FISHERIES RESEARCH AND DEVELOPMENT IN THAILAND, MALAYSIA AND INDONESIA — A STUDY TOUR REPORT

(10 JULY—24 JULY 1985)

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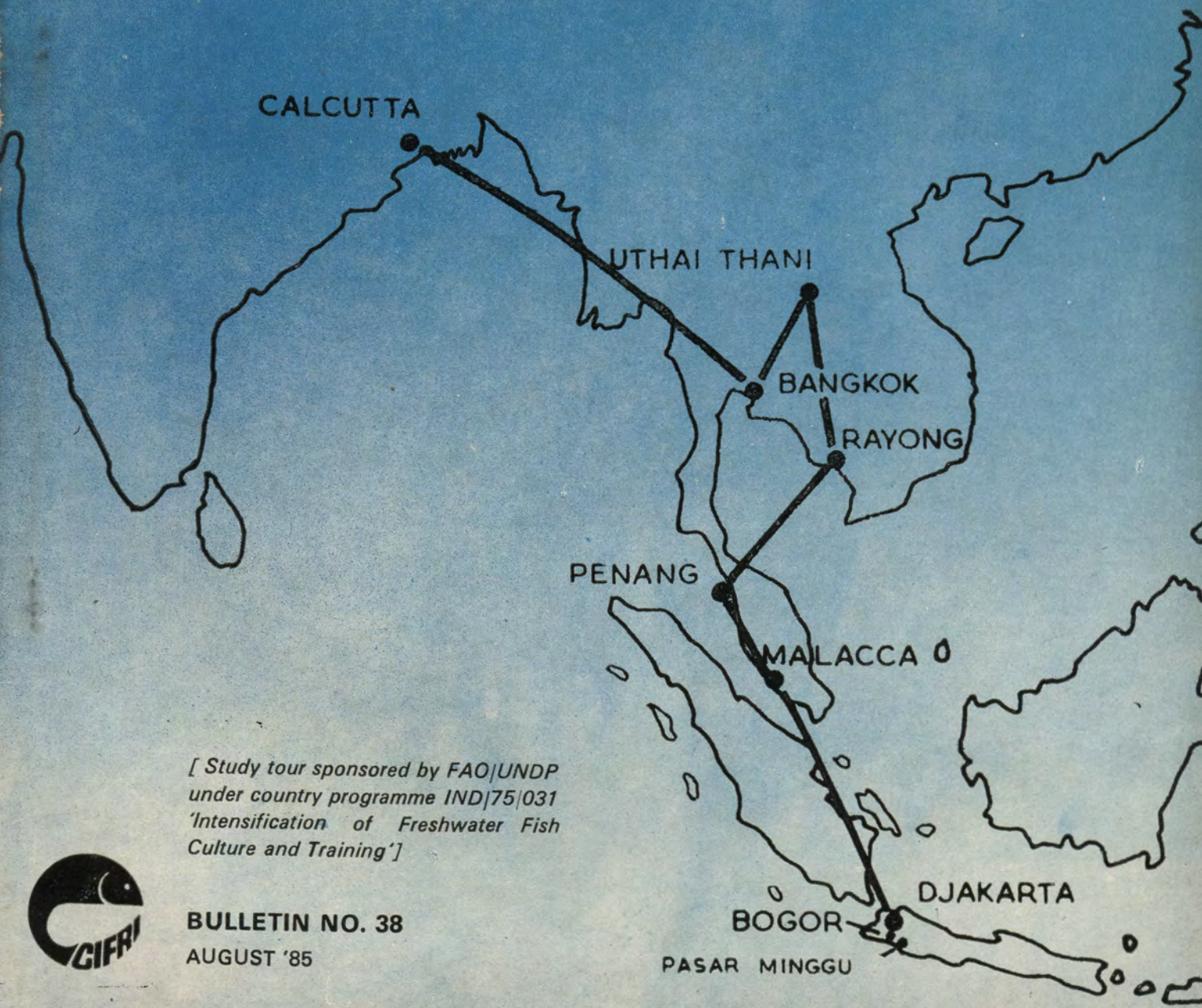

[Study tour sponsored by FAO/UNDP under country programme IND/75/031 'Intensification of Freshwater Fish Culture and Training']

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FISHERIES RESEARCH AND DEVELOPMENT IN THAILAND, MALAYSIA AND INDONESIA - A STUDY TOUR REPORT

(10 July - 24 July 1985)

BY

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[Study tour sponsored by FAO/UNDP under country programme IND/75/031 "Intensification of Freshwater Fish Culture and Training]

FISHERIES RESEARCH AND DEVELOPMENT IN THAILAND, MALAYSIA AND INDONESIA - A STUDY TOUR REPORT OF DR A.V. NATARAJAN, DIRECTOR, CENTRAL INLAND FISHERIES RESEARCH INSTITUTE, BARRACKPORE

(10 July - 24 July, 1985)

Left Calcutta on 10th July 1985 and arrived at Bangkok on the same day.

11-15 July 1985 (Thailand)

11th July : Visited National Inland Fisheries Research Institute on the campus of Kasetsart University, Bangkok and held discussion with Dr Thiraphan Bhukaswan, Director, NIFI, on organisational structure and research programme of the Institute. The research and extension activities of the Institute have been organised into ten units, namely, Fish Biology Unit, Ecology Unit, Fish Population Unit, Fisheries Management Unit, Water Pollution Unit, Aquaculture Unit, Fish Diseases and Parasites Unit, Fish Nutrition Unit, Taxonomy Unit and Extension Unit. The Institute is well equipped with library, computer facilities and an aquarium. The units cover programmes on Inland fish culture, fishery resources and habitat conservation, extension and training.

Visited the farm and hatchery facilities of the Institute which consists of 12 earth, 66 concrete ponds having a combined area of 1,400 sq m serving as brood stock and nursery ponds. The hatchery facilities include a series of fibreglass tanks of various capacities with well designed water and air supply system and is housed indoors. In addition the Institute has also a feed mill to produce fish feed pellets to serve the needs of nutritional research.

The existing hatchery facilities at the NIFI are at present used for research in breeding and seed production of tilapia (Red tilapia); Pangasius sanitwongsei, Aristichthys nobilis, Labeo rohita and Puntius gonionotus.

The catfish P. sanitwongsei is presently under the list of vanishing species and hence the breeding and hatchery success achieved in this species would go a long way in rehabilitation of this species.

12 July

Left Bangkok (Krung Thep) 9 AM for coastal town RAYONG on the Gulf of Thailand, situated about 250 km south of Bangkok.

On the way visited a private Kaset-Paw-Thip farm in Bangpree District. The farm is owned by Mr Voravit. He has established a small hatchery facility for Macrobrachium rosenbergii, Penaeus indicus and sea bass using instant sea water. The hatchery has air blower facility, hatchery made of six units of 6 ton capacity circular concrete tank and six units of rectangular concrete tanks each equipped with water inlet and outlet facilities, aeration system, drainage channel, two concentrated sea-water storage reservoirs each of size of 6 m X 6 m X 3 m., Fibre glass tanks of various capacities (½ to 1 ton), store room and pumping system facility. The hatchery has also an attached freshwater earth pond which is the main source of freshwater supply. The freshwater is used for dilution of concentrated sea water.

Also visited paddy fields specifically designed for breeding of Clarias batrachus in Bangpree District.

A series of parallel strips of dykes of 0.5 m height are constructed across the field which is also provided with perimeter tranches of 1 m depth. About 10 cm below the crest of dyke a series of horizontal holes of 30 cm diameter are dug to serve as breeding nests. Ten days after release of brood fishes in trenches, the water is raised to a level where holes in dykes are submerged and into which fish breeds. After 20 days the water level is lowered and the fry (10 mm) are collected for rearing in nurseries. About 1 million fry are produced in 1 acre paddy plots.

About 1,500 pairs of mature stock of C. batrachus are released in 1 acre of breeding paddy plots and about 2,000 holes (breeding nests) are dug in parallel dykes. The success of breeding depends on water level management.

The size of fingerling rearing pond of Clarias batrachus is 1,600 sq m. The depth of pond varies from 10 cm at inlet to 50 cm at outlet. The feed is made of ricebran and fish-meal (given in globular pellets). In addition ground meat of trash fish is also given to fry for which meat mincing machinery are installed in nurseries. The stocking density in rearing pond is 1 lakh fry per 1,000 sq m. Six crops are raised in a year.

The brood fish are maintained in separate ponds of 1,500 sq m area. They are fed with ground meat of trash fish mixed with ricebran.

The early fry of Clarias batrachus are sold at the rate of 1,000/10 Baht and fingerlings (1") 100/10 Baht.

Visited salt fields at CHONBORI province where brine shrimp Artemia salina is produced and the live specimens of brine shrimp are exported to Hong Kong @ 100 Baht per kg of brine shrimp.

Reached coastal Rayong on the Ban Phe Bay late in the evening on 12 July. Visited sea bass (Lates calcarifer) hatchery, shrimp maturation facility, shrimp hatchery at Rayong Brackishwater Fisheries Station, Ban Phe, Rayong.

Sea bass brood stock are held in a 1 ha pond which has a sluice control facility to draw sea water at high tide. Four pens each of 1,800 m^2 are installed within the pond. The pens are made of bamboo stakes. One hundred brood fishes are maintained in each pen. Four to five year old fish weighing 5-10 kg are used in breeding.

The fry of L. calcarifer are reared in concrete ponds of 120 sq m and depth 150 cm. The same pond is used till the fish attains 3 kg in 2 years. The juvenile and young carangids are chopped and given to fish till they reach a size of 3 kg. 3 kg sea-bass are then transferred to pens within earth pond. The salinity in the pond varies in the range 28-32 ppt all the year round in Ban Phe Bay.

