 120 |
| 52) | A. White enameled tray 290 mm | 32 |
| | B. White enameled tray 370 mm | 12 |
| | C. White enameled tray 495 mm | 12 |
| | D. White enameled tray 650 mm | 12 |
| 53) | Washing basket | 6 |
| 54) | A. Test tube rack | 10 |
| | B. Funnel support | 4 |
| | C. Buret support | 10 |
| | D. Pipette support | 10 |
| 55) | Brush for test tube | 60 |
| 56) | A. Tripod (150 mm) | 35 |
| | B. Asbestos coated wire gauge (210 mm) | 120 |
| 57) | A. Tongs for test tube | 12 |
| | B. Tongs for crucible | 1 |
| 58) | A. Pinchcock | 30 |
| | B. Clamp for flask | 30 |
| | C. Ball and socket joint | 10 |
| 59) | A. Filter paper (qualitative) L | 800 |
| | B. Filter paper (qualitative) M | 800 |
| | C. Filter paper (qualitative) S | 800 |
| 60) | A. Recording paper for spectrophotometer | 3 |
| | B. Printing paper for microcomputer | 3 |
| 61) | Chemicals | 1 set |

TABLE 4.5 (11). LIST OF EQUIPMENTS AND APPARATUS (11)

| No. | ITEM | Q'TY |
|---------------|--------------------------------|------|
| VI. Furniture | | |
| 1) | Office desk, a. Large | 2 |
| | b. Medium | 11 |
| | c. Small | 31 |
| 2) | Conference table | 1 |
| 3) | Table, a. For lecturer | 5 |
| | b. For trainee | 60 |
| 4) | Dining table | 11 |
| 5) | Table (for library) | 6 |
| 6) | Table (for laboratory) | 11 |
| 7) | Work table | 1 |
| 8) | Side table | 1 |
| 9) | Chairs, a. Armchair for office | 4 |
| | b. Ordinary chair for office | 11 |
| | c. Chair for lecturer | 5 |
| | d. Chair for trainee | 80 |
| | e. Chair for dining room | 66 |
| | f. Chair for library | 6 |
| | g. Bench | 4 |
| | h. Divan | 5 |
| | i. Sofa set | 1 |
| 10) | Cabinet | 8 |
| 11) | Bookshelf | 21 |
| 12) | Locker | 109 |
| 13) | Bed | 64 |
| 14) | White board | 12 |
| 15) | Rack | 10 |
| 16) | TV set | 1 |
| 17) | Stereophonic system | 1 |
| 18) | Newspaper rack | 1 |

TABLE 4.5 (12). LIST OF EQUIPMENTS AND APPARATUS (12)

| No. | ITEM | Q'TY |
|-----|---------------------------|------|
| 19) | Kitchen Utensils, a. Oven | 2 |
| | b. Sink | 2 |
| | c. Kitchen table | 2 |
| | d. Cooking table | 2 |
| | e. Shelf | 4 |
| | f. Rice cooker | 1 |
| | g. Refrigerator | 1 |
| | h. Freezer | 1 |

TABLE 5.1 STANDARD WAGE TABLE IN MALAYSIA

| Class | Career (Years after graduate) | Wage (M\$/month) |
|---------------------------|----------------------------------|---------------------|
| A-1 | Experience base | 6,350 |
| A-2 | Experience base | 6,000 |
| A-3 | | 5,700 |
| B | Experience base | 5,400 |
| C | 20 | 4,600 |
| D | 15 | 4,300 |
| E | 12-15 | 4,000 |
| F | 7-9 | 3,600 |
| G | 5-7 | 3,300 |
| Senior fisheries officer | 3 | 2,400 |
| Assit. fisheries officer | | 785 |
| Typist | | 500-700 |
| Driver | 3-10 | 300-520 |
| Cook | | 800 |
| Watchman | | 450 |
| Electrician and Mechanics | | 650-1,300 |
| Simple worker | | 400 |

Source: JKR, as of 1984.

TABLE 6.1A INPUT AND OUTPUT OF FRESHWATER MIXED CULTURE WITH GIANT PRAWN (1/2)

Production unit: 1.6 ha pond size

| Item / Year | 1 | 2-4 | 5 | 6-9 | 10 | 11-15 |
|--------------------------------------|--------|--------|--------|--------|--------|--------|
| 1. Output value(M\$)(*1) | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| 2. On-farm on factor input | | | | | | |
| a) Prawn fry (No.) | 21,800 | 21,800 | 21,800 | 21,800 | 21,800 | 21,800 |
| b) Lime | | | | | | |
| Quantity (ton) | 6.4 | 6.4 | 6.4 | 6.4 | 6.4 | 6.4 |
| Value (M\$/ton) | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 |
| c) Soya bean cake | | | | | | |
| Quantity (ton) | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |
| Value (M\$/ton) | 70.0 | 70.0 | 70.0 | 70.0 | 70.0 | 70.0 |
| d) Fertilizer | | | | | | |
| Quantity (ton) | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| Value (M\$/ton) | 96.0 | 96.0 | 96.0 | 96.0 | 96.0 | 96.0 |
| 3. Labour (manday) (*2) | 228 | 228 | 228 | 228 | 228 | 228 |
| 4. Equipment (M\$) | 500 | 500 | 500 | 500 | 500 | 500 |
| 5. Operation of pumps | 8 | 8 | 8 | 8 | 8 | 8 |
| (% of gross output value) | | | | | | |
| 6. Maintenance and repair (M\$) (*3) | 0 | 0 | 1,000 | 0 | 1,000 | 0 |
| 7. Subsidy (M\$) (*4) | 3,060 | 60 | 60 | 60 | 60 | 60 |
| 8. Repayment (M\$) (*5) | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 | 0 |

Remarks: *1: Output and input value: 1.6 ha

*2: Imputed of labour is M\$ 7.50/manday.

*3: Repair of bund is every 5th year and at 10% of the gross output value.

*4: Subsidies for big head carp, grass carp and giant prawn are given only in 1st year. Subsidy for common carp is given annually.

*5: For housing: M\$10,000 and pond construction: M\$10,000.

Source: Brackish Water Fish and Shrimp Culture in Pond, Pusat Penyelidikan Airpayau, Gelang Patah, Johor (Textbook for training)

TABLE 6.1B INPUT AND OUTPUT OF FRESHWATER MIXED CULTURE WITH GIANT PRAWN (2/2)

| Species | Stocking | | Yields | | | Ex-pond | Price | Input | |
|---------------|---------------|-----------------|--------|----------------|------------------|-----------------------|-----------------------|----------------|-------|
| | rate (No.) | Survival (%) | No. | Weight (kg) | Total Wt.(kg) | price (M\$/ kg) | Value of fry (M\$) | value (M\$) | |
| Giant prawn | 20,000 | 50 | 10,000 | 0.04 | 400 | 13.0 | 5,200 | 0.10 | 2,000 |
| Big head carp | 496 | 70 | 347 | 2.0 | 694 | 2.0 | 1,368 | 0.50 | 248 |
| Grass carp | 704 | 70 | 493 | 2.0 | 986 | 3.0 | 2,958 | 0.50 | 352 |
| Common carp | 600 | 70 | 420 | 0.6 | 252 | 1.8 | 454 | 0.10 | 60 |
| Total | 21,800 | 52 | 11,260 | --- | 2,337 | 4.2 | 10,000 | 0.12 | 2,660 |

