ICAR-CIFA ANNUAL REPORT 2015-16

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ICAR

ICAR - CENTRAL INSTITUTE OF FRESHWATER AQUACULTURE

CIFA

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ICAR-Central Institute of Freshwater Aquaculture

(Indian Council of Agricultural Research)

(An ISO 9001:2008 Certified Institute)

Kausalyaganga, Bhubaneswar 751 002, Odisha

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PREFACE

During 2015-16 ICAR-CIFA has made genuine efforts in its mandatory roles including research, training and capacity building, HRD, extension, fostering partnership and linkages, e-governance, technology commercialization and hand-holding, international collaborations and scientist-farmer contact programmes.We have revisited the thematic areas in which research is being conducted: (a) Productivity management, under which improved seed, feed and feed management, pond environment management and health management are the components, (b) Diversification of species and systems, with focus on increased fish production and farm income, widening of consumers' choice of varied fish protein, utilization of diverse water bodies and farming conditions, efficient input use, conservation of indigenous species, and livelihood and food security, (c) Cutting edge technology, such as new approaches in fish reproduction, fish health management, marker assisted selection, cryobiology, etc., (d) Aqua-business incubation and livelihood, under which equal weightage would be given to entrepreneurship development in aquaculture and skill development for livelihood improvement, and (e) Farmer FIRST initiative consisting of central schemes, demonstration and training, incubation and technical services and linkages and collaboration.

It is well accepted that species diversification is one of the important vertical expansion strategies for enhancing fish production through aquaculture. ICAR-Central Institute of Freshwater Aquaculture has always been in the sustained pursuit to add more species to its kitty by developing and standardizing their breeding and culture techniques. Successful captive breeding of several species was achieved during the reporting year, including Mahanadi rita (*Rita chrysea*), hilsa (*Tenualosa ilisha*), giant snakehead (*Channa marulius*), long whiskers catfish (*Mystus gulio*) andIndian medium carp (*Puntius pulchellus*).

For the first time the baby hilsa was tuned to accept artificial diet. Ground is set for initiating selective breeding programme for Nile tilapia. Study on water use for production of every 1000 rohu fry revealed significant reduction in gross water requirement with decreased water depth ($P<0.05$). Recombinant Apolipoprotein A-I (ApoA-I) could be used as a potential immunostimulant against *A. hydrophila* infection in

rohu. Our study documented and recorded the diseases viz., argulosis, other parasitic infestations like *Trichodina* sp., *Dactylogyrus* sp., *Myxobolus* sp., *Lernaea* sp., and bacterial disease due to *Plesiomonas shigelloides* in Odisha and Andhra Pradesh. Hypoxia tolerant transcripts of *Channa striatus* were identified and characterized. Whole genome data has been assembled using CLC bio as well as Abyss software resulting in 56.4% and 76% genome coverage in rohu, and 80% and 87% in magur, respectively. Screening of inhibitory compounds from bacterium have clearly demonstrated that whole and intracellular protein of *Clostridium bifermentans* CPSS2 could be one of the promising bio-control agent against common fish pathogen in freshwater aquaculture sector. A prototype fish vending carriage has been developed to sell around 100 kg of fish in the market in a single day and that too in a hygienic way.SC/ST communities in Khordha District of Odisha were facilitated to produce 25 lakhs fry of IMC and 1.5 lakh fry of common carp in FRP hatchery.

The institute could instill confidence through skill development in a Mechanical Engineering diploma holder, Shri Kiran Kumar to successfully take up breeding of *Channa striatus*; he is fully geared up to supply 5 lakh seeds to farmers from Odisha, and also has plans to culture the species in about 4 acres of water area.One progressive farmer, Shri Md. Amir Ali owner of Raja Hatchery, Murshidabad District, West Bengal is a happy man – he fed catla, rohu and mrigal broodstock with CIFABROOD™ in the last week of January, and achieved early maturation and breeding in March, which means he can have the fingerlings by June. An interesting observation on application of our product Biofert in horticulture fields is that its post-application monkey menace has been drastically reduced.

A long felt need to have a state level interaction of all those matters in aquaculture research and development was materialized when the Institute organized Odisha state level collaborative Research-Industry-Farmer-Extension interaction workshop, which was attended by over 180 delegates including Minister for Agriculture and ARD, Secretary-cum-Commissioner, Director of Fisheries, in addition to Deputy Directors of different Zones, District Fishery Officers, representatives from farmers, bank, feed industry, state fishery departments from Jharkhand, Assam, West Bengal and Andhra Pradesh. We are looking forward to assess and document the research and development need of 10 agro-climatic zones of Odisha and in order to develop a strategy for strengthening Research-Industry-Farmer-Extension linkage for aquaculture development.A workshop on “Improving technical support, extension and demonstration services to the farmers for Eastern Plateau and Hill Agro-climatic Region” addressed developmental issues related to fisheries, livestock, agriculture, horticulture, natural resource management, farm mechanization and forestry in Odisha, Chhattisgarh and Jharkhand. 2nd International Symposium on Genomics in Aquaculture (ISGA-II) and one training programme on Brood stock management and milt cryobanking of carps for 10 participants from Nepal during 15-25 February, 2016 were among the chief international linkage programmes organized by us during 2015-16.

Agri Business Incubation (ABI) unit which has started functioning actively in this institute has the onerous duty to see that many of our products which are yet to reach the industry and farmer should see light of the day. Hand holding of incubatees and commercialization of technologies have been attempted with renewed vigor. Farmers of Nalbari, Assam where ICAR-CIFA has provided technological inputs for magur breeding and farming have enthusiastically responded and good production of magur seeds has been witnessed; this district could develop as magur seed hub in the north east region.In a first major attempt by the Institute in Tamil Nadu, ICAR-CIFA has penned MoU with Tamil Nadu Fisheries University for technology dissemination and future collaboration. R. Ravichandran and Shri S.Pugalandhi, progressive farmers from the state are the beneficiaries of our improved rohu and CIFABROOD™. As part of extending our helping hand to less privileged sects of the society, the Institute has signed a MoU for providing financial help to develop freshwater aquaculture in Bodo Territorial Council (BTC). The Institute has signed MoU on 3 February 2016 with Sri Venkateswara Veterinary University (SVVU), Tirupati, Andhra Pradesh for continuation of the scampi brood bank and dissemination of improved giant freshwater prawn, *Macrobrachium rosenbergii* for development of brood stock for production of good quality seed.

ICAR-CIFA has shifted the gear to overdrive with reference to dissemination of improved variety of fish seeds and creation of awareness on BMPs in hatcheries. Several farmer-scientist interactions were held in West Bengal, Odisha, Arunachal Pradesh and Meghalaya to send across the message of quality seed production for profitable aquaculture venture.CIFA has supplied 1.8 million spawn of “Jayanti rohu” and 0.4 million spawn of catla (generation-1) to National Freshwater Fish Brood Bank (NFFBB), Kausalyaganga for further rearing and dissemination. Screening using rohu-catla hybrid identification kit developed by CIFA and seeds produced in hatcheries of four states showed high level of hybridization in West Bengal (68.5%), Gujarat (51%) and Bihar (11%), which needs urgent attention in the context of hatchery accreditation and seed certification in carp production.

Our KVK has distributed over 1000 soil health cards to farmers of Khordha district.A total 27 training programmes were conducted for stakeholders and entrepreneurs in different aspects of fish breeding, aquaculture, genetics and molecular biology where 425 stakeholders were benefitted. To recognize the contribution of the first fish breeder in India, CIFA took initiative to declare the Angul Fish farm as National Heritage site by District administration of Angul.

We continue to lament about technology not reaching the farmers, and extension remains as the weakest link in fisheries and aquaculture. The scenario has hardly changed from the early times when fisheries have emerged as an income generating venture. To compound the woes, the reluctance on part of at least a section of scientists to remain computer-bound and lab-bound, with hardly any inkling to go to the field has not served the cause better. Against this backdrop, Mera Gaon Mera Gaurav program is a genuine attempt to ensure flow of technology and advisories to the farmers’ field, and

more importantly the creator of the technology will be there with the end user more constantly than ever before. Nineteen groups of our scientists from the head quarter and centres have started moving to 90 villages, suggesting suitable remedial measures to encounter problems in farming and creating awareness on technology for maximizing farm productivity and profitability.

The first meeting of the reconstituted Research Advisory Committee (RAC) meeting held during 18-19 March 2016 recommended inter-divisional approach to tackle various issues, technology development and adoption to consider regional preferences and socio-economic levels, proper packaging of technology, diversification of species only based on completion of domestication and packaging of technology of each species before bringing more and more into the kitty, risk analysis of exotic species and recommendation for Ministry approval, upscaling murrel, magur and pabda adoption in NER, popularization of rohu-catla hybrid identification kit especially among regulatory authorities, metagenomics and microbiome approaches to study pond nutrient and biological interaction, alternate control measures for argulosis, risk assessment and efficacy of Biofert and Planktofert under field conditions to be conducted, Jayanti dissemination involving more structured comparisons with unselected rohu, multiplier units, Broodbank and E-publications.

I am gratified to mention that the fifth Regional Research Centre of this institute has become a reality; we have received land and a provisional office facility in Bathinda, Punjab for functioning of the centre.

The editorial committee comprising of Dr. J.K. Sundaray, Dr. P. K. Sahoo, Dr. J. Mohanty, Dr. S. Adhikari, Dr S.C. Rath, Dr. Shailesh Saurabh, Mr S. Ferosekhan , Mr Rakesh Das, Mr. Sivaraman and Dr. D.K. Verma have done commendable job to bring out the Annual Report on time. Mrs. B. Dhir and Shri S. Mahali have also supported well. We are grateful to Dr. S. Ayyappan, Secretary, DARE and DG, ICAR, Dr. B. Meenakumari, DDG (Fishery Science), Dr. S.D. Singh, ADG (Inland Fishery) and Dr Madan Mohan, ADG (Marine Fishery) and Dr Trilochan Mohapatra, Secretary, DARE and DG, ICAR and Dr J K Jena, DDG (Fishery Science), Dr Sudhir Raizada, ADG (Inland Fishery) and Dr Praveen Puthra, ADG (Marine Fishery) present office bearer for their continuous encouragement and support to continue our farmer-focused research, extension, training and consultancy programmes for the sustainable development of freshwater aquaculture in the country.