The sea-bass breeding in captively is carried out during May to August. The synthetic hormone Puberogen, marketed by Japan, is found highly successful in breeding L. calcarifer. 50 I.U. of Puberogen per kg of female fish and 20 units for male were found effective. One dose at above rates is found adequate and is administered at the same time for both female and male fish. The administration of synthetic hormone is

done in the morning at about 10 AM. It takes 24-48 hours for ovulation. The fishes, before injection of hormone, is released in a concrete breeding pond of area 120 sq m. Mature specimens numbering 30 with female to male at ratio 2 : 1 are released in the breeding pond. The fertilised eggs are pelagic and are collected using a scoop net. The average fertilisation rate was found to be 80%. The size of the fertilised egg is 2 mm. The incubation period ranges from 14-18 hours. The complete absorption of yolk in the hatchlings takes place in 2 days. The 2-day old hatchlings are given rotifers (Brachionus plicatalis) upto 10 days.

The 12-day old fry of Lates calcarifer are given Artemia nauplii mixed with rotifer upto 1" size and fry 1" and above are given chopped fish mixed with Acetes.

The hatchery facility of sea bass consists of 18 units of 1 ton tanks (concrete tanks having 60 cm depth) and 25 units of 2 ton tanks.

The floating eggs of sea bass are transferred from breeding tanks to 1 ton tank for hatching. The 2 ton tanks are used for rearing hatchlings upto 15 days.

(The air blower of 5 HP capacity supply aeration for both sea-bass and shrimp hatchery) 10 HP pump used to provide water for hatchery (sea bass and shrimp) estimated at 1,000 cubic metre per day.

Annual production of sea bass fry at Rayong hatchery of Brackishwater Division was of the order of 3,00,000. More than 10 entrepreneurs in private sector are now involved

in production of sea bass seed in Thailand. Cost of production of sea bass fry at Rayong hatchery of Brackishwater Division of Department of Fisheries was 150 Bhat/1,000 fry while the selling price was 250 Bhat per 1,000 fry.

Thailand exports more than 1 million sea bass fry to Hong Kong, Taiwan and Malaysia.

The Brackishwater Division of Department of Fisheries at Rayong has also a shrimp hatchery facility and shrimp maturation facility. The hatchery is largely meant for P. monodon.

The shrimp maturation facility consists of 6 units of 10 ton-capacity concrete tanks with provision for water inlet and outlet and aeration facilities. The air and water piping system are made of PVC material. The maturation process is accelerated through single eye stalk ablation. Nearly 50% of ablated females die within 3 months while 20% males within 2 months. 50 ablated shrimps, 25 females and 25 males are released in each 10 ton-capacity concrete circular tanks. The average size of shrimps is approximately 100 gm. The brood stock of shrimps are fed horse mussel, squid and green mussel. It hakes 3 weeks for shrimps to attain maturation after ablation. Rematuration in ablated shrimps takes place between one and four weeks.

The fertilised eggs are hatched in 200 litre capacity fibreglass tanks. Normally 6,00,000 eggs are hatched in 200 litre capacity tanks.

Nauplii are transferred to 50 ton capacity tanks. The Rayong hatchery has 8 units of 50 ton rectangular concrete

tanks. 5,00,000 nauplii are stocked in each tank. 2 million PL-1 are produced in 8 units with 50% survival from nauplii to PL-1.

PL-1 post-larvae are transferred to 4 ton capacity concrete tanks provided with cover. 40,000 post-larvae PL-1 are stocked in each 4 ton concrete tanks. Survival rate from PL-1 to PL-15 is 70% to 80%. Cost of production of PL-15 post-larvae is 150 Baht/1,000 PL-15. Selling price is 200 Baht/1,000 at Rayong Brackishwater Station of Department of Fisheries while it is 350 Baht/1,000 PL-15 in private sector. There are 5 shrimp hatcheries (Penaeus spp) in Thailand in private sector.

The production cycle from egg to PL-15 in shrimp hatchery covers a period of 25 days a crop. In a year 10 crops are raised barring winter months (December and January) when the water temperature drops below 18°C. The Brackishwater Station produces 10 million post larvae of P. monodon in a year.

The fertilised eggs normally hatches in a day. The nauplii phase is covered in a 2 day period, Zoea phase in a 4 day period, Mysis phase in a 3 day period. Post larvae PL-1 to PL-15, a 15 day period. Thus a production cycle in P. monodon from egg to PL-15 covers a period of 25 days.

Larval feeding follows the following schedule. Late nauplii to Zoea are given diatoms (Chaetoceros) and bread yeast. Late zoea to Mysis stages are given rotifers and boiled red egg.

Late Zoea to PL-7 are given brine shrimp nauplii. PL-3 to PL-12 are given minced green mussel. The water management

consists in maintenance of 70-140 cm depth in larval rearing tanks and daily addition of 20 cm depth filtered waters during nauplii to mysis stage. Subsequently water management consists of change of water 1/2 - 2/3 gross daily.

Visited World Aquaculture Ltd. hatchery facilities at Rayong on 13 July on way back to Bangkok. This is perhaps the biggest brackishwater hatchery in south and south-east Asia and specialises in the seed production of sea bass and shrimp (P. monodon and P. merguiensis). The company has six branches and controls grow-out ponds (160 ha). The company is thus also involved in forward integration. The hatchery covers an area of 5 ha adjoining sea at Rayong and consists of brood stock ponds for sea bass (earth and concrete ponds) and shrimp (P. monodon) (concrete ponds, 50 ton capacity), hatchery, phytoplankton production unit (mainly Chaetoceros, Tetraselmis), zooplankton production unit (Brachionus plicatilis) and hatchery facility for artemia. The hatchery has a well designed water supply and aeration system. The water and air pipings are made of PVC material.

The company produces 20 million post-larvae of P. monodon; 10 million post-larvae of P. merguiensis; and 10 million fry of sea bass. The company sells at the rate of 300 Baht per 1,000 PL-15 of P. monodon and 3,000 Baht per 1,000 fry of 1" of sea bass. The company exports sea bass fry to Hong Kong, Singapore, Malaysia and Taiwan.

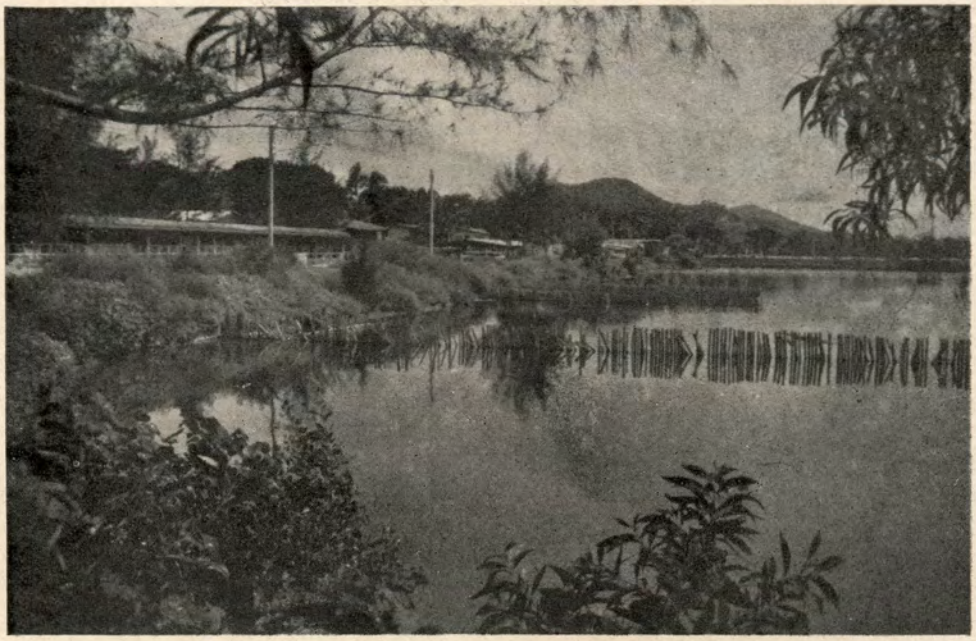
Visited a small reservoir at BANG PRA on way back to Bangkok from Rayong. The reservoir is shallow with a depth varying from 1-2 M. The shallowness has contributed to the profuse growth of aquatic weeds. Introduction of Tilapia

Backyard Freshwater prawn hatchery at BANG PRE (view of one section), Thailand.

Backyard Freshwater prawn hatchery at BANG PRE (another section), Thailand

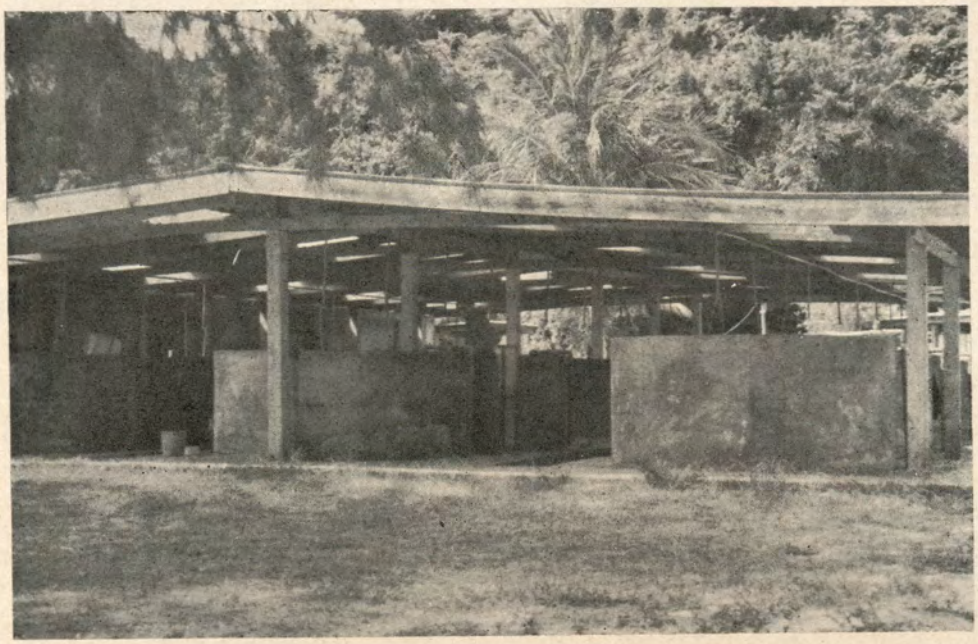
Fry rearing pond for Clarias batrachus at BANG PRE (Thailand).

