REPORT OF THE THIRD SURVEY FOR THE PLANNING OF BRACKISH WATER FISH CULTURE STATION IN PANAY ISLAND, PHILIPPINES

OVERSEAS TECHNICAL COOPERATION AGENCY

Japan

July 1973

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Tokyo, Japan
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PREFACE

The Overseas Technical Cooperation Agency (OTCA) has the pleasure of presenting the third survey report on the Planning of Brackish Water Fish Culture Station in Panay Island, of the study group of six experts headed by Dr. Kuronuma, which was organized and dispatched to the Republic of the Philippines by the OTCA at the request of the Southeast Asian Fisheries Development Center with the Consent of the Philippine Government.

The study group of experts stayed in the Philippines from February 25 to March 12, 1973 and successfully completed the field survey the site on the basis of the last two survey, including discussion and interview with the authorities concerned, and collection of informations and data with whole hearted cooperation from counterpart personnel representing the Government of the Philippines.

After their return to Japan, the study group of experts made further studies on data and informations, and the results were hereby compiled into the present report for presentation.

Finally, on behalf of OTCA, I whish to take this opportunity to express my sincere gratitude to the Government of Philippines for the generous cooperation and assistance rendered to the group of experts during their stay.

July, 1973

K. Tatsuke

Keiichi Tatsuke,
Director General,
Overseas Technical Cooperation
Agency

FOREWORD

The present report deals with the results of the survey conducted mainly in Panay Island during the period from February 25 to March 12, 1973 by the request of Secretary-General, SEAFDEC, Bangkok with the consensus of the Philippine Government. The survey with the aim to promote the planning of Aquaculture Department, SEAFDEC, which was sponsored by the Overseas Technical Cooperation Agency, Tokyo, covered field works and spot checks on the site as well as meetings held between the team members and the counterpart personnel representing government authoriries of the Philippines.

The drafting of the present report was shared by the hands of survey team members referring to the respective subjects to which they are specialized, although demarkation of the subjects is not necessarily clearly drawn. The subjects and the respective authors may be denoted as follows: engineering and hydrological problems by Juichi Kato, subjects on cltivation by Noboru Hoshino, questions on architect by Hitoshi Kawamura, and the matters on finance and government relation by Saburo Masai and Shigemitsu Takasugi ; compilation of materials and editing by Katsuzo Kuronuma.

The printing of the present report was made under supervision of Shigemitsu Takasugi, OTCA.

July, 1973

Katsuzo Kuronuma
Leader
Japan Survey Team

REPORT OF THE SURVEY FOR THE PLANNING OF BRACKISH WATER FISH CULTURE STATION IN PANAY ISLAND, PHILIPPINES FEBRUARY 25 to MARCH 12, 1973

BY THE JAPANESE SURVEY TEAM

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Report submitted to the Secretary-General, Southeast Asian Fisheries Development Center, Bangkok.

I TERMS OF REFERENCE

1 Inspection and observation on the newly established Marine Laboratory, Mindanao State University at Naawan in order to elucidate the layout and construction of its buildings and breeding or hatching tanks, thus, deriving informative background knowledge referred to the planning and implementation of the similar constructions to be established at Tigbauan for the SEAFDEC AQUACULTURE DEPARTMENT.

2 Study on the general basic planning of the DEPARTMENT at Tigbauan prepared by the Mindanao State University, which was recently nominated as the implementing agency of the Republic of Philippines for the establishment of the DEPARTMENT.

3 Field observation on the site at Balio Buyuan, Tigbauan Municipality where, by the recent proposal by the Government of Philippines, the main part of the DEPARTMENTincluding laboratories, breeding facilities and associated constructions as well as dormitory will be established in order to visualize the MSU's basic plan on the spot.

4 Field observation on the site at Leganes, where culture ponds of the DEPARTMENT will be constructed, in order to study the progress of the works on the ponds and water canal system as well as on the works for the digging of freshwater well.

5 Conference by the survey team and the Philippine Government officials including MSU experts discussing on the subjects : a)Marine Laboratory at Naawan reffering to the basic plan of the DEPARTMENT at Balio Buyuan, b) personnel to be appointed to the DEPARTMENT as counter-part workers, and their training in Japan, c) the items of equipment and supplies to be provided by the Government of Japan, d) schedule for the preliminary studies on the biology and breeding of shrimps in Panay Island prior to the establishment of the DEPARTMENT, e) financial matters reffered to establishment of the DEPARTMENT at Buyuan and Leganes and provision of equipment to the DEPARTMENT, f) working time schedule for the project paralleled by the two parties concerned and the SEAFDEC's Secretary-General, and g) other problems as raised for the promotion of the project.

II GENERAL MATTERS

A Itinerary

February 25	(Sunday)	Arrival at Manila 15 : 00 hours
February 26	(Monday)	Courtesy call on Secretary Tanco, Department of Agriculture and Natural Resources Conference with MSU officials
February 27	(Tuesday)	Conference with MSU officials
February 28	(Wednesday)	Courtesy call on Ambassador Urabe
March 1	(Thursday)	Arrival at Iligan, Mindanao 10:30 hours Inspection on MSU Marine lab. at Naawan
March 2	(Friday)	Arrival at Iloilo 14:00 hours
March 3	(Saturday)	Inspection on the site at Leganes
March 4	(Sunday)	Inspection on the site at Tigbauan and Leganes
March 5	(Monday)	Inspection on Mr. E. Jamandre's Fish Farm at Zarraga Courtesy call on the Mayor of Leganes Municipality
March 6	(Tuesday)	Observation on the shore at Tigbauan and the pond in Leganes region
March 7	(Wednesday)	Conference with MSU officials
March 8	(Thursday)	Inspection on the Fish Market, Iloilo Arrival at Manila 1000 hours
March 9	(Friday)	Conference with MSU officials, and, talking with Secretary Tanco Eel Culture Seminar by K. Kuronuma and T. Hoshino
March 10	(Saturday)	Inspection of Mr. Viri's aquarium in Manila City and his eel culture-pond at Apalit, Panpanga Province
March 11	(Sunday)	Discussion among survey team Resting

March	12 (Monday)	Courtesy call on Ambassador Urabe Arrival at Haneda Air Port, Tokyo 21:00 hours.

B MEMBERS OF THE SURVEY TEAM

Dr. KATSUZO KURONUMA	Leader, Ex-President of Tokyo University of Fisheries
Dr. JUICHI KATO	Fisheries Engineer, Chief, Saga Station, National Research Institute of Agriculture Engineering
Mr. NOBORU HOSHINO	Fishery Biologist, Ex-Chief, Okayama Prefecture Fisheries Experiment Station
Mr. SABURO MASAI	Fisheries Officer, Fisheries Agency
Mr. SHIGEMITSU TAKASUGI	Procurement Officer, OTCA
Mr. HITOSHI KAWAMURA	Architect, Chief, Construction Division, Sato Takeo Architect Inc., Tokyo

C PERSONS CONTACTED

The key personnel whom the survey team made contacts are listed below 'not in order'.

Hon. ARTURO TANCO, JR.	Secretary, Department of Agriculture and Natural Resources
Mr. ROLANDO S. F. STELLA	Assistant Secretary, Department of Agriculture and Natural Resources
Mr. LUIS BALTAZAR	Officer, Department of Agriculture and Natural Resources
Hon. TOSHIO URABE	Ambassador of Japan
Mr. KAZUHIRO MATSUSHITA	Secretary, Japanese Embassy
Dr. QUITORIC F. MIRAVITE	Vice-President, Mindanao State University

Mr. DOMICIANO K. VILLALUZ	Dean, College of Fisheries, MSU
Mr. SALVADOS L. MARIN	MSU-SEAFDEC officer
Mr. SALVADOR ARCENAS	Architect, MSU
Mr. BENJAMIN R. TOMONERA	Instructor, MSU
Mr. DAVID E. LACTUAN	Geoditic Engineer, MSU
Mr. BIENVENIDO LADRELA	Biologist, MSU
Mr. MADID SHEIK	Biologist, MSU
Mr. ORLANO YU	Engineer, MSU
Mr. ANGEL T. VIRI	President, A.T. Viri & Co. Inc.
Mr. TIRSO JAMANDRE, JR.	President, Jamadre Industries Inc.
Mr. ERNESTO V. JAMANDRE	President, Jamandre Fish Culture Inc.
Mr. ANDRES M. MANE	Ex-Commissioner of Fisheries
Mr. PEDRO ACOSTA	Officer, Bureau of Fisheries
Dr. ELVIRA O. TAN	Scientist, NSDB
Mr. ROGELIO JULIANO	Dean, College of Fisheries, UP
Mr. FELIX R. GONZALES	Director, Bureau of Fisheries
Mr. ARNOLD I. DE-GOCO	President, Sinaoga Fishpond Inc.
Mr. VINCENTO GORIBAY	President, Goribay Fishing Inc.
Mr. PORFIRO MANACOP	Deepsea Fishing Expert
Mr. ESPIRIDION JAGUNAP	Mayor, Leganes Municipality

ACKNOWLEDGEMENT

The present survey was made possible very successfully under the kind co-operation and large amount of helps in many ways rendered by the local personnel.