Source: See TABLE 6.1A

TABLE 6.2 OPERATION OF TIGER PRAWN CULTURE

Production unit: 2 ponds of 1.3 ha pond size, 2 production cycles/year

| Item | / | Year | 1-2 | 3 | 4-5 | 6 | 7-15 |
|--------------------------------|---|------|------------------------------|---------|---------|---------|---------|
| OUTPUT | | | | | | | |
| No. of prawn at harvest (No.) | | | 96,000 | 96,000 | 96,000 | 96,000 | 96,000 |
| Average no. per kg (No.) | | | 30 | 30 | 30 | 30 | 30 |
| Weight at harvest (kg) | | | 3,200 | 3,200 | 3,200 | 3,200 | 3,200 |
| Ex-farm price (M\$/kg) | | | 14 | 14 | 14 | 14 | 14 |
| INPUT | | | | | | | |
| On-farm non-factor input (*1) | | | | | | | |
| a) Prawn fry, Quantity (No.) | | | 240,000 | 240,000 | 240,000 | 240,000 | 240,000 |
| | | | Value (M\$/fry) | 0.08 | 0.08 | 0.08 | 0.08 |
| b) Pesticide, Quantity (kg) | | | 90 | 90 | 90 | 90 | 90 |
| | | | Value (M\$/kg) | 7.2 | 7.2 | 7.2 | 7.2 |
| c) Lime, Quantity (ton) | | | 3 | 3 | 3 | 3 | 3 |
| | | | Value (M\$/ton) | 170 | 170 | 170 | 170 |
| d) Trash fish, Quantity (ton) | | | 19.2 | 19.2 | 19.2 | 19.2 | 19.2 |
| | | | Value (M\$/ton) | 250 | 250 | 250 | 250 |
| e) Rice bran, Quantity (kg) | | | 1,080 | 1,080 | 1,080 | 1,080 | 1,080 |
| | | | Value (M\$/kg) | 0.3 | 0.3 | 0.3 | 0.3 |
| Labour-hired | | | 1 | 1 | 1 | 1 | 1 |
| Salary of labourer (M\$/month) | | | 250 | 250 | 250 | 250 | 250 |
| Equipments (M\$) | | | 500 | 500 | 500 | 500 | 500 |
| Operation and maintenance | | | 15 | 15 | 15 | 15 | 15 |
| | | | (% of pump cost) | | | | |
| Maintenance and repair (% of | | | -- | 40 | -- | 40 | -- |
| | | | bund construction cost) (*2) | | | | |
| OTHERS | | | | | | | |
| a) Food conversion rate | | | 6:1 | 6:1 | 6:1 | 6:1 | 6:1 |
| b) Survival rate (%) | | | 40 | 40 | 40 | 40 | 40 |

Remarks: *1: Inputs are for nursery pond and 2 rearing ponds.

*2: The cost of bund trimming is M\$24,000/bund.

Source: See Table 6.1.

TABLE 6.3 ESTIMATED BALANCE OF PRAWN CULTURE OF 60,000,000 FRY*1

Unit: M\$/year

| Item | Tiger prawn | Giant prawn (mix culture) | |
|-----------------------------------|---------------|---------------------------|---------|
| | (Monoculture) | Giant prawn | Fishes |
| 1) Income, Production (kg)*2 | 660,000 | 62,500 | 302,656 |
| Sales*3 | 9,240,000 | 812,500 | 750,588 |
| Total | 9,240,000 | 1,563,088 | |
| 2) Expense, Depreciation*4 | 788,970 | 486,642 | |
| Operation cost | | | |
| Fry | 2,035,000 | 185,000 | 34,650 |
| Lime | 116,712 | 66,060 | |
| Rice bran | 74,146 | ----- | |
| Soy bean cake | ----- | 38,595 | |
| Fertilizer | ----- | 13,212 | |
| Pesticide | 148,292 | ----- | |
| Labour cost | 635,906*5 | 392,241 | |
| Equipments | 195,048 | 114,688 | |
| Operation and maintenance of pump | 739,200 | 65,000 | |
| Maintenance and repair of bund | 1,234,060 | 31,262 | |
| Total | 5,956,164 | 1,427,340 | |
| Balance | 3,283,836 | 135,748 | |

*1: Based on Tables 6.1 and 6.2. Interest rate: 10%, life span: 30 years

*2: 55,000,000 tiger prawn fry, survival rate: 40%, marketable size: 30g

5,000,000 giant prawn fry, survival rate: 50%, marketable size: 25g

*3: M\$ 14/kg for tiger prawn, M\$ 13/kg for giant prawn, M\$ 2.48/kg for mixed cultured fish.

*4: Construction cost for pond: M\$ 6,250/ha, housing: M\$ 6,250/ha,

Pond size for tiger prawn: 595 ha (density: 92,308 prawn/ha

Pond size for giant prawn: 367 ha (density: 12,500 prawn/ha

*5: The cost is estimated by giant prawn culture (228 manday/year, M\$7.50/manday).

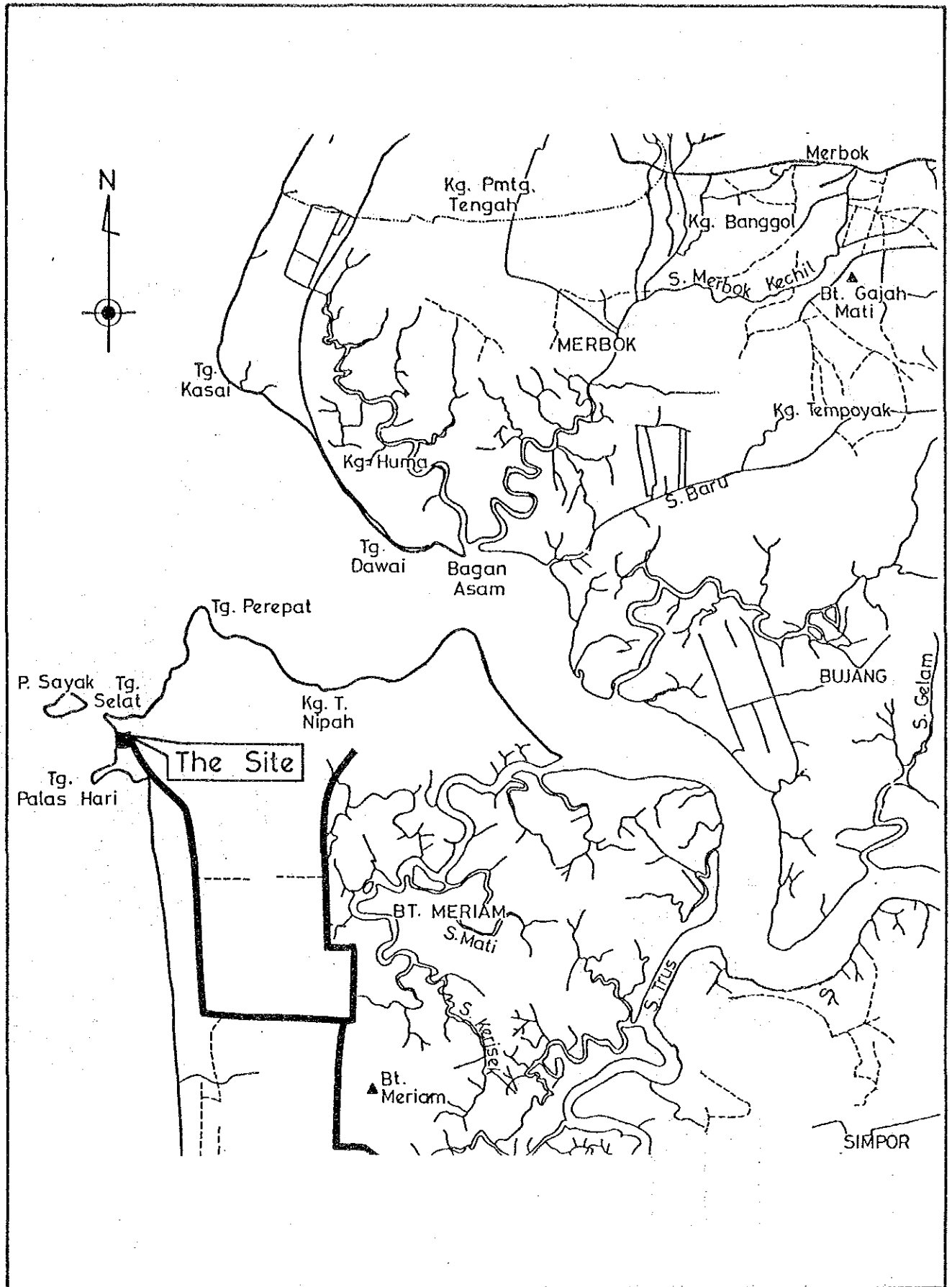


Fig. 3.1 Location of the Site.