Dr P. Jayasankar
Director

CONTENTS

EXECUTIVE SUMMARY

1.	**Name & address of the Institute**	**ICAR-Central Institute of Freshwater Aquaculture** Kausalyaganga, Bhubaneswar 751 002 Odisha, India
	a) Headquarters	Kausalyaganga, Bhubaneswar 751 002 Odisha
	b) Regional Centres	i) **Regional Research Centre** Rahara Fish Farm, Rahara 743 186, West Bengal (Field Station of RRC, Rahara: A/5, Phase-III Santhalpara, Nadia, Kalyani 741 235, West Bengal)
		ii) **Regional Research Centre** Hessarghatta Lake, Bengaluru 560 089,Karnataka
		iii) **Regional Research Centre** Penamaluru Fish Seed Farm, Penamaluru, Vijayawada 521 139, Andhra Pradesh
		iv) **Regional Research Centre** ATIC, Anand Agricultural University, Borsad Chowkadi, Anand 388001, Gujarat
	c) KVK	**Krishi Vigyan Kendra** (Khordha) Kausalyaganga, Bhubaneswar 751 002 Odisha

2. Budget (2015-16)

a) Institute (Rs. in lakhs)

Plan		Non-Plan					
Provision	Expenditure	Govt. grant	Allocation internal + additional amount provided by Hqrs out of council's share	Total allocation (col 3+4)	Exp. out of Govt. grant	Exp. out of revenue generation	Total Exp. (col 6+7)
1	2	3	4	5	6	7	8
590.00	586.44	2091.10	261.72	2352.82	2067.21	244.25	2311.46

b) External sources (Rs. in lakhs)

Source	Amount
BTIS	Nil
Pension &other retirement benefits	88.92
ICAR/APA/IPR/NFBSFARA/KVK/NAIP (Plan Scheme)	204.79
Non-plan Scheme	-
P Loans & Advances	12.00
Externally funded projects	323.57
Total	**629.28**

c) Revenue generated (Rs. in lakhs)

Source	Amount
Farm produce	4.63763
Sale of fish and poultry	13.01276
Sale of vehicle/other machine tools	-
Sale of publications	0.35270
Licence fee/water charges	8.16545
Analytical testing fee	0.61314
Cost of tender forms	2.35490
Services render	-
Training	12.46925
Miscellaneous	7.99363
Interest on loans and advances	9.31769
Interest on TDR	22.77196
Others (Royalty, & Instt. Charges)	5.65638
Total:	**87.34549**

3. Staff position (as on 31.3.2016)

Category	Sanction	Position	Vacant
Scientific			
Director	1	1	0
HoD	4	4	0
Principal Scientist	1	0	1
Senior Scientist	12	10	2
Scientist	60	58	2
Total:	**78**	**73**	**05**
Category (Technical)			
T-6	4	0	4
T-3	23	13	10
T-2	3	3	0
T-1 (Including Driver)	21	14	7
Total:	**51**	**30**	**21**

Category (Administrative)			
Sr. Administative Officer	1	1	0
A.O.	1	0	1
F&A.O.	1	1	0
A.A.O.	5	2	3
AF&A.O.	1	1	0
Security Officer	1	1	0
P.S.	1	1	0
P.A.	3	3	0
Assistant	10	7	3
U.D.C.	6	6	0
Junior Steno	1	0	1
L.D.C.	6	3	3
Total:	**37**	**26**	**11**
Supporting			
Skilled Support Staff	120	71	49
G.Total:	**286**	**200**	**86**

Staff position of KVK (As on 31.3.2016)

Category	Sanction	Position	Vacant
Scientific			
Programme Coordinator	**1**	**1**	**0**
Technical			
Subject Matter Specialist	**6**	**3**	**3**
Programme Assistant	**3**	**2**	**1**
T-1 (Driver)	**2**	**2**	**0**
Administrative			
Assistant	**1**	**1**	**0**
Junior steno	**1**	**0**	**1**
Supporting			
Skilled support staff	**2**	**2**	**0**
Total:	**16**	**11**	**5**

4. Research Projects

a) Institute-based : 14

b) Externally-funded : 24

5. Training programmes conducted

Level	No. of programmes	No. of participants
National	27	573
International	02	12

6. Manpower development

a) No. of persons trained at national level : 79

b) No. of persons trained at international level : 05

7. Workshops organized

National : 06

International : 01

8. Participation in symposia/seminars/workshops, etc.

Level	No. of participants
National	58
International	02

9. Infrastructure development

- Renovation of room for conducting training programmes
- Renovtion and mordernization of laboratories
- Maintenance including painting of Anabas and murrel hatchery complex
- Maintenance of Kalinga Trainees Hostel
- Repair and maintenance of roads inside the campus
- Repair and maintenance of CIFA Residential Colony
- Renovation/repair of 6 nos cemented cisterns
- Repair/sanitary installation of technology park

10. Salient achievement during 2015-16

The year 2015-16 has been a challenging year for the fisheries sector and CIFA has been able to cope up with the demand of all stake holders. The institute has worked in several in-house and externally funded projects and the salient achievements are given hereunder.

- The captive breeding and seed production of Mahanadi rita, *Rita chrysea* was standardized. The fecundity was about 9,000-12,000 eggs per 100 g body weight.
- Hilsa (*Tenualosa ilisha*) has been successfully bred in three breeding trials in the river Hooghly at Godakhali, West Bengal using wild broods by dry stripping (DS).
- Captive stocks of *Mystus gulio* have been successfully induced bred in freshwater by injecting gonadoprim.
- Successful induced breeding of giant snakehead *Channa marulius* was achieved under captive condition with the fertilization and hatching rates ranging between 75-85% and 60-70%, respectively.
- *Puntius pulchellus*, currently classified as Critically Endangered by IUCN Redlist, was induced bred at RRC, Bengaluru.
- Fifty-eight full sib families of generation 7 (G7) of selectively bred giant freshwater prawn *Macrobrachium rosenbergii* were produced. Heritability estimate for growth trait in female was higher than that of male. However, there was also high genetic correlation between the male and female heritability.
- Sixty-one fullsib families of improved rohu (*Labeo rohita*), control group and resistant line of rohu against aeromoniasis were produced during the year. The Institute has supplied 18.0 lakhs of 'Jayanti rohu' and 4.0 lakhs of catla (*Catla catla*) (generation-1) to NFFBB, Kausalyaganga for further rearing and dissemination.
- Genetic variability found among four different stocks of tilapia, *Oreochromis niloticus* using microsatellite markers indicated possibility of developing breeding strategy to control inbreeding and undertaking a selective breeding programme of tilapia in India.
- Transplantation worthiness of cryopreserved germ cells (GCs) of rohu was tested for their viability and colonization ability in the allogenic host (*Catla catla*), and more than 70% GCs were found viable.
- Successful purification of magur spermatogonial stem cells (SSCs) by using *THY1*$^{+}$ (a phenotypic marker) antibody following MACS was carried out. The *THY1*+ sorted cells seemed to be the self-renewing population of the SSCs and it was found that only 2% were fertile in nature.
- Pacu (*Piaractus branchypomus*) could be cultured in combination with rohu at a stocking density of 7000 and 500 nos. per hectare, respectively with a projected production level of 12-15 MT/Ha.
- A 60 day feeding trial with experimental feeds containing different levels of proteins and carbohydrates (gelatinized starch) indicated significantly higher ($P<0.05$) weight gain, SGR, PER and lower ($P<0.05$) FCR in 'Jayanti rohu' fry fed 30% CP and 25.5% gelatinized starch.

- The nutrient profiling of bata, pabda, punti, channa, tangra, wallago, pangas, calbasu, reba and fimbriatus has been carried out.
- Study on water use for production of every 1000 rohu fry revealed significant reduction in gross water requirement with decreased water depth ($P<0.05$), while the consumptive water use in terms of water exchange and replenishment did not differ with regard to varied water depth.
- Nano-ZnO induced developmental toxicity and oxidative stress in fish, *L. rohita* embryo and larvae at doses 10 mg/L and 20 mg/L.
- Identification and characterization of hypoxia tolerant transcripts of *Channa striatus* was achieved.
- H (heavy) chains of rohu immunoglobulin (Ig) Z and IgD have been cloned and sequenced.
- Full-length rohu kiss1 and kiss2 cDNAs were found to encode 116 and 125 amino acids, respectively. The level of expression of both the genes in different tissues suggests the involvement of two kiss genes in the control of seasonal gonadal development in rohu.
- Transcriptomic profiling to study the gene regulatory networks (GRNs) in BPGL (brain-pituitary-gonad-liver) axis of rohu was undertaken. A total of 440665 transcripts were generated in Trinity. The minimum contig length was 201 bp and maximum of 19331 bp. In tissue specific GRNs, 21, 36, 46 and 25 hub genes were identified respectively in brain, pituitary, gonad and liver tissues.
- The whole genome data of rohu has been assembled using CLC *bio* as well as Abyss softwares resulting in 56.4% and 76% genome coverage, respectively; whereas, the respective genome coverage for magur was 80% and 87%.
- Transcriptional analysis of immune-relevant genes in mucus of *L. rohita* following *Argulus siamensis* infection provides early insights for development of control methods against the parasite by immunological interventions.
- Functional characterization apolipoprotein A-I (ApoA-I) revealed its broad spectrum antimicrobial property, and indicated significant role during ectoparasitic infection. Recombinant ApoA-I could be used as a potential immunostimulant against *Aeromonas hydrophila* infection in rohu.
- The screening of inhibitory compounds from bacterium have clearly demonstrated that whole and intracellular protein of *Clostridium bifermentans* CPSS2 could be one of the promising bio-control agent against common fish pathogen in freshwater aquaculture sector.
- Under National Surveillance Programme the major diseases *viz.*, argulosis, other parasitic infestations like *Trichodina* sp., *Dactylogyrus* sp., *Myxobolus* sp. *Lernaea* sp., and bacterial disease due to *Plesiomonas shigelloides* were recorded in Odisha and Andhra Pradesh.
- A prototype fish vending carriage has been developed to sell more amounts (100 kgs) of fish in the market in a single day in hygienic manner.
- Carp seed production in FRP hatchery and development of integrated rearing system for livelihood development of SC/ST communities in Khordha District of Odisha has been successful by producing 25 lakhs fry of IMC and 1.5 lakh fry of common carp.
- There is an increasing trend in the adoption of the technologies in the states like Odisha, Assam and Tripura for murrel and catfish.
- KVK, Khordha carried out a total 88 activities which includes OFT, FLD and training for 2047 beneficiaries in Khordha and other districts of Odisha. Also, 1000 soil cards prepared jointly by KVK and Paradeep Phosphates Ltd. were distributed to farming communities during the period.
- A total 27 training programmes were conducted in the Institute for stakeholders and entrepreneurs in different aspects of fish breeding, aquaculture, genetics and molecular biology, and 425 stakeholders were benefitted.
- To recognize the contribution of the first induced fish breeding in India, the Institute took initiative to declare the Angul Fish farm as 'National Heritage Site' by District administration of Angul, Odisha on 10 July 2015
- The Institute has implemented the 'Mera Gaon Mera Gaurav' scheme in 75 villages of two adjacent districts, Khordha and Puri.

INTRODUCTION

Mandate

With a view to give proper direction and attention to such areas of research that would enable development of freshwater resources to obtain increased yield per unit area, thereby leading to higher aquaculture production from the culturable/ reclaimable ponds and tanks in the country, the following is the revised mandates of CIFA.

