वार्षिक प्रतिवेदन
ANNUAL REPORT
2006 - 2007

केन्द्रीय खारा जलजीव पालन अनुसंधान संस्थान
(भारतीय कृषि अनुसंधान परिषद)
75, संथोम हाई रोड, आर.ए. पुरम्, चेन्नै - 600 028

CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE
(Indian Council of Agricultural Research)
75, Santhome High Road, R. A. Puram, Chennai — 600 028

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Annual Report

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(Indian Council of Agricultural Research)

75, Santhome High Road, Raja Annamalaipuram

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PREFACE

The research and development initiatives of the Central Institute of Brackishwater Aquaculture have made lasting imprints on the growth of brackishwater aquaculture in the country. CIBA has crossed number of significant milestones, but still many challenges are emerging that needs to be addressed holistically to meet the expectations of different stakeholders. Due to CIBA's efforts brackishwater aquaculture is gradually waking up from a total dependence on tiger shrimp to the potential offered by species like seabass and mud crab.

The inauguration of the seabass hatchery built under Indo-French collaborative project was a landmark in the road map of CIBA. In the research front, the notable achievement was the natural spawning of seabass without hormonal injection under simulated natural conditions. Under organic farming, production of 1360 kg/ha tiger shrimp was achieved at Kakdwip Research Centre. Production of F_6 generation of kuruma shrimp, sequencing of viral resistant genes of tiger shrimp and Indian white shrimp, identification of virus like infectious agent in shrimps affected with loose shell syndrome, isolation of ammonia and sulfide oxidizing and nitrite bio-transforming bacteria and weaning diet for seabass larvae are some of the other notable achievements of the institute.

CIBA Perspective Plan-VISION 2025 which was released this year is an important document for the institute and the stakeholders. The vision outlined in the document can only be achieved with the full support of all stakeholders.

The institute organized three trainings, nine workshops / awareness programmes, three stakeholders meetings, one farmers' meet and participated in six exhibitions. During the period under report, three patents were filed and one scientist received award and another overseas fellowship. One scientist, one technical officer and two senior research fellows received Ph.D degrees.

The achievements made by the institute were due to the collective wisdom and sincere work and efforts by all the scientists and staff and I record my gratitude to every one. I am indebted to Dr.Mangala Rai, Secretary, DARE and Director General, ICAR, Dr.S.Ayyappan, Deputy Director General (Fy.), Dr.A.D.Diwan, Assistant Director General (M.Fy.) and Dr.V.V.Sugunan, Assistant Director General (I.Fy.) for their enduring support and guidance.

A.G.Ponniah
Director

EXECUTIVE SUMMARY

The Central Institute of Brackishwater Aquaculture (CIBA) is mandated to develop techno-economically viable and sustainable culture system for brackishwater finfishes and shellfishes and to transfer the technologies to benefit different stakeholders. The Institute reached a milestone achievement with the establishment of the state of art seabass hatchery under the Indo-French collaborative project "Seabass pilot unit hatchery and culture" which was inaugurated by Dr.Mangala Rai, Secretary, DARE and Director General, ICAR on 26 August 2006 in the presence of Dr.S.Ayyappan, Deputy Director General (Fy.), ICAR, New Delhi. CIBA has made significant research achievements in basic and applied research programmes related to brackishwater aquaculture as listed below through 11 in-house and 13 external funded and six network projects during 2006-07.

- Under development of technology package for organic farming of *Penaeus monodon* @ 6.5 nos./m^2 using organic manure, production of 1360 kg/ha in 110 days with 70% survival was achieved. The shrimps registered average size of 30g and the FCR achieved was 0.95.
- Under the genetic selection programme for *P. monodon,* 37 families were reared to 2g size and tagged for genetic selection studies.
- Nutrient utilization of different oil cakes as replacement of fish meal indicated that soya bean cake can be used up to 20 %, gingelly and copra oil cakes at 5% , mustard, rape seed and silk cotton cakes at 2.5 % and palm kernel cake at 2 %, without any changes in terms of survival, growth and FCR.
- F_6 generation of *Marsupenaeus japonicus,* a potential species for diversification was produced by maturing and spawning of F_5 generation shrimps under captive condition within the hatchery.
- Pond culture trials of *Fenneropenaeus merguiensis* in West Bengal and Gujarat confirmed the potential of the species to reach 22 g in 120 days of culture.
- More than 40 % survival was achieved in nursery rearing trials with *Scylla tranquebarica* in indoor tanks, with pellet feed and clam meat.
- Pilot testing of CIBA feed, in mud crab fattening trials conducted with the involvement of women self help groups demonstrated that CIBA feed performs equally well as trash fish, where the cost of trash fish is above Rs 8/ kg, use of CIBA feed will be economically advantageous.
- On-farm nursery rearing of seabass fry was undertaken @ 500 nos./m^2 in hapas in four farmers' ponds in Andhra Pradesh and Tamil Nadu. The fry were fed with CIBA feed / fish meat and mysids. Stockable size of seabass with survival above 50% was obtained.
- Natural spawning of seabass *Lates calcarifer* was observed in eight instances without hormone injection when the brood fishes were maintained in the continuous recirculation system established under the Indo-French hatchery. The hatching rate ranged from 40 to 95% and the average survival rate of the 25 day old fry was 22%.
- Seabass larvae fed with micro-diet in combination with rotifers was found to perform better in terms of survival, in comparison to groups fed with micro-diet and *Artemia* or *Artemia* and rotifers, from 9 to 25 days post hatch. This diet combination was also found to be a better diet during 25 to 40 days post hatch and was a better weaning diet for exclusive feeding with micro-diet.
- Grow-out culture of seabass was conducted in a farmer's pond in Andhra Pradesh @ 5000 nos./ha along

Inauguration of seabass hatchery by Dr. Mangala Rai, Secretary, DARE and Director General, ICAR, New Delhi.

Release of manual on seabass hatchery technology by Director General.

Director General visiting the hatchery facility.

with tilapia as forage feed. In 145 days, the fishes attained an average weight of 850g with 28% survival and a production of 1.19 ton/ha.

- Following breeding and larval rearing protocols for seabass developed by the Institute, a total of 2.11 lakh seed were produced and supplied to farmers.
- Based on bioassay experiments and histopathological investigations, the involvement of a virus like infectious agent has been identified in shrimps affected with loose shell syndrome.
- Viral resistant genes of *P. monodon* and *Fenneropenaeus indicus* were amplified and characterised. A cDNA library of *P. monodon* has been constructed and probed for identification of disease resistant genes.
- Ninety seven luminescent bacteria isolates from shrimp hatcheries have been characterized. Virulence factors of 86 isolates of *Vibrio harveyi* have been characterized.
- Twenty three ammonia oxidizing autotrophic bacteria and 63 sulfide oxidizing autotrophic bacteria have been isolated from shrimp farms and are being characterized.
- The following patents have been filed:

  1. Product from lignocellulosic waste for remediation of water contaminated with heavy metals. (Application No. 368/CHE/2006).
  2. Maximum percent recovery and detection of organochlorine and organophosphorus pesticides from brackishwater. (Application No. 369/CHE/2006).
  3. Immobilizing matrix from bagasse for bacterial biomass and process of preparation thereof. (Application No.633/CHE/2006).

- Isolated one nitrite bio-transforming bacteria from shrimp pond and its efficacy in bioremediation of pond discharge water was confirmed with the bacteria immobilized in the bagasse matrix.
- Analysis of land use map of Muthupet mangroves and surroundings prepared from satellite data of IRS 1C LISS III of the years 1988 and 2005 revealed that in the 75,215 ha of study area, aquaculture development had not been due to conversion of mangrove land. The study has conclusively proved that aquaculture development has not affected the mangroves of Muthupet.
- Evaluation of existing web kiosks operated under ITC's e-Choupal model indicated that if these are to be used by small farmers, the present model needs to be modified.
- An extensive survey of different stakeholders involved in brackishwater farming from Tamil Nadu and Andhra Pradesh revealed that more than 90 % of farmers depended on input trade representatives, for technical information. To address shortcomings in the present public sector extension mechanisms, a more participatory operational model of technology transfer has been developed.

1. INTRODUCTION

From a traditional activity practised in few coastal states of India, brackishwater aquaculture has made tremendous progress to attain the level of an industry. Brackishwater aquaculture is synonymous to shrimp aquaculture practised largely by small and marginal farmers. The 8129 km coast line of the country offers immense potentials for development of coastal aquaculture. The brackishwater resources of the country comprise 3.9 million ha of estuaries, 3.5 million ha of brackishwater area and 8 million ha of inland salt affected areas. Around 1.2 million ha brackishwater area suitable for aquaculture development is available in the coastal regions of the country and around 1.91 lakh ha was developed so far contributing production of 1.43 MT which was largely by a single species *Penaeus monodon.* This phenomenal growth was made possible by the large investments made by the different stakeholders in this sector from small scale farmer to corporate sector.

The Central Institute of Brackishwater Aquaculture was established in April 1987 to serve as a nodal agency for the development of brackishwater aquaculture in the country. The Headquarters of the Institute is located at Chennai with an Experimental Field Station at Muttukadu, about 30 km south of Chennai. The Institute has one Research Centre at Kakdwip in West Bengal. The Institute has a Director, 42 Scientists, 28 Technical, 24 Administrative and 55 Supporting staff as on 31.3.2007.

MANDATE

- To conduct research for development of techno-economically viable and sustainable culture system for finfish and shellfish in brackishwater
- To act as a repository of information on brackishwater fishery resources with a systematic database
- To undertake transfer of technology through training, education and extension – education programmes
- To provide consultancy service

ORGANIZATIONAL SET-UP

The research activities of the Institute are carried out under five Divisions *viz*.,

- Crustacean Culture Division
- Finfish Culture Division
- Aquatic Animal Health and Environment Division
- Nutrition Genetics and Biotechnology Division
- Social Sciences Division

The research activities of the Institute were of diverse in nature, starting from basic research to applied research to adaptive research. These activities were carried out under eleven in-house projects, nine AP Cess Fund, two DBT, one Indo-Norwegian, one Indo-French and six network projects.

Research Advisory Committee

DIRECTOR

Institute Management Committee

HEAD QUARTERS, CHENNAI, TAMIL NADU

- Crustacean Culture Division
- Finfish Culture Division
- Nutrition, Genetics and Biotechnology Division
- Aquatic Animal Health and Environment Division
- Social Sciences Division

- Administration
- Accounts & Audit
- Stores
- Library & Documentation Section
- ARIS Cell
- Technical Cell
- Engineering Cell
- Hindi Cell
- Project Monitoring & Evaluation Cell
- Institute Technology Management Committee

RESEARCH CENTRE

Kakdwip, West Bengal

FIELD CENTRE

Muttukadu, Chennai

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75 Santhome High Road
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Telephone : 03210-255072

MUTTUKADU EXPERIMENTAL STATION

Kovalam Post
Muttukadu 603 112
Tamil Nadu
Telephone : 044-27472344, 044-27472061

FINANCIAL STATEMENT

BUDGET 2006-07 (Rs. in lakh)		
	Allocation	**Expenditure**
Plan	300.38	291.86
Non-Plan	531.95	531.95

OFFICIAL LANGUAGE IMPLEMENTATION PROGRAMME

The Meeting of the Official Language Implementation Committee of the Institute was regularly conducted on quarterly basis. The CIBA News was published in bilingual form. The Hindi fortnight was observed during the month of September 2006 and the Hindi day was celebrated on 22 September 2006. Elocution and song competitions were conducted on the occasion.

STAFF POSITION

The details of the number of positions sanctioned, filled and remaining vacant as on 31.3.2007 are as follows:

Position	Sanctioned	Filled	Vacant
Director (R.M.P.)	1	1	-
Head of Division	2	1	1
Principal Scientist	2	2	-
Senior Scientist	14	1	13
Scientist	47	40	7
Technical Assistant	30	29	1
Administrative Officer	1	1	-
Finance & Accounts Officer	1	1	-
Junior Accounts Officer	1	1	-
Personal Assistant	1	1	-
Stenographer Gr.II	2	2	-
Stenographer Gr.III	2	2	-
Assistant	5	4	1
Senior Clerk	6	6	-
Junior Clerk	8	7	1
Supporting Staff	64	59	5
Total	187	158	29

2. RESEARCH ACHIEVEMENTS

IN-HOUSE PROJECTS

CRUSTACEAN CULTURE DIVISION

RESEARCH PROJECTS

Title of project : **Captive broodstock development, breeding, seed production and culture of *Penaeus monodon, Marsupenaeus japonicus* and *Fenneropenaeus indicus* (CCD/B&C/1)**

Principal Investigator : Dr.P.Ravichandran

Location of project : Chennai and Kakdwip

Co-investigator : Dr.S.Kulasekarapandian, Dr.S.M.Pillai, Dr.C.Gopal, Dr.C.P.Balasubramanian, Dr.A.Panigrahi, Dr.M.Jayanthi, Dr.P.Nila Rekha, Dr.G.Gopikrishna, Dr.D.Deboral Vimala, Dr.M.Muralidhar and Dr. M.Shashi Shekhar

Title of project : **Culture of mud crabs (*Scylla* spp.) (CCD/CF/1)**

Principal Investigator : Shri M.Kathirvel

Location of project : Chennai and Kakdwip

Co-investigator : Dr.S.Kulasekarapandian, Dr.C.P.Balasubramanian, Dr.J.Syama Dayal and Dr.A.Panigrahi

Title of project : **Assessment of brackishwater land resources (CCD/RA/1)**

Principal Investigator : Dr.(Mrs.) M.Jayanthi

Location of project : Chennai

Co-Investigators : Dr.P.Ravichandran, Dr.S.M.Pillai, Dr.M.Muralidhar and Dr.P.Nila Rekha

CAPTIVE BROODSTOCK DEVELOPMENT, BREEDING, SEED PRODUCTION AND CULTURE OF *PENAEUS MONODON, MARSUPENAEUS JAPONICUS* AND *FENNEROPENAEUS INDICUS* (CCD/B&C/1)

Domestication of *Marsupenaeus japonicus*

Rearing of F_5 generation

Evaluation of growth and reproductive performance of hatchery produced F_5 juveniles of *M. japonicus* was taken up in ponds (0.06 ha) and FRP tanks stocked @ 200 and 103 nos. respectively. After seven months of culture in ponds, the males attained an average weight of 24.4g and the females 31.7g. In the tanks males and females reached 25.5 and 31.1g respectively indicating no significant difference in the growth rates between pond and FRP tank systems. The survival rates of both sexes were 42% and 64% in the ponds and tanks. Growth performance of the shrimp in ponds and tanks is depicted in Fig.1.

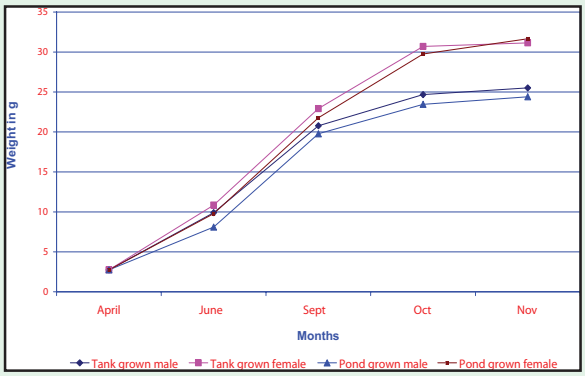


Fig. 1. Growth of *M. japonicus* in captivity in ponds and tank

Reproductive performance

The reproductive performance of the domesticated F_5 generation broodstock was compared with the wild spawners (Table 1). The study indicated that the growth of F_5 generation juveniles of *M. japonicus* in ponds and tanks is comparable. The poor reproductive performance in terms of average fecundity of the domesticated broodstock can be attributed to the smaller size than inbreeding depression.

Table 1. Reproductive performance of wild and domesticated spawners of *Marsupeneaus japonicus*

Spawner stock	Size of spawner (g)	Total spawners tested	Average fecundity (lakh)	Successful hatching (%)	Average no. of nauplii (lakh) produced/ female	Average no. of PL (lakh) produced/ female
Wild	40-90	36	4.2 + 1.96	77.9	2.7 +1.90	0.37+ 0.57
Domesticated	22-33	24	1.6 + 0.82	25.0	0.2 + 0.38	0.24+ 0.50

Production of F_6 generation

From six spawnings, a total of 4.95 lakh nauplii were obtained and 58,000 PL 20 of F_6 generation were produced which are being raised in tanks and ponds.

WSSV Challenge test

The resistance level of postlarvae of domesticated and wild stocks of *M. japonicus* to WSSV was compared by oral challenge test with two replicate and control. Postlarvae were fed with WSSV infected shrimp tissues and the mortality rates were recorded at regular intervals. No significant difference in the susceptibility of postlarvae of

both wild and domesticated *M. japonicus* to WSSV was discernible. In both the groups, the mortality had set in by the 2nd day of post challenge. On the 5th day of post challenge, the wild stock suffered 100% mortality while in the domesticated stock 100% mortality was observed on 8th day. In the control no mortality of shrimp was encountered even after 15 days of rearing (Fig. 2).

WSSV challenge test of domesticated juvenile *M. japonicus* showed that the juveniles were more tolerant to the WSSV compared to postlarvae. The first mortality of the juveniles was noticed only on the 5th day of post challenge. By the 10th day, the cumulative mortality was only 20% and by 15th day it reached 40%. The juveniles which survived beyond 15 days were first step positive to WSSV. PCR screening of dead shrimps indicated first-step positive for WSSV for both postlarvae and juveniles. Further tests are required to understand if the domesticated stocks of *M. japonicus* have some resistance to WSSV.

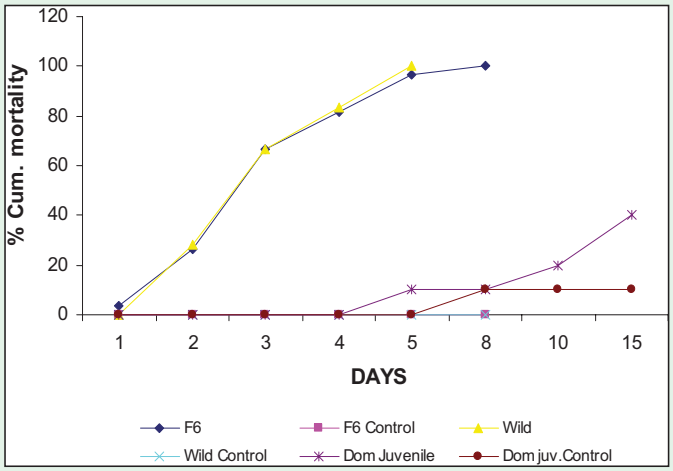


Fig. 2. Cumulative mortality due to post challenge with WSSV in *M. japonicus*

Culture of *P. monodon* at Kakdwip Research Centre

Three different sets of culture trials of *P. monodon* were carried out in Kakdwip. (i) Low density (6.5 nos./m^2) culture with organic inputs, (ii) Improved traditional system at 10 nos./m^2 and 15 nos./m^2 and (iii) Culture with indigenous feed at 10 nos./m^2.

Organic farming

In the organic farming of *P. monodon* at the stocking rate of 6.5 nos./m^2, an average production of 1305 kg/ha was obtained with organic inputs and marginal feeding. During the culture operation organic manures and yeast based organic preparations were used to its advantage. The organically grown shrimps exhibited higher growth rate and health status (including colouration and texture) compared to other shrimps under improved traditional culture. The economic return realised per rupee invested for operational cost at this low stocking density was better (2.18) than that of the higher stocking density which was 1.58 for 10 nos./m^2 and 1.34 for 15 nos./m^2. A higher feed conversion ratio of 0.95 was achieved in the low density organic shrimp ponds (Table 2) with a survival rate of 65%.

Table 2. Culture of *P. monodon* with organic inputs

Pond area (m^2)	Stocking density (nos./m^2)	Duration (days)	Survival (%)	Size at harvest (g)	Production (kg)	Productivity (kg/ha)	FCR
1000	6.5	109	70	30	136	1360	0.92
1000	6.5	110	60	32	125	1250	0.98

Improved traditional shrimp farming

Improved traditional pond culture trials with 15 nos./m^2 and almost zero water exchange yielded a production

Tiger shrimp cultured with organic inputs

level of 2392 kg/ha with a survival rate of 60%. With controlled feeding regimen using a commercial feed costing Rs.58/- per kg, an average FCR of 1.37 was obtained. At 10 nos./m^2 stocking, a production of 1633 kg/ha of shrimp was realised in 105 days of culture with an average body weight of 29g. The FCR obtained was 1.15. Prevalence of initial fluorescent *Vibrio* problem was overcome by better management practices, however survival of shrimp was affected (Table 3).

Table 3. Culture of *P. monodon* under two stocking densities

Pond area (m^2)	Stocking density (nos./ m^2)	Duration (days)	Survival (%)	Size at harvest (g)	Production (kg)	Productivity (kg / ha)	FCR
2750	15	111	57	26	615	2236	1.36
3720	15	114	63	25	890	2392	1.39
1960	10	105	58	28.3	320	1633	1.17
2750	10	107	44	29.4	355	1290	1.15

Culture of *P. monodon* with indigenous feed

An average production of 1028 kg/ha of shrimp was obtained with 10 nos./m^2 stocking using indigenous feed prepared from local ingredients. The FCR achieved was 2.32. A disease outbreak towards the end of the crop was effectively managed with regular health watch and careful judicious pond management which minimized the loss (Table 4).

Table 4. Culture of *P. monodon* with indigenous feed

Pond area (m^2)	Stocking density (nos. / m2)	Duration (days)	Survival (%)	Size at harvest (g)	Production (kg)	Productivity (kg/ha)	FCR
1620	10	112	43.3	21.9	157	948	2.63
1840	10	103	42.9	24.5	200	1087	2.02

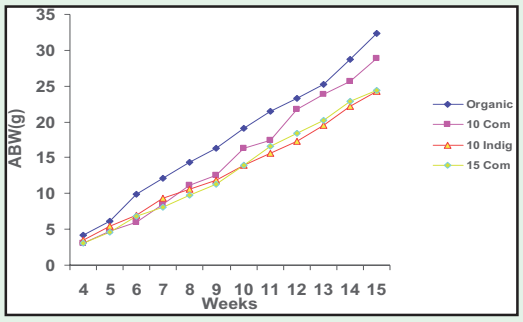


Fig. 3. Growth performance of tiger shrimp in different farming conditions and stocking densities

The comparative average body weight (ABW) under different farming conditions is given in Fig.3 and the highest ABW was obtained under organic farming.

Yeast and bacteria based preparations as inputs for organic aquaculture

Yard experiment was conducted to evaluate the effect of yeast *Saccharomyces cerevisae* or bacteria *Bacillus subtilis* based organic preparations on the growth and survival of tiger shrimp *P. monodon* juveniles. These organic extracts have a potential

role in organic farming, where chemicals and antibiotics are to be restricted or prohibited. A significantly higher growth and survival were recorded in yeast based organic juice treated group (Treatment II) compared to the control group after 10 weeks of experimentation (Table 5). Similarly, probiotic *Bacillus* treated group (Treatment I) registered a higher growth compared to that of the control.

Table 5. Experimental results showing growth, SGR and survival of the control and treated groups

Treatment	Initial Wt. (g)	Final Wt (g)	Initial length (mm)	Final length (mm)	SGR	Survival (%)
Control	1.19 ± 0.47	3.42± 0.17a	57.08 ± 7.83	73.61± 0.62 a	1.087 ± 0.01a	47.56 ± 2.31a
Treatment I	1.13 ±0.35	3.95± 041b	56.27 ± 6.28	78.09 ± 3.36 ab	1.284 ± 0.04b	52.44 ± 2.78a
Treatment II	1.14 ± 0.3	4.91 ± 0 .1c	55.96 ± 4.91	81.71 ± 1.58 b	1.506 ± 0.07c	63.56 ± 3.36b

SGR=Specific growth rate; Significant difference ($p < 0.05$) between the groups is indicated by different letters as superscripts.

Culture of other shrimp species

Culture of other shrimps like *Metapenaeus monoceros* and *M. brevicornis* was evaluated as alternate species for the low saline monsoon-winter crop in West Bengal. Wild seed of *M. monoceros* collected from the intertidal zone of Kakdwip was stocked @ 18 nos./m^2 in four ponds during September-October 2006. However, *M. brevicornis* constituted around 20 % of the stocked seed. Feeding was done with ingredients like rice bran, soyabean flour, mustard oil cake and fish meal etc in appropriate percentage. One group (A) was managed with thrust on natural productivity by encouraging periphyton growth through sugarcane bagasse whereas the other group (B) was reared with supplemental feeding without bagasse. Twisted bagasse-thick rope after seasoning was wounded around bamboo poles which are driven in to pond bottom. The average production after 12th week of culture was 260 ± 22 kg/ha and 247 ± 13.9 kg/ha in Group A and Group B respectively. A higher survival (53.16 ± 13.43%) was obtained in Group A ponds compared to Group B ponds (43. 26 ± 6.54%). However, a higher mean ABW was recorded in the Group B ponds. The overall low production may be because of the lower temperature profile in the pond (17-25^{o}C) during October to December. The studies indicate that with the culture practices adopted, these species would not constitute as alternate species for low saline monsoon-winter crop in West Bengal.

Sequence analysis of WSSV structural protein genes

Five different structural protein genes of WSSV were amplified by PCR (Fig. 4). As an approach towards molecular epidemiological study to identify the Indian strain of WSSV, sequence comparison of the amplified PCR products of the structural genes of WSSV was carried out with three reported complete genome sequences of WSSV isolates of China, Taiwan and Thailand. Sequence variations between the four isolates were found only in VP19 and VP24 genes. With respect to VP19 WSSV gene, Indian isolate was similar to Taiwan isolate. These two isolates differed from the Chinese and Thailand isolates and showed single amino acid substitution of (S→P) and (D→ V) respectively. In case of VP24 WSSV gene, Indian isolate showed similarity with Chinese and Thailand isolates. Taiwan isolate differed from the rest of the isolates in having (K→R)

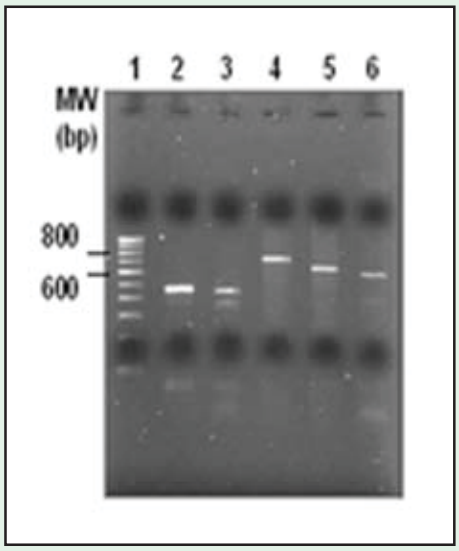


Fig. 4. Amplified PCR products of WSSV structural protein genes. Lane 1. 100 bp marker, Lane 2. VP15, Lane 3. VP19, Lane 4. VP24, Lane 5. VP26, Lane 6. VP28.

amino acid substitution. The conserved nature of WSSV viral structural proteins in different isolates indicates the suitability to develop immunodiagnostic assays and vaccines targeted against these structural genes which can be used as a common remedial measure against the shrimp viral disease occurring with different WSSV geographical isolates.

Expression of RNA dependent RNA polymerase (RdRp) recombinant protein of *Macrobrachium rosenbergii* nodavirus (*Mr*NV)

Amplified product of *Macrobrachium nodavirus* RdRp gene obtained by RT-PCR, was cloned into pET32a expression vector. The positive clones were confirmed for the presence of insert by PCR, restriction enzyme analysis and digoxigenin (DIG) labeled probe. Partial length of the gene (246 amino acids) has been expressed as recombinant fusion protein in *Escherichia coli* with an estimated molecular size of 39.9 kDa. Further work is under progress to purify the recombinant protein for its use in immunodiagnostics for virus detection.

Species identification of penaeids by molecular approach

Molecular characterization of mitochondrial genes was carried out for the penaeid shrimps, *F. indicus* and *F. merguiensis* and *F. penicillatus* as an approach towards species identification. Approximately 560 bp of PCR amplified product was obtained from *F. penicillatus, F. merguiensis* and *F. indicus* using 16s rRNA mtDNA primers. In case of control region of the mitochondrial gene amplification, an amplified product of 611 bp was obtained in all the three species of shrimps. The amplified PCR products of 16s rRNA gene were digested with Apo I and Ssp I restriction enzymes. The control region gene PCR products were digested with Apo I restriction enzyme. PCR-RFLP of 16sr RNA segment of mtDNA could successfully differentiate *F. merguiensis* from *F. penicillatus* and *F. indicus* using Apo I and Ssp I restriction enzymes. In case of PCR-RFLP of control region segments of mtDNA all the three penaeid species could be differentiated based on different RFLP profile generated by Apo I restriction enzyme.

CULTURE OF MUD CRABS (*SCYLLA* SPP.) (CCD/CF/1)

At Chennai

Rearing of megalopae/first crab instar of mud crab in indoor tanks

Rearing of hatchery produced megalopae of larger species of crab *Scylla tranquebarica* in indoor tanks showed a survival of 48% at first crab instar stage. The first instar baby crabs (3mm carapace width/ 0.03g weight) were stocked @ 5 crabs/100 litre tanks and reared with regular feeding. They attained an average size of 28mm/3g after 49 days of rearing with a monthly growth rate of 15.3mm/1.8g.

Transport of live mud crab seeds

An experiment was carried out to evaluate the rate of survival in long distance transportation of crab seeds. Baby crabs of *S. tranquebarica* (average size: 13.7mm/0.45g) packed in wet sand in six perforated plastic trays (58 cm^2 each) were transported from Rajiv Gandhi Centre of Aquaculture (RGCA) at Karaikkal to Muttukadu Experimental Station, Chennai. The survival rate of crabs in transportation was 97% in 9-hour road journey.

Nursery rearing of *S. tranquebarica* in indoor tank system

Rearing of crab seed was carried out for 45 days at two different stocking densities, 9 nos./m^2 and 25 nos./m^2. At a stocking density of 25 nos./m^2, four trials were conducted and a growth rate of 11.9mm/2.8g to 13.1mm/3.8g per month was obtained (average of 12.7mm/3.8g) with a survival rate of 10 to 16%. At a stocking density of 9 nos./m^2, the monthly growth varied from 11.5mm/3.7g to 17.8mm/10.9g (average of 14.6mm/6.9g) and the survival rate ranged from 38 to 41%. Lower stocking rate is better to achieve higher growth and survival rates.

Nursery rearing of mud crab

Nursery rearing of *S. tranquebarica* with pelleted and conventional feeds

In order to evaluate the efficacy of artificial pellet feed developed at the Institute on the growth and survival of mud crab seeds, two sets of rearing experiments with a control (clam meat) were conducted for 30 days. The crabs were stocked at a rate of 5 nos./500-litre tank. Initially, the crabs did not consume the pellet feed for a week and after some time started consuming the feed. The final size attained at the end of 30 days nursery rearing is given in table. The mortality was mainly due to cannibalism among the crabs. The study indicated that the pellet feed developed was as effective as clam meat.

Table 6. Nursery rearing of crab *S. tranquebarica* - comparative growth of crab seed with pellet and conventional feeds in 30 days under static tank system.

Trial	Feed	Initial (mm)		Initial (g)		Final (mm)		Final (g)		Survival (%)
		Range	Average	Range	Average	Range	Average	Range	Average	
I	Pellet	15.0- 18.6	16.5	0.7- 1.2	0.9	23.7- 29.7	26.6	1.9-3.9	2.8	60
I	Clam meat	15.2- 18.2	16.5	0.8- 1.0	1.5	26.3- 33.0	28.6	3.2-5.2	3.9	60
II	Pellet	27.6- 28.0	27.8	3.1- 3.3	3.2	37.5- 41.0	39.3	9.1-11.5	10.3	40
II	Clam meat	23.8- 29.6	26.7	2.2- 4.1	3.1	36- 37.8	37.4	7.2-11.1	10.4	50

Nursery rearing of *S. serrata* in earthen pond

To assess the growth potential during the nursery phase for smaller species of mud crab (*S. serrata*), wild seeds were stocked @ 1 crab/m^2. In 30-days culture, the crabs attained growth from an initial average size of 33.5mm/5.3g to 61.9 mm/38.5g with a survival rate of 64.5 %.

Short term grow-out trials with *S. serrata* in earthen pond

In grow out experiments conducted in earthen ponds, at a stocking rate of 0.7 nos./m^2, *S. serrata* grew from an initial average size of 61.9mm/38.5g to 90.7mm/132.3g in 45 days rearing with a survival rate of 64.8 %.

At Kakdwip Research Centre

Grow-out culture of *S. serrata* in earthen ponds

Juveniles of *S. serrata* (47± 10g) were stocked @ 1 no./ m^2 in two earthen ponds (800 m^2 and 600 m^2) and fed with pellet feed prepared at KRC. The rate of feeding was 2% (dry basis) of stocked biomass. After 6-months of culture, the average weight attained was 160 ± 41g (Fig. 6). The production was 240 kg/ha. The low production achieved in this crop was due to low survival which could be attributed to cannibalism among the crabs. The lower body weight and growth rate may be primarily due to the inherent growth potential of this species under the lower salinity regime experienced during the culture period.

Harvested *S. serrata*

ASSESSMENT OF BRACKISHWATER LAND RESOURCES (CCD/RA/1)

Use of Remote Sensing data and Geographical Information System for brackishwater aquaculture development

To evaluate the potential to apply Remote Sensing data and Geographical Information System to support planning for brackishwater aquaculture development, an assessment of land and water resources available for brackishwater aquaculture in Nagapatnam district and adjoining areas, was carried out. The study had two objectives of (i) determining the extend of present brackishwater aquaculture farms and identify additional potential areas for development, and (ii) to study the impact of aquaculture on mangroves. IRS 1C, LISS III data were used to assess the land and water resources using ERDAS Imagine 8.5 and Arc GIS 9.0.

Identification of future potential sites for regulated aquaculture

The existing aquaculture farms were delineated from the land use map (Fig. 5) and verified during ground truth verification using a GPS standard, GS5+. The existing aquaculture farm area was 2642 ha. With a view to find out additional suitable areas for increasing shrimp farming in future in a sustainable manner, the potential sites were delineated after considering the importance of ecosystems, soil and water quality parameters and

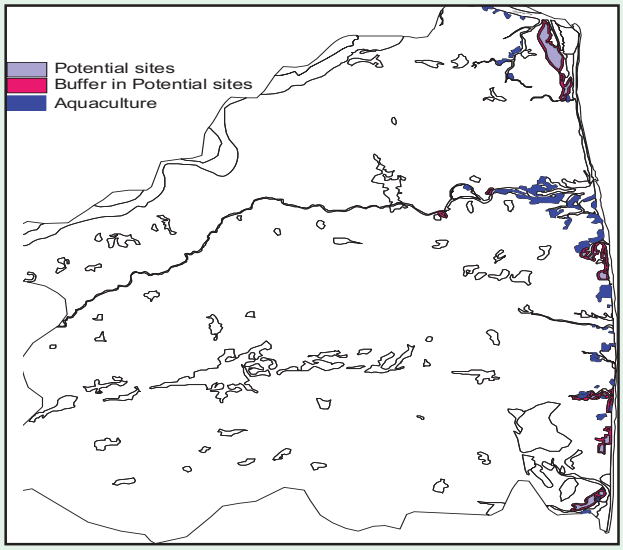


Fig. 5 Existing aquaculture farms in February 2005 and sites for possible future expansion

Coastal Aquaculture Authority (CAA) Guidelines in a GIS platform. Soil samples were collected from five coastal taluks of Nagapatnam district from different land class and analyzed for pH, EC, and organic carbon. Water samples from shrimp farms, bore wells and rivers were also collected and analysed for pH, salinity, ammonia nitrogen, nitrate nitrogen and available phosphorus (Table 7). Potential sites for future development of aquaculture and existing aquaculture farms were identified (Fig. 5) from the mud flats which are not liable to be flooded during rainy season and abandoned salt pans. The potential sites were identified from the areas with the optimal soil and water quality parameters given by CAA. The study has clearly shown that still 359 ha of potential areas in Nagapatnam district can be developed for sustainable brackishwater aquaculture.

Table 7. Range of values of soil and water parameters of different areas sampled in Nagapatnam District

Sample type	Parameters	Other land use classes*	Potential sites** for brackishwater aquaculture	CAA optimal limits
Soil	pH	6.72 – 9.18	7.21– 7.97	7 - 8
	EC (ds/m)	0.13 – 37.5	0.13–0.37	> 4
	Organic carbon (%)	0.09 – 2.52	0.09 – 2.45	1.5 – 2.5 %
Water	pH	6.87 – 8.46	7.63 – 8.51	7.5 -8.5
	Salinity (ppt)	0 - 35	15.4 - 27.0	15 – 25
	Ammonia nitrogen (ppm)	0.224 – 0.824	0.004 – 0.009	<0.01
	Nitrate nitrogen (ppm)	0.015 – 0.184	0.010 – 0.027	<0.03
	Available phosphorus (ppm)	0.041 – 0.114	0.017 – 0.114	Not specified

- Other land type includes agriculture, scrub, sandy areas and salt pan.
- The potential sites were identified based land type, soil and water characteristics, buffer from adjacent land use, drainage pattern, and transport network and were in agreement with CAA guidelines.

