PROCEEDINGS OF THE FIRST SEMINAR OF THE FISHPOND COOPERATORS' PROGRAM ON PRAWN CULTURE IN MINDANAO

Held on November 25-29, 1974
in Naawan, Misamis Oriental

SPONSORS: MSU-Institute of Fisheries Research and Development
SEAFDEC, Aquaculture Department
Bureau of Fisheries and Aquatic Resources
National Science Development Board

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MSU-SEAFDEC/BFAR/NSDB Cooperators'
Program Seminar

Schedule of Activities
November 25-29, 1974

November 25

a.m.		
08:00-09:00	Registration of Participants	
09:00-09:15	Welcome Talk	- Actg. Director Antonio Villaluz
09:15-09:30	Opening Remarks	- Dean D. K. Villaluz
09:30-09:45	History and Objectives of MSU-IFRD and Its Activities	- Mr. W. Adan
09:45-10:00	Recess	
10:00-11:00	MSU-SEAFDEC Linkages, Procedures and Guidelines	- Atty. J. Agbayani
11:00-12:00	Cooperator's Program in Iloilo	- Atty. J. Agbayani
p.m.		
12:00-01:30	Noon Break	
01:30-03:00	Fry Production	- Mr. M. Tumanda
03:00-03:15	Recess	
03:15-04:15	Fry Harvest and Pre-Transport with Demonstration	- Mr. M. Tumanda
04:15-05:00	Acclimatization and Stocking of Fry	- Mr. H. Dejarme

November 26

a.m.

08:00-10:30	Nutritional and Environmental Requirement of Sugpo in the Hatchery and in Ponds	- Ms. W. Destajo Ms. H. Vicente
10:30-10:45	Recess	
10:45-11:15	Diseases and Other Causes of Mortality in the Hatchery and in Ponds	- Mr. A. Villaluz
11:15-12:00	Eradication and Control of Predators and Competitors	- Mr. J. Dominisac

p.m.

12:00-01:30	Noon Break	
01:30-03:30	Pond Design and Construction	- Mr. R. Esguerra
03:30-04:00	Recess	
04:00-05:00	Cont. Pond Design and Construction	- Mr. R. Esguerra

November 27

a.m.

08:00-09:00	Machineries and Devices for Environmental Improvement in Sugpo Pond	- Mr. P. Acosta
09:00-10:15	Prawn Culture Practices in Japan	- Mr. H. Motoh Dr. U. Kobayashi
10:15-12:00	Aquaculture Practices in the Philippines	- Mr. R. Esguerra

p.m.

12:00-01:30	Noon Break	
01:30-03:00	Fishpond Financing	- Mr. P. Acosta
03:00-03:30	Recess	
03:30-05:00	Aquaculture Practices in SEA (Slide Showing)	- Mr. R. Esguerra

November 28

Field Trip

(Whole Day)

November 29

a.m.		
08:00-09:00	Pre-Market Treatment and Marketing of Sugpo	- Mr. S. Tan
09:00-09:45	Discussions on the Procedures to be followed during the Implementation of the Cooperators' Program	- Mr. R. Esguerra Atty. J. Agbayani Mr. A. Villaluz Ms. H. Vicente Mr. M. Tumanda
09:45-10:30	Recess	
10:30-12:00	Cont. Discussions on the Procedures to be followed during the Implementation of the Cooperators' Program	-
p.m.		
12:00-01:30	Luncheon	
01:30-02:30	Status of Sugpo Industry the Philippines	- Mr. J. Lopez
02:30-03:00	Preliminary Studies on the Monoculture of *P. monodon*	
03:00-03:30	Recess	
03:30-04:30	Evaluation	
04:30	Elections of Officers	
	Closing Remarks	- Atty. J. Agbayani
	Distribution of Certificates	- Mr. A. Villaluz Assisted by Mr. D. Quinto

C O N T E N T S

Mindanao State University
INSTITUTE OF FISHERIES RESEARCH AND DEVELOPMENT
Naawan, Misamis Oriental

GUIDELINES
For the Cooperators' Program on Prawn Culture in Mindanao, Philippines

Jointly Sponsored

by

Mindanao State University, SEAFDEC Aquaculture Department, Bureau of Fisheries and Aquatic Resources and the National Science Development Board

Knowing that Mindanao State University, through its Institute of Fisheries Research and Development at Naawan, Misamis Oriental, is engaged in the development of Aquaculture resources;

Cognizant of the fact that the SEAFDEC Aquaculture Department is likewise entrusted with the development of the Aquaculture resources of Southeast Asia, particularly the Philippines;

Realizing the potential of the Prawn Industry as a new source of food protein supply and income for the increasing Filipino population;

Aware of the need to intensify research on prawn to augment and push to commercial scale its cultivation and production in fish ponds;

Conscious of the responsibility to accelerate the transfer of the technology to the private sectors; Therefore:

The Mindanao State University and the Aquaculture Department of the Southeast Asian Fisheries Development Center, the Bureau of Fisheries and Aquatic Resources, the National Science Development Board, and the participant of the Cooperator's Program on Prawn Culture, do hereby agree to carry out the implementation of the following guidelines for the Cooperator's Program on Prawn Culture:

That MSU-SEAFDEC shall be responsible for the following contributions:

1. Conduct seminars or workshops for the training of fishpond operators in all aspects of prawn culture from pond construction and design to pond management and marketing;

2. Private technical men who will coordinate with the fishpond cooperators in the formulation of individual plan of work and in the implementation, thereof;

3. Provide the cooperator with free research materials in the forms of prawn fry, laboratory, chemical and supplies which may be necessary in the training and in the implementation of the cultivation research;

4. Share information on the results of the research project which may be helpful to the cooperator in future operations

The BFAR shall be responsible for the following contributions:

1. Stimulate the organization of fishpond operators/owners to cooperatives and/or associations.

2. Evaluate and recommend participants to the Cooperator's Program and Prawn Culture.

3. Provide representative lecturers in the training-seminar.

4. Assist the MSU-SEAFDEC extension workers in the performance of their duties.

The NSDB shall be responsible for the following contributions:

1. To provide necessary financial support in the implementation of the research-production project.

2. Make suggestions/proposals to the effective implementation of the program.

3. May provide representative lecturers in the training-seminar from time to time.

The Cooperator shall be responsible for the following as counterpart contributions:

1. Make available the pond according to the size and specifications as embodied in the research scheme.

2. Provide the pond hands who shall take care of the prawn stock in accordance with the requirements of the research design.

3. Shall be responsible for the care, maintenance and repair of the ponds.

4. Provide for the fertilizers, pond chemicals and necessary equipment.

5. Allow MSU-SEAFDEC researchers, NSDB and BFAR technicians and extension workers free entry into the ponds in the performance of their respective duties as provided for herein.

6. Follow instructions of researchers and to comply with such other requirements as maybe necessary in the implementation of the research scheme.

The Cooperator shall have full ownership of the prawns raised and produced in the experimental ponds after the researchers shall have declared the research project fully completed, while the MSU-SEAFDEC shall have full ownership of all the data gathered, the research report, and all other papers and documents related thereto. Provided, however, that MSU-SEAFDEC shall share with BFAR, NSDB and the Cooperator information on the results of the research project for the interest of all concerned.

MSU-SEAFDEC/NFAR/NSDB FISHPOND COOPERATORS' PROGRAM ON PRAWN CULTURE IN MINDANAO

Welcome Address

by

Antonio C. Villaluz

Ladies and Gentlemen:

Our sincere welcome to all of you.

The Mindanao State University, the Aquaculture Department of the Southeast Asian Fisheries Development Center, the Bureau of Fisheries and Aquatic Resources and the National Science Development Board, in response to the need of developing the Sugpo industry, have joined hands in organizing the Cooperators' Program on Prawn Culture to accelerate the transfer of technology to the private sector.

Leading researchers and training specialists have been invited to give lectures and to share with us their knowledge and experiences. The subjects for discussion have been carefully selected to give the participants an over-all view of sugpo culture, from hatchery operations to pond management, marketing and financing.

It is expected that by the end of this seminar, present cooperators shall be able to design and implement a workable scheme that would enhance fishpond production and benefit not only themselves, but also other fishpond operators engaged in prawn culture.

The Institutions involved in this Program are offering you their facilities and are making available the services of their Staffs to provide all possible assistance. Hopefully, this will lead to the development of Sugpo Industry in this region, in the entire Philippines and in the Southeast Asian countries, as well.

Opening Remarks*

We are very happy to have fishpond owners, bankers and technical men present in this seminar for manpower training for the Development of the Aquaculture Industry, especially for Prawns sponsored by MSU, SEAFDEC, BFAR, DNR and NSDB. It is also a great honor to announce to you that during the last 9th Ministerial Conference held in Manila, for the Economic Development of Southeast Asia last November 14-16, 1974, Director Felix Gonzales of the Bureau of Fisheries and Aquatic Resources and Dr. Q. F. Miravite, Director for General Affairs, SEAFDEC Aquaculture Department reported to his Excellency, President Ferdinand E. Marcos and Secretary Jose Leido, Jr., of the Department of Natural Resources about the organization of a Fishpond Cooperator's Program here in Mindanao, and they are very much interested. As a matter of fact President Marcos requested us to submit a personal report on the result of this seminar.

Gentlemen, allow me to brief you on the following background information of the Institute and also about SEAFDEC. In 1964, there was a need for a field laboratory in connection with the aquafarming courses offered by the MSU College of

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*Delivered by Dean D. K. Villaluz, Chief of SEAFDEC Aquaculture Department during the opening ceremonies of the Seminar for Fishpond Cooperators, held at Naawan, Misamis Oriental, November 25-29, 1974.

Fisheries for both inland and seawater species of fishes, crustaceans, mullusks, seaweeds, brackish/estuarine fishes, etc. and this site, the town of Naawan, Misamis Oriental was chosen for the following reasons: (1) accessibility of water, land and air transportation; (2) comparative distance from places considered as possible sources of pollution; (3) accessibility for free flow of clean estuarine water, brackishwater and seawater; and (4) availability of land necessary for the buildings and other infrastructures and the presence of 15 hectares of swampland for demonstration and experimental fishponds.

A pilot laboratory was established by the Mindanao State University in July 1969. The small building that you can see here is the original laboratory of this Institute.

With the approval of a Memorandum of Agreement, between the MSU and NSDB, MSU was able to get financial assistance from the NSDB for a research project entitled "Reproduction Larval Development and Cultivation of Sugpo, Penaeus monodon Fabricius". This Memorandum of Agreement was programmed for three years from July 1, 1969 to June 30, 1972 with a grant of ₱37,000.00 a year or a total of ₱111,000.00 for three years. Late in 1971 MSU established the Institute of Fisheries Research and Development, and with the old research laboratory as the nucleus, IFRD continued the program and constructed a new research laboratory complex comprised of administration and research laboratory, wet laboratory and hatchery, and a guest house which cost a total of around ₱800,000.00.

As early as 1969, the report of the MSU-NSDB on the result of sugpo research was published in the FAO Aquaculture Bulletin in Rome. It was again published in the Philippine Journal of Science, September-December 1969 issue. During the Second International Conference on Ocean Development and Exposition held in Tokyo, 4-8 October, 1972, the Second Annual Report with the same title was read and published in their proceedings.

SEAFDEC is a project of the Council of Ministers for the Economic Development of Southeast Asia which is composed of 12-member nations, including New Zealand and Australia. It is composed of three departments: (1) Training Department located at Bangkok; (2) Research Department located in Singapore and (3) Aquaculture Department located in Iloilo, Philippines. The first two departments were implemented two years ahead of the Aquaculture Department. It was only in July 1973 that the MSU was officially designated as the implementing agency of the Aquaculture Department. Since the MSU was already operating this Institute, we suggested that the SEAFDEC Aquaculture Department instead of being located in Iloilo should be transferred to Naawan, Misamis Oriental. However, there were good reasons offered by experts from Japan such as, it will take them another two years to make a survey of the Naawan area; the Philippines was already late by two years in the implementation of the Aquaculture Department and that Iloilo geographically is a strategic place, being located at the center of the country and accessible from all parts of the region, from Luzon, Visayas and Mindanao. These are some of the reasons why SEAFDEC Aquaculture Department is now in Iloilo, Although the Aquaculture Department of SEAFDEC is an international organization funded by the Philippines, Japan, Malaysia, Singapore, Thailand and South Vietnam, we in this department until now recognize the MSU as its implementing agency for our government.

One of the main objectives of the Department is the development of the aquaculture industry in Southeast Asia. Since in this country, aquafarming is a recognized industry, we thought that the Philippines as our host country deserves our priority attention and fullest support for its aquaculture development. Along this line of thinking we are now offering the Fishpond Owners Cooperators' Program for Sugpo Cultivation in cooperation with the MSU, NSDB, BFAR, DNR and others. We also thought of organizing a

Consortium of State Universities to offer courses leading to the degree of Master of Science in Aquaculture. The Universities and other Institutions involved aside from SEAFDEC are: The University of the Philippines, the Central Luzon State University, the Mindanao State University, Philippine Council for Agricultural Research, Bureau of Fisheries and Aquatic Resources, Department of Natural Resources and, lately, the Bicol University also expressed interest on the program.

Of allthe professions in the Philippines, the most neglected is Fisheries. There are only two Ph.Ds., a handful of Master's degree holders and very few holders of Bachelor of Science in Fisheries. In Agriculture, on the other hand, we have several Ph.Ds. in all disciplines. We are citing these facts because we believe that manpower development should go hand in hand in the development of the aquaculture industry. In short, we have related the role of SEAFDEC nationally and internationally. I would like to express in behalf of SEAFDEC Aquaculture Department, Department of Natural Resources, the Bureau of Fisheries and Aquatic Resources, the National Science Development Board and the Mindanao State University our sincere welcome to all of you, and we hope that this Seminar shall be the beginning of our continuous cooperative efforts for the development of the Philippine aquaculture industry. THANK YOU.

HISTORY, OBJECTIVES AND PROGRAMS OF MSU-IFRD

by

William R. Adan

Good Morning!

We are gathered here today - and the next four days to come because of this Sugpo thing. My task this morning is to give you an idea on how this whole thing was conceived, spawned and reared to reality. I am going to brief you, in that regard, on the historical and progressive transformation of this Institute and its programs of activities. This is to complement in a way some of the historical facts already mentioned by Dean D. K. Villaluz.

What is now being called as the Institute of Fisheries Research and Development, which presently triggers this revolutionary expectations on prawn culture in this country, started humbly as a field laboratory of the College of Fisheries of the Mindanao State University. That was some time in 1964, after the MSU successfully negotiated the acquisition of an approximately 15 hectares of swampland and adjoining lots with the Municipal Council of Naawan, Misamis Oriental and private land owners. There and then the swampland became the target of a concerted effort of the faculty and students alike of the College of Fisheries - to put theories into active practice that would eventually transform the site into scientifically designed experimental fish farm.

In 1969, Dean D. K. Villaluz of the College of Fisheries sucessfully convinced the National Science Development Board (NSDB) of the very bright prospect of prawn culture in the country. This led to the NSDB assistance of ₱37,000/yr for three years to a research project entitled "Reproduction, Larval Development and Cultivation of Sugpo, *P. monodon* Fabricius (Proj. 2.156)". With this assistance, the research team who had to handle the project led by D. K. Villaluz, managed to construct a pilot laboratory, and this was christened MSU-NSDB Marine Fisheries Laboratory. Here the preliminary and basic research on the biology of sugpo was initiated. Before the end of 1969 the research team had its technical report to the NSDB published in the September-December 1969 issue of the Philippine Journal of Science.

In 1971, the Sulu College of Technology and Oceanogprahy was created by Rep. Act. 6060 to develop the fisheries potentials of Sulu and nearby waters. In line with the objectives of Rep. Act 6060, the Institute of Fisheries Research and Development was organized to purposely intensify research on fisheries with the MSU-NSDB Marine Fisheries Laboratory at Naawan as its nucleus, and with the SCTO Coastal Fisheries Research Laboratory in Bongao, Sulu, and the College of Fisheries Inland Fisheries Research Laboratory in Marawi City as its research arms on coastal and inland fisheries, respectively.

On December 4, 1973, the MSU-Institute of Fisheries Research and Development was formally organized and made a distinct academic unit of the University, placing the MSU-Naawan Fisheries High School under its immediate supervision.

Presently, the Institute has its programs broken into 4 categories: 1) Research; 2) Training and Extension; 3) Academic; and 4) Conservation. Let me discuss these programs individually.

First, is Research. We have this objective: To undertake researches on the different forms of aquatic resources for their effective production, exploitation and conservation. Along this program we have the following on-going projects:

1. Mass Production of Sugpo Fry and Their Intensive Cultivation

So far we have attained an average survival rate of 24% from the 1st larval form to the fry size or stockable age of sugpo in ponds per mother per successful operation. A gravid female or pregnant sugpo spawns an average of 200,000 eggs. Therefore, with 24% survival rate, we already can harvest 48,000 sugpo fry per mother per operation. In the wild state a survival of .125% is reported for any marine animal. Therefore, what we've accomplished is already something to marvel at. But we are not content to stop at this point. We carry on with the attempt to improve the percentage survival of our animal and somehow standardize the techniques involved in the operation, with the aim to eventually transfer the prawn hatchery technology to the private sectors. On the other hand, our research on cultivation phase has just started. We cannot give conclusive findings as yet. This in fact is the primary factor that prompted the creation of this training-seminar.

2. Biology and Culture of Alimango, *Scylla serrata* Forskal

A berried or pregnant Alimango spawns an average of 2,000,000 eggs. In our latest experiment, we managed to have two Alimango larvae reached the crab stage or about 30 days old from hatching. Well, this is already an inspiring achievement to start with. In sugpo research, we also started from a zero point.

3. Biology and Culture of Alimasag, *Portunus pelagicus*

So far the Alimasag larvae spawned and reared in laboratory conditions only reached the zoea 11th day stage. As in Alimango culture, we are carrying on the studies on the basic factors involving survival, as food, immediate culture medium, etc.

4. Complete Life Cycle of Hipong Puti, *P. indicus* under Laboratory Conditions

This laboratory has succeeded in having hipong puti complete its life cycle under laboratory conditions. Eventually, side by side with sugpo, we'll mass-produce this crustacean. With the price it commands in the local markets, hipong puti, too, will become a real fishpond booster instead as a mere "bonus" from nature.

5. Preliminary Studies on the Maturation and Gonadal Development of Bangus

This preliminary research ultimately aims to artificially mass produce bangus fry like sugpo. It is a newly started research venture and deals with the first or basic phase as the title suggests.