Brine shrimp production in salt fields at CHON BORI province (Thailand).

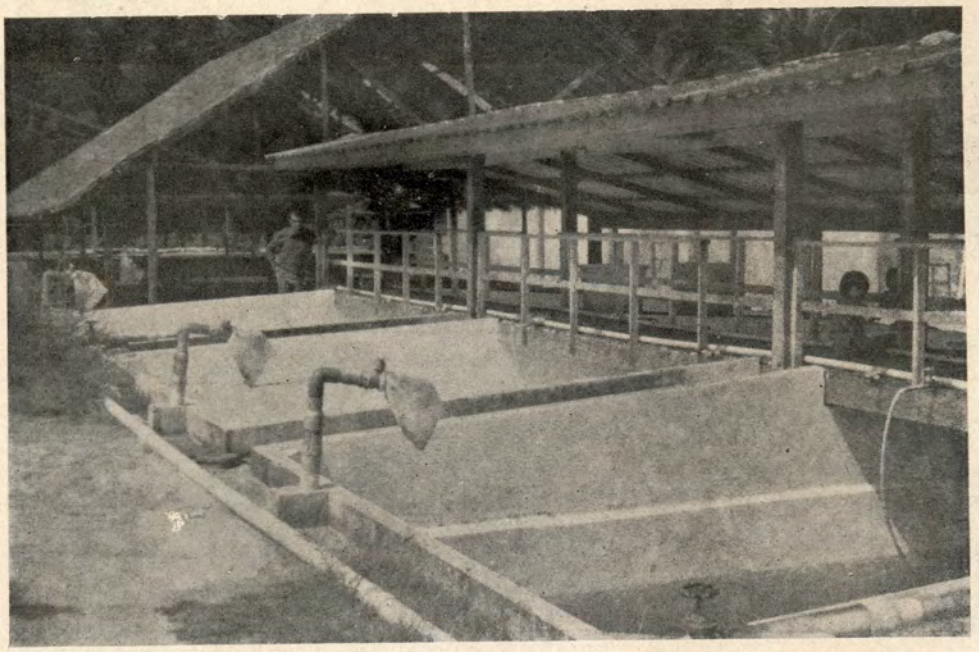


Pens for holding brood stock of sea bass (Lates calcarifer) at RAYONG (Thailand).

Hatchery facility for Lates crlcarifer at RAYONG (Thailand).



Shrimp maturation facilities at Brackishwater Fisheries Station at RAYONG (Thailand)



Larval rearing facilities for Penaeus monodon at RAYONG (Thailand).

Cage culture installations for P. sutchi at U THAI THANI in river SAKAE KRANG.

Another view showing fishes in the cages being given pelleted feed (U THAI THANI)

HATCHERY MANAGEMENT PROCEDURE FOR ESTUARINE SHRIMP AT RAYONG BRACKISHWATER FISHERIES STATION BAN-PHE, THAILAND

NUMBER OF DAYS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
STAGES	E	N_1	N_2	Z_1	Z_2	Z_3	Z_4	M_1	M_2	M_3	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}	P_{11}	P_{12}	P_{13}	P_{14}	P_{15}
FOOD	YOLK																								
	DIATOMS / BREAD YEAST																								
	ROTIFER / BOILED RED EGG																								
	BRINE SHRIMP																								
	MINCED GREEN MUSSEL																								
WATER MANAGEMENT	70 — 140 cm. DEPTH																	DAILY CHANGE OF WATER 1/2 — 2/3 GROSS DAILY							
	DAILY ADDITION OF 20 cm. DEPTH FILTERED WATER																								
POND CLEANING	POND BOTTOM CLEANING																								

REMARK 1) TRANSFER SHRIMP SEED TO ANOTHER REARING POND AT P_1 STAGE

2) HARVEST SHRIMP SEED AT P_{13} P_{15} STAGE

nilotica and Thai carp (Puntius gonionotus) has not helped in the control of weeds. In 1984, Chinese grass has been stocked. In Thailand the small reservoirs give an average production of 60 kg/ha. Under proper management they have potential for higher yield.

Visited a backyard hatchery for Macrobrachium rosenbergii belonging to Mrs. Orasa at Bangpra. The hatchery covers an area of 0.5 ha and has 4 blocks.

The first block has 8 rectangular units, each unit of 4 compartment rectangular concrete tanks with each compartment measuring 9' X 4' X 4'.

The second block has 22 circular tanks of 1 ton capacity. The third block has 8 rectangular units each of 4 compartments (10' X 4' X 4') and fourth block of 7 units each of two rectangular compartments.

The hatchery has 10 ton storage tank for freshwater and 15 ton storage tank for concentrated saltwater and 5 ton storage tank for mixed water (dilution of salt water with freshwater). The hatchery has an air blower of 3 horse power capacity. All the tanks are provided with water inlets and outlets and are equipped with aeration pipes.

The concentrated sea water is brought by truck 20 km away from hatchery site at the rate of 600 Baht per 12 ton of concentrated sea water.

The hatchery produces 1 million post-larvae per crop and 10 crops are produced in a year. The post-larvae of

Macrobrachium rosenbergii are sold at the rate of 10 Baht per 100 PL.

1,000 backyard hatcheries for Macrobrachium rosenbergii are now known to operate in Thailand. There are indications of oversupply of Giant freshwater prawn seed.

15 July 1985

Visited U THAI THANI province, 250 km north-west of Bangkok to observe cage culture operations of Pangasius sutchi. These operations appear to be going on for well over 3 decades along both banks of the river Sakae Krang, which is a tributary of Chao Praya river as per information supplied by one of the owners of cage installations, Mr. Som Phot. The cages are part of floating houses, both of which are kept afloat by bamboo rafts. The operators live whole time in the floating houses with their families. The tributary is a small stream varying in width between 300 and 500 M and has a maximum depth of 12 M. The river flow is meagure and appear stagnant at the time of visit.

Both the house and the cages are made of hardwood (local name Tachean). Along the banks where the cages are installed the depth varies 2 to 8 M. The cage size is 6 X 3 X 15 M, made entirely by hardwood planks. There are slots on the top used for feeding. In addition to kitchen wastes, the fishes are also given pelleted feed commercially available. The pelleted feed as per manufacturers is made of fish-meal, soyabean, coconut cake, corn starch, rice bran, vitamins and minerals. The feed contains 16.5% protein and

5% lipid. Pangasius fry of 5" size numbering 1,000-2,500 are stocked in 27 M^3 capacity cage. The fish are fed only once in the evening. Period of culture for markets is one year. Each cage produces 1 to 1½ ton of fish. The selling price at farm gate is 14 Baht per kg while at market it is 16 Baht per kg. Cost of production is 7 Baht per kg of fish.

The operators raise their own Pangasius seed during rainy season, July-August. Separate floating cages are maintained for brood stock. The operators have their own recipes for brood stock rations which they would not disclose but enquiries reveal they generally consist of fishmeal and rice bran. Homoplastic pituitary administration is resorted to for breeding. Stripping is done twelve hours after administration of pituitary gland extract. The dose details are not disclosed. The incubation period is 18 hours at 28°C. The two day old hatchlings are fed with rotifers (Moina). High density rotifers are produced in trash fish meal-rice bran mix medium. At a later stage fry are fed with duck weed and fish meal till they reach 5" size when they are ready for stocking in cages for culture to table size fish. Fry are also reared in floating cages.

Some operators are also found to grow Gourami (Osphronemus goramy) alongwith Pangasius in cages. They also engage themselves in 'smoking' operation of fishes, largely made of carp minnows captured from the river, in their floating households.

Left Bangkok 16 July and arrived at Penang on the same day.

17-18 July 1985 (Malaysia)

Visited Fisheries Research Institute, Glugor, Penang and held discussion with Dr. Mohd Shaari Bin Sam, Abd. Latiff, Director of Research, on organisational structure and research programmes pursued by the Institute. The Institute has four sections, namely, Resources section, Ecology section, Aquaculture section and Administration section and control research in marine and inland fisheries and aquaculture under one roof. While marine research is pursued at Glugor, Penang, Headquarters of Fisheries Research Institute, brackishwater culture programme is pursued at Jogor and freshwater culture programme at Malacca. The Aquaculture section at Glagor conduct hatchery research in Macrobrachium rosenbergii.

The Giant Malaysean Freshwater Prawn hatchery facility at Glugor includes fourteen 16-ton concrete tanks and seventeen 2-ton fibreglass tanks. The sea water is pumped from the adjoining sea to 2 settling tanks each of capacity 400 tons. The settling tanks are under opaque roof to prevent plankton growth and exposure to rainfall. The water is passed through filters and to overhead gravity tank from where it is supplied to larval rearing tanks. Freshwater is also stored in a reservoir which is exposed to sunlight to remove chlorine and then is pumped to gravity tanks.

All sea water and freshwater piping and valves are of PVC material. Root-type positive displacement air blower is used for aeration of rearing tanks.

The rectangular fibre glass tank is of dimension 3 X 1.2 X 0.6 M (2 ton capacity) while large concrete tanks

are 8 X 2.3 X 0.9 M (16 ton capacity) and both are used for larval rearing of Giant freshwater prawn. The concrete surfaces are given coating with epoxy paint or polyester resin. Twenty small fibre glass tanks of 0.9 X 0.6 X 0.6 M are used for holding and incubation of berried females.

The whole hatchery complex is housed indoors. The ratio between translucent and opaque roofing is adjusted in relation to optimum requirement of light and temperature.

The brood stock of Giant freshwater prawn is fed with cockle (Anadara granosa).