- Basic and strategic research for the development of sustainable culture systems for freshwater finfish and shellfish
- Species and systems diversification in freshwater aquaculture
- Human resource development through training, education and extension

Brief History

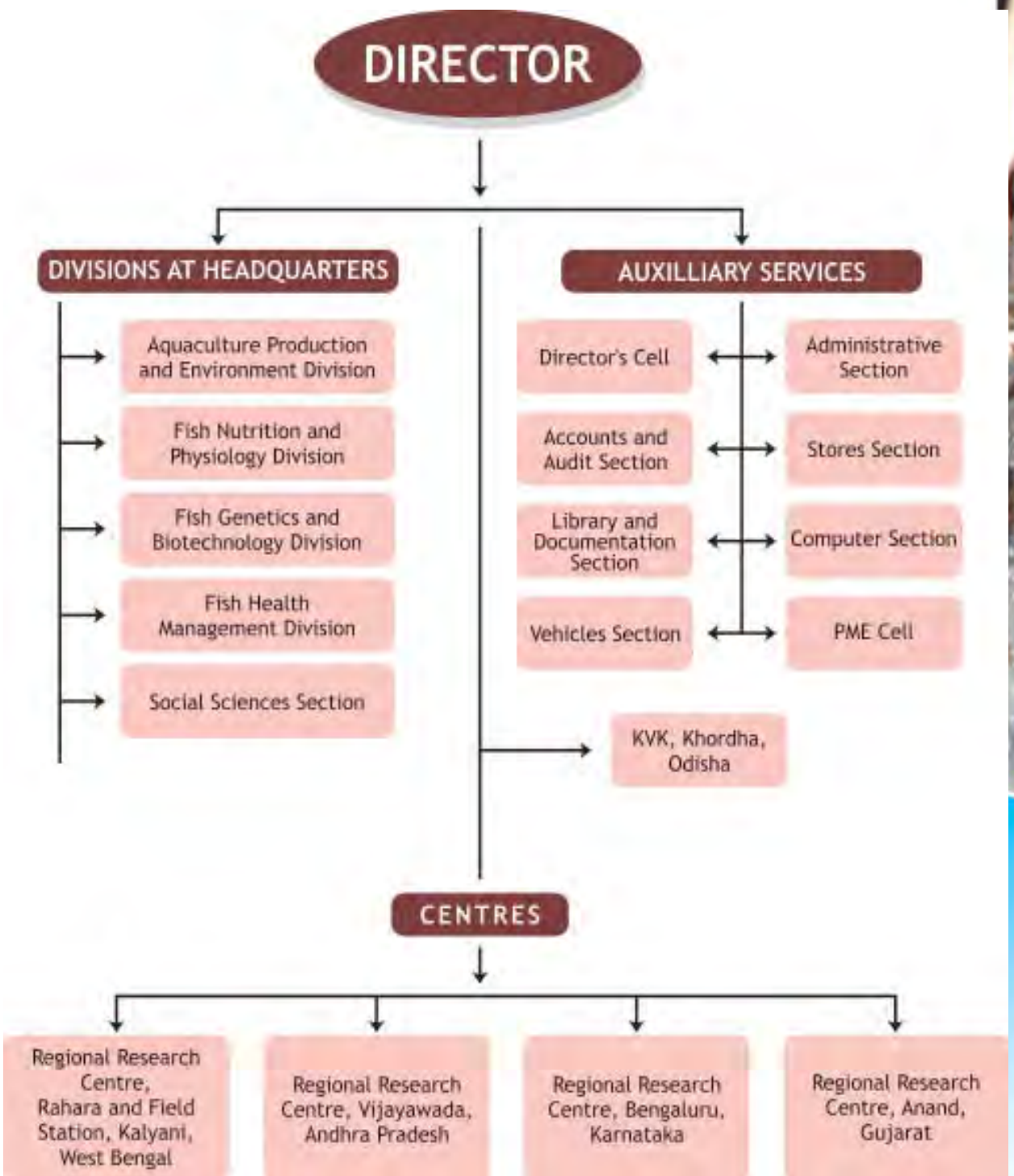
The Central Institute of Freshwater Aquaculture had its beginnings as the Pond Culture Division of the Central Inland Fisheries Research Institute, which was established at Cuttack, Odisha in 1949. The Division was later upgraded as the Freshwater Aquaculture Research and Training Centre (FARTC) established at Bhubaneswar in 1976 with UNDP/ FAO assistance. Further, the Centre attained the status of an independent Institute under the organization plan of ICAR during 1986, and the functional existence of the Institute came into effect from 1st April, 1987.

The Institute has a comprehensive mandate of research, training, education and extension in different aspects of freshwater aquaculture. With the largest freshwater farm comprising over 380 ponds of assorted sizes and yard facilities in the country at Kausalyaganga, Bhubaneswar, the Institute is undertaking researches on carps, catfishes, freshwater prawns and molluscs. The Institute possesses fully equipped laboratories in the disciplines of finfish and shellfish breeding, aquatic chemistry, microbiology, fish physiology, nutrition, genetics, biotechnology, pathology, ornamental fish breeding and culture, engineering, economics, statistics and extension.

The Institute has four Regional Research Centres operating in different parts of the country to cater to the specific needs of the regions viz. Regional Research Centre, Rahara (West Bengal); Regional Research Centre, Bengaluru (Karnataka); Regional Research Centre, Vijayawada (Andhra Pradesh) and Regional Research Centre, Anand (Gujarat).

The Institute is recognized as the Regional Lead Centre on Carp Farming under the Network of Aquaculture Centres in Asia-Pacific (NACA), which is an intergovernmental organization. A Depository Library of the Food and Agricultural Organisation (FAO) of the United Nations is also operational at the Institute. The CIFA works closely with many government organsations like Department of Animal Husbandy, Dairy and Fisheries (DAHD&F) and National Fisheries Development Board (NFDB) of Government of India.

CIFA ORGANOGRAM



RESEARCH ACCOMPLISHMENTS

A. Aquaculture Production and Environment

Project Title	:	Sustainable freshwater aquaculture
Sub-project	:	Breeding and larval rearing of *Puntius tambraparniei* Silas, 1954 an indigenous ornamental fish from the Western Ghats of India
Project code	:	I-80(a)
Funding Agency	:	Institute-based
Duration	:	April 2012 – March 2016
Project Personnel	:	Rajesh N. (PI) and S. K. Swain

Maintenance of *(Puntius tambraparniei)* at RRC Bangalore

Tambraparni barbs *(Puntius tambraparniei)* were reared at RRC of CIFA, Bangalore for captive breeding. High alkalinity and hardness of water adversely affect the growth and survival of fishes. Rain water was used to reduce the alkalinity and hardness of borewell water for brood stock maintenance. Normally, a layer of mud was applied on tank bottom to maintain the water quality parameters. Water quality parameters maintained for brood stock rearing were as follows : temperature 21°- 27°C; pH 7.5-8.5, alkalinity 120-180 ppm, hardness 104 ppm, oxygen 4 ppm and ammonia 0.01-10.1867 ppm.

Breeding in captivity

Brood stock development including conditioning of brooders was done in captivity. Spirulina enriched feeds were given during the rearing period. Breeding was conducted in breeding hapas of 1x 0.5x0.75 m^3 size. Hapa was arranged in an indoor cement or FRP tank. For attachment of eggs and easy transfer of larvae, breeding hapa was kept inside a cloth hapa made up of polyester. Continuous shower was provided on top of the hapa to simulate rainy envioronment. Five breeding trials were conducted during this period. First attempt was done in late July, using rain water in indoor tank. After hatching, heavy larval mortality was observed due to low water temperature (< 20°C). Subsequent three breeding trials were done at outdoor cement cistern to maintain required water temperature of 24-26°C. Due to high hardness and alkalinity of borewell water, the development of eggs were observed to be in arrested condition. In September, breeding attempts were again made in indoor tanks with rain water. Ovaprim (0.025-0.05 ml per fish) was used as an inducing agent in each breeding trial. Spawning was observed after a latency period of 8-10 h. Golden yellow colored eggs hatched within 24 -28 h. of incubation period. The larvae were transferred to glass aquarium tanks with aeration and heater facility for initial development.

Growth evaluation of young ones

The hatchlings were reared in glass aquaria under plankton feeding. Rain water was used in glass aquaria for larval rearing. Fishes readily accepted the powdered pellet feed after one month of rearing. To study the growth of fishes in captivity, length and weight of larvae were intened recorded at every ten days. The growth pattern of fishes for about 3 months duration is shown in graph (Fig. 1).

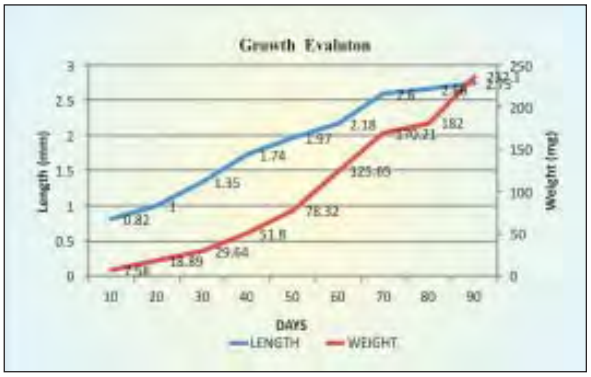


Fig. 1: Growth pattern of *P. tambraparniei* larvae in a 3 months feeding trial

Sub-project title	:	Germ cell proliferation in deficient gonads after cellular transplantation and maturation in carps
Project code	:	I-80(b)
Funding Agency	:	Institute-based
Duration	:	April 2012 - March 2016
Project Personnel	:	P. Routray (PI), S. Nandi and D. K. Verma

Transplantation worthiness of cryopreserved germ cells of Indian major carp, *Labeo rohita*

Cryopreservation is an essential tool for germplasm conservation and improvement of productivity in aquaculture. Here, transplantation worthiness of isolated cryopreserved germ cells (GCs) of Indian major carp, rohu (*Labeo rohita*) were tested by their viability and colonization ability in the allogenic host (*Catla catla*). GCs were cryopreserved using dimethyl sulfoxide (DMSO), ethylene glycol (EG) and glycerol. Rohu GCs were successfully cryopreserved with significantly higher viability using slow cooling rate of -1 °C/min and a medium containing 1.4 M DMSO as compared to EG and glycerol. It was found that more than 70% GCs were viable following this method. Transplantation experiment revealed that frozen/thawed GCs colonized and proliferated in the recipients' gonad. Hence, this technique of transplantation of GC into adult gonads paves the way for further applications in surrogate animal development. The process of cryopreserved GC transplantation in fish is depicted in Fig.2.