We go to Training and Extension. We have these objectives: 1) To bolster the fishery and aquaculture development oriented industries through demonstrations, dissemination of information in the form of seminars, consultations and handouts on the results of its various researches, and to work hand-in-hand with the different agencies of the government for their application; 2) To provide technical knowledge on prawn and fish farm management to fish culturists and fishpond operators through its manpower training program.

This training-seminar jointly sponsored by MSU-SEAFDEC, BFAR and NSDB falls to this program. This training-seminar under the Cooperators' Program is no less than an attempt to enlarge and have in-depth research on the cultivation aspect of sugpo, i.e., the growing of sugpo fry to the marketable size with different rearing methods and under different environmental conditions. As mentioned earlier, while our fry production is already considered successful since we now figure by millions per total successful hatchery operation, the research phase on cultivation is only but lightly scratched on the surface. We are involving the private sector - the fishpond operators, as you eventually will be the major factor in this particular phase of the sugpo industry. Our success in the hatchery will be in vain and futile if you in the fishpond fail.

Now, under this extension program we also give free consultation to fish farmers regarding the culture of marine animals within our field. This includes gratis assistance to fish farmers in the selection of fish farm site, pond lay-outing, etc. We also distribute gratis our preliminary studies on prawn cultivation in the form of handouts. We, likewise, welcome educational tours from any schools or societies.

Next, is Academic. As earlier mentioned the MSU Naawan Fisheries High School is now placed under the immediate supervision of the Institute by virtue of the reorganization on December 4, 1973. Presently, with 370 students and 21 faculty members, this academic unit of the Institute has this for an objective: To provide high school students with basic occupational skills, knowledge , and information essential in obtaining gainful employment. In this case our approach to secondary education is radically a departure from the traditional theory-oriented approach. Here, theories are immediately actualized or practiced in a situational classroom. For instance, we have alloted a certain portion of our fishpond area for our high school students for them to develop, pour in it everything they have learned or may learn in the process of making it productive.

Finally; we have this program on Conservation. Our objective is to rehabilitate some dwindling population of our aquatic animals by stocking rivers, lakes and seas with cultured and artificially propagated fry in the research station.

This is one program which we have not yet given close attention. Nonetheless, with our increasing sugpo fry production, we hope to implement this in the opportune time. We have to return to nature a certain percent of our produce - a kind of stock recycling. Stocking natural waters with seeds produced in the laboratory, of course, requires another serious studies.

Thank you.

SUGPO FRY PRODUCTION AT MSU-IFRD

by

Marcelino I. Tumanda, Jr.

INTRODUCTION

Status of Fry Production in the Philippines

Prawn culture has attracted the interest of various sectors of the country because of the ever-increasing demand for prawn and its by-products both in the local and foreign markets. At present, intensive cultivation of this crustacean is difficult to realize owing to the unavailability of fry seedlings that would supply the vast fishponds scattered throughout the archipelago in any time of the year. Thus, many fishpond operators could only content themselves of availing whatever fry seedlings may come into their fishponds the moment they open their gates to allow fresh tidal water. Moreover, this supply is not constant due to changes in the natural population from season after season and from year after year.

The picture is clear. For intensive cultivation of prawns in rearing ponds to be viable, steady supply of fry seedlings is an imperative. This could only be possible if seed banks could be established at strategic locations in the country where local fishpond operators could avail themselves of the needed fry.

The hatchery project being undertaken by the Mindanao State University through the Institute of Fisheries Research and Development in collaboration with the National Science Development Board and other agencies both public and private, is aimed to elevate the status of prawn culture to a level of stability where prawn seedlings may be made available in adequate quantities throughout the year. Hatchery technology is being developed and standardized with the hope of transferring this technology to the private sectors who may wish to put up such venture for commercialization.

This technology has already caught fire. With the establishment of the Naawan prawn hatchery, the Southeast Asian Fisheries Development Center at Tigbauan, Iloilo, followed suit. There are two private hatcheries existing in Luzon; one is in Batangas and the other one is in Quezon. In the Visayas there is one private hatchery laboratory in Roxas. In Mindanao, the province of Agusan is reported to have one. It is hoped that the results of this present Cooperator's Program will further stimulate the private sectors to engage in the seed production venture.

Spawner Collection and Transport-

Spawners are collected from Panguil and Iligan Bay area by fishermen who operate fish corrals, gill nets or trawling. The gravid females are segregated from the non-gravid ones and packed for immediate transport to the Naawan Station. Gravid ones are recognized by the presence of big dark ovaries. Along the dorsal body axis which could be seen if viewed against the light.

Two methods could be employed in packing the spawners for transport. One is the dry method using chilled sawdust. The spawners are kept in suspended animation during transport and then revived in the laboratory by placing them in fresh seawater. Another is the chilled seawater method where spawners are placed inside plastic bags measuring about 50 x 96 cm. The bags are filled with 3 to 4 liters of fresh seawater, charged with oxygen and placed in styrofoam boxes. Crushed pieces of ice placed in small plastic bags and wrapped in old newspapers are placed in the box to lower the temperature of the water in the bags to approximately 18°C to 20°C. This condition lowers the metabolic rate of the spawners thereby reducing oxygen intake and minimizing mobility.

Hatchery Operation-

A. <u>Preparation of Hatchery Tanks</u>

The hatchery tanks are thoroughly scrubbed and rinsed with fresh seawater and dried for at least two days before being used. This will rid of possible harmful organisms that may be present in the tank during the previous operation. Filtered seawater is then pumped into the tanks to a height of 1 meter and aerated sufficiently. Water is taken 130 meters from the shoreline via a series of culvert pipes. It then passes through a sedimentation and filter tank where it is filtered through layers of finely graded sand and gravel before it is sucked by the water pumps. Water is again refiltered before entering the hatchery tanks by a secondary filter or by a plankton net. The filtration set-up removes course particles and possible predator organisms but retains the tiny phytoplankton and zooplankton essentially needed as food by the sugpo larvae and post larvae. Roots Blowers are used to aerate the water through airstones or airfoams.

B. Stocking of Gravid Females

The MSU-IFRD hatchery tanks are varied in sizes and shapes, thus having different holding capacities. The small rectangular tanks have an individual holding capacity of 16 tons; the big rectangular tanks 60 tons and the circular tanks, 144 tons. The number of gravid females to be used in the hatching experiment would therefore depend on which tank will be used in the operation. By experience, the 16 ton tanks require from 2 to 4 spawners; the 60 ton tanks, from 6-10 spawners; and the 144 ton circular tanks, from 15-20 spawners.

C. Spawning, Hatching and Larval Development

Spawning usually takes place between 8:00 o'clock P.M. and 4:00 o'clock A.M. To get good spawning results aeration is reduced to the minimum to avoid too much turbulence. Lights are shut off during the night to simulate darkness of the sea bottom where they naturally spawn. It is either complete or partial.Spawning is considered complete when all the eggs in the ovary from the anterior to the posterial lobes have been extruded, and partial, when there are some eggs left in any of the anterior, median or posterior lobes. Spent females are removed from the hatchery tanks the following morning.

C.1 Egg Stage

The eggs are spherical and settle down to the bottom of the tanks after being extruded. Cell division soon follows forming the embryo within the egg membrane. About 8 to 10 hours after spawning, the embryo develops 3 pairs of appendages and exhibits slight convulsive movements which become progressively freqtent just before hatching. About 12 to 13 hours after spawning the fully developed embryo emerge from its colorless and transparent egg membrane as a tiny nauplius larva.

C.2 Nauplius Stage

The nauplius larvae are capable of swimming by beating their three pairs of appendages in a paddling fashion, stopping momentarily for a while, then resume swimming at random in all directions. The larvae remain in the nauplius stage for about 48 to 53 hours, molting six times throughout the duration of the stage. Each stage is differentiated from the rest by its own distinctive size and morphological features.

C.3 Zoea Stage

The larvae after passing the sixth nauplius stage metamorphose into the zoea stage. The body of the larvae is considerably elongated. The larvae possess the carapace which initially covers about one-half of the body length but gradually tend to reduce proportionally as the length of the segmented somites increases. They are three substages namely: Zoea I, zoea II, and zoea III, each stage being characterized by its own distinctive morphological features. After three moltings within 5 or 6 days the larvae metamorphose into the mysis stage.

C.4 Mysis Stage

The larvae in the mysis stage appear like tiny shrimps with their bodies oriented in a vertical position, their heads oriented downwards. They swim downward and upward by means by their periopods and may dart backward by bending their abdomen in successive jerks. During this stage buds appear from the ventral side of their bodies which progressively grow and develop into the pleopods although they are non-functional during this stage. After 3 moltings within 4 to 5 days the larvae transform into the post larval stage.

C.5 Post Larval Stage

The post larvae appear like miniature adult prawns and measure about 0.5 cm during the first day. The pleopods or swimmerets which were non-functional during the mysis stage are now used for swimming. They remain planktonic during the first few days after which they settle to the bottom or crawl on the walls of the hatchery tanks. Twenty to twenty five days (P_{20}-P_{25}) after the first post larval stage the fry are now ready for harvest and stocking in the nursery or rearing ponds.

D. Hatchery Management

This implies the caring of the larvae from the time they are hatched from the eggs up to the time they are harvested for stocking into the rearing ponds. There are three main parts in the hatchery management namely: (1) maintenance of good water quality, (2) maintenance of an adequate supply of food in the hatchery tanks and (3) prevention of water pollution.

In operating the hatchery tanks clear seawater with high salinity (30-31 ppt) is preferred to assure good environmental condition for the developing larvae. In case the source is turbid, water is pumped to the reservoir tank to allow tiny sand particles to settle down before delivering it to the hatchery tanks. Secondary filters or fine nyloon screens are fitted to the inlet pipes to trap whatever sand particles may be carried after the sedimentation period.

The larvae in the nauplius stage require no feeding as they get their nourishment from the yolk contained within their bodies. Therefore no food is introduced into the hatchery tanks at this stage of larval development. However, when the larvae have reached the sixth nauplius stage, food is introduced into the tanks so they may be made available to the larvae when they transform into the zoea stage. It is during this stage and in later subsequent stages where the larvae start to derive their nourishment from external source.

There are a variety of food given to the larvae, a great majority of them constitute the cultured food organisms. Mixed diatoms, which are microscopic plants of the sea, constitute one important food in the diet of the zoea larvae. In the hatchery operation mixed diatoms are maintained in the hatchery tanks until harvest time. Bread yeast is another good substitute for diatoms especially when the diatoms fail to bloom in the hatchery tanks. In recent experiments a combination of mixed diatoms and bread yeast diet proved to be very promising, bread yeast being introduced into the hatchery tanks from the zoea stage up to early post larval stage.

In a joint MSU-SEAFDEC research venture, various kinds of food have been tested and found promising. Among them are blended eelgrass juice, filamentous algae washings, sargassum washings and fermented minced clam juice. These juices and washings contain microorganisms (bacteria, protozoans, algae, diatoms) which are utilized by the larvae for their nourishment.

When the mysis stage is reached the larvae have the propensity of feeding on small animals or zooplankton. Hence, these food organisms are introduced into the tank at this stage of larval development. Brine shrimp nauplii fed at the rate of 5 gm/10,000 larvae/day (dry egg weight) give good results in terms of larval survival. Brachionus sp. a rotifer is also an ideal food for the mysis, but is introduced into the hatchery tank during the early zoea stage to allow its population to increase in time for the larvae to change into the mysis stage. Small copepods harvested from the sea by using water pump and light traps are eaten by the mysis larvae with relish.

All food organisms given to the mysis larvae are also fed to the post larvae. However, the introduction of brine shrimp nauplii is stopped during P_3 or P_4 stage to cut on the cost of food. This is substituted by minced clam which will then constitute the main bulk of their diet until harvest time.

The success of each hatchery operation rests on forming an environmental or ecological balance in the hatchery tank. Inadequate food would lead to starvation that could exact heavy mortality on the population of the larvae. On the other hand, too much food would result to accumulation of sediments on the bottom of the tank and cause water pollution. To anticipate such problems, draining and addition of fresh seawater is carried on daily usually starting during late zoea or early mysis stage until harvest time. Periodic checks on the chemistry of the water are done to determine if critical factors related to water pollution are present. Phytoplankton and zooplankton counts are analyzed daily to give an appraisal on the status of food in the tank. Larval population is estimated daily to get the percentage survival trend at the same time give an index of estimating the food to be introduced into the hatchery tank. All these factors intricately interwoven in the hatchery tank are considered in order to have a good hatchery management.

D.1 Culture and Preparation of Food Organisms

1. Mixed diatoms - fresh seawater containing small quantity of diatoms is pumped into diatom culture tanks. They are fertilized daily with 2.0 ppm $NaNO_3$ (or KNO_3), 0.2 ppm $FeCl_3$, 0.2 ppm K_2HPO_4, 1.0 ppm

Na_2SiO_3 and 1.0 ppm Clewat until they attain blooming peaks usually from three to four days (without starter diatoms).

2. Brachionus culture - starter brachionus could be obtained from fishponds or by fermenting crushed crabs in suitable containers. The starter brachionus can now be allowed to propagate in big tanks by feeding them with chlorella or bread yeast (10 gm/ton/day) or both. Suitable aeration should be installed in the culture tanks.

3. Chlorella culture - starter chlorella stock could be obtained from mud pools. The water appears greenish if they are abundant in the water. This starter chlorella is subjected to gradual acclimatization until the stock becomes adjusted to pure seawater. This stock culture can then be mass-propagated in big tanks by fertilizing them with inorganic fertilizer. Fertilizers used are $Ca.(PO_4)_2$ (100.0ppm), Urea (2.0 ppm), $FeCl_3$ (0.2 ppm), K_2HPO_4 (0.2) and Clewat (1.0 ppm). Fertilization hastens the growth and reproduction of these unicellular plants making the water intensely green when they reach blooming peaks. When blooming peeks are reached they are harvested

and fed to the brachionus culture.

4. Brine Shrimp Culture - This requires a culture separator tank and utilizes the positive phototactic behavior of the brine shrimp nauplii. The culture-separator tank has a partition with holes about 2 inches from the bottom floor and plugged with rubber stoppers. The culture and separator compartments are filled with seawater and freshwater in a 2 to 1 proportion. Brine shrimp eggs are placed inside the culture compartment and aerated vigorously. The eggs hatched into nauplii in about 24 to 36 hours.

The aeration is shut off to allow the water to become still. Under this condition, the unhatched eggs and shells settle to the bottom and those non-viable and hitherto light eggs float and concentrate on the water surface. The culture compartment is then covered with black cloth to create a dark condition inside. Then the rubber stoppers are unplugged from the partition to allow the nauplii to swim to the other side by light attraction leaving the shells and unhatched eggs behind. When the nauplii are already separated from the eggs the partition is resealed again and the nauplii harvested and concentrated. They are fed to the mysis and early post larvae in the hatchery tanks.

5. Bread yeast - The required dosage 2 gm/ton/feeding three times daily is weighed and fermented in fresh water for about 12 hours. This is then divided into three parts and feed to the larvae at a specific time interval.

6. Minced clam - The clam meat is thoroughly cleaned with fresh seawater to remove the slimy juices. It is fed to a blender to mascerate the tissues. This mascerated or minced clam meat is washed again several times until all the remaining juices are removed. Then it is stocked in the freezer.

In feeding the post larvae a weighed portion of the minced clam is reblended until the desired size of particles is attained. The time for reblending depends on the size and stage of the post larvae.

FRY HARVEST AND PRE-TRANSPORT TREATMENT

by

M. I. Tumanda, Jr.

INTRODUCTION

Fry intended for stocking in ponds situated far from the hatchery undergo pre-transport treatment. This involves acclimatization of the fry to lower temperature ranges before they are packed for transport. Lowering the temperature slows down metabolic activity inside the containers thereby cutting down oxygen consumption. Moreover, the release of carbon dioxide as by-product of respiration is also minimized, thus reducing the possible fatal effects of CO_2 poisoning.

FRY HARVEST

The fry are harvested from the hatchery and concentrated in small wooden tanks. Harvesting is done by draining the tanks with the use of siphon until the depth of the water is about one-half meter or less. The siphon is fitted with a screen box in order to prevent the fry from being sucked during the siphoning process. Lowering the level of the water also reduces the pressure of the water coming out from the tank as soon as the valve of the drain pipe is opened. Thus, mechanical stress that would possibly be inflicted on the fry during the draining process would be minimized.

Two methods are being used in collecting the fry from the drain pipe of the hatchery tank. One method employs a cylindrical plankton net, one end being fitted to the drain pipe and the other free end held by one worker. The drain pipe is opened trapping the fry inside the plankton net. Then at a proper time the worker holding the free end of the net loosens it to flush the trapped fry into a bucket held by an assistant. Another method employs an inverted rectangular net with an opening fitted with an elbow which is oriented upwards to prevent the water carrying the fry from rushing directly to one side of the net. The fry collect inside the net when the drain pipe is opened. They are then transferred to small wooden tanks by buckets or scoop nets.

The temperature of the water in the wooden tanks where the fry are concentrated is lowered 5°C below the temperature of the hatchery tank. The fry stay at this temperature for 30 minutes to one hour. This temperature is further lowered to 18°C or 20°C before the fry are packed in plastic bags measuring about 50 cm x 96 cm. Under this temperature condition the fry are in a state of stupor and therefore exhibit less movements.

Fry density is estimated by using a population sample of head-counted individuals-placed in a basin with a predetermined volume of water. This becomes a standard or basis for determining the fry density of subsequent batches. The basin containing the standard is placed side by side with another identical basin where the succeeding batches of fry are to be estimated. The fry from the wooden tanks are transferred to this basin until the fry density would equal or approximate the density of the standard. The estimated fry are then packed and the process is repeated all over. By experience, 40,000 P_{15}-P_{20} can be packed in one plastic bag containing 16 liters of chilled seater, notwithstanding the density, this still results in high survival rate.

The plastic bags containing the fry are charged with oxygen before they are sealed. This will supply the oxygen needs of the fry while in transit. These bags are placed inside styrofoam boxes with crushed pieces of ice added to maintain the temperature inside the bags during transport. Proper arrangement should be made inside the styrofoam boxes such that the contact of the crushed pieces of ice with the water is avoided, as this may drastically lower the temperature of the water beyond the fry's limit of tolerance. The fry cannot tolerate temperature ranges below 15°C.

The fry can be transported by land, by sea or by air depending on the practicality of the mode of transport. However, it should be borne in mind that the fry inside the plastic bags are in a condition which may be considered critical and therefore should reach their destination the shortest possible time. Fry transport experiments to SEAFDEC Iloilo involving 8 to 9 hours of travel have given excellent results ($\sim$100% survival in most cases). On the other hand, fry transport to Legaspi, Albay, involving 37 hours of travel gave a 12.5% survival.* These two examples illustrate the point that time is a vital element in the transport.