Impact of brackishwater aquaculture on mangroves

The output of the GIS analysis of Nagapatnam district (Fig. 6) indicated that Kodiyakarai forest was not affected due to aquaculture. Nearer to the forest area, there were only salt pans and no shrimp farms have been developed.

A more detailed study on the impact of aquaculture on Muthupet mangroves which lies in Nagapatnam district and adjoining areas of Thanjavur district was evaluated. For this study, 1988 satellite data were used to determine the pre aquaculture status of the wet land and 2005 data for the present scenario in the region. The study highlighted that the mangroves have not been converted for aquaculture purpose. The accuracy of the overall

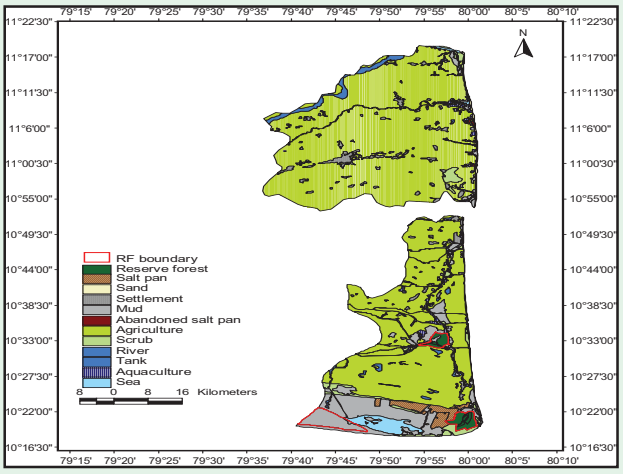


Fig. 6 Aquaculture and other land use patterns in Nagapatnam district in February 2005

assessment using only remote sensing images was 88.85% which is within the 85% used as standard. Dense mangroves have decreased from 2374.89 ha to 2016.76 ha and sparse mangroves have increased from 1410 ha to 2264.25 ha between 1988 and 2005. Aquaculture farms have not been developed nearer to dense mangrove areas and the reduction in mangrove cover was due to the trough shaped portion of the mangrove wetlands that induces hyper saline pore water to move laterally to the dense mangrove areas and leads to reduction in mangrove vegetation. The formation of trough shaped areas in mangrove wetlands has been attributed to the earlier felling of mangrove trees, and the subsequent drying and subsidence of soil. GIS analysis also revealed that from 1988 to 2005, brackishwater aquaculture has been developed from earlier agricultural lands (133.58 ha), mud flats (688.98 ha), waste lands (83.13 ha) and salt pans (41.1 ha) (Fig. 7). Overlaying reserve forest boundary clearly indicated that the aquaculture farms are outside the forest boundary and the dense mangroves have been located far away from them.

The study has convincingly demonstrated that brackishwater aquaculture development has not caused any negative impact on Kodiyakarai forest and Muthupet mangroves.

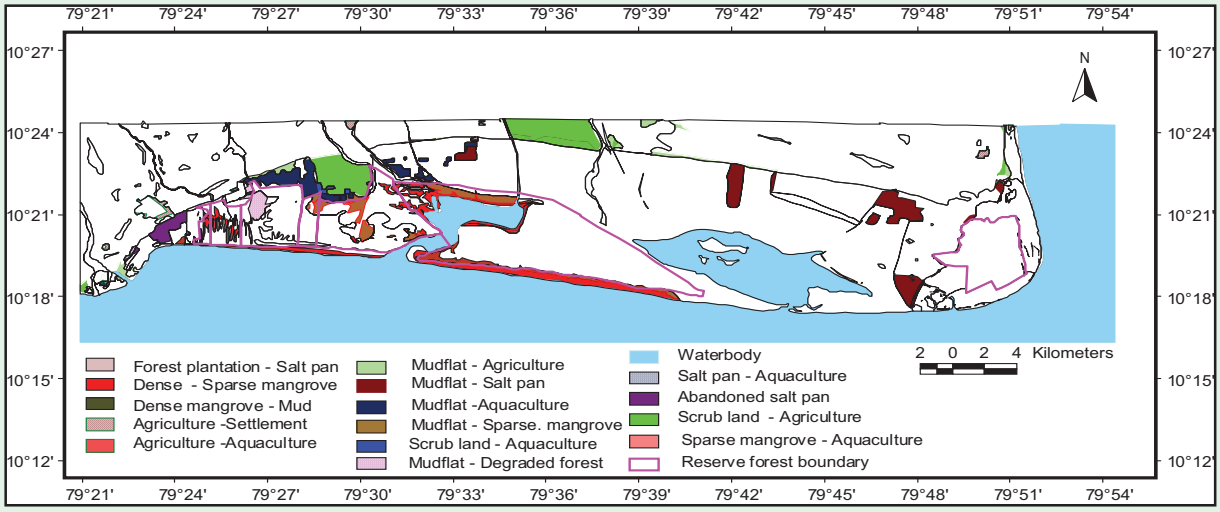


Fig. 7. Landuse changes between 1988 and 2005 in Muthupet region

FINFISH CULTURE DIVISION

RESEARCH PROJECTS

Title of project : **Broodstock development, breeding, seed production and culture of grey mullet, *Mugil cephalus* and culture of pearlspot, *Etroplus suratensis* (FCD/B&C/1)**

Principal Investigator : Dr.M.Natarajan

Location of project : Chennai and Kakdwip

Co-Investigator : Dr.Mathew Abraham, Dr.C.P. Rangaswamy, Shri R.K.Chakraborti, Dr.M.Kailasam, Dr.J.K.Sundaray and Dr.Debasis De

Title of project : **Culture of Asian seabass, *Lates calcarifer* and milk fish *Chanos chanos* (FCD/B&C/3)**

Principal Investigator : Dr.A.R.Thirunavukkarasu

Location of project : Chennai and Kakdwip

Co-Investigator : Dr.Mathew Abraham, Dr.M.Kailasam, Dr.J.K.Sundaray, Dr.T.C.Santiago, Dr.S.A.Ali, Dr.N.Kalaimani, Dr.S.V.Alavandi, Dr.J.Syama Dayal and Dr.K.Ambasankar

BROODSTOCK DEVELOPMENT, BREEDING, SEED PRODUCTION AND CULTURE OF GREY MULLET, *MUGIL CEPHALUS* AND PEARLSPOT, *ETROPLUS SURATENSIS* (FCD/B&C/1)

Broodstock maintenance at Muttukadu

Mugil cephalus broodstock fishes (135 nos) in the size of 0.4 to 1.9 kg were maintained in two 100 t RCC tanks at Muttukadu (Table 8). The fishes were fed on a specially formulated broodstock feed (crude protein 32%; lipid 6-9% and carbohydrates 30%) at 5% of body weight daily in two instalments. Fish oil, phospholipids (lecithin), *Spirulina*, protected vitamin C, α-tocopherol and squid meat were also incorporated in the feed at appropriate levels to accelerate gonadal maturity. The broodstock tanks were provided with running water flow through system to ensure quality seawater. Water quality parameters such as temperature and salinity were in the range of 27-31ºC and 25–33 ppt respectively.

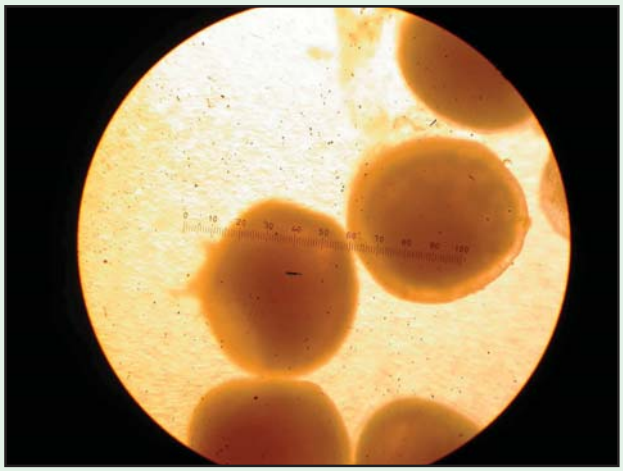
Table 8. Size groups of *M. cephalus* captive broodstock

Sl. No	Size groups (g)	No of fishes
1	< 400	24
2	401-650	57
3	651-750	25
4	751-1000	9
5	1001-1900	20

Captive broodstock of fishes were examined periodically for oocyte maturation from October onwards. After anaesthetizing the fish with 2-phenoxyethanol (250 ppm) biopsy of gonads were taken for measurement of ova diameter. Progression of ova development is given in Table 9. Vitellogenic oocytes were seen in October with mean oocyte diameter ranging from 315-240 µm. Thereafter, oocyte development was rapid and the maximum oocyte diameter of 525-606 µm (mean 588 µm) was recorded during the first week of November 2006, coinciding with the first spell of rain fall. In the subsequent weeks, gradual reduction in the ova diameter was observed. Resorption of oocytes set by the end of November and complete resorption of ova took place by the first week of January 2007.

Table 9. Maturation of oocyte in *M. cephalus*

Date	Oocyte diameter µm (range of means)	No of fishes examined	Remarks
20.10.'06	315-340	3	Vitellogenesis initiated
31.10.'06	212-498	5	Rapid development
07.11.'06	271-588	6	Rapid development
15.11.'06	299-565	6	Rapid development
22.11.'06	100-445	5	Resorption sets
28.11.'06	248-454	5	Resorption continued
02.01.'07	246-343	2	Resorption completed



Mature *M. cephalus* oocytes (525 - 606 µm)

Induced breeding experiments

Two induced breeding trials were conducted with captive brood fishes. In the first trial, a female fish (1230g/545mm) with mean ova diameter of 588 µm (525-606 µm) was given a priming dose of 12,000 IU HCG and released in to 20 t RCC tank (salinity: 33 ppt). The fish died after 16 h of priming dose.

In the second trial, a female fish (1680g/545mm) with mean ova diameter of 543 µm (505-576 µm) was administered a priming dose of 17,000 IU of HCG (@ 10,000 IU/kg) and released in a 20 t RCC tank. After 24 h, the fish body weight increased by 50g and the ova diameter by 69 µm from 543 to 612 µm (566-656 µm). A resolving dose of 200 µg of

Implanted captive males in oozing condition

LHRHa/kg body weight was administered after 24 h. The female was maintained along with three oozing males (830g, 730g and 900g). Each male was administered 100 µg of LHRHa. The salinity, temperature and pH of the fish holding tank were 33 ppt, 29.1ºC and 7.4 respectively. After 7 h of administration of the resolving dose, the fish died even though there was considerable bulging on the abdomen. On examination it was found that the visceral cavity was filled with fluid mixed with blood and the oocytes were in clumps.

Induced spermiation in *Mugil cephalus* males

Male fishes were implanted with cholesterol pellet containing 5 mg of 17-α methyl testosterone in September 2006. All the implanted males attained oozing condition after 3-4 weeks and milt was observed until January 2007.

Cryopreservation of mullet milt

Cryopreservation of milt (400-500g) collected from oozing male *Mugil cephalus* obtained from Muttukadu and Kovalam backwaters was done in sterile tubes during the month of November and December 2006. The estimated sperm density was 2.02 X 10^{11}/ml in un-diluted milt. Milt containing more than 90% spermatozoa showing forward motility was taken for cryopreservation. The cryodiluent used was 5% DMSO in Fish Ringer solution at the ratio of 1:3. After 10 minutes equilibration in ice, the milt was cooled to -50ºC for 30 minutes using a programmable freezer and then cryopreserved in liquid nitrogen. About 3 ml of milt was successfully cryopreserved which showed 70% sperm motility after cryoperservation.

Broodstock development, breeding, seed production of pearlspot (*Etroplus suratensis*) at Kakdwip

Broodstock of pearlspot was maintained in a pond (0.06 ha) with artificial diet for conducting breeding programmes. Adult pearlspot (100 nos) was distributed to the nearby farmers to encourage seed production of this species. Palmyra leaves were fixed in the breeding pond to act as spawning substrata. Fry and juveniles were collected from the pond by regular netting.

A total of 1600 pearl spot fry were sold to the ornamental fish traders for promoting pearlspot as an ornamental fish. Juvenile pearlspots were acclimatized to fresh water (0-16 ppt) and stocked with Indian major carps in farmer's ponds under composite fish culture. Pearlspot attained maturity and spawned naturally in the freshwater ponds of the farmers. However, the fecundity was low in freshwater (3000-4000) compared to those bred in saline water (10000-20000).

Stocking of pearlspot in farmer's pond

Farmer with pearlspot fry

Monoculture of *Liza parsia*

Monoculture of *Liza parsia* was evaluated with two treatments namely, fertilizer based and artificial feed based conditions at a stocking density of @ 25000/ha. The fishes attained 13 to 30g in fertilizer based pond from an initial mean body weight (MBW) of 0.86 g and 10 to 22g in artificial feed pond from an initial MBW of 0.66g in 300 days of culture. Production of 341 kg/ha and 367 kg/ha were achieved from fertilizer based and supplementary feed based ponds respectively (Table 10). The fertilizer based pond with an average primary productivity of 650 mgC/m^3/hr gave better growth rate. The result indicated that fertilizer based pond culture can be the most economical pond based culture system for *Liza parsia.*

Harvest of *Liza parsia*

Table 10. Monoculture of *Liza parsia* in tide fed ponds at Kakdwip.

Treatment	Fertilizer based (Inorganic & organic)	Supplementary feed (dough, 20% CP)
Stocking density (no./ha)	25000	25000
Initial weight (g)	0.86	0.66
Final weight (g)	21.33	14.42
Per day increment (g)	0.070	0.047
Days of culture	301	306
Survival (%)	12.8	26.8
Productivity (kg/ha)	341	366.7
FCR	-	3.7

Monoculture of grey mullet, *Mugil cephalus*

Monoculture of *Mugil cephalus* with two levels of protein (20 and 30%) in supplementary feed was undertaken in two ponds at a stocking density of 6500/ha with input of organic and inorganic fertilizers. The primary productivity ranged between 250 and 500 mgC/m^3/hr in pond 1 and between 300 and 500 mgC/m^3/hr in pond 2 respectively. The fishes attained size of 133.5 and 167.5 g with 20% and 30% protein levels in feed respectively at the end of 300 days of culture. The feed containing 30% protein level showed better growth (0.562g/day) and survival rate (76%) compared to fishes fed with 20% protein feed (0.45g/day and 60%). A production of 1124 kg/ha/crop was achieved with 30% protein feed. The performance index and production size index were better with fishes fed with 30% protein level than 20% protein level (Table 11).

Harvest of *Mugil cephalus*

Table 11. Monoculture of *M. cephalus*

Treatment	20% protein feed	30% protein feed
Stocking density(no./ha)	6500	6500
Initial weight (g)	5	5
Final weight (g)	133.5	168.7
Per day increment (g)	0.445	0.562
Days of culture	300	300
Survival (%)	60	76
Productivity (kg/ha)	777	1125

CULTURE OF ASIAN SEABASS, *LATES CALCARIFER* AND MILK FISH *CHANOS CHANOS* (FCD/B&C/3)

Development and maintenance of captive broodstock of Asian seabass *Lates calcarifer*

Asian seabass *Lates calcarifer* broodstock (40 fishes) in the size range of 1.5 to 10 kg were maintained in 12 x 6 x 2 m RCC tanks @1kg/m^3. Fishes were fed daily with tilapia @ 5% of the body weight. The tanks were maintained hygienically with 90% water exchange on alternate days. An additional stock of 15 fishes of F_3 generation were also added to the existing broodstock. Water quality parameters such as temperature, salinity, pH, DO and total alkalinity were monitored regularly and they ranged from 26 to 33°C, 22 to 33 ppt, 7.8 to 8.3, 3.8 to 5.6 ppm and 1.8 ppm respectively.

Assessment of maturity status

Maturity condition of the captive broodstock fishes were monitored regularly. Gravid females with ova diameter more than 0.44 mm and oozing males could be obtained from the captive stock from April to June. Fishes were found to be in gravid condition even at 22 ppt salinity. Females with gravid ovary could be observed continuously for three months when the maturation tanks were provided with optimal salinity conditions and recirculation facility. This is a significant milestone in captive maturation of broodstock.

Captive spawning

So far seabass was induced bred by the administration of exogenous hormone LHRHa @ 65 µg/kg body wt. for females and 35 µg/kg body wt. for males. For the first time, natural spawning was achieved by providing suitable environmental conditions through water recirculation and environmental control systems. Totally, 24 spawning trials were conducted. Successful spawning was observed in 22 cases. Second spawning during subsequent day was noticed in six cases. The number of eggs per spawning ranged from 5000 to 1.5 million. Fertilization rate varied from 45 to 95% and hatching rate 40 to 95%. The details of induced and natural spawning are given in Table 12. The success of natural spawning without hormone administration through provision of optimal environmental conditions indicated that use of hormones may be dispensed with in seabass seed production.

Table 12. Captive natural and induced spawning of *Lates calcarifer*

Spawning	Months	No. of trials *	Successful 1st spawning (No.)**	Successful 2nd spawning (Nos.)	Fecundity (million)	Fertilization rate (%)	Hatching rate (%)
Induced	May-October	10	8	2	0.05–1.5	52 -70	65-80
	November-March	6	6	2	0.06–1.0	40-75	40-60
Natural	May-October	2	2	1	0.03–0.90	70-90	70-95
	November-March	6	6	1	0.05–0.40	65-95	66-82
Total / range		24	22	6	0.05-1.50	40-95	40-95

The normal spawning periods in the previous years were from May-June to September –October. During this year, the successful spawnings observed in 11 months indicate the possibility of seabass seed production round the year. This is an outstanding achievement with regard to marine fish breeding in India. However, in the natural spawning, in the extended period of spawning from November to March, the number of eggs obtained per spawning was less. This indicates that the environmental conditions required for the complete natural spawning during this period might not be adequate and further investigation is required to address this.

Larval rearing

Out of the total hatchlings obtained in the controlled breeding trials, 3.5 million hatchlings were used for further rearing to fry size of 1.0 cm. Larvae were stocked in rearing tanks @ 10 – 100 nos./l and the feeding regimen followed was rotifers alone from 3rd to 9th day and from 10th to 15th day *Artemia* nauplii was supplemented in addition to rotifers. From 16th to 25th day the fry were fed with *Artemia* nauplii only. The survival rate ranged from 0 to 48.4% with an average of 22.2% up to 25th day of rearing. A total of 7.8 lakh fry (1.20 cm) were produced.

Nursery rearing

Nursery rearing of seabass was carried out at Muttukadu and Kakdwip under three rearing systems, namely, earthen ponds, hapas and FRP tanks in terms of survival and growth.

Nursery rearing in ponds at Muttukadu

Earthen ponds

Seabass fry (11 mm/22 mg) was reared at Muttukadu in an earthen pond (84 m^2) at a stocking rate of 48 nos./m^2. *Artemia* nauplii biomass was earlier built up in the ponds prior to the stocking and additionally minced fish meat was used @ 5-10% body weight. The fry grew to the size of 33 mm/73mg in one month with 36% survival.

At Kakdwip, advanced nursery rearing of seabass was conducted in four ponds (0.06 ha). Seabass fry with initial weight of 50mg was stocked @ 10,000 nos./ha under prey-predator culture system with live tilapia as feed in two ponds and in the other two ponds the fishes were fed with frozen trash fish @ 10-12% body weight. The fishes attained 4.0-5.34g weight in prey-predator culture system, where as in trash fish fed ponds, the fishes reached final weight of 4.75g in 35 days of culture.

Hapas

Nursery rearing of fry (11 mm/20 mg) was also conducted in hapas (2x1x1m) at three stocking densities *viz*., 250, 375 and 500 nos./ m^3 at Muttukadu. A mixture of minced fish meat and a nursery diet was fed to the fry @ 25-100g/day. The final size of the fry ranged from 80-300 mg with 55.7% (250 m^2), 44.2% (375 m^2) and 47.2% (500 m^2) survival after 30 days of culture.

Nursery rearing in hapas at Muttukadu

Nursery rearing in hapas at KRC

At Kakdwip, seabass (0.085g/19.3 mm) was nursery reared in four hapas (2x1x1.3 m) stocked @150 and 100 nos./ hapa with two replicated for each density. They were fed @10% of body weight with a commercial larval diet. At the end of 38 days of rearing, the fry had attained mean size of 1.05g and 1.04g with survival rate of 56.5% and 83% in 100 and 150 nos. densities respectively.

FRP tanks

At Kakdwip, 3000 seabass seed were reared in 3 ton FRP tanks and fed daily with zooplankton and egg custard @ 8% body weight. Shooters were segregated daily and reared separately in a pond. At the end of 21 days of rearing, the shooters (11%) attained average weight of 20g and the rest of the seed in the FRP tanks reached average weight of 5g with a survival rate of 6%.

On-farm trials

Three nursery rearing trials were carried out in farmers' ponds in Tamil Nadu and Andhra Pradesh using CIBA feed, minced fish meat and mysids. In trial I, minced fish meat and mysids were fed in one set of hapas and CIBA feed in another set of hapas @ 20% body weight. In II trial, CIBA feed was provided @ 20% body weight and mysids were fed *ad libitum* in trial III (Table 13). In all the three trials feeding was done four times in a day. When fed with CIBA feed the fry exhibited uniform size while those fed with natural feed displayed diverse size. Since the stocking size, density and rearing periods were not same in all the trials, comparison between trials is not possible. However these trials have shown that it is possible for farmers to obtain stockable size seabass through nursery rearing in hapas with survival of 50% and above.

Table 13. On-farm seabass nursery rearing trials using different feeds

Trial (No. of happas)	Loca tion	Feed type	Stocking size		Hapa size (m)	Stocking rate (nos. /m^2)	Days of rearing (nos.)	Survival rate # (%)	Final size #	
			mm	g					mm	g
I (5)	Kota (AP)	CIBA feed	9.0	0.22	2x1x1	500	30	75	4.8	2.02
I (5)	Kota (AP)	Fish meal & mysids	10.0	0.30	1x2x1	300	30	50	6.0	3.5
II (6)	Muthu pet (T.N.)	CIBA feed	8.2	0.18	3x2x1	250	30	50	50	2
III (6)	Guntur (AP)	Mysids	9.2	0.2	1x2x1	300	45	58	65	3.8

Data on survival rate and final size as reported by the farmers

Development and maintenance of live feed culture

Four species of green algae, *viz*., *Nannochloropsis oculata*, *Chlorella salina, Isochrysis galbana* and *Tetraselmis* spp. are regularly maintained in indoor stock culture facilities. Mass culture of *Nannochloropsis oculata* was done in 5 and 10 t FRP tanks to feed the rotifer, *Brachionus plicatilis.* Cultures of green algae and rotifer were maintained round the year as live feed for seabass larvae.

Evaluation of seabass seed quality

With the objective of evaluating antioxidant defense system in early larval stages of seabass and to understand the seed quality, the activity levels of anti-oxidant enzymes such as super oxide dismutase (SOD), catalase (CAT) and selenium-dependent glutathione peroxidase (SeGPx) and low molecular weight free-radical scavengers such as reduced glutathione (GSH) and ascorbic acid (vitamin C) were evaluated from gastrulation (GS) to 25 days post-hatch (dph) larvae (Table 14). Oxidative damage due to lipid peroxidation (LPO) was also assessed, by evaluation of the formation of malondialdehyde (MDA).

Table 14. Status of antioxidant enzymes and antioxidants in different developmental stages of *L. calcarifer*

Different stages of eggs and larvae	SOD (units/mg ptn.)	Catalase (µM H2O2 consumed /min/mg protein)	Se-Gpx (GSH utilized /min/mg protein)	LPO (nmoles of malon-dialdehyde released /mg ptn)	GSH (µg /mg ptn)	Vit-C (µg/mg protein)
FE	43.93± 5.04a	16.63 ± 2.80a	50.25± 2.09a	34.56± 2.91a	95.25± 2.49a	27.72± 2.88a
GS	46.81± 5.9a	20.19±3.56b	56.07± 2.05b	64.29± 3.02b	25.36± 3.13b	8.12± 1.46b
3dph	43.77± 5.3a	18.53±1.90ab	31.07± 4.20c	5.18± 1.49c	102.72± 6.25c	69.21± 2.39c
5dph	43.38± 5.45a	6.59±1.02c	17.02± 1.34d	4.10± 1.06c	85.41± 6.24d	36.11± 3.37d
10dph	43.33± 5.23a	1.71±1.00de	16.98± 1.67d	11.49± 1.36d	66.33± 4.67e	36.06± 3.78d
15dph	43.27± 5.01a	1.24±0.49d	28.99± 1.82c	11.02± 1.14d	57.17± 2.37f	36.03± 2.63d
20dph	43.17± 4.83a	3.47±0.41de	35.06± 1.84e	17.19± 1.52e	20.23± 2.58b	12.09± 2.94be
25dph	43.44± 4.91a	4.30±0.65ce	41.57± 1.24f	18.09± 2.38e	80.26± 3.48d	13.40± 1.96e

FE: Fertilized egg; GS: Gastrulation; dph: day after hatching; Results are Mean ±SD (n=4). Values within each column bearing different superscripts are significantly different $P<0.05$.

All the three anti-oxidant enzymes, SOD, CAT and GPx, showed high activities during gastrulation, suggesting an increased metabolic rate during the period of embryonic development. Though the SOD activity apparently decreased progressively during 3–20 dph of larval development, the difference was not significant. CAT showed

high activity during gastrulation and remained constant up to 3 dph, suggesting an increased need to metabolise hydrogen peroxide (H_2O_2) and organic peroxides. In contrast, SeGPx activity increased progressively from 5 dph to 25 dph during larval development, indicating an increased need to detoxify lipid peroxides. This is evident from the observation of increased lipid peroxidation from 10 dph to 25 dph during larval development. GSH levels were low at gastrulation, indicating increased metabolic rate and formation of lipid radicals during this period corresponding to the decrease in the level of ascorbic acid which is consumed for regeneration of GSH.

Seed supply

Seed produced in the hatchery were supplied to 21 farmers in Tamil Nadu, Andhra Pradesh, Karnataka, Kerala, Gujarat and Goa for grow out culture in their farms. A total of 2.11 lakh seed was supplied and revenue of Rs.1.80 lakh was realized.

Grow out culture of seabass at Kakdwip

Monoculture of seabass (43-47g) was undertaken in four tide fed ponds at Kakdwip to evaluate frozen trash fish and live trash fish as feeds, with two replicates for each feed. In 340 days of culture, the fish fed with frozen fish attained size of 0.25-2.3kg while that fed with live trash fish reached 0.1-1.1 kg with 68% and 33% survival, respectively. The low survival rate when fed with live trash fish could be due to high rate of cannibalism. Under trash fish and live fish as feeds, production of 510 kg/ha and 250kg/ha was obtained with FCR of 7.14 and 2.57 respectively.

Seabass harvest

Shooters (20g) and smaller fishes (5g) obtained in the nursery rearing in FRP tanks were stocked in a pond and fed with live trash fish and miscellaneous shrimps. The shooters attained size range of 100-930g, where as smaller fishes reached 70-930g in 340 days of culture with 40% and 74% survival respectively. The production achieved was 445 kg/ha.

Grow out culture in farmer's pond

Seabass culture was demonstrated in farmer's ponds in Andhra Pradesh and Tamil Nadu. In Guntur (A.P), seabass was farmed at a stocking density of 5000 nos/ha along with tilapia. In 145 days of culture the seabass reached the size of 0.45-1.2kg (average: 850g). The recovery rate was 28% with an estimated yield of 1.19 t/ha. At Thampikottai (Thanjavur District, Tamil Nadu), seabass fry (1.5 cm) was stocked @ 10,000/ha with tilapia. The fish attained 150 to 350g in 135 days of culture. At Puthagaram (Thiruvarur District, Tamil Nadu), seabass seed (1.0 cm) stocked @ 5000 nos. /ha and fed with trash fish attained average size of 200g in 150 days.

Captive broodstock development of milkfish

Three year old broodstock (36 nos.) of milk fish *Chanos chanos* (1.5 to 3.0 kg) are being maintained in RCC tanks at Muttukkadu. The fishes were fed with a formulated diet (38% crude protein and 7% lipid) @ 2-3% per day. Fishes weighing more than 2.5 kg were examined by biopsy for assessing the stage of gonadal maturation. However, no fish was found in matured condition. Broodstock maintenance is being continued with a view to develop captive broodstock of milk fish.

AQUATIC ANIMAL HEALTH AND ENVIRONMENT DIVISION

RESEARCH PROJECTS

Title of project : **Fish health management in brackishwater aquaculture using epidemiology, diagnostics, prophylactics and molecular biology (AAHED/DIS/1)**

Principal Investigator : Dr.T.C.Santiago

Location of project : Chennai

Co-Investigators : Dr.N.Kalaimani, Dr.K.P.Jithendran, Dr.S.V.Alavandi, Dr.M.Poornima and Dr.A.R.Thirunavukkarasu

Title of project : **Development of technology for the discharge water treatment of shrimp farms (AAHED/DWT/1)**

Principal Investigator : Dr.B.P.Gupta

Location of project : Chennai

Co-Investigators : Dr.K.K.Krishnani, Dr.M.Muralidhar, Dr.R.Saraswathy, Dr.S.M.Pillai, Dr.C.Gopal, Dr.C.P.Balasubramanian, Dr. M.Shashi Shekhar, Dr.S.Kannappan and Dr.Ch.Sarada

FISH HEALTH MANAGEMENT IN BRACKISHWATER AQUACULTURE USING EPIDEMIOLOGY, DIAGNOSTICS, PROPHYLACTICS AND MOLECULAR BIOLOGY (AAHED/DIS/1)

Bacteriology and water quality of shrimp larval rearing tanks

Bacterial load, alkalinity and hardness in twelve larval rearing tanks were monitored in a commercial *P.monodon* hatchery from stocking shrimp nauplii up to PL 15 stage. The objective of the study was to understand bacterial populations in larval rearing tanks and their relationship with water quality parameters. The bacterial populations in these tanks ranged from 3.3 x 10^4 to 1.8 x 10^6 cfu ml^{-1} and vibrio counts from to 8.5 x 10^4 to 7.9 x 10^5 cfu ml^{-1}. Average alkalinity varied from 102 to 136 mg l^{-1} (of $CaCO_3$). Higher alkalinity was observed during mysis II to PL 6 stages and it dropped significantly as the larval development progressed. Hardness of source water was

considerably high (6480 mg l^{-1}) and in larval rearing tanks it ranged from 5200 to 6250 mg l^{-1} (of $CaCO_3$). Average hardness of rearing water was about 6000 mg l^{-1} and it showed decreasing trend as the larval development progressed (Fig.8). No definitive relationship could be observed between the bacterial load and alkalinity or hardness of water in the hatchery tanks. The study indicated that there was significant variation in the type and total count of bacteria between sampling dates from the same tank. There was also variation between hatchery tanks even though they received water from the same source

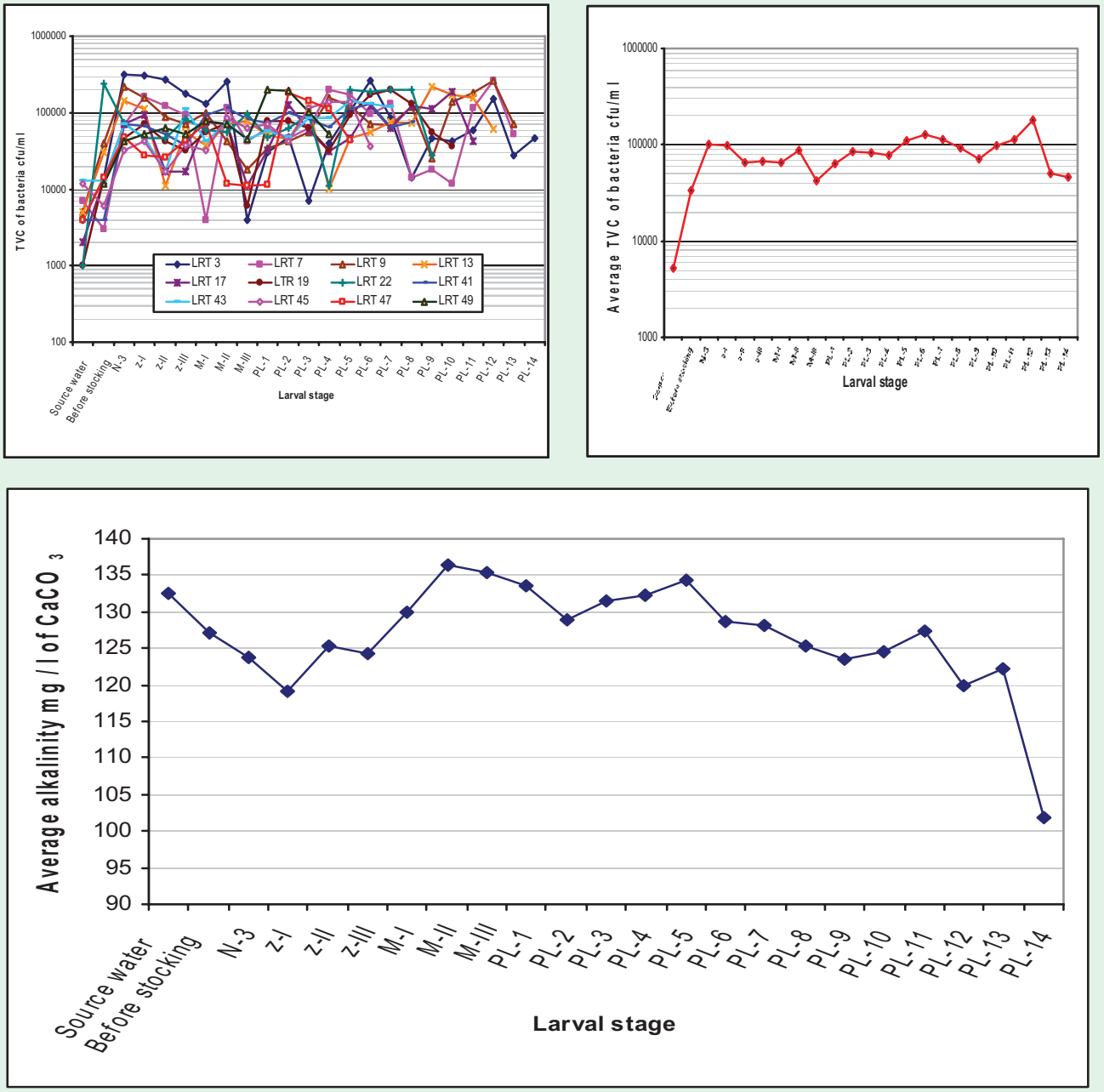
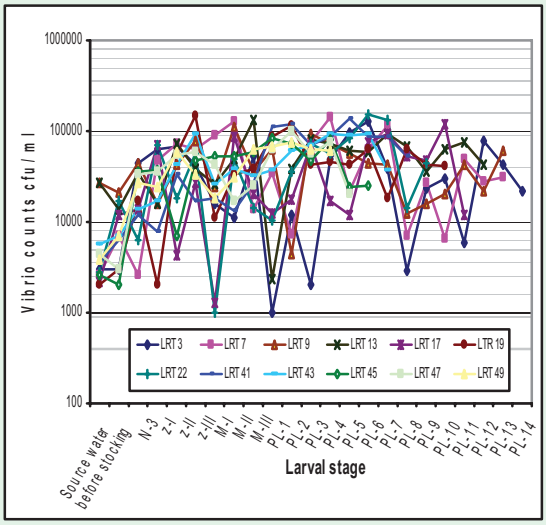
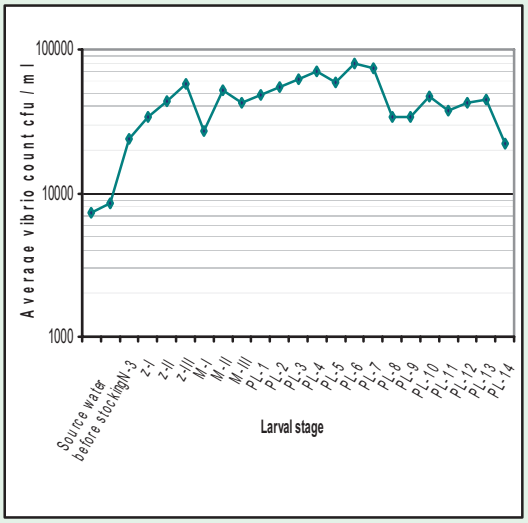
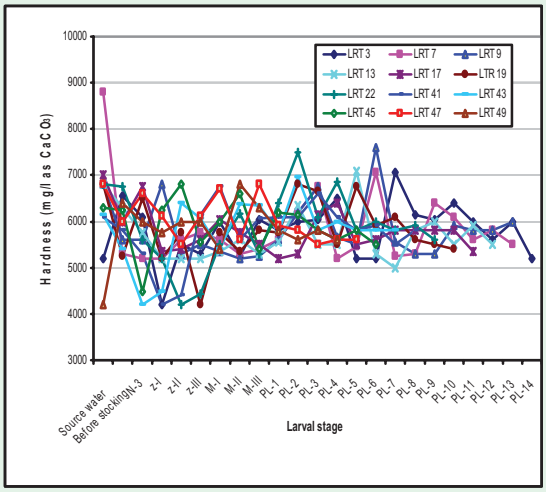


Fig.8. Bacterial populations and water quality of *P. monodon* larval rearing tanks. 1st row: total viable counts(TVC) of bacteria, average TVC of bacteria; 2nd row: alkalinity, average alkalinity, hardness and average hardness.