The survey team wishes to express high gratitudes and appreciations to each one of the persons named above, and to the government authorities to which they are named above, and to the government authorities to which they are affiliated, The persons in private sector were in the same way generous by giving various helps and encouragement to the team on the fields and in the meetings. To each of them the survey team herewith presents many thanks from the bottom of heart.

III RESULTS OF THE SURVEY AND MEETINGS

A MSU MARINE LABORATORY AT NAAWAN, MINDANAO ISLAND

The survey team started its field works from the observations and studies on the constructions which have been nearly completed at MSU Marine Laboratory at Naawan beach, Lamao Norte Province, Mindanao Island in the anticipation that such studies on the spot will bring out extremely useful information and knowledge, which as they stand will play an important role for the planning of the Aquaculture Department at Buyuan, Tigbauan Municipality, Pamay Island, where the site has been reserved for the SEAFDEC project above.

Through visual observation and hearing on and about the constructions on the site at Naawan, the survey team gained general impression on them and achieved suggestions or recommendations for its betterment and improvement, which are noted below on several items. The notes is preceded by a commentary statement advocated by Dr. Juichi Kato referring to his concept on the engineering works as associated to aquaculture project.

1 Significance, position and planning of hydrological and civil engineering works and facility construction in aquaculture project

It is firmly understood that the basic planning and implementation imposed on the shoulder of hydrological and civil engineers will build up basic foundation, on which functional constructions and facilities stand as required for the cultivation of aquatic organisms. The aquaculture engineering persuits formation or construction of an environment in which aquatic organisms such as fish and shrimp are placed for their living and growth. For the achievement of the objective as defined clearly above, it is of prime importance to know the basic factors which are responsible to the raising of survival and growth rate of those animals confined in the particular

environment. The engineering works in this sense bear high significance in contrast and similar to biological and chemical management on the fishes and on the waters.

From the viewpoints of aquaculture engineering as stressed in the paragraphy above, it is regrettable to mention that the facilities established in aquaculture operation, whether in Japan and Philippines, are not working and functioning as they should be. The one of condition among many others responsible for such defects may undoubtedly be found in the fact that the biological knowledge available at present concerning the living and growth of the fishes in confinement is far inadequate, also, pathological information on these fishes is poorly known.

In the full realization of the present status to which the operation of aquaculture is destined, the engineering techniques will have to follow up rather than to ride on the rails of tightly fixed, then, the actual steps to be taken whether in the construction of facilities or its assembling will be the nature of so-called "trial end error", while, the advance and accumulation of biological knowledge are hopefully marching on.

2 Layout of buildings and tanks on the site

The buildings and other constructions on the site are layed out leisurely in a tipical tropical landscape endorsed by many coconut-tree. But the constructions as a whole should have been located further apart from the shore line, because the sandy beach developed in front of the buildings, if wider than the present would have presented a feeling of relaxation, also, it would have played a role of buffer against high water and waves.

The concrete pool attached in front of the main building is not deep enough to add expected scenic elaboration to the landscape.

3 The main buiding

a The rooms in general are too bright by substantial sunlight coming through wide opened windows, which may result troubles to visual sense of the workers. Screeening of windows will help the situation. Also, ventilation system of some sort will be needed.

b The floor of the building wholly tiled by concrete is not appreciated, because the tight solid floor will make the workers weary in their standing for extended hours. With the exception of chemical laboratory where concrete of

tile flooring is preferred, the rooms may better be floored by wooden materials of possibly by rubber tile.

c The desks arranged in laboratory rooms measuring 90 cm high are not comfortable to the users (Asians). The height 75-80 cm on the floor is recommended.

d The experiment desks in chemistry laboratory are narrow for the conduct of works. With the shelves fixed in the middle of the desk, which are used on eighter side, the surface space should measure 150-175 cm in width. Depending on the floor space available the desks will have to be installed 120-140 cm apart from one row to the other.

The sinks installed in chemistry lab. are too small for convenient use, also, its hard inner wall often causes easy break of glass-wears. The sinks usually will measure 80 cm high on the floor, 50 cm wide and 25 cm deep, and the inner wall will be covered by lead plate, stainless plate or other suitable materials.

Drought chamber is a must item installed in the chemistry lab., so is the solid concrete foundation on which precision balance is placed.

e The library room will need wider space for the storage of books and other publications.

4 Breeding and hatching tank

a The tanks in general appeared too high from the ground level. Accordingly, further footing devices will be needed in order to facilitate water supply system and aeration device as well as to secure safeguard of workers.

b The draining pipe and orfice of all the tanks are too narrow or small. The collecting basin or pool attached to the tank is also too narrow, so are the size of waterways constructed on the ground.

c It is remembered that the water in the tank is drained by adopting siphon as required in addition to the draining through outlet pipe or orfice.

d The circular tanks is preferred to have an outlet in the center of the floor in addition to the draining pipe installed on the wall. The operation of circular tank will be made more effective by understanding the facts experienced in Japan as commented below. (1) The water in the tank motivated by discharged water from a pipe makes a circulating move in the tank, and the movement conveys the easte products and refuses in the water round and round and eventually to the center. (2) However, the circulating move of the water, often as a mass of water consolidated

in a shape of dough-nut, does not play a role of aeration nor mixing of water. (3) In contrast the water moving in the angular tanks with corners does the works of aeration and collection of debris. (4) For the purpose of effective aeration, vertical move of the water effected by the rotation of a propeller installed on the bottom of tank is recommended combined with the contemporary method of air bubbling, but with careful checking on the cost of installation and operation. (5) It may be concluded that circular tank is not recommended at least for some time to come, and octangular tanks is preferably adopted.

e For the reference in the determination of the size of draining pipe or orfice, the mathematical principle and calculation may be presented below.

It is supposed that 25-ton of water is drained within 30 minutes. As shown in Fig. 1 (top) there is a relation as expressed by a formula, $A \cdot dz = Q \cdot dt$, where A is sectional area of water in the tank, dz minimal height of water, Q amount of water discharged, and dt minimal time. Whereas, $Q = ca\ \sqrt{2gz}$, where c is coefficient of dishcarge, a the diamter of orifice, and $\sqrt{2gz}$ (=v) the velocity of water flow. Then, there are relations as follows ;

$$- A \cdot dz = ca\ \sqrt{2gz} \cdot dt$$

$$\text{and } T = \frac{2A}{ca\ (2gz)}\ \sqrt{H}$$

where, in the present case, $A\ (cm^2) = \pi \times 200^2$; T (sec) = 30 x 60 ; H (cm) = 200; g (cm/sec) = 980 ; c = 0.96 - 0.6 (subject to the shape of orfice). Then, the answer wanted in this case is calculated as : $a = 46.46\ cm^2$ (ordinary orfice) or $a = 74.33\ cm^2$ (Bell mouth orfice).

The size of draining pipe referred to the time of draining is also hinted in section III, B, in the present report.

5 Rearing of shrimp larvae

a Larvae of sungpo (Penaeus monodon) have been reared in wooden tanks about 2 tons in capacity. Feeding, according to the workers, started from diatom cultured in other container. The feeding of diatom contained in the water also effects the changing of tank water ; brine shrimp are fed to the larvae in mysis stage, and post-larvae are given shrimp-meal, coconat-oil refuse, etc.

b The natural food, as called by workers here and are given to the larvae, is zooplankton grown naturally in a dirt pond of about 20-ton ; fertilizers and mangrove leaves are applied to the pond to raise the fertility of water. Mosquito larvae, also grown in the pond, are fed to shrimp larvae.

The items of food required for the breeding of shrimp larvae are also discussed in the present report (Section III, B, 7) in conjunction with the plankton materials collected locally during the survey.

c Efforts expedited by the workers stationed here were highly appreciated, and their dedication to duties was observed in high spirits. It may be suggested that the Laboratory, now well equiped by working facilities, will have to be provided by tools and instruments for precision works as well as reading materials for reference.