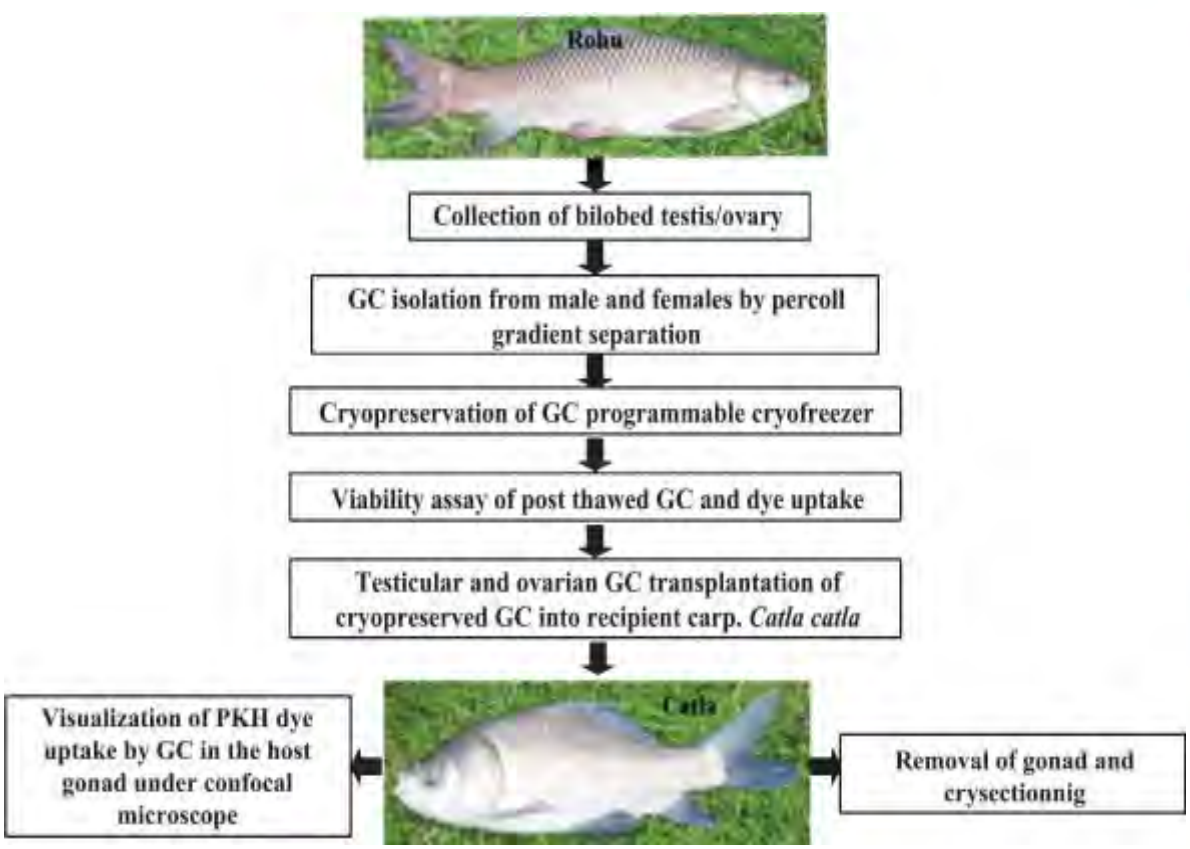


Fig. 2: Process of cryopreserved GC transplantation into host gonads and their viability study

Sub-project title	:	Refinement of freshwater pearl culture technology for sustainable production of pearls in confined conditions
Project code	:	I-80(h)
Funding Agency	:	Institute-based
Duration	:	April 2013 - March 2016
Project Personnel	:	Shailesh Saurabh (PI), Rajesh Kumar, S. Adhikari, J. Mohanty and U. L. Mohanty

Study of nacre deposition in *Lamellidens marginalis* fed blue green algae, Spirulina in confined condition

An experiment of 150 days was conducted in confined conditions to study the nacre deposition in *L. marginalis* fed blue green algae Spirulina in confined condition. A separate set of control and implanted mussel was maintained in aquaria. Remarkable nacre deposition was observed on the implanted nucleus. This type of study was conducted for the first time and this study will further generate the idea of possibility of production of freshwater pearl in a small confined space.

Fig. 3: Deposition of nacre on biocompatible nucleus

Growth and survival study of freshwater mussel fed with fish hydrolysate

Freshwater mussel, *L. marginalis* (average length 73.50±1.65mm) after acclimatization were stocked randomly in four 35 L glass aquarium tanks (10 mussel tank^{-1}) containing 30 L of aged freshwater. The experimental mussel was fed with fish hydrolysate. Prior to feeding fish hydrolysate was taken and then mixed with aquarium water with little disturbance to the live mussel. Growth parameters were measured and survival of the control and implanted mussels was recorded (Table 1).

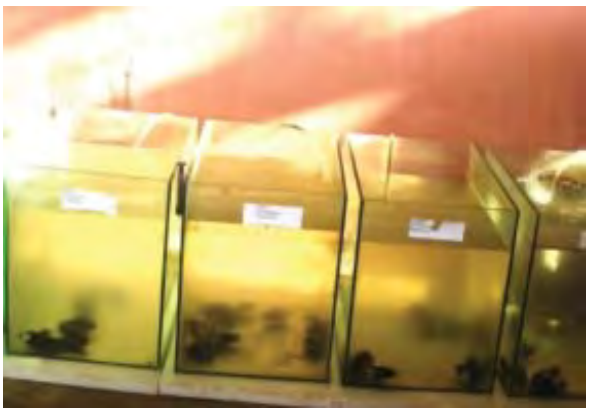


Fig. 4: Experimental Setup

Table 1: Shell length, shell width, shell height, wet weight and survival of the freshwater mussel in the experimental aquaria (120 days)

Mussel	Shell length (mm)		Shell height (mm)		Shell width (mm)		Wet weight (gm)		Survival
	Initial	Final	Initial	Final	Initial	Final	Initial	Final	
Control	73.50±1.65	78.78±0.57	37.85±0.85	39.95±1.04	24.96±0.76	25.15±0.26	31.625±0.88	33.70±1.35	50%
Implanted Mussel	73.50±1.65	76.78±0.29	37.85±0.85	40.95±0.45	24.96±0.76	25.0±0.13	31.625±0.88	32.08±2.38	60%

Sub-project title	:	Breeding and culture of tilapia for popularization and brood banking
Project code	:	I-80(I)
Funding Agency	:	Institute-based
Duration	:	April 2013 - March 2016
Project Personnel	:	P. Routray (PI), P. K. Meher, B. C. Mohapatra, N. K. Barik, C. K. Mishra, K. C. Das, G. M. Siddaiah and D. K. Verma

Genetic and phenotypic variation among four tilapia populations using microsatellite and morphological features

Phenotypic and genetic differences among the four tilapia populations collected from different locations of India viz. West Bengal population (WB), Gujarat population from Rudramata dam site of Bhuj reservoir (RM), Odisha state

population (OD) and Gujarat pond population (GP) were studied. Tilapia with a broken lateral line and the most obvious characteristics of regular dark vertical stripes throughout the depth of its dark body was taken as identifying character of *Oreochromis niloticus*. Four morphometric variables (total length, body weight, depth at first dorsal fin, head length) were measured from each animal. Blood and fin samples were collected (n = 50 per population) for genetic characterization. Mean body weights (g) of tilapia after 5 months were: 351 ± 0.51, 281 ± 0.43, 395 ± 0.63 and 255 ± 0.82 for WB, RM, OD and GP, respectively. ANOVA followed by Duncan multiple range test at 5% level of significance indicated higher body weight of WB and OD stock than RM and GP stock after five months of culture. Morphometric truss analysis showed RM and GP stock in one cluster and OD and WB in other clusters. Genetic variation using microsatellite markers indicated variation among populations. Eight heterologous primers were selected based on amplification, band quality, reproducibility and the presence of distinctive bands. Genetic variability among four different stocks of tilapia indicate that the possibility of developing a breeding strategy to control inbreeding and develop a selective breeding programme among available species of tilapia in India.

Table 2: Microsatellite wise Heterozygosity Index for six microsat loci of tilapia

Locus	Ho	H_E	*F (Fixation Index)*)	PIC
TI-10	0.570	0.868	0.310	0.847
TI-12	0.490	0.898	0.467	0.885
TI-14b	0.603	0.867	0.293	0.842
TI-21	0.573	0.845	0.322	0.856
TI-24	0.403	0.857	0.566	0.848
TI-28	0.613	0.854	0.283	0.836
Mean	0.576	0.865	0.375	0.852

Table 3: Population wise Heterozygosity Index for Three populations of tilapia

Population	Ho	HE	F (Fixation Index)
WB	0.633	0.783	0.197
GP	0.422	0.844	0.508
RM	0.487	0.790	0.472
OD	0.389	0.834	0.452
Mean	0.544	0.808	0.371

Sub-project title	:	Development of alternate gel based food as a substitute for high value live food
Project code	:	I-80(j)
Funding Agency	:	Institute-based
Duration	:	April 2013 - March 2016
Project Personnel	:	B. B. Sahoo (PI), M. R. Raghunath, B. R. Pillai, P. L. Lalrinsanga, K. C. Das, S. Ferosekhan, P. Routray, S. K. Sahoo, Rajesh Kumar and U. L. Mohanty

Fish gel has a high concentration of protein, all the essential amino acids and fatty acids. It has a softer elastic flexural characteristics of natural fish muscle i.e carps 3200-3000 Cp (Centi poise) panga's 3200 Cp and murrel 4700 Cp. Fish gel was used as a base form for making larval food. To improve the texture and handling properties, 1% gelatin or sodium alginate was tried and it further increased the viscosity by 1000 Cp in the larval food. Mineral mixture and micronutrient supplements were made to a level of 1% and the gel food made into a microbound diet. The microbound diet was dispensed for hygienic handling of larval food. Studies were conducted to evaluate incorporation of 1% of natural gum viz. guar gum, babool gum, acacia, karaya and xanthan gum into gel food. Natural gum at 1% level produced an increased gel viscosity of around 1000 Cp. The gel food was found to be optimum viscosity and suitable for reverse spherification through molecular gastronomy to produce gel beads of different sizes to be used as larval food.

Project title	:	Aquaculture development through participatory approach
Sub-project title	:	Development of ornamental fish villages, Landijhari and Sarauli in Deogarh district of Odisha
Project code	:	I-84(b)
Funding Agency	:	Institute-based
Duration	:	April 2012 - March 2016
Project Personnel	:	S. K. Swain (PI), B. K. Das, P. K. Meher and Mukesh Kumar Bairwa

Skill development programme for dissemination of technology

Beneficiary farmers of 177 nos. are involved in ornamental fish culture from 4 villages i.e. Landijhari, Saruali, Nuagaon and Daanra. Mobilization, awareness, skill building through training, exposure visits, handholding of the farmers, backyard unit establishment, guidance and technical support have been given with market linkage. Farmer's meet and demonstration programme were conducted at each village where villagers showed their interest and attended the programme for knowledge sharing in the community. Total of 2,90,100 live bearers have been produced by 177 farmers with an average income of Rs. 7000- Rs.9000/8 months with an investment of Rs. 4000- Rs. 6000/farmer. The new village "Daanra" is added in Barkote block, where 12 backyard units have been established and in 2015-16 they have produced 4100 livebearers, specially guppy, molly and platy. Linkages have been established with state administration for setting up a field laboratory and construction of new concrete tanks besides ATMA'S financial support of Rs 2000/- per farmer.

Project title	:	Demonstration and dissemination of freshwater aquaculture technologies for tribal farmers of India (TSP)
Project code	:	I-87
Funding Agency	:	Institute-based
Duration	:	April 2013 - March 2016
Project Personnel	:	B. C. Mohapatra (PI), P. P. Chakraborty, S. K. Swain, B. K. Das, N. Sridhar, M. R. Raghunath, Hemaprasant, B. Gangadhar, R.N. Mondal, K. N. Mohanta, S. K. Sahoo, B. B. Sahu, C. K. Mishra, K. Murmu,Rajesh Kumar, N. K. Barik, S. Sarkar, P. K. Meher, S. Ferosekhan, P. Jayasankar, Anantharaja K., U. L. Mohanty, N. Panda, D. P. Rath and B. D. Mishra

Portable carp hatchery used for seed production in TSP, ICAR-CIFA adopted areas of India

During monsoon period of 2015, total 120.0 lakh carp spawn was produced in FRP carp hatchery installed at Subarnapur Village, Gop Block, Puri District of Odisha; 7.0 lakh spawn at Muniguda, Rayagada District of Odisha. 18.0 lakh spawn was produced at Bali Island, Sunderban, West Bengal which is first of its kind in carp seed production in the island.