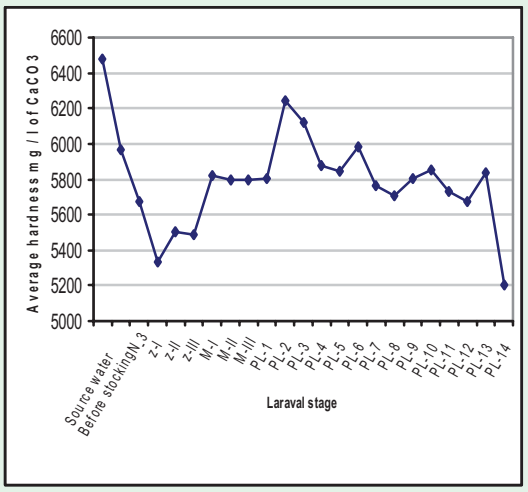


Fig.8 Bacterial populations and water quality of *P. monodon* larval rearing tanks. 1st row: total viable counts(TVC) of bacteria, average TVC of bacteria, vibrio counts, and average vibrio counts; 2nd row: alkalinity, average alkalinity, hardness and average hardness.

Screening of *P. monodon* broodstock

Prevalence of MBV and WSSV in shrimp brooders in a commercial hatchery located south of Chennai was studied during February to April 2006. About 42.52% of 1351 brooders sampled were found to harbour MBV occlusions in the faecal samples screened by malachite green stained wet mount preparations (Fig.9). Prevalence of WSSV was found only in 3.3% among the 450 shrimp brooders screened by nested PCR (Fig.10). The low level observed in the present study compared to those reported by hatchery could be due to the short term nature of the study. However it is imperative that the brooders have to be screened for MBV and WSSV prior to their induction in hatcheries for breeding purposes.

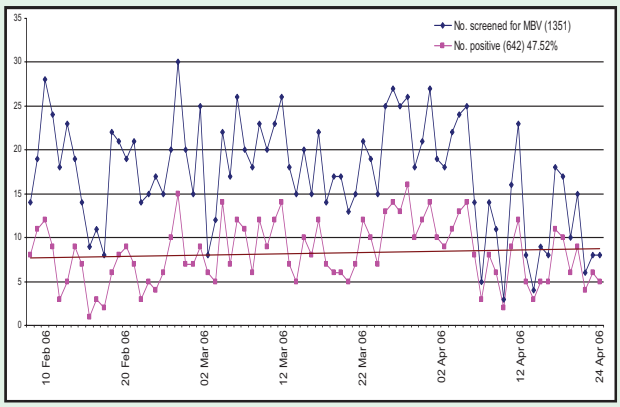


Fig. 9. Prevalence of MBV in shrimp brooders

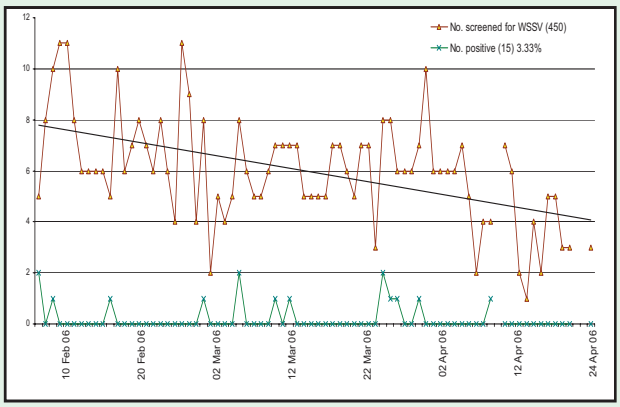


Fig. 10. Prevalence of WSSV in shrimp brooders

Screening of bacteria from mangrove ecosystem for probiotic potential

Forty seven microbes were isolated and identified from Sunderban mangrove swamps and Pichavaram mangrove areas and screened for their antagonistic activity against luminescent bacteria. Bacteria from these ecosystems were identified as *Bacillus* spp. (7 isolates), *Pseudomonas* spp. (11 isolates), *Micrococcus* spp. (4 isolates), *Vibrio* spp. (21 isolates) and *Flavobacterium* spp. (4 isolates). Three isolates of *Bacillus* spp. and seven isolates of *Pseudomonas* spp. showed antagonistic activity against luminescent bacteria (*V. harveyi*) *in vitro*. These bacterial isolates with antagonistic activity could be used as putative probionts for control of luminescent bacteria.

Post quarantine screening of *Litopenaeus vannamei* brooders

Microbial flora of *Litopenaeus vannamei* brooders imported by one of the two private companies was studied. The samples were collected upon release of brooders after their arrival in the hatchery. Analysis of external swab samples from four brooders and four water samples revealed predominant growth of *Vibrio* species. A total of 27 bacterial isolates were obtained from these samples among which, 21 were *Vibrio* spp. (predominated by *V. alginolyticus*) and other gram negative bacteria *viz.*, *Flavobacterium* spp. (3 isolates), *Alkaligens* spp. (2) and *Pseudomonas* spp. (2 isolates). These bacterial flora observed in imported shrimp are natural microbial flora of shrimp and coastal and marine water.

Nodavirus infection in fishes

Fish nodaviruses belonging to Nodaviridae have been reported to cause disease in approximately 40 species of

marine finfish aquaculture worldwide. Wild fishes are considered as carriers for the cultured species of finfishes. Several species of fish (trash fish used as feed for the seabass), pearl spot, mullet and some of the freshwater aquarium fishes like Gold fish (*Carassius auratus auratus*) and Rainbow shark (*Epalzeorhynchos frenatum*) and its colour varieties (Albino Rainbow shark) were tested for nodavirus infections by histopathology and nested PCR. The primer sets used are known to detect all the genotypic variants of fish nodavirus in Asian region with a target product of 430 and 280 bp in first step and second step PCR, respectively. The brackishwater fishes were found negative for VNN infections while, most of the nodavirus strains gave a positive reaction with some of the freshwater aquarium fish species (Fig.11). Histopathology of these fishes also revealed typical lesions of VNN. The study showed that aquarium fishes play crucial role in the spread of VNN through their commercial movement from one region to the other. Further the fishes were found to be with subclinical symptoms. This is the first report of natural infection of VNN in freshwater aquarium fishes in India, which has resulted in mortality.

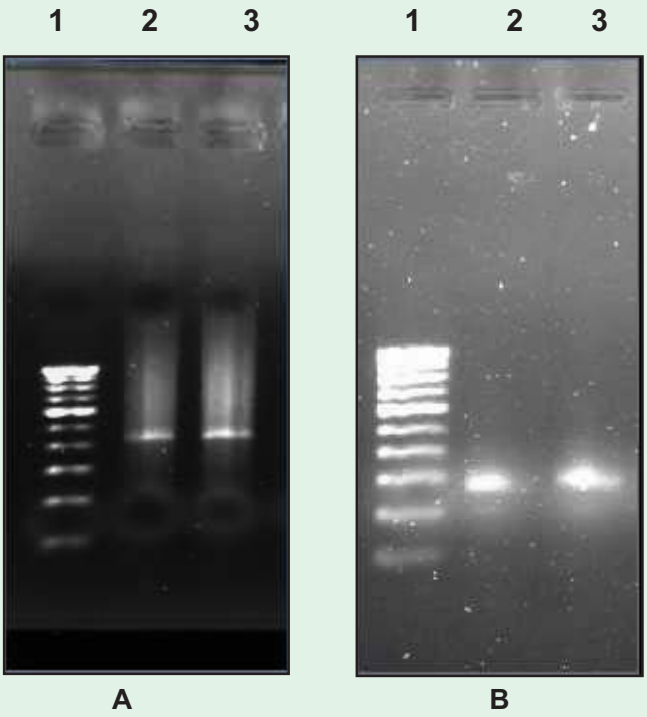
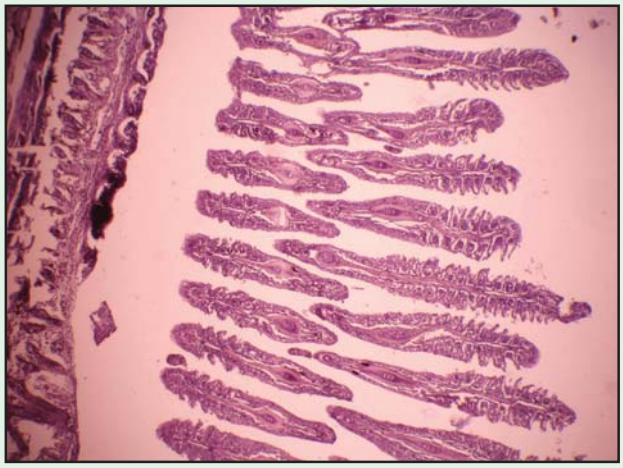


Fig. 11.Detection of VNN by RT-PCR (A) and nested PCR (B) amplifying products of 430 and 280 bp (Lane 1, 100 bp ladder, 2 and 3 RNA samples from brain and spleen, respectively)

Clinicopathology of monogenean infections in *Lates calcarifer* and *Etroplus suratensis*

The monogenean, *Dactylogyrus* sp. and *Diplectanum* sp. at hyper-infection levels on the gills were observed to cause 60% mortality in seabass (*Lates calcarifer*). On microscopic examination, large number of readily visible and active parasites was found attached to the gill filaments and / or skin by its haptors. The infected gills with frayed out margins were found off-colour, covered with mucous and with extensive haemorrhagic patches. Loss of scales was noticed in the head region near the eyes while caudal region showed extensive erosion associated with intense infection of the monogeneans. Large number of actively moving parasites were found attached to the gill filaments by its haptors resulting in the sloughing of the gill tissues. The heavily infested fish showed excessive mucus secretions on the body surface and secondary bacterial infections on skin. Histopathological studies revealed mild necrotic changes in the gills and the intensity of infestation was correlated to the severity of pathological alterations on the gills. Flukes cause lesions and tissue damage as well as side effects such as hyperplasia of both skin and



Seabass gills showing parasite sections and hyperplasia (100x)

gill epithelium, thereby creating entry sites for secondary infections. The results indicated the severity of co-infections of different monogeneans in fish. Morbidity and mortality of fish occurs due to excessive parasite load associated with crowding, inadequate sanitation and deterioration of water quality. In the present study, the source of infections could be live trash fish feed or fresh stock of juvenile fish introduced at later stage since water was not added and salinity was maintained with rock salt. Maintenance of water quality and pre-stock management to check the entry of infective stages and their multiplication in the rearing system is of paramount importance to prevent parasitic infection.

Prophylaxis and control of parasitic infections in shrimp and fish hatchery

Monitoring of shrimp hatchery for water born infestation was initiated by examining the free living and invasive stages of parasitic crustaceans. During July-August, it was observed that the free living and the parasitic copepodid stages of *Caligus* spp. and *Cyclops* spp. enter the shrimp broodstock tanks through the contaminated water trapped inside the clam shells used as live feed. To avoid infection, fresh clam meat may be fed after dip in fresh water for 5 minutes or cooked / frozen clam meat may be given. The prophylactic treatment of the infected shrimp with 25 - 50 ppm formalin will get rid of these parasites.

Copepodid stages of *Caligus* sp.

Adult female *Cyclops* sp.

Cyclops larvae

A case of fouling caused by sessile colonial protozoan was also observed on the tank wall and water inlets and pipes during February-March. Mortality of naupliar and postlarval stages of shrimp were observed within 2-3 days after its presence on tank wall, however adult broodstocks were found unaffected. The invasive nature, if any, of the sessile protozoan colonising the tanks is yet to be ascertained. Since they reappear after cleaning the tanks or giving formalin treatment, these are suspected to be water born organisms.

Ciliate protozoans causing fouling in shrimp larval tanks

Prophenoloxidase activity in *S. tranquebarica*

As crab culture is increasing, prevention and control of diseases are important and in this connection knowledge regarding the immune system of crabs will be useful. The pro-phenoloxidase system is considered as an important mechanism of innate defense mechanism in decapods. Following are some of the baseline values and characteristics of phenoloxidase (PO) in normal healthy crab. Phenol oxidase (PO) is actively involved in the defense system of crustaceans. The abundance of the enzyme in various tissues such as haemocyte lysate supernatants (HLS) and plasma were studied (Table 15). Phenoloxidase exist as a proenzyme in the hemocytes of *S. tranquebarica.* The pH optima, the biotic and abiotic stimulants / inhibitors of PO were also investigated. The enzyme prefers L-dihydroxyphenylalanine (L-dopa) as its substrate than phenol (Table 16) and is optimally active at pH 8.0. Besides trypsin, the proPO was also activated by both Gram positive and Gram negative microbes *in vitro* and PO activity was maximum in *V.fisherii* and minimum in *V.cholrae* (Fig. 12). Chemicals like sodium azide, thiourea and ethylene diamine tetraacetic acid significantly inhibited the enzyme activity. The stability of the enzyme activity at various temperatures has also been studied. The proPO was found to be temperature sensitive and became inactivated after 3 weeks of storage at 4°C, while it shows some activity even on 35th day when stored at –4°C. This enzyme in HLS was active even after 35 days of storage at –30°C.

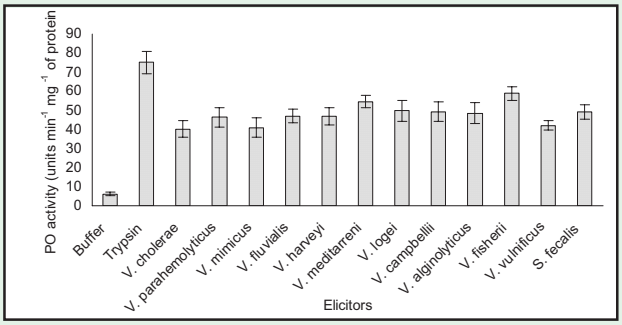


Fig. 12. Effect of exogenous elicitors on PO activity of haemocyte lysate from *Scylla tranquebarica*.

Table 15. PO activity from haemocyte lysate supernatant (HLS) and plasma of *Scylla tranquebarica* (mean ± SD; n = 8).

Sample	PO activity (units min^{-1} mg^{-1} of protein)
HLS	134.18 ± 3.48
Plasma	2.42 ± 0.45

Table 16. Km and maximum velocity of crab proPO with L-dopa and phenol as substrates.

Substrate(s)	K_m (mM)	V_{max} (Δ Abs min^{-1})
L-dopa	2.10	2.458
Phenol	4.03	0.003

Effect of immunostimulant and herbal additive on antioxidant status of *P.monodon*

Experiments were conducted to study the effect of β-glucan and spirulina individually and in combination in increasing the immunity at the time of infection with WSSV and in increasing the antioxidant status of *P.monodon* in terms of antioxidant enzymes such as Superoxide Dismutase (SOD), Catalase, Glutathione Peroxidase, Lipid Peroxidative products and antioxidants such as Reduced Glutathione (GSH), Vitamin C, and Vitamin E to reduce the oxidant stress during infection. Preliminary results indicate that β-glucan and spirulina were effective individually than in combination.

DEVELOPMENT OF TECHNOLOGY FOR THE DISCHARGE WATER TREATMENT OF SHRIMP FARMS (AAHED/DWT/1)

Field testing of products developed from lignocellulosic agro-wastes for the removal of nutrient load from discharge water

The discharge water from shrimp farms contains lot of nutrients and if released directly into the source water bodies, may lead to environmental problems. Bioremediation is one means to reduce the nutrient load in the discharge water. Based on the trials conducted with various agrowastes under laboratory conditions, bagasse has been found to be the most effective substrate for improvement of water quality. For further validation of the capacity of bagasse for bioremediation, field trials were conducted in one ton FRP tanks containing shrimp farm discharge water at Mahabalipuram, near Chennai. The SEM images of bagasse show the physical integrity of the lignocellulosic material.

The results confirmed that bagasse was an ideal substrate for the removal of ammonia and nitrite (Fig. 13) to bare minimum within 48-96 hours and also help to reduce the water turbidity to some extent by settling the total suspended solids. It was found to be non-toxic to *P. monodon* (PL 20) and also conditioned the water quality. Based on the results of the field trials, it is recommended to make small bundles of bagasse and erect in shrimp ponds one month before the harvest. This will help to condition the water quality during the last one month of the culture period, when the load of the nitrogenous toxicants is usually high.

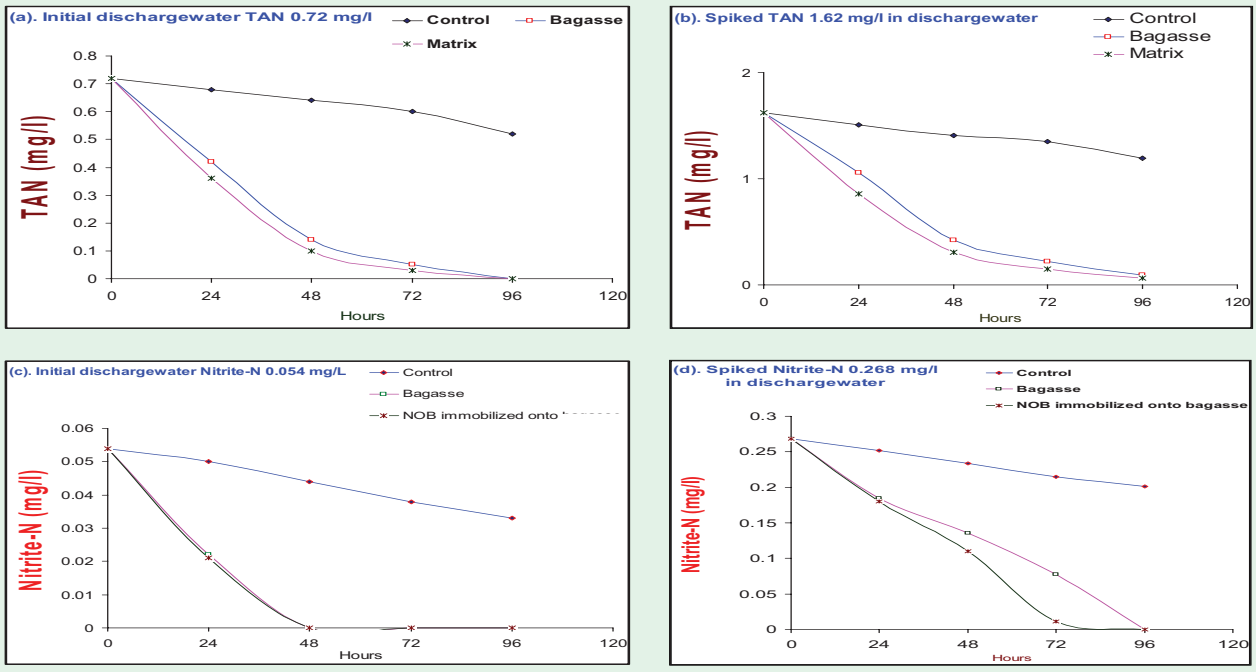
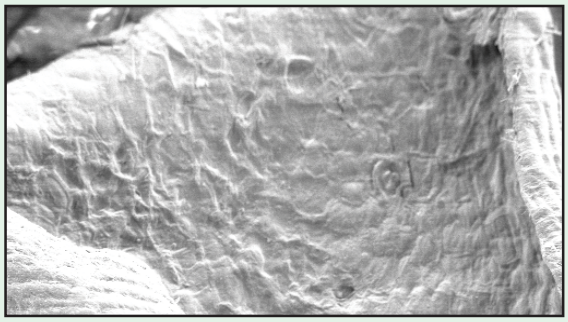


Fig. 13. Removal of ammonia and nitrite from discharge water in field experiment using bagasse, chemically modified bagasse (Matrix) and immobilized NOB onto bagasse.

Removal of ammonia (a). 0.72 mg/l initial TAN and (b). 1.62 mg/l spiked TAN using bagasse and chemically modified bagasse (Matrix).

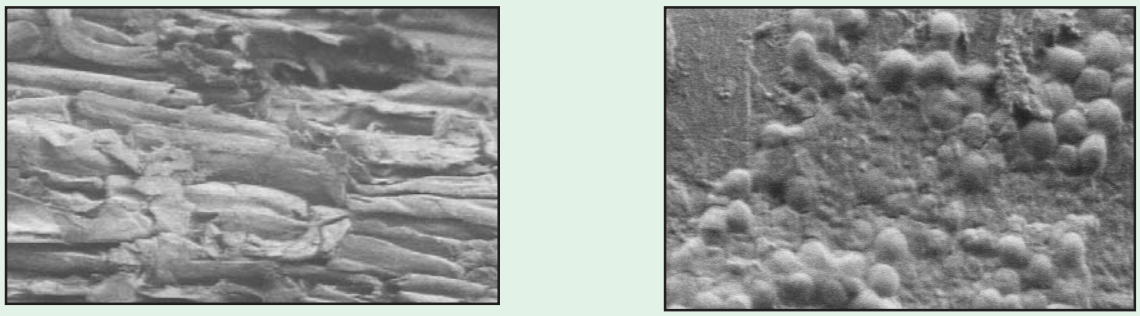
Removal of nitrite (c). 0.054 mg/l initial nitrite (d). 0.268 mg/l spiked nitrite using bagasse and immobilized NOB onto bagasse.

Biosorbent from agrowaste for the removal of heavy metals



SEM image of biosorbent developed from agro-waste.

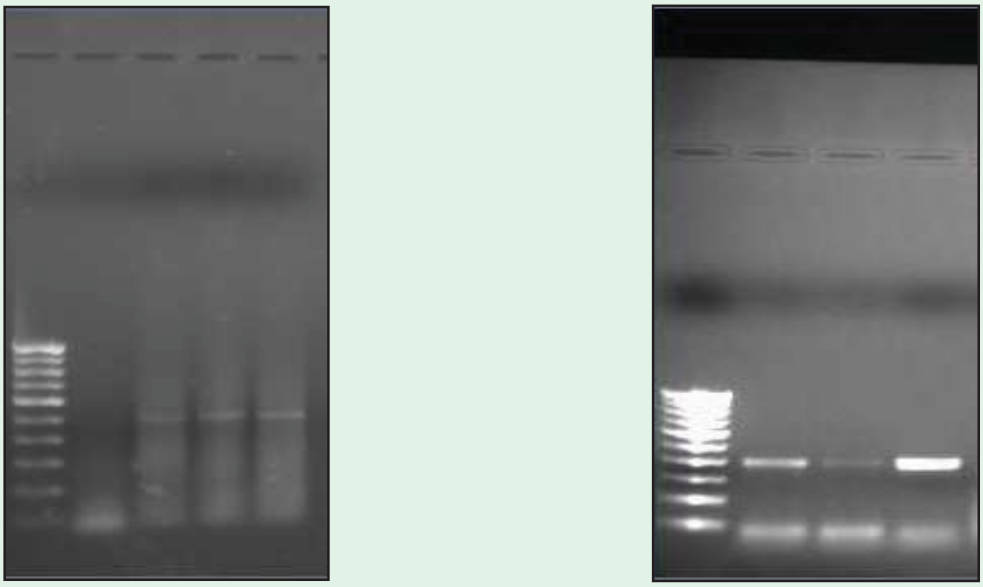
A biosorbent developed from lignocellulosic agro-waste is effective for the removal of eight different heavy metal ions such as Pb^{2+}, Hg^{2+}, Cu^{2+}, Cd^{2+}, Cu^{2+}, Ni^{2+}, Co^{2+}, and Mn^{2+} from contaminated water. Different experimental approaches such as batch isothermal equilibrium, continuous column adsorption and speciation were applied to evaluate the maximum sorption capacity, pH dependence and removal mechanism of the metal ions onto the biosorbent. Bio-sorption data were interpreted using Langmuir isotherm which reflect the influence of metal concentration on the uptake of the metal ion. The product has been characterized through microscopic, spectroscopic and potentiometric studies. This biosorbent is an interesting and suitable biomaterial in the treatment of metal contaminated water in batch and continuous flow system. This has an edge over the other conventional methods by virtue of its higher maximum adsorption capacity, large availability as a waste product, very low cost and minimal sorbent preparatory costs. The removal of heavy metals from contaminated waters collected from various places near Chennai (Ambattur) using the product has been demonstrated. This has an application for the treatment of industrial wastewater and also in freshwater aquaculture. Complete specifications have been submitted for filing of the patent (Patent Application No. 368/CHE/2006) on "Product from lignocellulosic waste for the remediation of water contaminated with heavy metals".



SEM image of (a) Matrix, (b). Biofilm mode of immobilization onto matrix

Development of biostimulation and bioaugmentation products

Matrix developed by CIBA from abundantly available byproduct from sugarcane industry is very cost effective and environment friendly. The matrix and biofilm mode of immobilization have been characterized. Molecular techniques were applied to identify immobilized organisms. Ammonia and nitrite oxidizing bacteria have been isolated from brackishwater aquaculture ponds from different locations. PCR amplification and sequencing of the gene implicated in nitrification (Fig.14), indicated that brackishwater aquaculture pond systems have the consortium of bacteria capable of ammonia and nitrite biotransformation. Field experiment conducted in 1-ton capacity tanks containing discharge water from shrimp farm at Mahabalipuram revealed enhanced bioremediation of ammonia and nitrite in the treatment with matrix and immobilized bacterial isolate. This matrix has applications in development of bioremediation products and probiotics and microscopic and biofilm studies. The patent entitled "immobilizing matrix from bagasse for bacterial biomass and a process for preparation thereof" has been filed (Patent Application No. 633/CHE/2006).



a b

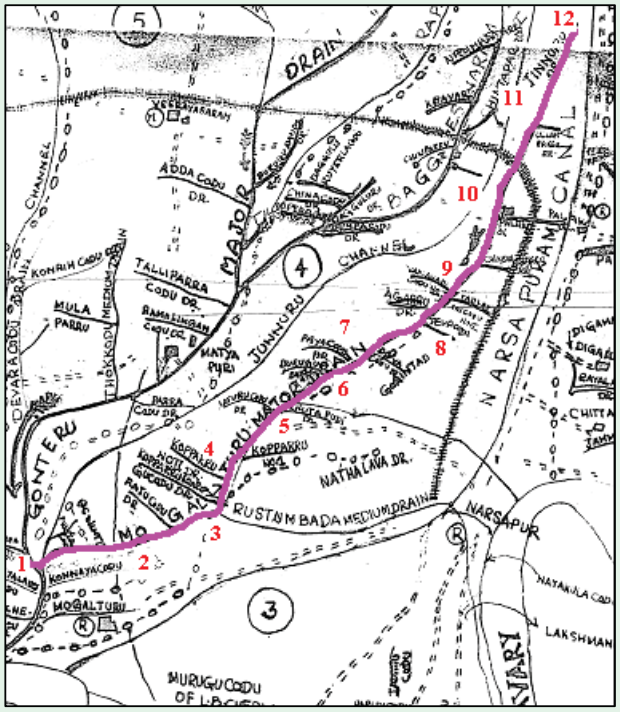
Fig. 14. Detection of (a) ammonia oxidizing bacteria and (b) nitrite oxidizing bacteria in brackishwater pond samples

Recovery and detection of pesticides in brackishwater

A patent has been filed on "Maximum percent recovery and detection of organochlorine (α-HCH, β-HCH, γ-HCH, aldrin, endosulfan, dieldrin or alternatively DDE, endrin and DDD) and organo-phosphorous pesticides (methyl parathion, chlorpyriphos, malathion and ethion) from brackishwater (Application No. 369/CHE/2006). This has applications in the field of bioremediation studies, analytical chemistry, analysis of pesticide residues and environmental impact assessment studies.

Carrying capacity assessment of Mogalthur drain for shrimp farming

Previous studies on assessment of carrying capacity for developing area specific recommendations were concentrated in Andhra Pradesh and Tamil Nadu on water bodies that are source and sink for only one activity, namely shrimp farming. Mogalthur drain in West Godavari District, Andhra Pradesh was investigated as a water source for shrimp farms and sinks for discharge water from both shrimp farms and paddy fields. The drain length is 24.6 km and passes through three mandals in



1. Ramulabandhugarvu, 2. Kothapalem, 3. Serepalem, 4. Kopparru, 5. Likhitapudi, 6. Mallavaram Peddalanka, 7. Mallavaram Chinnalanka, 8. Agarthipalem, 9. Agarru, 10. Chandaparru, 11. Poolapalli, 12. Jinnuru

Fig. 15. Sampling villages on the Mogalthur major drain

the district. The drain starts from Ramalabandhugarvu village in Mogalthur Mandal and ends into Narasapuram canal at Jinnuru. The drain was divided into three zones for collection of discharge water samples from the shrimp farms and paddy fields (Fig. 15) and their analyses were completed. Based on the nutrient loading into the drain from shrimp farms and paddy fields and carrying capacity of the drain (Fig. 16) maximum area was recommended for shrimp farming in each zone (Table 17). The drain is polluted in zone 3 due to anthropogenic and industrial activities. Further identification of potential area for development has to be ratified according to Coastal Aquaculture Authority guidelines and CRZ rules. The computer software developed for estimating maximum shrimp farming area has been upgraded by including the component of nutrient loading from paddy fields. These upgradations in the software are useful for the estimation of maximum area on source water supporting more than one activity either as source or sink (for example, shrimp aquaculture and agriculture in the present study) unlike the earlier version that supports only one activity (shrimp aquaculture).

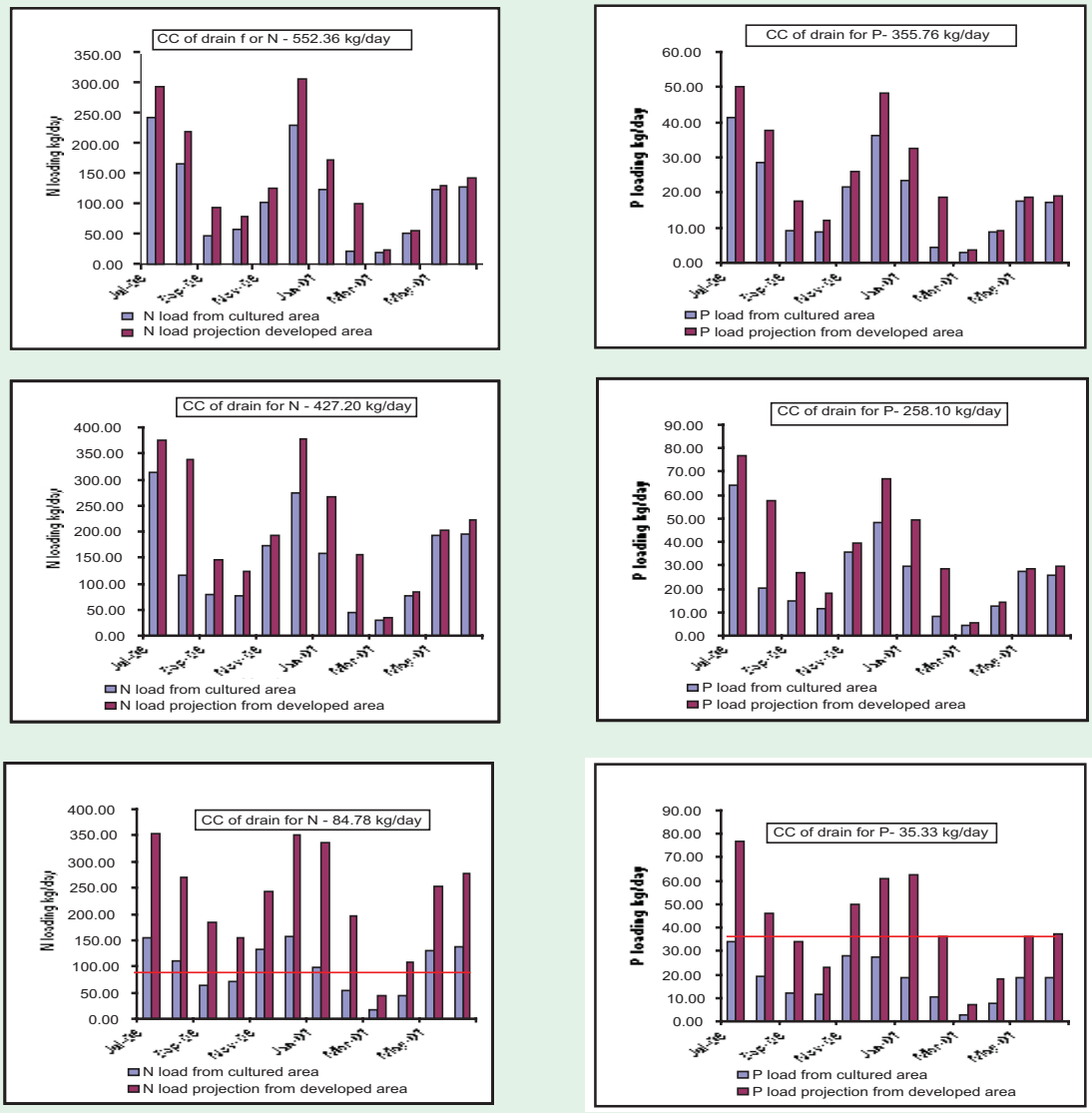


Fig. 16. Nutrient loading from shrimp farms and paddy fields into different zones of Mogalthur drain and their carrying capacity (Red line indicates that nutrient loading into zone 3 exceeded the carrying capacity)

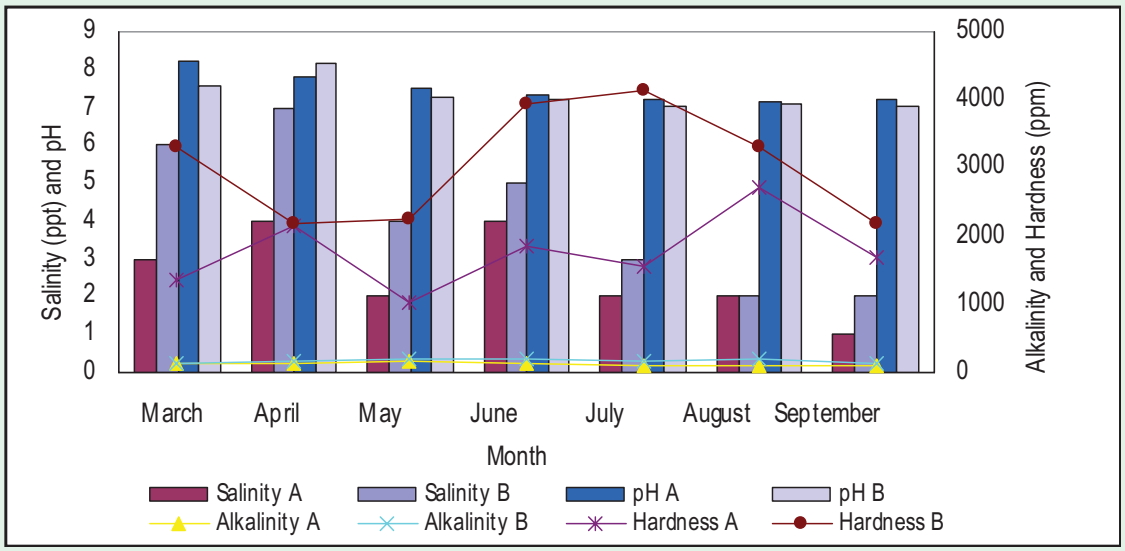
Table 17. Carrying capacity based area recommendation for shrimp farming on Mogalthur drain

Area details	Zone 1	Zone 2	Zone 3
Developed area (ha)	206.39	316.98	398.78
Recommended area (ha) for further development	369.52	357.24	94.96

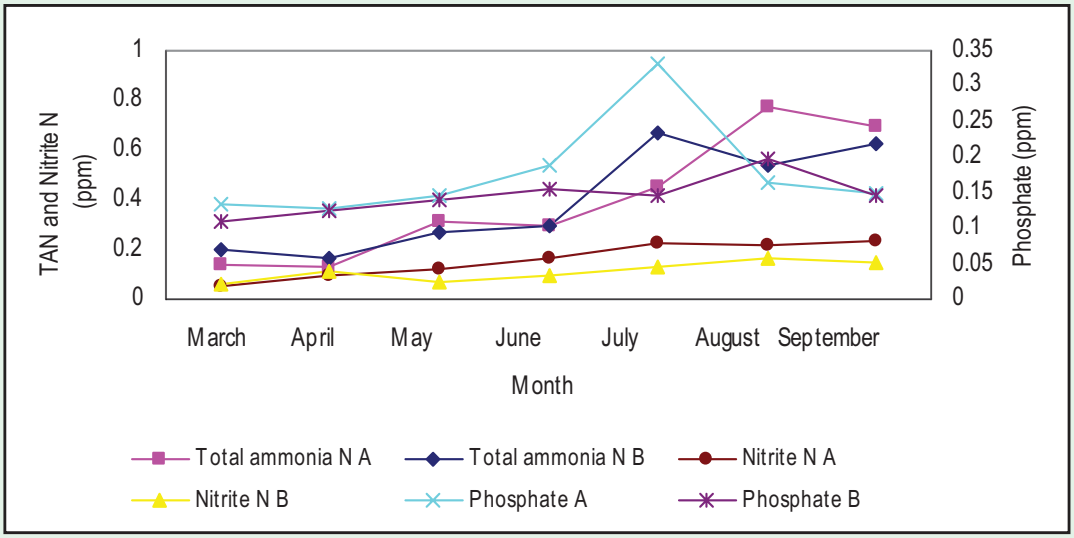
Soil and water quality with muddy - moldy smell problems in shrimp

In order to define environmental conditions associated with muddy - moldy smell in shrimps, studies were continued during the second crop (summer crop of 2006) in Akividu Mandal, West Godavari District, Andhra Pradesh. Soil, water and biological samples were collected from the shrimp (*P.monodon*) farms that were converted from older fish ponds (represented as A) that are likely to be affected with muddy-moldy smell and older shrimp farms (represented as B). In some of the shrimp farms converted from fish ponds alternate cropping of shrimp and fish is practiced. The source water for the farms was irrigation canal and bore wells. The stocking density and production in the farms ranged from 22850 – 40000 PL/acre and 895 – 1115 kg/acre, respectively. Average zooplankton density was 946 ± 30 nos./l. Adults and nauplii of cladocerans and copepods were the most dominant groups of zooplankton. As cladocerans are generally confined to freshwater environment, the occurrence of these groups in these shrimp farms is interesting.