Upon reaching their destination, the fry, are again acclimatized to the temperature and salinity of the nursery or rearing ponds before they are altogether released.

*Travel was delayed due to some unavoidable circumstances.

ACCLIMATIZATION AND STOCKING OF FRY

by

Henry E. Dejarme

Acclimatization is the process by which one animal becomes adapted to an unfamiliar set of environmental conditions. It implies adaptation to all aspects of a new physical environment. The adaptation may be structural, behavioral or physiological. In the acclimatization of sugpo fry for stocking, the adaptation we are concerned with is physiological. Such adaptation entails actual changes in the body brought about by the environmental influences. It connotes a decrease in physiological strain as the sugpo continues to be exposed to the new conditions.

During the period of adaptation the fry may experience physical discomfort, an indifferent appetite and lack of energy. The sugpo fry in poor conditions may find their lot worsened by the strain. So it is well advised to make the shift between two widely differing environments in gradual stages.

Temperature and salinity are the two elements of greatest significance in acclimatization. Temperature is important in the environment because of its direct action upon the physiological processes of the sugpo, especially upon the rate of metabolism. Among the marine animals, it is generally observed that the rate of metabolism is much accelerated with rise in temperature(within favorable limit).

Salinity is an environmental fact or that affects the regulation of body fluid. The maintenance of the proper and stable internal fluid environment is relatively simple for marine animals as long as they remain in the sea, but it is quite a different matter when they move into hypoosmotic media such as the brackish water or estuaries.

Many marine animals are incapable of moving into such habitat. Since their body fluids always lose salts until they have about the same salinity and osmotic concentration as the external fluids, and since their cells generally can not tolerate much change in the make up of the fluid bathing them, these animals soon die when they are put into brackish water. For every native animals like sugpo, regulation of body fluid from marine to estuarine environment may not be as dangerous as for purely marine animals especially when the salinity difference between the two environments is not so wide. Although said animal is capable of withstanding remarkable range of salinity, it certainly functions best under circumstances where there is a reasonable degree of comfort and freedom from strain in vital organs.

The fry that will arrive the fishpond operators from the hatchery have already been subjected to temperature acclimatization. I am referring to the pre-transport treatment of fry which was discussed by our hatchery in-charge. So upon arrival of the fry to fishponds, the first step of acclimatization is to equalize the water temperature of the fry container and that of the pond water where they will shortly be stocked. This is easily done by allowing the container to float or partially immersed in the ponds without untying the knct that sealed its opening. When, after some time, the temperature of the plastic bag container has roughly equalize to the temperature in the pond, the acclimatization of salinity be started. This is effected by introducing pond water into the fry container in small quantity and allowing the pond water to mix with the H_2O in the container. When the container is full some of the H_2O is removed and pond water is gain introduced in the same manner. It may be necessary to repeat this process for some time (depending on the salinity differences) until after the salinities are approximately the same. The container is then tilted to let the fry escape into the pond.

In stocking the fry, one should see to it that they will be as evenly distributed as possible over the pond because the newly-stocked fry do not wander immediately in search for food. They remain where they are liberated for same time.

The acclimatization and stocking of sugpo fry may be done in nursery ponds or into the rearing ponds. We refer to the former as indirect stocking and the latter the direct method of stocking. At present there's not enough information as to what the best method is. That we hopefully would know after this program is completely implemented.

There are several stocking rates observed by fishpond operators in shrimp farming and each of them merely indicate one standard because the stocking rate in nursery ponds and in rearing ponds largely depends upon availability of food and the production capacity of the ponds. According to Caces-Borja and Rasalan, the stocking rate in the nursery pond is 300,000 to 500,000 fry to a hectare in mono culture. A rearing pond with a good growth of "lab-lab" and provided with supplementary feed of animal protein can be stocked with 2 sugpo juvenile per square meter or 20,000/ha although the ordinary practice of fishpond owners is to stock the rearing pond with 1 sugpo/m^2 or 10,000/ha.

In the case of P. *japonicus* in Japan, Shigeno was reported successful in stocking 20-25 juveniles/m^2 of H_2O. A very remarkable rearing success was done by Fujinaga in which he stocked 150/m^2 of young shrimp. All these experiments were done under laboratory conditions.

In Naawan laboratory the first experiment on cultivation was stocked with 15-20 fry/m^2 or 150,000 - 200,000 fry/ha. At present we have three ponds each with a different stocking rate, namely: 1 sugpo/m^2, 2 sugpo/m^2 and 3 sugpo/m^2.

With the implementation of this cooperators' program we hope that we can gather enough data and information that thereafter will provide the necessary support in formulating and recommending the best suitable stocking rate for a particular kind of fishpond.

ENVIRONMENTAL REQUIREMENTS OF SUGPO: PHYSICAL AND CHEMICAL FACTORS

by

Warnita Destajo

INTRODUCTION

There are two important factors in the culture environment of either prawns or fishes that strongly determine the survival and growth of the stocks: (1) Biological, and (2) Physico-chemical factors. We are going to expound on the latter. Knowledge of the physical and chemical factors, such as temperature, turbidity, dissolved oxygen, carbon dioxide, pH, total alkalinity, and salinity, especially the effects of these factors to the productivity of the pond is vital in commercial fish farming.

PHYSICAL AND CHEMICAL FACTORS

A. Physical Factors

1. Temperature

Temperature influences environmental factors such as dissolved oxygen and salinity of the water. At low temperature more oxygen is dissolved in water and at high temperature the salinity of the water increases due to evaporation.

Temperature acts directly upon the physiological processes of animals, particularly on rate of metabolism.

Animals take in oxygen and give off carbon dioxide. With rising temperature, the rate of oxygen consumption increases. Temperature also affects food consumption in fishes. Daily food consumption in carp is for instance, greater at 23-27°C, which is the preferred temperature than at 16-18°C and at 29-30°C.

Temperature has also an effect on the spawning of fish and crustaceans. Carp in natural waters, spawns at 17°C. In case of the gravid sugpo in the hatchery tanks, usually spawns at night time with a temperature ranging from 26 to 27°C.

Regarding their survival, Carp acclimatized at 20°C has been observed to have 50% mortality and 100% mortality at 37 to 39°C. For sugpo, they normally survive at temperature between 20 to 35°C. In a certain experiment, Sugpo (P_{10}) died at temperature below 15°C and above 40°C.

2. Turbidity

Turbidity is due to rains, floods, or the action of finely divided organic matter in the water or on account of the nature of the pond soil itself. It may be permanent or temporary. It affects light penetration, hence disturbing the process of photosynthesis and is therefore unfavorable in relation to the supply of oxygen and food of the cultured animals.

3. Depth

The depth of water also affects light penetration in the bottom layers of the pond. Water in the pond must not be very deep nor very shallow. Too shallow pond gets warm rapidly and adversely affects the physiological state of the cultured stock. Very deep water, on the other hand, lessens the photosynthetic activity and therefore lowers the productivity of the pond. Turbidity, likewise, has a negative effect on the photosynthetic activity in the pond.

B. Chemical Factors

1. Dissolved Oxygen

Dissolved oxygen, D.O., is of primary importance in its role in respiration and decomposition within the ponds. It comes from two sources: a) from the atmosphere, as a result of its interaction with the water, and b) from photosynthesis of phytoplankton and other submerged plants.

Stratification of water in ponds is common, especially during hot weather when there is little or no wind. When water does not circulate through the pond the deeper layers develop a shortage of oxygen. In fertile water containing blooms of phytoplankton, especially at night the zone of well-oxygenated water becomes relatively thin in the upper layer or to the water surface. At night the supply of oxygen may be reduced to such low that fish or prawn have too little oxygen for respiration.

Fish culturist can often save their fish by supplying aeration to the ponds. This aeration drives air into the pond and helps circulate the water. If aerations are not available, outboard motors or various manual methods may be used to stir the water and cause circulation in ponds.

Aeration in the hatchery tanks drives additional oxygen to the water and oxygen checks the activity of the anaerobic bacteria, thus preventing the production of H_2S which is a poisonous gas.

Based on our experiments, the lethal concentration of D.O. for Sugpo are as follows:

Zoea stage	---------0.54 ppm	for 25 hours
Postlarvae	---------0.81 ppm	for 5 hours
Juvenile	-----------0.64 ppm	for 2 hours
Adult	--------------0.76 ppm	for 5 hours

The experiments started with a uniform D.O. of 5.00 ppm.

2. Free-Carbon Dioxide

Carbon dioxide, CO_2, is present in air at 3 parts per 10,000. Pure water at 1 atmosphere air pressure at 25°C contains only 0.40 ppm CO_2 when in equilibrium with CO_2 in air. In deep waters, much higher CO_2 concentrations are built up due to their release by respiration and decomposition.

Concentration of CO_2 in excess of 15 ppm is detrimental to pond fishes. Those fish able to gulp air at the surface can survive 100 ppm, whereas of those unable to gulp air find difficulty in breathing at 30 ppm and may die at slightly higher concentrations.

CO_2 plays in the photosynthetic reaction. Planktons need this chemical compound for their manufacture of food:

$$CO_2 + H_2O \xrightarrow{\text{Light}} C_6H_{12}O_6 + O_2$$

Since water acidity can be attributed to the presence of CO_2, this compound influences the pH and alkalinity of the water. It tends to lower the pH and increases the bicarbonate alkalinity of the water.

3. Total Alkalinity

Total alkalinity has been taken as a good measure of productivity of waters by several authors. Higher alkalinity values gives higher productivity of ponds.

PPM $CaCO_3$	Significance
10 - 50	1. water not productive 2. CO_2 supply is poor 3. dangerous to fish
50 - 200	1. productivity medium 2. CO_2 supply medium
500	1. productivity alleges to decline 2. rarely found

Alkalinity is largely calcium and magnesium salts and more or less equivalent to hardness. However, it is not the hardness nor alkalinity alone alone that is responsible for high natural fertility, but the fact that high calcium content of soils is usually correlated with a high content of phosphates, nitrogen and other plant nutrients.

The cyclic carbon principally useful in photosynthesis is that present as free-CO_2 and half of it is present as bicarbonate, HCO_3. Where plankton is abundant in the zones of active photosynthesis often all free CO_2 has been used up plus most of all of that released from the bicarbonates as the CO_2 tension decreases;

$$Ca\,(HCO_3)_2 \longrightarrow CaCO_3 + H_2O + CO_2$$

so that the pH rises to 9.5 or 10.0

Total alkalinity is inversely proportional to pH. If the total alkalinity is high the pH is low.

4. Hydrogen Ion Concentration, pH

The measure of the acidity or alkalinity of a solution is expressed in pH. Pure water has pH value of 7, which is neutral.

$$1 \xleftarrow{\text{Acidic}} 7 \xrightarrow{\text{Basic}} 14$$

A solution with pH 5 is 10 times acidic as one with pH 6. One with pH 4 is 100 times as acidic as one with pH 6. pH values ranging from 7-9 is a characteristic of good water suitable to fish life. While pH less than 6.0 and more than 10.0 is found unsuitable.

5. Salinity

The content of dissolved salts in sea water is usually expressed as salinity. Prawns can live within a wide range of salinity. They can survive at salinity range from 10-40 o/oo

Abrupt changes in salinity is harmful to prawn.

CORRELATION OF CHEMICAL FACTORS

From our experimental ponds, data are correlated as:

	H_2O temp.	D.O.	pH	To. Alk.	Salinity	CO_2
6 AM	low	low	low	high	low	high
3 PM	high	high	high	low	high	low

In the hatchery tanks, since the water is not directly exposed to the sun, and also supplied with aeration, the fluctuation of chemical factors is not much as compared to that in the experimental ponds.

Ranges of Chemical Factors

PONDS:

	(^{o}C)	(ppm)		ppm$CaCO_3$	o/oo	ppm
	H_2O temp	D.O.	pH	Alk.	Salinity	CO_2
6 AM	24-28	2-6	7-8	100-190	23-30	0-10
3 PM	30-36	6-12	8-8.5	90-170	30-35	negligible

HATCHERY TANKS:

9 AM	26-29	4-8	7-8.5	100-150	28-33	negligible

NUTRITIONAL REQUIREMENTS OF SUGPO IN HATCHERY AND IN PONDS

by

Helen Jambcy Vicente

INTRODUCTION

The increasing world demand for protein ushers a widespread and intensive search for new sources. Recently, the aquaculture ventures of many countries, particularly in shrimp and prawn[1/] culture, are given serious consideration. In the Philippines the promise of the new industry as a new source of food protein supply and additional income to its teeming population, has stimulated in-depth research on the culture and cultivation of its native species, sugpo, spearheaded by two research institutions- the MSU Institute of Fisheries Research and Development and the Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC).

NUTRITION OF SUGPO UNDER NATURAL CONDITIONS

The gut of sugpo is composed of a mouth with a short esophagus which leads into a large capacious cardiac and pyloric stomach which is equipped with a gastric mill and hepatopancreas (Fig. 1). The esophagus, cardiac stomach and the interior half of the pyloric stomach with the gastric mill

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[1/] See differences between shrimp and prawn in Table 1 or median teeth are parts of the foregut. The midgut is limited to the posterior half of the pyloric stomach. The hindgut refers to a long intestine extending from the pyloric stomach through the abdomen and opens to the exterior on the ventral side of the telson.

Little is known concerning the actual nutrition of sugpo. Under natural conditions they feed on the bottom epiflora (plants) and epifauna (animals) of the mud substrata and as such, they are described as "omnivorous scavengus" or "detritus feeders". Findings on gut analyses show the presence of indigestible remains (chitin fragments, annelid jaws and setae, etc.), organic detritus, algal material, small organism contained in the mud, and sand.

During digestion, digestive juices are produced almost entirely by cells of the hepatopancreas. Since sugpo does not chew their food effectively with the mouthparts, food chewing or grinding is the function of the gastric mill. Intensity of food ingestion is correlated with the degree of fullness of the gastric mill. Based on observations, within several minutes after a starved sugpo is given abundant blended food, the anterior chamber of the proventriculus fills to capacity. Ingestion ceases until some food has passed through the gastric mill. Defecation may begin in an hour after feeding and reaches a peak in 4 to 6 hours.

CRITERIA OF GOOD NATURAL AND SUPPLEMENTARY FOOD IN COMMERCIAL SUGPO PRODUCTION AND CULTIVATION

There are certain criteria to be observed in the selection of food to be given to sugpo at different larval stages and to adult. The following are:

A. Quality

A.1 Good Nutritional Value

In considering sugpo nutrition one must recognize the various developmental stages (nauplius, zoea, mysis, post larvae, juvenile and adult) because each stage requires certain environmental conditions related to the physiological condition of the animal as well as to its feeding characteristics.

Sound nutrition determines growth, maturation, and reproduction. Nutritional requirements for growth and metabolism consist of different classes of nutrients. These nutrients are the food elements which are the end products of digestion such as:

(1.1) AA (amino acid): The building block of Protein.

Protein is a body builder. Sugpo is made up of protoplasm which in turn is composed of nitrogenous compounds. Protein is the only food element containing nitrogen and is therefore essential to sugpo diet. Protein is composed of AA (amino acid) which is necessary in almost every metabolic processes (growth, replacement and repair of tissue cells). It is in the form of amino acids that protein is absorbed through the intestinal wall and into the blood.

In the formulation of feeds it has been found that the amount of required crude protein ranges from 40-60% for fishes. In the search of shrimp crude protein requirement, researches in Japan revealed that the value was generally proportional to the protein content ranging from 60 to 75%. With this finding, it is known that shrimps require higher amount of protein. In this connection, in the evaluation of nutritive value of a given shrimp feed, it should be made as a standard to find out whether or not the amino acid components in the feed approximate the requirements of the shrimp (Table 2). In the selection then of materials for the formulation of feeds, their amino acids content is the primary consideration. Table 3 shows amino acid analysis on common shrimp feeds. From this data, it is highly significant to find that amino acids composition held by the feeds of higher efficiencies is approximated to that found in the shrimp. The best among the tested feeds are short-necked clam and squid meal. These contain amino acids that are very close to that of the shrimp.

Next in rank is vegetable soy-bean protein of whose amino acids approximate that of the shrimp than the crustacean brine shrimp. Whale meal, on the other hand, is rich in the amount of amino acids but the composition is different from that of the shrimp. The same is true with fish meal which is short in the content of basic amino acids essential for shrimp growth like phenylalanine, lysine, histidine and arginine. Lack of these elements is found to lower the food efficiencies of fish meal, as evidenced in the feeding experiment done by Shigeno in Japan. Other identified amino acids necessary for shrimp growth are threonine, valine, methionine, isoleucine, leucine and triptophane.

(1.2) Simple Sugars

It is in this form where carbohydrates (CHO) is being absorbed in the blood. Carbohydrates are utilized by the tissue cells for energy or carried to the muscles where they are stored for future use. Table 3 shows certain percentage of CHO in some feeds used for shrimps.

(1.3) Fats

These are the richest source of energy. Weight for Weight basis, they yield more than twice as many energy units of either CHO or protein. Fats are utilized by the body in metabolism their original form or as fatty acids of which all fats are composed. Stored fats serve as a reserve supply of energy and to a certain extent as insulation in the body. Table 3 also shows fats content on tested shrimp feeds.

(1.4) Vitamins

Vitamins are chemical substances manufactured in plants and found deposited in animal tissues. They are essential to life and good health. In extremely small amounts they govern and regulate many important functions of the body such as metabolism. Example of vitamins used with sugpo feeds are thiamine, riboflavin, nicotinic acid, biotin, folic acid, choline chloride, menadione, ascorbic acid and cyanobalamin. Table 4 gives the composition of vitamin mixture in mg % in shrimp diet.

(1.5) Minerals

These are chemical substances for building and repairing tissue cells and regulating body processes. Important minerals are Ca, O, Fe, I, Na, K. Mn, Cl, - Mg Common mineral salts used with shrimp feeds are K_2HPO_4 (10%) $Ca_2\ (PO_4)_4$ (15%) and Ca-lactate (75%).

To further evaluate good nutrition for sugpo is to use growth factor as an index. Growth is a process which involves increase in the number and size of cells composing the organism.