The cysts of the brine shrimp is hatched in conical fibreglass tanks with aeration from bottom for better hatching efficiency. In addition to brine shrimp nauplii as larval feed, culture of brackishwater cladocerans (Diaphanosoma) was carried out using unicellular green algae as feed. The cladoceran has been found a good larval feed and a good substitute for Artemia. Egg custard, fish flesh, dried egg yolk and powdered chicken feed are also used as feed for Giant freshwater prawn larvae.

Berried females of size 80 gm and above are first held in small fibreglass tanks till they are ready to hatch and then transferred to larval rearing tanks for direct hatching after which the females are removed.

Both clear and green water are used for larval rearing. The salinity at 10-15 ppt is maintained during larval rearing.

Under proper hatching management the production cycle takes 40 days with a production rate of 10,000 post-larvae/juveniles per ton rearing tank volume.

The Glugor Giant Freshwater Prawn hatchery produces 1-2 million post larvae/juveniles per year.

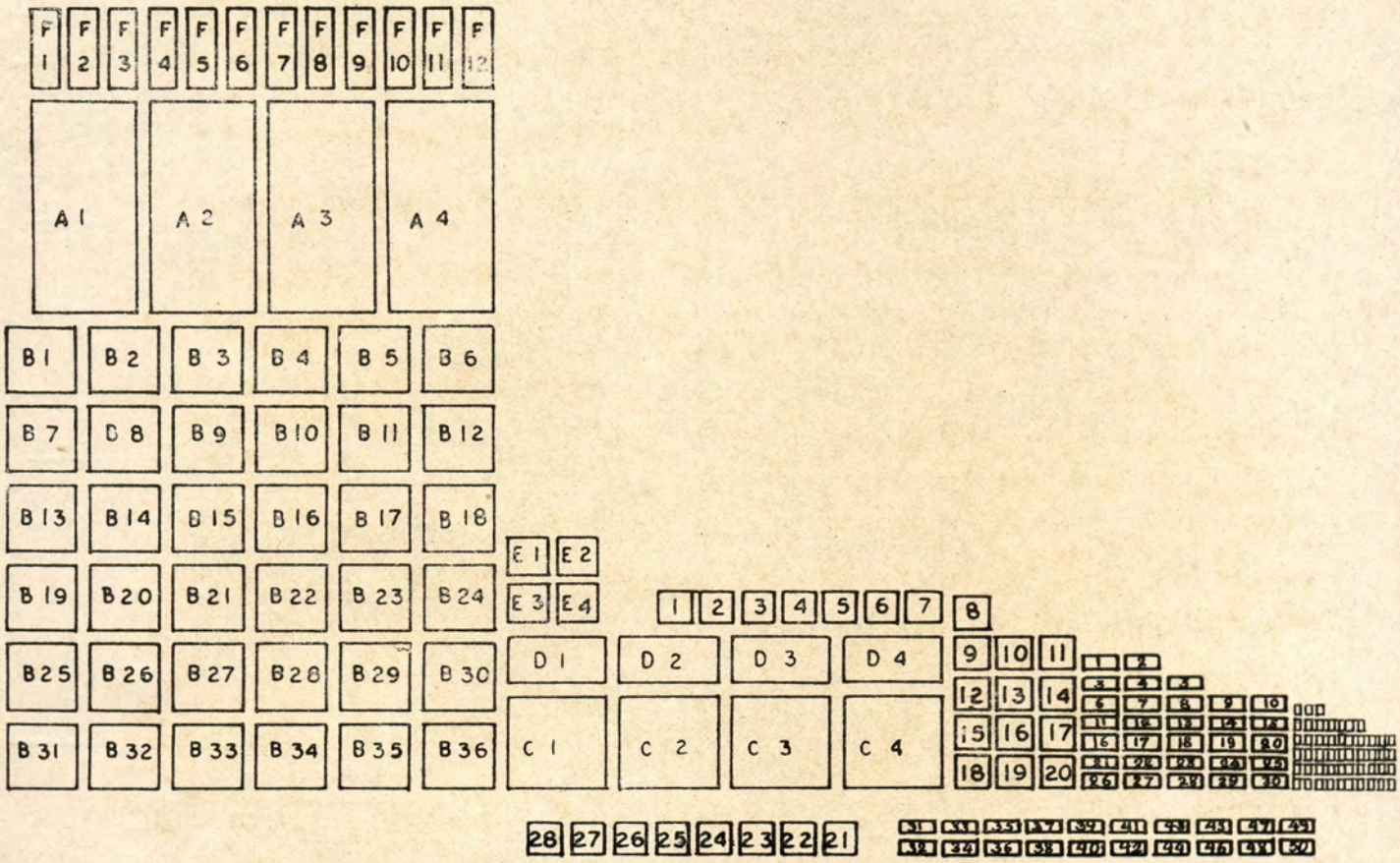
The Glugor hatchery is also now used as hatchery for sea bass.

The wild spawners of sea bass are held in floating cages in the sea and are induced bred during March-July period. The incubation period of developing egg is 10-17 hours. The hatchlings depend upon its own yolk on first day but feeding is initiated from 2nd day onwards. Rotifers are supplied as feed during 2-14 days of rearing. Artemia and Acetes mix are given for fry of 14 days and above.

The Glugor hatchery is also used for breeding and larval rearing of P. monodon. Mixed natural diatoms are given for Protozoea, Artemia nauplii for Mysis stage; pelleted commercial feed (as meals) for post larvae. The post larvae are grown upto PL-20.

The Glugor hatchery depends upon wild spawners of P. monodon. No breeding programme of shrimp species is undertaken during May, June and July due to southerly winds and rough seas.

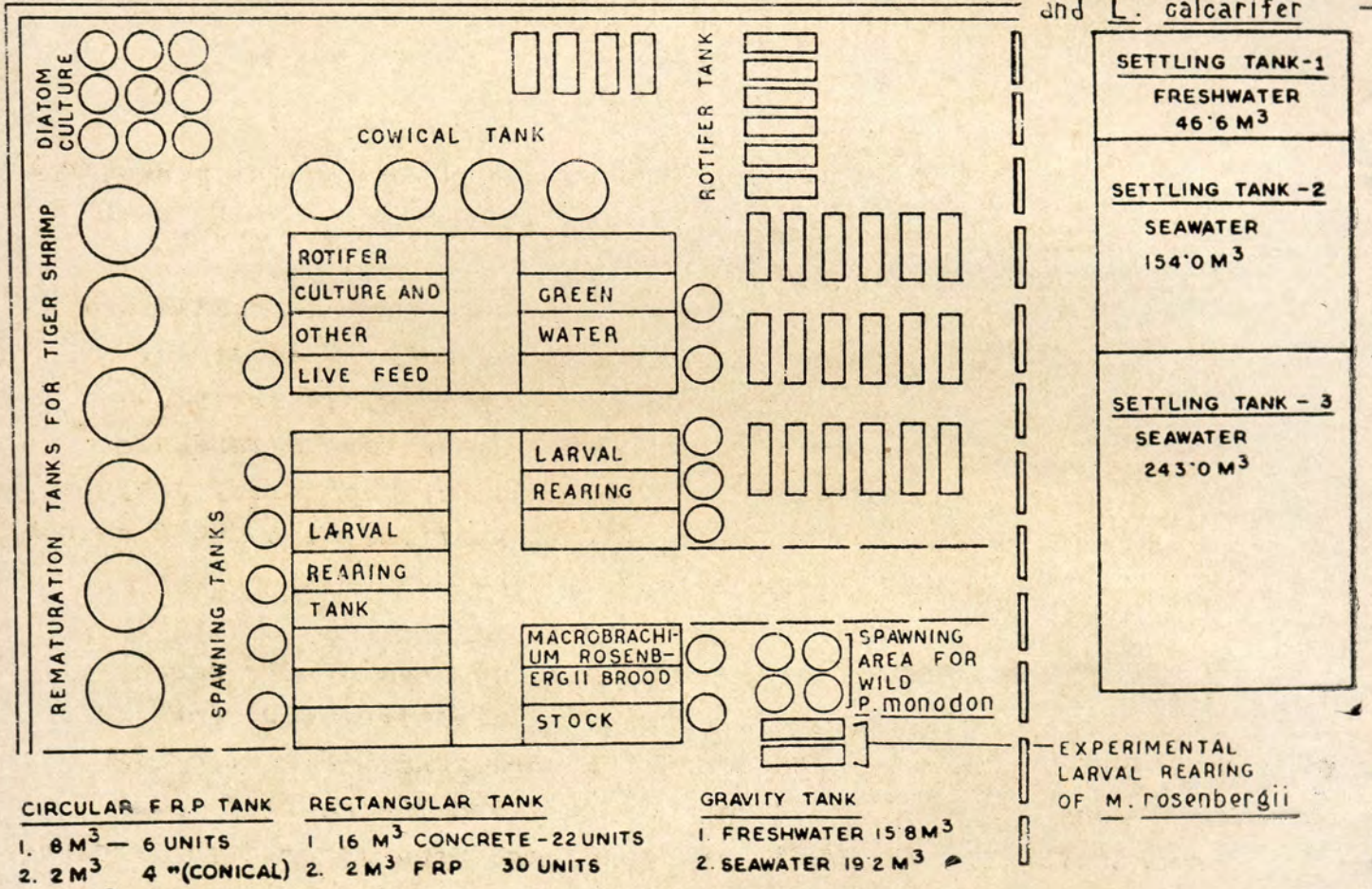
The lay-out of Glugor hatchery, now used as a composite hatchery is given elsewhere in this report.