Freshwater aquaculture in Sunderban Delta, West Bengal

The successful breeding of rohu, catla and bata was carried out in the FRP carp hatchery installed at Bali Island Sunderban, West Bengal during the monsoon of 2015. Based on the request from the Forest Department of West Bengal Government, IMC fingerlings were supplied from Bali Island to Kumirmari Island for stocking in a freshwater canal of 500 m length and 15 m width.

IMC seed stocked at Niladriprasad GP, Banapur Block, Khordha District, and at Jamusahi Village, Dasapalla Block, Nayagarh District Odisha

The IMC advanced fry was stocked in 17 acre tribal ponds at Niladriprasad GP of Banapur Block, Khordha District on 12 November 2015 and at Jamusahi, Dasapalla Block, Nayagarh District on 13 November 2015.

Hatchery layout plan in different places under TSP

A team of ICAR-CIFA had visited the FRP carp hatchery installation cites of Jamusahi Village, Daspalla Block, Nayagarh District; Kardabandha Village of Muniguda and Maa Majhi gouri Samabaya Samiti, Siltiguda of Rayagada District; and Bisoi and Badasahi Blocks of Mayurbhanj District of Odisha and provided the layout plans for hatchery unit establishment. The hatchery was installed at Jamusahi village during the period under report.

Programmes conducted in South India

Regional Research Centre of ICAR-CIFA, Bangalore organized a demonstration of seed production through induced breeding technology using FRP Hatchery installed at Karapuzha, Wayanad District, Kerala for the tribal fishermen during September, 2015. Reconnaissance survey of tribal belts at Mysore and Coorg Districts was carried out for imparting knowledge on freshwater aquaculture techniques to the tribal farming community during September,2015. The tribal hamlets at Sulebhavi, Somvarpet Taluk, Jungle Haadi and Thithimathi under Virajpet Taluk under Coorg District were visited and the tribals were met. In Mysore District the tribals at Handigudda, Piriyapatna Taluk were met. An awareness programme for tribal fishermen on fish health management practices was conducted at Karapuzha reservoir, Nellarachal, Wayanad District, Kerala during December 2015. The fishermen were made aware of the primary causes of fish diseases, how to identify a sick or diseased fish, measures to be adopted to prevent occurrence of diseases and what to do if disease occurs in spite of these precautions.

Workshop-cum-training for tribals at Dahod, Gujarat

An Interactive workshop-cum-training programme on "Scientific aquaculture by tribal fish farmers of Gujarat" was organized by Anand Regional Research Centre of ICAR-CIFA at Krishi Vigyan Kendra (AAU), Muvaliya Farm, Dahod on 26 October, 2015. Dr P. Jayasankar, Director of ICAR-CIFA, Bhubaneswar while inaugurating the programme emphasized for improvement of livelihood conditions of tribal farmers through adoption of scientific aquaculture practices including good quality fish seed for stocking, providing supplementary feed to fish and adopting better management practices. Dr B.C. Mohapatra, Chairman of TSP and Principal Scientist, ICAR-CIFA, Bhubaneswar said that there is huge demand of good quality seed in India which could be met through wider adoption of FRP hatcheries and focused for dissemination of location specific aquaculture technologies in the tribal areas of Gujarat. Genetically improved seed of Rohu, Jayanti was distributed to the progressive tribal farmers of Gujarat. More than 100 participants including scientists, academicians, extension officials, development officers and progressive fish farmers attended the event.

Farmers' meet and launching of FRP Carp Hatchery at Amarpur, Potaspur, West Bengal

Regional Research Centre of ICAR-CIFA, Rahara/ Kalyani organized farmers' meet and launched portable FRP carp hatchery unit for the Kharia tribal farmers of Amarpur Village, Potaspur Block of East Midnapur District, West Bengal on 20 December 2015. Sri Jyotirmoy Kar, Hon'ble Minister of Co-operation, Govt. of West Bengal, Chief Guest of the event complimented ICAR-CIFA for adopting the tribal beneficiaries of Amarpur Village for demonstration of quality fish seed production through FRP hatchery and scientific aquaculture. Sri Sisir Adhikari, Hon'ble Member of Parliament, Contai stressed on the need of tribal community of the area and advised them to take benefit of assistance provided by the State and Central government for their economic upliftment. Dr. P. Jayasankar, Director, ICAR-CIFA emphasized that aquaculture can improve livelihood of tribal community if quality seed, feed, medicine and market are available to them. He requested the State government to initiate establishing a fish brood bank in the region for which technical guidance would be provided by CIFA.

Indian Army sponsored training programme for tribal youths at ICAR-CIFA inaugurated

A training programme on "Freshwater aquaculture as a livelihood option for tribal youths of Assam" was conducted at ICAR- CIFA, Bhubaneswar during 13-16 January, 2016. The programme was sponsored by 21 Battalion, the Mahar Regiment, Indian Army. In this programme 20 tribal youths from frontier areas were trained in new techniques of freshwater aquaculture practices.

Project title	:	Diversification towards sustainable development
Sub-project title	:	Development of protocol for seed production and grow-out culture of some important snakeheads species
Project code	:	I-91(a)
Funding Agency	:	Institute-based
Duration	:	April 2015 - March 2018
Project Personnel	:	Rajesh Kumar (PI), P. C. Das, S. Nandi, S. Ferosekhan and U. L. Mohanty

Successful induced breeding of giant snakehead *Channa marulius* under captive condition

The broodstock raised in concrete cisterns weighing about 700-950 g was selected for induced breeding. Fishes were given first injection with human chorionic gonadotropin (HCG) @ 2500 IU/kg body weight to both male and female. After 36 h interval, fishes were given second dose of HCG @ 2000 IU/kg body weight to female and 1000 IU/kg body weight to male. Fishes spawned 16-18 h after second dose of hormone administration. The fecundity was estimated to 2000-6000/ kg body wt. The eggs were floating, non-adhesive light yellow in colour and hatched out in 40-44 h at 25-27°C. The fertilization and hatching rates ranged between 75-85% and 60-70%, respectively. The hatchlings were transparent and about 3.2-4.0 mm in length and float upside down on the water surface. The successful induced breeding in hatchery condition would help in boosting the farming of this highly priced fish and also to restore its dwindling wild population.

Effect of stocking density on growth and survival of *Channa marulius* larvae

Five different stocking densities of larval i.e., 1/L (T1), 2.5/L (T2), 5/L (T3), 7.5/L (T4) and 10/L (T5) were taken. Larval were fed ad-libitum with zooplankton and fecal matter was siphoned out daily. After four weeks of rearing the highest survival (95%) was observed in T1 group.

Demonstration of striped murrel breeding and seed production technology to the farmers

Mr. Kiran Kumar from Mangalajodi, District Khordha, Odisha successfully bred the fish with the help of this institute in June 2015. Subsequently, he continued the breeding and produced more than 20,000 seed during 2015. This success has given him a major boost to his confidence to produce more and more seed in coming years.

Sub-project title	:	Standardization of grow-out production technology of Pengba, *Osteobrama belangeri*
Project code	:	I-91(b)
Funding Agency	:	Institute-based
Duration	:	April 2015 - March 2018
Project Personnel	:	P. C. Das (PI), S. P. Kamble and Khuntia Murmu

Study on compatibility of *Osteobrama belangeri* with major carps

One year grow-out study on compatibility of *Osteobrama belangeri* (pengba) with Indian major carps (catla and rohu) has been initiated during April, 2015 in nine earthen ponds of 0.08 ha in ICAR-CIFA farm. The three treatments used were T-1 (control): catla and rohu at 1:1, T-2: rohu and pengba at 1:1; and T3: catla and pengba at 1:1. Ponds were stocked at a combined density of 6500 fingerlings ha^{-1}. The average initial size of catla, rohu and pengba were 30.8, 9.4 and 12.4 g, respectively. Standard procedures of pre-stocking pond preparation including removal of predatory and weed fishes using bleaching powder (10 mg l^{-1} chlorine) and basal fertilisation [cowdung at 3 t ha^{-1} and single super phosphate (SSP) at 30 kg ha^{-1}] were carried out. Water quality parameters such as temperature, dissolved oxygen, pH, total alkalinity, hardness and inorganic nutrients (ammonia, nitrite, nitrate and phosphate) were measured in the laboratory following standard methods (Table 4). Liming and intermittent fertilisation were carried out depending on the productivity status of the ponds. Fish are being fed with a mixture of rice bran and groundnut oil cake (1:1 ratio) during the first month and commercial floating pellet subsequently (ABIS feed, 28% protein). Fish growth was being assessed through monthly sampling and the quantity of daily feed was calculated based on the average fish growth with an assumed 80% survival. The result of the study up to 10 months of culture is presented in Fig. 5 a & b.

Table 4 : Water quality during the grow-out study on compatibility of *O. belangeri* with major carps

Parameter	T-1	T-2	T-3
Temperature (°C)	27.6 -33.3 (29.36±1.44)	27.6 -33.3 (29.34±1.42)	27.6 - 32.7 (29.37±1.45)
Transparency (cm)	20.1 - 76.6 (37.80±6.97)	34.5 – 81 (52.50±11.84)	26.8 - 92.3 (58.98±15.34)
pH	7.15 - 8.60	7.13 - 8.30	7.00 - 8.43
Dissolved oxygen (mg l^{-1})	1.6 - 4.8 (3.33±0.69)	1.6 - 4.2 (2.81±0.80)	1.2 - 4.2 (2.73±0.86)
Free CO_2 (mg l^{-1})	0 - 8 (2.27±2.71)	0 - 8 (2.81±2.51)	0 – 8 (3.18±2.51)
Total alkalinity (mg as $CaCO_3$ l^{-1})	32 – 112 (65.55±20.80)	24 – 120 (60.53±23.12)	24 – 112 (56.33±20.48)
Total hardness (mg as $CaCO_3$ l^{-1})	40 – 96 (67.27±14.84)	32 – 100 (62±15.65)	32 – 96 (59.63±16.43)
Total ammonia-nitrogen (mg l^{-1})	0.016 - 0.86 (0.23±0.025)	0.028 - 0.96 (0.28±0.029)	0.013 - 0.98 (0.30±0.033)
Nitrite-nitrogen (mg l^{-1})	0.006 - 0.024 (0.009±0.005)	0.002 - 0.014 (0.0071±0.0027)	0.003 - 0.020 (0.010±0.0036)
Nitrate-nitrogen (mg l^{-1})	0.050 - 0.780 (0.29±0.23)	0.045 - 0.770 (0.28±0.23)	0.064 - 0.760 (0.290±0.240)
Phosphate (mg l^{-1})	0.040 - 0.410 (0.110±0.092)	0.032 - 0.420 (0.10±0.091)	0.025 - 0.390 (0.100±0.088)
Plankton (ml per 50 L)	0.3 - 4.5 (2.14±0.67)	0.5 - 2.3 (1.20±0.41)	0.2 - 2.8 (0.93±0.49)