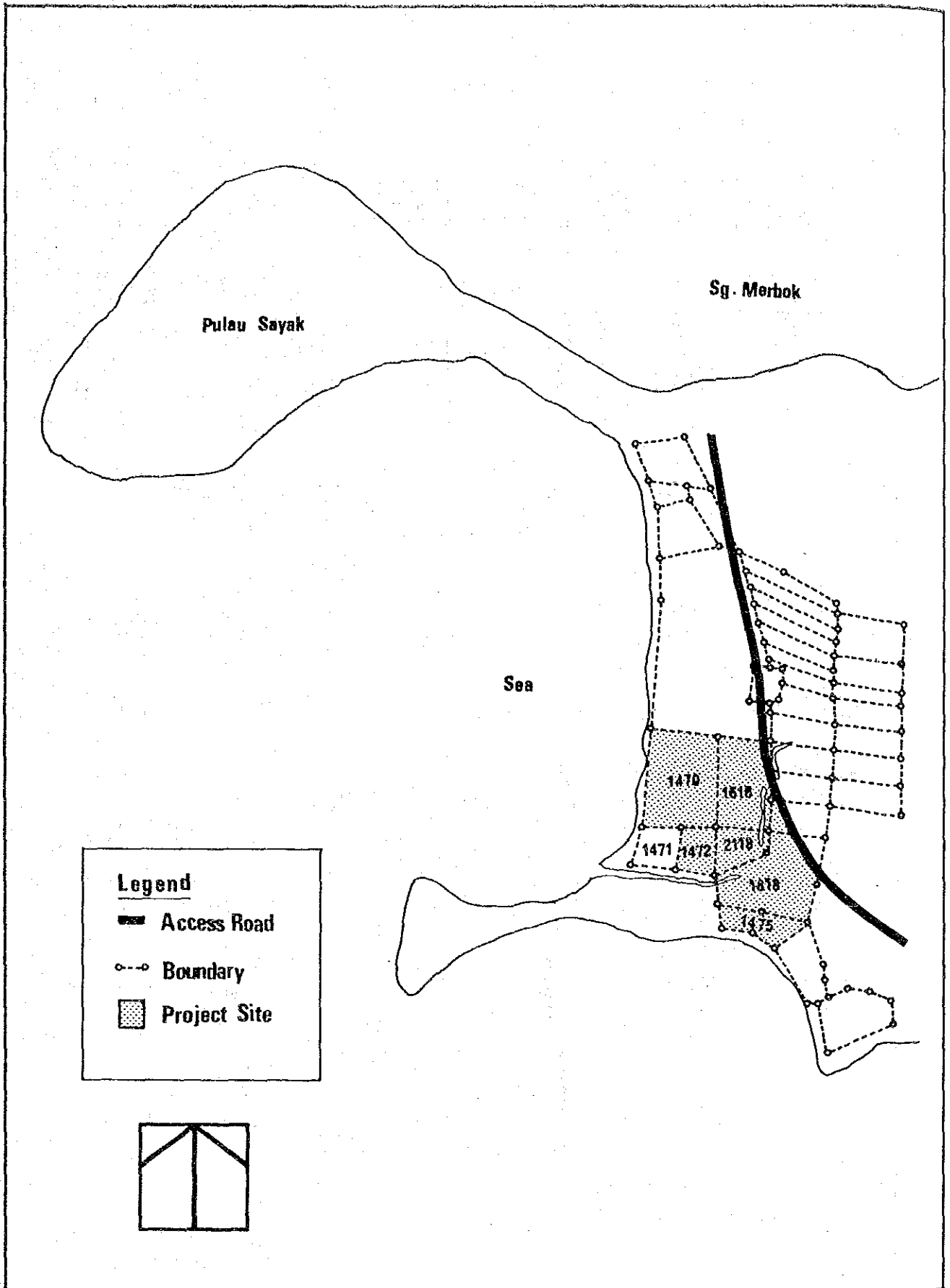


Fig. 3.2 Lot Number of the Site.

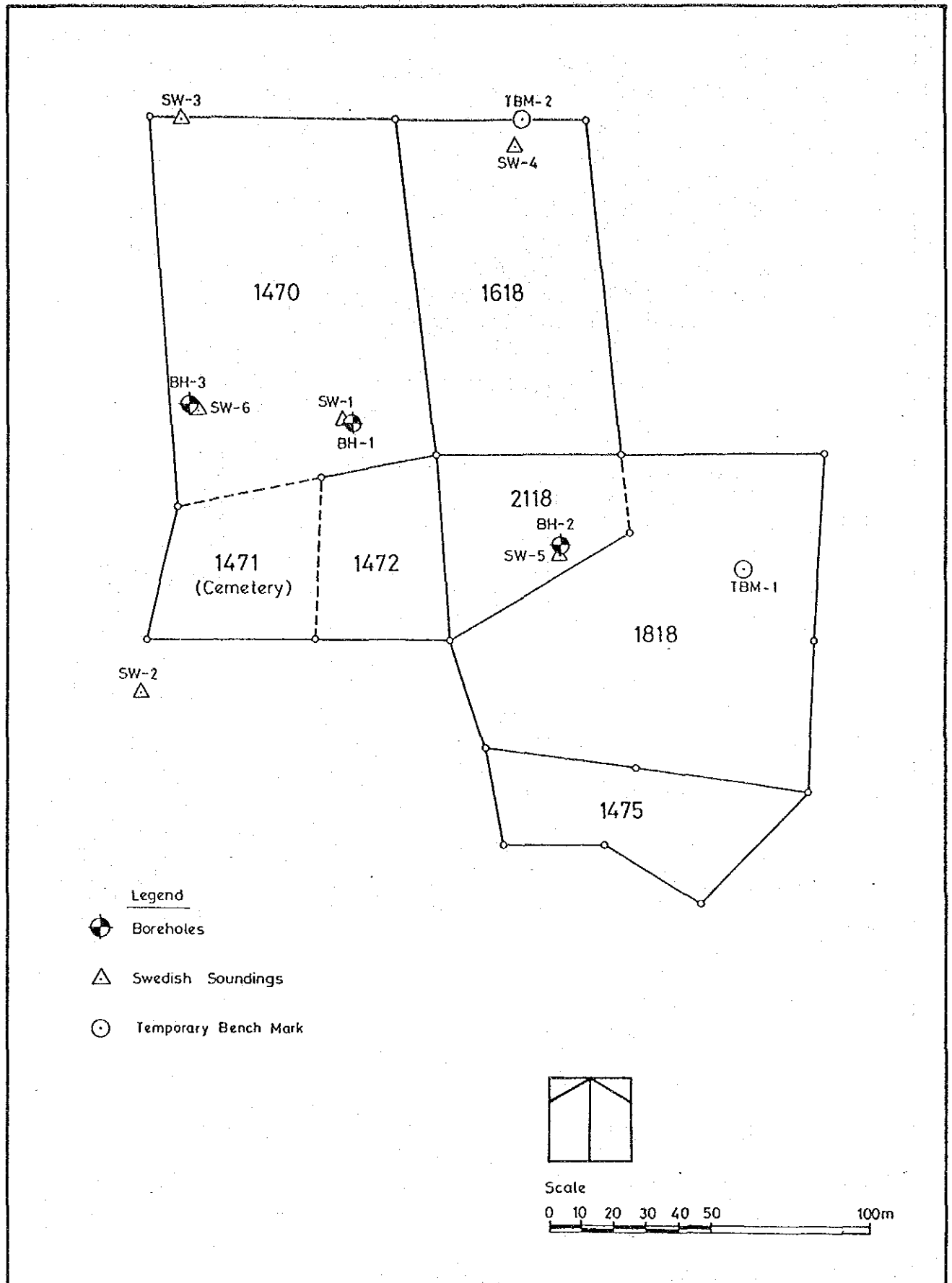


Fig. 3.3 Location of Boreholes and Swedish Soundings.