Growth as effected by food can be measured by calculating gross feed conversion efficiency (Eg) by the formula adapted from Brett, et a. (FAO publication 1970):

$$Eg = \frac{G}{I} \times 100\%$$

where:

G = growth

I = food intake

ex: $\frac{\text{2 kg (growth of shrimp in terms of weight)}}{\text{4 kg (food given in terms of weight)}} \times 100\% = 50\%$

Then:

food conversion ratio = 2.4

food conversion effieiency = 50%

Another way of solving growth is by adapting the Shigeno formula as presented below:

$$\text{daily growth rate \%} = a = \left(\sqrt[t]{\frac{W}{W_o}} - 1\right) \times 100$$

$$\text{rate of daily feed intake \%} = b$$

$$b = \frac{F \times 100}{\frac{n_o + n}{2} W_o \left(1 + (1 + a) + (1 + a)^2 + \ldots + (1+a)^t\right)}$$

$$\text{feed efficiency \%} = e = \frac{(W + D) - W_o}{F} \times 100$$

Where:

W_o = initial body weight (average) in grams

W = final average body weight in grams

n_o = initial number at the start

n = final number at harvest

t = duration of rearing experiment in days

F = total amount of feed-intake in grams

D = total body weight of dead shrimp in grams

The first conversion efficiency formula is simple than the second. Whichever is applied provides an extremely useful measure of the growth phenomenon for it indicates both the circumstances under which the animal is most efficient and the criterion for most economical use of the feed.

A.2 Food preference and utilization efficiency.

Limited knowledge exists on both food preference and utilization effiency. Certain species characteristically show changes in food preferences and feeding habits. Food preferences and utilization efficiency are due to the impact of different feeds or individual nutrient components on the flavour or organoleptic quality of shrimp. Organoleptic quality of shrimp has something to do with the attrativeness, odor, and taste of the food given. Texture, size and shape would be other factors to consider which has effects on the ingestion and digestion or morphological structure offeeding adaptation of sugpo.

B. Comparative Low Cost Feeds

In sugpo farming cheaper cost of production would depend on pond productivity andpond carrying capacity. Pond productivity is a result of the interplay of many factors, such as the depth of the water in the pond, the quality of the water, the quantity of fresh water allowed into it, the temperature of the water and its surrounding, the composition of the fish population and the type of pond soil.

The degree of productivity varies even in between two adjacent ponds. This is a result of the ability to produce more natural feed as "lab-lab" which houses plankton and bottom animals. The rate of increase of these small unicellular plants is markedly controlled by the intensity of the prevailing light and to a lesser extent by the ambient temperature. To produce and maintain a large population, adequate nutrients in the form of inorganic nitrogen and phosphorous compounds, minor nutrients and dissolved CO_2 must be made available. And this is being done by fertilization.

Pond productivity does not apply to the production of weeds in ponds. A weed is a plant that grows in a location where it is not wanted. Aquatic weeds in ponds divert the flow of the basic nutrients (N-P-K), CO_2, and solar energy from the desired form of plant life to an undesirable one.

The ideal food chain in growing sugpo is:

Basic substances ------→phytoplankton/bacteria --→zooplankton--→ sugpo
(fertilizer)

In ponds where supplemental feeding is being done, weeds interfere with feeding of the sugpo. Further, where large amounts of weeds are present during periods of cloudy weather, the needs of D.O. may exceed the photosynthesis input, causing sugpo losses from reduced O_2 in ponds. Example of these weeds are filamentous algae (lumut), hydrodictyon, pithophora, and potamogeton.

Pond carrying capacity is a term used to denote maximal attainable yield for a given season, taking into consideration of optimal increase in daily growth. It was found out that higher temperature reduce carrying capacity because of a greater demand for O_2 by the cultured species and by microoorganisms (algal growths, protozoa, and bacteria) that commonly accompany it. The criterion which limits the carrying capacity in this case is the reduction of oxygen level to 6 ppm. The O_2 supply must be sufficient to maintain normal growth (7-9 ppm).

Weeds can reduce the capacity of a given pond by inhibiting later development of phytoplankton to support the desired fish population throughout the growing season.

Control of the growth of weeds may be done by employing manual labor, introducing herbivorous fish and using of copper sulfate or lime.

C. Readily Available Feeds

For sugpo food to be categorized as readily available it must be obtained locally at any given time if the needs for it arises. And since shrimps have a high metabolic rate when active or when its food reserve is low, the food supply is extremely important to the growth of the animal.

FOODS UTILIZED IN EXTENSIVE AND INTENSIVE CULTURES OF SUGPO AND NUTRITIONAL PROBLEMS

A. Food Used in Production and Cultivation of Sugpo

Extensive culture involves the use of natural bodies of water with minimal control of the environment, competition and predation. Sugpo fry come from natural sources and feed on natural food in the water which may be added with minimal artificial food. It is a low-density culture method which usually involves low capital investment, and thus, profits can be low and variable. Intensive culture on the other hand, is expensive as it may necessitate the construction of hatcheries, raceways and ponds. Culture is high density and thus requires full control over hatchery supply of sugpo fry. Artificial food is used, supplemented by naturally-developed food.

In intensive sugpo fry production types of food given in Table 5 prove to be good in attaining higher survival rates.

TABLE 5: FOOD USED IN SUGPO FRY PRODUCTION

FOOD	Stages		
	Zoea	Mysis	Postlarvae
Diatoms	+	+	+
Single Cell	+	+	+
Protein(Bread yeast, fodder yeast, bacteria flock)	+	+	+
Juice (Eelgrass, filamentous algae sargassum)	+	+	
Cake (soya bean, mongo bean	+		
Brachionus/chlorella		+	+
Artemia nauplii		+	+
Minced clam		+	+
Shrimp meal			+
Formula feed (pelleted squid meal plus other ingredients)			+

Sugpo cultivation feeds could be enumerated as follows:

1. lab-lab (diatoms + blue greens + zooplankton)
2. "lumut" (filentous algae + diatoms + zooplankton)
3. skin of cow or carabao
4. bia (bagtis)
5. minced fish (tilapia)
6. clam meat (amahong)
7. Shrimp
8. concentrated algal frozen foods
9. dried shrimp heads and waste left after processing and mixed with rice bran

The ability of sugpo postlarvae to accept non-living food makes it better suited for intensive cultivation. However, with increase in size of the maturing animal, the size of the food particles should be proportionally increased. Percentage survival of P. monodon post-larvae on various foods is given in Table 6. While minced clam has been used as the main bulk of sugpo food, researches to be undertaken are geared to the development of "artificial" or synthetic diets. Feeding dosage of the supplementary food is still to be determined, so that the effects of decomposition of un-utilized food in the growing ponds will cease to be a serious problem.

Table 6. Survival Rate % of Advance Stage of P. Monodon Post Larvae Fed with Various foods (MSU-IFRD), 1973-1974)

Food	P_4--------P_{15}	P_7---P_{26}	P_{10}-----P_{33}
Benthic (Bottom) Diatoms	√	√	√
Planktonic (floating) Diatoms	√	√	√
Copepod	√		
Brachionus	√		√
Artemia	√	√	√
Minced Clam	√	√	√
Bread Yeast	√	√	√
Dinoflagellate	√	√	√
Protozoans	√	√	√
Count at Nauplius Stage	288,000 1,072,138	332,640	423,360
Count at harvest	195,000 530,000	60,000	60,000
Persentage Survival at harvest	67.71 46.64	18.04	14.17

B. Problems in Shrimp Nutrition

The following are of important consideration in the nutrition of shrimp:

1. Determination of an Optimal Feeding Environment. To determine the environmental factors that enhance feeding efficiency , it is necessary to experiment on temperature and salinity requirements, effects of aeration; effective removal of waters/sedimentation, as well as the effects of possible contaminants in the water.

2. The inherent variability in the animal. Differences in growth rates among individual shrimp seem to be greater than those observed in some other animals. This inherent variability makes interpretation of data more difficult especially in the comparison of groups of 10-20 individuals. A mean from this population growth will be markedly affected by the presence of one rapid or one slow growing shrimp. Although attempts have been to made to choose animals of a uniform age and size with a known feeding history, variability is still an important factor to be considered by investigators.

3. The selection of the form of food in its ingredients. Food for shrimp should retain its form and consistency for a number of hours in water. It must also be attractive and available to the stage to which it is presented. The food form whether a flake in the water column or a pellet on the

bottom, should be determined based on the behaviours of a given stage. For example, the tendency of sugpo $P_1 - P_5$ to spend much of their time in the water column may account the success of live brachionus sp., copepod or brine shrimp nauplii as food. These food organisms are frequently encountered and thus ingested, since they swim actively in the water column.

4. The presentation of the data in a form useful to other investigations and to the commercial mariculturist. Because our data must eventually be of use to the commercial aquaculturist, the use of simple, direct presentation of data is more desirable. For example, growth presented as percent increase either in mean weight or biomass is complicated when comparison between groups of animals of different initial weight is taken for percent increase is inversely related to initial weight. To have simplier data presentation on growth, growth should be taken as a function of time. Thus graphing of the data may be understood better with mean weight on the Y-axis and elapsed time on the x-axis.

CONSIDERATION IN DEVELOPMENT OF "ARTIFICIAL OR SYNTHETIC DIET RATION FOR SUGPO

The food supply for the larval and postlarval stages of sugpo is a challenging problem. In this regard, the encapsulation and pelleted food ration may offer the great possibility of the development of a completely chemically-defined food.

The techniques of micro-encapsulation and pelleting consists of enclosing substrates (single or mixed materials, i.e. squid meat and vitamins and mineral salts) within a develpped binder or wall (starch, gulaman or agar-agar), Selection and combination of a typical binder can control flexibility or permeability of the wall to effect controlled release of the nucleus. This slow leaching of nutrients will attract shrimp and stimulate their feeding response . Density of the capsule or pellet should also be noted. This has something to do with the neutral bouyancy of the fed in sea water or its rapid sinking to the bottom. If these processing techniques will be fully developed it might be the excellent vehicles for the introduction of hormones and other chemical regulatory substances that will influence the behavior and growth of sugpo larvae, post larvae and adults.

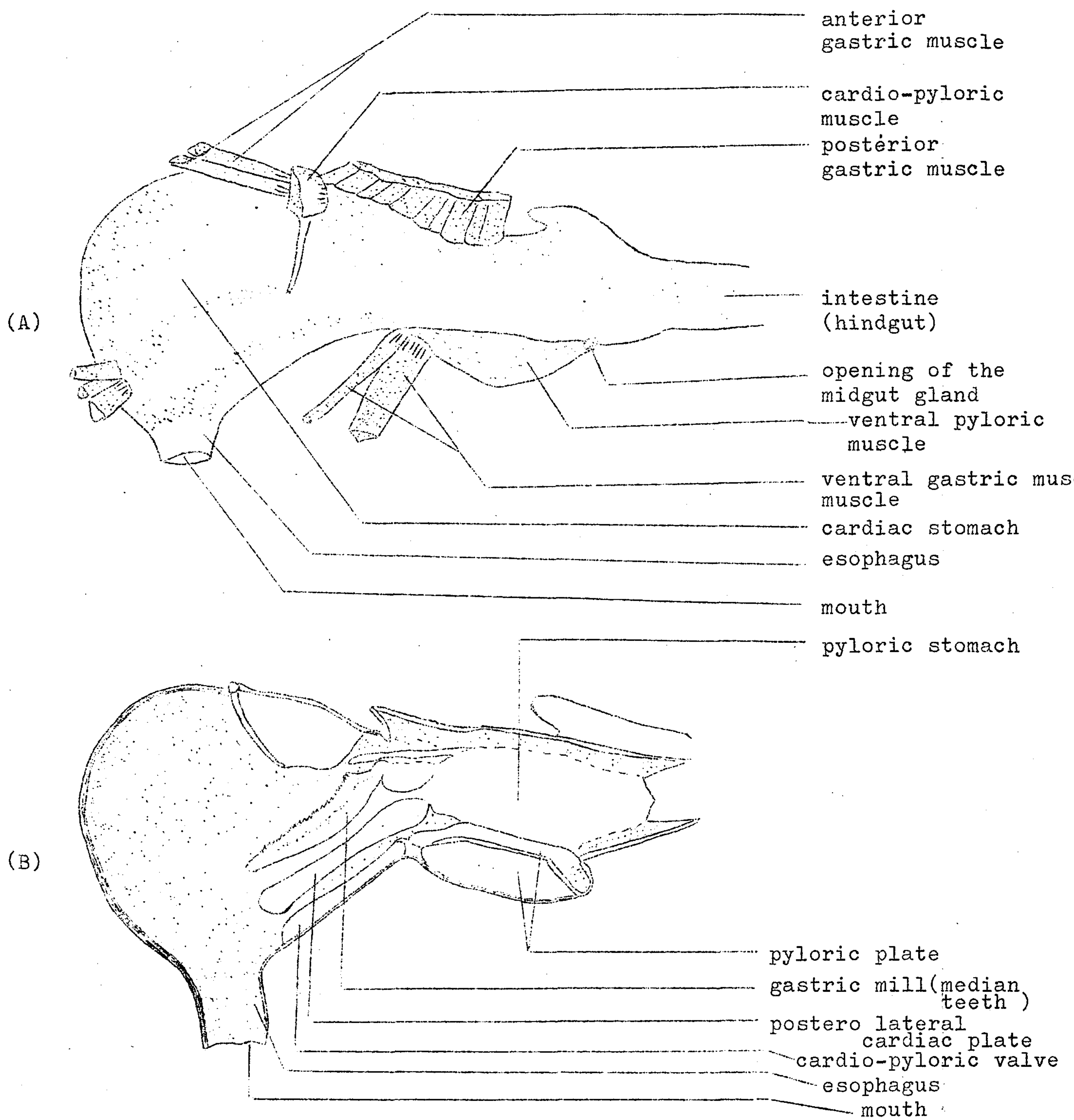


FIGURE 1. Stomach of Penaeus monodon (Fabricius). (A) Lateral View, (B) Sagital section.

Table I

Differences between shrimp and prawn

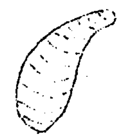
FACTORS	SHRIMP	PRAWN
1. Family	Penaeidae	Palaemonidae
2. Gills	Dendrobranchiate 	phyllobranchiate 
3. Characteristics abdominal pleura of 2nd segment	do not overlap with first abdominal pleura	overlaps with first abdominal pleura
4. Example	Penaeus monodon	Macrobrachium rosenbergii

Table 2. Amino-acid Analysis of Whole - Body of 4 Penaeid Shrimps (Dry Matter), Jan., 1973

(Shigeno)

Species and Locality	*P. merguiensis* (Thailand) AA %	*P. merguiensis* (Thailand) Composition %	*P. monodon* (Thailand) AA %	*P. monodon* (Thailand) Composition %	*M. monoceros* (Thailand) AA %	*M. monoceros* (Thailand) Composition %	*P. japonicus* (Japan, Fished) AA %	*P. japonicus* (Japan, Fished) Composition %	*P. japonicus* (Japan, Cultured) AA %	*P. japonicus* (Japan, Cultured) Composition %
Aspartic acid	5.99	11.80	5.47	10.62	5.74	15.25	5.38	11.38	5.03	12.18
Threonine	2.13	4.20	2.09	4.06	1.48	3.93	2.23	4.72	1.81	4.38
Serine	2.18	4.29	2.08	4.04	1.44	3.83	1.87	3.96	1.71	4.14
Glutamic acid	8.39	16.53	8.53	16.56	6.08	16.16	7.71	16.31	6.76	16.37
Proline	1.84	3.62	2.25	4.37	1.28	3.40	1.62	3.43	1.70	4.12
Glycine	2.47	4.87	2.79	5.42	1.73	4.60	2.35	4.97	2.27	5.50
Alanine	2.97	5.85	2.88	5.59	2.09	5.55	2.64	5.58	2.29	5.55
Cystine	0.43	0.85	0.52	1.01	Tr.		0.54	1.14		
Valine	2.79	5.50	2.84	5.51	1.93	5.13	2.84	6.01	2.04	4.94
Methionine	1.37	2.74	1.32	2.56	1.04	2.76	1.28	2.71	0.92	2.23
Isoleucine	2.29	4.51	2.57	4.99	1.86	4.94	2.27	4.80	2.13	5.16
Leucine	3.88	7.64	3.83	7.43	2.86	7.60	3.97	8.40	3.35	8.11
Tyrosine	1.84	3.62	1.97	3.82	1.42	3.77	1.79	3.79	1.57	3.80
Phenylalanine	2.27	4.47	2.41	4.68	1.67	4.44	2.12	4.48	2.05	4.97
Lysine	4.18	8.23	4.00	7.76	2.92	7.76	3.55	7.51	3.03	7.34
Histidine	1.13	2.23	1.23	2.39	0.88	2.34	1.10	2.33	1.04	2.52
NH_3	0.89	1.75	0.93	1.77	0.60	1.59	0.77	1.63	0.67	1.62
Arginine	3.71	7.31	3.83	7.43	2.61	6.95	3.24	6.85	2.91	7.05
	50.77		51.52		37.63		47.27		41.28	

Table 3

Chemical composition of shrimp feeds (Shigeno & Deshimaru (1972)

Feeds	Percentage on dry basis		
	Crude Protein	Fat	Carbohydrate
Squid meal	81.38	9.63	5.33
Shrimp meal	76.05	2.72	5.57
Brine Shrim meal	54.44	4.92	21.48
Marine Yeast	25.63	2.69	63.50
Petroleum Yeast	61.22	2.10	26.24
Fish Meal	70.47	7.69	1.74
Sperm Whale Meal	78.97	3.83	7.36
Fin-back Whale Meal	82.34	3.49	8.82
Soyben-protein	50.39	1.17	41.92
Short-necked clam	84.20	-	-

Table 4

Composition of vitamin mixture used in shrimp feeds (Shigeno, 1972)

Vitamins	mg % in diet
Thiamine -hydrochloride	5
Riboflavin	40
Pyridoxine - hydrochloride	10
Cyanacobalamin	0.01
Nicotinic acid	75
Ca-oantothenate	50
Biotin	1
Inositol	200
Folic Acid	3
Choline chloride	250
p-Aminobenzoic acid	40
Menadione	2.5
Ascorbic acid (Ca-salt	500
Cholesterol	1250

DISEASES AND OTHER CAUSES OF MORTALITIES OF SUGPO IN THE HATCHERY AND IN PONDS

by

Antonio C. Villaluz

Sugpo, like any other living thing, get sick. They are subject to all kinds of diseases from the moment the eggs are spawned up to old age.

It is recognized fact that poor water quality and inadequate nutrition are the basic determinants of disease outbreaks and should be of primary concern in disease control. Disease is an expression of a complex interaction of host, disease causing organisms and environment, and the environment as well as the cultured organisms are highly abnormal in many intensive-high density culture situations. The infections disease problems that have surfaced thus far, are microbial in origin - caused by bacteria, fungi and protozoa. Undoubtedly as sugpo culture in this country expands, new or presently unsuspected disease entities will emerge and assume positions of significance in the commercial production.