LAY-OUT OF FARM FACILITIES IN BATU BERENDAM, MALACCA, MALAYSIA

LAYOUT PLAN OF FRESHWATER PRAWN HATCHERY AT GLUGOR, PENANG, MALAYSIA

[NOW USED AS COMPOSITE HATCHERY FOR P. monodon . M. rosenbergii and L. calcarifer]



CIRCULAR F.R.P TANK

1. 8 M^3 — 6 UNITS
2. 2 M^3 4 "(CONICAL)
3. 0·5 M^3 27 "

RECTANGULAR TANK

1. 16 M^3 CONCRETE - 22 UNITS
2. 2 M^3 F.R.P 30 UNITS

GRAVITY TANK

1. FRESHWATER 15·8 M^3
2. SEAWATER 19·2 M^3

Left Penang on 19 July and arrived at Malacca (MA LEKA) on the same day.

19 July (MA LEKA)

Met Mr. Ti Teow Loon, Head, Freshwater Fisheries Research Centre, Malacca (MA LEKA).

The centre has a Research section, Service section and Administrative section. The Research Wing has 7 sections, each of which is headed by a Research Officer, an Assistant Research Officer, Fishery Assistants, Laboratory Attendants. The service section covers tractor drivers, mechanics, pump operators and labourers. Some of the sections have two Research Officers. Total sanctioned staff of the Centre is 103.

The Centre has a farm covering an area of 217 acres. There are in all 192 ponds varying in size from 0.01 acre to 4.5 acres. There are 36 nos. of 1 acre pond, 16 nos. of ½ acre pond, 28 nos. of ¼ acre of pond and the rest of lower denominations. The 0.01 acre ponds are used for rotifer production (Moina) and as nurseries. The lay-out of the farm is given elsewhere in the report. The Research Wing of the Centre has the following 7 research sections.

1 Mono- and Polyculture Fishery Section

Largely confined to evolving culture practices for economic species for high production and productivity. The fishes covered are Bighead, grass carp, Puntius gonionotus,

red tilapia, Pangasius sutchi and Macrobrachium rosenbergii.

2 Air Breathing Fishes Section

Research on cultural practices on Pangasius sutchi, Clarias batrachus, Clarias macrocephalus, Trichogaster pectoralis is conducted by this section.

3 Breeding Section

Species studied include indigenous carp species and grass carp, big head, catla, rohu among exotic carps.

4 Tilapia Section (Breeding and Culture)

The section devotes on developing red tilapia strain. Red tilapia is gaining popularity in Malaysia especially in Chinese restaurents. Stocks received from Philippines and Taiwan reveal that Red tilapia does not breed true to colour with off-spring belonging to red and pinkish types or displaying pink with black blotches.

5 Feed and Nutrition Section

The present research effort is towards developing feed for Pangasius sutchi and local carps. Local poultry feed mill is associated in the production of fish feed on the basis of formulations evolved by the section through feed trial bioassays and fish nutrition studies.

6 Disease Section

Devotes on microbiological, bacterial and parasite aspects of fish diseases.

7 Limnology and Cage Culture

Limnological studies are largely devoted to evaluating the suitability of different aquatic habitats for cage culture.

The centre has also taken up a preliminary limnological survey in three reservoirs, namely Durean Tunggal (Me Leka), Chenderoh (Perak) and Bukit Merati (Perak) and limnological observations made rotationally every 2 months i.e. 18 observations in a year for all the three reservoirs.

University of Penong and University of Malaya, Kualalampur are also involved in studies in reservoirs, but such studies are limited to ecological and biological aspects but not on fishery management.

The Polyculture section of the centre has achieved a maximum production of 6.2 tonnes in 2 crops per ha/yr using Big head, grass carp, Puntius gonionotus, Red tilapia, Pangasius sutchi and M. rosenbergii. The Big head attains a size of 800-1,000 gm, Grass carp 800-1,000 gm, P. gonionotus 350 gm, Red tilapia 150 gm, P. sutchi 300 gm, Macrobrachium rosenbergii 50 gm. This production rate has been achieved using only poultry manures. No supplementary feeding is given except for Napier grass for grass carp.

The Extension Division of Department of Fisheries produces only local carp fry. The Chinese carp fry are imported from Taiwan, Hong Kong, fry of 1" size costing 10 cents. Carp seed import has been going on for a number of years and carp culture in Malaysia is based on such imports by and large.

Sea fish fetches much higher price in Malaysia than freshwater fish with the exception of air breathing fish which is a costly item in any restaurant where they hold live air breathing fishes. Among Chinese carps Big head fetches high price only for head part but not for body part. Silver carp has no market in Malaysia.

20 July 1985

Visited the Laboratories. At limnology laboratory the study was restricted to limnochemical aspects of three reservoirs already referred to and cover parameters like water temperature, pH, Sp. conductivity, NH_3-N, NO_2-N, NO_3-N, PO_4, Hardness, Calcium, Magnesium, SO_4, Sulphite, Chloride TDS, Sodium, Potassium, Secchi disk, transparency and primary productivity.

Visited Air Breathing Section laboratory and hatchery facilities attached to the Section, the latter being largely made of 12 nos. of 2 ton capacity cement cisterns (rectangular) with well designed water circulation and aeration systems. The breeding programme is largely confined to Clarias macrocephalus, Pangasius sutchi (classified as air breathing fish in Malaysia) and Trichogaster pectoralis. Clarias macrocephalus, under culture practices, at Malacca Research Centre grows upto 1 kg in 12 to 14 months. The fecundity of the fish is 20 to 30 thousand eggs per 200 gm of fish. The eggs are demersal and adhesive.

C. macrocephalus responds by breeding to two doses of homoplastic administration of pituitary gland extract, each dose being equivalent to a pituitary gland of donar fish of same weight

as recipient. The fish also responds to H.C.G. at 350 I.U. per 50 gm of male fish. LRH - analog (Chinese formulation) is also effective at doses of one I.U. per gm of fish for induced breeding.

[The breeding of Clariid catfish C. batrachus in designed paddy fields is done in Malaysia in the same manner as is followed in Thailand]

The Malacca Freshwater Research Centre has also achieved success in breeding Pangasius sutchi. The fish is induced bred using HCG along with homoplastic pituitary gland extracts. The fish needs 100 I.U. of H.C.G. as primary dose, followed by 300 I.U. of H.C.G. plus one dose of pituitary gland extract (the meaning of dose already defined early) as stimulatory and finally followed by 500 I.U. of H.C.G. plus 1.5 dose of homoplastic pituitary gland extract as resolving. The results achieved indicate 100% ovulation.

P. sutchi has a fecundity of 1 million eggs per 3 to 4 kg of fish. The fertilised egg is demersal and measures 0.1 mm. The incubation period is 22 to 25 hours. The yolk absorption in hatchlings is completed in 2 days.

The hatchlings after yolk absorption are highly cannibalistic and involves saturation feeding to overcome this tendency. The processed cockle meat is given during nursery phase. The cockle Anadora granosa is de-shelled using boiling water, the cooked meat ground in blender and sieved using 200 micron sieve before given as feed for hatchlings. The hatchlings reach a size of 10 mm in 10 days.

Trichogaster pectoralis grows to 70 to 80 gm and has a good local market as a live fish. Eichornia roots are used as a nesting substrate for this fish. Male fish prepares a bubble nest in which the eggs are deposited. The eggs are collected and transferred to an enamel/plastic basin for hatching. The yolk absorption takes place within 2 days of hatching. The 2-day old hatchlings are given rotifers (Moina) initially for a few days and transferred to nursery ponds. They are given a ration of fish meal and rice bran at 32% protein level as a supplementary feed at nursery ponds.

Visited Red Tilapia Fish Genetics Laboratory, Fish Disease Laboratory and Fish Culture Laboratories and connected experimental facilities. Efforts are underway to develop a pure strain of red tilapia at the Research Centre.

During 19th and 20th July discussed various research programme of the Malacca Centre with Mr. Ti Teow Loon, Head, Freshwater Research Centre, Malacca, Mr. Zulkafli Abd. Rashid, Mrs. Thalathiah, HJ. Saidin, Mr. Chuah Hean Peng and Ismail Awang Kechik.

Arrived Jakarta on 21st July 1985.

22-24 July 1985 (Indonesia)

The Agency for Agricultural Research and Development (AARD) promotes and controls research in agriculture, horticulture, industrial crops, animal sciences and fisheries.

Visited Research Institute for Inland Fisheries at Bogor, 80 km south of Jakarta. Met Mr. Atmadja Hardjamulia,

Head of the Institute and visited the laboratories. The Institute has Fish nutrition, Fish feed and Fish disease sections. Besides it also has frog breeding section. The fish nutrition and fish feed technology section has a wet laboratory having 34 fibreglass tanks (150 litre capacity) for feeding experiments, 3 aluminium tanks for water stability test for pellets, a workshop provided with a meat chopper, grinder, mixer and blender required in connection with pellet preparation and a chemistry laboratory for proximate analysis of ingredients and feed for crude protein, fat, ash, carbohydrate, calcium and phosphate. The fish disease section is provided with a wet laboratory for pesticide residue experiments.

The Institute has in addition separate hatchery facilities for fish and frogs and is provided with a generator, air blower and water conveyor system and is provided with a battery of cement cisterns, fibre glass tanks of various shapes and dimensions.

The Institute has achieved success in breeding and culture of Rana catesbiana. The young frog of this species was introduced from North America. It takes about 1½ years for the young frog to attain maturity. The physical facilities include spawning-cum-culture unit, hatching unit and tadpole rearing unit.

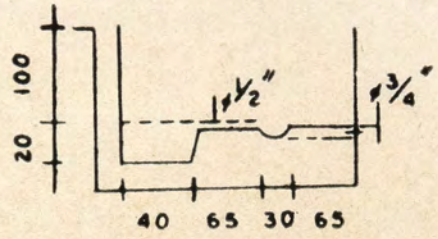
The spawning-cum-culture facility has three sub-units and is made of a spawning pond of concrete structure of dimension 6½ X 1½ X ½ M. This is connected to a concrete cistern of 2 X 1½ X ½ M chamber. The last one has circular (½ M dia) perforated aluminium basin fitted into a circular depression.