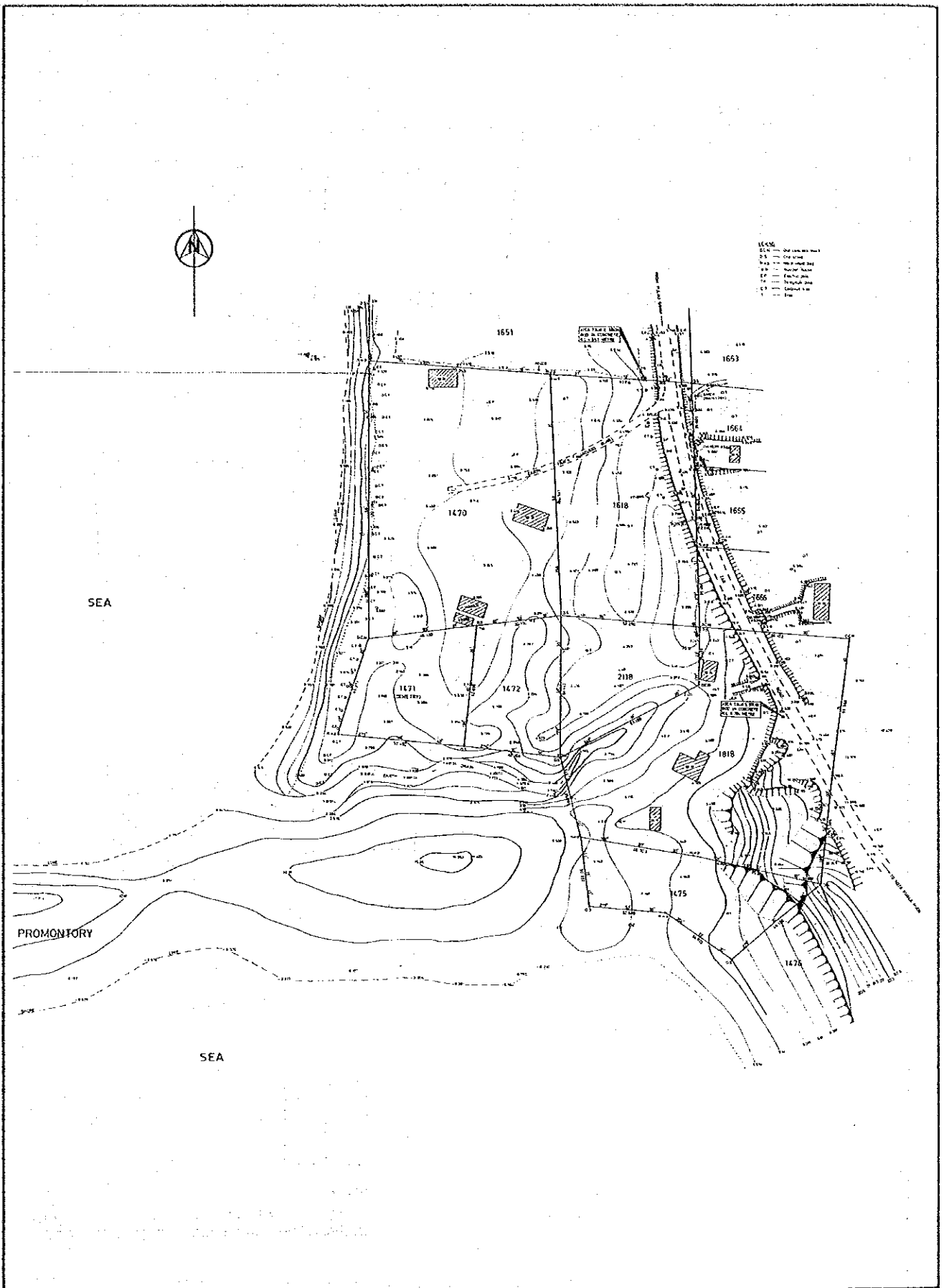
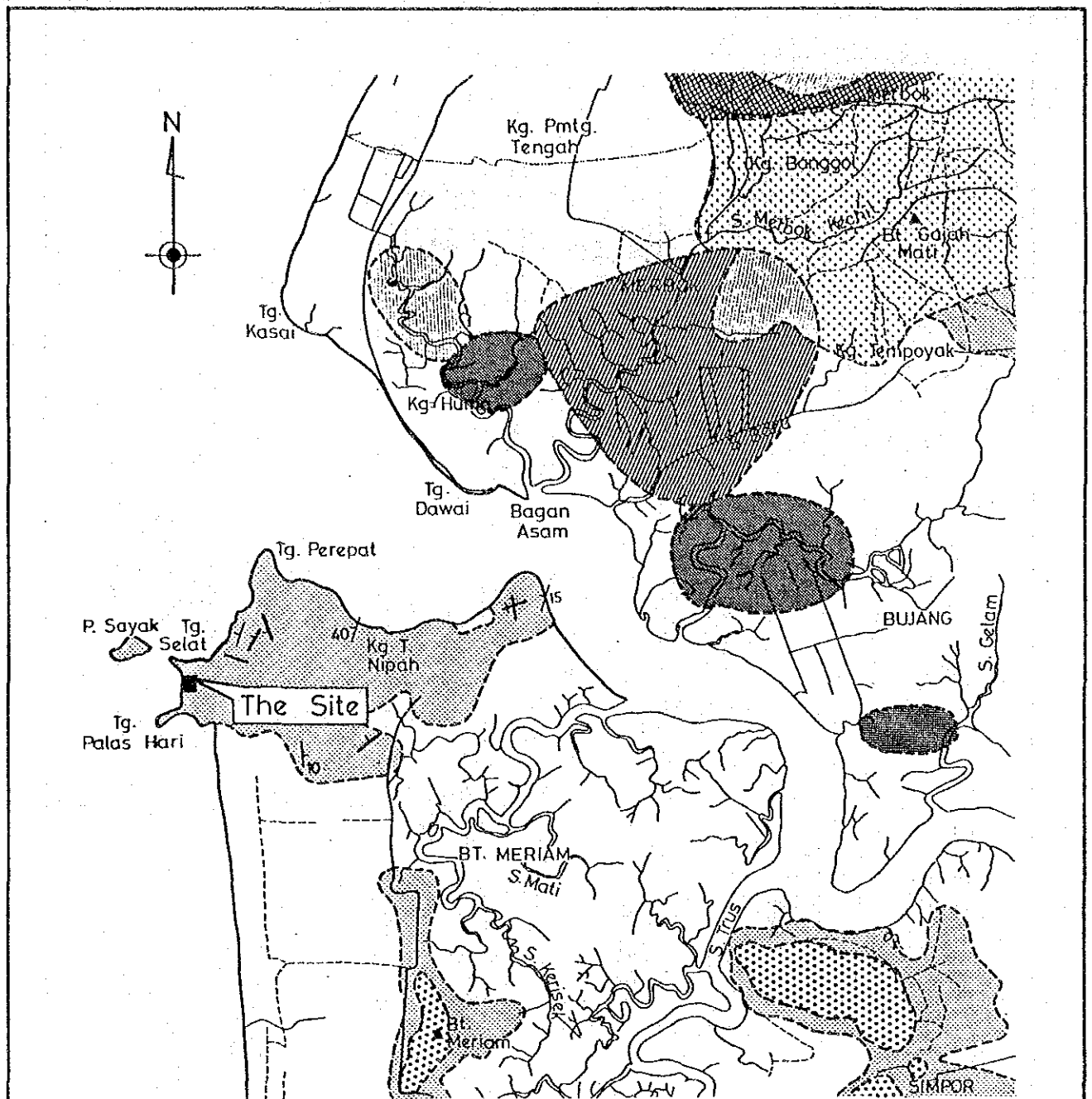


Fig. 3.4 Levelling and Detailing Survey of the Site.



Legend:

| | | | | |
|------------------------------|--|---------------------------|--|-------------------------------------------|
| Alluvium | | Marine deposits. | | Shale and mudstone. |
| Granite and Associated Rocks | | Vein quartz. | | Sandstone / quartzite. |
| | | Granite. | | Alluvium underlain by shale and mudstone. |
| | | Granite. (under alluvium) | | Quartzite. |
| | | | | Schist. |
| Scale: 0 1 2 3 km | | | | |

Fig. 3.5 Geological Map around the Site.