In the intensive rearing of fry in hatchery tanks, environmental factors are greatly altered and outbreaks of diseases occur. Water used in the hatchery is generally of high salinity, clear and relatively free from biological, organic and inorganic pollutants. Failure to attain such water condition give way to infestation of the eggs by bacteria and fungi a few minutes after spawning, causing very low hatching rate. Minute one-celled animals called protozoans may also attack the egg membrane and kill the developing prawn larvae.

After hatching, the larvae are sometimes infested by fungi which gradually invade and replace all their tissues. The infected individuals turn milky white in appearance and become immobile. Mortality may reach 100%. At times, microscopic plants (benthic diatoms) and protozoans attach themselves to the eyes and appendages of the larvae, inhibiting their swimming action and forcing them to settle on the bottom of the hatchery tank. This prevents them from eating, thus causing mortality due to starvation. On some occasions, diatoms and protozoans form a mat on the gill surface and suffocate and larvae. The use of anti-biotics, drugs and other chemicals have been experimented on, but no effective control has yet been formulated.

On the over-crowded condition of the hatchery tank, the water quality gradually deteriorates. The larvae extrudes gases and substances such as NH_4; CO_2, and feces which are continually building up in the rearing water, making the medium detrimental to the well being of the larvae. The larvae eventually die when toxic levels are reached.

Introduction of diatoms to utilize NH_4 and CO_2 in the environment and frequent changing of the rearing water to dilute the accumulated poisonous materials are instituted to prevent weakening and retardation of the larvae.

It has been observed that diatoms alone are not nutritionally sufficient for the zoea stage. Vitamins are also needed, such Thiamine or Vitamin B. complex which bread yeast can amply provide.

Sugpo, cultured in small numbers in ponds, grow vigorously healthy, while those cultivated intensively, easily get sick and growth is retarded, again the vi tims of unfavorable conditions and nutritional deficiencies. In a pond containing small numbers of sugpo, the environmental parameters needed for good health and speedy growth are well taken cared of by nature and the favored food organisms are not exhausted until harvest, while the opposite occurs when they are cultured in large numbers within a limited space.

There are two possible solutions to these problems. One is to circulate the water in the pond with the use of aeration or water pump and furnish the prawn with artificial feeds such as amahong, trash fishes and other kinds of food rich in protein. The other solution is by rotating the sugpo in a number of ponds, that is, transferring them to a previously prepared pond every two months, the pond area progressively bigger every transfer.

The environmental factors in the fishpond are very hard to control. Heavy rains, for example, create a series of changes in the chemistry of the pond. Salinity on the surface becomes lower, resulting in the stratification of the pond water. This condition causes O_2 depletion on the lower layer of the pond water and since sugpo stay on the bottom of the pond, and as they are very sensitive to low oxygen level, mass mortality takes place.

Turbidity or too much suspended mud particles in the water, especially at high temperature is fatal to the prawns being cultured.

The juvenile sugpo in the fishpond may also be infested by bacteria, progressively destroying the exoskeleton of the prawn and providing routes of entry for secondary disease causing organisms. These bacteria are always present in the marine environment and live on the surface of the shell of sugpo. Prawns with this disease have brownish coloration at the back. The effects of this disease may be eliminated by moulting, but usually, the underlying tissues are already damaged by secondary invaders that they seldom recover. For preventive measures, it is best to practice the two methods described earlier.

Other sources of infestations of sugpo in ponds are the protozoans. Heavy infestations produce a mat on the gill surface and occasionally on the eyes, appendages and carapace, causing heavy mortalities, particularly among young individuals when the oxygen concentration is low.

Prawns are not exempt from diseases involving reproductive organs caused by protozoans. The infected sugpo are rendered sterile, weakened or more vulnerable to other environmental stresses.

Many parasites of sugpo from natural waters have been observed, particularly worms and crustaceans, but these have not been observed of significance to aquafarm populations. Some of these may emerge a problem in the future, however. As we culture sugpo more and more intensively, diseases and parasites will transform into greater problems until adequate and defined diets, as well as effective control of water quality can be realized.

ERADICATION AND CONTROL OF PREDATORS AND COMPETITORS IN FISHPONDS

by

Jaime Dominisad

INTRODUCTION

To be certain of a profitable harvest a fish farmer should always consider among others that his fishpond is freee from predators, pests and competitors before stocking it with prawn fry or any other cultivable fish fry.

Meager harvest in fishpond has often been ascribed to predation. This is indicated by the presence of bigger predatory fish caught with cultured stocks during harvest. An observant fish farmer, however, will observe that predators are not limited to those animals which share in common the culture media with the stocks. Snakes and even birds, too, especially in unkempt ponds, may contribute to the losses of a fish farmer.

Not properly treated fishponds may become fertile breeding place of mosquitoes, which may possibly compete with the stocks in the need of food and oxygen, or may promote the growth of competitors as snails and parasitic worms which may be harmful to the stocks and its primary consumers, humans themselves. Presence of unchecked numbers of burrowing crustaceans, such as crabs and crayfish, may inflict damages to the physical structure of the ponds. This would mean additional expense to the fish farmer.

Maintaining a predator-free, pest-free, competitor-free fishpond is however a big problem. In the first place, we can not entirely determine all these organisms present in our ponds unless we do intensive research on this matter, which, to small fishpond operators, may not appear practical.

The purpose of this lecture then is to share and exchange with you knowledge on proper cultivation of sugpo through control and elimination of pests, predators and competitors. And with this, as thefirst step, we may be at least certain of better production.

PESTS

Pests are those that do not prey on cultivated species but adversely affect production through various indirect ways:

1. Those that compete for food and space like tilapia and top minnow. Tilapia was introduced in 1950 in the Philippines, and up to now is considered as the worst pest in our ponds, because they compete for food and destroy pond bottom by their burrowing habit especially during breeding. They can be exterminated by draining then drying or direct poisoning of the pond. Top minnow locally called "paitan" is also a competitor that was introduced in the Philippines as a mosquito control. The same method can be used to exterminate this species. Recently, however, there have been reports that Tilapia is also a predatory fish.

2. Those that disturb pond bottom and affect algal growth like mollusks and polychaet worms. In mollusks, we have for example "tapok-tapok", "egui", or "suso". These snails breed on ponds and hinder growth of lablab. And worst, they may be active carriers of diseases and parasites. They can be eradicated by liming, poisoning, manual labor, or draining and drying. Polychaet worms are large ballon-like mucilaginous egg masses that cause death of fry by entanglement. To eliminate them, gather the cocoons and throw them on top of dikes to dry. Or, apply phenol or nicotine.

3. Those that settle and grow on sluice mechanisms hindering the free interchange of water like acorn barnacles and oysters. Acorn barnacles stick on wooden slabs and cause clog on the screens or expose wooden slabs to dry. Also scrape the barnacles off. Oysters like "talaba" grow on wooden and concrete gates promoting growth of other undesirable species. The same method can be used to get rid of them. In the case of their growth on concrete gates, scrape them before they become too thick.

4. Those that bore on wooden structures like wood boring mullusk (*Teredo* sp.) and wood boring crustaceans (*Limnoria* sp.) These are minute organisms causing minute holes in the inner portion of the wood rendering it unusable in few weeks, if not properly eliminated. To do so, apply thick coatings of tar or use copper compound solution.

5. Those that do considerable damage in the dikes by their burrowing habits like crabs and crayfish. Crabs (Fam. Portunidae and Fam. Grapsidae) that commonly caught are alimango, talangka and alicomo. If not exterminated may render ponds unproductive forever. Grayfish like "kolokoy" (THalassina scorpioinoides) is also a menace to ponds. To eliminate these pests, nets and traps are commonly used. Examples of these gears are bintol, sakag, panukot and a bamboo trap for crayfish.

PREDATORS

These are the carnivorous species of fish, aquatic snakes, birds and mammals, that prey on cultivated species of fish and crustaceans.

1. Among the predatory fish are bugaong (Therapan jarbua), bulan-bulan (Megalops cyprinoides), bidbid (Elps hawaiienses), apahap or bulgan (lates calcarifer), bia or goby (Fam. Gobidae), kasili or eels, baracuda (Fam. Sphyraenidae), etc. To control is simply by draining and subsequent drying of pond.

2. For the predatory reptiles, the most commonly encountered is the water snake (Cerberus rhynchops). Roestami and Pillai reported on one snake observed with 24 fish (5 cm total length) in the stomach. To control this predator, encourage people to kill them with weapons, baited traps, poisoned bait, etc.

3. Predatory birds includes herons, kingfishers, cormorants, fish eagles, etc. They can be minimized by scaring them away with the use of the scarecrows, raise scares, such as empty cans or bamboo rattles and bells across the surface of the water.

4. In predatory mammals, otters are listed. But since they are not common in the Philippines, what is left as the most probable predator is man.

GENERAL PRACTICES IN ERADICATION OF PESTS AND PREDATORS

1. Draining and drying of ponds. This usually requires 1 to 3 weeks of preparation. After draining the pond is dried to crack. If mudfish or dalag or eels are present, it is suggested to allow water and dry again. This will remove the burrowing fish. The decomposing bodies will act as fertilizer.

2. Use of insecticides and poisons. This is especially used to unleveled ponds that which some portions can not be drained. The following are used:

a) Derris root (powder) or "tubli". Use it at the rate of $4\ gm/m^3\ H_2O$ or in the case of solution, 0.5 ppm.

b) Endrin) 0.1 to 0.6 ppm will be
Dieldrin)---------considered effective
Aldrin) eliminate all kinds of
Toxaphane) predators and competitors.

Brestan	- 1 ppm
Aquatin	- 2 ml/m^3 H_2O
Buter WP Extra	- 0.5 ppm
c) DDT	- 8 to 10 cc/5% solution of DDT is kerosene
d) Sodium cyanide	- commercially called Cyanegg is effective at the rate of 1 ppm.

Of course, the use of these pesticides in the elimination of predators has recently been questioned because of its residual or cumulative effects in the pond, to the stock itself and possibly to its primary consumer. Ecologists also complain on its deleterious effects in the natural eco-system, as in creeks, rivers, lakes and the coastal waters.

3. Use of pesticides which act subsequently as fertilizer. This method is widely accepted because of its double effect: to control predators and at the same time, fertilize the ponds. The following are suggested:

a) Tobacco dust - broadcasted at 12-15 kg/ha

b) Tea seed cake (Saponin) - is used in varying concentrations: 15-18 kg/ha - will kill fish and snails
180 kg/ha - will kill snails and crabs

c) Rice bran - 400-600 gm/m^2 at 5 cm H_2O depth.

d) Quicklime - Liming is the simplest fish toxine obtained by dissolving quicklime in water to make thick solution. It is applied in pools and damp areas where fish are likely to survive. It is used at 1,000 kg per hectare.

POND DESIGN AND CONSTRUCTION

by

Ricardo Esguerra

Selection of pond site: The soil must be either clayey or loamy clay, as these types can retain water and support good growth of filamentous algae and microbenthic organism. The soil pH should be 6.5 to 7.5. Soil with pH lower than 6.5 needs heavy liming while higher than 7.5 needs acidic fertilization. Water supply must be clean and adequate throughout the year. It may come from sea or tidal streams. Topography of the site must be level. The elevation should be punch that it is under water during ordinary low tide but could be drained by gravity when desired. Draining is necessary in growing feed of fishes, harvesting and eradication of undesirable fishes. The site should be free from flood away from swelling rivers and adjacent to mountainousregion. Bangos fry should be available in sufficient quantity and the bangos harvest must have a ready market.

General layout of bangos fishpond: It is more economical to construct and convenient to manage fishoond if the layout is a square. No other geometrical figure can have the shortest perimeter with a maximum area enclosed than a square. However, the fishpond layout may be of any shape a rectangle, a trapezoid. The shape of the pond is governed by the condition of the available site.

A complete bangos fishpond system has three main ponds, namely the nursery, transition or stunting and the rearing ponds. An auxiliary pond may serve as a combination of catching pond and supply canal or head pond.

<u>The nursery pond</u> constitute 1 per cent of the whole area. It is divided into series of ponds ranging from 1,000 - 5,000 sq. m. each. Bangos fry are stocked in the nursery pond at the rate of 50-100 to a sq. m., until they reached fingerlings size.

<u>The transition or stunting pond</u> constitute 9 per cent of the whole area. This pond is divided into series of ponds, each ranging from 1-2 hectares. Bangos fingerlings are stocked in one stunting pond at the rate of 1-15 fingerlings per sq. m. to retard the growth of the fish until the rearing ponds are ready for the next stocking crop season.

<u>The rearing pond</u> constitute 90 per cent of the whole milkfish pond area. This pond is divided into ponds with an area ranging from 5-10 hectares. It is where milkfish fingerlings are stocked at the rate of 1-3 fingerlings per sq. m. or 1,000 to 3,000 fingerlings per hectare until they reached marketable size.

<u>Tools and facilities used in the fishpond construction</u>

The digging blades generally used are the Luzon and Visayas types. The former is a flat steel about 50 cm, long and 15 cm. wide at the point and taper to 5 cm. toward the wooden dumb-bell shape handle. This is used for making and block for dikes construction and for excavation, preferably used during low tide. The latter type is the same as that of Luzon type except the handle which is a long bamboo pole that can be used during high tide.

The dug-out banca or flat boat is used for transporting and block from the place of excavation to the place of dike construction (details PI. VI).

A piece of wooden sliding board usually 1" x 12" x 14' is a set in inclined position to facilitate the movement of mud block from the place of excavation to the place of dike construction when the distance of source of mud block is near.

The above tools and facilities are used manually in group labor in contractual work. In a group there is a division of labor, that is one group do the digging or mud block making, the second group do the transporting of the mud blocks and the third group do the piling of the mud blocks to form the dikes.

Machineries used in fishpond construction. In newly opened fishpond sites a mechanical puller is used. It is a native invention a manually operated devise consisting of pulley and gear mounted on a flat boat used in pulling or uprooting live mangrove tree or stumps. A crane with clan bucker mounted on a barge is used economically in dike construction in tidal flats or coves. A bull-dozer can be used in swamplands where the soil can support its weight (details-Cabangbang, Bartolome).

<u>Dikes and their construction.</u> The main dike is the largest dike in the fishpond system and it encloses the whole area. Usually the base of the main dike is 5-10 m. wide, the height 1.5-2 m., at least 0.5 higher than the prevailing highest tide to be constructed and if the site is a swampland, the path of the dike has to be cleared of all trees, stumps, debris, etc. If the soil is hard, puddle trench of 30 cm. wide and 50 cm. deep is dug along the middle of the path of the dike to minimize the seepage underneath. The trench (metcha) is filled with new soil preferably clayey loam and free debris. The dike is raised by piling and block layer. It is necessary to allow each layer to slump before layer is piled.

In a tidal flat if the soil is soft, the outer limits (toe and heel) of the base of the proposed dike are first staked preferably with bamboo poles one meter apart. Bamboo mattings or worn out lumber are set inside, against the poles. The soil will press the matting against the poles thus preventing the washing off of the soil by the wave action.

The secondary dike is smaller than the main dike. It is constructed when the whole area is already enclosed by the main dike. The purpose of this dike is to divide the fishpond into rearing ponds, catching or head pond and supply canal. The base of this dike is 2- 4 m. wide, height is 1-15 m. and the crown is 0.8-1 m. It is constructed in the same manner as the main dike.

The nursery is the smallest dike in the system. It divided the nursery area into small ponds and constructed the same manner as the secondary dike. It has a base of 1-2 m. wide, height 0.5/-1m. and the crown 0.5-8m. wide.

Water control gates. Gates are installed to control the letting in and out of water in the fishpond system. Each pond should at least have one gate. It should be situated in such a place that it is independent from other pond in letting in and out of water. With such condition, it is possible for one pond to be dry while other ponds under water. It should be constructed at the lowest portion of the pond to effect total drainage when desired.

The main gate controls the letting in and out of water direct to the sea or tidal stream and situated along the main dike. In some cases, this is made of wood. To make this effective, durable and stable,it should be made of reinforced concrete.

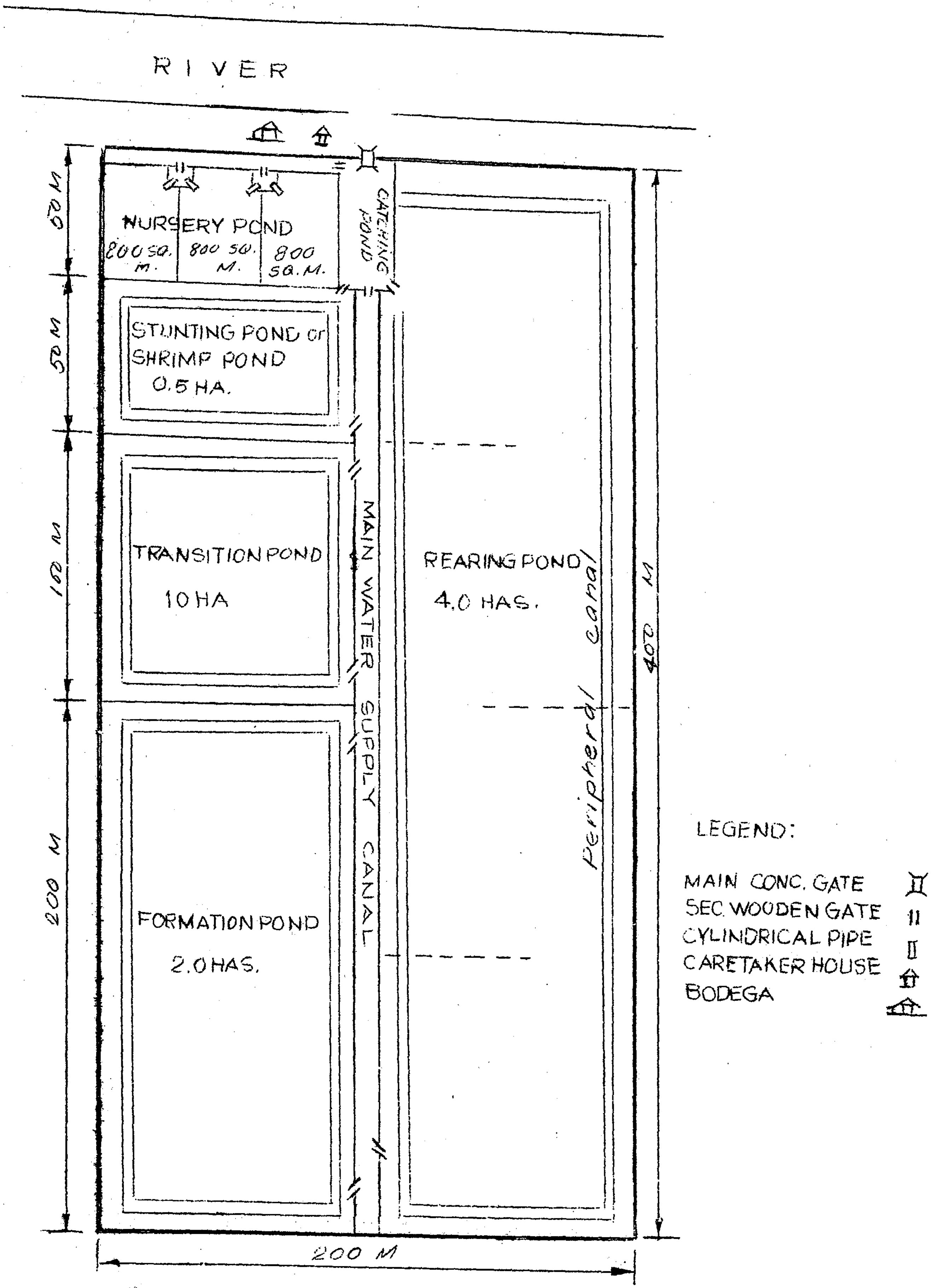
Muddy or sandy foundation should be improved by bamboo piles to insure stability of the gate. The opening of the gate should be at least 1 m. wide for every 10 ha. fishpond area.