The basin has provision to receive water from an inlet pipe and is discharged through a drain pipe. The outlet pipe is controlled by a valve such that 4" deep water can be retained in aluminium feeding basin. The incoming water agitates the food (chopped snails and worms) to which the frog is attracted towards the moving (agitated) feed in the basin. The whole structure is covered by metal screen on sides and top with provision of door for entry. There are six such spawning-cum-feeding units. All pipings are of PVC material.

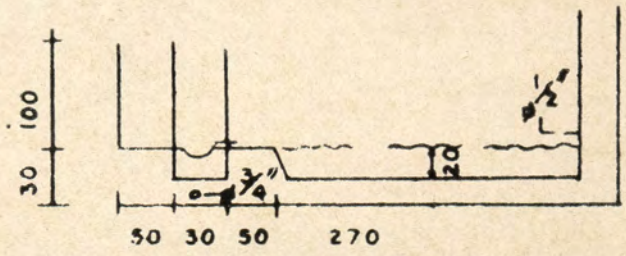
5 pairs of mature frogs in the ratio of 1 : 1,M : F are released into spawning pool. The egg mass are then transferred to hatching pool facility which has water intake and outlet pipes and aeration facilities. There are 8 hatching pools in 2 rows and each of 1 X 1 X ½ M size. The incubation takes 3 days.

The hatchlings are transferred to tadpole rearing concrete tanks each of 2 X 2 X 2 M. There are six such units. They have water intake and drain pipes and aeration facilities.

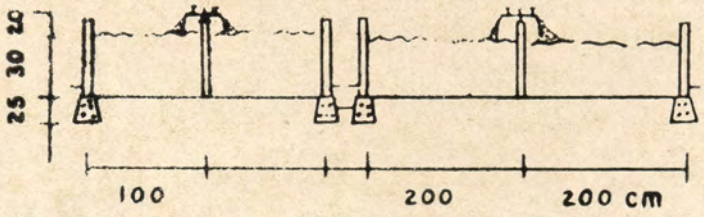
It takes 2 to 3 months for the larvae through hatchling and tadpole stages before metamorphosis to early frog. No cannibalism is encountered during tadpole rearing in Rana catesbiana. The tadpole are fed with fish meal and leaf (Amaranthus) the latter ground and used in powder form and with composite feed containing 28% protein. The ration is given at 10% body weight each day. The early frog is given chopped snails and worms in feeding basins as described above. The newly metamorphosed frog registers a growth of 10 gm during 1st month and 200 to 250 gm in 10 months. The hind legs form 30% of body weight.



CROSS SECTION OF FEEDING TANK
OF Rana catesbiana



CROSS SECTION OF BREEDING TANK
OF Rana catesbiana



CROSS SECTION OF HATCHING TANK
AND REARING TANK (TADPOLE)
OF Rana catesbiana

RESEARCH INSTITUTE OF FRESHWATER FISHERIES
BOGOR, INDONESIA

The breeding takes place in rainy season in September-April period in Indonesia.

The frog species Rana cancrivora and R. lymnocharis are encountered in rice fields in Java while Rana macrodon is common in Sumatra. The paddy pest Nilaparvata lugens, besides crabs and worms, are encountered frequently in the diet of R. cancrivora and R. lymnocharis.

Visited running water fish culture installation at Cinagara about 20 km from Bogor. The owner of the facility is Mr. M. Sulaeman. The running water installation was established in 1981 and consists of 2 nursery units, each of 200 M^2 and a depth of 1 M; 7 nos. of grow-out ponds each of 60 M^2 in area and 1.5 M in depth; and a brood stock pond of 2,000 M^2 with a depth of 1½ M. All units are of concrete structure with water intake/sluice and drain pipe facilities. The source of water is Cinagara river from which water is drawn into 1 ft. wide concrete canal. The facility includes a store house and living quarters.

The cost of the whole installation including land is about 25 million ruppia (Indonesian currency) and occupies an area of 4,000 M^2.

The common carp is commonly cultured in the running water system. The variety used appears to be a hybrid between a local strain and Taiwan strain. The fish is bred and fingerlings raised within the running water production complex. The stocking size of the common carp is 100-200 gm and 40-80 number of fingerlings are stocked per sq m area. The pelleted commercial feed containing 26 to 28% protein is used as feed. The feeding ration was at the rate of 4% of the body weight during

first month; 3.5% during second; and 3% during the third month. The culture period is only for 3 months and the fish grows on an average 400 gm during the three month culture period.

The net production is 2 tonnes/60 sq M/3 months. On an average about 3 crops are taken in a year. No disease problem is encountered in running water system.

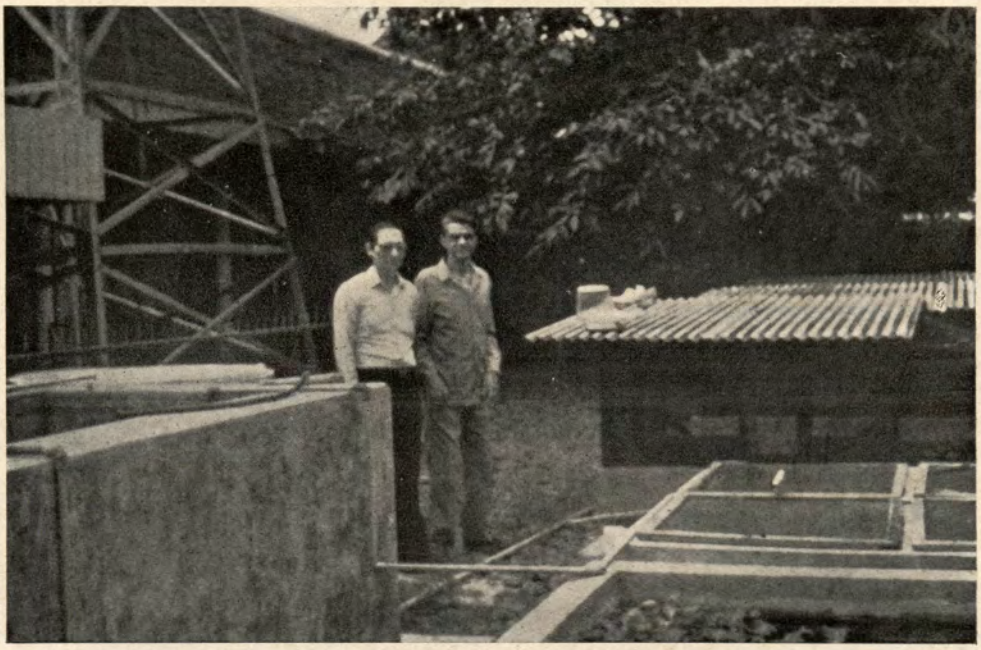
The fish is marketted at Jakarta. The cost of production is 1,300 ruppia per kg of fish while selling price at farm gate is 1,500 ruppia per kg.

In the village visited there were 17 running water units. Enquiries show that there are as many as 1,800 running water installations in West Java. The culture installations are put up at elevation 600 msl to 900 msl to take advantage of running water of hill streams.

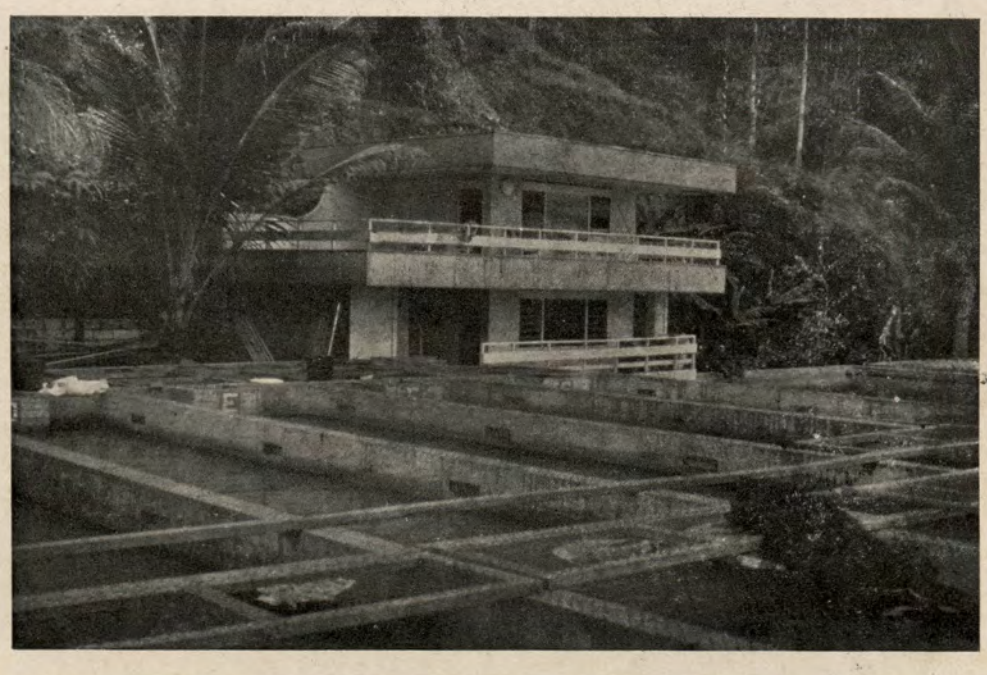
Visited experimental floating cage culture installations of the Bogor Research Institute on a natural lake at Lido, 20 km from Bogor. The maximum depth of the lake is 40 M. The floating structures are made of metal frame which are floated on iron drums or barrels and encloses 33 floating net cage units. The facility includes a floating watchman's hut and a boat. Each cage is of dimension of 7 X 7 X 1½ M. The common carp and Tilapia nilotica are cultured in these units. The stocking density is 30 to 60 number of fingerlings per sq m and the size of fingerlings are 100-200 gm. They are given pelleted commercial feed. A net production of 1,000 kg per cage in 4 month is achieved. Two crops are raised in a year.