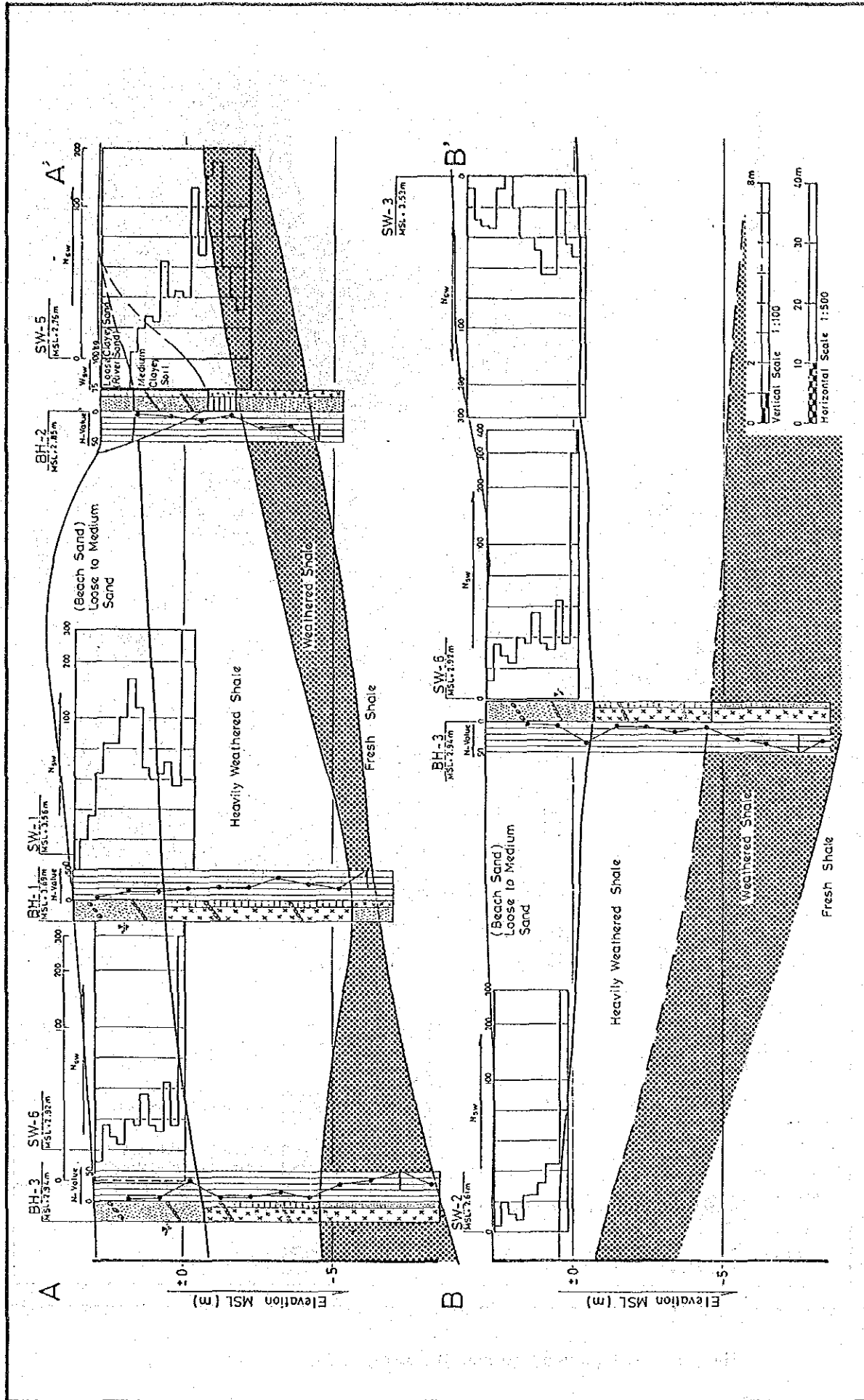


Fig. 3.6 Soil Profile.

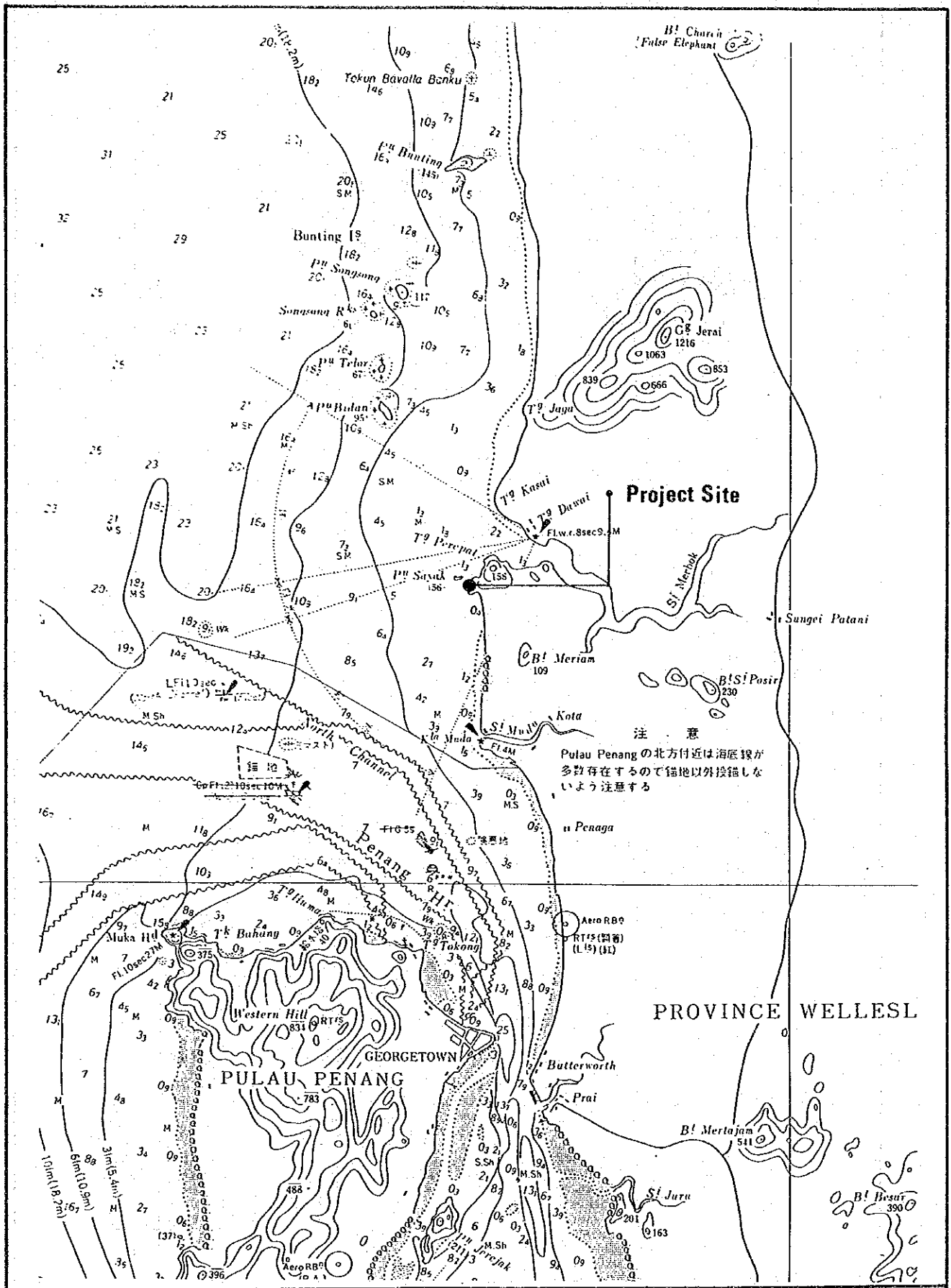


Fig. 3.7 Chart around the Site.