6 Experiment fish pond

a An experiment pond about 40 m^2 has been used to trace the growth of shrimp, and a device was constructed to prevent the entering of predators and obstructive animals into the pond.

b The device in terms of its simple structure and easy operation gave impression of an innovation. Because the problem of predator animals penetrating into fish pond, which is a serious trouble spread in most of the fish pond in Asia, awaits immediate solution.

c The device is simple in its structure. The inlet gate to the point is made up by 2 wooden flash boards, which are in their edges insterted into crevices on the side concrete walls; the space between the boards is filled by mud, thus, 'mud-screen' is constructed. 4 pieces of plastic tube, each 5 cm in diameter, are placed passing through the mud-screen as illustrated in Fig. 2, a pair above and the other below. Each tube as a socket receives a cylinder-liner also of plastic made ; the cylinder is provided by a layer of glass-fibre supported by two pieces of percolated metal plates. This cyclinder-liner is removed from the socket tube with ease, so that glass-fibre could be removed and renewed as frequently as required. It appears certain that small particles such as fish eggs are blocked by the glass-fibre, not speaking of yound predator fishes and other aquatic animales. (See Fig. 2)

d The present device or the idea brought up for the solution of problem will be further investigated. Mechanical improvements will be accomplished in near future leading to more effective filtration of water and to the enlargement in dimension of the device allowing the passage of larger amount of water within required time.

7 Collection of gravid female shrimp

The part experiences carried out by the workers at Naawan will prove the problem not necessarily optimistic in terms of its technique and economy. Further studies are encouraged on the subject motivated by the fact that the rearing tanks now fully established will have to be fully functional not only technically but also economically.

B ESTABLISHMENT OF AQUACULTURE DEPARTMENT AT BUYUAN, PANAY ISLAND

In early part of 1973 the survey team was informed that the major constructions of Aquaculture Department, SEAFDEC are proposed to be established at the one site on the beach located in Tigbauan Municipality instead of the site at Leganes. The motive of the proposal is based, it is understood, on the reasonings that in the Leganes site there is so far no sign in availability of fresh water, the nature of poor sub-soil calls high expenses for the construction of buildings, and the area of the site is not wide enough for the constructions of SEAFDEC facilities in addition to those of National Project, further, there is a site in Tigbauan Municipality provided for the SEAFDEC Aquaculture Department.

It may be noted here that during August 1971 Japanese survey team headed by Dr. Kuronuma made studies in the region of Balio Buyuan referring to its topography, fresh water wells and nature of offshore water as well as biology and fishing of shrimp. The team confirmed that the region is suitable for the establishment of hatching- and rearing-tanks for shrimp. The results of the studies, then, were reported (Report No.2) and disseminated at SEAFDEC Fourth Council Meeting, Bangkok, June 1972.

In the understanding of the development of the affairs, the present survey team made studies on the site at Buyuan with emphais on the construction of facilities namely buildings, tanks, etc. In the studies the team made careful examination on the basic plan in blue-prints prepared by the MSU engineer. The impression and suggestion or recommendation derived are enumerated below. Needless to mention that the same presented for Naawan project in preceding pages in the present report may be carried over as they stand to Buyuan.

1 Layout of the constructions and other subjects in general

a The site allocated is not wide enough to accomodate various constructions.

Also with possible future expansion of the buildings and other facilities, it is recommended to widen the area either continuously from the present site or plotting other place located nearby.

b The palm-trees and other natural environment are conserved as much as possible. To prevent sand storm the ground is covered by lawn.

c A levee will be needed along the site facing the sea to cope with contingency.

d The beach water is too shallow for the building of jetty. Accordingly, small boats will be beach landed, and larger vessel will be moved to Iloilo harbour in case of typhoon and other emergencies. In connection to the emergencies the Department will be provided by convenient communication system in order to catch precise weather-cast.

e For the general management of the Department especial measure will be needed for the security of facilities, properties and personnel. Also a regulation is needed to prevent intrusion of the unwelcome visitors to laboratories and tanks.

2 Buildings

a The rooms, especially laboratories, will need air-conditioning for precision works and refreshing habitation ; ceiling-fan will substitute the function in other rooms. Fine-mesh screen attached to windows will keep the room sand free.

b The experiment desks, sinks and other laboratory settings are provided by manufactured products. So are the piping in the laboratories. But lighting equipment is included in the construction.

c Refrigeration system is a must item to the laboratories some parts of which are provided.

d Several portable generators with mufflers are provided. The main generators are also provided placed in the power-house, which should be constructed and located far apart from the main building.

e Motor-pool should be constructed.

f The wet-lab, roofed by transparent or translucent material (plastic may be) over some 4 m from the ground effecting sufficient ventilation, will have several small concrete tanks (2-3 tons) built-in on the floor and the pipings for water and compressed air supply. The side wall is not needed in the wet-lab.

The floor space will be expanded subtatially enough to accomodate the built-in concrete tanks mentioned above, and also for some 20 pieces of portable plastic tanks (1-2 ton capacity). A wooden stand with 2-3 layers of shelves will be installed in a proper place, on which series of glass-aquaria are arranged.

These concrete tanks and plastic tanks are used for the cultivation of planktonic organisms which are fed to larval shrimps as well as the hatching and rearing of the larvae. The trainee start their studies on these subjects by means of these tanks in wet-lab., then, they enter the operation of larger hatching tanks.

g The dormitory to accomodate trainee maximum of 20 persons is to be constructed with due consideration to provide comfortable living atmosphere. It is noted that many of the trainee are alien to local living condition which is different from their own. Some recreational provisions will save their feeling of solitude and accelerate friendship among them.

Prepared to the emergencies on the trainee and staff some simple medical facilities will be needed. The electric current will have to be supplied from the municipality, and measure should be taken as soon as possible for this effect. It mentioned that the Department's own power-house should be established in the sense of auxiliary function.

3 Hatching and rearing tank

It may be commented that those tanks will be designed referring to suggestions and recommendations provided for those at Naawan. The survey team is declined to build circular tanks at Buyuan. Instead, octangular tanks are recommended to substitute the former.

In the actual designing of the tanks, the critical point will be the determination of the size or diameter of outlet pipe or orfice, as proviously explained (Section III, A, 4, a-e) in the report. Its determination will be made based on a simple equation presented before, also, a few explaes tabulated below will be of some help as a reference. It is understood easily that the larger the size or diameter of the outlet, the faster the time required for the draining of the tank water. In this connection it is remembered that the water in the tank carries millions of shrimp larvae, also, that the water can be drained by a siphon in addition to the discharge of water through outlet pipe.

Relation between the diameter of outlet pipe and time required for draining of tank water in 4 tanks of different capacities

Type	Rectangular			Circular
Holding capacity (ton)	250	120	70	350
Size (m)	10 x 12 x 2	8 x 8 x 2	8 x 5 x 2	15 (dia) x 2
Time of draining:				
by 5 cm pipe (h;m)	18:24	8:50	5:9	25:46
by 10 cm pipe (h:m)	2:36	2:12	1:24	6:26
Diameter of pipe (cm) to	15	10	8	18

Notes : Calculation was made approximately by N. Hoshino; coefficient of discharge not considered; drained water supposed to be discharged to waterway on the ground but not to collecting basin.

Also, for the designing of tanks the following point is recommended : the collecting pool or basin is not necessarily needed to each of the tanks, rather, in order to simplify the structure as a whole, plan will be made to construct one collecting basin which could be shared by several tanks.

The following comments are also believed worth to be remembered at this time, The recent development of techniques toward the intensive rearing of larval shrimp in the tank has been directed, especially in Japan, to the adoption of mechanical agitation of the tank water combined with the aeration of water by compressed air. The agitation of water is enforced by the slow rotation of a propeller installed on the bottom of tank. This mechanical manupulation of the water effects through diffusion of air-bubile (or oxygen), and prevents the settling of residues and debris on the bottom. The substatial supply of oxygen will naturally accelerate the biological function of bacteria for mineralization of tank water, or, in general terms, purification of water.

4 Fish pond in the site

The rearing or nursing of larval shrimp from P_{20} to juveniles is one of the most critical work to be carried out in the course of shrimp culture. Because shrimps in those stages, when they change their habitats from mid-layer of water to the bottom (planktonic to benthic) accompanied by necessary change of feeding

habit, are very sensitive to the change of environment; naturally the mortality of the larvae is much higher during these stages than other stages they endure in the tanks (nauplius to musis).