The muddy-moldy smell was not observed during the study period and the harvested pond bottom condition was good as revealed by green colour patches without any black soil. The blue green algae (cyanobacteria) that are capable of producing musty odour compounds *viz*., geosmin and 2-methylisoborneol (MIB) are responsible for off-flavour in freshwater fish ponds. In the present study, mixing of waters could have altered the blue green algae composition. Soil and water characteristics during the study period are given in Fig. 17. Though total ammonia nitrogen N and nitrite N in water and organic carbon content in soil were high in shrimp ponds converted from fish ponds, their values were comparatively less in summer crop than the previous winter crop. Management practices such as flushing the water through ponds to remove blue green algae and low stocking density could have avoided the problem.



A - Shrimp farms converted from fish ponds (n = 6);



B - Shrimp farms (n =3)

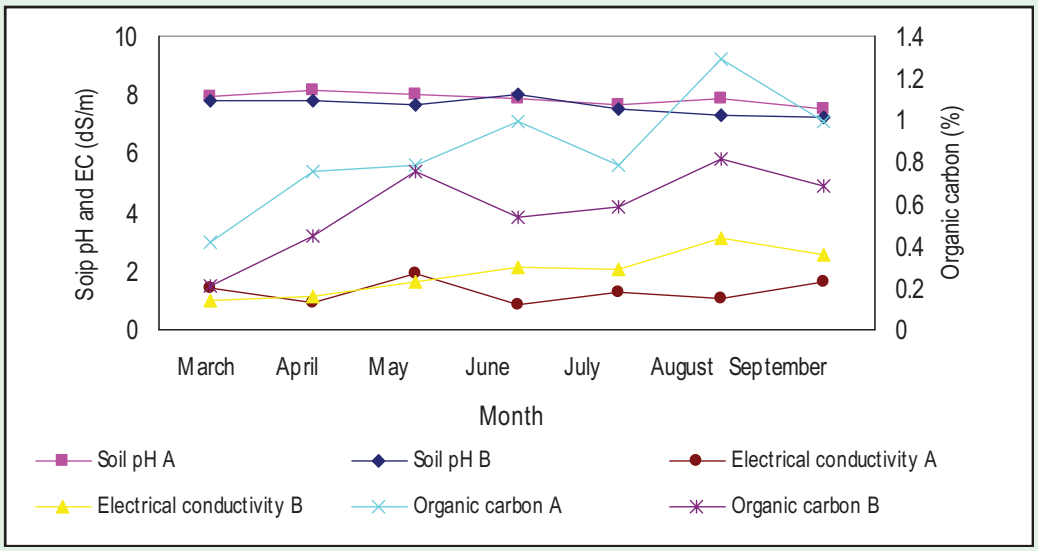


Fig. 17. Water and soil quality in shrimp farms converted from fish ponds and older shrimp farms

NUTRITION, GENETICS AND BIOTECHNOLOGY DIVISION

RESEARCH PROJECTS

Title of project	:	Development and demonstration of balanced feeds for Asian seabass, crabs and improvement of shrimp feeds (NGBD/NT/2)
Principal Investigator	:	Dr.S.A.Ali
Location of project	:	Chennai and Kakdwip
Co-Investigators	:	Dr.J.Syama Dayal, Dr.Debasis De, Dr.K.Ambasankar, Dr.C.Gopal, Dr.M.Shashi Shekhar, Dr.S.Kannappan and Dr.T.K.Ghoshal
Title of project	:	Genetic studies and application of molecular techniques in brackishwater shellfish breeding programmes (NGBD/MG/2)
Principal Investigator	:	Dr.G.Gopikrishna
Location of project	:	Chennai
Co-Investigators	:	Dr.C.Gopal, Dr. M.Shashi Shekhar and Dr.S.Kannappan

DEVELOPMENT AND DEMONSTRATION OF BALANCED FEEDS FOR ASIAN SEABASS, CRABS AND IMPROVEMENT OF SHRIMP FEEDS (NGBD/NT/2)

Freeze dried micro diet for weaning seabass larvae

The micro diet with 50% protein developed by freeze drying technique was tested on 12- day old Asian seabass (*Lates calcarifer*) larvae with a mean initial body weight of 1.6 mg and 2-3 mm length with the objective of introducing micro diet at the earliest and wean them to compounded feed. The larvae were stocked in a 500 l FRP tank @ 60 larvae/l (total 3000 larvae per tank) and maintained in a flow through system. The following feeding protocol as per days post hatch (DPH) of larvae was adopted in this experiment (Table 18).

Table 18. Feeding protocol for micro diet to wean seabass larvae

Days Post Hatch	Micro- diet particle size(μ)	Quantity of diet / day (g)	Feeding frequency	Live feed
12-14	180-200	10	7 times	90% of the total live feed requirement
15-17	220-300	12	6 times	60% of the total live feed requirement
18-20	300-375	14	5 times	30% of the total live feed requirement
21-23	375-425	16	5 times	10% of the total live feed requirement
24-26	425-500	18	5 times	Live feed stopped
26-27	500-550	20	5 times	Exclusive micro diet only

The larvae fed with micro diet grew to a length of 5.5 mm with a mean body weight of 4.5 mg with 85% survival. The number of shooters developed is only 0.94%. The striking observation is that almost all the larvae were of uniform size suggesting that co-feeding micro diet with the live feed *Artemia* results in better survival and reduces cannibalism.

Oven dried micro diet with fish hydrolysate

Hydrolysate prepared by predigesting the fish protein with a protease enzyme was added to the formulation at 20% level, replacing fish meal. The diet was dried at 60-70° C and prepared into micro particle of size ranging from 150 to 400 microns. The micro diet with 50.5% protein was fed to 12-day old (3000 larvae in 500 l tank), *L.calcarifer* larvae along with *Artemia* in a co-feeding trial as outlined in Table 19. The *Artemia* was gradually replaced and the larvae were successfully weaned to the micro diet. At the end of 26-day trail, the survival of larvae was 85.0%. The larvae co-fed with micro diet and *Artemia* were uniform in size with reduced cannibalism (2.9%). The results also indicated that efficacy of the improved diet dried at 60-70° C is as good as that of freeze dried diet.

The effect of different levels of fish protein hydrolysate (FPH) in the diet of seabass larvae was evaluated by including FPH at 0, 5, 10, 15 and 20% levels. Twelve day old 3000 seabass larvae with a mean body weight of 1.5 mg and a length of 2.5 mm were randomly distributed in 15 tanks (100 l each) @ 200 larvae / tank and the feeding trial was carried out in triplicate upto 30 days post hatch and the results are shown in Fig. 18. The results indicated that inclusion of FPH up to 15% in the diet improved the larval survival and the malformation (skeletal deformities like bent tail and vertebral column) rate decreased as the level of FPH in the diet increased (Fig. 18). This improved micro diet was used in the subsequent trials.

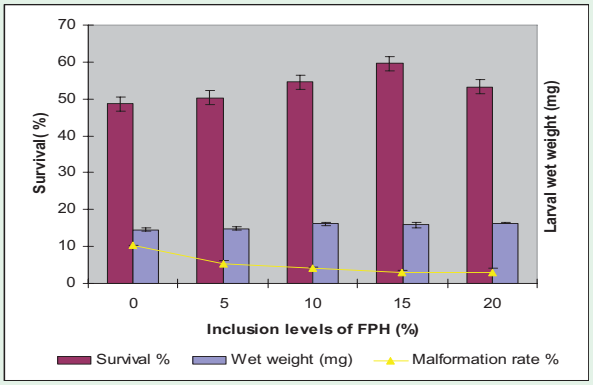


Fig.18. Effect of fish protein hydrolysate on growth, survival and malformation rate in seabass larvae

Evaluation of weaning protocol with the improved micro diet

Feeding trails with the improved micro diet were conducted to evaluate suitable weaning protocol for the 9-day old post hatch larvae of seabass with a mean initial body weight of 1.3 mg and 2-2.5 mm length stocked @ 40 larvae/l in a 500 l FRP tank with a flow through system. The three weaning protocols evaluated were (i) co-feeding of

micro-diet along with rotifer (ii) co-feeding micro diet with live feed *Artemia* nauplii and (iii) feeding with live feeds rotifer and *Artemia* nauplii. The experiment was conducted from 9 to 25 DPH. The results are given in Fig.19 and indicated that co-feeding micro-diet with rotifer excluding the use of *Artemia* nauplii up to 25 DPH resulted in better survival, uniform growth and reduced cannibalism. Significantly, the larval metamorphosis was started as early as 19th day in this protocol. Co-feeding micro-diet with *Artemia* nauplii resulted in better survival (Fig.19) than the use of live feed alone. Even though exclusive live feed protocol resulted in better weight, the larvae were not uniform in size and marked variation in length and weight was observed. This higher weight may possibly be due to the higher cannibalism in this regime. Hence co-feeding micro-diet with rotifer excluding the use of *Artemia* nauplii up to 25 DPH is the best weaning protocol for rearing seabass larvae.

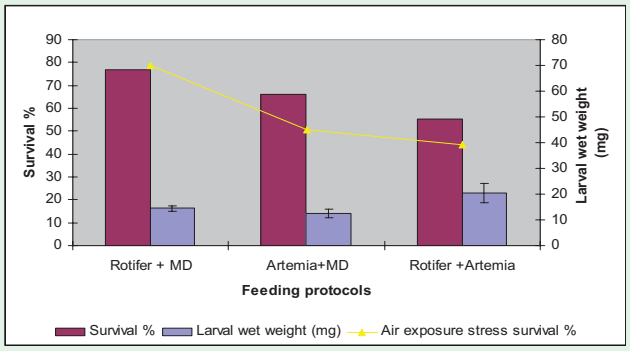


Fig.19. Growth and survival of seabass larvae fed by three different feeding protocols

The 25 DPH larvae from the evaluation of weaning protocol experiment were taken and the larvae from each protocol were divided into two sub groups and each sub-group in triplicate was tested. For the first group of larvae the same mixed protocol was followed and for the second group exclusive use of micro-diet was followed. The feeding trail was run up to 40 days post hatch. The results are given in table 19.

Table 19. Growth and survival of seabass larvae (25 to 40 DPH) under different feeding protocols

Larval parameter	Micro-diet + Rotifer co feeding (upto 25 DPH)		Micro - diet+*Artemia* co feeding (upto 25 DPH)	
	Fed with same co-feeding regime	Fed with micro-diet alone	Fed with same co-feeding regime	Fed with micro-diet alone
Final mean length± SE(mm)	17.12± 0.36	17.16± 0.53	20.38± 1.15	15.82± 1.05
Final mean weight ± SE (mg)	35.7± 1.65	32.9± 0.62	41.5± 1.61	26.2± 0.85
Survival ± SE (%)	62.37± 1.73	71.23± 1.08	42.59± 1.85	56.12± 1.11

The results indicated that seabass larvae co-fed with micro-diet + rotifer protocol group upto 25 DPH performed better during 25 to 40 DPH and it was easy to wean them to exclusive micro-diet than the other group co-fed with micro-diet and *Artemia*.

Formulated diet for nursery rearing of seabass larvae

Experiments with seabass larvae collected from the wild

A diet was formulated with 40% protein for nursery rearing of seabass fry (weight 0.45 g) collected from Kakdwip. The fry were successfully weaned to the formulated feed by mixing the diet with fish meat initially and completely to the compounded diet within three days. At the end of 25 days, the average body weight increased to 1.96 g with 75% survival. The fry were maintained in 5 ton cement tanks.

Experiments with hatchery reared seabass larvae

One hundred and twenty five 40-day post hatch seabass larvae with a mean body length of 17mm and a mean body weight of 95.6 mg were reared in a 2x 1x 1 m hapa and fed with the nursery feed at Muttukadu Experimental Station. At the end of 45 days of rearing, the fishes affaired average body weight of 1.81g with 46% survival.

Formulated feed for grow out culture of seabass

In order to evaluate the seabass grow out feed for its use in cage culture, one trial was carried out in hapa for four months. Hatchery reared seabass fry with an average body weight of 0.6 g were stocked in a hapa (2x1x1 m) @ 75 nos. and fed with nursery feed for one month. After that the fishes were fed with grow out diet in the form of semi moist dough for one month and then fed with dry pellet feed.

Table 20. Evaluation of grow out feed for seabass

Duration of the experiment in months	Average body weight (g)	Weight gain (%)	FCR	No of fishes	Survival (%)
1 month	2.62	336.66	3.1	56	74.66
2 month	8.81	236.25	2..8	47	62.6
3 month	51.13	480.36	2.6	46	61.3
4 month	219.4	329.10	2.5	45	60.0

The results (Table 20) showed that in two months of rearing, the fish attained an average body weight of 8.81 g and after that the growth is very fast and the fish reached about 220 g in four months. The survival in the first month was around 74.6%. Thereafter, the survival was 97.8 % once the fish reached above 8 g size.

Protein requirement of *Mugil cephalus*

Four isoenergic (4 Kcal/g) pellet feeds with four different protein levels, 20%, 25%, 30% and 35%, were formulated and prepared using locally available feed ingredients to study the effect of protein level on growth performance of *Mugil cephalus* juveniles with an initial average body weight ranging from 0.54 to 0.64 g. Feeding trials were carried for 125 days with test diets in FRP tanks with 20 fish in each tank and three replicates for each treatment. It was observed that 30% protein was optimum for growth of *M. cephalus* fry at 4 Kcal/g energy level (Table 21).

Table 21. Performance of *M. cephalus* fed with diets of different protein levels

Parameter	Group I (CP-20 %)	Group II (CP-25 %)	Group III (CP-30 %)	Group IV (CP-35 %)	P Value
Initial body weight (g)	0.57±0.02	0.54± 0.03	0.55± 0.05	0.64± 0.02	0.25
Final body weight* (g)	3.39a± 0.29	3.58ab± 0.26	4.36b± 0.24	4.34b± 0.17	0.04
Total weight gain* (g)	2.82a± 0.31	3.10ab± 0.32	3.81b± 0.23	3.70b± 0.16	0.06
Av. daily gain (mg)	22.56± 2.44	24.80± 2.55	30.48± 1.86	29.60± 1.24	0.08
FCR*	7.69b± 0.65	6.36ab± 0.90	4.86a± 0.53	6.01ab± 0.25	0.06
PER	0.66± 0.06	0.64± 0.08	0.70± 0.08	0.48± 0.02	0.13
SGR (%)	1.42± 0.10	1.52± 0.11	1.66± 0.08	1.54± 0.03	0.32

* $p<0.06$, a, b values bearing different superscripts in a row differ significantly

Effect of *Leucaena leucocephala* leaf meal in the diet of *Liza parsia*

An experiment was conducted to study the effect of *Leucaena leucocephala* leaf meal (LLM) in the diet of *Liza parsia* (initial body weight 1.51-1.79 g) on its growth. Feeding trials were conducted in FRP tanks (four groups with three replicates). Pellet feeds with three different levels of LLM, 10% (group-II), 20% (group-III) and 30% (group-IV) were formulated and prepared using locally available feed ingredients and compared with test diet containing no LLM (group-I). After 154 days of feeding, it was found that *Leucaena leucocephala* leaf meal (CP-22.68%) can be incorporated at 10% in the diet without substantially affecting the growth (Table 22).

Table 22. Performance of *L. parsia* fed different level of LLM

Parameter	Group I (LLM-0 %)	Group II (LLM-10 %)	Group III (LLM-20 %)	Group IV (LLM-30 %)
Initial body weight (g)	1.79 ± 0.15	1.61 ± 0.05	1.51 ± 0.05	1.71 ± 0.04
Final body wt (g)	6.50 ± 0.55	5.82 ± 0.16	5.30 ± 0.37	5.35 ± 0.17
Total weight gain (g)	4.71 ± 0.66	4.21 ± 0.20	3.79 ± 0.42	3.65 ± 0.12
Av. Daily gain (mg)	30.59 ± 4.26	27.32 ± 1.32	24.61 ± 2.75	23.68 ± 0.81
FCR	7.42 ± 1.20	7.98 ± 0.41	9.02 ± 0.94	9.18 ± 0.33
PER	0.47 ± 0.07	0.42 ± 0.02	0.38 ± 0.04	0.36 ± 0.01
SGR	0.84 ± 0.10	0.83 ± 0.04	0.81 ± 0.07	0.74 ± 0.01

Nutrient dynamics studies on *M. cephalus* grown in cement cisterns

A nutrient dynamic study was carried out in two cement cisterns provided (5 m x 3 m x 1m) with a layer of soil at the bottom with *M. cephalus* fingerlings (initial body wt. 3.96-4.02 g) and fed with formulated feed to understand the nutrient flow in the system, amount of nutrient utilized by fishes and to quantify the nutrient load leftover in the system. Salinity of the tank water was 4 ppt. Feed was given @ 3-4% of biomass. Nutrient load of water and soil was measured before offering any feed. Every fortnight different physico-chemical parameters of water and nutrient load in water was measured. Dissolved oxygen (DO), pH, temperature and alkalinity varied from 8.34-8.53 ppm, 8.04-8.22, 24.72-24.75°C and 128.22-141.22 ppm, respectively. Primary productivity was 187.08-206.16 mgC/m^3/h. Nitrate-nitrogen, nitrite-nitrogen and ammonium-nitrogen load in water were 21.08-23.27 µg/L, 5.58-5.83 µg/L and 0.014-0.015 µg/L, respectively (Fig. 20). Phosphate-phosphorus was 8.76-9.40 µg/L. Nitrogen content of fish was 9.37-9.77% at the end of 150 days experiment. Feed conversion ratio was 1.85-2.71:1

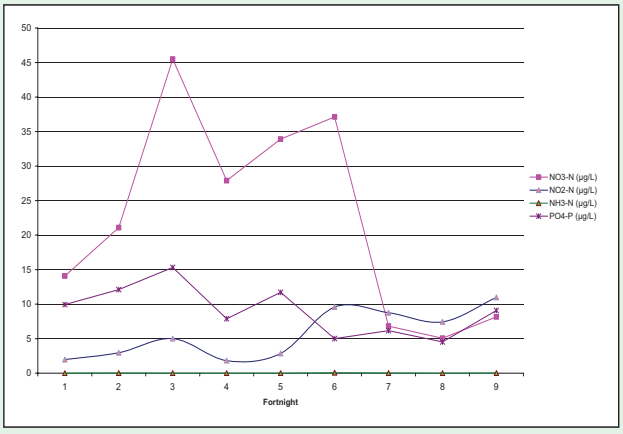


Fig. 20. Fortnightly nutrient load of water in cement cisterns

Broodstock feed for milkfish

A formulated feed with 38% protein and 7% lipid was developed as floating pellet using twin screw extruder technology and is being used for development and maintenance of captive broodstock of milkfish *C. chanos*.

Evaluation of different vegetable oils in shrimp diet

The effect of replacing fish oil by different vegetable oils on growth was studied in the Indian white shrimp, *F. indicus* and tiger shrimp (*P. monodon*) with a mean initial body weight of 3.34 g and 4.52 g respectively. The standard CIBA shrimp feed containing 3% fish oil was taken as control and the fish oil was replaced in total (W/W) by vegetable oils namely, ground nut oil, gingilli oil, sunflower oil and rice bran oil. The shrimp were fed with test feeds in laboratory experiments at 5% of body weight in three equally divided rations. The trials were carried out in triplicate and the results of eight weeks feeding trial are presented in Table 23.

Table 23. Effect of different vegetable oils on white shrimp and tiger shrimp

Oil source used in diet	White shrimp			Tiger shrimp		
	Weight gain ±SE (%)	FCR±SE	Survival±SE (%)	Weight gain ±SE (%)	FCR±SE	Survival±SE (%)
Fish oil	112.7± 1.12	1.81± 0.03	92.6± 1.84	82.7± 1.54	1.81± 0.02	93.3± 1.83
Rice bran oil	109.5± 3.19	1.86± 0.05	96.3± 1.85	84.4± 2.63	1.92± 0.03	93.3± 1.85
Gingili oil	107.3± 2.33	1.83± 0.02	90.7± 1.85	81.3± 1.78	1.87± 0.02	92.2± 1.78
Groundnut oil	100.8± 5.04	1.79± 0.02	88.9± 3.21	84.7± 3.19	1.85± 0.01	92.2± 2.21
Sunflower oil	109.7± 2.06	1.85± 0.01	87.0± 3.20	93.3± 2.49	1.85± 0.03	96.7± 1.84
Soybean oil	--	--	--	80.7± 3.12	1.79± 0.01	98.9± 1.45
Palm oil	--	--	--	79.5± 2.16	1.86± 0.02	96.7± 1.28
Coconut oil	--	--	--	81.3± 1.94	1.93± 0.02	90.7± 1.95

The results indicated that fish oil can be largely replaced with vegetable oils without adversely affecting the growth and FCR in both *F. indicus* and *P.monodon*.

Demonstration of CIBA shrimp feed in farmer's pond at Nellore

CIBA shrimp feed was demonstrated in a farmer's pond at Nellore (Maipadu). The farmer stocked 40,000 PL-14 of *P. monodon* in 0.4 ha pond .The shrimp were fed with CIBA shrimp feed from the day of stocking. The postlarvae were maintained in a hapa for 18 days and then released in to the pond. The shrimps were harvested on 97th day of culture due to continuous heavy rain for four days. A total of 565 kg of shrimp was harvested with a mean body weight of 21g and the survival rate was 67.26%. The FCR was 1.7:1. Large crab hole was found in one of the bunds. It was estimated that 150 - 200 kg of shrimp might have escaped through the crab hole. The FCR might have been lower if this had been prevented.

Demonstration of CIBA mud crab feed for fattening and culture

Mud crab fattening trials were conducted in Sattankuppam, and Koraikuppam villages in Pulicat lake with the help of self help groups (SHG) and NGO, PREPARE-ARW using pellet feed developed by CIBA for mud crab fattening. Trash fish was used as control feed. At Sattankuppam, the soft crabs (*Scylla tranquebarica*) were individually

stocked in compartments of floating cages having nine compartments in each cage. A total of 45 soft crabs were stocked in five cages. In the first three cages, CIBA feed was used and fed @ 2% (dry weight of feed) of total biomass. In the other two cages, trash fish was fed @ 10% (wet weight of feed). At Koraikuppam village crab fattening was conducted in two cages using CIBA feed alone following the protocol feeding as in the first trial. The formulated feed was readily accepted by the crabs. At Sattankuppam village, in both the treatments, crabs hardened within 16 days. At Koraikuppam village the crabs were harvested after 26 days after hardening.

Table 24. Performance of CIBA feed in crab fattening in cages

Parameters	Sattankuppam village		Koraikuppam village
	CIBA feed (5 cages)	Trash fish (2 cages)	CIBA feed (2 cages)
Total weight of crabs stocked (kg)	12.90	8.50	20.40
Total weight of crabs harvested (kg)	14.30	9.30	22.60
No. of days of rearing for hardening of crabs	16	16	26 days
Increase in weight (kg)	1.40	0.80	2.20
Weight gain (%)	10.85	9.41	10.78
Survival (%)	100	100	100
Total feed used (kg)	4.12	10.0	10.6
Cost of feed @ Rs.18/kg for pellet feed and Rs.7.5/kg for trash fish	74.3	75.0	191
Cost of purchase of water crabs (Rs.)	1645	1084	2852
Cost of selling of hardened crabs (Rs.)	2354	1531	5260
Gross Profit (Rs.)	709	447	2408
Percent gain over the investment	43.1	41.2	84.4

At Sattankuppam village, there was a weight gain of 10.85% in crabs fed with CIBA pellet feed and 9.41% in those fed with trash fish (Table 24). The gross profit was Rs.709/- in case of pellet feed fed crabs and Rs.447/- in case of control feed fed crabs and the percentage gain over the investment is 43.1% and 41.2% respectively, while expenditure on pellet feed and the control feed being practically same. At Koraikuppam village trials, the weight gain was 10.78% similar to that in Sattankuppam village trials. The gross profit was Rs.2,408/- and percentage gain over investment was higher at 84.4%, mainly due to the higher selling price.

The trials with the involvement of SHGs have demonstrated that CIBA feed performs equally well as trash fish. In addition to the advantage of easy storage of formulated feed, in locations where trash fish is not available or costs more than Rs. 8/- per kg, it will be advantageous to use CIBA feed.

Testing of formulated feed for *S. serrata* in grow-out pond

At Kakdurip, two ponds, A (800 m^2) and B (600 m^2) were stocked with mud crab (*S. serrata)* having an initial body weight of 47 ± 10g @ one crab / m^2. Crabs were fed with formulated pellet feed @ 2% (dry basis) of biomass. After 180 days of culture, crabs attained mean body weight of 160 ± 41 g with a carapace width of 90 ± 5.1 mm and carapace length of 68 ± 5.4 mm. A total quantity of 240 kg/ha was harvested.

GENETIC STUDIES AND APPLICATION OF MOLECULAR TECHNIQUES IN BRACKISHWATER SHELLFISH BREEDING PROGRAMMES (NGBD/MG/2)

The Kuruma shrimp *Marsupenaeus japonicus* has a lot of export potential with a niche market in Japan. This species is available along the Tamil Nadu coast and it has been successfully domesticated with the production of F_6`generation. The species is amenable for culture in FRP tanks inside hatchery and in ponds. There is an urgent need to study their production performance as well as the resistance to White Spot Disease and the present study has been undertaken with focus on these two major points which are important in respect to farming of this species.

Two inbred females (average weight: 34 g) maintained from the earlier breeding trials matured in the hatchery and were subsequently bred with two males (average weight:29 g) and two full-sib families were obtained from these matings for further rearing. Eight dam families were obtained from wild gravid females (40 to 70 g). In total, 10 families have been obtained. The post larvae (PL) were screened for WSSV and about 1000 PCR negative PL from each family were stocked in two 500 l FRP tanks on January 2007. Daily 20% of the water was exchanged with filtered and UV irradiated seawater. Continuous aeration was provided in each tank. The PL was treated once a fortnight @ with 50 ppm formalin for 30 minutes. Once in a fortnight, the tank is cleaned thoroughly after removing the water completely. Feeding is carried out six times in a day at an interval of four hours. Water quality parameters are being monitored. Sampling was carried out regularly. The average wet weight is shown in (Table 25).

Table 25. Variability in body weight in different families of *Marsupenaeus japonicus*

Family No.	Sampling on 34th day		Sampling on 68th day	
	Average body weight (n=30)	Coefficient of Variation (%)	Average body weight (n=20)	Coefficient of Variation (%)
1	0.135 ± 0.006	26.03	0.602 ± 0.129	95.61
2	0.112 ± 0.008	39.37	0.387 ± 0.037	42.57
3	0.080 ± 0.006	42.76	0.325 ± 0.033	45.24
4	0.118 ± 0.012	56.64	0.519 ± 0.052	45.07
5	0.114 ± 0.009	45.18	0.396 ± 0.036	40.30
6	0.127 ± 0.013	57.83	0.491 ± 0.031	28.28
7	0.055 ± 0.004	36.10	0.226 ± 0.018	36.46
8	0.037 ± 0.003	46.97	0.206 ± 0.019	40.69
9*	0.464 ± 0.042	49.47	1.557 ± 0.111	31.77
10*	0.125 ± 0.011	48.06	0.519 ± 0.045	38.86

* inbred stock

Comparison of the average weight of PL over time indicates that families 8,1,4,10,7 and 3 in the decreasing order showed higher growth increase and exhibit potential for heavier body weights. The values of coefficient of variation indicate that body weight in Kuruma shrimp is amenable to selection.

SOCIAL SCIENCES DIVISION

RESEARCH PROJECT

Title of project : **Technology transfer, socio economic aspects and informatics in brackishwater aquaculture (SSD/EXTN/3)**

Principal Investigator : Dr.M.Krishnan

Location of project : Chennai

Co-Investigators : Dr.T.Ravisankar, Dr.V.S.Chandrasekaran, Dr.(Mrs.) B.Shanthi, Dr.(Mrs.) D.Deboral Vimala, Dr.M.Kumaran, Dr.K.Ponnusamy, Mrs.P.Mahalakshmi and Dr.(Mrs.) Ch. Sarada

Evaluation of Communication Effectiveness

A study on the communication effectiveness of CIBA extension publications and a compact disc (CD) on mud crab culture was taken up among fishery extension workers with respect to subject matter, style, presentation, layout and illustrations. The evaluation was conducted with 47 Fishery Extension Officers from Tamil Nadu (22) and Andhra Pradesh (25). The results which included suggestions for use of more pictorial representations and use of local language for technical words, will be incorporated in improving the communication effectiveness in the publications.

CIBA Scientists took active part in a group discussion entitled "Reducing the cost of production in shrimp culture" organised by the College of Fishery Science, Muthukur, Nellore District, Andhra Pradesh in which specialists from MPEDA, State Fisheries Department, aqua farmers, aqua consultants and farm equipment dealers from Nellore and Prakasam districts participated. It was identified that supply of quality shrimp seeds, use of alternate protein sources to fish meal to reduce feed cost, restricting the usage of probiotics, monitoring of farms by trained personnel, reducing the electricity tariff, provision of institutional credit and market intelligence were the means to reduce the cost of production in shrimp culture.

Evaluating "Web kiosk in Aquaculture"

The study examined the existing activities of ITC's e-Choupal model in aquaculture in Prakasam District of Andhra Pradesh Information was also generated covering various aspects such as, history, center facilities, services and content, center usage and drawbacks. Based on an overall assessment of the aquachoupal centers in Prakasam district certain shortcomings were observed. To overcome these, the following suggestions are given:

- The centers seem to be used more by the large farmers. It needs be extended to small farmers.
- The aqua-choupals are now owned and operated by aqua companies. Each Shrimp Farmers Association can take up the initiative of installing an aqua-choupal in their mandal which will ensure information exchange among the fellow farmers and check communication and time lag.

- Since awareness of such initiatives and opportunities offered by aqua-choupals among small and marginal farmers is limited, awareness can be created with regard to the facilities in the aqua-choupal for the benefit of the farming community.
- The role of women in brackishwater aquaculture is increasing and they also play greater role in decision making in both on and off farm activities. Therefore, efforts should be made to empower female population through aqua-choupal.

Information needs assessment for Village Knowledge Centres

A study was undertaken in Pudhucherry to assess the information needs of users and non-users of Village Knowledge Centres (VKCs). The investigation was carried out in four coastal centres namely Veerampatnam, Pannithitu, Periyakalapet, Ganapathychettikulam where MSSRF has set up VKCs, through structured questionnaire. A total of 103 questionnaires were completed. Number of parameters like culture practices, e-learning modules and their components, extension service requirements, value added operations in fisheries and basic information like need for addresses of fisheries institutes and departments were the main parameters used to evaluate the needs of the the different VKCs. Each of the main parameters had multiple sub parameters. Each individual VKC then ranked the sub parameters which were aggregated under the main head parameter. This reflected the rank of each VKC in respect of aggregated broad parameter. This constituted the final ranks of the requirements of each VKC. These ranked items were then analysed for correlation coefficient. The calculated values of rank order correlation coefficients (r_s) between VKC users were quite high which were estimated to be 0.925, 0.884, 0.819, 0.782, 0.686. This indicated that almost similar ranks were assigned to various information needs by VKC users.

Evolving brackishwater aquaculture practices

Crab culture in Nellore

A farmer from Nellore, Andhra Pradesh has demonstrated the feasibility of mud crab farming as an alternate cropping system to shrimp farming. Mr. Goush Basha, a tiger/scampi farmer in Gurithipalam near Nellore started polyculture trials on mud crabs, scampi and milk fish in a 0.5 ha grow-out pond. He stocked the pond with 1200 crab juveniles (25 - 30 g) and harvested 800 crabs with 67% survival rate and realized an income of Rs.44,690/- in 8 months through sale proceeds of crab (Table 26)

Table 26. Crab farming in Nellore, Andhra Pradesh by a private farmer

Grade	Live weight (g)	Quantity harvested (kg)	Rate / kg (Rs.)	Income (Rs.)
XL	750 & above	17	340	5780.00
Big	500 – 750	100	240	24000.00
Medium	350 – 500	100	140	14000.00
Small	250 – 340	13	70	910.00
	Total :	230	Total Income :	44690.00

Mud crab farming in Tuticorin, Tamil Nadu

Mud crab *Scylla tranquebarica* is cultured in earthen ponds at Punnakayal fishing village, Tuticorin by a women crab farmer Mrs. Sussammal Nazareen. The crab culture is done for about 9 months in a year in a water spread

area of 100 ha consisting of 25 ponds with varying sizes and depths (2-6 ft). Sea water is pumped into the ponds. Stocking is carried out during April to June and juvenile crabs (< 100 g) are stocked @ 0.5 / m^2. The cost of seed was Rs.60/kg. The crab grows to marketable size in approximately 4-6 months. Trash fish @ 160 kg/day was given as feed to the crabs. Partial harvesting is carried out and crabs with an average weight of 500 g and above were hand picked and sold in live condition to the exporters. Crabs weighting less than 500 g were sold @ Rs. 200/kg and that weigh at 750 g @ of Rs.250-300/kg. Harvesting is done on staggered basis. The estimated production was found to be 750 kg/ha and the gross annual production was 75 tons. On an average, Rs. 1.5 lakh/year is realized from the sale of mud crabs.

Estimates of short-run Indian seafood exports instability model

The short run Indian Seafood Instability Model computed the instability of exports by using the measure based on the average percent deviation of the observed values proceed from an exponential path. Instability index of seafood exports earnings can be expressed as a function of commodity concentration (CC), Geographic Concentration (GC) and Instability in country's GDP which reflects per capita income of the exporting country.

The short term coefficients are smaller than their long run counter parts. This suggests that impact of these variables causing instability in Indian seafood exports requires time for adjustment**.** The estimated coefficients show that all the variables except instability in cultured shrimp production did not show significant short-run impact on instability in seafood exports. The significance of this short run effect is minimized by the error-correction term, which is significant with expected sign and of a fairly larger magnitude. This finding not only supports the validity of long-run equilibrium relationship among the variables but also indicates that instability in seafood exports is sensitive and tends to depart from the equilibrium value in the previous period. Its magnitude indicates that deviation from long-run is adjusted fairly quickly when 54.6 per cent of disequilibrium is recovered in each period. The results also substantiate the fact that the seafood export sector is responsive to the fast changing profile of the market. Conforming to HACCP standards, improvements in processing and packaging standards and development and marketing of niche products to select markets are enabled quickly in order to take advantage of gains from trade even in the short run.

Assessment of performance of fish transportation cycle rickshaw

Central Institute of Post Harvest Engineering and Technology (CIPHET), Ludhiana developed a Fish Transportation Cycle Rickshaw for the small fish retailers /venders for storing the fish with ice for short duration and marketing, under the Adhoc Project 'Design and development of devices for freshwater fish for short distance transportation, holding and retail marketing'. One unit of the rickshaw was given to CIBA to conduct the field trials and it was handed over to a Women Self Help Group (SHG), Kadapakkam village, Cheiyur Taluk, Kancheepuram District on temporary basis for utilization after getting the MOU signed by CIPHET, CIBA and the SHG on 12th September 2006 and its performance was evaluated subsequently.