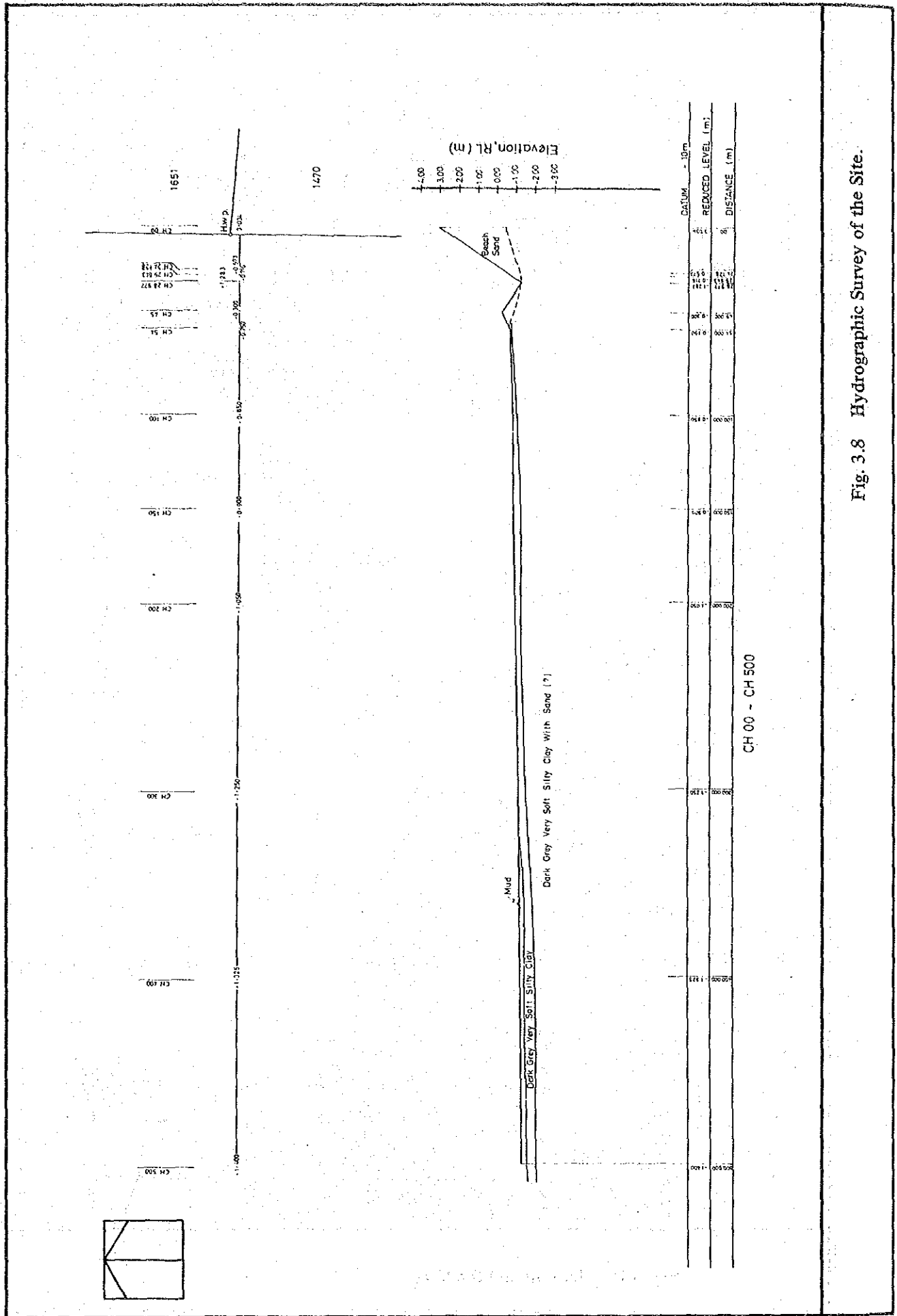


Fig. 3.8 Hydrographic Survey of the Site.

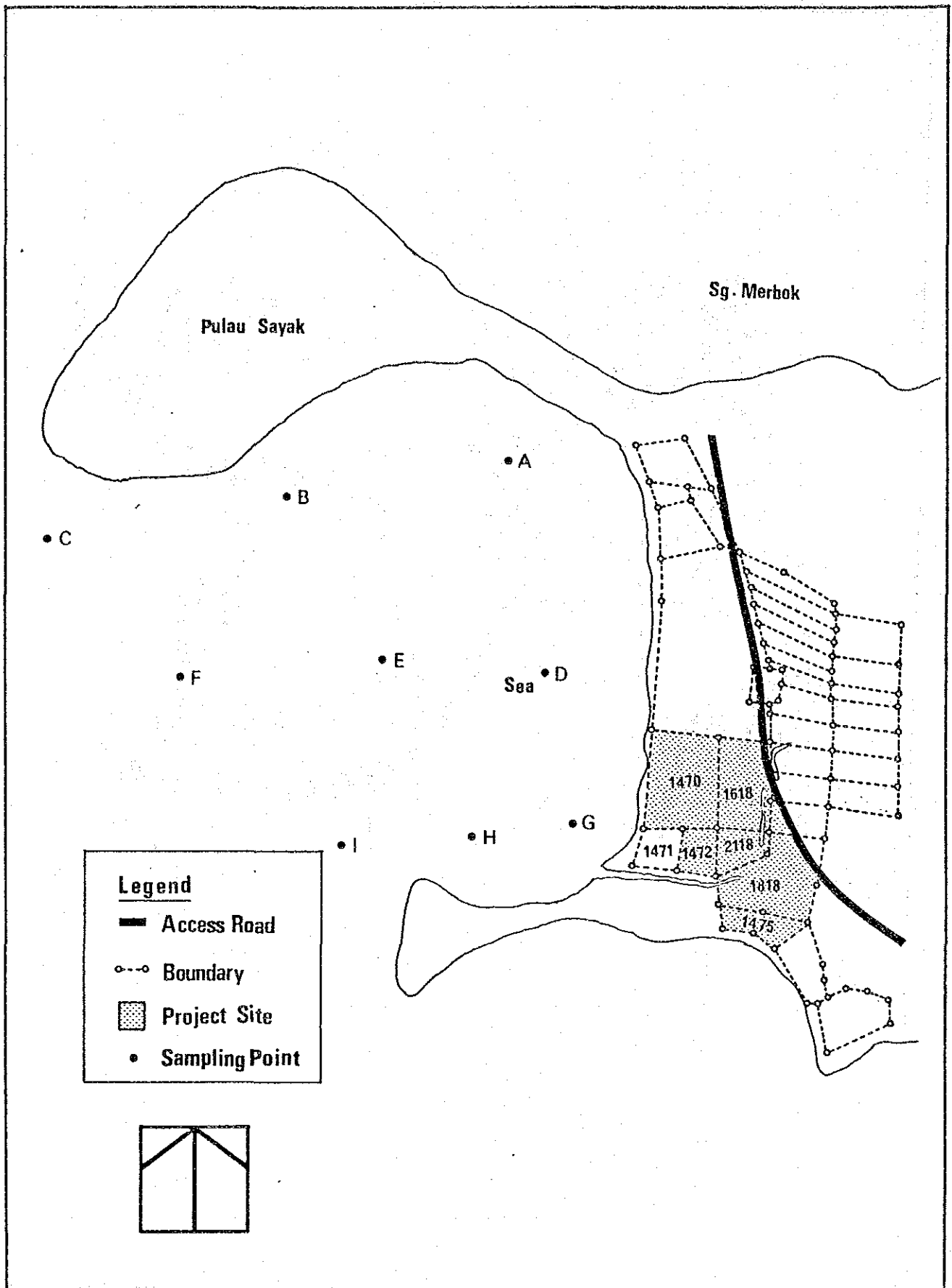


Fig. 3.9 Location of Sampling Points for Salinity Test.

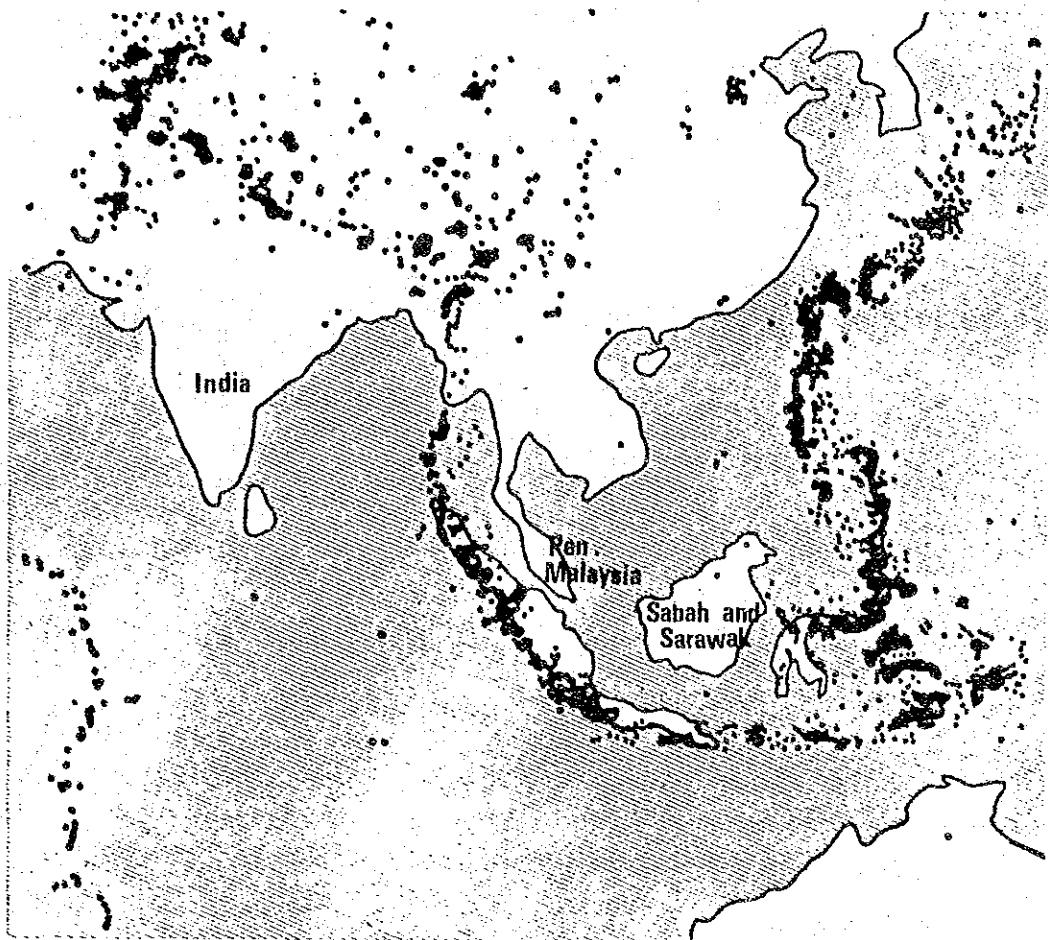


Fig. 3.10 Distribution Map of Seismic Centers.