The rearing of the shrimp from post-larvae to juveniles is known in Japan as "intermediate cultuvation" meaning the culture operation inserted between the growing of the larvae in tank (egg to post-larvae) and the growing (juveniles to marketable size) in pond. The intermediate cultivation is, in other words, corresponds to the nursing, thus, the pond used for this purpose is nothing but a nursery pond in its function.

In the present project of SEAFDEC Aquaculture Department, the culture ponds are established at Leganes site, which is far located from the Department headquater at Buyuan. It is, therefore, obvious that the nursery ponds which require careful attendance should not be located at Leganes site at least for some time to come.

a Consequently, the nursery ponds should be established within the site at Buyuan or a site very close to the Department. One unit of the pond will measure 200 - 300 m^2 wide and about 1 m deep; due to the nature of soil at thesite the ponds will have to be concrete made. At least 3 units of the ponds are needed.

b In addition to the nursery ponds noted above one unit of small natural pool (500-1500 m^2) should be provided within the site. Such a pool or reservoir is constructed on the ground surrounded by a low dike ; concrete enforcement is required, but some provision will be needed to prevent too much seepage. The pool receives all the effluents coming from the tanks and laboratories (poisonous contamination should be avoided).

5 Fresh water well

The fresh water is required at the Department, Buyuan for the management of the dormitory (drinking, cooling, sanitation, etc.) and for the works of researches and experiments conducted in the laboratories, wet-lab. and hatching or breeding tanks. Aside from the requirement by the dormitory, the fresh water must be supplied enough to the uses in various works perhaps amounting the maximum of 80 - 100 tons a day.

a It was observed that there is a subterranean water-vein running along and close to the highway in this region, and a number of fresh water well are utilized by local people. The survey team experienced that one of the well, 75 cm wide, according to its owner, is drained out in 1/2 hours by pumping 126 cm^3/sec.

b To secure ample supply of fresh water to the Department it is suggested to carry out boring test within earliest date in order to find out the magnitude of existing water-vein at the site . An unfortunate case at Leganes site will be kept in mind.

6 Collection of sea water

There are several ways to bring in the sea water to the land, and the survey team recommends the particular system, of which the general scheme is presented below.

a A simplified design of the system is illustrated in Fig. 3. A concrete tube with top opened is installed on the beacon (tidal zone) named a in the figure, and similar concrete tube named b is placed on the land above the highest tide level, its top closed; the 2 tubes are linked by a pipe. The sea water collected in the tube a is sucked by the action of vacuum pump connected to the pipe and sent to the tube a. The water in the tube b is transferred to the filter. In this system the pipe linking the 2 tubes, if choked by the growth of organisms or debris, can be renewed without difficulties.

b The filter or filtration-tank recommended here is also shown in Fig. 3. The tank is divided into 4 compartments A, B, C and D ; A and B are connected on the bottom, B and C on the top, while, C and D on the bottom. Section B is filled by gravel and C by sand. The sea water passing through the tank, either by gravitation or pumping, will be pure and clean enough for the rearing of shrimp or fish in the hatching or rearing tanks or for laboratory use. The water thus treated by the filter of this type contains micro-organisms in it.

c The other system of sea water collection, through not recommended for the Department, may be explained below merely for the sake of reference. The design as shown in Fig. 3 is simple.

A concrete tube, with percolation towards the lower end, is burried in the tidal zone on the sandy beach. In the course of setting the tube in excavated hole, gravel is piled on the bottom of hole in layer to the level of percolation on the tube; the hole is otherwise filled entirely by sand. The water reached to the tube, which is filtered by these gravel and sand, is pumped up directly to the tanks or reservoirs. The experience in Japan tells that the system often loses its function due to poor water filtration through the bottom sand on the sea bed because of the scum precipitated. Also, sea water sometimes reaches directly the tube through the crevices which are formulated in the bottom layer by uneaven passage of the water, and in this case water is not filtered at all.

7 Analysis of plankton collected at Leganes site

The planktonic materials were collected by N. Hoshino at several places shown in the Table below (13 lots); the net used was TXX 200 (58 micron), and 50 l of water was collected for each lot with exception of Lots 5 and 7, of which no qualitative

sampling was made. The materials brough back to his laboratory in Okayama Prefecture, Japan were examined on its quantitative composition by forms, and the number of cells in 50 l of water is shown in the Table below. The present examination excluded Cyanophyceans, and the rest of the organisms was identified only to the Genus.

Collecting data of planktonic materials, March 1973.

Lot . No.	Day	Locality
1	4	Shore water off Buyuan, Tigbauan Municipality
2	4	Same as above
3	5	Water canal in Mr. E. Jamandre's Fish Farm, Zarraga
4	5	Small pool, "
5	5	Sludge in "poor" milk-fish pond, "
6	5	A milk-fish pond, "
7	5	Sludge in "good" milk-fish pond, "
8	5	Milk-fish nursery pond (daytime), "
9	5	" " (night), "
11	5	A milk-fish pond (daytime), Leganes
12	5	" " (night), "
14	5	Another milk-fish pond of higher production, Leganes
16	5	One other milk-fish pond of lower production, "

The collection of planktonic organisms attempted during the present survey is far from adequate in quantity to draw confirmative findings. However it may suggest that rotatorian animalcules are scarce in milk-fish ponds in Leganes region, and that some of the ponds (Lots 8, 9, 11, 12) carry only few diatoms, while, the sludges (Lab-Lab ?) on the bottom of other ponds (Lots 5 and 7) contain a considerable amount of diatoms.

A limited amount of informations available from various parts in Asia including Japan indicate that extremely important roles are played by planktonic organisms in shrimp culture whether in hatchery tank, nursery pond or growing pond. In Taiwan it was heard that in tank breeding of larval shrimp (Penaeus monodon) they are fed as subsidiary item by zooplakton such as Oithona, Eurythemora, etc. which are collected in milk-fish pond. In Thailand it was experienced that breeding of the larvae (P. monodon and other species) had to depend heavily on the brine-shrimp or Artemia due to the failure in mass-growing of planktonic organisms locally available. Also the significance of "Lab-Lab" in Philippines and "Kelekap" in Indonesia for shrimp culture operation can never be over-emphasized.

Extensive and intensive studies on these organisms should be carried out in the region by collecting samples periodically from different kinds of water including fish pond, canal, creek and sea shore. Studies should be anticipated to find out in near future some planktonic organisms which will substitute expensive brine-shrimp. In the connection the Table inserted below might show a general trend of feeding for shrimp larvae in breeding tank compared in the 2 species.

Specific differentiation in 4 larval stages of Penaeus monodon and P. japonica. (From various sources)

Stages	Major food items taken	Moulting (times)	Body length (mm)	Duration (hours)
Nauplius :				
P. monodon Diatom	Diatom	6	0.32 - 0.33	48
P. japonica	–	6	0.3 - 0.5	36
Zoea :				
P. monodon	Diatom	3	0.91	120
P. japonica	Diatom	3	0.9 - 2.5	96
Mysis :				
P. monodon	Copepod, artemia	3	3.4 - 4.4	120
P. japonica	Artemia, others	3	2.8 - 4.3	92
Post-larvae :				
P. monodon	Copepoda, artemia	3	5.2	–
p. japonica	Artemia, others	3	5.0	–

Quantitative analysis of plankton materials collected on March 4 and 5, 1973 from different bodies of water around Leganes and sea water off Buyuan, Iloilo Province, Panay Island. Identification by N. Hoshino. Numerals the number of cells in 50 l of water. See text and Table for method and localities of the collection.

Forms \ Lot No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16
BACILIARIO-PHYCEAE															
Coscinodiscus	13	107	37		3	3	3							10	
Rhizosoloenia			10											3	
Bactriostrum	13														
Chaetoceras	210			3										50	48
Striatella		10		397	57	10									
Thalassinema	17	17	47												
Pleurosigma	7		13		3	3			23					3	
Nitzschia					553	2601	750	140	38	63				500	98
PROTOZOA															
Ceratium															
NEMATHEL-MINTHES															
Nematoda					17	7									
ROTATORIA															
Brachionus	17		40												
MOLLUSCA															
Gastropoda			7												
CRUSTACEA															
Copepoda															
Calanoida	3			10							3	10	17	16	
Cyclopoida															
Oithona	7	3	7								3	3			
Harpacticoida	27	6	17		3						30	7		207	
Copepod nauplius	43	3	5								183	73	23		
Malacostraca															
Mysidacea												3			

C COMMENTS ON THE WATER SYSTEM AND THE PLANNING OF GROUND CONSTRUCTIONS AT LEGANES

In the clear understanding reached between the Government of Philippines and Japan, the site at Leganes is shared by National Project of the former Government and the Department of Aquaculture, SEAFDEC. And about 1/4 in area of the site has been disposed to the use of the Department, also, it was agreed upon between the two parties that main water canal and the gates attached are placed under common use and management. Naturally any of planning and designing commented or proposed by the present survey team requires consensus of University of Philippines, the implementing agency of National Project.