Fish transportation cycle rickshaw

KAKDWIP RESEARCH CENTRE

RESEARCH PROJECT

Title of project : **Refinement of traditional brackishwater aquaculture systems for sustainable production of shrimp and fishes**

Principal Investigator : Dr.M.Natarajan

Location of project : Kakdwip

Co-Investigators : Dr.A.Panigrahi, Dr.Debasis De, Dr.J.K.Sundaray, Dr.T.K.Ghoshal, Dr.V.S.Chandrasekaran, Dr.M.Jayanthi, Dr.S.V.Alavandi and Dr.M.Muralidhar

Assessment and monitoring of the disease prevalence in traditional farms

Disease prevalence among the farmers surveyed (n =110) can be categorized as the percent prevalence of white spot syndrome virus disease (27%), bacterial disease (5%), loose shell syndrome (4%), low pH (2%) and other diseases (2%). The disease outbreak in South 24 Parganas was recorded and the most prevalent one was WSSV. Other diseases encountered are loose shell syndrome, gill rot and disease associated with environmental problems like low pH and NH_3. The disease reported in the Fraserganj Fisheries Project of State Fisheries Development Corporation, West Bengal was investigated and confirmed as WSSV based on PCR screening.

Evaluation of the Indigenous Technology (ITK) know-how

Several ITKs were recorded from different sources and put on a story board to have a preliminary classification in to various categories based on their origin and scientific basis. Some of the interesting ITKs are raking one fourth portion of the pond to improve plankton bloom, use of chopped banana plant to improve water quality, tamarind juice / vinegar to reduce pH and to remove black spot, "Tal misri" – Palm sugar candy to improve health of the shrimp and use of trap to collect diseased shrimp in a pond.

Improvement of productivity in traditional brackishwater aquaculture systems

For understanding the dynamics of bheri system, two bheries situated close to KRC were selected and the soil and water quality parameters were analysed during each tidal phase along with the available fish fauna. At every high tide, the species composition in the inlet waters was sampled through cast net and shooting net operations. The species occurring in the high tide phase during February – April 2007 in decreasing order of abundance are *Metapenaeus monoceros* (62-88 mm), average weight 4.78g, *M. leander* (56-78 mm) 2.41g, *M. brevicornis* (65-101 mm) 4.04g, *F. penicillatus* (121-140mm) 12g, *Liza parsia* (50-95 mm) 8g, *Mystus gulio* (90-133mm) 10.9g, and *Scylla serrata* (CL:43-65mm; CW: 63-93 mm) 87g .

NETWORK PROJECT

Title of project : **Fish germplasm exploration, cataloguing and conservation between CIBA-NBFGR**

Location of Project : CIBA (Chennai and Kakdwip)

Project Coordinator : Dr.A.G.Ponniah

Principal Investigator : Dr.C.P.Rangaswamy

Co- Investigators : Dr.A.Panigrahi, Shri G.Biswas and Dr. R.Ananda Raja

India has vast and diverse aquatic genetic resources and conservation of the genetic diversity is essential to maintain ecological and socio-economic equilibrium. The fish and shellfish germplasm resources from Pulicat Lake (Tamil Nadu) and Kakdwip area (West Bengal) were studied for cataloguing, conservation and management and gene banking of fish and shell fish species.

Fish biodiversity of Pulicat Lake (Tamil Nadu)

Samples were collected regularly from fish landing centres of Pulicat and Arambakkam villages in Pulicat Lake for cataloguing of germplasm resources. Examination of the samples revealed the occurrence of 45 species -31 fish species belonging to 22 families namely Gerridae, Cichlidae, Serranidae, Sparidae, Sillaginidae, Mugilidae, Latidae, Terapontidae, Siganidae, Scatophagidae, Polynemidae, Mullidae, Chanidae, Engraulidae, Clupeidae, Elopidae, Belonidae, Hemiramphidae, Ariidae, Bagridae Triacanthidae, Tetradontidae and 14 crustacean species belonging to three families namely Penaeidae, Portunidae and Ocypodidae.

Fish biodiversity of Kakdwip (West Bengal)

Exploration on fish and shell fish resources was carried out from Kakdwip, Namkhana, Bakhali and Sagar fish landing places in Kakdwip area and other parts of Sunderban biosphere. A total of 54 species consisting of 43 fish species belonging to 27 families, namely Trichiuridae, Stromateidae, Cichlidae, Lutjanidae, Mugilidae, Pomadasyidae, Theraponidae, Gobiidae, Polynemidae, Ephippidae, Leiognathidae, Carangidae ,Nemipteridae, Scombridae, Gerreidae, Sciaenidae, Carangidae, Clupeidae, Chirocentridae, Bagridae, Belonidae, Chanidae, Muraenesocidae, Triacanthidae, Bregmacerotidae, Cynoglossidae and Gymnuridae and 11 crustacean species belonging to three families, namely Penaeidae, Palaemonidae and Portunidae have been recorded.

Maintaining live of gene bank at Kakdwip Research Centre.

A live gene bank of brackishwater fish species commonly available in the Kakdwip area is being maintained in a pond at Kakdwip Research Centre. The water quality of the pond, health, growth and maturity of the fishes were regularly monitored.

Exploration of the germplasm resources of Pulicat Lake and Kakdwip area revealed the occurrence of rich and diverse fish and crustacean resources. A total of 45 fish and crustacean species belonging to 25 families and 54 fish and crustacean species, belonging to 30 families have been recoded respectively from Pulicat Lake and Kakdwip so far. No new species has been recorded.

EXTERNALLY FUNDED PROJECTS

AP CESS FUND OF ICAR

NATIONAL RISK ASSESSMENT PROGRAMME FOR FISH AND FISH PRODUCTS FOR DOMESTIC AND INTERNATIONAL MARKETS

Location of project : Chennai

Principal Investigator : Dr.B.P.Gupta

Co-Investigators : Dr.M.Muralidhar, Dr.K.K.Krishnani, Dr.C.Gopal, Dr.S.V.Alavandi and Dr.K.P.Jithendran

The network project on risk associated with bio-accumulation of heavy metals, pesticides, antibiotics, microbial and parasitic infection of cultured shellfish/finfish in coastal aquaculture systems started in July 2003 was completed in July 2006. This study was confined to Nellore (AP), Cuddalore and Nagapattinam (TN). During the study period, 2461 harvestable size shrimp samples from 96 farms, 27 domestic markets, four export companies and 50 wild caught sample of sea fish / shrimp were procured for analysis. The research highlights are that heavy metals (Pb, Cd, Cr, Zn, Hg and As), pesticides (isomers of HCH (BHC) and heptachlor were below the maximum permissible limits. The gills and intestine of shrimp were free of protozoan and metazoan parasites causing human risk.

PARTICIPATORY TECHNOLOGY TRANSFER MODEL FOR SUSTAINABLE COASTAL AQUACULTURE

Location of project : Chennai

Principal Investigator : Dr.M.Kumaran

Co-Investigators : Dr.N.Kalaimani, Dr.V.S.Chandrasekaran, Dr.(Mrs.)D.Deboral Vimala and Dr.(Mrs.)Ch.Sarada

This project had been implemented in Andhra Pradesh (AP) and Tamil Nadu (TN) with a sample of 1008 aqua farmers, 96 hatchery operators, 38 public extension personnel, 130 private extension personnel and 49 researchers to study the information management and extension needs of coastal aqua farmers, 'adoption-gap' in Better Management Practices (BMP) of coastal aquaculture, research-extension-farmer linkage in coastal aquaculture and to evolve a model for participatory approach in technology transfer for sustainable coastal aquaculture.

The study revealed that 90% of aqua farmers depend on input trade representatives for information. Further, fellow farmers, consultants, farm publications, Marine Products Export Development Authority (MPEDA) and Department of Fisheries (DoF) were the information sources respectively for 76%, 24%, 18%, 14 and 14% of farmers. However, the farmers felt that their dependence on trade representatives was mainly due to the non-availability of public extension service. It was expressed that continued dependence on trade representatives whose objective is profit maximization may not be beneficial to the farmers and the system *per se.* In this critical juncture,

strengthening the public extension service is the reliable and sustainable approach. However, this needs huge budget, sincere efforts and resources which may not be forthcoming immediately. Hence, with the present scenario, the sensible strategy would be that the public research and extension system should make use of the farm opinion leaders and consultants to access the farming community.

Better management Practices (BMPs) of shrimp farming that are critical for the successful culture were voluntarily adopted by the shrimp farmers. However, BMPs which addresses environmental and food safety issues like proper site selection, conversion of other land uses, overcrowding of farms, lack of pond for reservoir and ETS, use of bore well and low stocking density were not adopted. Though these BMPs are not directly concerned with the productivity, they are very essential for the long-term sustainability and marketability of the produce. Hence, suitable awareness programmes need to be carried out on the importance of the BMPs concerned with long term sustainability, food safety and marketability issues. Contrarily, most of the shrimp seed production guidelines were found adopted. It is recommended that DoFs should plan schemes to be funded by the National Fisheries Development Board (NFDB) to conduct 'on field trainings' on shrimp health and water quality management with farmer friendly training modules.

It was found that linkage existed between research and extension systems was consultative not collaborative as desired. It is suggested that the public funded research and extension agencies should have partnerships with service oriented institutions like NGOs and farmers groups for reaching the farmers. In the absence of required NGOs in coastal aquaculture the farmers groups would be the natural partner for technology validation, know-how transfer and adoption of BMPs. Farmer groups will play a vital role in the growth and development of subtainable coastal aquaculture by ensuring collective compliance of aquaculture guidelines in their farm cluster. Suitable schemes may be initiated to strengthen these farmers' groups with analytical labs and online infrastructure to function as 'field level knowledge centres' (FKC) and make them as contact points for the research and extension agencies. The extension agencies should organise farmers' field schools for education and empowerment in each cluster.

The study concluded that success of farm extension outreach depends predominantly upon an institutionalized extension mechanism at the state level comprising of research-extension-farmer linkage to develop, validate need based farm innovations for wider diffusion and voluntary adoption at field level. An operational model of technology transfer (Fig. 21) and conceptual model for participatory technology development, dissemination and feedback for sustainable coastal aquaculture (Fig. 22) are suggested.

Fig. 21. Participatory technology development and feedback model for sustaibable coastal aquaculture

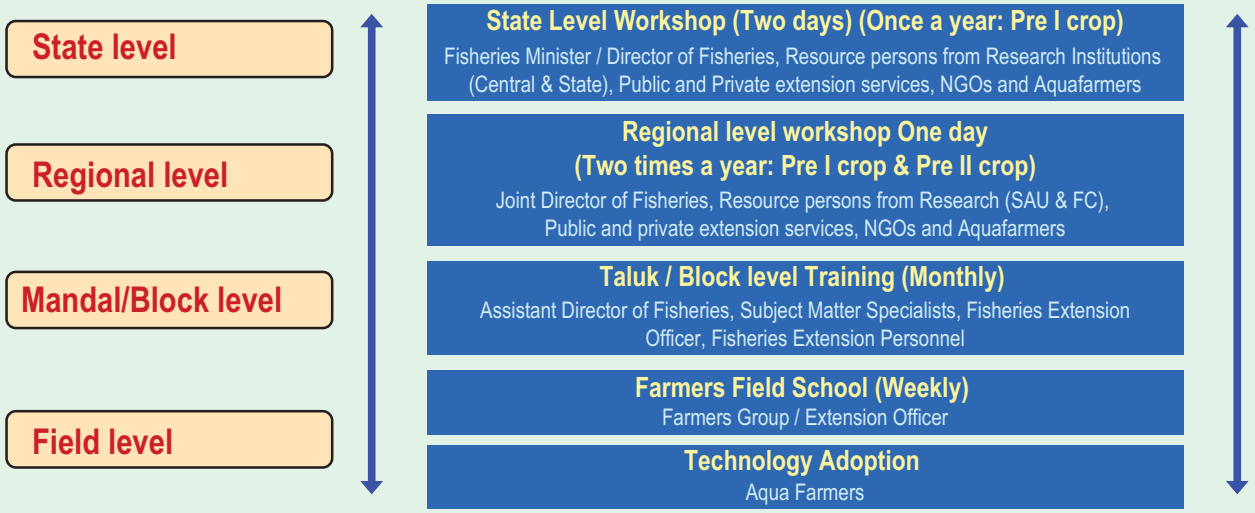
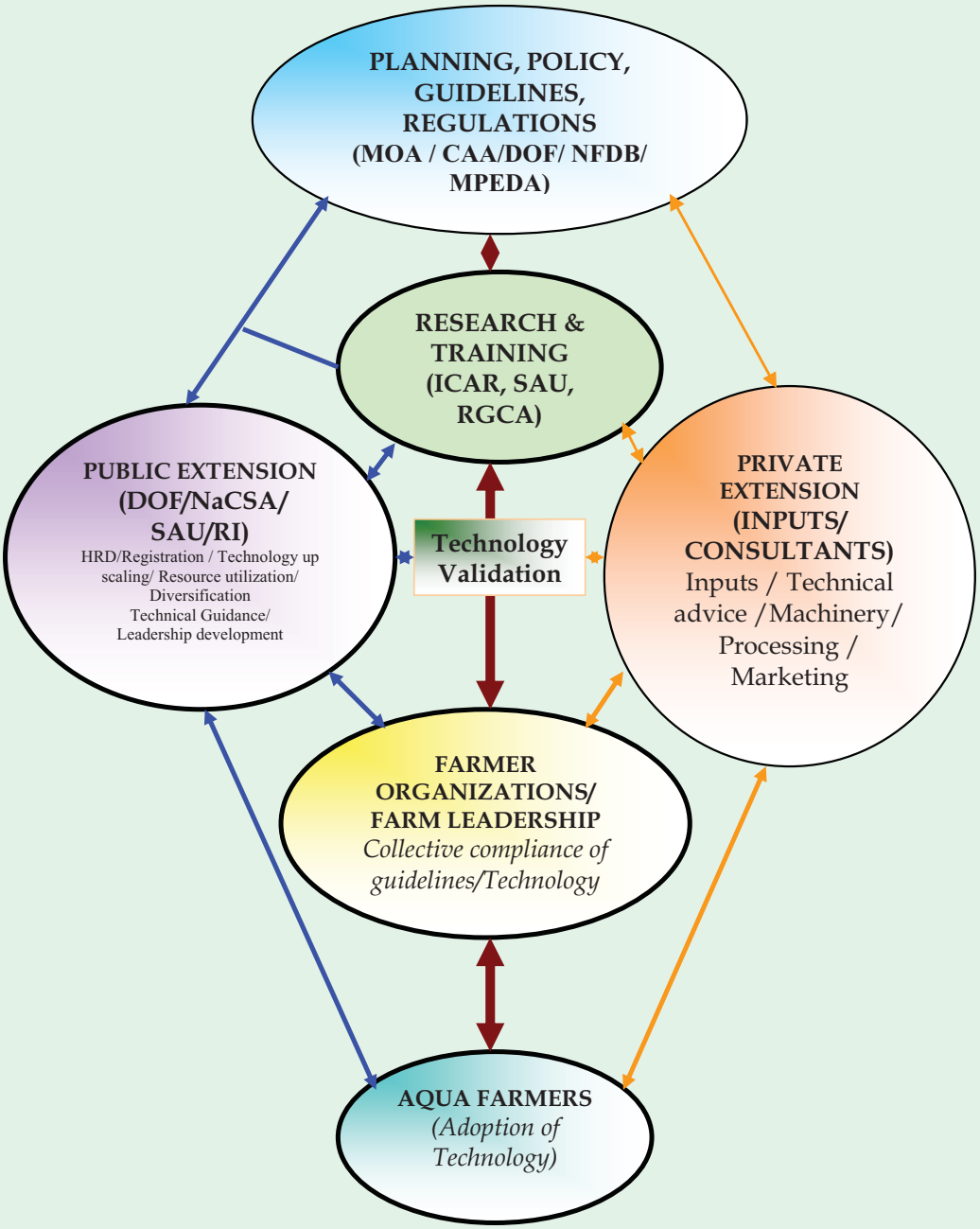


Fig. 22. Participatory technology development, dissemination and feedback model for sustainable coastal aquaculture



EVALUATION OF NUTRITIVE VALUE OF DIFFERENT STRAINS OF ROTIFERS (*BRACHIONUS* SPP.) AND THEIR SUITABILITY FOR LARVICULTURE OF ASIAN SEABASS *L. CALCARIFER* (BLOCH)

Location of project : Chennai

Principal Investigator : Dr.M.Kailasam

Co-Investigators : Dr.A.R.Thirunavukkarasu and Dr.J.Syama Dayal

Knowledge on the food preference and feeding behaviour of fish larvae during initial stage would help to increase the seed production in the hatchery. Hence, it is important to find out suitable rotifer (*Brachionus*) species and an optimum culture technique to enhance its nutritive value. Rotifer fed with marine algae *Nannochloropsis oculata* and *Chlorella salina* reached the highest density of 886 nos./ml on 11th day and 543 nos./ml on 10th day respectively. Water temperature, salinity and pH of the rotifer production tanks were recorded as 27.0±1°C, 26±0.5 ppt and 8.1±3.0 respectively. The study revealed that the maximum density of rotifer was produced with *N. oculata* (Fig. 23.)

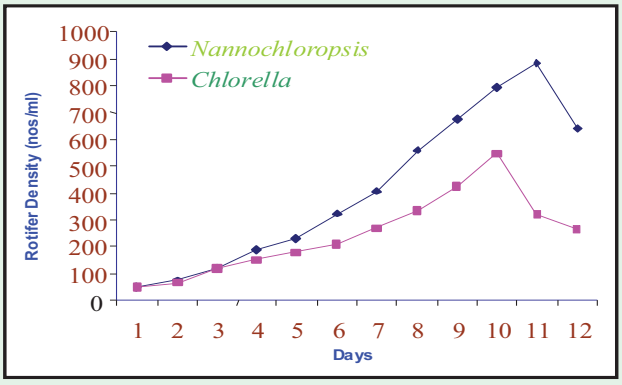


Fig. 23. Influence of micro algae on rotifer density

The fatty acid profiles of the rotifers cultured with various algal diets was studied using Gas chromatograph. The results indicated that among different algal fed rotifers, the percentage of saturated fatty acid content (from total fatty acid profiles) was highest in *Chlorella salina* (39.08%) followed by *Skeletonema costatum* (38.6%), *Chaetoceros calcitrans (34.83%)* and *Nannochlorpsis oculata (20.75%)*. But the percentage of unsaturated fatty acid content was highest in *N. oculata* (50.26%), followed by *C. salina* (38.42%), *S. costatum* (26.40%) and *C. calcitrans* (10.30%). Considering the unsaturated fatty acids, the maximum percentage was constituted by dienes followed by trienes and monoenes.

Rotifer culture was undertaken in different salinity ranges such as 10, 15, 20 and 25 ppt with *N. oculata* as feed. Maximum rotifer density was observed at 25 ppt (421nos./ml) on 9th day followed by 20 ppt (320 nos./ml) and 15 ppt (208 nos./ml) and decreased after 9th day, which may be attributed to decrease in algal density. Low rotifer density was recorded in 10 ppt (176 nos./ml). Initially 66% of inoculated rotifers were in the size group of 141-220 µm. Abundance of higher size group rotifers were noticed in 25 ppt when compared to 10, 15 and 20 ppt.

Growth and survival of seabass larvae fed with enriched rotifers

The highest rotifer density was recorded in rotifer culture tanks enriched with cod liver oil at 15 ppm concentration (352 nos./ml) followed by 25 ppm (289 nos./ml), 5 ppm (254 nos./ml) and 10 ppm (248 nos./ml). The rotifer density was low in control tank without cod liver oil. Survival rate of seabass larvae fed with cod liver oil enriched rotifers was comparatively higher (57.4%) than control (24.8%).

Rotifers enriched with cod liver oil, gingili oil and coconut oil were fed to seabass larvae for assessing the growth and survival. Seabass larvae fed with cod liver oil enriched rotifer registered the highest growth (TL 3.90 mm, SL 3.21 mm and Weight 0.91 mg) followed by gingili oil (TL 3.80mm, SL 3.39 mm and weight 0.84 mg) and coconut oil (TL 3.77 mm, SL 3.37 mm and weight 0.82 mg). Maximum survival rate was recorded when seabass larvae were fed with cod liver oil enriched rotifers, than others.

The influence of delayed initial feeding (48, 72, 96 and 120 h) on the growth and survival of seabass larvae was studied under controlled conditions to identify the correct time of first feeding. The larvae fed at 96 h and 120 h after hatching showed less growth rate compared to feeding at 48 h. It was also observed that the yolk absorption in seabass larvae is completed by 96 h. Similarly, complete oil globule utilisation in seabass larvae takes place at 120 h. After 21 days rearing, the survival rate was higher for seabass larvae initiated feeding after hatching at 48 h (31.46%) when compared to 72 h (21.18%) and 96 h (8.42%). Complete mortality was recorded on 9th day when the larvae were initiated to feeding at 120 h. Total length, head depth, body depth, gut height (Fig. 24) and other morphometric measurements were carried out for the four treatments. The larvae initiated to feeding after 48 h of hatching had higher values for all the parameters. From the present study it could be suggested that delaying initial feeding of seabass larvae beyond 48 h will result in lower viability of the larvae.

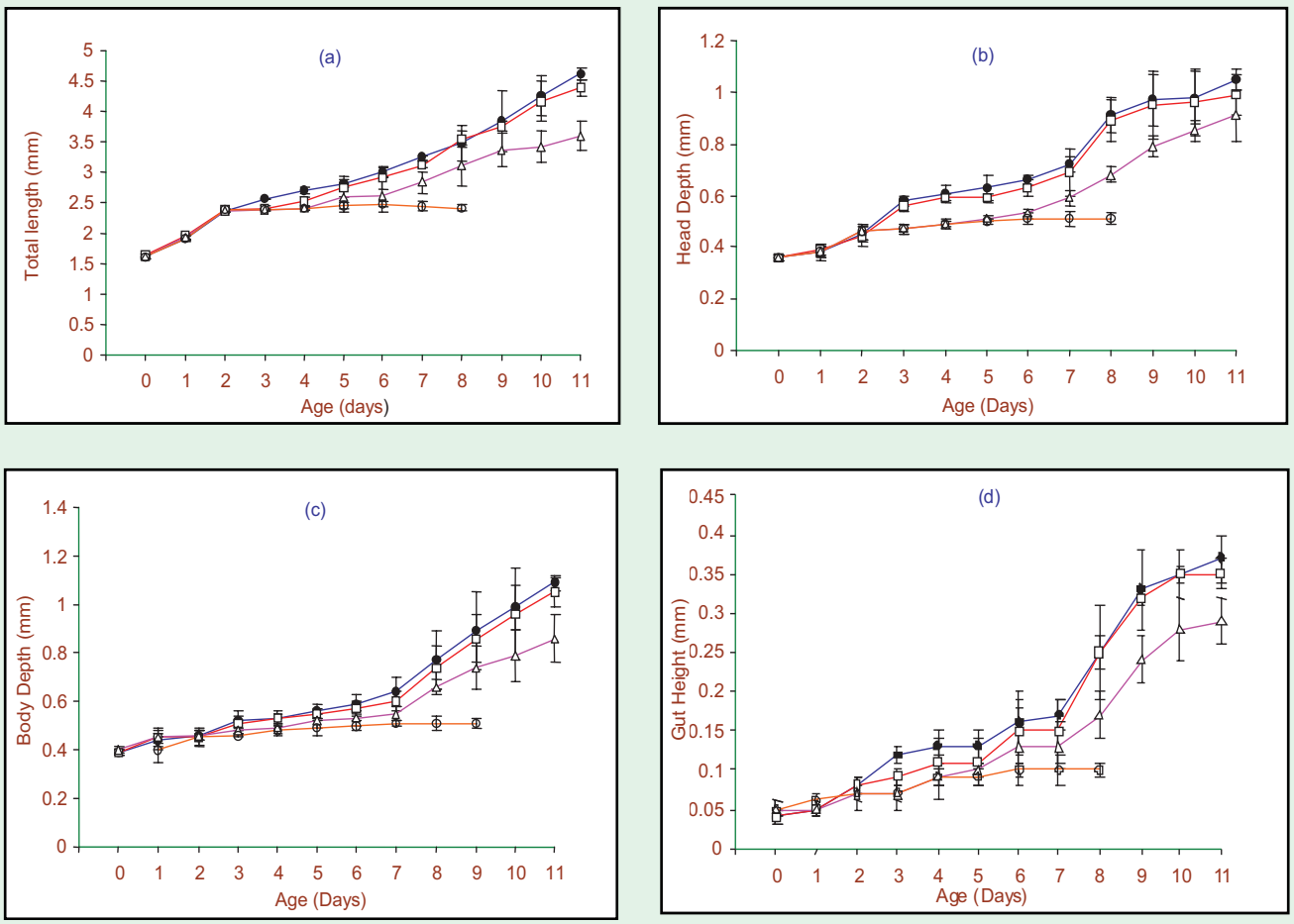


Fig. 24. Morphological characteristics of Seabass larvae after delayed first feeding (□-48 h, □-72 h, Δ-96 h, □-120 h). (a) Total Length (b) Head Depth (c) Body Depth (d) Gut Height. Bars indicate the standard deviation

DEVELOPMENT AND DEMONSTRATION OF HATCHERY AND CULTURE TECHNOLOGY FOR THE BANANA SHRIMP, *FENNEROPENAEUS MERGUIENSIS* AS AN ALTERNATE SPECIES FOR SHRIMP AQUACULTURE

Location of project : Chennai

Principal Investigator : Dr.S.M.Pillai

Co-Investigators : Dr.P.Ravichandran, Dr.C.Gopal and Dr.C.P.Balasubramanian

The project has been implemented to develop banana shrimp as an alternate species in shrimp aquaculture

Collection of broodstock

A total of 67 wild adult *F. merguiensis* (43 females and 24 males) in the size range of 140-175 mm / 27.4-55.3 g were collected from Puri, Orissa during September 2006 and airlifted to Chennai. The shrimps were treated with 50 ppm formalin for 10 minutes and held in the Quarantine section and screened for White Spot Syndrome Virus (WSSV) and MBV (Monodon Baculovirus) by PCR. All the shrimps tested negative and they were then transferred into maturation tanks.

Captive broodstock development

Development of captive broodstock of *F. merguiensis* and its domestication was initiated in an earthen pond (0.07 ha), outdoor cement tanks (15 t capacity) and indoor FRP tanks (5 t capacity) by stocking juveniles (1-1.5 g) @ 45000 nos/ha. The shrimps were fed with commercial pellet feed @10% of the body weight in the pond. The shrimps in indoor and outdoor tanks were fed with live feeds @10%of body weight with clam meat and polychaete worms, supplemented with pellet feed. Regular water quality management such as pH, salinity and temperature was followed and the growth was monitored. The shrimps attained average weight of 39.7 g in 210 days of culture (DOC). In outdoor and indoor tanks shrimps, reached weight of 33.6 g and 34.5 g in 300 days, respectively (Fig. 25). Shrimps matured in all the three culture systems indicating the efficiency of captive broodstock development of *F. merguiensis* in ponds as well as in outdoor and indoor tanks.

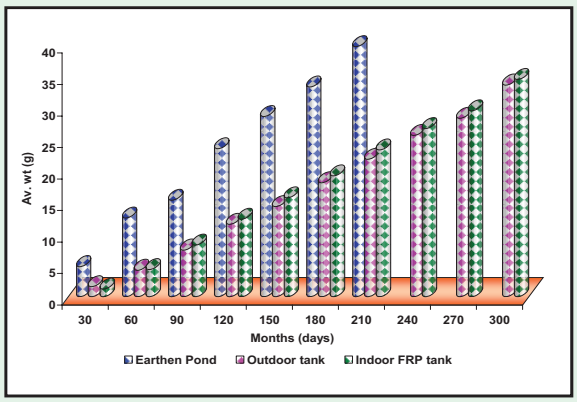


Fig. 25. Growth of banana shrimp broodstock in different systems

Induced maturation, spawning and larval rearing

The maturation room had photoperiod of 12 h light and 12 h darkness and the temperature, salinity, dissolved

oxygen and pH were maintained at 30±1°C, 30±1 ppt, 6 mg/l and 8.1±0.2 respectively. Feeding was done @ 20% of biomass with fresh polychaete worms and clam meat four times a day (06.00, 12.00, 18.00, and 24.00 h). The total feed was divided and given at 40 and 60 % during day and night respectively. Gonadal development was assessed daily by observing the size and colour of the gonads.

The fecundity of wild, pond reared and tank reared shrimp varied from 65,000 to 1,80,000, 14,000 to 74,000 and 41,000 to 86,000 respectively. The respective postlarval (PL 20) productions were 2.0, 4.0 and 1.3 lakh for wild, pond reared and tank reared shrimps. Female *F. merguiensis* (167 nos.) from wild and those reared in pond and tank were acclimatized to hatchery conditions. Shrimps were induced to mature by eyestalk ablation.

Challenge test with WSSV

To study the susceptibility / resistance of *F. merguiensis* to WSSV, juveniles with average weight of 1.5 g were challenged with WSSV through oral route. The mortality pattern was studied over a period of 10 days in three replicates (15 shrimps/replicate) and observed that 100% mortality in all the treatments after 96 h. Presence of WSSV in dead shrimps was confirmed through Nested PCR test. The results indicated that *F. merguiensis* is susceptible to WSSV.

Pond culture in different agro-climatic zones

Pond culture of *F. merguiensis* was carried out in two agro-climatic zones. At Gujarat, 70,000 PL 22 were stocked in a 0.85 ha pond of M/s Onaway Industries Ltd., Bilimora, on 23.10.2006 under public private partnership mode where low temperature and low salinity prevails during the winter.

Pond matured *F. merguiensis* from Bilimora, Gujarat

The water temperature and salinity at the time of stocking were 20°C and 25 ppt respectively and both these parameters progressed gradually during culture to 32.5°C and 44 ppt respectively at the time of harvest in May. The shrimps were fed with commercial pellet feed @ 10% of body weight. In 120 days of culture, the shrimp attained an average weight of about 22 g and the monthly growth rate also increased from 0.10 - 0.16 g and then stabilized to 0.14 g. The pond was harvested on 08.05.2007 and the final average size of shrimp was 26.5 g with 78% survival. The production was 806 kg/ha. The female shrimps weighing 40 g and above were found to mature in the pond itself and were transported to CIBA, Chennai to conduct breeding trials. The results indicated that culture of *F. merguiensis* can be adopted during winter season as an alternate species to *P. monodon* which is known to grow very slowly during winter.

F. merguiensis culture pond in Bilimora, Gujarat

Director, CIBA interacting with the shrimp farmers during the harvest in Gujarat

At Kakdwip Research Centre of CIBA, 20,000 PL were stocked in two low saline (8 ppt) ponds @ 10,000 each on 24.01.2007. The shrimps attained average weight of 22.6 g and 21.7 g in 172 and 155 DOC. The survival rate was 28.1 and 40.3%, respectively. The production obtained was 381.0 and 525.4 kg/ha. The culture was extended beyond four months since the growth of shrimps was observed to be slow during rainy season. Although the production and survival are low, the trails indicated the potential of this species for culture during low saline conditions. However more trails are needed at higher stocking density to develop a viable technology for banana shrimp culture in tide fed systems.

DEVELOPMENT OF LOW FISH MEAL FEEDS FOR SHRIMP AQUACULTURE

Location of project : Chennai

Principal Investigator : Dr.J.Syama Dayal

Co-Investigators : Dr.P.Ravichandran, Dr.S.A.Ali and Dr.K.Ambasankar

The high cost of shrimp feed is mainly due to the high levels of fish meal that is required. If fish meal could be replaced with plant proteins, the cost can be brought down. The objective of this project is to evaluater different plant proteins and make shrimp feed more economical by partial replacement of fish meal.

Nutrient utilization of soybean cake

Five test feeds having 15, 20, 25, 30 and 35% levels of soybean cake were prepared by replacing fish meal in the CIBA shrimp feed. To measure the digestibility parameters in the shrimp, 0.5% chromic oxide is added in all the test diets. The coarse ingredients were powdered in a micropulveriser and passed through 500 µm mesh screen. All the dry ingredients including 0.5% chromic oxide (as an inert marker) were mixed in an electrical blender and thoroughly homogenized. Water was then added (30 ml/ 100 g mash) to the diet mix and kneaded into dough. It was steamed for 5 minutes at atmospheric pressure and pelleted in an experimental pellitizer with a 2 mm die. The pellets were dried at 60^{0}C for 12 h and stored in desiccator until use. The proximate composition of test feeds was analysed as per the standard AOAC methods.

Table 27. Effect of inclusion of soybean cake at varying levels in shrimp (*P. monodon*) feed

Levels (% inclusion)	Weight gain (%)	FCR	Survival (%)
15 (control)	208.6 ± 3.83	1.91 ± 0.05	82.22 ± 5.88
20	213.6 ± 2.38	1.79 ± 0.148	93.33 ± 3.85
25	218.9 ± 2.05	1.68 ± 0.110	93.33 ± 3.85
30	196.3 ± 2.85	1.95 ± 0.159	97.78 ± 2.22
35	175.6 ± 4.09	2.16 ± 0.104	75.56 ± 2.22

The feeds are tested with *Penaeus monodon* juveniles weighing 0.5 g. Fifteen shrimps per tank (three tanks per treatment) were randomly distributed in 500 l oval FRP indoor tanks with seawater supply and aeration. Eighty percent of the water in the tanks was exchanged daily. The shrimps were fed *ad libitum* and the uneaten feed was removed daily from the tank and oven dried for determining the feed intake. Faecal matter was carefully collected after 4 h of feeding from 4th day of experiment with a pipette on to a bolting silk cloth and gently washed with distilled water to determine the chromium content and protein digestibility. The test parameters included weight gain, survival, FCR (Table 27) and digestibility of nutrients (Fig 26).

The weight gain (%) was significantly ($P < 0.05$) lower in shrimp fed at 30% and above with soybean cake contained diets. Similarly FCR increased from 1.91 to 2.16 in shrimp fed diets with 15 to 35% soy bean cake. The dry matter and protein digestibility was 70.3 and 83.2%, respectively in 15% soybean cake feed. At 35% soybean cake inclusion, the digestibility of dry matter and protein have drastically reduced to 60 and 74.3%, respectively (Fig. 26). Amino acid digestibility ranged between 94.5 to 79.2%. There is a slight increase in essential amino acid (EAA) digestibility at 20% inclusion of soybean cake compared to 15% level. Based on the results it can be concluded that soybean cake can be included in shrimp feeds up to a maximum level of 20%.

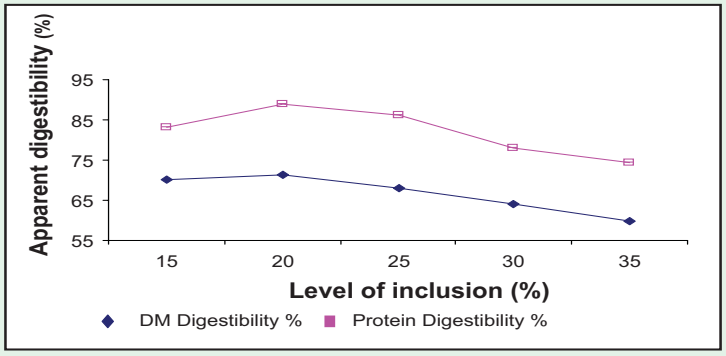


Fig. 26. Dry matter and protein digestibility of soya cakes at varying levels in *Penaeus monodon*

Nutrient utilization of mustard cake, gingili oil cake, copra cake and silk cotton cake in shrimp, *Penaeus monodon*

Vegetable oil cakes like mustard seed cake, gingili oil cake, copra cake and silk cotton cake were included at 0, 2.5, 5.0, 7.5 and 10% levels in shrimp feed by replacing fish meal on w/w basis as described earlier. These feeds were tested in *Penaeus monodon* juveniles in a 45 day growth cum digestibility study. The incorporation

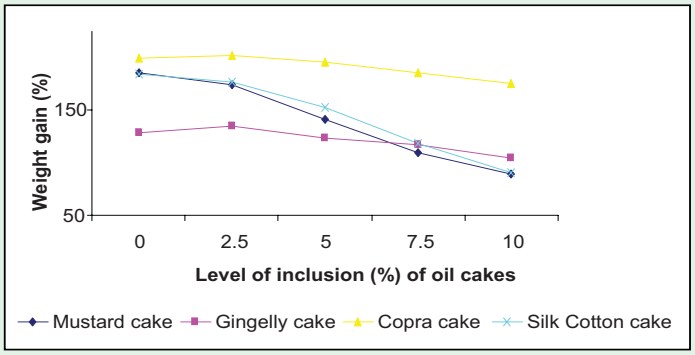


Fig. 27. Effect of inclusion of oil cakes at varying levels on weight gain in shrimp feed

of mustard cake from 0 to 10%, has led to drastic reduction in weight gain from 186.2 to 89.7% (Fig. 27). The dry matter and protein digestibility decreased with increase in inclusion levels of these cakes from 2.5 to 10% in shrimp feed. The protein digestibility decreased by 10% as the level increased from 2.5 to 10% in shrimp feed. The test results indicated that gingilli and copra oil cakes can be incorporated @ 5% level whereas the mustard cake and silk cotton cake can be incorporated only up to 2.5%.