The secondary gate controls the letting in and out of the water of a pond to either catchings or head pond or supply canal and is situated down the initial construction cost of fishpond project.

A wooden gate does not need foundation improvement with bamboo pile. But if the tidal fluctuation in the location is great, it should have wooden flooring to prevent the scouring of the bottom. At least 1 m. opening secondary gate is necessary for every 10 hectare pond.

The nursery gate is the smallest gate in the pond system. It controls the letting in and out of water of the nursery pond to either catching pond or supply canal. It is situated along the nursery dike. This gate is usually constructed with wooden slabs in the same manner as the secondary wooden gate.

In some places this gate is replaced by pipes. The pipes may be either quadrangular or circular. Quadrangular pipes are usually made of 4 pieces of lumber while circular are made out of palm trunk. Lately concrete or asbestos circular are being used.

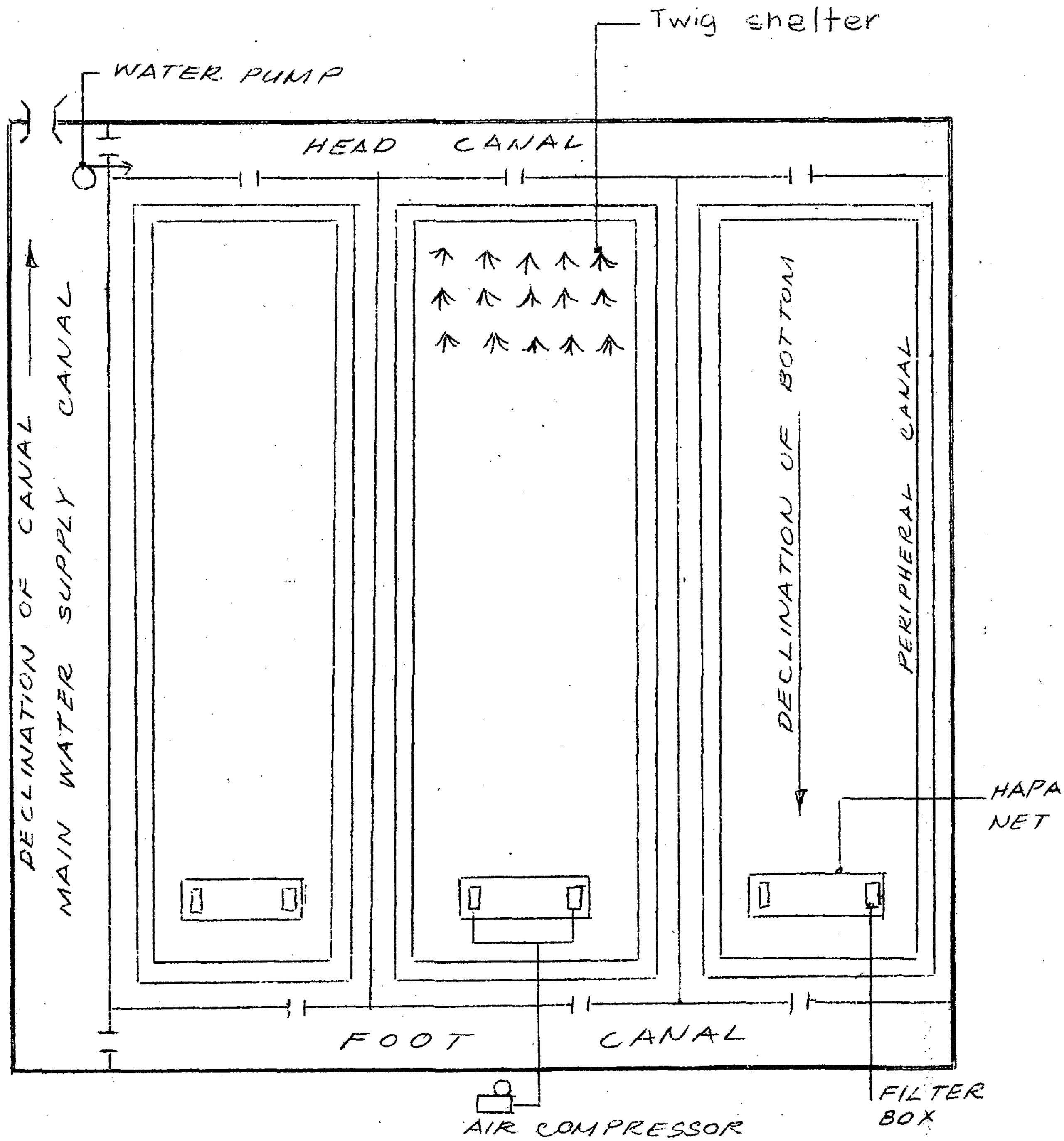


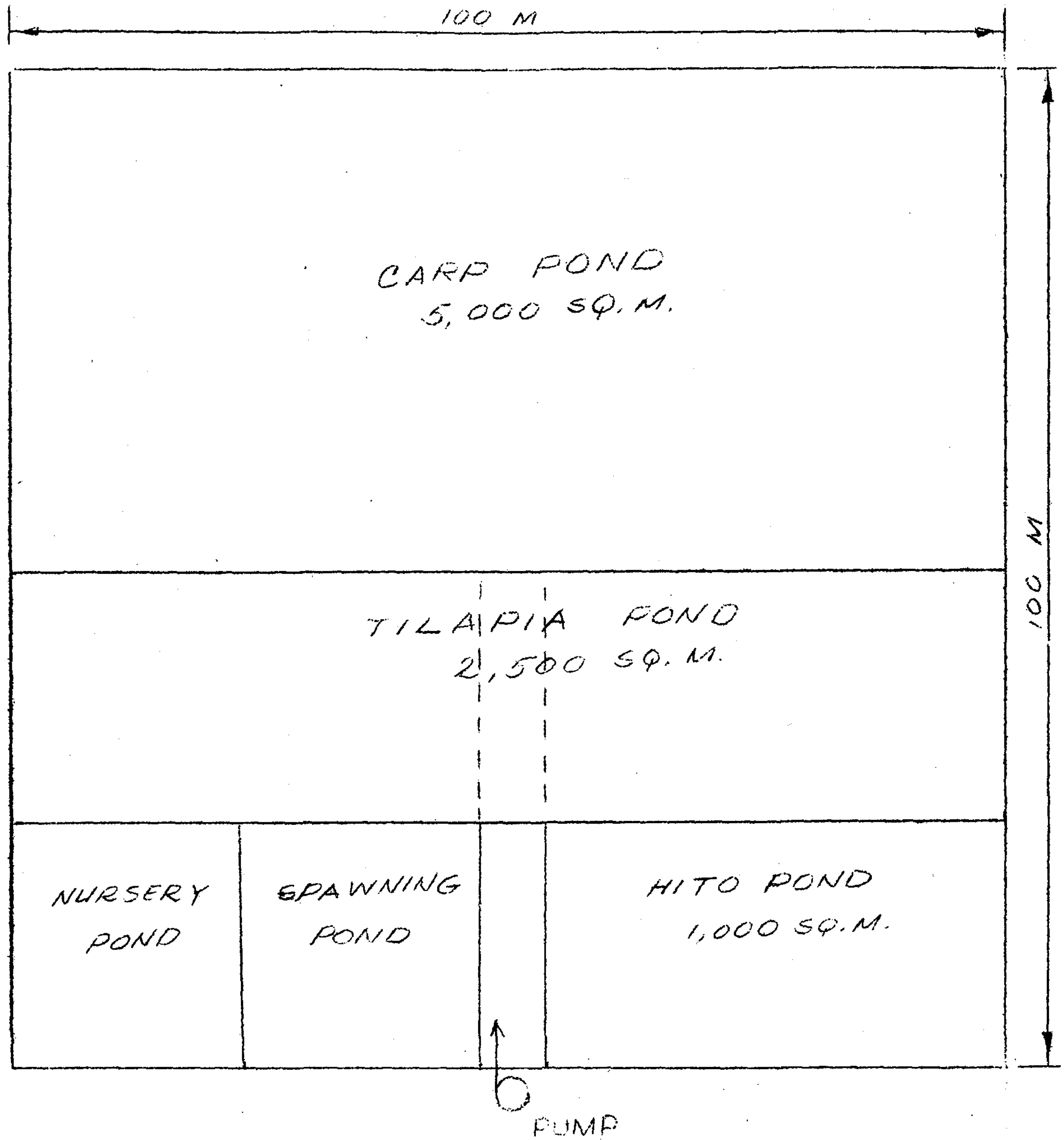
LAYOUT PLAN FOR AN 8 HAS. BANGUS FISHPOND

MAIN DIKE = 5m. b, 1.5m. h, 2m. c

SEC. DIKE = 3m. b, 1m. h, 1m. c

PROPOSED LAYOUT OF A ONE HECTARE SUGPO POND
(IMPROVED METHOD)





LAYOUT OF A ONE HECTARE FRESH WATER FISH FARM

AQUACULTURE FISHERIES IN JAPAN AND IN THE PHILIPPINES - A COMPARISON

Hiroshi MOTOH

At the outset, I would like to express my thanks for the privilege given me to be with you this morning. MAGANDANG UMAGA PO SA INYONG LAHAT.

I would like to speak this morning on the topic "AQUACULTURE FISHERIES IN JAPAN AND IN THE PHILIPPINES - A COMPARISON". In Japan, we have two most popular Aquaculture methods, namely: Pond Culture method and Marine Culture method.

In the Pond Culture method, the fry obtained from the hatcheries by artificial propagation techniques or from natural sources are being reared in the culture ponds up to marketable size. The culture of Yellow tails and Red Sea Breams are good examples. On the other hand in the Marine Culture method, millions of fry from artificial breeding in hatcheries are being liberated into the open sea and let them grow up to maturity under natural conditions, instead of stocking them in culture ponds. In other words, this type of fishery is a combination of artificial and natural methods and is sometimes called "Farming Fishery". Unlike in Pond Culture, wherein the products belong to the pond owners only, in the Marine Culture method, the products belong to nature, hence, to everybody.

The pond Culture industry is not as popular in Japan as it is in the Philippines. This is due to the scarcity of cultivable pond areas. In fact, we usually make use of existing salt beds and convert them into culture ponds. Thus, if we just depend upon Pond Culture method, consumption demand for marine products could never be met.

Realizing the limitations in Pond Culture industry, Marine Culture method was developed by the Japanese ten years ago to help meet the demands for marine products and to replenish the declining populations of marine resources in natural waters due to overexploitation and due to industrial pollution of fishing and spawning grounds. However, in order to effectively replenish the stock in the sea, there is the problem of securing millions of fry for stocking. Ten years ago, this great quantity of fry needed for stocking could not be produced artificially. Thus, during that time, pond culture and marine culture fisheries depended mainly upon natural sources. After a few years, however, mass seed production technique of Kuruma ebi 'scientific name, Penaeus japonicus) was establish by the Seto Inland Sea Fish Farming Association researchers under the leadership of Dr. Motosaku Fujinaga. As a result of the pioneering work of Dr. Fujinaga on Kuruma ebi, artificial propagation techniques of other species - for example, other shrimps, crab, abalone, flatfish and rockfish - were studied and established. The results of the researches of fisheries universities and fisheries laboratories supported by the Japanese government, were propagated to Prefectural Fisheries Experimental Stations and to fisheries cooperatives located throughout Japan.

At present we can produce two hundred million fry of Kuruma ebi or prawn and also several million fry of other edible shrimps, crab, abalone, rock fish, in others in a year. By the way, which is more profitable for fishermen, Pond Culture or Marine Culture? In my opinion, if we apply the modern techniques in artificial propagation in large scale, and if we can use cheap, unpolluted and large pond areas, pond culture fishery is more profitable than marine culture fishery. It is because, in pond culture method, we can exterminate the predators and competitors easily and also ponds could be easily managed than the natural sea. In the case of the marine culture method, most of the fry liberated into the sea are under the mercy of predators. And also, it is a pity that there is no good method yet on how to evaluate the restocking effects.

In spite of this situation, the fishermen are forced to release their fry into the open sea due to Japan's geographical limitations and also due to pollution of shallow coastal areas.

The following are the steps taken in the marine culture method: (This is in the case of Kuruma ebi, Penaeus japonicus.)

Step I. Artificial Seed Production in the Hatchery

The mother shrimps used for spawning are usually big shrimps weighing over 50 grams on the average. The larvae hatched out are reared artificially up to stocking size or 20 mm body length for about 30 days. Presently, we can produce two hundred million fry of the above-mentioned size in a year. On the average one hundred thousand fry or an equivalent of 30 percent survival rate from nauplii larvae to fry stage, could be produced from one spawner. On the other hand, under natural conditions, only a small percentage of the larvae can survive, thus I think the effect of artificial rearing is tremendous. We usually use 200 to 500-ton concrete tanks in the hatchery.

Step II. Rearing in the Nursery Ponds

The fry from the hatchery, owing to its very small size, are not directly released into the sea but are first reared in the nursery ponds. This is to train them to escape from enemies, train them to search and catch their foods and to acclimatize them to their natural habitat in the sea. It is, in short, a training for survival. Usually we keep the fry in the nursery for one or two weeks which is situated in shallow coastal waters surrounded with artificial dikes.

Step III. Release of Fry into the Sea.

Generally, shrimps are nocturnal in habit and are usually observed inhabiting shallow coastal waters to escape from big predators. Thus, we release the fry into the sea during night time or during the lowest tide. Furthermore, we appeal to fishermen to refrain from catching the newly released young shrimps until they reach marketable size.

Step IV. Recapture of the Adult Shrimps

After about six months the released shrimps reach marketable size of about 15 cm in body length. Some of the shrimps migrate to spawning grounds. It is considered good, if fishermen could catch three percent of the total number of fry stocked.

Now, I would like to comment on the Aquaculture Fisheries in the Philippines. Frankly speaking, I think the pond culture fishery in the Philippines has brighter future for development than that in Japan for the following reasons:

1. The fish being reared in Philippine ponds has higher growth rate because water temperature is constantly high, from 27°C to 31°C and that fish or shrimps could be cultured throughout the year.

2. There is less pollution of coastal waters by industrial plants and sewage disposal, except for a few areas.

3. There are vast areas of undeveloped mangrove swamps and estuaries in various parts of the country. Also, the price of potential pond areas is much cheaper than that in Japan.

4. The spawning seasons of useful fishes are longer in the Philippines than in the temperate zones, thus more fry could be produced for a longer period.

5. Water management in culture pond could easily be done due to wide range between low and high tides. In this case, competitors and predators of cultured fish or shrimps could easily be handled.

6. Lab-lab, which is a conglomeration of diaroms and zooplanktons, grow naturally in nursery and culture ponds which serves as a cheap supply of feeds for Bangus and other species. And,

7. The price of sea foods is high and demand is great.

In connection with the above-mentioned observations, I would like to suggest that artificial seed production techniques best suited for tropical and sub-tropical zones conditions be studied and established, in order to fully develop the fish pond industry.

I would like to suggest further, that Bangus culture and Sugpo culture be given priorities due to the following reasons:

1. Both species have high market value and are in great demand.

2. Both grow rapidly in ponds the whole year round.

3. Bangus are generally herbivorous, specifically plankton-feeders. Thus, pond owners could just apply both organic and inorganic fertilizers in their ponds to grown natural feeds. And,

4. Bangus and Sugpo could be cultured together without problems at all. Thus, higher yield per acre of pond could be expected.

By the way, the AQUACULTURE DEPARTMENT of SEAFDEC, Southeast Asian Fisheries Development Center, located in Tigbauan, Iloilo, and the MSU-Institute of Fisheries Research and Development in Naawan, Misamis Oriental, are now conducting researches in seed production and cultivation of some valuable marine species, Sugpo (scientific name, Penaeus monodon), Long-legged Giant Prawn (Macrobrachium rosenbergii), Alimango (Scylla serrata), Alimasag (Portunus pelagicus), Oysters, Seaweed and other species of high economic values. It is hoped that SEAFDEC would in some day contribute to the fisheries economic development of the country.

It is observed that population growth increases remarkably around the world every year. Twenty years from now, it is estimated that the world population would reach the five or six billion mark. Scientists believe that the animal proteins requirements of the increasing population could only be supported by the sea.

Thus, the full development of aquaculture fisheries in the Philippines will play a major role in supplying the protein needs of the world in the near future. This is only possible if both the government and private sectors join hand in hand together in the wise and efficient utilization of our natural marine resources.

MARAMING SALAMAT PO.

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MSU-SEAFDEC/BFAR/NSDB COOPERATORS' PROGRAM

Mechanization & Devices for Environmental Improvements In Sugpo Ponds

by

Mr. P. A. Acosta
SEAFDEC Researcher

I. 1. Introduction and observation on the beginnings of shrimp pond culture in the Philippines and present innovations and improvements.

2. Definitions of mechanization (machines) and devices (tools) for scientific study to simulate the shrimp ecology and pond improvements and gadgets for study on sugpo ponds or instrument application.

II. Mechanical equipment used in pond layout construction and development.

1. (a) Bulldozers for general topographic leveling on land elevation, corrections for earth-moving like dike filling and pond bottom excavation. Practices on infrastructure on road building, drainage canal and other water pipe installations.