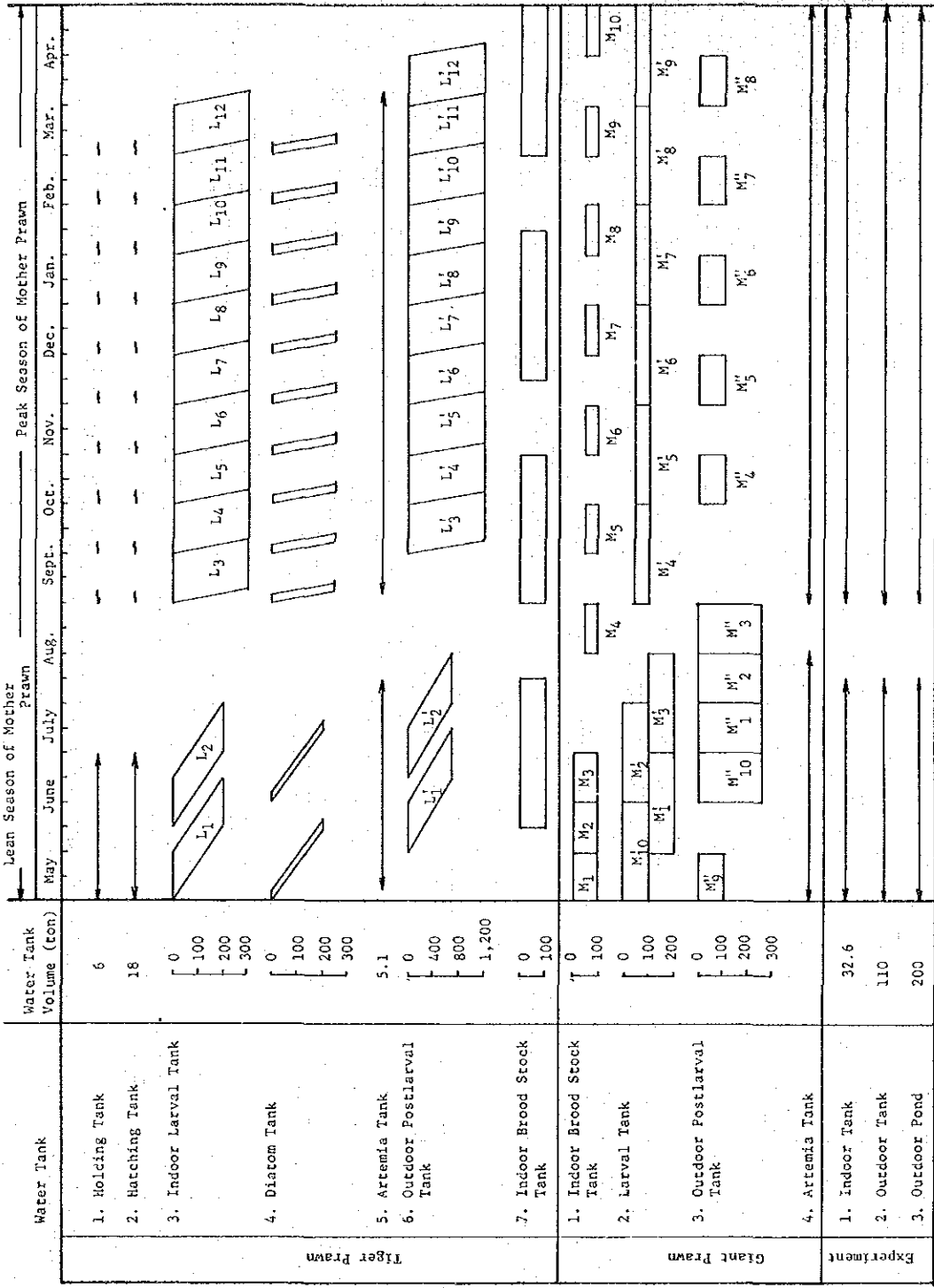


Fig. 4.1 Annual Operation Schedule for Water Tanks.

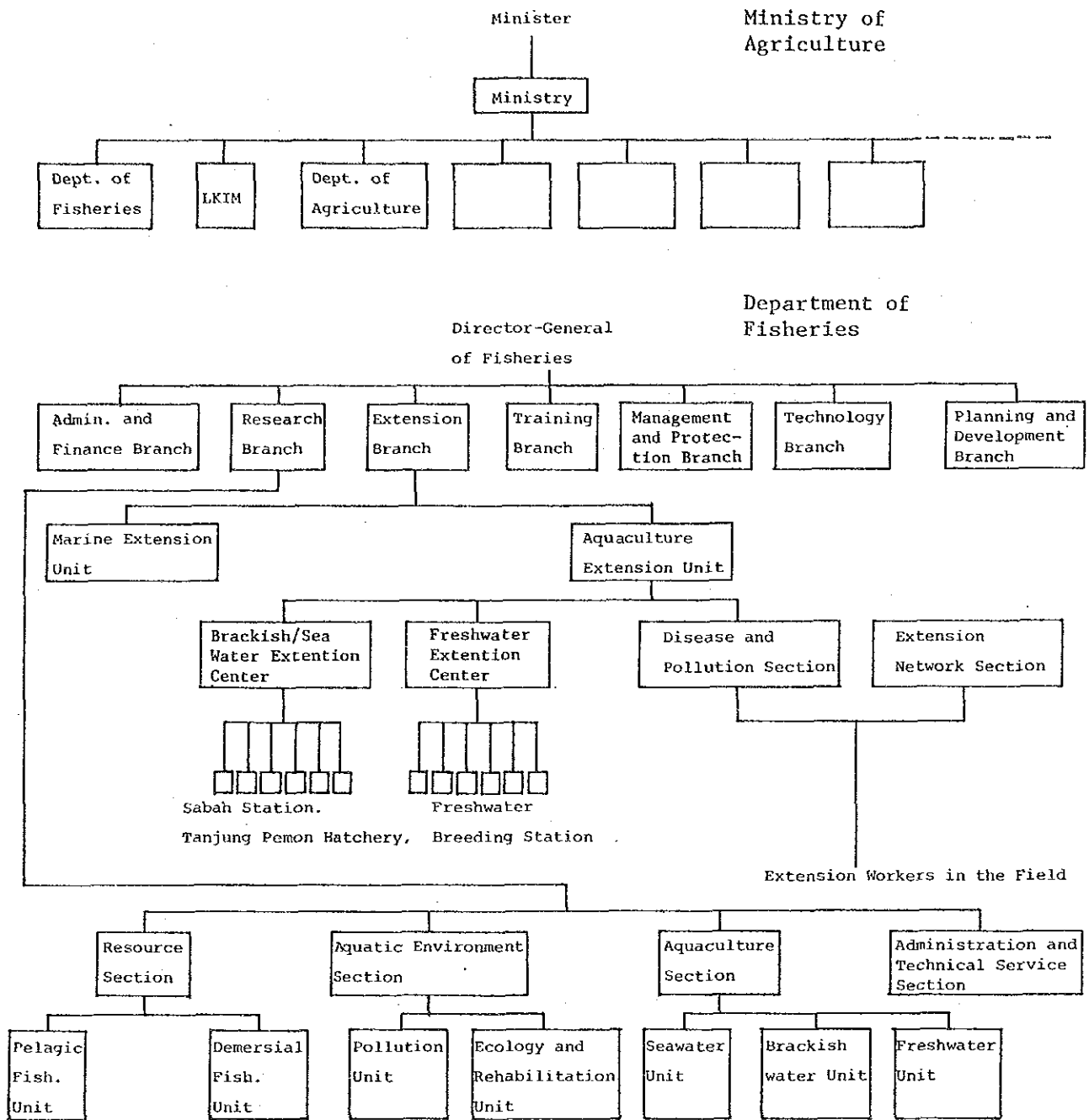


Fig. 5.1 Organization Chart of Ministry of Agriculture (MOA) and Department of Fisheries (DOF).

ANNEX

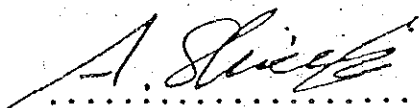
MINUTES OF DISCUSSION

BASIC DESIGN STUDY ON NATIONAL PRAWN FRY PRODUCTION
AND RESEARCH CENTRE PROJECT IN MALAYSIA

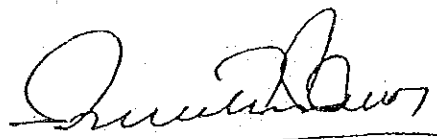
In response to the request made by the Government of Malaysia for the National Prawn Fry Production & Research Centre Project (hereinafter referred to as "the project"), the Government of Japan has sent through the Japan International Cooperation Agency, a team headed by Dr. A. Shiota, Director of Coastal Fisheries Development Division, Japan Sea Regional Fisheries Laboratory, the Fishery Agency of Japan, to carry out a basic design study for the project from October 24 to November 13 1984. The team carried out field survey, had a series of discussions and exchanged views about the project with the Authorities concerned of the Government of Malaysia.