Visited set cage culture installations on Cibalok river near Bogor at msl 258. These cages are known locally as

Runing water cage culture installations (Keramba) *on CIBALOK river near Bogor, Indonesia.*



Frog hatchery and larval rearing tanks at BOGOR, Indonesia.



Running water culture inst llation at CINAGARA near Bogor, Indonesia.

Runing water culture installation at CINAGARA (another view), Indonesia.

Keramba. The cage is made of wooden planks with opening at top for harvesting. The cages are set all along the bank of the river one below the other on both sides, each cage separated from the other by a few meters only. The stream varies in width from 20 to 100 M. Each cage unit is 4 M long, 2 M wide and 1 to 1½ M deep. The cage is set ½ M below surface of water with a free board of ½ to 1 M above water level. Common carp is cultured in these cages. The production varies from 1 to 3 kg/sq m in a culture period of 3 months. No supplementary feed is provided, the production depending entirely on natural feed.

23 July 1985

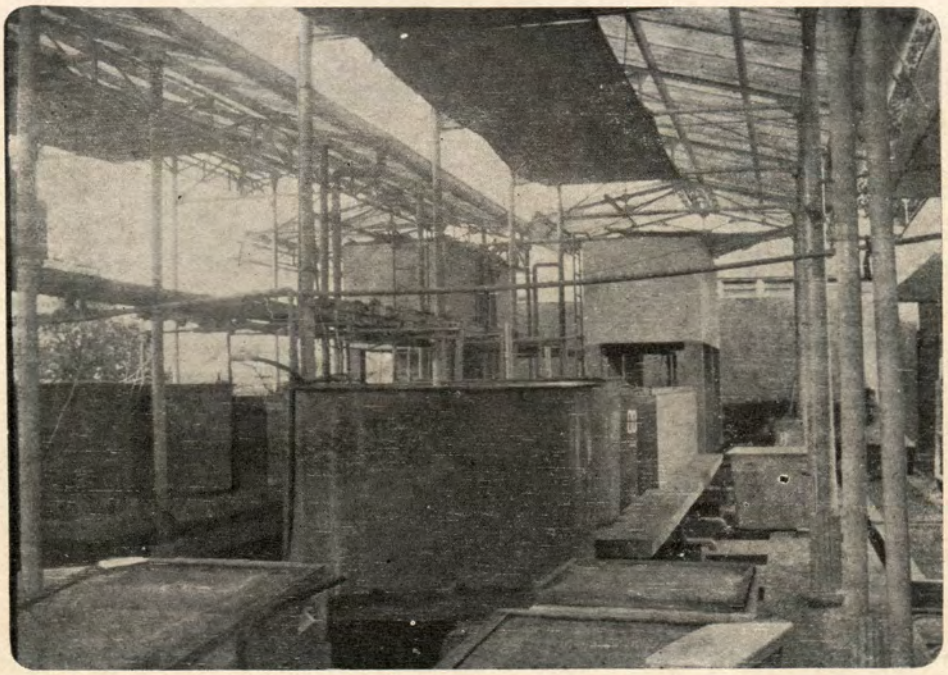
Visited Freshwater Prawn Research-cum-hatchery Centre, at Pasar Minggu, 10 km south of Jakarta. The centre is 20 km away from sea coast on the north (Java sea). The hatchery for M. rosenbergii was established in 1952 but the research programmes on breeding and larval rearing of 'Udang galah' (M. rosenbergii) was initiated in 1973 only. The centre has three scientists namely Mrs. Haniah Handidjaya Suharto, Officer Incharge of the centre, Mrs. Darti Satyani, Incharge of Hatchery and Mrs. Lies Emmawati, Incharge of Water Management of hatchery. The hatchery has larval rearing tanks (800 litres capacity); breeding tanks (4 X 2 X 0.5 M); post larvae rearing tanks (4 X 2 X 0.5 M); and Artemia culture tanks (500 litres capacity). It has in addition Root-type air blower, generator, sea water storage tank (7 M^3 capacity) and brackishwater storage tank (7 M^3 capacity). There are 12 units of larval rearing tanks, 3 units for post larval rearing tanks and 3 units of spawning tanks. All are provided with water inlets, drain pipes and

aeration pipes and are made of PVC material. These units together produce about 0.5 million PL per cycle. There are 8 production cycles in a year. To achieve the above target about 1,280 brood stock (M + F) (45% of which is assumed to become berried)is required. About 70 PL/L is expected to survive at a stocking density of 150 Zoea/L.

The hatchery has also 50 L capacity double layed experimental green fibreglass tanks (conical type) in sets of three as a single unit. The inner tank is used for larval rearing while the outer 'buffer tank' is used to control temperature. The 'buffer tank' is filled with freshwater and is provided with 600 W heater to maintain water temperature at 29-31°C.

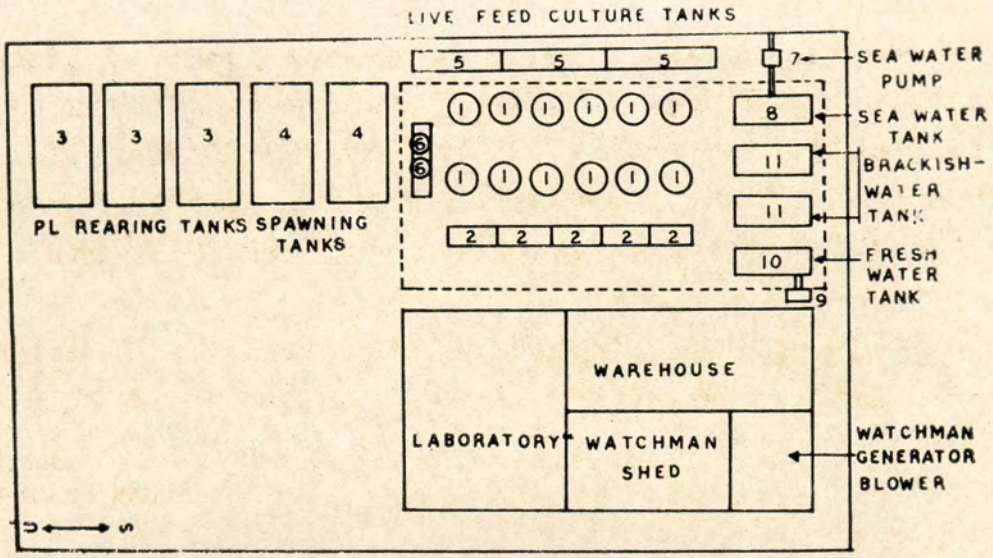
The salinity is kept at 8 to 10 ppt during larval rearing period. The Zoea reach 11th stage by 25 days. The PL is retained in post larval tanks for another 20 days. The larvae is given artificial feed as well as brine shrimp nauplii. The artificial feed is made of wheat flour, fish meal (Channa spp.), non-fat dry milk, chicken egg, vitaminsA, B. complex, C and D, calcydol, coccilin/antibiotics. The formulation has 44.2% protein, 15.1% fat, 1.47% calcium, 2.05% phosphate and 22.3% carbohydrate. For every 5,000 larvae reared, artificial feed and brime shrimp nauplii are given @ 1 gm/5 nos. of B.S. nauplii for 1 to 6 stages of Zoea 3 to 5 gm/5 nos. of B.S. nauplii for 6 to 11 stages of Zoea and 6 to 12 gm/10 nauplii for PL.

During larval rearing siphoning and water replacement are done every day. Streptomycin was given once three days at 1.5 ppm as preventive measure.



Hatchery for fresnwater prawn (M. rosenbergii) at PASAR MINGGU near Jakarta.

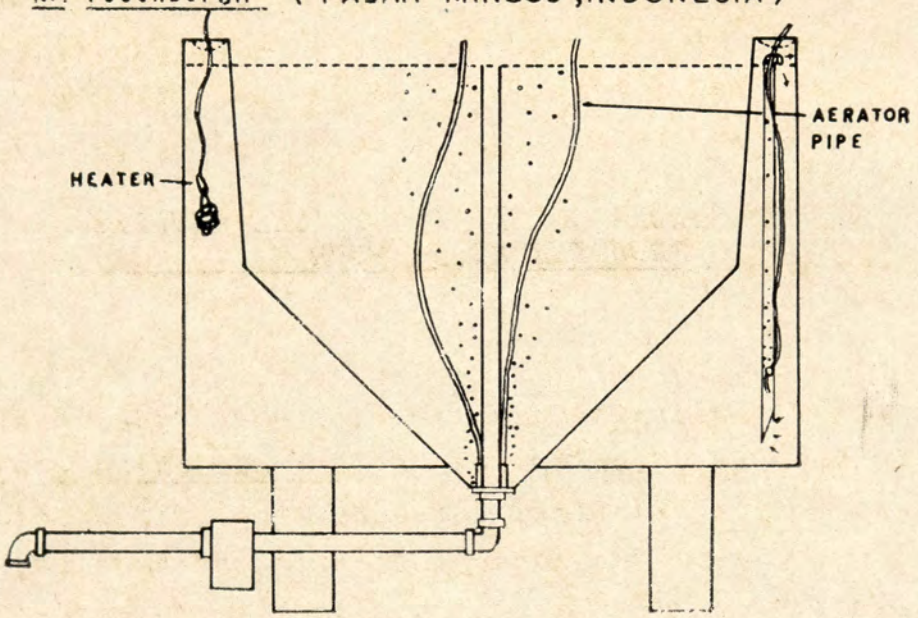
Double layered experimental conical tank for larval rearing of M. rosenbergii at PASAR MINGGU near Jakarta.



LAY OUT OF HATCHERY FOR GIANT FRESHWATER PRAWN
M. rosenbergii

PRAWN HATCHERY CENTRE, PASAR MINGGU NEAR JAKARTA

DOUBLE WALL TANK FOR LARVAL REARING OF
M. rosenbergii (PASAR MINGGU, INDONESIA)



The centre has a set of grow-out ponds at Depok, 20 km south of Pasar Minggu. Studies have been conducted at various stocking densities from 20,000 to 80,000 PL/juveniles per ha. Maximum production of 800 kg/ha/3 months has been achieved in experimental tanks with average growth at 30-50 gm.