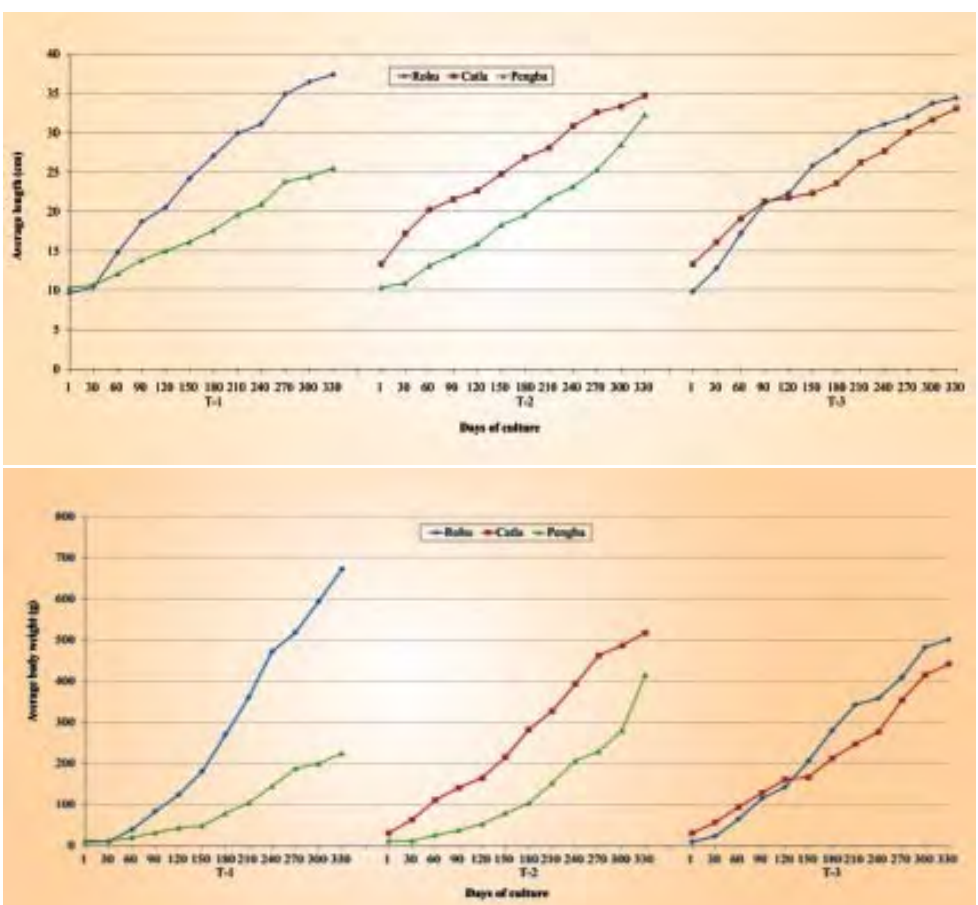


Fig. 5 (a & b): Growth curves of different species during the grow-out study on compatibility of *O. belangeri* with major carps

Sub-project title	:	Development of captive breeding and seed rearing technique of Mahanadi Rita, *Rita chrysea*
Project code	:	I-91(c)
Funding Agency	:	Institute-based
Duration	:	April 2015 - March 2018
Project Personnel	:	S. Ferosekhan (PI), S. K. Sahoo, S. S. Giri and B. K. Das

Captive breeding and seed production technique of Mahanadi Rita

The captive breeding and seed production technique of Mahanadi Rita, *Rita chrysea* was developed and standardized. The brood fish of 130-150 g were selected for induced breeding and injected with commercially available synthetic hormone, Ovatide @ 1.0 ml kg^{-1} body weight of fish. Female fish was stripped after 13-15 h of hormonal injection and male was sacrificed for the collection of testis and preparation of sperm suspension solution. The ovulated eggs were demersal, non-adhesive and transparent. The diameter and weight of ovulated eggs were 1.1 – 1.3 mm and 1.2- 1.4 mg, respectively. The fecundity was 9,000-12,000 eggs per 100 g body weight. The egg hatched out in 24- 26 h of incubation at 26-28 °C. Fertilization and hatching rates ranged between 70-80% and 60-70%, respectively. The hatchlings were about 3.5 – 4.5 mm in total length and 0.8 to 1.2 mg in wet weight. The larvae were fed with live feed.

Fig. 6: Brood fish of Mahanadi Rita

Table 5 : Breeding performance of Mahanadi Rita, *Rita chrysea*

Treatment	Body weight(g)	Latency period (h)	Total fecundity	Fertilization (%)	Hatching (%)
Rita chrysea (n=6)	116.33 ± 14.24	14.17 ± 0.75	11021.67 ± 2633.67	81.33 ± 2.8	64.83 ± 3.54

Fig. 7: Fingerlings of Mahanadi Rita (2-3 g)

Sub-project title	:	Genetic improvement of freshwater prawn *Macrobrachium rosenbergii* (de man) in India (Phase-III)
Project code	:	I-91(d)
Funding Agency	:	Institute-based
Duration	:	April 2015 - March 2018
Project Personnel	:	B. R. Pillai (PI), K. D. Mahapatra, P. L. Lalrinsanga, P. K. Jesna and B. Mishra

Production of generation seven (G7) of selectively bred freshwater prawn *Macrobrachium rosenbergii*

Mate allocation and breeding of 6th generation of selectively bred giant freshwater prawn *Macrobrachium rosenbergii* was carried out during April to October 2015 and 58 full-sib families of generation 7 (G7) were produced. Post larvae (PL) from all the 58 full sib families were nursed up to taggable size in nylon hapas (2.5 x 1x1.0 m; 116 hapas). The PL were fed twice daily with pellet feed in crumble form and growth and

survival of the stocked PL were sampled once in every 3 weeks. During the sampling, all PL were removed from hapas and counted and group weighed, and then returned to a new hapa. After nursing for 80 to 90 d, the nursed juveniles (140 individuals) from each of the 58 full sib families were stocked in two large nylon net hapas (5x2x1 m) for grow-out. These hapas were fixed in 100 m^2 concrete tanks or ponds. Grow-out is continuing and final data collection of 38 families was already completed. During final data collection all survived prawns were collected and classified by sex and male morphotype. All prawns were individually measured for carapace length, standard length, total length and individual weight. Ten to 12 largest male and 20 largest female prawns were selected from each hapa and tagged with VIA tag and returned to hapas till mate allocation for the production of next generation was finalized. Final data collection of 45 families has been completed so far. The genetic parameters of the harvest body weight of *M. rosenbergii* are presented in Table 6. Heritability estimate for female was higher than that of male. However, there was also high genetic correlation between the male and female heritability.

Due to intense heat and rapid changes in environmental parameters, frequent mortality was occurring in most of the hapas which adversely affect the selective breeding programme.

Table 6 : Variance components, heritability and maternal common environment effect for harvest weight ($HW^{0.5}$) for mixed sex and of males and females of *M. rosenbergii*.

Parameter	REML Estimate (Standard error)		
	HW (mixed sex)	HW male	HW female
Additive genetic variance (standard error)	0.226 (0.062)	0.1823 (0.0732)	0.2375 (0.0653)
Maternal and common environmental variance	0.104 (0.022)	0.1188 (0.0315)	0.1045 (0.0229)
Phenotypic variance	1.050 (0.030)	1.2428 (0.0389)	0.8824 (0.0308)
Heritability	0.22 (0.06)	0.1467 (0.0569)	0.2691 (0.0681)
Maternal common environment	0.10 (0.02)	0.0956 (0.0249)	0.1185 (0.0256)
Genetic correlation		0.9384 (0.1157)	
Maternal common environment correlation		0.6335 (0.1199)	

Project title	:	Carbon sequestration and carbon footprint in some aquaculture systems
Project code	:	I-92
Funding Agency	:	Institute-based
Duration	:	April 2015 - March 2018
Project Personnel	:	S. Adhikari (PI) and B. Mishra

Carbon sequestration studies in nursery and stocking ponds in Banapur, Khurdha, Odisha

To study the carbon sequestration, soil samples were collected and analyzed from the nursery and stocking ponds of Moharatha fish farm, Banapur, Khurdha district, Odisha. The sediment depth was 0.075 ± 0.030 m in the nursery pond, while the same was 0.065 ± 0.021 m in the stocking pond, respectively. The organic carbon content of the nursery pond soils was 1.19 ± 0.30% while the same was 0.68 ± 0.11% in the stocking pond soil. The dry bulk density was 1.06 ± 0.45 mg/m^3 in the soil of nursery pond, while the same was 1.05 ± 0.37 mg/m^3 in the stocking pond soil, respectively. The carbon sequestration was 9.31 ± 3.93 mg C/ha (Mega gram carbon per hectare) in the nursery pond soil, while the same was 4.46 ± 1.12 Mg C/ha in the stocking pond soil. Considering 1.0 cm depth, the average C pool was 1.30 and 0.70 Mg C/ha in the nursery and stocking pond soil, respectively.

Carbon sequestration studies in aquaculture ponds in Rayagada, Odisha

Soil samples were collected and analyzed from fish ponds and from the nearby agricultural land in Rayagada, Odisha. The organic carbon content of the pond soils was 0.52% while the same was 1.29% in the crop soil. The dry bulk density was 0.68 and 0.87 mg/m^3, in the pond and crop soil, respectively. The carbon sequestration was 2.70 and 11.21 Mg C/ha in the pond and crop soil, respectively. Considering 1.0 cm depth, the carbon sequestration was 0.36 and 1.12 Mg C/ha in the pond and crop soil, respectively.

Carbon Sequestration studies in aquaculture ponds in Moyna, East Midnapur, West Bengal

Soil samples were collected and analyzed from fish ponds and from the nearby agricultural land in Moyna, East Midnapore, West Bengal. The organic carbon content of the pond soils was 1.25±0.66 % while the same was 0.73 % in the crop soil. The dry bulk density was 0.78±0.19 and 1.26 Mg/m^3, in the pond and crop soil respectively. The carbon sequestration was 12.54±6.38 and 5.24 Mg C/ha (Mega gram carbon per hectare) in the pond and crop soil, respectively. Considering 1.0 cm depth, the carbon sequestration was 0.97±0.43 and 0.92 Mg C/ha in the pond and crop soil, respectively.

Carbon footprint and sequestration studies in aquaculture ponds in Vijayawada

The carbon footprint analysis showed that the total inputs in carp culture (rohu: catla= 90:10) in West Godavari, Andhra Pradesh ranged from 15,270 to 21,121 kg CE/ha (carbon equivalent) with an output of 6,251 to 10,000 kg live weight/ha. Total inputs in carp culture system (rohu: catla= 90:10) in Krishna district, Andhra Pradesh ranged from 10,959 to 14,924 kg CE/ha with an output of 7,000 to 10,000 kg live weight/ha. Ratio of output: input, considering only the fish as output on live weight basis ranged from 0.35 to 0.65 in West Godavari, Andhra Pradesh, while the same was 0.59 to 0.68 in carp polyculture in Krishna district, Andhra Pradesh.

Soil carbon sequestration studies in fish ponds of three districts of Andhra Pradesh, namely, West Godavari, Krishna and Guntur districts revealed that the soil carbon sequestration at 1.0 cm depth was 0.939±0.708, 0.730±0.303, and 0.750±0.327 Mg C/ha (Mega gram carbon per hectare) respectively in the three districts. The total soil carbon sequestration was 9.491±5.670, 6.698±3.732, and 8.524±3.785 Mg C/ha, respectively in West Godavari, Krishna and Guntur districts (Fig.8).