As a result of the survey and discussions, both parties have agreed to recommend to their respective Governments to examine the result of the survey attached herewith.

Kuala Lumpur
November 10, 1984

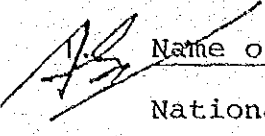


.....
(AKIHIKO SHIROTA)
Team Leader,
The Japanese Basic Study Team,
The Japan International
Cooperation Agency



.....
(MOHAMED BIN OMAR)
Director of External Assistance,
Economic Planning Unit,
Prime Minister's Department,
Malaysia.

Main result of the Basic Design Study Team

 Name of the Project

National Prawn Fry Production & Research Centre

2. The objectives of the Project

This project aims at achieving the sustainable supply of aquatic animal protein, especially Prawns, to the farmer and encourage aquaculture industry development in Malaysia.

3. The Activities of the Centre

The following activities will be carried out in the Centre

- (1) To produce fry of Penaeus monodon and Macrobrachium rosenbergii in mass scale to promote prawn farming in Malaysia.
- (2) To carry out research which will facilitate mass fry production techniques, breeding, nutrition, feed, disease, and other related aquaculture systems.
- (3) To conduct training on prawn fry production and other aquaculture systems.

4. Location of the Project Site

Pulau Sayak, Kuala Muda, Kedah, Malaysia

5. Department of Fisheries, Ministry of Agriculture

Malaysia, is responsible for the administration & execution of the project.

..2/



6. The team will convey to the Government of Japan the ~~AS~~ desire of the Government of Malaysia that the former takes necessary measures to cooperate in implementing the project and provide facilities listed in Annex I within the scope of Japanese Economic Cooperation programme in Grant Aid Form.

7. The team explained the systems of the Japanese Grant Aid and Malaysian side understood it. Government of Malaysia will take necessary measures listed in Annex II on condition that the Grant Aid Assistance would be extended.

ANNEX I

The requirements of the project to be borne by the Government of Japan include as follows:

1. Production facilities

(Indoor and outdoor)

- (1) Broodstock tank
- (2) Spawning tank
- (3) Larval tank
- (4) Live food organisms tank
- (5) Mixing tank
- (6) Filter and sedimentation tank
- (7) Water reservoir
- (8) Storage and freezer
- (9) Pump house
- (10) Experimental tank and pond
- (11) Other necessary equipments and facilities for fry production

2. Research facilities

- (1) Laboratory
- (2) Library
- (3) Meeting room
- (4) Workshop and storage
- (5) Other necessary equipment and facilities for research work

3. Training facilities

- (1) Lecture room
- (2) Accommodation for trainee

- (3) Training and teaching aid equipment
- (4) Other necessary facilities and equipment for training

~~AS~~
Others

- (1) Office
- (2) Facilities for distribution of electricity, water supply, drainage within the site
- (3) Transportation and installation of equipment

ANNEX II

Items, required to be taken and borne by the Government of Malaysia are as follows:

1. To secure a lot of land for the construction of the centre
2. To clear, level and reclaim the site when needed.
3. To construct the gate and fence in and around the site.
4. To provide facilities for distribution of electricity to the site.
5. To provide water supply mains to the site
6. To provide external drainage and sewage line to the site
7. To provide telephone line and equipment to the site
8. To provide space necessary for such construction as temporary office, working area stockyards, etc.
9. To ensure prompt unloading and customs clearance of products and machinery at the port of disembarkation in Malaysia.
10. To accord Japanese nationals whose service may be required in connection with the supply of the products and the service under the verified contract such facilities as may be necessary for their entry into Malaysia and stay there in for the performance of their work.
11. To bear all expenses other than those to be borne by the Grant, necessary for the execution
12. To provide data and information necessary for the performance of the execution.

MEMBERS OF THE TEAM

| Name | Speciality | Present Department |
|------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Dr. Akihiko SHIROTA | Team Leader | Ministry of Agriculture, Forestry and Fisheries, Fisheries Agency, Japan Sea Regional Fisheries Research Laboratory |
| Mr. Katsuhiro SASAKI | Project Coordinator | Japan International Cooperation Agency (JICA) |
| Mr. Yukihiro MIZUSHIMA | Aquaculture Development Planner | System Science Consultants, Ltd. |
| Mr. Masanori SUEMITSU | Prawn Fry Production Planner | System Science Consultants, Ltd. |
| Mr. Hajime TAKAI | Construction Planner | System Science Consultants, Ltd. |
| Mr. Yukitaka DATE | Mechanical Engineer | System Science Consultants, Ltd. |

RELATED PARTIES OF MALAYSIA

| Organization | Position | Name |
|---------------------------------|--------------------------|------------------------------------------------|
| Ministry of Agriculture | | |
| Department of Fisheries | Director General | Y. M. Tengku Dato Ubaidillah b. Abdul Kadir |
| | Deputy Director General | Mr. Shahrom Abd. Majid |
| Extension Branch | Director | Mr. Tan Cheng Kiat |
| | Senior Fisheries Officer | Mr. Siow Kuan Tow |
| Technology Branch | Director | Mr. Chen Shih Hsie |
| Planning and Development Branch | Director | Mr. Cheah Eng Kean |
| | Fisheries Officer | Ms. Razidah Budin |
| Fisheries Research Institute | | |
| | Director | Mr. Mohd Shaari b. Abdul Latif |
| Aquaculture Section | Senior Fisheries Officer | Mr. Ong Kah Sin |
| | Fisheries Officer | Mr. Hambal Hanafi |
| | ditto | Mr. Che Utama |
| | ditto | Ms. Choo Poh Sze |
| Pulau Sayak Prawn Hatchery DOF | | |
| | Fisheries Officer | Mr. Palanisany |
| | ditto | Mr. Yacob Bin Ahmad |
| | ditto | Mr. Osman Muhamad |

| Organization | Position | Name |
|------------------------------------------------|---------------------|-----------------------------|
| Members of Task Force Committee of the Project | | |
| State Agriculture Committee | | |
| | Chairman | Mr. Datuk Zainal |
| State DOF | Director | Mr. Hasim Ahmad |
| State EPU | Officer | Mr. Mukhti Abdullah |
| Kuala Muda District Office | | |
| | Chief | Mr. Jamil Jamaludin |
| Land and Mine | Officer | Mr. Othman |
| Land Revenue | Assistant Director | Mr. Mohd Omar Bin Mohamad |
| JKR | District Engineer | Mr. Wan Ngah |
| JPT | Officer | Mr. Mat Rahim |
| LLN | Officer | Mr. Muhmed Tahir |
| JT | Officer | Ms. Sharoom |
| | Officer | Mr. Wan Mustaffa Wan Mahmud |
| | Officer | Mr. Ali Aiou Buler |
| | Officer | Mr. Hi Hrshim Iz Osm |
| Fire Department Kuala Kampong | | |
| | Officer | Mr. P. Rajan |
| LKIM Brackish Water Aquaculture Complex | | |
| | Pond Project Leader | Mr. Mohd Rosli Ismail |
| | Hatchery Manager | Mr. Azlan Hasar |
| Economic Planning Unit (EPU) | | |
| External Assistance | Director | Mr. Mohamed Bin Omar |
| | | Ms. Roskina Hj. Mohd Salfah |
| Agriculture section | | Mr. Ramli Bin Haji Hasoon |
| Tiger Prawn Hatchery Center Sdn. Bhd. | | |
| | Manager, Director | Mr. Wang Tian Shang |
| | Aquaculturist | Mr. Khoo Eng Wah |
| CNEXO / France | Project Manager | Mr. Hatt Philippe Jacques |
| | | Mr. Roffino Pierre |
| Chin Aquaculture Sdn. Bhd. | Director | Mr. Teoh Thean Jian |
| Aquatic Enterprise | | Mr. Wong Wai Seng |
| | | Mr. Salim See |
| Fibra Haiman Sdn. Bhd. | Director | Mr. Parman Bin Md. Hairi |
| AkiteK Akiprima Sdn. | Architect | Mr. Ong Chong |

JICA