Macrobrachium rosenbergii has been known in Indonesia to occur in various phenotypes in terms of variations in periopods, colour, size, body length - head length ratio in Sumatra, Celebes and Java. The Pasar Minggu is taking up studies on prawn genetics.

24 July 1985

Met Mr. Sofyan Ilyas, Head, Central Institute of Fisheries of Agency for Agricultural Research and Development at Jakarta and briefed him of visit to Bogor and Pasar Minggu Research Stations and thanked him for all facilities and hospitality extended that rendered the visit to Indonesia a success.

Left Jakarta and arrived Calcutta on the same day.

POSSIBLE AREAS OF BENEFIT TO THE COUNTRY FROM THE STUDY TOUR

Thailand, Malaysia and Indonesia have made considerable progress in hatchery development for Macrobrachium rosenbergii, the progress made by Thailand being particularly spectacular. Thailand is promoting the concept of backyard hatchery for Giant freshwater prawn. The banks have come forward to provide financial assistance to entrepreneurs. A good number of hatcheries have been put up in this manner in private sector both closed and open systems. The closed system can

be practised in hinterland but would need transport of concentrated sea water. India would benefit by adopting Thailand model of backyard hatchery. This may be especially suitable for educated unemployed with some financial resources. The hatchery technology needs capital investment, the scale of which varies depending upon size of installation, technology and output and as such it is ill-suited for small and marginal farmers, landless labourers and uneducated and economically weaker classes.

2 Thailand has made considerable progress in research and development of hatcheries of Penaeus monodon, the tiger shrimp. Various models have been studied in detail during the trip in Thailand and Malaysia. It is possible to adapt some of the models to our country's need. Central Inland Fisheries Research Institute has already acquired considerable expertise in Penaeid shrimp hatchery during VIth Five Year Plan and must be provided with necessary financial resources to put up demonstration hatcheries without further loss of time.

3 Thailand (and Malaysia to an extent) has made significant progress in breeding and seed production of sea bass, Lates calcarifer. The sea bass seed has export market in Taiwan, Hong Kong, Singapore, etc. which is already exploited by Thailand. During study tour an indepth study was made on hatchery facilities required and site selection for Lates calcarifer. It is possible to adopt this technology in thie country. Central Inland Fisheries Research Institute has already launched a research programme on sea bass seed production during VIth Five Year Plan. Research efforts would be further intensified in the context of knowledge gained during the study. Proper momentum to this programme is possible only if CIFRI gets adequate financial resources and a mechanism for faster development of hatchery infrastructure.

4 Both Thailand and Malaysia have made considerable progress, the former particularly, in breeding, seed production and culture of Pangasius sutchi. The species is already classified as air breathing fish in Malaysia. Recent researches at CIFRI go to show that even the Indian counterpart P. pangasius has air breathing traits. A production upto 1½ tonnes per cage of 27 sq m has been obtained in cage culture in sluggish streams in Thailand. This practice can be adopted in this country also and CIFRI would soon put up demonstration programmes. In addition, Pangasius pangasius, by virtue of its air breathing traits would be eminently suitable for pen culture in swampy warers, beels in Eastern Uttar Pradesh, Northern Bihar, West Bengal and Assam and Collair Lake in Andhra Pradesh. CIFRI would soon intensify research programmes on breeding and seed production of P. pangasius in the light of knowledge gained during study tour.

5 Thailand has made considerable progress in seed production and culture of the air breathing clariid catfishes Clarias macrocephalus and C. batrachus. The redesigning of paddy plots through construction of a number of cross dykes with provision of horizontal breeding nests and perimeter trenches for holding breeders at appropriate sites and slopes and the water management practices which include control of water level to facilitate breeding are worthy of adoption in this country on a large scale. CIFRI would soon launch a demonstration programme in this regard provided adequate resources are made available to the Institute. The Thailand model of breeding of C. macrocephalus is already adopted in Malaysia.

6 Detailed discussion with scientists at Fisheries Research Institute, Malacca, revealed that air breathing catfish C. macrophalus is ecologically compatible with Clarias

batrachus. If this be so, there is a case for introduction of C. macrocephalus into this country as a special case as C. macrocephalus grows to a kilogram in a year, has a higher facundity, better flesh and would give a boost to air breathing fish culture. A production of 4 to 5 tonnes can be reasonably achieved in 3 months and 3 to 4 crops can be raised in a year (Production many times this level has been achieved in Thailand under intensive culture). The matter of introduction of C. macrocephalus needs however a closer examination and ecological assessment.

7 Indonesia has made spectacular progress in running water culture using hill stream at msl 500-900 M. The water passes through race-ways and finally re-enters in the stream. A production of 2 tonnes per 60 sq m raceway per 3 months using common carp has been achieved. The number of grow-out production units varies from owner to owner depending upon topography and financial resources. This production system can be easily adopted in India. The same running water facilities at msl 500-900 M can also be utilised as production units for Indian species of mahseer and the system has relevance to the western ghat and eastern ghat in Peninsular India and Shivalik range of mountains in North India. This system can be adopted by entrepreneurs who have some resources to invest and would need a Government policy that encourages such installations. The CIFRI would be in a position to put up a demonstration running water system based on knowledge gained on the tour provided it is given adequate financial resources.

8 Fixed cage culture along river banks along the lines followed in Indonesia can also be followed in this country.

9 The Inland Fisheries Research Institute, Bogor, Indonesia has set up an experimental frog hatchery-cum-production units for Rana catesbiana. CIFRI has made spectacular progress

in hatchery and culture relating to Rana tigrina during VIth Plan. Some of the ingredients of Indonesian model can be profitably incorporated into our model in respect of spawning-cum-production system of frogs of Indian species. CIFRI would soon take necessary action in this regard when its frog hatchery is installed at its newly acquired land at Kalyani, West Bengal for this purpose.

ACKNOWLEDGEMENT

I take this opportunity to thank profusely Dr N.S. Randhawa, Director General, Indian Council of Agricultural Research and Dr R.M. Acharya, Deputy Director General (AS) for according approval of the study tour; and UNDP/FAO for sponsoring the study tour under the country programme IND/75/031. The success of the tour is largely due to assistance received to the following and which is acknowledged with thanks and gratitude :-

Dr E. Bojadzievski, FAO Representative in India; Mr M.J. Priestley, UNDP Representative in India; Mr A.L. Mendiretta, Programme Assistant, FAO Office, New Delhi; Mr Chen Foo Yan, Project Coordinator, NACA of FAO and UNDP Bangkok; Dr Tiraphan Bhukaswan, Director, National Inland Fisheries Institute, Thailand, Bangkok and his colleagues, more particularly Dr (Mrs) Mali Boonyaratpalin, Mr Sompong Niranwat, Mr Pakorn; Mr Pichit Srimukda, Brackishwater Fisheries Station, Rayong; Dr Mohd Shaari Bin Sam Abd. Latiff, Director of Research, Fisheries Research Institute, Glugor, Penang and his colleagues Mr N.G. Fong Oon, Mr Ali Awang, Mr Zulkifli Talib; Mr Ti Teow Loon, Head, Freshwater

Fisheries Research Centre, Malacca and his colleagues, Mrs Thalathiah H.J. Saidin, Mr Chuah Hean Peng, Mr Ismail Awang Kechik, and Mr Zulkafli Abd. Rashid; Mr Sofyan Ilyas, Head, Central Research Institute for Fisheries, Agency for Agricultural Research and Development, Jakarta and his colleagues, namely, Mr Atmadja Handjamulia, Head, Research Institute for Freshwater Fisheries, Bogor and Mrs Haniah Hadidjaya Suharto, Mrs Darti Satyani, and Mrs Lies Emmawati of Freshwater Prawn Hatchery Centre, Pasar Minggu, Jakarta.

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STUDY TOUR ITINERARY OF DR A.V. NATARAJAN, DIRECTOR, CENTRAL INLAND FISHERIES RESEARCH INSTITUTE, BARRACKPORE

(10 - 24 July, 1985)

10th	*Departure Calcutta; and arrival Bangkok*
11th	*Visit to NIFI Laboratories and farm and hatchery facilities at Bangkok*
12th	*1 Visited a private composite hatchery in BANG PREE DISTRICT*
	2 Visited breeding facilities in designed paddy fields and culture ponds relating to Clarias batrachus at BANG PREE DISTRICT
	3 Visited salt fields used for brine shrimp production in CHON BORI province
	4 Visited Brackishwater Fisheries Station, Rayong, 250 km south-east of Bangkok
	Visited hatchery facilities of sea bass (L. calcarifer) and other species at Rayong
13th	*Visited World Aquaculture Ltd. hatchery facilities for sea bass and tiger shrimp at Rayong*
	Visited a small reservoir at BANG PREE to study management aspects
	Visited a backyard hatchery for M. rosenbergii at BANG PREE (closed system)
14th	*SUNDAY*
15th	*Visited U THAI THANI province, 200 km north-west of Bangkok to study cage culture operations of P. pangasius in river SAKAE KRANG*

16th	Arrival Penang
17th-18th	Visited Fisheries Research Institute and hatchery facilities at GLUGOR
19th	Arrival Malacca
20th	Visited Freshwater Fisheries Research Centre, Malacca
	Visited Laboratories and attached hatchery facilities and farm facilities
21st	Arrival Jakarta
22nd	Visited Research Institute for Inland Fisheries at BOGOR, 80 km from Jakarta
	Visited Laboratories and hatchery facilities
	Visited Running water Fish Culture installations at CINA GARA, 20 km from BOGOR
	Visited Floating Cage Culture installation at LIDO
	Visited Set Cage Culture installation on CIBA LOK River near BOGOR
23rd	Visited Freshwater Prawn Hatchery Centre, PASAR MINGGU
24th	Departure Jakarta; and arrival Calcutta same day.

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