Carbon footprint and sequestration analysis in aquaculture ponds at Keonjhargarh, Odisha under different management practices

The carbon footprint analysis showed that the total inputs in carp culture practices (rohu: catla: mrigala = 40:30:30) in Keonjhargarh district, Odisha ranged from 923 to 5869 (av.3552) kg CE/ha (carbon equivalent/ha) with an output of 1800 to 4500 (av. 2604) kg live weight/ha under feed, fertilizer, and manures system. Under this system, the ratio of output: input was 0.73. Under fertilizer and manure system, the total input was 100 to 1000 (av.550) kg CE/ha with an output of 1100 to 2750 (av.1935) kg/ha; and the output/input ratio was 3.51. Under organic manure system, the total input was 49 to 138 (av.101) kg CE/ha with an output of 1300 to 3000 (av.1891) kg/ha; and the output/input ratio was 18.72.

The carbon sequestration in the soils collected from the fish ponds of Keonjhargarh district, Odisha varied from 1.58 to 11.54 Mg C/ha (Mega gram carbon per hectare) (Fig. 9). Considering 1.0 cm depth, the carbon sequestration ranged from 0.13 to 1.2 Mg C/ha in this pond soils. Under feed, fertilizer and manures system, the carbon sequestration was 3.470 to 11.407 (av. 7.233) Mg C/ha while the same at 1.0 cm depth was 0.403 to 1.009 (av.0.668) Mg C/ha. Under fertilizer and manure system, the carbon sequestration was 3.878 to 4.620 (av. 4.249) Mg C/ha while the same at 1.0 cm depth was 0.646 to 0.770 (av. 0.708) Mg C/ha. Under organic manure system, the carbon sequestration was 5.781 to 11.972 (av. 9.023) Mg C/ha while the same at 1.0 cm depth was 0.460 to 1.203 (av.0.717) Mg C/ha.

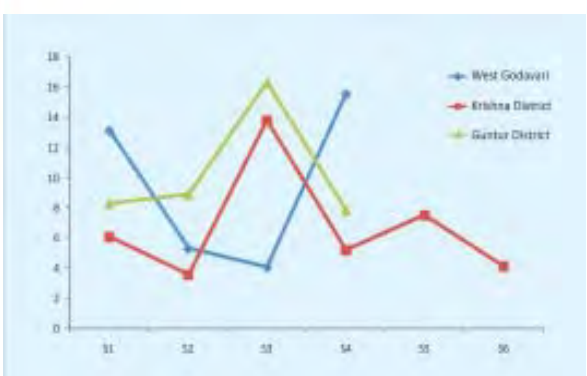


Fig. 8: Carbon sequestration in aquaculture ponds in different districts of Andhra Pradesh

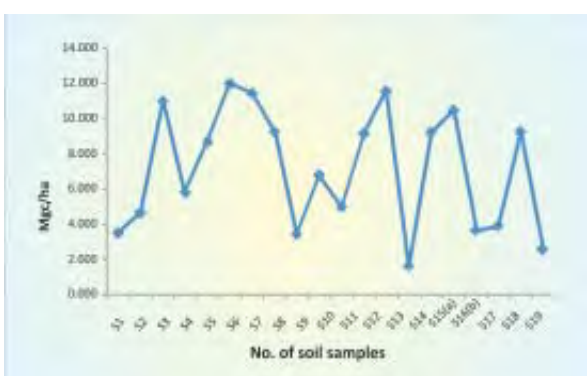


Fig. 9: Carbon sequestration in aquaculture ponds in Keonjhar, Odisha

Carbon footprint and sequestration analysis in aquaculture ponds in Puri, Odisha under different management practices

The carbon footprint analysis showed that the total inputs in carp culture practices (rohu: catla: mrigala = 40:30:30) in Puri district, Odisha ranged from 720 to 3380 (av. 1988) kg CE/ha (carbon equivalent/ha) with an output of 1250 to 3750 (av. 2522) kg live weight/ha under feed, fertilizer, and manures system. Under this system, the ratio of output: input was 1.27. Under organic manure system, the total input was 44 to 860 (av. 323) kg CE/ha with an output of 1000 to 2500 (av.1406) kg/ha; and the output/input ratio was 3.73. Under lime input system, the total input was 35 to 377 (av.206) kg CE/ha with an output of 880 to 2000 (av.1440) kg/ha; and the output/input ratio was 6.99.

The carbon sequestration in the soils collected from the fish ponds of different blocks of Puri district, Odisha varied from 0.96 to 14.21 Mg C/ha (Mega gram carbon per hectare) in the pond soil (Fig. 10). Considering 1.0 cm depth, the carbon sequestration ranged from 0.27 to 2.83 Mg C/ha. Under feed, fertilizer and manure system, the carbon sequestration was 1.484 to 8.093 (av. 3.574) Mg C/ha while the same at 1.0 cm depth was 0.200 to 1.109 (av.0.590) Mg C/ha. Under organic manure system, the carbon sequestration was 0.968 to 6.060 (av. 3.705) Mg C/ha while the same at 1.0 cm depth was 0.276 to 1.069 (av. 0.639) Mg C/ha. Under lime input system, the carbon sequestration was 5.989 to 7.080 (av. 6.534) Mg C/ha while the same at 1.0 cm depth was 0.544 to 0.894 (av. 0.719) Mg C/ha.

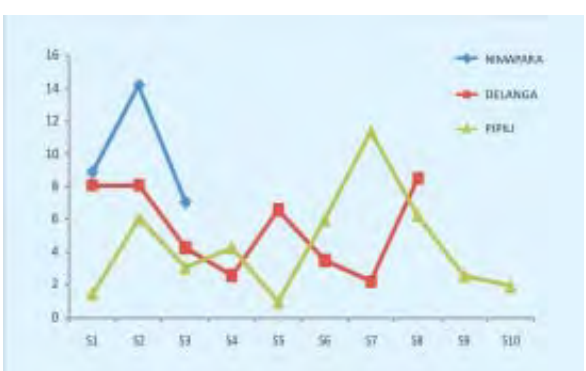


Fig. 10: Carbon sequestration in aquaculture ponds in Puri, Odisha

Project Title	:	Carp seed production in FRP hatchery and development of integrated rearing system for livelihood development of SC/ST communities in Khordha District of Odisha
Project Code	:	E-88
Funding Agency	:	DBT, Govt. of India
Duration	:	July, 2014-July 2017
Project Personnel	:	B. C. Mohapatra (PI), N. K. Barik, B. B. Sahu, K. Anantharaja and P. R. Sahoo (on study leave)

Project Implementation Sites

The beneficiaries of the following four Blocks were identified for implementation of the project mandate.

Cluster 1:

Balipatna Block & Balianta Block

Cluster 2:

Banapur Block

Cluster 3:

Begunia Block

Table 7 : Information on beneficiaries and ponds

Item	Cluster 1	Cluster 2	Cluster 3	Total
No of ponds	7	5	5	17
Total area (ha)	2.39	1.8	5.0	9.19
Brood ponds (ha)	0.4	-	0.2	0.6
Area for seed rearing ponds (ha)	0.4	-	0.2	0.6
Area of grow out and integrated	1.59	1.8	4.6	7.99
farming ponds (ha)				
No. of beneficiaries:	**48**	**68**	**76**	**192**
Male:	45	56	22	123
Female:	3	12	54	69
SC:	35	16	2	53
ST:	0	51	70	121
OBC:	10	1	0	11
GEN:	3	0	4	7

Establishment of FRP carp hatcheries in C.D. Blocks of the district

Three FRP carp hatcheries were supplied and out of those, two were installed and operated for carp seed production in the first year.

Table 8 : FRP carp hatchery in adopted clusters

Sl.No.	Site for Installation of FRP hatcheries	Transported to the site	Installed/ Operated	Remarks
1	Cluster 1: Puranapadhan village	Yes	Installed and Operated	Operated from 21 June, 2015
2	Cluster 2: Aranga village	Yes	Not installed	To be operated in 2016 monsoon
3	Cluster 1 : Kantabada village	Yes	Installed and Operated	Operated from 1 August, 2015

Carp Breeding Programme in FRP Hatchery

Carp breeding operations were conducted in 2 hatchery units *i.e.*, Puranapadhan and Kantabada during the monsoon of 2015. The FRP carp hatchery of Puranapadhan was operated 20 times and the hatchery of Kantabada once. At Puranapadhan Village, 20.4 million carp spawn (*Labeo rohita*, rohu; *Cirrhinus mrigala*, mrigal; and *Cyprinus carpio*, common carp) were harvested and at Kantabada Village, 0.5 million rohu spawn was harvested from carp breeding operations. Out of total spawn production, 142 lakh were sold and rests were reared by the farmers.

Table 9 : Carp breeding operation data of adopted areas in 2015

Sl. No	Location of hatchery	Species bred	Total wt. of male brood (kg)	Total wt. of female brood (kg)	Spawn recovered (lakh)
1	Puranapadhan	*L. rohita*	7.6	8.4	12.0
2			7.0	7.3	9.0
3			8.1	8.7	11.0
4			6.9	7.2	9.0
5			6.5	7.0	9.0
6			12.0	12.0	18.0
7			8.4	9.3	12.0

8			4.7	4.9	7.0
9			13.0	11.0	17.0
10			6.5	6.7	9.0
11			8.4	9.1	12.0
12		*C. mrigala*	5.8	7.0	9.0
13			6.2	6.5	8.0
14			9.0	9.6	11.0
15			6.9	6.8	8.0
16			7.6	8.2	11.5
17			8.5	8.7	10.5
18			7.3	7.1	8.0
19			6.0	6.4	7.0
20		*C. carpio*	6.0	7.0	6.0
21	Kantabada	*L. rohita*	4.5	5.0	5.0

Seed rearing for fry, fingerling and yearling production

At Puranapadhan Village, fry production was conducted in three batches in 2 ponds of size 0.2 ha each. Total 15 lakh rohu fry (survival 44.12%) was harvested by rearing 34 lakh spawn; 10 lakh mrigal fry (survivl 41.67%) by rearing 24 lakh spawn; and 1.5 lakh common carp fry (survival 37.5%) by rearing 4 lakh spawn. Out of those harvested fry, 24.3 lakh (rohu 14.3, mrigal 9.0 and common carp 1.0) was sold by the beneficiaries and the rest were kept for fingerling production. The net profit from the fry production was calculated to be Rs. 4,57,529/-. For fingerling production, 0.7 lakh rohu, 1.0 lakh mrigal and 0.5 lakh common carp fry were stocked again in the same 2 ponds mentioned above. After 70-90 d of stocking, 0.4 lakh rohu (survival 57.14%), 0.5 lakh mrigal (survival 50.0%) and 0.3 lakh common carp fingerlings (survival 60.0%) were harvested. Out of this, 0.38 lakh rohu, 0.45 lakh mrigal and 0.29 lakh common carp fingerlings were sold and the rest were kept for yearling production. The net profit from the fingerling production was calculated to be Rs. 90,670/- .