Nutrient utilization of palm kernel cake in shrimp, *Penaeus monodon*

Palm kernel cake (PKC) is included at 0, 1, 2, 3 and 4% levels in the shrimp feed by replacing fish meal on w/w basis as described elsewhere. These feeds were tested in *P. monodon* juveniles weighing around 1.5 g. The test parameters included weight gain, survival, FCR and digestibility of nutrients. The results of a 45 day growth trial indicated that the inclusion of palm kernel cake reduced weight gain from 157.1 at 2% level to 106% at 4% level (Table 28). The dry matter and protein digestibility decreased from 71.33 and 82.3% at 1% level to 55.61 and 70.1 % at 4% PKC level. Similarly, EAA digestibilities also reduced drastically as the level of PKC increased to 4%. The digestibility of arginine, lysine and methionine reduced from 90.6, 87.3 and 91.1 at 0% to 71.1, 68.1 and 71.2 per cent at 4% inclusion level respectively. The results indicate that incorporation of PKC beyond 2% in shrimp feed will have deleterious effects.

Table 28. Effect of inclusion of palm kernel cake at varying levels in shrimp feed on growth, FCR and survival in *P. monodon*

Levels (% inclusion)	Weight gain (%)	FCR	Survival (%)
0	142.2 ± 11.26	1.68 ± 0.149	86.67 ± 3.85
1	147.2 ± 12.12	1.61 ± 0.076	82.22 ± 2.22
2	157.1 ± 2.72	1.68 ± 0.130	84.44 ± 4.44
3	140.0 ± 9.93	1.85 ± 0.224	66.67 ± 3.85
4	106.0 ± 2.90	2.01 ± 0.215	68.89 ± 4.44

THE ASSESSMENT OF LOSSES IN SHRIMPS IN BRACKISHWATER AQUACULTURE DUE TO DISEASES

Location of project : Chennai

Principal Investigator : Dr.N.Kalaimani

Co-Investigators : Dr.T.Ravisankar and Dr.S.Kannappan

The objective of the project is to assess the relative loss in production and income generation to farmers across regions from various diseases. In general culture practices being followed along the East Coast are better compared to West Coast as revealed from the data on mean harvest/ha from different states. The success of the crop in these states as revealed from the study may be attributed to the experience in shrimp aquaculture, good awareness due

to better educational status of the farmers and the intervention of experienced technicians/consultants which is not the case with many of the farmers along the West Coast. Among all the states the net profit by the shrimp farmers of Goa was observed to be on the negative side while maximum was observed among the farmers of Andhra Pradesh (AP) followed by Maharashtra, Gujarat, Tamilnadu, Orissa, West Bengal and Karnataka in that order. The decrease in profit margin by the farmers of Tamil Nadu (TN) compared to earlier years may be attributed to the high amount of investment in the farm inputs for taking preventive measures against the diseases. The better profit margin realized by farmers of Maharashtra and Gujarat may be attributed to the low expenditure inputs in spite of the decreased mean harvest/ ha.

The following points identified in the study as the practices in specific states determined disease incidence and economic loss due to diseases. Crop holiday is not practiced in AP where two to three crops are being harvested in a year, whereas single crop is harvested in West Bengal. Most of the farmers in the states surveyed do not have reservoir ponds and effective effluent treatment is not given which speak of the poor biosecurity measures followed by the farmers in shrimp aquaculture. Compared to West Coast states, disease has not caused appreciable loss to the farmers in AP and TN since the of disease (if any) incidences occurred after 100 DOC when the harvest size is not uneconomical for marketing and the income is not less than the expenditure incurred till the day of harvest. But in the case of farmers along the West Coast, especially in Karnataka and Goa the disease incidences have been noticed much before the shrimps attained appreciable marketable size (40-80DOC). Size variation probably due to slow growth syndrome had been reported in summer crop in few farms along the West Coast.

The following gives an idea of the relative incidence of different diseases across the different states. Comparatively majority of the farmers in all the states except Karnataka and Goa reported no disease during the culture in their farms. Diseases, if present were mainly due to WSSV and LSS as reported by the farmers in the states of TN and AP. Few farms in these two states also reported other diseases like bacterial, fungal and loss due to DO problem. LSS has been reported in more number of farms in Tamil Nadu and Andhra Pradesh compared to other states. In Karnataka and Goa, WSSV was the major disease. In Gujarat there was no report of LSS disease in any of the farms surveyed.

In general there was less loss reported by the farmers during 2006 - 07 as observed from the data on net profit of shrimp farms in the states surveyed except Goa. This may be attributed to the fact that (i) few farmers have closed their shrimp farms due to the losses suffered during the yester years and (ii) adoption of improved culture practices by farmers who are still continuing shrimp culture. The improved culture practices is based on lessons from their previous experience with disease occurrence and this has involved observing better precautionary/ preventive measures such as testing of seeds to confirm absence of WSSV, better environmental management and adopting biosecurity disease preventive measures by forming associations/aqua-clubs in their shrimp farming area. However accurate conclusions can be arrived at only after detailed statistical analysis of the data which is being carried out presently.

ASSESSMENT OF POTENTIAL SITES FOR SUSTAINABLE AQUACULTURE USING MODERN TECHNOLOGICAL TOOLS

Location of project : Chennai

Principal Investigator : Dr.M.Jayanthi

Co-Investigators : Dr.P.Ravichandran, Dr.M.Muralidhar and Dr.(Mrs.)P.Nila Rekha

The project has aimed to identify the potential sites suitable for further expansion of shrimp farming and to assess the impact of aquaculture on land cover classes using remote sensing data and Geographic Information System. The potential sites have been identified based on the methodology developed from the project CCD/RA/1 titled "Assessment of brackishwater land resources". The changes on the land and water resources due to aquaculture development have been assessed using time series satellite data.

Monitoring aquaculture development

Four datasets of satellite images such as Landsat - 5 of 1986, Landsat -5 and IRS-1B of 1996, IRS P6 and IRS 1D of 2004 from National Remote Sensing Agency (NRSA) were used for the assessment of changes in land cover class due to aquaculture development. Different land classes such as agriculture, aquaculture, lake, lake-mud (lake area liable to be flooded during rainy season), river, tanks, canal, coastal plantation, mangrove swamp, reserve forest, salt pan, sand, waste land and settlement were delineated from the satellite data. The land use map (1986) of Nellore district indicates that aquaculture was not present in 1986. The aquaculture has developed in 1990s and reached 19079 ha and 33839 ha in 1996 and 2004 respectively. The present study proves that the rate and extent of aquaculture development can be assessed and monitored for retrospective period using time series satellite data. This assessment proved that aquaculture has developed progressively in spite of the challenges such as diseases.

Changes in land cover class due to aquaculture

GIS overlay analysis of 1986 and 1996 land use maps (Fig. 28) indicates that for the development of aquaculture, other land classes such as agriculture land (15987 ha), mud flats (243 ha), scrub land (1729 ha) and waste land (1110 ha) have been utilized. The analysis of 1996 and 2004 land use maps presents different scenario of reutilization of aquaculture farms to agriculture lands. Out of 19079 ha of aquaculture area in 1996, 8250 ha only continued with aquaculture land class in 2004. The remaining 10829 ha of aquaculture land was changed to agriculture (6964 ha), other land classes (685 ha) like scrub land, waste land (573 ha) and abandoned aquaculture farms (2607 ha). Between the years 1996 and 2004 (Fig. 29), new aquaculture development took place to the tune of 25589 ha. This development has utilized agriculture lands (24682 ha), mudflats (2 ha), scrub land (425 ha) and waste lands (480 ha). This study indicates that there were two way transformation on the land use such as conversion of other land classes to aquaculture and vice versa.

The reconversion of 6964 ha of aquaculture farms to agriculture lands indicates the possibility of reutilization of aquaculture farms for agriculture. The main problems expressed for the reconversion were White Spot Syndrome Virus (WSSV) and Vibriosis disease. The rice production in the year of conversion from the reconverted agricultural lands was 20-25 bags/acre. The yield was regularized to 30-40 bags after one year, equivalent to other agriculture farmers. This indicated that the conversion did not have any adverse impact on the productivity of agricultural lands.

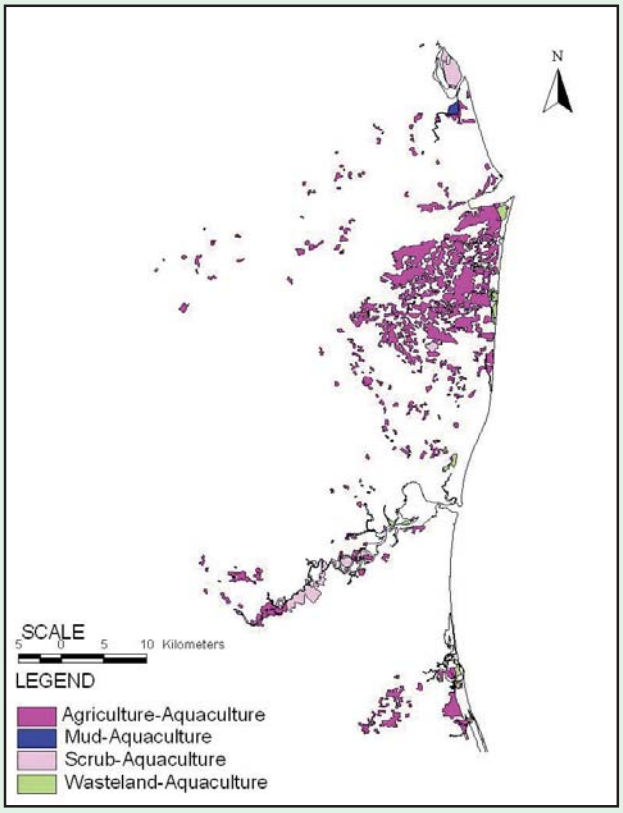


Fig. 28. Changes on land cover class for aquaculture development between 1986-1996 in Nellore district

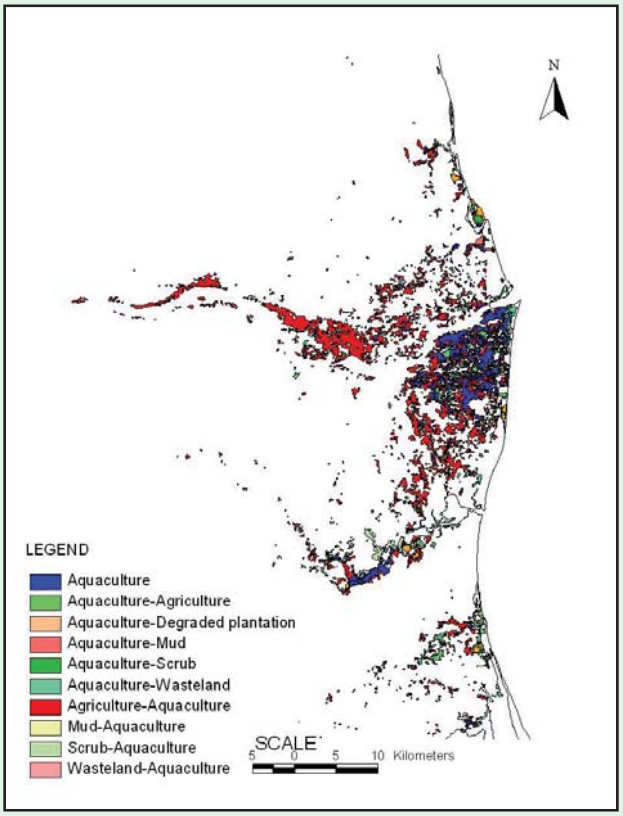


Fig. 29. Changes on land cover class due to aquaculture development between 1996 -2004 in Nellore district

Identification of sites for further expansion of regulated aquaculture

In addition to the existing aquaculture farms, to expand aquaculture in a sustainable manner, potential sites of 8468 ha were identified from waste land, mudflats, scrub land and abandoned aquaculture farms. This was carried out by applying Coastal Aquaculture Authority guidelines and site specific characteristics on 2004 land use map. The study indicated that there are still resources available for regulated aquaculture even in a district that is fully developed with aquaculture farms.

INVESTIGATION ON LOOSE SHELL SYNDROME AMONG FARMED TIGER SHRIMP *PENAEUS MONODON*

Location of project : Chennai

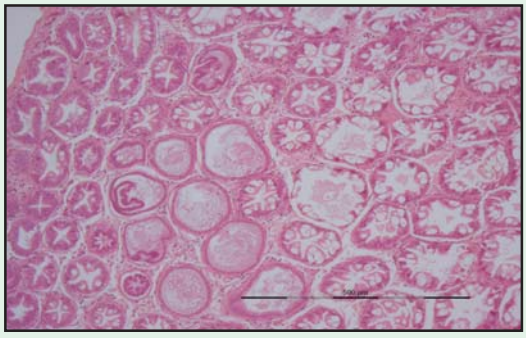
Principal Investigator : Dr.S.V.Alavandi

Co-Investigators : CIBA : Dr.T.C.Santiago

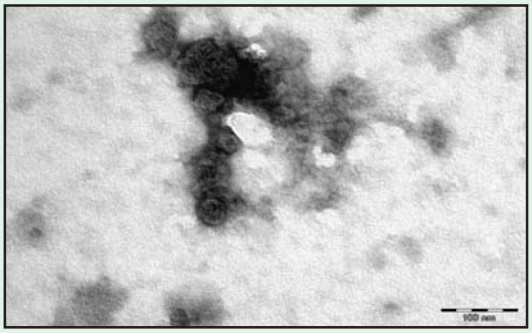
CMFRI : Dr.K.K.Vijayan

The project was initiated in July 2005 with an objective to understand the causative factors involved in the 'loose shell syndrome. Bioassay experiments and histopathological investigations carried out during the year 2005-06 had indicated involvement of a filterable infectious etiology for the continuing LSS episodes in the shrimp farms. Necrotising hepatopancreatitis causing α-proteobacterial and other bacterial etiology were ruled out using PCR techniques and bioassays. Histopathological examination revealed marked atrophy of the hepatopancreas of LSS affected shrimp. Inter-tubular and sinus space was enlarged indicating oedema. The hepatopancreatic tubules appeared inflamed with haemocytic infiltration and the R cells had low levels of lipid droplets. Studies were intensified to confirm the infectious nature of LSS by challenge experiments with LSS infected tissues and purified agent. Bioassay experiments confirmed infectious nature as revealed by reproduction of LSS symptoms in healthy tiger shrimp. Efforts were also intensified to isolate the suspected etiologic agent and a viral-like agent was isolated and purified from LSS affected shrimp tissues by sucrose density gradient ultracentrifugation. Transmission electron microscopic examination of the purified viral-like agent showed particles of about 13-18 nm enveloped oval to elliptical shaped structures with a central dense core. Similar agent could be also observed in the nucleus of the hepatopancreatocyte of LSS affected shrimp. The purified viral-like agent was also examined for the type of nucleic acid and it was revealed that the purified viral-like particles showed presence of DNA. Two commercial products were tested for the mitigation of LSS and experiments revealed that LSS could not be mitigated by the two products tested.

Two shrimp farms, one in Andhra Pradesh and another in Tamil Nadu were routinely monitored for water quality and microalgal density and diversity. Frequent algal crashes could be noticed in the LSS-affected ponds. Among the microalgae, diatoms were predominant in both LSS-affected and unaffected shrimp culture ponds.



Histopathology of hepatopancreas of LSS affected tiger shrimp showing various stages of tubule necrosis, depleted reserve granules, and inter-tubular edema during advanced stage of disease.



Transmission electron microscopic examination of the purified viral-like agent from LSS affected shrimp showing electron dense particles of about 13-18 nm.

MOLECULAR CHARACTERIZATION AND ANALYSIS OF VIRULENCE FACTORS IN PATHOGENIC *VIBRIO HARVEYI* ISOLATES FROM SHRIMP LARVICULTURE SYSTEMS

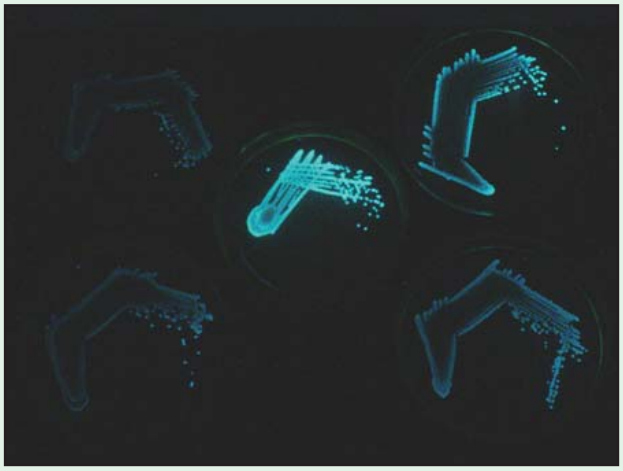
Location of project : Chennai

Principal Investigator : Dr.S.V.Alavandi

Co-Investigators : Dr.T.C.Santiago

CMFRI: Dr.K.K.Vijayan

The project was initiated in July 2005 with an objective to build a stock of luminescent bacteria (LB), characterize them and develop methods to differentiate pathogenic and non-pathogenic strains. Three commercial shrimp hatcheries were closely monitored for the occurrence of luminescent bacterial disease (LBD) and LB were routinely isolated from various sources within the hatchery. The study has revealed that LB are widely distributed in the hatchery ecosystem. A total of 1195 hatchery samples comprising brooders, water from maturation, spawning and larval rearing tanks, eggs, nauplii, zoea and mysis, were processed for LB and 256 luminescent bacteria were isolated. Ninety seven of these isolates were phenotyped using a battery of conventional physiological and biochemical tests including cultural characteristics, morphology, salt tolerance, aminoacid decarboxylation, sugar fermentation, production of indole, acetyl methyl carbinol etc and susceptibility to vibriostatic compound O/129. *V. harveyi* was found to be the predominant LB in the hatchery systems and other luminescent bacteria such as *V. splendidus*, *V. logei*, *V. fisheri* and *Photobacterium* sp were also occasionally found.

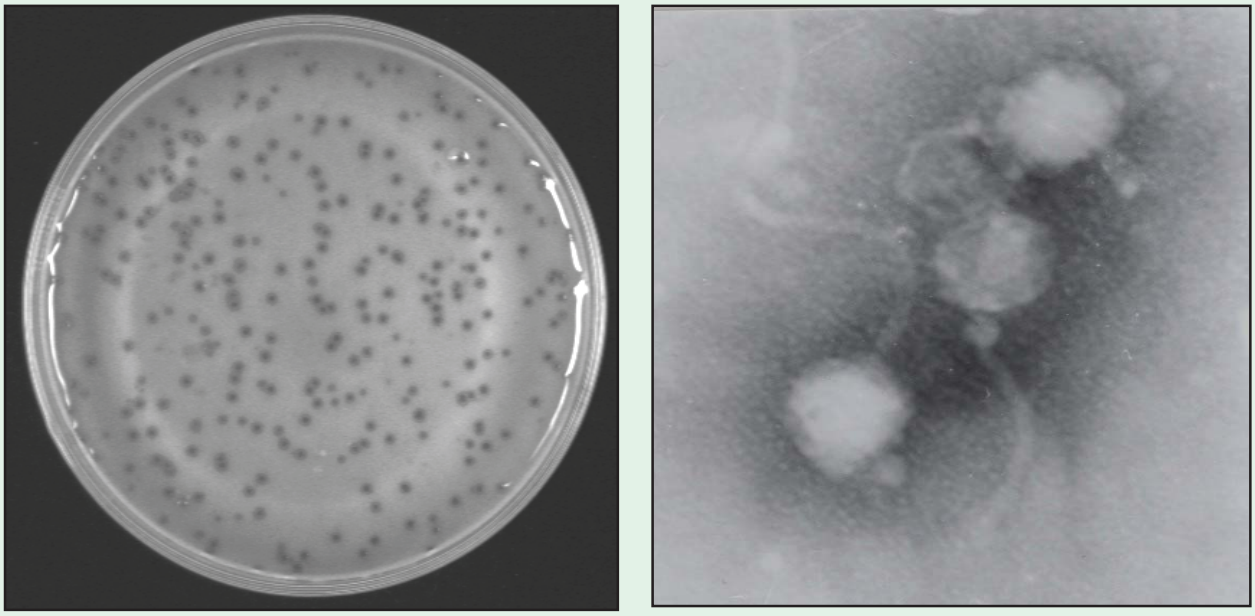


Luminescent bacteria isolated from shrimp hatcheries

Of the 1195 samples processed, LB could be isolated from 21% of the samples. The shrimp brooders were found to be the main source of LB as revealed by the rate of isolation of these bacteria from gills and surface swab samples (71-80%) and intestinal and faecal samples (33-59%). A large percentage of water samples from the maturation and spawning tanks (73% and 80% respectively) had significantly high counts of LB (17-290 x 10^4 and 9-590 x 10^4 cfu ml^{-1} respectively). LB could not be recovered from eggs and nauplii. The eggs were washed with iodine and formalin soon after collection as a management practice in the hatcheries, which appears to help a great deal in their containment after spawning. During one of the larval production cycle affected by luminescent bacterial disease, colonization of protozoeal stages with luminescent bacteria preceded their occurrence in the larval rearing tanks (LRT) during the nauplius stage. LB could be recovered from 17% of nauplius tank water samples prior to onset of LB disease. LB could be found in 70% of the tank water samples during the protozoeal stage with considerably high counts ranging from 0.18-42 x 10^4 cfu ml^{-1} (with averages of 3-56 x 10^4 cfu ml^{-1}).

Virulence factors of 86 isolates of *V. harveyi* were tested and all these isolates produced proteases, while siderophores, haemolysins and phospholipases were produced by 67%, 83% and 86% of the isolates respectively. None of the isolates produced acetyl methyl carbinol, while 28% of the isolates could ferment sucrose.

Isolation of bacteriophages of LB was also taken up to use them for biocontrol of LB disease in hatchery. Sixty five bacteriophages capable of infecting luminescent *V. harveyi* isolates were isolated from hatchery samples.



Bacteriophage plaques on a lawn of V. harveyi (left) and electron micrograph of bacteriophage

INDO-FRENCH COLLABORATIVE PROJECT

SEABASS PILOT UNIT HATCHERY AND CULTURE

Location of project : Chennai

Principal Investigator : Dr.A.R.Thirunavukkarasu

Project Associate : Dr.M.Kailasam

A model fish hatchery has been established for the first time in India with the following units to facilitate the hatchery production of seabass seed. The hatchery facility was inaugurated on 26th August 2006.

Director General, ICAR observing the seabass larval rearing tank.

The hatchery has the following separate units:

1) Quarantine and storage unit with six numbers of 10m^3

FRP tanks provided with central drainage facilities, regulated water and air inlet system and belt feeders.

2) Maturation unit with two independent biosecure systems, each with one cylindrical 10 m^3 FRP tanks with provision for continuous supply of filtered and degassed seawater with complete exchange in every 5 h. There are provisions for maintaining photoperiod (14 h/day), water temperature (30-31°C) and salinity adjustment.

3) Egg incubation and hatching unit consists of four cylindro-conical 150 l FRP tanks provided with filtered continuous flow through water system.

4) Larval rearing unit consists of four 10 m^3 tanks in two rooms with auto timer for lighting, central drainage and flow through filtered water.

5) Weaning and nursery rearing unit is provided with six circular 4 m^3 FRP tanks, three for weaning and three for nursery rearing with box type belt feeder.

6) *Artemia nauplii* production unit which consists of eight cylindro-conical FRP tanks.

7) Rotifer production unit consists of five (3 m^3) circular conical tanks with central bottom central drainage facility.

8) Algal culture unit is located in an isolated room with one section for stock culture and another for mass culture in 10 nos. of cylindrical fiberglass 300 litres translucent tanks with bottom drainage valve.

Besides these there are technical room, water and air supply network, laboratory, cold room, administrative office, generator shed and pump room.

The major achievements of this project are the year round breeding under controlled conditions, increased larval survival and quality. Under the collaborative project, scientists and technicians involved in the controlled breeding and seed production of Asian seabass were trained in reputed hatcheries in France. This exposure and hands-on training on the broodstock maintenance, maturation, spawning and larval rearing and live feed production have helped in acquiring additional knowledge on fish breeding and seed production.

On the whole, the outcome of the project has been enhanced capacity in terms of infrastructure and expertise in finfish seed production.

INDO-NORWEGIAN COLLABORATIVE PROJECT

GENETIC IMPROVEMENT OF *PENAEUS MONODON* (TIGER SHRIMP) THROUGH SELECTIVE BREEDING FOR GROWTH AND WHITE SPOT DISEASE RESISTANCE

Location of project : Chennai

Principal Investigator : Dr.P.Ravichandran

Core Staff : Dr.G.Gopikrishna and Dr.C.Gopal

Project Associate : Dr.S.M.Pillai, Dr.S.V.Alavandi, Dr.C.P.Balasubramanian and Dr.M.S.Shekhar

Collaborating institutions : CIBA, Chennai

CIFE, Mumbai

AKVAFORSK, Institute of Aquaculture Research, ÅS, Norway.

The main aim of the project is to develop a genetically improved strain of *Peaneus monodon* which grows fast and is resistant to the white spot viral disease. A total of 37 full-sib families of *Penaeus monodon, i.e.* 21 and five link families from Tamil Nadu [TN], one family from Andaman and 10 link families from Andhra Pradesh [AP] were procured and maintained family-wise in 500 l FRP tanks. Regular monitoring of the water quality parameters (salinity 25 to 33.3%, pH 7.7 to 8.3, temperature 28 to 30.4°C, DO 3.16 to 4.7 mg/l, total ammonia 0.07 to 0.257 ppm and nitrite 0.042 to 0.29 ppm) and growth was carried out. Standard practices of feeding and water quality management were followed. Ten families from AP (approx 5000 post larvae in each family) were transported to Chennai by CIFE personnel as link families to Tamil Nadu during the first week of September 2006. Similarly five link families from TN were delivered at CIFE, Kakinada for larviculture. After four months of larviculture, 7314 juveniles were tagged with Visible Implant Elastomer tags using five colours-Blue, Green, Orange, Pink and Red. A total of 1230 tagged shrimp were transported from CIBA, Chennai to CIFE Kakinada for commercial testing at Kakinada. Similarly, from CIFE, a total of 2800 tagged shrimp were received at Muttukadu for challenge testing, commercial rearing and brood stock development. A total of 2433 tagged shrimp from both the centres were stocked in a 600 m^2 pond for commercial testing alongwith 3347 untagged shrimp of similar size. The tagged shrimp of both centres (4228 nos.) were stocked in a pond for broodstock development. Challenge test was carried out on 1950 shrimp of both the centres and the data has been subjected to extensive preliminary quantitative genetic analyses based on a series of linear animal models and Weibull Proportional Hazard Frailty models. The results demonstrated very low additive genetic variability for survival in the present data, demonstrating the need for improvement of the challenge test protocols before conducting the next batch of challenge test. To improve the challenge test protocol, factors such as ambient temperature and dosage of the virus have been identified.

The shrimp tagged (1120 nos.) in December 2005, were maintained in a pond. A few shrimp that exhibited signs of maturation in the pond were transferred to the hatchery and one pair of shrimp mated and yielded 100,000 eggs. From this 60,000 nauplii were obtained. Larval rearing was continued and 720 shrimps (PL 60 stage) were available.

DEPARTMENT OF BIOTECHNOLOGY

GENE EXPRESSION IN *PENAEUS MONODON* AND *PENAEUS INDICUS* IN RELATION TO MICROBIAL INFECTION AND ENVIRONMENTAL STRESS

Location of project : Chennai

Principal Investigator : Dr.T.C.Santiago

The standard protocols for the extraction of RNA from preserved tissue samples of *P. monodon* and *F. indicus* have been optimized. Both mRNA: cDNA hybrid cloning method and cDNA cloning kit were used and standardized. Out of 70 colonies, 13 were confirmed to have cDNA inserts from *P. monodon* using homopolymer tailing method

and 20 out of 52 colonies using cDNA cloning kit. In *F. indicus*, six out of 16 colonies confirmed to have cDNA inserts. The cDNA cloning is in progress and hundreds of clones to be obtained towards the generation of EST.

Antiviral genes such as PmAV and Penaeidin have been amplified and characterized. The complete ORF of the PmAV have been amplified, both the genes are to be cloned and expressed. PmAv gene sequences of *P. monodon*, *F. indicus* and *M. rosenbergii* have been compared and discussed. Subtractive library is to be constructed using WSSV, MBV and loose shell affected shrimp samples.

DEVELOPMENT AND APPLICATION OF CMG FAMILY RECOMBINANT HORMONES, THEIR ANTAGONISTS AND RNAI TECHNIQUE FOR INDUCED MATURATION AND SPAWNING OF *PENAEUS MONODON*

Location of project : Chennai

Co-Investigator : Dr.C.P.Balasubramanian

The project aims to optimize the induced maturation techniques of *P. monodon* using molecular tools like recombinant hormones. Oogenesis of *P. monodon* was characterized using histological tools and a maturation scale comprising eight oocyte growth phase was established. The effect of inducement (unilateral ablation) and captivity on vitellogenesis was also studied. Small proportion of cortical oocytes and high frequency of atresia were noticed towards the end of the hatchery production cycle. A preliminary study on the reproductive performance of the broodstock of *P. monodon* sourced from different geographical areas in Tamil Nadu (Chennai and Pazhayar) was assessed through successive spawns of unilaterally eyestalk ablated females. Significant variation in reproductive performance such as latency period (10 *vs.* 15) and fecundity (0.33 million *vs.* 0.18 million) between Pazhayar *vs.* Chennai stock was noticed.

NETWORK PROJECTS

IMPACT ASSESSMENT OF FISHERIES RESEARCH IN INDIA

Location of project : Chennai

Project Associate : Dr.T.Ravisankar

Impact assessment of research at macro level helps to justify the investments and enhances the accountability of the system. This project is an attempt to quantity and measure the impact of fisheries research in India. The project is led by NAARM, Hyderabad and CIBA is one of the eight partner institutions of the project. The work completed at CIBA under this project during 2006-07 were development and testing of questionnaire and finalization of sampling frame, collection of primary and secondary data and analyses. A multi stage random sampling methodology was followed for finalizing sampling frame. Four states, Tamil Nadu, Andhra Pradesh for modern farming and West Bengal and Kerala for traditional were selected for sampling since these states have a predominance of these systems. For each state two districts were selected with a sample size of 30 farmers. The units of districts were also

selected following random sampling procedure. The respondent farmers were selected following simple random selection from district list of farmers obtained from MPEDA field offices and Department of Fisheries.

The average area under culture for the last three years (2004 to 2006) was computed based on data collected (Table 29).

Table 29. Average area (ha) under brackishwater aquaculture for years 2004 to 2006

Year	West Bengal	Orissa	Andhra Pradesh	Tamil Nadu	Kerala	Karnataka	Goa	Maharashtra	Gujarat	All States
2004	49925	12116	69638	3214	14029	3085	963	615	1013	154600
2005	50215	7030	61429	3684	10797	1528	295	524	891	136390
2006	50474	8172	57712	4946	13871	3262	331	647	1297	140682
Average	50205	9106	62926	3938	12899	2625	530	595	1067	145495

Secondary data compilation *i.e.,* time series data for 1980's to till date on research investment related to research and production, productivity and returns from brackishwater aquaculture has been completed and primary data collection from shrimp farms and data entry work are in progress.

PADDY-CUM-FISH CULTURE

Location of project : Kakdwip

Principal Investigator : Dr.A.K.Panigrahi

Co-Investigators : Dr.J.K.Sundaray, Dr.T.K.Ghoshal and Dr.Debasis De

Two experimental stations for the paddy-cum-fish culture demonstration programme were selected in Akshayanagar village, Kakdwip, South 24 Parganas Dt. as per the recommendation of ICAR Regional Committee II.

Experimental station 1

With the onset of the monsoon, the land was tilled and paddy variety "Swarna Pankaj" was sowed. The pond was stocked with Indian major carps catla (*Catla catla*), rohu (*Labeo rohita*) and mrigala (*Cirrhinus mrigala),* pearlspot (*Etroplus suratensis)* and scampi (*Macrobrachium rosenbergii)* with average initial weight of 6, 3, 3, 2.8 and 1g respectively. At the time of harvest, the fishes had attained the size of 250, 115, 47, 10 and 40g respectively. A total of 2480 kg (5475 kg/ha) of paddy and 256 kg (2950 kg/ha) of fish were harvested after 90 days and 150 days of culture. The revenue obtained from fish and paddy production was Rs.18,000/- and Rs.15,025/- respectively. The farmers also got an additional income of Rs.1,200/- from horticultural crop. The overall net return was Rs.35,000/- per ha.

Horticulture crop under Paddy-cum-fish farming

Experimental station 2

The field was sowed with "Dudher Sara" paddy variety. The pond was stocked with Indian major carps, catla, rohu, calbasu, mrigal and pearlspot with average body weight of 15, 3, 3, 10 and 2.8 g respectively. At the time of harvest mrigala, rohu, catla, calbasu and pearlspot have attained average body weight of 100, 91, 128, 91 and 7g respectively. The total paddy harvested was 485 kg (1450 kg/ha) after 130 days and the amount realised from the sale was Rs.7,300/-. A total of 159 kg (2450 kg/ha) fish was harvested in 121 days and the revenue was Rs.7,900/-. The overall net return was Rs 26,450/- per ha.

Fish harvest from paddy cum fish culture

APPLICATION OF MICROORGANISMS IN AGRICULTURE AND ALLIED SECTORS - MICROBIAL DIVERSITY AND IDENTIFICATION

Location of project : Chennai

Principal Investigator : Dr. T.C.Santiago

Co-Investigator : Dr. N. Kalaimani

The objective of the project is collect and catalogue interesting microbes. A total of 556 isolates of microbes comprising 329 bacteria, 66 actinomycetes, 55 fungi, 21 yeast isolates and seven Archae bacterium were isolated from different brackish geographic locations. Six agarolytic isolates, three nuclease producing bacteria, 13 sulfur metabolizing bacteria, four denitrifying bacteria, 10 protease producing bacteria, 15 lipase producing, eight chitinase producing, nine ligninase producing, seven cellulase producing, six chitosanase producing, 20 high salt resistant bacteria, 10 isolates of bioluminescent bacteria, 16 isolates of pigment producing bacteria have been isolated. A total of 21 *Vibrio harveyi* has been isolated from different brackishwater system of East Coast of India and they have been identified using species specific 16S rRNA primer,Box, ERIC and RAPD primers.

Twenty bacterial 16S rRNA gene has been amplified using universal 16S rRNA primer and sequenced. All the sequence has been used for the identification of the bacterial species using data base information. A total of 7 Archae bacterium has been isolated form salt pan and identified using 16S rRNA primer which is specific for Archae bacterium.

APPLICATION OF MICROORGANISMS IN AGRICULTURE AND ALLIED SECTORS - AGROWASTE MANAGEMENT, BIOREMEDIATION AND MICROBES IN POST HARVEST PROCESSING

Location of project : Chennai

Principle Investigator : Dr. S. V. Alavandi

Co- Investigator : Dr.T.C.Santiago and Dr.N.Kalaimani

As per the set objectives, work was initiated on the first activity, *i.e.*, isolation of ammonia oxidizing bacteria (AOB) and sulfur oxidizing bacteria (SOB). Sediment samples were collected from shrimp farms located in Mamallapuram, Marakanam and Nagapattinam in Tamil Nadu and Nellore in Andhra Pradesh and processed for chemolithoautotrophic AOB and SOB. Fifty-five samples from shrimp culture ponds and effluents were processed for chemolithoautotrophic ammonia oxidizing bacteria (AOB) and sulfur oxidizing bacteria (SOB). A quantitative estimation of AOB and SOB in the pond sediment samples during the shrimp culture period has been made. Population of AOB and SOB as determined by MPN technique ranged from 110 -1800 and 425-1800 per g respectively.

The growth rate of chemolithoautotrophic AOB even by using enrichment protocols was extremely slow, some isolates requiring as much as 6-8 weeks for growth. So far, 23 chemolithoautotrophic AOB and 60 SOB have been

isolated using enrichment protocols and selective media. These AOB were identified by cultural and physiological characteristics and belonged to *Nitrosomonas* spp., *Nitrosococcus* spp., *Nitrosospira* spp. and some unidentified genera. These isolates were also subjected to screening for ammonia monooxygenase (amoA) a gene coding for the key enzyme in the ammonia oxidation pathway by PCR according to protocols of Rotthauwe *et al* (1997). Twelve of the 23 isolates of AOB tested were confirmed to possess amo*A* gene (Fig. 30a).

Some SOB isolates were identified as *Thiosphaera* spp. and *Thiobacillus* spp., based on cultural characteristics, while other SOB could be grouped under *Marinobacter* and *Halothiobacillus hydrothermalis* based on PCR for SoxB gene (Fig. 30b) performed as per the protocols of Ralf Petri *et al* (2001).