(b) Soil rotavator, cultivators, leveling gadgets like the transit and dummy levels, CPG caterpillar scrapers, plow disc/ditch blades, tampers and the like.

(c) Shovel cranes, Fuco cranes with air compressors, pneumatic trans-excavator, and other earth movers.

(d) Tree stump pullers with tripod frames and block lift chains, and winch or pulley action for mechanical advantages.

(e) Flat bottom boat and barges, wooden dugouts, bamboo rafts or wooden conveyors for dike building devices.

2. Dike, crown, side slope protection, use of berms and W.S.C.

To control soil erosion, water turbidity or pollution and pond bottom sedimentation or siltation use:

(a) Boulder rock riprap; adobe, CHB, bamboo stakes and concrete slabs or poured concrete walls.

(b) Sodding with creeping grasses and other economic plants or vegetables on dike slopes, berms, and dike crown with sometimes coconuts, pineapple and "dampalit".

(c) Use of brick, tiles or plastic/rubber sheet covering to check borers, dike leaks and holding water in canvas or rubber pools, improvised marine plywood tanks, CHB holding tanks including the ferro cement structures and asbestos/ cement tubes. esp. plastic molded vats

3. Self-recording devices or automatic paraphernalia:

(a) Weighing techniques, thermograph with clockwork or transistorized testers; salinity-alkalinity meters, seawater oxygen recorders, pH meters, light and temperature meters; GE needles for turbidity and pond fertilizer indicator; portable air pumps used in plastic bag fry transports.

(b) Water supply pipes (PVC) and drainage asbestos/ cement or concrete pipes and culverts cast iron with gate valves and water concrete tanks of different sizes and designs with overhang lips (eel ponds), CHB and solid or semi-poured concrete formulations.

4. Mechanical agitators (oxygenators) using:

   (a) Water mill, paddle wheel or propellers; vertical flow pumps and sprayers; running waters in raceway tanks, waterfalls; horizontal and vertical water circulators; sprinkler type with compressed air like in feeding tubes; sandstone or false bottom arrangement for automatic feeding/waste control; gravity flow pond arrangement notably with tank culture.

      1. running water type-moving water where water is changed 7 to 10 times a day with continuous flow also in eel tank culture and shrimp culture tanks with pumps or water head pressure-flow.

      2. semi-running type-where water is changed once a day like in the shrimp hatchery procedure; conditioning ponds or rearing ponds.

      3. Stale or lotic condition- water is changed or water replacement is done to take care of water loss due to evaporation or water percolation in the pond bottom like in natural impoundments or fertilized rearing ponds or recycling tanks for water re-utilization or settling ponds.

5. Fry collecting devices/paraphernalia:

   (a) Grass "bon-bon" shelter collectors, sakag or mechanized push nets or floating fry trawl, blanket scope net; mechanized suction filter pumps or adopting yellow light attracting shrimps in sluice gates on night watering while the shrimps are feeding and floating with the currents.

6. Water control environmental modifications and adaptations:

   (a) Use of water sluice gate; drain pipes or valves; supply canals, polyethelene air tubings with air stones; roots blower; pond bottom sheltering or use of sand mounds and furrows pond gate screening with v-trap baclad to lesson predators; metal sheet sluice gates with worm or windlass action or pulley action.

(b) Soil auger for soil depth sampling; core sampling for waterline stability or the use of a sand core to establish dike stability to break water moisture line.

(c) Use of water pumps and compressed air connections and tide water management with 1.0-1.5 M depth optimum or pond arrangement oriented to gravity-flow; water circulation both vertical and horizontal; use of different vertical flow pumps; agitators and false bottom arrangement to have automatic waste feed and water discharge example of Shigueno-airlift type culture method in circular concrete pools for culture of shrimps (marketable).

7. Harvesting gadgets for shrimp ponds:

a) trammel or gill net
b) filter net
c) baclad or lift set net called "tower"
d) shrimp trawl or pond draining
e) shrimp trawl net with electric or compressed air attachment

8. Algae control by mechanical sieve; pump or chemical action; fish pen or floating baskets/pens in cones like fish pens for freshwater shrimps or prawn; use of open/continuous flowing W.S.C. (part of bangos layout); box experiments and methods of transporting fry and marketable shrimp; embankment combination with fish nets/framed GI fine-mesh wire or plastics. Frozen shrimps, cured shrimps and live shrimp marketing techniques.

AQUACULTURE PRACTICES IN THE PHILIPPINES

Lerma Method of Bangus Production

by

Ricardo Esguerra

FISHPOND LAYOUT

A highly productive and profitable fish farm is like a well designed subdivision. But instead of subdivision roads it has water canals; instead of subdivision lots, it has fishponds which vary in size depending on their use.

Consider a 100-hectare fish farm:

a) It should have 4 has. of nursery ponds, each 2,000 square meters in size and serviced by a water canal. See Fig. 1.

b) It should have 16 has. of transition ponds, each pond one hectare in size and serviced by a water canal. See Fig. 2.

c) The rest of the fish farm, after deducting space for canals and a service area, is laid out into growing pond modules. Each of these modules should have three ponds:

1)	growing pond No. 1	- 1 ha.
2)	growing pond No. 2	- 2 has.
3)	growing pond No. 3	- 4 has.
	Total per module	- 7 has.

A fish farm of 100 has. would therefore have 10 growing pond modules. See. Fig. 3.

PRODUCTION SCHEDULE

The beginning of the crop year starts at the time when bangus fry become available in quantity. In the Visayas, fry season is generally from February-June. In Mindanao, it is almost the whole year round.

As early as possible during the fry season, all nursery ponds are stocked up with a density of 50 fry per sq. m. A well-managed fish farm has its nurseries stocked up at all times.

One crop year overlaps into the next. This assures uninterrupted production for the fish farm.

After two months in the nursery pond, the bangus are transferred to the transition ponds. At this stage the bangus are about 1" to 2" in size. Stocking density of the transition ponds will be 25,000 to a hectare. Here the bangus await transfer to the growing pond modules. TPs are stocked up the whole year round - one crop year overlapping into the next - to assure continuous availability of fingerling for the growing ponds.

Growing Pond No. 1 receives bangus fingerlings 2" to 4" in size from the transition ponds. Stocking rate is 8,000 per hectare. After two months, this stock of 8,000 fingerlings is transferred to Growing Pond No. 2. Note that here the density becomes 4,000 per hectare. Growing Pond No. 1 will then be empty and after a few days pond preparation will get a new stock of 8,000 fingerlings from the transition ponds.

After 2 months in Growing Pond No. 2, the bangus is transferred to Growing Pond No. 3. After two months here it is harvested for sale. The size will be about three to a kg.

Note again that the stocking density will drop to half that of the previous pond.

As soon as No. 2 becomes empty, it is immediately prepared to receive a new stock of bangus from No. 1.

Thus each module harvests 8,000 pieces of bangus (330 grams per pc.) every two months.

Once a year, in summer, all ponds are allowed to dry up and lie exposed to the sun for one month to cut short any disease cycle and to prevent parasite and predator build-up.

SOME FISHPOND PRACTICES

1. Some years ago, fish farming yield was limited by the amount of food that could be made available to the fish. Now stocking rates can be increased five times without a decrease in the rate of growth of the fish. With correct fertilization enough fish food can be grown economically provided there is enough oxygen in the water. This is why more and more fish farms in Japan, US, and Europe are adopting mechanical aeration to be able to increaze fish density and thereby dramatically increase production. Here, the factor becomes economic - the cost of mechanical or electric power needed for aeration as compared to the increase in income brought about by such aids.

2. Fish are given enough water space proportionate to their size. Thus, in a nursery pond where the fish is only 1" long, stocking rate can be 500,000 per hectare. But in

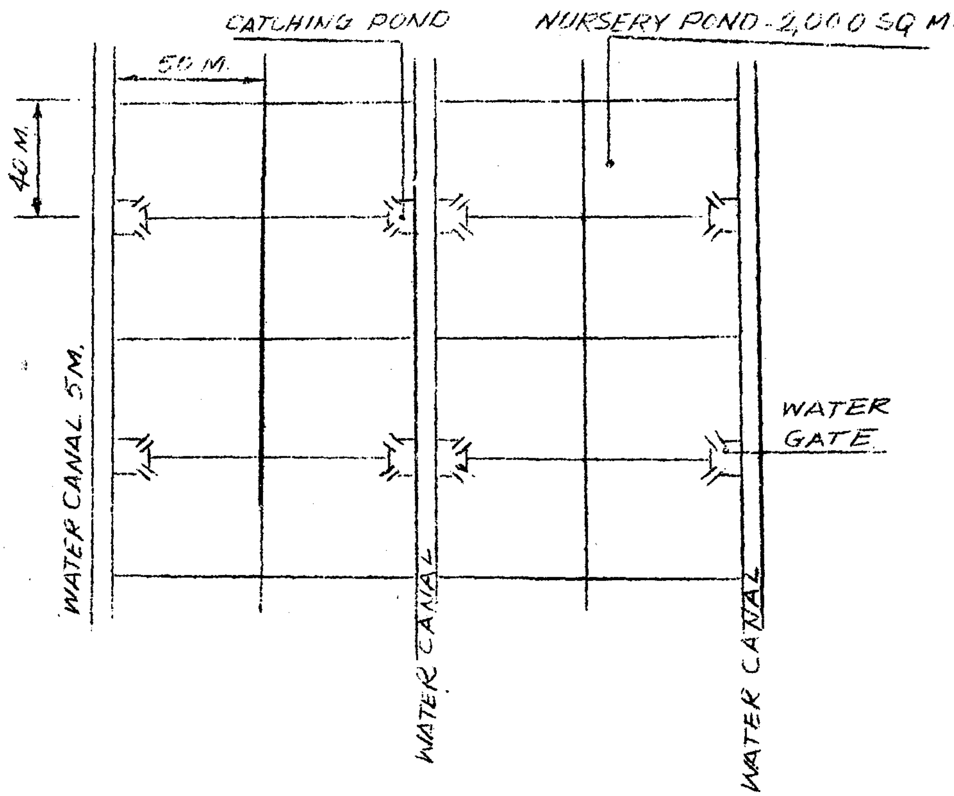
Growing Pond No. 3 where the fish is about 12" long density is only 2,000 per hectare. Too much space wastes good fish farm area but not enough space will kill the fish.

3. Very low rates of return on investment is realized in artificial or direct feeding of bangus. Better results are obtained by growing food in the pond through the application of 18-46-0 fertilizer.

4. Shrimps and crabs cannot stand heavy fertilization. They are more sensitive to oxygen deficiency than <u>bangus</u>, <u>carp</u>, <u>tilapia</u>, or <u>hito</u>.

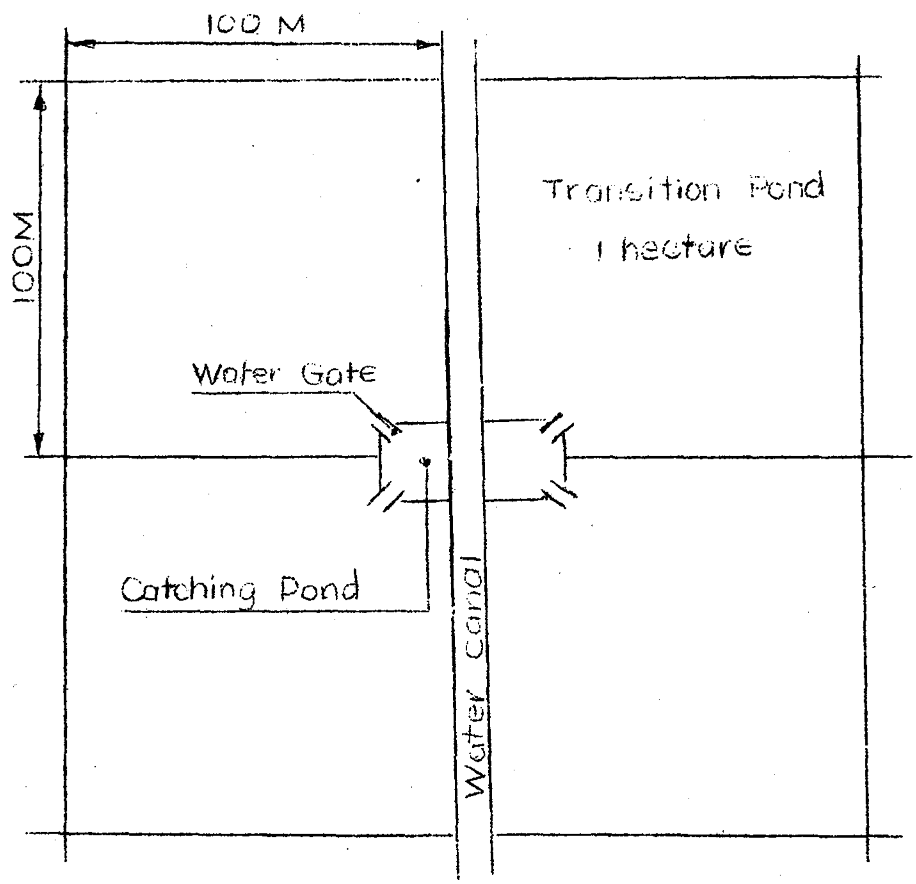
5. The trend in shrimp production in Japan, US, Europe, and Mindanao State University is to employ environmental control. The "poultry housing" method and feeding technique is used more and more in shrimp farming. Artificial feeding of formulated balanced feed, mechanical aeration, complete change of water every 24 hours, control of pH, salinity, and water turbidity. All these cost money but quality is very high, harvest is reliable and production can be scheduled.

FIG. 1 - NURSERY AREA



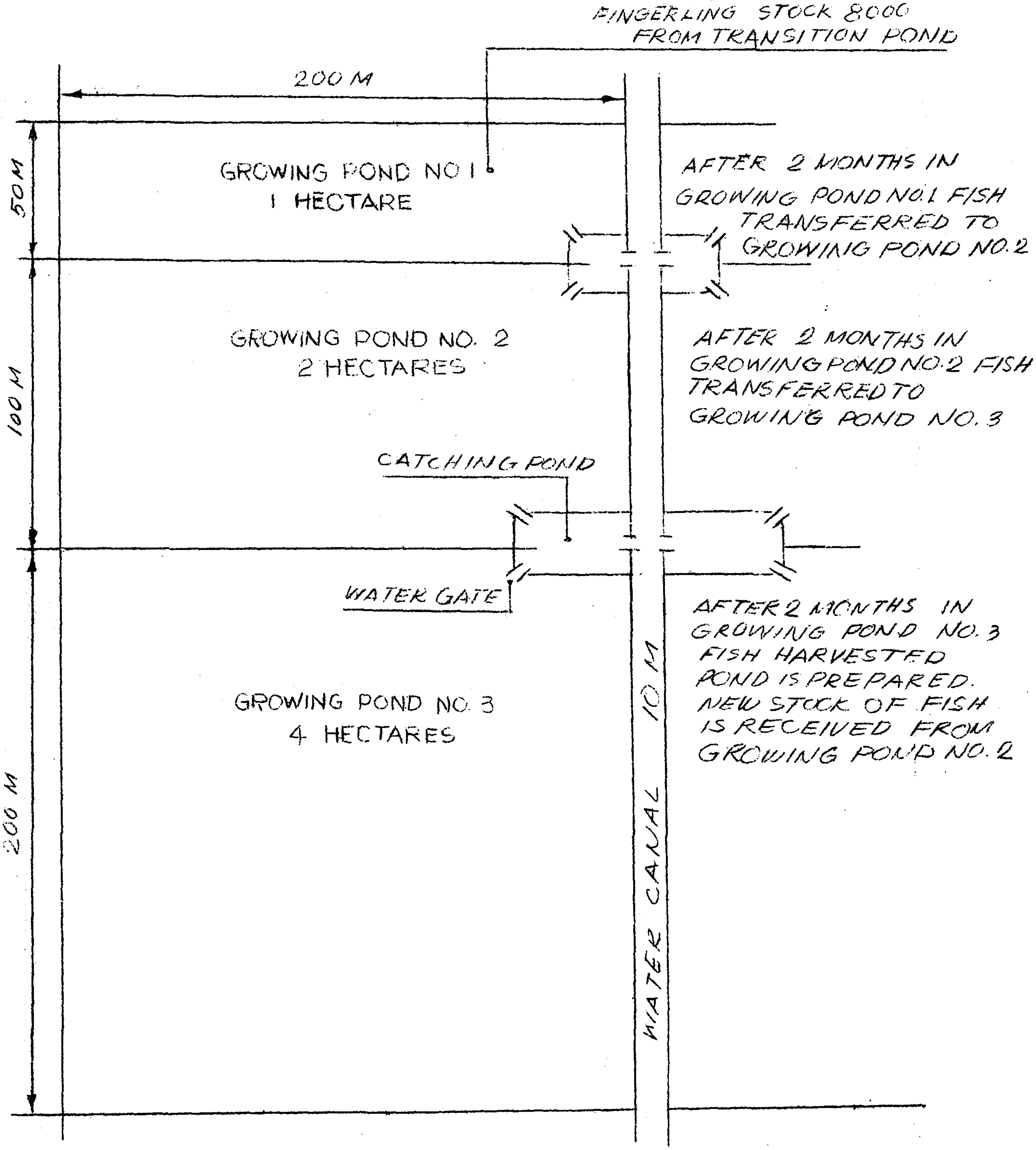
SCALE 1 CM = 25M

FIG. 2 - TRANSITION AREA



SCALE 1CM = 20M

FIG. 3 - GROWING POND MODULE



SCALE 1CM = 20M

Development Bank of the Philippines

Guidelines

for

FISHERIES INDUSTRY LOAN PROGRAMS

For a more consistent implementation of DBP's new fisheries financing programs as well as of loan programs under the RP-IBRD Fisheries Credit Project, the Board of Governors last May 23, 1973 formulated general guidelines to be observed in the processing of loan applications for fishery projects, as follows:

x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x

B. INLAND FISHERIES PROJECTS

1. Fish Culture Projects

a. Qualifications of Borrower

A borrower for inland fishery projects may be individual, a partnership, a cooperative, an association, or a private corporation that is presently engaged in the business of inland fishery production and desires to expand current operations; or one who proposes to engage in a new inland fishery project and can demonstrate his capabilities to undertake such project successfully.

If the borrower has an existing account with the DBP, such account shall not be in arrears.

The borrower may be a lessee of the area on which the project is to be established, or he may be a private owner thereof.

b. Purposes of the Loan

Loans for inland fisheries may be for fresh-water or brackish water fishponds for the production of milkfish, carp, hito, Crustaceans and other fishpond products.