With the recent modification of the present project effecting that the site at Leganes is used soly for the culture ponds, it is understood that the site is provided by ponds and canal system, and also a small office building to accomodate several workers. Also, with the same reason as noted above it became apparent that the research and training works anticipated at the site will cover such subjects as categorized under ; a) the growth of fish or shrimp referring to salinity of water, b) feeding and food staff, c) prevention and eradication of predators and competitors, d) growing of planktonic organisms (Lab-Lab), e) combination culture, etc.

The present survey team made visual observation at the site and witnessed the progress of the works carried out including the digging of deep water well* and partially completed fish ponds and canal system. The comments and proposals enumerated below were derived from the observations at the time and the results of the previous surveys carried out during 1972 (Survey Reports Nos. 1 and 2).

1 Fish pond

a Designing of fish ponds at Leganes firmly stands on the basic concept that the ponds are supplied by both marine and fresh water by running system, that complete drainiing of spond water is made possible, and that the taking in and out of the water is conducted within a required duration of time.

b The bottom of pond, as designated in the Report No. 2, is leveled to MHLW line (= + 40 cm).

It is highly regrettable to find at the time of drafting the present report (early part of June, 1973) that the digging of deep well at the site has not succeeded to hit the fresh water-vein.

c The depth of pond water measures 120 cm. Accordingly the crown of levee, considering contingency like flooding, stands 220 - 250 cm high on the pond bottom.

d The one unit of pond measures one hectare in surface area. The subdivision of the unit pond will be made, if required, in future. The total of 5 unit ponds will be built at this moment, and the rest will be constructed in conjunction with training, on the reason that the planning, designing and actual building of fish pond are requisite curricula in the course of aquaculture training. In this connection it may be announced here that Dr. Juichi Kato is now drafting a guide book dealing with the principle and practice of designing coastal aquaculture pond and associated water system which are treated from the view points of hydrology and civil engineering.

2 Canal system and the water gates associated

a The canal system includes 3 main channels, the one running across the middle of the site from east to west, the second running parallel to the former but on the southern edges of the ponds arranged in series, and the last one extending from the Jalaud River to the mid-portion of the site, thus, meeting the two channels in right angle. The former two channels end at the Gui-gui Creek, and lead in sea water, while, the last one takes in fresh water from the river. For the draining of pond water the second channel will be usually used.

b The water gates in total of 3 are established, 2 on the Gui-gui Greek and one on the Jalaud River, each located in the terminal end of respective channels or water canals.

c The size of each water gate is proposed to measure 2 m in minimum under an assumption that the depth of water in the pond is 120 cm, the total area of the 5 ponds is 5 ha, and the water is led into these ponds within 24 hours taking advantage of 1 1/2 to 2 tidal changes in a day. The gates with same dimension will allow the complete draining of the pond water within the same period of time as for the supplying. It is clearly understood that the size of water gate as designated above may be subjected to change when the requirements by The National Project will be or should be clearly presented as to the use of pond water and other conditions. Such adjustment, if unfortunately neglected, will invite various kinds of troubles after the completion of the ponds and water systems including gates.

d It may be added here that the dimensions proposed for ponds, gates and others were derived based on the formulae introduced in the Report Nos. 1 and 2 and theoretical assumption as graphically presented in Fig. 1. In this connection the survey team suggests strongly that the workers stationed at Leganes will conduct the survey on the tidal fluctuation in the Gui-gui Creek as frequently

as possible following the procedure taken by the survey team in 1971, also, possibly attempt experiments about the size of water gate(s) as to its efficiency on water passage in relation to tidal change.

e Considerations on its construction, cost and operation lead the present survey team to recommend 'Sluice gate' with flash boards constructed and operated in same way as those adopted by local fish culturists.

f It is recommended to install a pump at the water gate opening to the Jalaud River, and a sub-gate at the end of the first main canal running in the middle.

g For the contingents (heavy rain, flooding, high sea water, etc.), protective measures are to be taken such as construction of spill-ways and heightening or intensification of the dykes surrounding the ponds.

3 Civil engineering works at the site

As pointed out elsewhere in the present report the ground soil at the Leganes site is not necessarily suitable for the construction on the ground. The test of some samples of the soil collected in the depth of 2 m during present survey also elucidated the fact that the site carries poor clayish subsoil, which is not favourable to the ground construction. The commentary notes presented herewith may afford some assistance to the workers concerned with the project at the site.

a Prior to the actual construction works intended, it is necessary to know the depth and spreading of subsoil layer, and to estimate the magnitude of loading we weight, so that the boundary condition will be elucidated

b The poor sub-soil is defined as follows. It is a condition of the soil in which water is satulated mixed in clay particles, and the pore water permeates along with the sedimenttion of clay particles with the progress of time. The so-called settlement of subsoil due to consolidation or the thinning of clay layer by the sedimentation of clay particles is accelerated by the loading weight of the constructions, which include also the weight and pressure of water. When the balance is lost between loading weight and support of subsoil, the breaking of the latter takes place due to the slipping in the soil layer, which, eventually leads to the collapse of loading weight.

c The precaution for the problem is, in simple terms, to accelerate properly the consolidation settlement and to prevent breaking of the layer. The counter measures taken in usual case include ; (1) counterweight filling, (2) displacement, or

(3) Pile foundation

d In 'counterweight filling' weight is given over the suspected sliding surface by piling up of soil and/or sand along with the progress of construction work and taking account the time limitation of the work. In the displacement method, the poor subsoil is replaced by sand or other solid soil. In the pile foundation, friction piles are planted for the betterment of weight balance.

e It is concluded that the improvement of poor subsoil could be achieved by careful and well calculated planning refering to the 3 conditions loading weight, estimated period of work, and the progress of work.

f In view of civil engineering it may be warned that the dykes or levees surrounding the ponds which are expected to rise quite high, might be exposed to collapse when, for instance, the levels of water on its two sides is outbalanced, heavy load is placed on the crown (heavy trucks, bull-dozers, etc.) or, other causes.

D PROCEEDING OF THE MEETINGS

The survey team had the meetings with representative personnel from the Philippine Government and Institutions, counting 5 occasions in Manila City and once at Iloilo City. In 2 occasions, Hon. Tanco, Secretary of Agriculture and Natural Resources presided. The following accounts, arranged by subjects which were discussed or agreed upon during the 6 meetings, will give only highlighted points. It may be noted here that statements given here were made by the survey team in its capacity, consecuently, they do not neccessarily convey commitment imposed on Japanese Government.

1 Communication

To promote quick and smooth correspondence between Philippines and Japan it was agreed that MSU Manila Office will take part of the agency for the former country, and Japan will nominate the same agent in later time. The nature of correspondence, however, is restricted to technical matters, and its copy is forwarded to respective government authorities.

2 Construction works at the site

The constructing works of buildings, tanks and other facilities at the site of Buyuan will start in June 1973 and are expected to complete within one year period. Fish ponds and other water system at Leganes site will be worked out in parallel with the project at Buyuan, and, also, corporated to the progress of the National Project. The final base plan for the construction at the two sites will be prepared by Architect Salvador Arcenas during his visit to Japan for two weeks in May 1973.

3 Personnel in counterpart workers

a In addition to the two trainees, Antonio Villaluz (Fish culture) and Alfredo Santiago (Biology) who are staying in Japan for one year from January 1973, two other specialits will be trained in Japan during fiscal year, 1973. Those two trainee, to be compulsory counter workers at the SEAFDEC Department upon returning from Japan, are advised to send application by way of SEAFDEC Secretary-General, Bangkok. It is suggested that one of them will work on the field of chemistry and the other in hydrology and civil engineering.

b For the request of other trainees sent to Japan as promoted by MSU, it is suggested to apply the trainingship under Colombo Plan, separated from SEAFDEC programme.