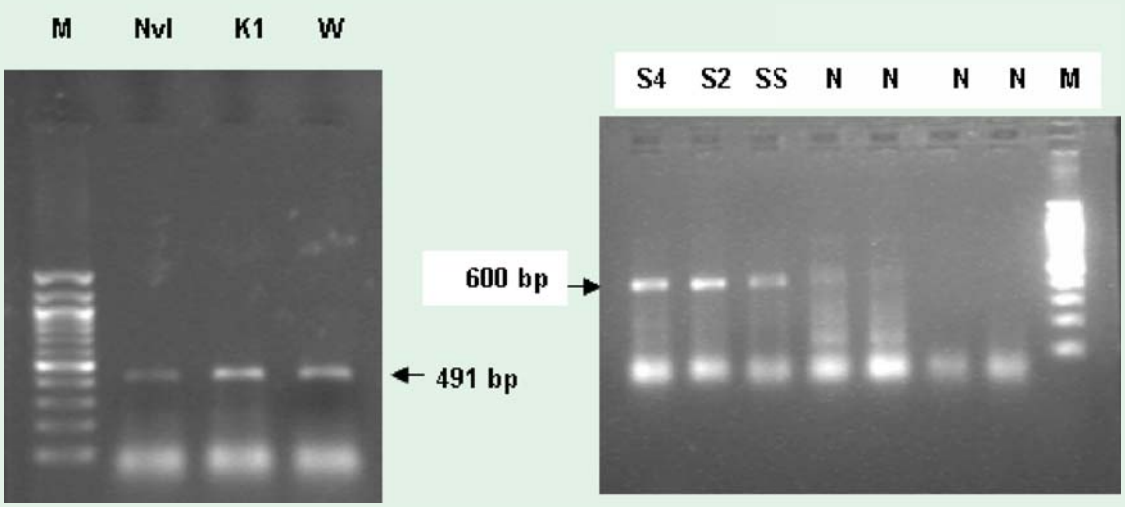


Fig. 31. a. Amplification of amoA gene in chemolithoautotrophic nitrifying bacteria (left) and b. sox B gene in sulfur oxidizing bacteria isolated from shrimp culture ponds

MEGA SEED PROJECT - SEED PRODUCTION IN AGRICULTURAL CROPS AND FISHERIES

Location of project : Chennai

Nodal Officer : Dr.S.M.Pillai

Seabass : Dr.A.R.Thirunavukkarasu

Shrimp : Dr.P.Ravichandran

Quality seed production of shrimps and seabass was the main objective for this National project with a total allocation of 112.2 lakh including 15 lakh for revolving fund for both seabass and shrimp seed production. Infrastructure in terms of hatchery sheds, broodstock and larval rearing tanks and equipments were developed. During the period under report, 5 lakh PL 20 of *P. monodon* and 1.5 lakh fry of *L. calcarifer* were produced.

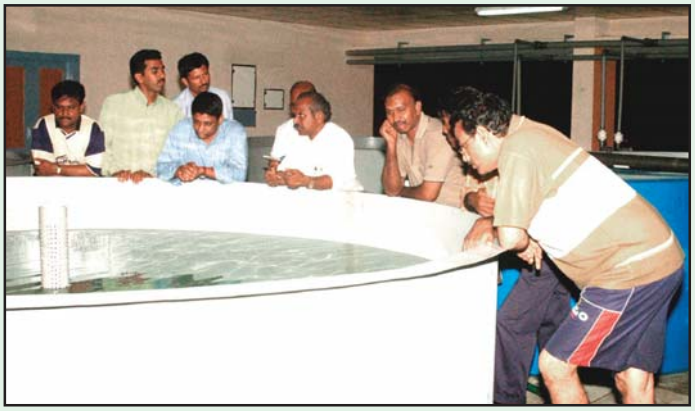
3. TECHNOLOGY ASSESSED AND TRANSFERRED

The technologies/knowledge-base developed by the Institute were extended during the year to progressive fish farmers, private entrepreneurs, officials of state and central governments etc. through the following short-term training programmes.

Sl.No.	Training Programme	Duration	No. of participants
1.	Seabass breeding and culture.	17-29 August 2006	11
2.	Shrimp and fish nutrition and feed management.	14 – 23 November 2006	10
3.	Histological techniques in shrimp disease diagnosis.	11-16 December 2006	5

Training on shrimp disease diagnosis.

Training on shrimp and fish nutrition.



Training on seabass breeding and culture.

4. TRAINING AND EDUCATION

HUMAN RESOURCE DEVELOPMENT
SCIENTIFIC / TECHNICAL / ADMINISTRATIVE

International

Name & Designation	Training Programme	Place of Training	Duration
Dr.M.Kailasam, Senior Scientist and Shri V.R.Senthilkumar, Technical Officer (T-5)	Seabass breeding and culture	France	2-11 May 2006
Dr.S.M.Pillai, Principal Scientist	Study visit to Shrimp Nucleus Breeding Centre under NORAD project	CENIACUA, Cartagena, Colombia	16-21 May 2006
Dr.M.Muralidhar Senior Scientist	Norman E. Borlaug fellowship under Indo-US Agricultural Knowledge Initiative	USA	6 October to 5 November 2006

National

Name & Designation	Training Programme	Place of Training	Duration
Dr.J.K.Sundaray, Senior Scientist	Recent advances in biochemical and molecular techniques and their applications in aquaculture	CIFE, Mumbai	28 March to 17 April 2006
Dr.S.Kannappan, Senior Scientist	Techniques in fish cell culture	Dept. of Aquaculture, Fisheries College & Research Institute, TANUVAS, Thoothukudi	24-28 April 2006
Dr.(Mrs.) M.Jayanthi, Senior Scientist, Dr.(Mrs.) P.Nila Rekha, Scientist (SS) and Dr.(Mrs.)P.Mahalakshmi, Scientist	Introduction to Arc GIA 9	ESRI, India, NIIT GIS Ltd., Chennai	19-23 June 2006
Dr. K.Ponnusamy, Senior Scientist and Dr.(Mrs.)P.Nila Rekha Scientist (SS)	GIS based decision support systems for sustainable agriculture	NAARM, Hyderabad	5-25 July 2006
Shri R.G.Ramesh, Assistant Administrative Officer	Financial rules for Head of Offices and DDO's	ISTM, New Delhi	24 July to 4 August 2006
Dr.K.Ponnusamy, Senior Scientist	Current issues in management of food processing industries	Tamil Nadu Agricultural University, Coimbatore	22-31 August 2006
Dr.M.Kumaran, Scientist (SS)	Computer based multimedia presentation	NAARM, Hyderabad	20 February to 12 March 2007

Lectures and demonstrations were conducted for the following at CIBA, Chennai and Muttukadu Experimental Station:

- B.F.Sc. III year students (44) and two Assistant Professors from College of Fisheries, Mangalore on 13 July 2006.

- B.Sc. (Biotechnology) students (45) and five Assistant Professors from Harur Muthu Science and Arts College, Dharmapuri district of Tamil Nadu on 20 July 2006.
- B.Sc. (Advance Zoology and Biotechnology) II year students (55) and two Assistant Professors from Meenakshi College for Women, Chennai on 3 August 2006.
- Fisheries Technology students (38) of Central Polytechnic College, Taramani, Chennai on 8 September 2006.
- P.G.& Research Department of Advanced Zoology and Biotechnology students (27) of Loyola College, Chennai 27 September 2006.
- M.Sc. (Aquaculture) students (20) and faculty members from Nandanam Arts College, Chennai on 12 February 2007.
- M.Sc. (Zoology) students (22) and a faculty member Dr.S.Godwin Wesley from Scott Christian College, Nagercoil on 1 March 2007.
- A batch of 25 aqua farmers and 2 Fisheries Development Officers from Prakasam district on 29 March 2007.

Students at fish hatchery and nutrition laboratory

5. AWARDS AND RECOGNITIONS

Dr.K.P.Jithendran, Senior Scientist was awarded the Biotechnology Overseas Associateship Award for the year 2005-06 by the Department of Biotechnology, Ministry of Science and Technology, Govt. of India for undergoing training on '*Molecular and biological characterization of nerve necrosis virus isolate (s) from marine fishes'* at the Laboratory of Aquatic Pathobiology, Graduate School of Biosphere Science, Hiroshima University, Japan for a period of three months from 11.10.2006 to 09.01.2007.

Mrs.P.Mahalakshmi, Scientist received the Young Scientist Award 2006 for the best paper presentation of the paper "Web kiosks in Aquaculture : A study of aquachoupal model in Prakasam district of Andhra Pradesh" at the National Seminar on "Extension Strategies for Fostering Knowledge Centric Agricultural Growth" organised by the Society of Extension Education at Puducherry, during 2-3 December 2006.

Ph.D. Programme

	Name	Thesis title	University	Date of award	Guide
	Mr. K. Ponnusamy Senior Scientist	Multi-dimensional analysis of integrated farming system in the coastal agro-eco system of Tamil Nadu	National Dairy Research Institute Karnal	1st May 2006	Dr. (Mrs.) Jancy Gupta Head Division of Dairy Extension Education NDRI, Karnal
	Ms. V.Parimala Senior Research Fellow	Studies on the removal of nitrogenous toxicants heavy metals and pesticides form coastal water	University of Madras	5th July 2006	Dr.K.K.Krishnani Senior Scientist CIBA
	Mr.S.Sivagnanam Technical Officer, T-6	Studies on the characterization and biochemical composition of different strains of Artemia (Crustacea : Anostraca) in South India	University of Madras	14th November 2006	Prof. N.Munuswamy Dept. of Zoology University of Madras
	Mr.V.Stalin Raj Senior Research Fellow	Morphological and molecular studies on White Spot Syndrome Virus (WSSV) and Monodon Baculovirus (MBV) from South East Coast of India.	University of Madras	16th March 2007	Dr.K.K.Vijayan Senior Scientist CIBA

6. LINKAGES AND COLLABORATION

THE INSTITUTE HAD LINKAGES WITH THE FOLLOWING:

NATIONAL

1. ICAR Institutes

- Central Institute of Fisheries Education, Mumbai
- Central Marine Fisheries Research Institute, Cochin
- National Academy for Agricultural Research Management, Hyderabad
- National Bureau of Agriculturally Important Microorganisms, Mau
- Directorate of Seed Research, Mau
- Central Agricultural Research Institute, Port Blair
- Central Inland Fisheries Research Institute, Barrackpore
- Central Institute of Fisheries Technology, Cochin
- National Bureau of Fish Genetic Resources, Lucknow

2. Other Institutes / SAUs / State Agriculture Departments

- College of Fisheries, University of Agricultural Sciences, Mangalore
- College of Fisheries, Sri Venkateswara Veterinary University, Muthukur
- Fisheries College and Research Institute, Tamilnadu Veterinary and Animal Sciences University, Thoothukudi
- West Bengal University of Animal and Fisheries Sciences, Kolkata
- CCS Haryana Agricultural University, Hisar
- Navsari Agricultural University, Navsari, Gujarat
- Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), Chennai
- Dept. of Horticulture, Govt. of Tamil Nadu, Chennai.
- Dept. of Animal Husbandry, Govt. of Tamil Nadu, Chennai.
- Agricultural College and Research Institute, Tamil Nadu Agricultural University, Tiruchirapalli
- Madras University, Chennai

3. Govt. of India

- Ministry of Agriculture
- National Fisheries Development Board
- Department of Animal Husbandry, Dairying and Fisheries
- Coastal Aquaculture Authority, Chennai
- Ministry of Science and Technology
- Ministry of Commerce
- Marine Products Export Development Authority
- Department of Biotechnology
- Department of Science and Technology

4. State Fisheries Departments / BFDAs

The Institute has well established linkages with State Fisheries Departments / BFDAs mainly with regard to transfer of technology programmes.

INTERNATIONAL

1. M/s.COFREPECHE, Government of France

The Institute has taken up an Indo-French Collaborative Project entitled 'Seabass Pilot Unit' with M/s.COFREPECHE, Government of France.

2. NORAD

A project entitled "Genetic improvement of *Penaeus monodon* (Tiger shrimp) through selective breeding for growth and white spot disease resistance" is taken up with AKVAFORSK, Norway.

7. LIST OF PUBLICATIONS

- CIBA Annual Report for the year 2005-2006
- CIBA News Vol.11, No. 3 & 4
- Training Programme Calendar, 2006-2007
- Training manual on Shrimp and Fish Nutrition and Feed Management, CIBA Special Publication No.29
- Training manual on shrimp farming, CIBA Special Publication No.30

BOOKS AND BOOK CHAPTERS

Chandrasekaran, V.S. 2006. Siru thozhil adipadayil nanneril meen valarpu patriya kaiyaedu (Hand book on small scale fresh water fish farming), *FAO Training series No.24,* p. 205 (Translated and co-published in Tamil language) ISBN 81-7525-756-3 with funding support from FAO**.**

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8. LIST OF ON-GOING RESEARCH PROJECTS

Sl. No.	Title of the Project	Principal Investigator
CRUSTACEAN CULTURE DIVISION		
1.	Captive broodstock development, breeding, seed production and culture of *Penaeus monodon, Fenneropenaeus indicus* and *Marsupenaeus japonicus*	Dr.P. Ravichandran Principal Scientist
2.	Culture of mud crabs (*Scylla* spp.)	Shri M.Kathirvel Principal Scientist
3.	Assessment of brackishwater land resources	Dr.(Mrs.)M.Jayanthi Senior Scientist
FINFISH CULTURE DIVISION		
4.	Broodstock development, breeding, seed production and culture of Grey mullet *Mugil cephalus* and Pearlspot *Etroplus suratensis*	Dr.M.Natarajan Principal Scientist
5.	Culture of Asian seabass *Lates calcarifer*	Dr.A.R.Thirunavukkarasu Head, FCD
AQUATIC ANIMAL HEALTH AND ENVIRONMENT DIVISION		
6.	Fish health management in brackishwater aquaculture using epidemiology, diagnostics, prophylactics and molecular biology	Dr.T.C.Santiago Principal Scientist
7.	Development of technology for the waste water treatment of shrimp farms	Dr.B.P.Gupta Principal Scientist
NUTRITION, GENETICS AND BIOTECHNOLOGY DIVISION		
8.	Development and demonstration of balanced feeds for Asian seabass, crabs and improvement of shrimp feeds	Dr.S.A.Ali Principal Scientist
9.	Genetic studies and application of molecular techniques in brackishwater shellfish breeding programmes	Dr.G.Gopikrishna Senior Scientist
SOCIAL SCIENCES DIVISION		
10.	Technology transfer, socio economic aspects and informatics in brackishwater aquaculture	Dr.M.Krishnan Principal Scientist
KAKDWIP RESEARCH CENTRE		
11.	Refinement of traditional brackishwater aquaculture systems for sustainable production of shrimp and fishes	Dr.A.Panigrahi, Senior Scientist
NETWORK PROJECT		
12.	Germ plasm exploration, cataloguing and conservation of fish and shellfish resources of India (CIBA – NBFGR)	Dr.C.P.Rangasamy Principal Scientist
FUNDED PROJECTS AP CESS FUND		
1.	National risk assessment programme for fish and fish products for domestic and international markets.	Dr.B.P.Gupta Principal Scientist
2	Participatory technology transfer model for sustainable coastal aquaculture	Dr.M.Kumaran Scientist (SS)

3.	Evaluation of nutritive value of different strains of rotifers (*Brachionus* spp.) and their suitability for larviculture of Asian seabass *Lates calcarifer* (Bloch)	Dr.M.Kailasam Senior Scientist
4.	Development and demonstration of hatchery and culture technology for the Banana shrimp, Fenneropenaeus merguiensis as an alternate species for shrimp aquaculture	Dr.S.M.Pillai Principal Scientist
5.	Development of low fish meal feeds for shrimp aquaculture	Dr.J.Syama Dayal Scientist (SS)
6.	The assessment of losses in shrimps in brackishwater aquaculture due to diseases	Dr.N.Kalaimani Principal Scientist
7.	Assessment of potential sites for sustainable aquaculture using modern technological tools	Dr.M..Jayanthi Senior Scientist
8.	Investigation on loose shell syndrome among farmed tiger shrimp *Penaeus monodon*	Dr.S.V.Alavandi Senior Scientist
9.	Molecular characterization and analysis of virulence factors in pathogenic *Vibrio harveyi* isolates from shrimp larviculture systems	Dr.S.V.Alavandi Senior Scientist
IFREMER		
10.	Seabass Pilot Unit (Indo-French Collaborative project)	Dr.A.R.Thirunavukkarasu Head, FCD
NORAD		
11.	Genetic improvement of *Penaeus monodon* (Tiger shrimp) through selective breeding for growth and white spot disease resistance	Dr.P.Ravichandran Principal Scientist
DBT		
12.	Gene expression in *Penaeus monodon* and *Penaeus indicus* in relation to microbial infection and environmental stress	Dr.T.C.Santiago Principal Scientist
13.	Development and application of CMG family recombinant hormones, their antagonists and RNAi technique for induced maturation and spawning of *Penaeus monodon*	Dr.C.P.Balasubramanian Senior Scientist
NETWORK		
14.	Impact assessment of fisheries research in India	Dr.T.Ravisankar Senior Scientist
15.	Paddy-cum-fish culture	Dr.A.K.Panigrahi Senior Scientist
16.	Application of microorganisms in agriculture and allied sectors - Microbial diversity and identification	Dr.T.C.Santiago Principal Scientist
17.	Application of microorganisms in agriculture and allied sectors - Agrowaste management, bioremediation and microbes in post harvest processing	
18.	Mega seed project - Seed production in Agricultural Crops and Fisheries Fish - Dr.A.R.Thirunavukkarasu, Head, FCD Shrimp - Dr.P.Ravichandran, Head, CCD	

9. CONSULTANCY / COMMERCIALIZATION OF TECHNOLOGY

A consultancy programme on the "Survey and demarcation of sea water inundated areas for eco-friendly aquaculture in Andaman and Nicobar Islands" was undertaken for the Department of Fisheries, A & N Administration, Port Blair.

Commercialisation of CIBA shrimp feed technology

The indigenous shrimp feed technology developed by CIBA has been commercialized to the following private establishments:

1. Bismi Feeds (P) Ltd., Deen Complex, O.S.M. Nagar, Mayiladuthurai, Nagapattinam Dist., Tamil Nadu.
2. M/s PISCICULTURE CARE UNIT, Village Madhubati, P.O. Kamarpukur, Hoogly Distrcit, PIN- 712612, West Bengal.

Both the entrepreneurs have installed feed mills with a production capacity of one ton per hour and are producing and marketing the shrimp feed.

10. RAC, IMC, SRC AND IJSC MEETINGS

RESEARCH ADVISORY COMMITTEE (RAC)

The Research Advisory Committee was constituted by ICAR (Council's order F.No.18-2/2004-ASR-I dated 10 June 2004) for a period of 3 years from 25 July 2004 with the following members.

Dr.N.R.Menon — Chairman
Former Director, School of Marine Sciences
Cochin University of Science and Technology
Fine Arts Avenue, Ernakulam, Cochin 682 016

Dr.Rakesh Bhatnagar — Member
Professor, Centre for Biotechnology
Jawaharlal Nehru University, New Delhi 110 067

Dr.(Mrs.) Katre Shakunthala — Member
Professor, Department of Zoology
Bangalore University, Bangalore 560 056

Dr.P.Keshavanath Director of Instruction, College of Fisheries, Mangalore 575 002	Member
Dr.A.G.Ponniah Director, CIBA, Chennai	Member
Dr.S.M.Pillai Principal Scientist & OIC, Technical Cell, CIBA, Chennai	Member Secretary

INSTITUTE MANAGEMENT COMMITTEE (IMC)

The Institute Management Committee was re-constituted by ICAR vide letter F.No.6-25/2003 IA-VI, dated 15 December 2004 for a period of 3 years with effect from 8.12.2004 as follows:

Director CIBA, Chennai	Chairman
Assistant Director General (M.Fy.) Indian Council of Agricultural Research, New Delhi	Member
Director of Fisheries Government of Tamil Nadu, Chennai	Member
Director of Fisheries Govt. of Andhra Pradesh, Tank Bund Road, Hyderabad	Member
Dean Fisheries College and Research Institute TANUVAS, Thoothukudi, Tamil Nadu	Member
Dr.S.N.Mohanty Principal Scientist, CIFA, Bhubaneswar	Member
Senior Finance & Accounts Officer CMFRI, Cochin, Kerala	Member
Administrative Officer CIBA, Chennai	Member Secretary

The 29th meeting of the Institute Management Committee was held on 15 November 2006. The major recommendations of the meeting are:

- To meet the additional fund required for the construction of additional two floors in the headquarters building, request may be sent to council for Rs.48.75 lakh.

- Nomenclature of minor works should be changed under subheads, repair / renovation / special repairs etc. and for such works, the total amount can be paid in advance to CPWD.
- The research achievements should be published without delay and to be hosted in the Institute website immediately.
- For procurement of equipments, the details along with the cost should be provided to the IMC.
- All outstanding advances with CPWD and DGS&D should be settled immediately.
- The fund available under HRD may be used for imparting training to staff, scientists and also for preparing training material and TA for such expenditure related to HRD.

IMC meeting

STAFF RESEARCH COUNCIL (SRC)

The 19th meeting of the annual Staff Research Council was held during 30-31 May 2006. The following are the major recommendations.

- A technology package for seed production and culture of *M. japonicus* has to be brought out.
- Considering that RGCA has already standardized crab seed production and a private entrepreneur with training from CIBA had set up a crab hatchery, CIBA can concentrate on culture of mud crabs and standardization of technology package.
- Breeding programme on *M. cephalus* was going for a long time and a technology package has to be brought out within this year.
- Technology package for seed production and culture of *E. suratensis* is to be finalized.

SRC meeting

- Focus should be towards seabass culture and a package need to be developed including economics of seabass culture.
- Trials of brackishwater ornamental fishes may be initiated.
- The component on emerging diseases need not be a programme under the project. Efforts should be made to extend services like PCR testing to private sector.

- Larval and grow-out diets for seabass and mud crabs are to be field tested.
- Social sciences programmes should have linkages with CCD and FCD.

INSTITUTE JOINT STAFF COUNCIL (IJSC)

(Reconstituted by CIBA for a period of 3 years with effect from 6 May 2003, vide office order F.No.13-1/90-Admn. dated 6 May 2003). The composition of the Institute Joint Staff Council (IJSC) is as follows :

Official side

Director, CIBA	Chairman
Dr.P.Ravichandran, Principal Scientist	Member
Dr.S.Kulasekarapandian, Principal Scientist	Member
Dr.S.M.Pillai, Principal Scientist	Member
Dr.A.R.Thirunavukkarasu, Principal Scientist	Member
Junior Accounts Officer	Member
Administrative Officer	Member

Staff side

Shri V.R.Senthilkumar, Tech. Officer (T-5)	Member
* Shri.R.Kandamani, Assistant	Member
Shri.S.Pari, Upper Division Clerk	Member
Shri.N.Harinathan, SS.Gr.II	Member

* Shri.R.Kandamani, is also a Member of Central Joint Staff Council, New Delhi.

11. PARTICIPATION IN CONFERENCES/ MEETINGS/ WORKSHOPS/SYMPOSIA

Particulars	Organizers	Duration
Dr.A.G.Ponniah, Director		
NACA Lead Centre's Meeting	NACA, Thailand	27-28 November 2006
SPF shrimp seed *(P. monodon)* and multiplication centre in India through transfer of technology from M/s Moana Technologies, Hawaii, USA	National Fisheries Development Board	5-8 February 2007
Discussion on the import of P.monodon	Ministry of Agriculture, Krishi Bhavan, New Delhi	3 April 2006
Inception meeting of National Fish Seed Project "Seed Production in Agricultural Crops and Fisheries" under the Chairmanship of DDG (Fy.), ICAR.	CIFA, Bhubaneswar	6-7 April 2006
Meeting of the Directors of Fisheries Research Institutes	NRC for Coldwater Fisheries, Bhimtal	15-16 April 2006
Brainstorming session on Participatory Technology Transfer Mechanism for sustainable coastal aquaculture	Organised by CIBA at Fisheries College and Research Institute, Tuticorin	25 April 2006
Meeting of the NORAD Project	CIFE, Mumbai	3 June 2006
Meeting on development of Inland saline aquaculture in the State of Haryana	CIFE, Rohtak	8-9 June 2006
Shrimp Aquaculture Stakeholders Interactive Session – SASIS 2006	Chennai	22 June 2006
National Consultation on Water Management in Fisheries and Aquaculture	Association of Aquaculturists, Inland Fisheries Society of India, CIFA, Bhubaneswar and CIFRI, Barrackpore, at NASC, New Delhi	23-24 June 2006
Consultation for approach of XI Plan for Fisheries component of TIFAC	NAAS, New Delhi	25 June 2006
Meeting to discuss the approach paper for fisheries in the XI Five Year Plan	NAAS, New Delhi	26 June 2006
Meeting of Mega Seed Project "Seed Production in Agricultural Crops and Fisheries"	NBPGR, New Delhi	27-28 June 2006
Brainstorming session and Feedback Mechanism on Participatory Technology Transfer for Sustainable coastal Aquaculture	Organized by CIBA at College of Fisheries, Muthukur	14 July 2006
Brainstorming Session on "Fish Germplasm Exchange/ Quarantine guidelines"	NBFGR and CIBA, at CIBA, Chennai	24 July 2006
Meeting to discuss the infrastructure development in Fisheries Sector for the XI Plan of DAHD & Fy., Ministry of Agriculture	CIFT, Kochi	18 August 2006
Planning Commission Meeting of the XI Plan Document of DAHD & Fy.	CIFRI, Barrackpore	21-22 August 2006
Meeting regarding Vision Document	ICAR, New Delhi	29 August 2006
Task Force Committee Meeting of DBT	DBT, New Delhi	4 September 2006
Inauguration of National Fisheries Development Board (NFDB) at the Auditorium of A.N.G.Ranga Agricultural University, Hyderabad	NFDB	9 September 2006

Meeting of the Coastal Aquaculture Authority	CAA, Chennai	22 September, 22 November 2006 and 10 January 2007
One-day focused discussion on Human Resource Planning for aquaculture extension	CIBA at SIFT, Kakinada	18 October 2006
Meeting of the NaCSA	MPEDA at Kakinada	19 October 2006
Stakeholders consultation on shrimp farming in Andamans, Port Blair	Port Blair	26 October 2006
Meeting of the XI Plan Working Group on Fisheries	ICAR, New Delhi	31 October–1 November 2006
Meeting on Fish Seed Certification Document	ICAR, New Delhi	2 November 2006
Directors' Conference	ICAR, New Delhi	3-4 November 2006
SAP Meeting regarding SPF Program of Kona Bay	SAP, Chennai	9 November 2006
Meeting of the Sub-Committee for the purpose of formulating guidelines for farming of Crabs, Lobsters and Seabass	CIBA, Chennai	23 November 2006 & 23 January 2007
94th Session of the Indian Science Congress	Annamalai University, Chidambaram	5 January 2007
INDAQUA 2007	MPEDA, Chennai	11-13 January 2007
12th Meeting of the National Committee on Introduction of Exotic Species into Indian Waters	ICAR, New Delhi	19 January 2007
National Workshop on Ornamental Fish Culture Development in India	Madras Veterinary College, Chennai	22 February 2007
DBT Task Force Meeting to evaluate Cell line proposals	DBT, New Delhi	28 February 2007
Review Meeting of the Seed Project "Seed Production in Agricultural Crops and Fisheries	ICAR, New Delhi	1-2 March 2007
Workshop on "Participatory Management and Conservation of Lobster Resources along the Indian coast"	CMFRI & MPEDA at Chennai	6 March 2007
169th Meeting of the Board of Tamil Nadu Fisheries Development Corporation Limited	Secretariat, Chennai	21 March 2007
Cost and Time over run committee meeting	ICAR, New Delhi	28 March 2007
Dr.A.R.Thirunavukkarasu, Head, FCD		
Interactive meeting with shrimp aquaculture stakeholder	Society of Aquacultural Professional	22 June 2006
Awareness campaign	Aquaculture Foundation of India at Kayalpattinam	8 July 2006
Round Table Consultancy Meeting on Scoping Shrimp Certification	PREPARE	6 September 2006
Workshop on Technology needs of aquaculture industry with special reference to Andhra Pradesh	Department of Marine Living Resources, Andhra University at Kakinada	20 September 2006
INDAQUA 2007	Marine Products Export Development Authority at Chennai	11-13 January 2007
National Workshop on Ornamental fish culture development in India	Fisheries Technocrats Forum, Chennai	22-23 February 2007
Dr.P.Ravichandran, Head, CCD		
Meeting on Collate and refine better management practices (BMPs) for smallholder shrimps supply chains	NACA Secretariat, Bangkok, Thailand	29 November to 1 December 2006

INDAQUA 2007	Marine Products Export Development Authority at Chennai	11-13 January 2007
Shri M.Kathirvel, Principal Scientist		
INDAQUA 2007	Marine Products Export Development Authority at Chennai	11-13 January 2007
Dr.S.Kulasekarapandian, Principal Scientist		
Disease free shrimp seed production in the hatchery	Ocean and Atmospheric Science & Technology Cell, Andhra University, Visakhapatnam	29 March 2007
Dr.S.M.Pillai, Principal Scientist		
Workshop on Right to Information Act 2005	NAARM, Hyderabad	18-19 April 2006
National consultation of XI plan for fisheries component of Technology Information, Forecasting and Assessment Council	TIFAC, New Delhi	25 June 2006
Meeting to discuss the approach paper for fisheries in the XI plan	ICAR, New Delhi	26 June 2006
First meeting of the mega seed project Seed Production in Agricultural Crops and Fisheries	ICAR, New Delhi	27 June 2006
Brainstorming meeting on Awareness programme on aquatic species introduction and quarantine	National Bureau of Fish Genetic Resources, Lucknow and Central Institute of Brackishwater Aquaculture at Chennai	24 July 2006
As Nodal Officer organized and participated in the consultation meeting on Institute-Industry linkage for collaborative work between CIBA and private shrimp hatcheries	CIBA, Chennai	25 August 2006
Meeting to finalise the perspective plan document of fisheries institutes convened under the chairmanship of Secretary, DARE and DG, ICAR	ICAR, New Delhi	28-29 August 2006
Consultation meeting for registration of shrimp hatcheries	MPEDA, Kochi	30 August 2006
Round Table Consultation Meeting on Scoping of shrimp certification	PREPARE, Chennai	6 September 2006
20th Annual General Meeting of OSSPARC and 31st Executive Committee and 13th AGM Meeting of RGCA at Chennai	MPEDA, Chennai	12 September 2006
Seminar on Records management	National Archieves of India, New Delhi at Chennai	19 September 2006
Workshop on Right to Information Act, 2005 – Obligations & Strategies	Industrial Management Academy, New Delhi at Chennai	16-17 October 2006
National Agricultural Innovation Project Meeting to prepare concept note on Development of Island Fisheries and Aquaculture	Central Marine Fisheries Research Institute, Cochin	9-10 November 2006
First meeting of the Expert Committee on Repositories of National Biodiversity Authority at Chennai	National Biodiversity Authority, Chennai	28 November 2006
INDAQUA 2007	Marine Products Export Development Authority at Chennai	11-13 January 2007
Annual review meeting of the mega seed project "Seed production of agricultural crops and fisheries "	ICAR, New Delhi	1-2 March 2007
Meeting of the cost and time over-run committee of ICAR with regard to additional expenditure for 3rd and 4th floor of CIBA headquarters building	ICAR, New Delhi	28 March 2007
Dr.T.C.Santiago, Principal Scientist		
INDAQUA 2007	Marine Products Export Development Authority at Chennai	11-13 January 2007
Workshop on Management of Intellectual Property Rights in Biotechnology	Biotech Consortium India Ltd., Chennai	22-23 February 2007

Dr.S.A.Ali, Principal Scientist		
INDAQUA 2007	Marine Products Export Development Authority at Chennai	11-13 January 2007
Workshop on Management of Intellectual Property Rights in Biotechnology	Biotech Consortium India Ltd., Chennai	22-23 February 2007
International Seminar on Environmental Biotechnology Envirotech 2006	Justice Basheer Ahmed Sayeed College for Women, Chennai	6 July 2006
Dr.C.P.Rangaswamy, Principal Scientist		
INDAQUA 2007	Marine Products Export Development Authority at Chennai	11-13 January 2007
Dr.N.Kalaimani, Principal Scientist		
INDAQUA 2007	Marine Products Export Development Authority at Chennai	11-13 January 2007
Dr.M.Natarajan, Principal Scientist		
Colloquium on Government-Institute-Industry collaboration in Fisheries Development	Association of Fisheries College Alumini, Chennai	24 June 2006
Dr.M.Krishnan, Principal Scientist		
Shrimp stakeholders interactive session - SASIS 2006	Society of aquaculture professionals at Chennai	22 June 2006
Colloquium on Government-Institute-Industry collaboration in Fisheries Development	Association of Fisheries College Alumini, Chennai	24 June 2006
International Conference on Marine-hazards and opportunities	Federation of Indian Chamber of Commerce and Industry	3-5 July 2006
Research priorities in social sciences research in fisheries and aquaculture during XI plan	ICAR at New Delhi	26 - 27 September 2006
INDAQUA 2007	Marine Products Export Development Authority at Chennai	11-13 January 2007
Workshop on ornamental fish culture development in India	Madras Veterinary College at Chennai	22 - 23 February 2007
Workshop on Responsible fisheries, strategies and practices	CMFRI at Chennai	26-27 March 2007
Dr.G.Gopikrishna, Senior Scientist		
INDAQUA 2007	Marine Products Export Development Authority at Chennai	11-13 January 2007
Dr.T.Ravisankar, Senior Scientist		
Workshop on Share your experiences	Sugarcane Breeding Institute, Coimbatore	29 September 2006
INDAQUA 2007	Marine Products Export Development Authority at Chennai	11-13 January 2007
Dr.V.S.Chandrasekaran, Senior Scientist		
Workshop on Right to Information Act 2005	NAARM, Hyderabad	18-19 April 2006
One-one business meeting and conference with 2006 Taiwan aquaculture trade mission in South Asia	Society of Aquaculture Professionals at Chennai	15 May 2006
Shrimp stakeholders interactive session - SASIS 2006	Society of aquaculture professionals at Chennai	22 June 2006
Colloquium on Government-Institute-Industry collaboration in Fisheries Development	Association of fisheries College Alumini, Chennai	24 June 2007
Seminar on Records management	National Archieves of India, New Delhi at Chennai	19 September 2006
Research priorities in social sciences research in fisheries and aquaculture during XI plan	ICAR at New Delhi	26 - 27 September 2006

Workshop on Right to Information Act, 2005 – Obligations & Strategies	Industrial Management Academy, New Delhi at Chennai	16-17 October 2006
INDAQUA 2007	Marine Products Export Development Authority at Chennai	11-13 January 2007
Dr.K.K.Krishnani, Senior Scientist		
INDAQUA 2007	Marine Products Export Development Authority at Chennai	11-13 January 2007
Workshop on Management of Intellectual Property Rights in Biotechnology	Biotech Consortium India Ltd., Chennai	22-23 February 2007
Dr.(Mrs.)M.Jayanthi, Senior Scientist		
National Conference on Eco-environmental impact on water resources potential towards relinking and integrating its hydrological cycle	Anna University, Chennai	3-5 January 2007
Dr.(Mrs.)B.Shanthi, Senior Scientist		
Colloquium on Government-Institute-Industry collaboration in Fisheries Development	Association of Fisheries College Alumini, Chennai	24 June 2006
Workshop on Participatory management and conservation of lobster resources along the Indian coast	CMFRI & MPEDA, Cochin at Chennai	6 March 2007
Workshop on Responsible fisheries, strategies and practices	CMFRI at Chennai	26-27 March 2007
Dr.M.Kailasam, Senior Scientist		
National Workshop on Ornamental fish culture development in India	Fisheries Technocrats Forum, Chennai	22-23 February 2007
Dr.(Mrs.)D.Deboral Vimala, Senior Scientist		
National Seminar on "Extension strategies for fostering knowledge centric agricultural growth".	Society of Extension Education, Tamil Nadu Agricultural University, Coimbatore at Pondicherry	2-3 December 2006
Workshop on Technology models for wastelands development	Ministry of Rural Development, Dept. of Land Resources, New Delhi at Hyderabad	9 January 2007
Workshop on Responsible fisheries, strategies and practices	CMFRI at Chennai	26-27 March 2007
Dr.M.Shashi Shekhar, Senior Scientist		
Workshop on Management of Intellectual Property Rights in Biotechnology	Biotech Consortium India Ltd., Chennai	22-23 February 2007
Dr.J.K.Sundaray, Senior Scientist		
Meeting regarding expertise and facility for providing training to fishery extension officer at KRC of CIBA, Kakdwip	Director (Fishery), Govt. of West Bengal	
Hindi Workshop and exhibition on Matsyaki Anusandhan Evam Vikas – Dishayein Aur Aayaam	CIFRI, Barrackpore	17-18 March 2007
Dr.J.Syama Dayal, Scientist (SS)		
INDAQUA 2007	MPEDA at Chennai	11-13 January 2007
Dr.M.Kumaran, Scientist(SS)		
Shrimp stakeholders interactive session - SASIS 2006	Society of aquaculture professionals at Chennai	22 June 2006
National Seminar on "Extension strategies for fostering knowledge centric agricultural growth".	Society of Extension Education, Tamil Nadu Agricultural University, Coimbatore at Pondicherry	2-3 December 2006
Workshop on Data analysis and data mining	NAARM at Hyderabad	26 February 2007

Dr.K.Ponnusamy, Scientist (SS)		
Colloquium on Government-Institute-Industry collaboration in Fisheries Development	Association of Fisheries College Alumini, Chennai	24 June 2006
Workshop on Participatory management and conservation of lobster resources along the Indian coast	CMFRI & MPEDA, Cochin at Chennai	6 March 2007
Workshop on Responsible fisheries, strategies and practices	CMFRI at Chennai	26-27 March 2007
Dr.A.Panigrahi, Scientist (SS)		
Workshop on Eco-based management of fisheries resources.	College of Fisheries, OUAT, Rangailunda, Orissa	26 December 2006
INDAQUA 2007	Marine Products Export Development Authority at Chennai	11-13 January 2007
National seminar on Frontiers in health management in aquaculture	Central Institute of Freshwater Aquaculture, Bhubaneswar	8-9 March 2007
Dr.(Mrs.)P.Nila Rekha, Scientist (SS)		
National conference on Eco-environmental impact on water resources potential towards relinking and integrating its hydrological cycle	Anna University, Chennai	3-5 January 2007
Stakeholders meeting on Integrated water resources management	Centre for Water Resources, Anna University	20 March 2007
Workshop on Responsible fisheries, strategies and practices	CMFRI at Chennai	26-27 March 2007
Dr.(Mrs.)P.Mahalakshmi, Scientist		
International seminar on Environmental biotechnology : ENVIROTECH 2006	Justice Basheer Ahmed College for Women at Chennai	5 - 7 July 2006
National seminar on Extension strategies for fostering knowledge centric agricultural growth.	Society of Extension Education, Tamil Nadu Agricultural University, Coimbatore at Pondicherry	2-3 December 2006
Meeting on Video conferencing for nodal officers of ICAR institutes	ICAR at New Delhi	4 December 2006
National workshop content creation and capacity building for Village Resource Centres	Ayurvedic Hospital and Research Centre at Kottakal	19 - 20 January 2007
Workshop on Mobile fisheries application	MSSRF at Chennai	22 March 2007
Shri K.U.K.Menon, Finance and Accounts Officer		
Seminar on Records management	National Archieves of India, New Delhi at Chennai	19 September 2006
Shri M.S.N.Murthy, Administrative Officer		
Seminar on Records management	National Archieves of India, New Delhi at Chennai	19 September 2006
Mrs.K.Nandini, Junior Accounts Officer		
Workshop on Negotiation skills	ISTM, New Delhi	12-14 March 2007
Shri D.Raja Babu, Technical Officer (T-6)		
National seminar on Frontiers in Health Management in Aquaculture	Central Institute of Freshwater Aquaculture, Bhubaneswar	8-9 March 2007
Mr.M.Shengabakumar, Technical Officer (T-5)		
Workshop on Maintenance of Personal Management Information System Network (PERMISNET) and to launch Intelligent Reporting System (IRS)	ICAR, New Delhi	21-22 July 2006
Seminar on IT sector of Government Bodies	SMART IT Solutions for Government buyers at Chennai	15 March 2007

Lectures delivered

Dr.S.A.Ali, Principal Scientist Dr.J.Syama Dayal, Scientist (SS) Dr.K.Ambasankar, Scientist (SS)	Summer school on Recent advances in the feed additives for production of residue free livestock / poultry products. Delivered lecture on "Feed additive"	Dept. of Animal Nutrition, Madras Veterinary College, TANUVAS, Chennai	17 August – 6 September 2006
Dr.A.R.Thirunavukkarasu, Head, FCD	Seminar on Swasraya Bharath 2006. Delivered talk on Ffinfish farming for environmental friendly & economically sustainable brackishwater aquaculture in India	Swadesh Science Movement, Cochin	14 October 2006
Dr.M.Kailasam, Senior Scientist	Awareness campaign of SHGs. Delivered lecture on Seabass seed production and farming	Adaikalapuram Village, Tuticorin	8 July 2006
Dr.M.Kailasam, Senior Scientist	Awareness campaign of SHGs. Delivered lecture on Seabass farming	Puducherry	28 December 2006

12. SERVICES IN COMMITTEES

Dr.A.G.Ponniah, Director, CIBA served in the following Committees:

- Member, Executive Committee and Governing Body, Rajiv Gandhi Centre for Aquaculture (MPEDA), Mayiladuthurai.
- Member, National Committee to Oversee and Regulate Introduction of Exotic Aquatic Species, Ministry of Agriculture, Govt. of India.
- Member, Coastal Aquaculture Authority, Ministry of Agriculture, Govt. of India.
- Member, ICAR Regional Committee No.VIII.
- Member, General Body of Orissa Shrimp Seed Production Supply and Research Centre (OSSPARC), Orissa
- Member, Scientific Advisory Committee of Dr.Perumal KVK, Krishnagiri Dist.
- Member, Task Force Committee on Fisheries Development Mission – T.N. State Fisheries Department
- Director - Board of Directors of Tamil Nadu Fisheries Development Corporation Limited, Chennai.
- Expert Member – Tamil Nadu Fisheries Research Council
- Member, Task Force Committee on Aquaculture and Marine Biotechnology, Department of Biotechnology
- Member, Working Group on Fisheries for the Eleventh Five Year Plan (2007-2012)
- Member, National Centre for Sustainable Aquaculture (NaCSA)
- Member, Expert Committee on Repositories & Terms of Reference of National Biodiversity Authority
- Chairman – Sub-committee of Coastal Aquaculture Authority for formulation of guidelines for farming of crabs, lobsters and seabass
- Chairman, Study group to carry out the risk analysis/assessment on the introduction of *L.vannamei* into India.