More specifically, loan funds for the rehabilitation of damaged fishponds and the development and construction of fishponds shall be utilized as follows:

(1) Clearing of the project area

(2) Construction of main, secondary and tertiary dikes

(3) Construction of main, secondary and tertiary gates

(4) Construction and excavation of nursery, transition, rearing ponds and catching ponds

(5) Purchase of bangus fry

(6) Procurement of fertilizers and other productive inputs

(7) Procurement of equipment and paraphernalia required for fishpond operation.

c. Amount of Loan

The amount of loan shall be based on actual needs of the investment project.

Actual needs shall be based on Project scales that have been evaluated and found to be technically feasible and economically viable.

d. Equity Contribution

All borrowers shall be required to make a minimum contribution towards the incremental investment costs of the project to be financed, in the following proportions to the area of ponds to be developed:

Size of Ponds	Contribution
Up to 25 hectares	10%
More than 25 hectares and Up to 50 has.	15%
More than 50 hectares	20%

e. Loan Securities

The loan shall be secured as follows:

(a) If the project site is privately-owned, whether titled or untitled, the property shall be mortgaged in favor of the DBP; or

(b) If the project site is covered by a leasehold agreement from the Philippine Government, leasehold rights thereon shall be assigned in favor of the DBP.

Also, all durable assets procured or acquired out of loan funds shall be chatteled in favor of the Bank.

f. Repayment

The term repayment, including grace periods, shall be based on the payment ability of the borrower and the estimated cash flow of the project to be financed.

In general, repayment terms and grace periods shall not exceed the following:

Project	Grace Period	Term of Repayment (excluding grace)
Fishpond Rehabilitation	2-3	5-7
Development of Existing Fishponds	3-4	7-9
Construction of New Fishponds	3-4	10-12

g. Interest Rate

The rate of interest shall not be less than 12% per annum.

x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x-x

Excerpts from Guidelines for Fisheries Industry Loan Programs of the Development Bank of the Philippines.

PRE-MARKET TREATMENT AND MARKETING OF SUGPO

by

Santiago P. Tan

PREPARATION

Before harvesting your sugpo, preparation of materials like container and sufficient ice is necessary. The container must be airtight to minimize the rapid melting of the ice and conserve its coolness. It must be made of wood or plywood or G.I. (galvanized Iron) insulated with styrofoam.

Icing should be done immediately after weighing the shrimps. Avoid exposure of the shrimps to the heat of the sun. It causes deterioration and thus produce poor quality product. The shrimps should be placed in prepared chilled water before the final packing.

In packing the shrimps, ice should be cracked into small pieces to have a better contact with the layer of shrimps. A container of 15-20 kilos capacity will be convenient in handling and transporting to the site of the factory or market.

This preparation immediately following harvest is very important to maintain the freshness of the product.

MANUFACTURING PROCESS

The moment the iced shrimps arrive in the factory or the processing plant the shrimps are re-weighed and washed with cold or chilled water. After weighing and recording the same, the head of the shrimp is removed completely. This process should be done if the product is intended for export. This is done to minimize cost of materials for packing, cost of transportation, and to keep the product longer in storage.

The next step after removing the head is another washing, using cold or chilled water. Cold or chilled water is used in washing the shrimps so that it will not be subjected to sudden change of temperature, as this will affect the quality of the products. After washing the headless shrimps are classified and sorted according to sizes or grouping. Two kilograms of headless shrimps of the same sizes or grouping is placed in each tray. The tin tray is constructed to hold at least two kilograms of healess shrimps and its dimension is made to fit to size of the inner-waxed boxes for systematic handling and packaging. The arrangement of the headless shrimps in the tray should be made so that the bottom and topmost layers of the shrimps appear and the tail ends are in the center of the tray while the shrimp meaty portion (section where the head is separated from the body) is placed facing outwards.

The arrangement is made, so that when the ice block is formed with the headless shrimps they can still be easily seen at the two side of the eyes block. The quality and freshness of shrimp frozen products, can then be easily determined visually, by just looking at both sides of the ice blocks where the shrimps are encased.

After placing and arranging the two kilograms of headless shrimps of uniform sizes and same grouping in each tray, the shrimps are pressed to level its content, using either the hands or the bottom of another tray. Only the bottom and top most layers are arranged systematically, leaving the middle portion, at random arrangement. When all the headless shrimps are already arranged and placed in the tray, according to size and groupings, the tray are subjected to quick freezing to -30 to -40^{o}C. temperature for one hour. Quick freezing is made to kill or de-activate most of the bacteria inthe shrimps, Lower bacterial count, also enhances the preservation and retains the freshness of the frozen product.

After one hour of quick freezing at -30 to 40^{o}C, the trays are removed and filled with cold or chilled water on the top, level of the shrimps, and quick-frozen again for another one hour at 40^{o}C. A small ice block with headless shrimps encased is formed inside the tray. By sudden immersion in the ordinary tap water, the ice block thus formed can be easily removed from the tray, and this is placed inside the plastic film before placing the same in the inner-waxed cartoon.

Marking as to size assortment should be made on the outer covering of the inner waxed-boxes. These boxes, with two kilogram shrimps content, are placed in a bigger or outer cartoon with 10 boxes capacity or 20 kilograms in total contain of shrimp weight. Markings are also made according to sizes assortment or groupings of the 10 boxes inside.

After sealing the cartoons using the plastic sealer, they are placed inside the cold storage having minus 15-20 degrees centigrade. This complete the processing up to packaging, and thefinished frozen products are ready to be shipped by boat, having refrigeration unit, to destination.

WHOLE AND HEADLESS FROZEN SHRIMPS

For domestic marketing of frozen shrimps, the shrimps are frozen as a whole piece or with head-on. The difference is that for export market shrimps are marketed headless, while for local consumption and inasmuch as the Filipinos prefer to partake their shrimps in whole piece, these are sold with head-on. This food preference is always taken into consideration in the domestic marketing of frozen shrimps, On the other hand, the Japan export market prefers that their frozen shrimps be headless due to the economy of handling and transportation. Here the purpose is more on economic expediency and less on food preference.

CLASSIFICATION OF FROZEN SHRIMP IN THE EXPORT MARKET

In the export market, the headless shrimps are grouped according to their sizes. As practiced, the frozen shrimps are classified as follows:

Black Tiger (Sugpo)	White Shrimps
U-10 pcs/lb	21-25 pcs./lb
10-15 pcs/lb	26-30 pcs./lb
16-20 pcs/lb	31-40 pcs/lb
21-25 pcs/lb	41-50 pcs./lb
26-30 pcs/lb	51-60 pcs./lb
31-40 pcs/lb	61-70 pcs./lb
41-50 pcs/lb	71-80 pcs/lb

For illustration -- in the classification under 10, it means that to make one kilogram of headless shrimps, the number of pieces of same size should not be more than 10 pieces. Approximately, one headless shrimp weighs more than 100 grams.

PERCENTAGE OF MEAT ON HEADLESS PRAWN WHEN PROCESSED

Head part --------------	35%
Body meat portion ------	65%
Total	100%

If the prawn weighs 100 grams, the body part weighs only 65 grams and the head part, 35 grams.

WASTE DISPOSALS

What is to be disposed of is the estimated 35% head portion of the shrimps. This portion is collected, dried and sold as protein feed supplement , or make into Patis or into shrimp kropeck, depending on which offers a good economic return.

PRESENT STATUS AND PROBLEMS OF
PRAWN CULTURE IN THE PHILIPPINES

by

Juan V. Lopez

AREA AND SCOPE. The total area suitable for prawn culture development in the Philippines is about 176,032.10 hectares (bangos fishpond convertible to shrimp farm). About 400,890 hectares of brackishwater tidal coves, sheltered bays, and mangrove swamps await possible (BFAR Statistics 1973) development.

Some of the known species of shrimp found in bangos fishponds are: *Penaeus merguiensis* (hipon puti), *P. monodon* (sugpo), *P. semisulcatus* and *Metapenaeus monoceros* (hipon suahi).

MANPOWER. Per information and statistics of the Bureau of Fisheries and Aquatic Resources, the number of fishpond operators, pond caretakers and other persons involved in fishpond operation is about 176,000 people (based on 1 man/ha). The average rate of annual increase of persons engaged in fishpond corresponds to the increase of fishponds being developed.

FIELD AND PRODUCTION. The estimated total yield of ponds from the natural production of shrimp is about 50 kg/ha/yr. However, enterprising bangos fishpond operators have been producing about 500 kg/ha/yr of sugpo and other species of shrimps.

SOURCES OF SEEDS AND CULTURE METHODS. The seed stock comes from the natural estuarine areas. These are carried by tidal currents into the brackishwater and tidal rivers, streams and creeks. Fry concessioners and catchers gather different sizes of fry and juvenile stages of sugpo and shrimps. These are transported in plastic bag containers with oxygen and brought to fishpond centers.

The known sugpo fry fishing grounds are: Dasol Bay in Pangasinan, Ternate in Cavite, Balayan and Calatagan in Batangas, Calauag and Aloneros, Tagkawayan in Quezon Province, Iloilo City, Panguil Bay in Lanao del Norte, Sibuguey Bay in Zamboanga del Sur, and Zamboanga City.

The traditional method of rearing prawn in ponds is to gather the juvenile and fry stage from the estaurine areas. These are usually grown with Bangos, Samaral (Teuthis sp.) and/or Kitang (Scatophagus sp.). The stocking rate of sugpo ranges from 5,000 to 10,000 fry per hectare. They grow to marketable size (15-30 pcs/kg) in about 5 to 7 months in the rearing pond with lumot and/or lablab as food. Mortality rate ranges from 30 to 50% during the growing period. However, some fishpond operators claim 70-80% survival if ponds are properly managed while others may loss entirely their stock or with negligible survival during the rainy season (nalolosao).

In a recent field test on the rate of growth of sugpo in brackishwater pond, thirty thousand (30,000) fry were stocked in a hectare compartment with fair growth of lab-lab and lumot. In addition 40,000 bangos fingerlings (30 mm-35 mm) were also reared in the same pond. After a month of rearing in the 1 hectare compartment a cut along the dike of an adjoining compartment (3 hectares) was undertaken. This increased the area of rearing to 4 hectares. In about 3 months growing period, 10 samples were measured (see Table 1). The maximum and minimum length and weight were 213 mm & 117 mm and 81.2 grams & 12.5 grams respectively and with an average weight of 41.84 gm. This preliminary field test was made to determine possible detailed study on the culture of sugpo in brackishwater pond.

The cost of sugpo fry ranges from ₱0.08 to ₱0.15 depending on the source and abundance of supply.

Marketable size sugpo costs ₱25.00 to ₱35.00/kg in the Manila markets and suburbs while hipon puti and hipon suahi cost ₱12-₱15/kg and ₱16-₱20/kg, respectively.

PROBLEMS. The problems confronting prawn culture development in the Philippines are similar to those of the countries developing shrimp culture, particularly in Southeast Asia as follows:

a) Meager information and expertise

b) dearth of trained technical men (shrimp culturist) and

c) timid flow and/or lack of financial resources.

It is sad to note that inspite of the favorable climate and environmental conditions mother nature has endowed to our country, no real shrimp culture project has been developed as yet. The SEAFDEC Shrimp Research Project at Tigbauan, Iloilo and the MSU Shrimp Laboratory (with financial aid from NSDB) at Naawan, Misamis Oriental are the two institutions pioneering in the mass production of prawn fry. In addition, some private institutions are now engaged in research and field test on the commercial production of cultivable species of shrimp.

Table 1. Measuremet of Sugpo (P. monodon) Reared in a Brackish-water Pond Near Ragay Gulf from August to November 10, 1974

Sample Number	Length mm	Depth mm	Weight gm	Sex
1	213	30	81.2	M
2	210	29	76.2	F
3	182	25	48.5	M
4	190	26	54.9	F
5	181	26	50.0	F
6	150	20	26.9	M
7	140	19	22.0	M
8	140	20	22.5	F
9	145	19	23.7	M
10	117	15	12.5	F
Total	1669	229	418.49	
Average	166.8	22.9	41.849	

Preliminary studies on the Monoculture of P. Monodon

I. OBJECTIVES:

1. To determine survival rate of prawn fry using HAPA NET as nursery for 3 to 4 weeks with and without aeration.

2. To determine the survival rate of prawn from fry to marketable size using different sheltering methods in rearing ponds for a culture period of 6 months.

3. To determine the efficiency of some locally available materials as shelter in rearing ponds.

II. MATERIALS AND METHODS

One to two hectare pond from each cooperator shall serve as study areas. A "hapa net" made of sack cloth material shall serve as the nursery for a period ranging from 3 to 4 weeks. Each cooperator must prepare a "hapa net" measuring 3 x 15 (or 4 x 20) square meters.

From the nursery, the juveniles will be released to the rearing ponds at a stocking rate of 2 fry per square meter of water surface. Actual count of the juveniles from the "hapa" will be made to determine the survival rate before they are released to the rearing pond.

Fertilization when necessary may be done two weeks prior to stocking. Natural food will be grown by traditional method. Average depth of the pond shall be maintained at 80 centimeters throughout the culture period of 6 months.

Physico-chemical factors like temperature, dissolved oxygen, salinity, alkalinity and pH will be taken daily. Data related to weather conditions, light penetration and water color will also be recorded daily.

To estimate population and record the growth rate, monthly sampling will be made.

Food and feeding will also be studied along with the qualitative and quantitative analyses of various organisms found in the various ponds.

Samples of bottom soil from various ponds will be analyzed.

III. RESEARCH DESIGN:

Pond No.	Nursery Plan	Rearing Plan	Sheltering
1	The fry to stay in HAPA NET for 3-4 weeks with aeration	Juveniles to be stocked in 2 ha. ponds without shelter. Culture period-6 months Stocking rate - 2 fry/square meter.	Without shelter
2.	The fry to stay in HAPA NET for 3-4 weeks with aeration	Juveniles to be stocked in 2 ha. ponds with shelter. Culture period- 6 months Stocking rate - 2 fry/square meter	a. Coconut leaves or Api-api branches as shelter. b. Bamboo twigs or bundles of grasses
3	The fry to stay in HAPA NET for 3-4 weeks without aeration	Juveniles to be stocked in 2 ha. pond without shelter. Culture period- 6 months Stocking rate-2 fry/ square meter.	a. Coconut leaves or Api-api branches. b. With bamboo twigs, or bundles of grasses as shelter.

IV. REQUIREMENTS

A. Member Cooperator:

1. Total area-

2. Number of cooperators -

3. Minimum from each member:

   1-2 hectare clean ponds with strong gates and dikes, levelled bottom and predator free.

4. Field house (one nipa hut) to serve as field laboratory.

5. "Hapa Net" measuring 3 x 15 meters (or 4 x 20 m)

6. Manpower: one full time pond caretaker.

B. SEAFDEC:

1. Fry: 40,000

2. Equipment and supplies for physico-chemical and biological analyses.

3. Technical assistance:

   a. 2 (biologist) prawn culturists
      1 chemist

V. PLAN OF WORK:

Description	Duration in Weeks	Remarks
Organization of Cooperators	5 days	To begin October 9
Nursery preparation	2 weeks	To begin October 14
Culture	24 weeks	To begin October 30

EVALUATION OF THE TRAINING PROGRAM

by

William R. Adan

At the closing of the five-day training program evaluation forms were distributed to the participants to effect a functional assessment of the entire program. Results will become the basis for improvement and/or modification in the conduct of future training-seminar.

Out of the 46 respondents who turned in their evaluation forms, 24 rated the training as very good, 13 as good, 8 as average and 1 gave no response. Thirty-nine said the objectives were fully attained, 5 said partially, 1 said maybe and another 1 gave no response. As regards to the method of instruction, 18 rated it very good, 16 rated it as good, 8 as average, 1 as poor and 3 gave no response. Regarding the length of training, 26 said it was just right, 12 said it was too short, 3 claimed it was too long and 5 gave no response. With respect to the fieldtrip, 16 said it was poor, 11 said it was very poor, 7 said it was average, another 7 said it was good, 1 said it was very good and 4 gave no response.

As to the question on the content areas they would like included in future sessions, the following were recommended:

1. The culture of other fishes and crustaceans as a ready alternative in case of failure in the sugpo project
2. Recent techniques in improved bangos production
3. Theory-application approach in all content areas
4. Fisheries Regulations or laws under the New Society for the proper guidance of fish farmers and/or fishermen

Other recommendations included the following:

A. Instruction

   1. The use of the dialect or mixed English-dialect medium of instruction to effectively communicate particularly with the fishpond caretakers

2. Active communication and to avoid reading sessions of lecture topics

3. Simplified lectures and avoidance of technical terms

4. Longer period for open forum after each lecture

5. Demonstration on the use of all equipment necessary in the implementation of the research scheme under the Cooperators' Program

6. More slides show

B. Course Content Areas

1. Extensive discussion on diseases and other causes of mortality in the hatchery and in the ponds

2. Actual participation of the trainees in demonstrations regarding transport-handling and stocking of fry in ponds

3. More discussions on feeding and fertilization

C. Training Facilities

1. Lodging house or dormitory for participants within the training compound

2. Ready transportation for field trips

3. Classroom chairs in a more spacious lecture room

4. Recreation facilities

Another salient recommendation was for the cooperators to convene and share with all members feedback information on the results and/or experiences in their respective rearing of sugpo after some time from stocking.

Elections of Officers

To have an operative mechanism whereby research efforts on prawn cultivation can be well coordinated and effectively implemented, the fishpond cooperators formed themselves into an association and call it "Fishpond Cooperators' Association of Northern Mindanao". The association shall be governed by a Board of Directors composed of 9 members, all of whom shall come from the following provinces represented: Lanao (2); Misamis Occidental (2); Misamis Oriental, Bukidnon, Camiguin (2); Agusan (2); and Surigao (1).

Elected officers were:

Chairman : Engr. Federico P. Jugador
Vice Chairman : Mr. Glecerio A. Lim
Sec.-Treasurer: Mr. J. Fernandez
Members of the Board:

1. Mr. Ismael Andaya
2. Mr. Johnny Fernandez
3. Judge Allan Marban
4. Mr. Gregorio Engracia, Jr.
5. Mr. Felipe F. Lagoc
6. Mr. Dalmacio Lopez

Board of Directors:

A. Lanao:
   1. Gleoerio A. Lim
   2. Dalmacio R. Lopez

B. Misamis Occidental:
   1. Felipe F. Lagoc
   2. Gregorio L. Engracia, Jr.

C. Misamis Oriental, Bukidnon and Camiguin:
   1. Federico P. Jugador
   2. Allan I. Marban

D. Agusan:
   1. Ismael Andaya
   2. Johnny Fernandez

E. Surigao (To be recommended by Dir. Urbano, BFAR Reg. X)