4 Equipment and tools provided

The equipment required for the research and training of aquaculture as defined in the plan of operation amounts in a great number and item (see Annex). The two parties in the meeting studied carefully the lists of equipment prepared by the two parties. However it was not possible to reach full agreement between the parties as to the specification of the items, number of pieces to be provided and other details, because the problem is highly complicated due to the conditions such as the amount of budget defrayed by Japanese Government which is only approximate, specification and number of many items not made clear, possible adjustment of items and numbers within the limit of budget, and so on. Many problems were carried over to further checking and negotiation by the two parties, but some of the subjects enumerated below may serve to show the scope and the direction of the issue.

a Government of Japan will defray the budget amounting some 150 million yen for the procurement of equipment, among which about 30 million will be ex-

pedited to those items which fall on the category of the first priority as agreed upon by the two parties. They will be shipped to SEAFDEC in Iloilo City, c/o MSU regional office during the period from June to October 1973.

b Precise specification is needed as to the type or model of radio communication sets and of bulldozers. Mr. Tirso Hamandre, Jr. was suggested to be consultant on the subject.

c The details of several items for chemical studies and experiments will be determined by Dr. Kuronuma in Japan.

d The items falling on the categories of the second and the third will be delivered also to Iloilo City around September to October 1973, it is anticipated.

e The 2 research or survey vessels provided are facilitated by small fishing-gear, live-tank, oceanographical instruments and other machines and tools. The smaller vessel of 4-ton will be delivered under the category of the first priority. The larger boat will be transferred in fall, 1974. A dinghy with outboard engine is also provided together with the smaller 4-ton vessel.

As to the determination of the size of larger vessel there were some conflicting ideas exchanged during the meeting, but it was agreed to make it 20-ton.

5 Preliminary studies on the biology and breeding of shrimp

The preliminary studies on this subject will cover : 1) collection of gravid shrimps in the regional water by purchasing from fishermen and through experiment fishing (baby-trawl, gill-net, etc.) by the hands of experts, 2) investigation and experience on carrying back gravid shrimps alive to the laboratory, 3) hatching and breeding of eggs and larvae in small tanks, the works including cultivation of food organisms and management of tank water, 4) rearing of post-larvae to juveniles and to grown-up stage, and 5) other subjects as required. It goes without saying that the utmost effort must be paid to obtain a considerable amount of gravid females as the starting line of the studies. The failure to obtain the materials, if happened, will invite a tragedy to the project of Aquaculture Department, SEAFDEC.

It is easily understood that the experiences and materials of various sorts accumulated during the course of preliminary studies will formulate a basic source for the conduct of training in near future which is assigned to the Department. Also, the materials as such will build up actual undertanding knowledge for the determination of detailed subjects and scopes of the researches which are also assigned to the Department. Under such circumstances it is emphasized that the nature of the preliminary studies should be of highly teachnical and must be well documented.

The studies on the field will start possibly from June, 1973 and will last one year ; for the studies 2-3 experts will be dispatched from Japan. For the implementation of the studies some requirements and remarks are presented below.

a The Government of Japan will be able to dispatch the experts to the field by receiving such request from Secretary-General, SEAFDEC, Bangkok.

b The Philippine Government is requested to take step for the effect that the youths in Japan Overseas Cooperation Volunteer will be stationed on the same field in order to assist the experts dispatched from Japan.

c The preliminary studies will be carried out in the neighbourhood of Buyuan and other places in Province of Iloilo, Panay Island.

d Experts may extend thier works to Naawan, Mindanao Island, where they will gain large amount of knowledge on the line. It is stressed in this connection that the preliminary studies planned at the present are carried out under the programme of of SEAFDEC project.

6 Financing

It is highly gratifing to see that, as expressed by high government officials, Aquaculture Department is now well supported by generous amount of financing presented by the Government of Philippines. It is understood that among total lump sum of over 4 million Peso defrayed by the Government, 2.6 million is ready for immediate spending for the construction of buildings and other facilities on the site.

IV. PERTINENT DOCUMENTS REFERRED

1 Progress report of the Aquaculture Department of the Southeast Asian Fisheries Development Center, Iloilo, Philippines, with the Mindanao State University as implementing agency.
2 List of equipment proposed for the SEAFDEC Aquaculture Department.
3 Basic Plan in blue-prints.
4 Plan of operation, SEAFDEC Aquaculture Department.
5 Report of survey for planning of brackish water fish culture Station at Leganes, Panay Is., Philippines (Nos. 1 & 2)

ANNEX

List of equipment for the Aquaculture Department, SEAFDEC, proposed by Mindanao State University, Implementing Afency for the Government of Philippines

The list covers about 400 items grouped under 18 major categories. During the meetings the items were classified into 3 indentities referring to the time of provision or Priority No.1, No.2 and No.3 ; also the number in piece(s) of each item falling on Priority No. 1 was determined. The list presented below, however, shows only the names of the items proposed.

I. Items for Biological Studies & Experiments

1. Universal Projector
2. Binocular Microscope
3. Research Microscope
4. Balance
5. Tortion Balance
6. Time Switch
7. Stop Watch
8. Microtone
9. Drying Chamber
10. Thermostat
11. Glass Aquarium (20 lits.)
12. Plankton Counting Gauge
13. Plankton Counting Slide
14. Centrifuge Machine (big)

15. Centrifuge Machine (table model)
16. Water Propeller
17. Variable Transformer (heavy duty)
18. Air Conditioning Unit (1 HP)
19. Analytical Balance (direct reading)
20. Inverted Microscope
21. Microscope light with adapter
22. Sedgwich-rafter counting chamber
23. Petri-dish
24. Microscope slides & cover glass (boxes)
25. Byer (Speciment Jar)

II. Items for Biology Field Work

1. Dissolved Oxygen Tester
2. Water Sampler
3. Bottom Sampler
4. Turbidity Meter
5. Salinometer
6. Winkler Oxygen Analyzer
7. Redox Meter
8. Hydrophotometer
9. Ph. Meter (electric)
10. Plankton net
11. Hydrometer (for S.G.)
12. Walky Talkie
13. Thermometer
14. Core Sampler
15. Dinghy (plastic or fiberglass) (3 meters)
16. Binocular
17. Transistor Radio
18. Recording Thermometer
19. Ice Box
20. Plankton Sedimentation Tube
21. Outboard Engine (20 HP)
22. Ph. Meter (colorimetric)
23. Secchi Disk
24. Larvae Net
25. Nansen Bottle
26. Reversing Thermometer (protested)
27. Reversing Thermometer (unprotected)

III. Items for Chemistry Studies & Experiments

1. Balance (ordinary)
2. Analytical Balance (direct reading)
3. Ph. Meter (electric)
4. Gas-Chromatographer
5. Rotary Evaporator
6. Electric Heater
7. Condensers
8. Vacuum Pump
9. Water Bath
10. Spectrophotometer
11. Centrifugal Pump (gasoline engine, 0.5 HP)
12. Membrane Filter
13. Freezer (12.cu. ft.)
14. Refrigerator (6 cu. ft. gas powered)
15. Water Filtration System
16. Fume Hoods
17. Air Conditioning Unit (1HP)
18. Amino-Acid Analyzer
19. Thin layer - chromatographer
20. Drying Oven (electric)
21. Furnace
22. Erlnmayer Flask (50 ml; 1000 ml.)
23. Florence Flask (50 ml; 1000 ml.)
24 Volumetric Flask (50 ml; 1000 ml.)
25. Buret (10 ml; 25 ml; 50 ml.)
26. Micro-buret
27. Pipette (2 ml; 5 ml; 10 ml; 20 ml.)
28. Pipette (volumetric 2 ml; 5 ml; 10 ml.)
29. B.O.D.
30. Reagent Bottles (amber colored 50 ml; 100ml; 500 ml; 1000 ml.)
31. Graduated cylinders (5 ml; 10 ml; 25 ml; 50 ml; 100 ml; 500 ml; 1000 ml.)
32. Weighing Bottles
33. Morter & Pestle
34. Centrifuge (electric)
35. Magnetic stirrer
36. Test tubes (different sizes)
37. Chemicals

IV. Items for Cultural Operation & Outdoor Works

1. Plastic makeshift tank
2. Spot Lights
3. Creener
4. Grinder
5. Panlite tank
6. Root Blower
7. Condenser
8. Vertical Pump
9. Diesel Engine (portable)
10. Platform Scale
11. Water Filtration System (portable)
12. Portable Generator (25 KVA)
13. Rubber hose (assorted sizes)
14. Plastic hose (assorted sizes)
15. Thermohumidity Meter
16. Fernbach flask (16 volume capacity; assorted)
17. Carboys (polyethylene 51;101;251;501)
18. Bolting cloth (assorted mesh)
19. Pressure Gauge (hatchery pipes)
20. Automatic Air Pressure Gauge Alarm