13. WORKSHOPS/SEMINARS/MEETINGS ETC

ORGANISED BY THE INSTITUTE

TRAINING WORKSHOPS

The following training workshops / demonstrations were organised by the Institute in different regions:

Sl. No.	Programme	Venue	Date
1	Brainstorming session on Participatory technology transfer and feedback mechanism for sustainable aquaculture	Fisheries College and Research Institute, Thoothukudi, Tamil Nadu College of Fishery Science, Muthukur, Nellore District, Andhra Pradesh	25 April 2006 14 July 2006
2	Brainstorming workshop on Training needs of fishery extension officers of Andhra Pradesh	State Institute for Fisheries Training, Kakinada	18-19 May 2006
3	Brainstorming session on HACCP in shrimp aquaculture	CIBA, Chennai	7 June 2006
4	Awareness programme on Aquatic species introduction and quarantine	CIBA, Chennai	24 July 2006
5	Workshop on Stakeholders appraisal of vital missing links in coastal aquaculture development	CIBA, Chennai	10 – 11 August 2006
6	Awareness programme on Empowerment of rural women in aquaculture and dissemination of information through ICT for aquaculture development in collaboration with ATMA (NATP)	Tollapalem Village Tangatur Mandal, Andhra Pradesh.	16 August 2006
7	Awareness building workshop on NAIP project	CIBA, Chennai	19 August 2006
8	Brainstorming session on Development of content on brackishwater culture for Village Resource Centres / Village Knowledge Centres of MSSRF	Chennai	18 September 2006
9	Focus group discussion on Human resource planning for aquaculture extension	State Institute of Fisheries Technology, Kakinada, Andhra Pradesh CIBA, Chennai	18 October 2006 10 January 2007

Brainstorming session on participatory technology transfer at Nellore

Brainstorming workshop on training needs at Kakinada

Workshop on stakeholders appraisal of vital missing links in coastal aquaculture development at Chennai

Awareness programme on aquatic species introduction and quarantine at Chennai

(a) (b)

Focus group discussion on human resource planning for aquaculture extension at (a) Kakinada (b) Chennai

MEETINGS

The Institute organised the following meetings:

- Consultation meeting between Industry (private shrimp hatchery operators) and institute at Chennai on 25 August 2006.
- Interaction meeting on "Status and Future Prospects of Asian seabass" at Muttukadu Experimental Station of CIBA on 26 August 2006.
- Interaction meeting with industry, NGOs and other research organizations to prepare a concept note on "Production to Consumption System of High Value Aquaculture" for NAIP at Chennai on 14 November 2006.

FARMERS' MEET

A Farmers' Meet was conducted at Kakdwip Research Centre (West Bengal) on 4 July 2006 to popularize CIBA technologies to the local farmers and to learn their experiences in brackishwater aquaculture. About 114 farmers from Sagar, Namkhana, Pathar Pratima, Mathurapur and Kakdwip participated in the meet. Dr.P.Ravichandran, Head, Crustacean Culture Division, CIBA presided the function the chief guest was Mr.H.Bagchi, Chief Executive Officer, Brackishwater Fish Farmers Development Agency. Mr.S.Subba Rao, Assistant Director, MPEDA, Kolkata offered felicitation. Dr.V.S.Chandrasekaran, Senior Scientist, Social Sciences Division, CIBA, Chennai also participated in the Meet.

Farmers' meet at Kakdwip

WORLD ENVIRONMENT DAY

The World Environment Day was celebrated on 5 June 2006 at Kattur village, Tiruvallur district, Tamil Nadu. About 100 participants comprising aqua farmers, State Fisheries Department officials, feed dealers, technicians, Women Self Help Group members and the local people of Kattur attended the function. Dr.M.Krishnan, Scientist-in-Charge, Social Sciences Division, CIBA welcomed the gathering. Dr.A.G.Ponniah, Director, CIBA, in his presidential address emphasized the importance of sustainable, environment-friendly practices of shrimp farming and stressed the need for group approach in resolving many of the administrative and legal conflicts confronting aquaculture development.


World Environment Day celebration

Dr.P.Ravichandran, Dr.S.A.Ali and Dr.M.Kailasam delivered lectures on shrimp farming, seabass farming and shrimp feed technology. Shri R.Ravichandran, Research Assistant, State Fisheries Department, Govt. of Tamil Nadu briefed the initiatives of Govt. of Tamil Nadu for development of brackishwater aquaculture. The participants interacted on the aspects of optimum stocking density, effluents from Ennore Thermal Power Station, testing facilities on soil and water qualities, incidence of diseases, supply of electricity with reduced tariff, sudden price crash of shrimp, iron content in the water and polyculture of shrimp and fish.

ICAR FOUNDATION DAY

ICAR Foundation Day celebration

The Institute celebrated ICAR Foundation Day on 18 July 2006 at Chennai. Four distinguished speakers, two professors and about 40 students from five city colleges attended the programme. The function was presided over by Hon. Justice A.K.Rajan, Chairman, Coastal Aquaculture Authority. Dr. O. Henry Francis, Assistant General Manager (Rural Development), Agri-Business Unit, State Bank of India, Local Head Office, Chennai, Shri P.K.Ramachandran, President, Waterbase Limited and Shri S.Chandrasekar, Country Manager, INVE Aquaculture participated in the programme along with the scientists and staff of the Institute. An inter-collegiate quiz competition was also held for students from five city colleges namely, Ethiraj College, Loyola College, Meenakshi College, Madras Christian College and Nandanam Arts College. Madras Christian College and Ethiraj College won the first and second prizes.

EXHIBITIONS

The Institute participated in the exhibitions organised during the following events:

- Inauguration of National Fisheries Development Board at Hyderabad on 9 September 2006.
- International Symposium on Sustainable Fisheries Development for Food and Health Security, College of Fisheries, Mangalore held during 20-21 December 2006.
- "INDAQUA" organised by Marine Products Export Development Authority, held at Chennai during 11-13 January 2007.
- Krishi Mela arranged by Swami Vivekananda Gram Panchayat held at Kakdwip during 23-25 January 2007.
- National Workshop cum Exhibition on "Fisheries Research Development – Directions and Thrust" (Matsyaki Anusandhan Evam Vikas- Dishayein Aur Aayaam) held at CIFRI, Barrackpore during 17-18 March 2007.

Exhibition at INDAQUA, Chennai

- Bharat Nirman Public Information Campaign (PIB) held at Pondicherry during 26 February to 2 March 2007.

Exhibition at Mangalore

Exhibition at Pondicherry

14. VISITORS

Name of the Visitor	Date of Visit
Dr.S.Ayyappan, DDG (Fy.), ICAR and Dr.S.J.Kaushik, Director, Nutitrion Aquaculture & Genomics Research Unit of INRA-IFREMER, France	1-2 May 2006
Dr.A.D.Diwan, Assistant Director General (M.Fy.), ICAR, New Delhi	15.11.2006
Mr.Ashok Nanjappa, Water Base Limited, Chennai	10.5.2006
Prof.S.Ramachandran, Director, Centre for Research, Anna University, Chennai	11.5.2006
Dr.Morten Rye, AKVAFORSK , Norway	1.6.2006
Dr.N.Ramanathan, Director of Research (Fisheries), Fisheries College & Research Institute, Tuticorin	6.6.2006
Dr.M.Sakthivel, President, AFI and Mr.V.G.Eraniappan, Periyar Integrated Fish Farm.	12.6.2006
Mr.Ajit Sinha Patil, Pancham Aqua, Mumbai	6.7.2006
Dr.R.A.Selvakumar, Ex-ADG (M.Fy.), ICAR, New Delhi	22.7.2006 & 1.3.2007
Dr.M.A.Haniffa, St.Xaviers College, Palayamkottai	4.8.2006
Dr.N.Manoharan and a team of delegates from Sri Lank	5.9.2006
Dr.O.Henry Francis, Assistant General Manager and General Manager, State Bank of India, Chennai	27.9.2006
Dr.V.K.Venkataramani, Dean, Fisheries College & Research Institute, Tuticorin	15.11.2006
Mr.A.K.Upadhyay, Secretary, ICAR	6.1.2007
Visit of NACA Team to CIBA	8.1.2007
Prof.M.Devaraj, Director, University of Madras, and Dr.T.Balasubramanian, Director, CAS in Marine Biology, Annamalai University	1.3.2007

15. PERSONNEL

(Not a gradation list)

DIRECTOR
Dr.A.G.Ponniah
(joined on 26.4.2006)

HEAD OF DIVISION

Dr.A.R.Thirunavukkarasu

PRINCIPAL SCIENTIST

Dr.P.Ravichandran
Dr.Mathew Abraham (retired on superannuation on 28.2.2007)
Shri M.Kathirvel
Dr.S.Kulasekarapandian
Dr.S.M.Pillai
Dr.T.C.Santiago
Dr.Syed Ahamad Ali
Shri R.K.Chakraborti (retired on superannuation on 31.7.2006)
Dr.C.P.Rangaswamy
Dr.B.P.Gupta
Dr. N.Kalaimani
Dr.M.Natarajan
Dr.M.Krishnan

SENIOR SCIENTIST

Dr.G.Gopikrishna
Dr.K.P.Jithendran
Dr.Azad Ismail Saheb (on deputation to Kuwait Institute of Scientific Research, Kuwait from 8.10.2004)
Dr.C.Gopal
Dr.(Ms.) Shiranee Periera (on deputation to PFA, New Delhi w.e.f. 24.10.2005)
Dr.T.Ravisankar
Dr.V.S.Chandrasekaran
Dr.K.K.Krishnani
Dr.M.Muralidhar
Dr.(Mrs.) M.Jayanthi
Dr.(Mrs.) B.Shanthi
Dr. S.V.Alavandi
Dr.C.P.Balasubramanian
Dr.M.Kailasam
Dr.(Mrs.) D.Deboral Vimala
Dr. M.Shashi Shekhar
Dr.S.Kannappan (w.e.f. 22.3.2005)
Dr.K.Ponnusamy (w.e.f. 1.5.2006)
Dr. J.K.Sundaray (w.e.f. 8.9.2006)
Dr. Akshaya Panigrahi (w.e.f. 7.2.2007)

SCIENTIST (SENIOR SCALE)

Dr.P.S.Sudheesh
Dr.J.Syama Dayal
Dr.M.Kumaran
Dr.Debasis De
Mrs.M.Poornima
Dr.(Mrs.)R.Saraswathy
Dr.(Mrs.) Saradha Chundari (relieved on 5.12.2006)
Dr.(Mrs.) P.Nila Rekha
Dr.K.Ambasankar
Dr.T.K.Ghoshal
Mrs.P.Mahalakshmi (w.e.f. 12.11.2005)

TECHNICAL OFFICER

T (7-8)

Shri R.Elankovan

T-6

Shri S.Sivagnanam
Shri D.Rajababu

T-5

Shri M.Shenbagakumar
Shri R.Puthiavan
Shri V.R.Senthil Kumar
Shri M.G.Subramani
Shri M.Gopinathan Nair
Shri B.B.Roy

TECHNICAL ASSISTANT

T-4

Shri S.Stanline
Shri S.Rajamanickam
Shri S.Rajukumar
Shri Joseph Sahayarajan
Shri Marella Ravi (transferred to NAARM, Hyderabad on 31.10.2006)
Shri A.Nagavel
Shri R. Subburaj
Shri S.Nagarajan (joined on 12.4.2006 from NCIPM, New Delhi)
Shri R.Rajasekharan (joined on 14.11.2006 from CPCRI, Kasargod)

T-2

Shri N.Ramesh
Shri S.Saminathan
Shri C.Ananthanarayanan
Shri P.C.Mohanty (transferred to CIFA, Bhubaneswar on 30.6.2006)
Shri K.Paranthaman
Shri R.Balakumaran
Shri P.Manickyam (retired on superannuation on 29.4.2006)
Shri P.S.Samantha
Ms.Chanda Mazumdar
Shri N.Jagan Mohanraj
Shri D.M.Ramesh Babu
Shri G.Thiagarajan
Shri K.Karaiyan

ADMINISTRATION & FINANCE

Administrative Officer

Shri M.S.N.Murty

Finance & Accounts Officer

Shri K.U.K.Menon

Junior Accounts Officer

Mrs.K.Nandini

Assistant Administrative Officer

Shri R.G.Ramesh

Assistant

Shri R.Kandamani
Shri P.K.Roy
Shri S.K.Bindu

Personal Assistant

Shri K.G.Gopala Krishna Murthy (joined on 26.6.2006 from ICAR, New Delhi)

STENOGRAPHER

Grade II

Shri S.K.Halder

Ms.S.Nalini

Grade III

Mrs.K.Hemalatha

Mrs.K.Subhashini

Senior Clerk

Mrs.V.Usharani
Shri S.Pari
Mrs.E.Amudhavalli
Shri A.Manoharan
Shri A.Sekar
Mrs.Arati Rani Panigrahi

Junior Clerk

Mrs.E.Mary Desouza
Shri P.Srikanth
Mrs.R.Vetrichelvi
Shri B.Palanivelmurugan
Mrs.B.Prasanna Devi (joined on 11.6.2006)
Mrs.M.Mathuramuthu Bala (joined on 17.7.2006)

SUPPORTING STAFF

S.S.Gr.IV

Shri N.C.Jana
Shri S.C.Mondal
Shri L.C.Manna

Shri Prakash Chandra Saha
Shri R.K.Behera
Shri Shyam Bhoi (transferred to CIFA, Bhubaneswar on 30.6.2006)

S.S.Gr.III

Shri M.N.Biswas
Shri A.K.Biswas
Shri Biswanath Mondal
Shri N.N.Mondal
Shri N.C.Samanta
Shri P.Arumugam
Shri Baman Jally (transferred to CIFA, Bhubaneswar on 30.6.2006)
Shri Sasidar Betal
Shri Rash Behari Das
Shri Gaur Hari Jena
Shri Kalipada Mondal
Shri M.C.Behera | (transferred from PRC of
Shri K.C.Samal | CIBA to CIFA, Bhubaneswar)

S.S.Gr.II

Shri Pani Gharami
Shri Sudarshan Naik | (transferred to
Shri Bijay Bhoi | CIFA, Bhubaneswar
Shri Balram Das | on 30.6.2006)
Shri Patit Paban Halder
Shri Abhimanyu Naskar
Shri R.K.Roy
Shri Pranesh Chandra Saha
Shri M.Santhosam
Shri Maharaga Majhi (transferred to CIFA, Bhubaneswar on 30.6.2006)
Shri N.Harinathan
Shri Narendra Nath Jana
Shri V.Jeevanandam
Shri Amar Gharami
Shri K.Mariappan
Shri Krishna Pada Naskar
Mrs.S.Santhi
Shri Premananda Bisoi (transferred to CIFA, Bhubaneswar on 30.6.2006)
Shri K.Nityanandam
Shri V.M.Dhanapal
Shri B.C.Paik
Mrs Lashmi Rani Bhuiya
Shri M.Dhandapani (joined on 17.7.2006 from SBI, Coimbatore and relieved from CIBA on VRS on 8.2.2007)

S.S.G.r.I

Shri M.Subramani
Shri V.Kumar
Shri E.Manoharan
Shri K.V.Delli Rao
Shri C.Saravanan
Shri S.Kuppan
Shri Uttam Kumar Santra
Shri M.Pichandi
Shri R.Kumaresan
Shri S.Selvababu
Shri D.Senthilkumaran
Shri C.Raghu
Shri P.G.Samuvel
Shri M.Sakthivel
Shri R.Mathivanan
Shri A.Paul Peter
Shri R.Indrakumar
Shri G.Dayalan
Shri Kanaka Prasad
Ms.M.Annamary (resigned on 19.3.2007)
Mrs.S.Premavathy
Shri Bholalal Dhanuk
Shri Purna Chandra Das
Shri J.Devaraj (transferred to SBI, Coimbatore on 19.7.2006)
Shri M.Sampath Kumar

16. INFRASTRUCTURE DEVELOPMENT

The following major works were carried out during the year.

HEAD QUARTERS OF CIBA

Construction of additional two floors for the use of 3rd floor for CIBA and 4th floor for CMFRI. Providing internal aluminium partition for IIIrd floor at CIBA Hqrs, R.A.Puram, Chennai.

Muttukadu Experimental Station of CIBA, Muttukadu

- Construction of Compound wall around the hatchery complex
- Concrete platform for outdoor culture of live feed organisms
- Renovation of A series ponds with PVC coated chain link fencing
- Renovation of pond A 2-3 (Damages due to Tsunami on 26.12.2004) at MES of CIBA, Muttukadu
- Renovation of nursery ponds (6 nos.)
- Construction of 1-80 m dia open fresh water wells (3 nos.)
- Translucent sheet roofed shed for shrimp live feed culture
- Construction of under ground sump for fresh water storage for shrimp hatchery

Under National Seed Project

- Seawater storage and treatment tanks for shrimp seed production
- RCC fish spawning tanks with enclosures for seabass fish seed production
- Semi permanent shed for shrimp seed production
- RCC tanks for Artemia/Rotifier culture
- RCC tanks for fish seed production
- Semi permanent shed for fish seed production

Kakdwip Research Centre of CIBA, Kakdwip

- Construction of brick pitched road
- Farm / street lighting

17. LIBRARY, INFORMATION AND DOCUMENTATION

LIBRARY HOLDINGS

Subscriptions were made to 22 foreign and 30 Indian journals and also for the library at Kakdwip Research Centre. The library acquired 50 books. The library had a total holding of 1950 books, 1515 nos. of journal back volumes, 660 reprints and photocopies, 1,720 reports / bulletins and 3,825 miscellaneous publications.

ON-LINE ACCESS TO JOURNALS

LAN connectivity with internet facility is created in the library. The on-line connectivity for the following journals subscribed by the Institute is established.

- Aquacultural Engineering
- Aquaculture
- Aquaculture International
- Aquaculture Nutrition
- ASFA Online Search
- Asian Fisheries Science
- Diseases of Aquatic Organisms
- Fish and Fisheries
- Fish Physiology and Biochemistry
- Fisheries Science
- Journal of Experimental Biology and Ecology
- Journal of Fish Diseases
- Journal of Marine Science and Technology
- The Biological Bulletin

In addition, 47 free on-line journals available in the internet sites were also established.

CD-ROM Databases

The CD-ROM databases are installed and can be accessed for reference.

- Aquatic Sciences and Fisheries Abstracts (AFA-I) 1978-2004
- Fish and Fisheries World Wide

- Water Resources Abstracts
- Marine Oceanographic and Freshwater Resources
- Code of conduct for Responsible Fisheries
- World Fisheries & Aquaculture Atlas
- Simple Methods for Aquaculture, Manuals from the FAO Training series
- Participatory environment education and training for sustainable agriculture
- Multilateral trade negotiations on agriculture – A resource manual
- AGRIS – Database CD-ROM
- BOBP – CD-ROM (1979-2000)
- ICAR-RPF CD-ROM
- CD-ROMs – 2 Nos. of digitized version of CIBA's Publications (1986-2004)
- FAO Selected Technical Paper
- FAO Project Reports (1966-1995)
- Better-practice approaches for culture-based fisheries development in Asia
- Asian Fisheries Science issues
- Cambridge Scientific Abstracts 2005 (contents of 5 CDs)
- FAO Publications and Reports on Inland fisheries and Aquaculture

Exchange services

The library maintained exchange relationship with national and international organization of mutual interest. The library maintained free mailing of Institute's Annual Report and other publications to various research organizations, Universities and other agencies.

CIBA-Institutional Membership in other Libraries

During 2006-07, CIBA has enrolled as an institutional member to get access to the literature and other resources of libraries of Indian Institute of Technology, Anna University, Madras University and Central Leather Research Institute, Chennai.

E-Journal Consortium under NAIP

Under NAIP's e-journal consortium scheme, online access to the following journals were established by NAIP as a trial basis and the scientists of the Institute were informed from time to time about this facility.

i) Nature

ii) Science Direct (Only journals of Agricultural and Biological Sciences, Biochemistry, Genetics and Molecular Biology)

iii) Scopus (collection of abstract database)

CIBA-Current contents

The contents of foreign journals subscribed by CIBA is compiled twice in a year and brought out as "CIBA CURRENT CONTENTS". These are sent to all the scientists of Kakdwip Research Centre for dissemination of scientific information.

Other services

The library also provides reprographic service. In addition, research scholars and students from several Universities / Colleges and Research Institutes, farmers and members from NGOs are regularly visiting our library for reference work on brackishwater aquaculture.

18. कार्यकारी सारांश

केन्द्रीय खारा जलजीव पालन अनुसंधान सं:थान (सिबा) की यह ज़िम्मेदारी बनती है कि वह खारा पानी में रहनेवाली पर युक्त मछली और घोंघा के लिए आर्थिक रूप से व्यावहारिक प्रौद्योगिकी एवं दीर्धकालिक पालन व्यवस्था का विकास करे और विभिन्न पणधारियों के लाभ हेतु प्रौद्योगिकी को ह:तां तरित करे। वर्तमान में सं:थान ने "समुी बैस पायलट इकाई :फु टनशाला एवं पालन" की भारतीय-ृा सिसी सहयोगी परियोजना के अंतर्गत अद्यतन समुी बैस :फु टनशाला की :थापना की है, जिसे एक महत्त्वपूर्ण उपलब्धि मानी गई है। भारतीय कृषि अनुसंधान परिषद्, नई दिल्ली के महाउपनिदेशक (मत्स्यकी), डॉ एस अय्यप्पन की उपि:थिति में दिनांक 26 अग:त 2006 को डॉ मंगला राय, सचिव, डीएआरई ने उक्त व्यव्स्था का उदघाटन किया। केन्द्रीय खारा जलजीव पालन अनुसंधान सं:थान (सिबा) ने वर्ष 2006-07 के दौरान 12 आंतरिक अनुसंधान परिषद् एवं 17 बाह्य निधि प्राप्त परियोजनाओं के माध्यम से निम्नलिखित सूची के अनुसार खारा जलजीव पालन से संबंधित मूलभूत एवं अनु्य ुक्त अनुसंधान कार्यक्रमों द्वारा महत्त उपलब्धियां हासिल की हैं।

- कार्बनिक खाद का ूयोग करते हुए ***Penaeus monodon*** (पेनियस मॉनोडॉन)@ 6.5 संख्या./मीटर^2 के कार्बनिक खेती हेतु प्रौद्योगिकी पैकेज के विकास के अंतर्गत 70% जीवित शेष के साथ 110 दिनों की अवधि में 1360 किलो/हेक्टेयर का उत्पादन लआय प्राप्त किया गया। झींगे में 30 माम का औसत आकार पाया गया तथा 0.95 एफसीआर उपलब्ध हुई।
- *P. monodon* (पी मोनोडॉन) के आनुवंशिक चयन कार्यबम के अंतर्गत, 37 परिवारों को 2 माम आकार तक पाला गया और उन्हें आनुवंशिक चयन अध्ययनों के लिए चिन्हित किया गया।
- मत्स्य खाद्य पदार्थ के :थान पर विभिन्न ूकार के तेल खली को पौष्टिक आहार के रूप में ूति:थापित किए जाने पर यह पाया गया कि जीवित शेष, वृद्धि एवं एफसीआर के सन्दर्भ में 20% सोयबीन खली, 5% का तिल एवं नारियल खली, 2.5%

सरसों, रेप सीड एवं रेशम रुई खली तथा 2% ताड़ गूदा का ूयोग किया जा सकता है।

- *Marsupenaeus japonicus* (मा:र्युपेनेयस यापोनिकस) के एफ6 वंश, :फु टनशाला में बन्दी ि थिति में एफ5 वंश झींगे तैयार करके अंडजनन के उत्पादन उत्पादन द्वारा विविधीकरण के लिए एक संभाव्य जाति है।
- पश्चिमी बंगाल एवं गुजरात में ***Fenneropenaeus merguiensis*** (फेन्नेरोपेनियस मेर्गुइंसिस) के तालाब पालन शायल के माध्यम से यह :थापित किया गया कि 120 दिनों के पालन में इस संभाव्य जाति को 22 माम के आकार तक लाया गया।
- अन्दर के टंकियों में पेल्लेट खाद्य पदार्थ एवं तरी मांस का ूयोग करते हुए *Scylla tranquebarica* (:कै ल्ला शांक्वेबेरिका) के साथ पालनघर में पालन शायल में 40% से अधिक जीवित शेष उपलब्ध किया गया।
- स्त्री :वयं सेवक दलों को शामिल करते हुए मिट्टी केंकड़े को मोटे करने के शायल में केन्द्रीय खारा जलजीव पालन अनुसंधान सं:थान (सिबा) के खाद्य पदार्थ के पायलट परीक्षण से यह निरूपित किया गया कि शैश मत्स्य की तरह ही सिबा खाद्य पदार्थ ने काफी अच्छा कार्य किया है तथा रु.8 ूति किलो की लागत पर बिकनेवाली शैश मत्स्य की तुलना में सिबा खाद्य पदार्थ के ूयोग करना आर्थिक रूप से भी लाभदायक होगा।
- आन्ध्र ूद ेश एवं तमिलनाडु के राज्यों में चार किसान खेतों के तालाबों में हपस में खेतों में पालनघर में 500 संख्या./मीटर^2 के दर पर समुि बैस ै या बैस के छोटे बच्चों का पालन किया गया। उक्त ै को सिबा खाद्य पदार्थ/ मत्स्य के मांस और मैसिड खिलाया गया। इससे 50% से अधिक जीवित शेष के साथ अच्छी माऽा में समुि बैस प्राप्त किया गया।

- भारतीय कृषि अनुसंधान परिषद के अंतर्गत संस्थापित निरंतर पुनरुपयोग व्यवस्था में मत्स्यों को झुंड में बनाए रखने पर आठ घटनाओं में समुद्री बैस ***L. calcarifer*** (एल कैलकेरीफेर) का स्वाभाविक अंडजनन पाया गया। इसमें 40-95% का स्फुटन दर पाया गया और 25 दिन पुरानी पौध के औसत जीवित शेष 22% पाया गया।

- 9 से 25 दिन स्फुटन के पश्चात, जीवित शेष संख्या के सन्दर्भ में, माइक्रो-खाद्य पदार्थ एवं *Artemia* (आर्टेमिया) तथा रॉटिफर खिलाए गए झुण्डों की तुलना में रॉटिफर के साथ में माइक्रो-खाद्य पदार्थ खिलाए गए समुद्री बैस इल्लियों की जीवित शेष संख्या काफी बेहतरीन पाई गई। उक्त डायट मिश्रण ने 25 से 40 दिन की अवधि में काफी अच्छा पाया गया तथा छुड़वाने के लिए प्रयुक्त विशिष्ट माइक्रो डायट के लिए भी यह काफी उपयुक्त पाया गया।

- आन्ध्र प्रदेश में एक किसान के खेत में तिलापिया चारा के खाद्य पदार्थ खिलाने के साथ निर्धारित पालन व्यवस्था से दूर करने के लिए समुद्री बैस पाला गया। मत्स्यों ने 145 दिनों के अन्दर ही 28% जीवित शेष संख्या के साथ 850 ग्राम का औसत वज़न प्राप्त कर लिया था और इससे 1.19 टन/ हेक्टेयर का उत्पादन प्राप्त हुआ।

- संस्थान में विकसित *Lates calcarifer* (लेटस कैलकैरीफेर) हेतु प्रजनन एवं इल्लियों के पालन व्यवस्था से प्राप्त कुल 2.11 लाख बीज के उत्पादन किसानों को दिया गया।

- जैव आमापन अनुप्रयोग एवं ऊतक विकृति अध्ययन के अन्वेषणों के आधार पर डीले शैल युक्त झींगों में वायरस जैसे ऐजेंट की पहचान की गई।

- *P. monodon* (पी मोनोडॉन) एवं *Fenneropenaeus indicus* (फेन्नेरोपेनियस मेर्गुइंसिस) के वायरल ूतिरोधी जीन का वि:तार करने के साथ उनके लक्षणों की पहचान की गई।
- झींगे :फु टनशाला से 97 ूकाश पैदा करनेवाले जीवाणुओं की पहचान की गई और उनके अभिलक्षणों का भी पता लगाया गया। *Vibrio harveyi* (विृयो हार्वेयी) के 86 पृथकों के विषैले तत्त्व के अभिलक्षणों की पहचान की गई।
- झींगे के खेतों से 23 अमोनिया ऑक्सीकरण करनेवाले :वपोषण जीवाणु तथा 63 सल्फाइड ऑक्सीकरण करनेवाले :वपोषण जीवाणुओं को पृथक किया गया और उनके अभिलक्षणों की पहचान की जा रही है।
- जीवाणु जैवसमूह के निश्चलीकरण हेतु बैगासे से एक मैट्रिक्स का विकास किया गया और इसका अनुयोग , जैवउत्तेजन एवं जैवसंवृद्धि उत्पाद के विकास में अत्यंत महत्त्वपूर्ण माना जाता है। "जीवाणु जैवसमूह एवं उसकी तैयारी की ूबिया के लिए बैगासे से मैट्रिक्स के निश्चलीकरण" पर एक पेटेंट दर्ज़ किया गया है (एप्लीकेशन संख्या 633/सीएचई/2006) ।
- झींगे के तालाब से एक नाइशाइट जैव-रूपांतरण जीवाणु पृथक किया गया और बैगासे मैट्रिक्स में जीवाणु निँकलीकरण के साथ तालाब के नि:सारण पानी के जैवप्रत्युपाय में उसकी क्षमता की पहचान की गई।
- समुी बैस इल्लियों को छुड़वाने की ूबिया के लिए 50.54% ोटीन युक्त 150 से लेकर 400 माइबॉन कण के आकार का माइबो डायट तैयार किया गया। 26वें दिन के शायल के अंत में, इल्लियों को अर्टेमिया से पूरी तरह छुड़वाया गया और 86% जीवित शेष संख्या के साथ उन्हें माइबो डायट के साथ जोड़ा गया।

- वर्ष 1988 एवं 2005 के दौरान उपग्रह से प्राप्त आइआरएस 1सी एलआइएसएस **III** डेटा से तैयार किए गए मुत्तुपेट वायुशिफ क्षेत्र एवं उसके चारों ओर की जगहों में भूमि प्रयोग मानचित्र के विश्लेषण से यह पता चलता है कि 75,215 हेक्टेयर के अध्ययन क्षेत्र में जलजीव पालन का विकास, वायुशिफ क्षेत्र के परिवर्तन से नहीं हुआ है। इस अध्ययन के निष्कर्ष से यह साबित होता है कि जलजीव पालन के विकास से मुत्तुपेट वायुशिफ क्षेत्रों पर प्रतिकूल प्रभाव नहीं पड़ा है।
- आइटीसी के इ-चौपाल प्रतिरूप के अंतर्गत प्रचालित वर्तमान वेब कियोस्क के मूल्यांकन से यह संकेत मिलता है कि यदि छोटे किसान इनका उपयोग करते हैं, तो वर्तमान प्रतिरूपों में परिवर्तन करने की आवश्यकता है।
- तमिलनाडु एवं आन्ध्र प्रदेश में खारापानी खेती के व्यवसाय में कार्यरत विभिन्न पणधारियों के एक विस्तृत सर्वेक्षण से यह पता चलता है कि 90% किसानों को तकनीकी सूचना के लिए व्यवसाय सूचना प्रतिनिधियों पर निर्भर रहना पड़ा। वर्तमान सार्वजनिक क्षेत्र के विस्तार व्यवस्थाओं में निहित कमियों को दूर करने के लिए प्रौद्योगिकी हस्तांतरण की एक आदान-प्रदान प्रचालित प्रारूप व्यवस्था का विकास किया गया है।