V. Items for Hatchery & Wet Laboratory

1. Polyvinyl chloride pipes & fittings (various sizes)
2. Corrogated Plastic sheets (for roofing)
3. Flood lights
4. Valves (assorted sizes)
5. Plastic hoses (assorted sizes in rolls)
6. Electric Motors (1/2 HP)
7. Rearing Tanks (plankton)
8. Rearing Tanks (larvae)
9. Rearing Tanks (juveniles)
10. Rearing Tanks (reserve)
11. Water Pump with Diesel Engine
12. Roots Blower
13. Nylon Rope (assorted sizes)
14. Portable Electric Generator (110-220 5KVA)

VI. Items for Land Survey & Hydrography

1. Transit
2. Level
3. Pole & Stave
4. Tape Scale (steel)
5. Tape Scale (cloth)
6. Pantograph
7. Planimeter
8. Echo-sounder
9. Tracing Table
10. Water gauge
11. Current meter (assorted)
12. Thermister
13. Point gauge
14. Lettering Set
15. Drafting Set
16. Binocular

VII. Items for Library

1. Micro film viewers
2. Slide viewers (assorted)
3. Book stacks (30,000 vols.; Asia Edition)
4. Portable Dehumidifiers
5. Air Conditioning Units (10 tons; central type)
6. Exhaust fans
7. Binding Machine
8. Mimeograph Machime
9. Paper Cutter
10. Tape Recorders
11. Cassette Recorders
12. Typewriter (electric)
13. Fuji Xerox copying machine
14. Adding Machine
15. Loud Speakers
16. Microfilming camera set
17. Portable Air conditioning unit (1HP)

VIII. Items for Audio Visual Training & Lecture

1. Movie Projector (8 mm.)
2. Movie Projector (16 mm.)
3. Slide Projectors
4. Portable Screen
5. Video Tapes
6. Cassette Recorders
7. Radio w/ amplifiers, speakers & microphones
8. Exhaust Fans
9. Air Conditioning unit (2HP)
10. Variable Transformers (portable: step up step down)
11. Volt meter
12. Ammeter
13. Circuit Braker
14. Portable Generator (5 KVA)
15. Vedeo recorder
16. Portable Television sets

IX. Items for Photography

1. 35 mm camera
2. Underwater camera
3. Microsope camera
4. Slide Projector
5. Screen
6. Photography dark-room set
7. 8 mm movie camera
8. Movie Projector (8 mm)
9. Tripod
10. Flashlight (Stolobo)
11. Exposure meter
12. Camera accessory set
13. Exhaust fan
14. Camera Lucida
15. Movie camera (16 mm)
16. Movie projector (16 mm)

X. Items for Weather Observation

1. Wind-vane
2. Photometer
3. Rain gauge
4. Sunshine Recorder
5. Hygrometer
6. Temperature recorder
7. Barometer
8. Instrument screen

XI. Items for Physical Plant

1. Electric Generator (75 KVA)
2. Water Pump w/ diesel engine (fresh water)
3. Carpentry set:
    a) Electric welding set
    b) acetylene welding set
    c) power saw
    d) electric drill
5. Lathe machine
6. Painting set w/ complete spray gun and air compressor
7. Automotive repair tools
8. Concrete mixer (1 bagger capacity) w/ gasoline engine
9. Portable Soldering set
10. Small Bulldozer
11. Small Swampdozer
12. High Pressure Pump w/ gasoline engine
13. Pay Loader
14. Automatic Transformer (75 KVA)
15. Volt tester
16. Portable Earth Compacting Machine
17. Portable Concrete Vibrator
18. Blow Torch

XII. Items for Communication

1. Radio Transceivers
2. Walkie Talkie

3. Walkie-Talkie
4. Telephone (intercom equipment w/ automatic switchboard 40 outlets)
5. Bull Horns (transistorized)
6. Microphone
7. Amplifiers
8. Loud Speakers
9. Turntables
10. Tape Recorders
11. Cassette Recorders

XIII. Items for Tramsportation

1. Jeep (land cruiser w/ 4 wh. drive)
2. Pick-up (3/4 ton)
3. Station Wagon w/ AC
4. Mini-Bus (15 persons; AC)
5. Fider Glass Boat (15 ft.)
6. Outboard motor (2OHP)
7. Forklift
8. Dumptruck

XIV. Items for Office Use

1. Calculating machine (battery operated)
2. Typewriter (electric)
3. Typewriter (manual)
4. Fuji Xerox copying machine
5. Mimeographing machine
6. Drafting Lamp
7. Lettering Set
8. Drawing Instruments

XV. Items for Survey Vessel

1. 4 Ton Boat w/ live well, echo sounder and bady trawl
2. Fishing Boat - shrimp trawler, stern type, steel hull, 20 tons net w/ 180 HP Diesel, complete w/ 5KVA generator, trawling winch, mast & boom, A-frames, line roller and engine spares

3. Live well - built-in live wells, 1 cu.m. capacity, complete w/ piping system & pump to be constructed in the fishing vessel
4. Dinghy - fider glass 15x5x2.5 ft.
5. Outboard motor - 10HP complete w/ tank & pipe connection and with spares
6. Trawl Nets - two-seam net for shrimps, 50 ft. & 40 ft. rope, nylon, complete w/ plastic floats and lead weights
7. Alter Door - wood 48" x 30", 150 kgm. complete w/ brackets, chain & shoes
8. Trawl warp - 500 m. steel cable, 3/8" dia. 6x19
9. Submarine Lamps - electric, heavy duty, complete w/ heavy duty lines and bulbs
10. Aqua Lung - complete w/ oxygen tabks & mouthpiece, swim suit, fins, spear gun, wrist watch, depth gauge and flashlight
11. Snorkel - snorkel head, gear, complete w/ air tube
12. Air Compressor - air compressor w/ engine complete w/ attachements & gauge
13. Trammel Nets - nylon, for shrimp, 50 meters long, each shackle complete w/ floats & sinkers

XVI. Items for Refrigeration

1. Cold Storage - 2 ton capacity, blower type, complete w/ engine and compressor
2. Slice-ice Machine - 1 ton capacity for 24 hrs. complete w/ engine, electric generator & 1 ton ice storage
3. Freezer - contact freezer, 1 ton capacity for 24 hrs., complete w/ electric generator
4. Air Conditioning unit - complete w/ 1/2 HP motor for laboratory and washing room
5. Freezer (gas oprated; 12 cu.ft.)
6. Refrigerator (electric; 12 cu.ft.)

XVII. Items for Food Processing

1. Boiler - horizontal type, complete w/ electric fire, 1 HP
2. Pulper - 200 kgm/24 hrs. complete w/ driving electric motor
3. Hammer mill - 300 kgm/hr. complete w/ driving electric motor
4. Pellet Machine - pelletizing machine, 200 kgm/hr. capacity compelte w/ driving electric motor
5. Autoclave - 20 gallons capacity complete with trays pet cap etc.

XVIII. Items for Rearing Tanks

1. Rearing Tanks - PVC made, circular type, 1 ton capacity
2. Angular Stainless Steel - for aquarium, 2" x 2" angular
3. Tempered Class - 2m x 1m x 3/4" thick

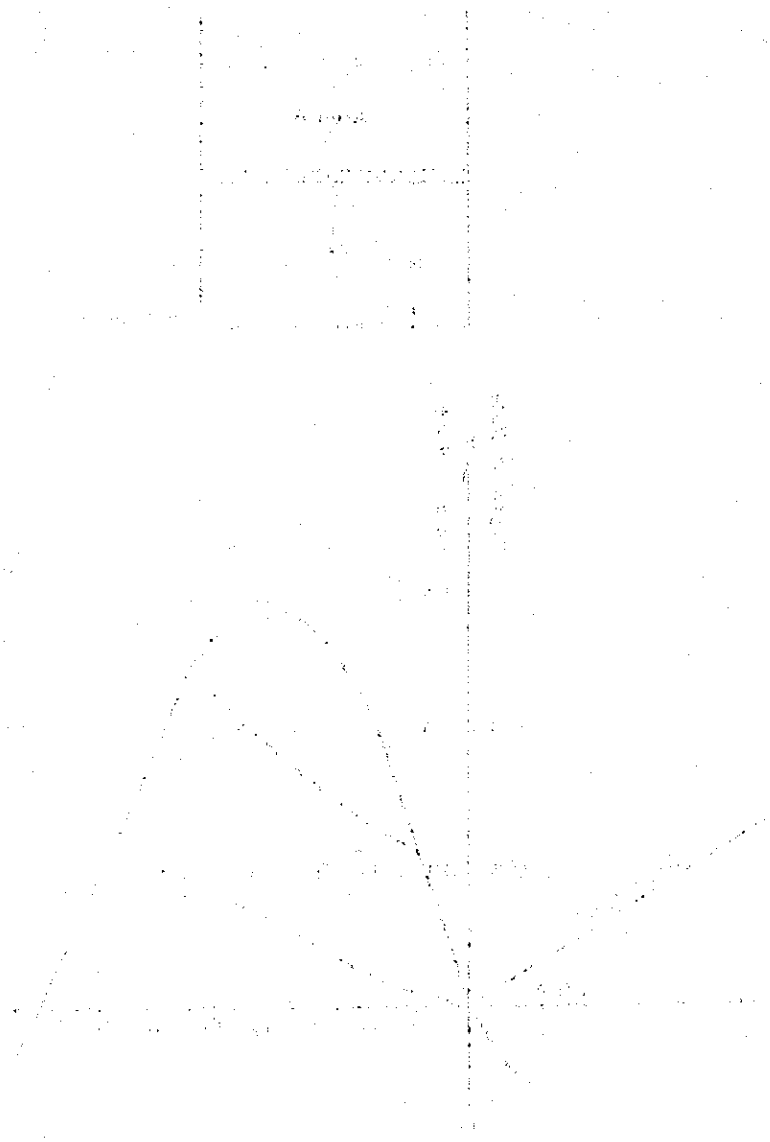

Fig. 1. Diagramatic Illustration to show the theory on the discharge of water from a tank through orfice (top). Figure (bottom) showing the relation of tidal change to the amount of water l led into pond; tidal change in the Gui-gui Creek, tidal curve measured in the creek; ζ_{p2}, curve of water level in pond during the second tide in a day; ζ_{p1}, the same during the first tide; Q, amount of water in pond.

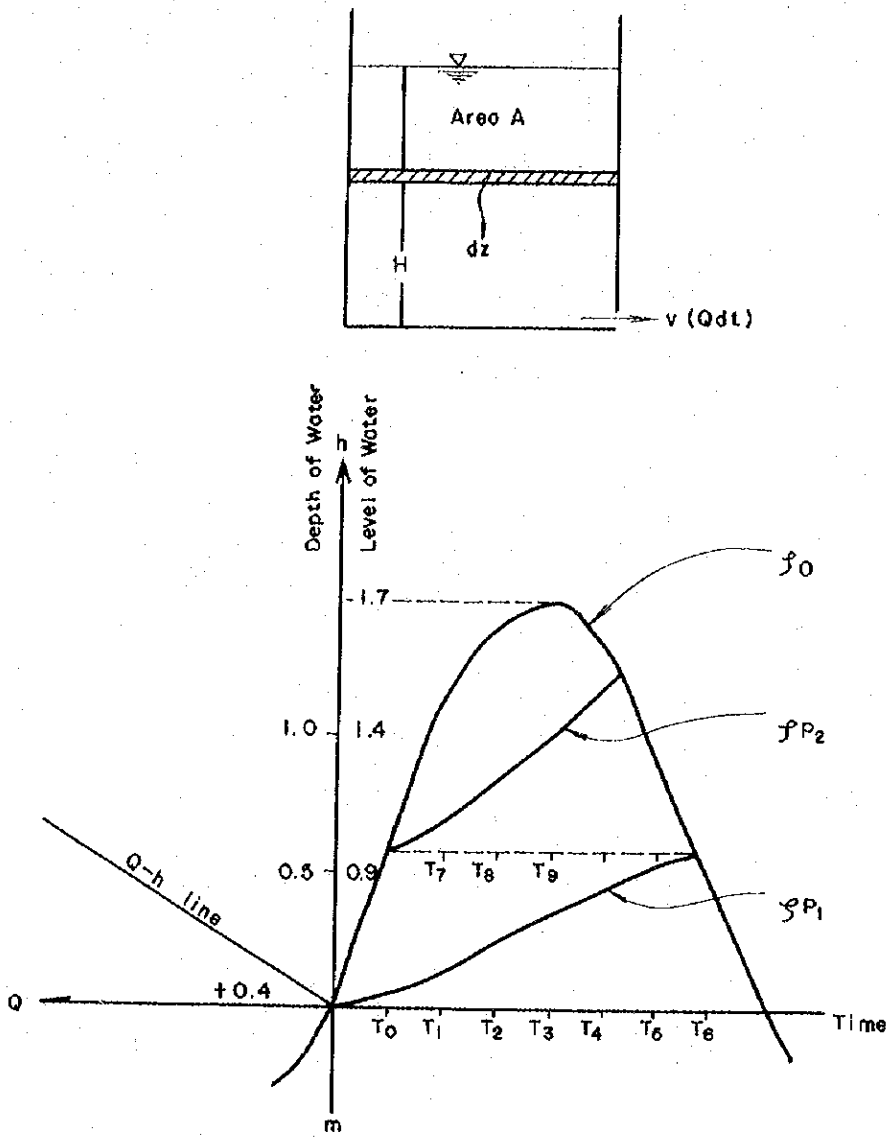

Fig. 2. Diagramatic drawings to illustrate the structure of 'mud-screen' and glassfibre filter installed in plastic tube. The device innovated by the staff, MSU Marine Laboratory at Naawan, Mindanao Island.

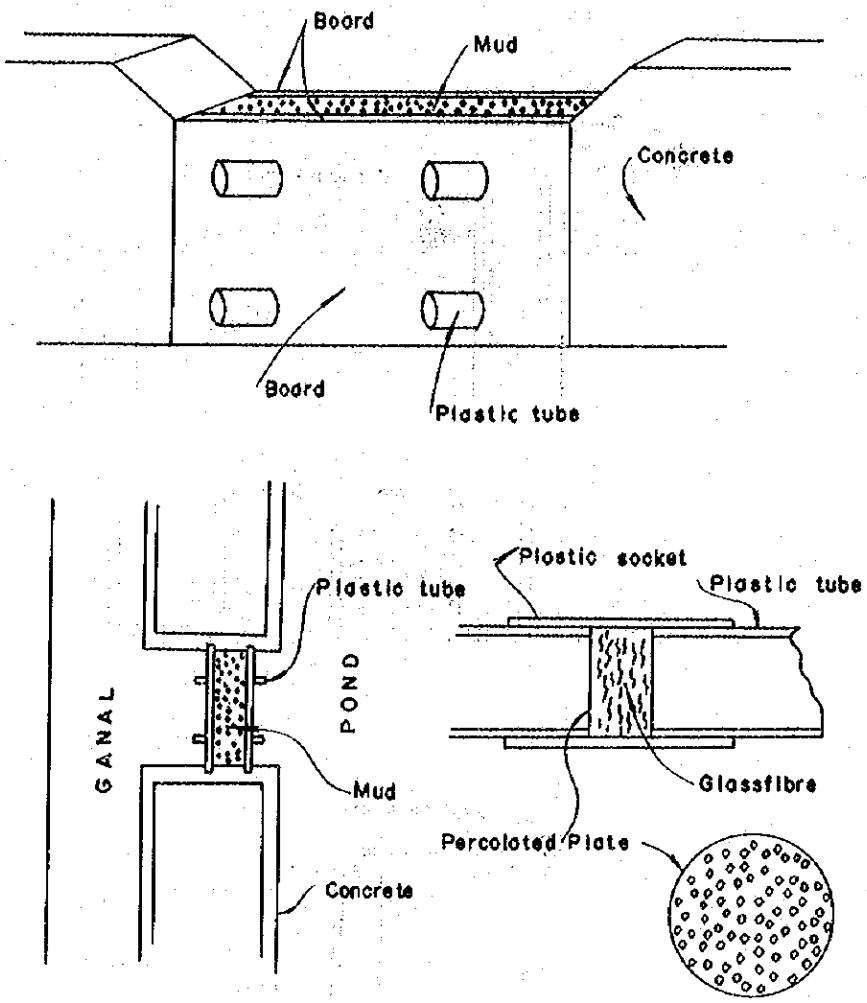

Fig. 3. Diagramatic drawings to illustrate the system of water collection from sea to land (top), cross-section view of filtration tank (middle), and another system of water collection by burrying a percolated tube on the tidal zone of beach.