At Kantabada Village, 3.0 lakh fry (survivabal 60.0%) was harvested out of 5.0 lakh spawn from a 0.2 ha pond. Out of that 1.6 lakh fry was sold and rest 1.4 lakh fry were reared 90 days and got 0.9 lakh fingerling. Out of the harvested fingerling 0.8 lakh were sold out and rest 0.1 lakh were kept for yearling production.

Grow-out Culture of Indian Major Carps

Grow out culture of Indian Major Carps are being practiced in 7.99 ha pond area (1.59 ha in Cluster-1; 1.8 ha in Cluster-2 and 4.6 ha in Cluster-3). The advanced fry of IMCs (catla: rohu: mrigal:: 1:2:1) were stocked @ 10,000/ ha meter water. The fish seeds were stocked on 30 July, 2015 at Naroda Village of Cluster-1; 3 September 2015 at Jemamantadeipur Village of Cluster-3 and 4 September 2015 at Aranga, Dolagobindanuasahi, Beguniasahi and Silingpada Villages of Cluster-2. Normal fish seed rearing practices of ICAR-CIFA were followed. Floating pelleted feed was provided to the farmers for fish feeding in ponds.

Physico-chemical and productivity analysis of aquaculture system and their improvement

Physico-chemical parameters and availability of plankton in the adopted aquaculture pond waters were analyzed monthly during the culture period. The water parameters of all the ponds were found similar *i.e.*, pH 7.0-8.1, conductivity 267-914 m.mho/cm, total alkalinity 50-130 mg/l and total hardness 40-110 mg/l. The adopted ponds were found less productive in terms of plankton volume 0.3-1.9 ml/50 l water and number of different species recorded were 12-16 nos./50 l water. All the ponds were found suitable for fish rearing with BMP advices.

Table 10: Water parameters in adopted ponds

Parameters		Cluster-1	Cluster-2	Cluster-3
pH		7.0-8.1	7.2-7.8	7.3-7.9
Conductivity (mille mho/cm)		458-914	267-581	384-872
Total alkalinity (mg/l)		50-120	60-130	60-100
Total hardness (mg/l)		50-100	40-110	60-90
Plankton volume (ml/50 l)		0.5-1.9	0.3-1.2	0.6-1.4
Plankton quality	Zooplankton	6	5	5
(No. of species)	Phytoplankton	10	7	9

Project Title	:	Adaptation and mitigation strategies in fisheries and aquaculture to climate change with special reference to freshwater aquaculture
Project Code	:	E-94
Funding Agency	:	ICAR-NICRA
Duration	:	June 2015 to March 2017
Project Personnel	:	S. Adhikari (PI), P. Routray, G.S. Saha, R.N. Mandal, H.K. De, Gangadhara Barlaya, A. S. Mahapatra, Ramesh Rathod, I. Sivaraman, Chaudhari Ajit Keshav

Hatching of rohu (*Labeo rohita*) embroys incubated at different temperature regimes

The fertilized eggs of *Labeo rohita* were incubated at different temperatures (28°C, 30°C, 32°C and 34°C) and hatching duration post fertilization was observed at every hour interval. At incubation water temperature of 34 ^{0}C all larvae hatched at 11.6 h whereas it took 16 h at 28 ^{0}C that is considered normal. It was further observed that the elevated incubation temperature during embryonic development resulted in premature hatching of larvae and also produced several malformed larvae that eventually died. These premature hatch-outs showed improper growth being half hatched and malformed.

Studies on growth and feed intake of *Labeo rohita* fingerlings in relation to temperatures

The study was conducted to investigate the effect of different water temperatures on growth performance, and feed intake of *Labeo rohita* for 49 days (Fig: 10 & 11). The five temperatures were 18, 22, 26, 30 and 34°C. Two replicates were followed for each water temperature. The feed was offered at the rate of 4% of wet body weight of the fish. *Labeo rohita* attained significantly higher body weight gain (2.11±0.007 g) under water temperature of 30°C. This was followed by 1.93 ± 0.003 g body weight gains under water temperature of 26°C and 1.89±0.009 g body weight gains for the water temperature of 34°C. The body weight gain was 1.70±0.008 g under water temperature of 22 ^{0}C, and 1.47± 0.006 g body weight gains under water temperature of 18°C. The fish reared in 30°C water temperature showed the best feed intake value (80% consumed), followed by those maintained at 26°C (75% consumed), 34°C (68% consumed), 22°C (64% consumed) and 18°C (59% consumed), respectively.

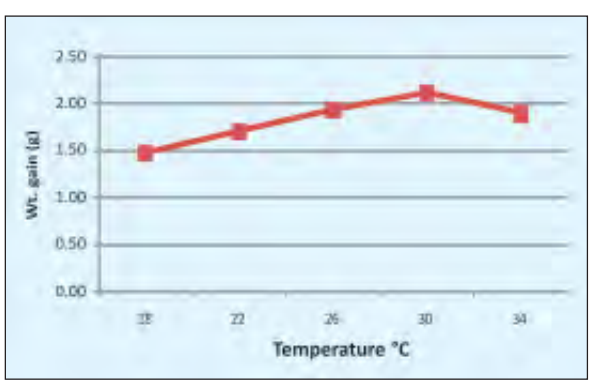


Fig. 10: Weight gain in *Labeo rohita* fingerlings at different temperature

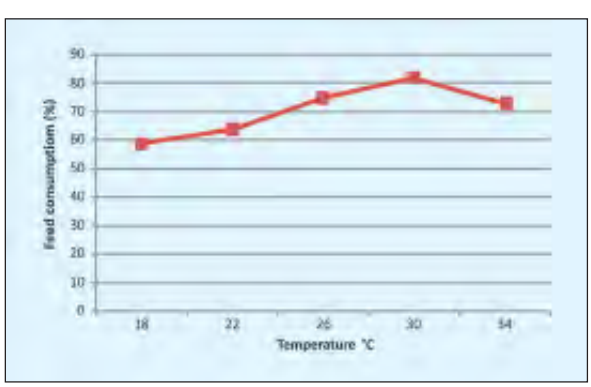


Fig. 11: Feed consumption in *Labeo rohita* fingerlings at different temperature

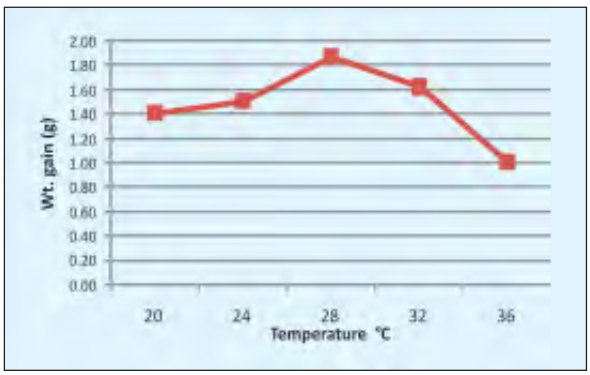


Fig. 12: Weight gain in *Catla catla* fingerlings at different temperature

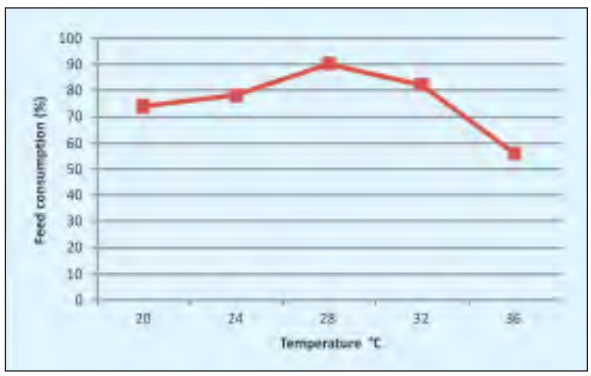


Fig. 13: Feed consumption in *Catla catla* fingerlings at different temperature

Studies on growth and feed intake of *Catla catla* in relation to temperatures

The study was conducted to investigate the effect of different water temperatures on growth performance, and feed intake of *Catla catla* for 25 days (Fig: 12 & 13). The five temperatures were 20, 24, 28, 32 and 36°C. Two replicates were followed for each water temperature. The feed was offered at the rate of 4% of wet body weight of the fish. *Catla catla* attained significantly higher body weight gain (1.87±0.007 g) under water temperature of 28°C. This was followed by 1.62±0.008 g body weight gains under water temperature of 32°C and 1.50±0.009 g body weight gains for the water temperature of 24°C. The body weight gain was 1.40±0.008 g under water temperature of 20°C, and 1.00± 0.006 g body weight gains under water temperature of 36°C. The fish reared in 28°C water temperature showed the best feed intake value (90% consumed), followed by those maintained at 32°C (82% consumed), 24°C (78% consumed), 20°C (74% consumed) and 36°C (56% consumed), respectively.

Freshwater aqua farmer's perception regarding climate change vulnerability

With reference to the exposure of fish farmers to climate change vulnerability, the variations in perceptions were observed and noted from the freshwater aqua farmers of three states viz., Odisha, West Bengal and Andhra Pradesh. The farmers of three states agreed to the perception that there was increase in temperature and decrease in rainfall or sporadic rainfall in subsequent years. The percentage of farmers agreed to such perception was 100, 99, and 70 from Andhra Pradesh, West Bengal and Odisha, respectively. Positive respond was received by 72% farmers of Andhra Pradesh, 43% farmers of West Bengal and 23% farmers of Odisha regarding the perception of threats to farming operations by extreme climatic events. The agreed opinion regarding the loss of crops due to extreme events like cyclone, severe drought, floods etc. were 60, 43, and 22% of farmers of Andhra Pradesh, West Bengal and Odisha, respectively. However, the perception of water deficit in farms was agreed by 86% farmers of West Bengal, 25% farmers of Odisha, and 14% farmers of Andhra Pradesh. The views expressed about the loss of farm soil productivity were 96, 86, and 17% of farmers of Andhra Pradesh, West Bengal, and Odisha, respectively.

Project Title	:	Consortia research platform on water: CIFA component 3.2: Water budgeting and enhancing water productivity by multiple use of water in different aquaculture production system
Project Code	:	E-95
Funding Agency	:	ICAR (XIIth Plan) ICAR- ACRP on Water (collaboration between CIFA and IIWM)
Duration	:	January 2016 to March 2017
Project Personnel	:	P. C. Das (PI), Rajesh Kumar, S. Ferosekhan, S. P. Kamble, I. Sivaraman and C. K. Mishra

Evaluation of water requirement for nursery rearing of rohu, *Labeo rohita* (Hamilton) in large outdoor concrete tanks

Study was carried out in the seed rearing facility of Institute farm to enumerate the water requirement for nursery rearing of rohu. Total of nine concrete tanks of 50 m^2 each (10 m X 5 m x

1.2 m) were grouped into three treatments T-1, T-2 and T-3 and were filled with varied water depths of 1.0, 0.75 and 0.5 m, respectively. Each tank was stocked with 0.5 lakh hatchery-produced spawn @ 1000 spawn/m^2 and reared for 20 days. Tanks were filled with filtered pond water 5 d before spawn stocking and pre-stocking tank preparation was done as per standard protocol. Supplementary feed (powdered GNOC and rice bran at 1:1) were provided on the second day after stocking at 450 g/lakh which was subsequently increased by 50 g every day. Water exchange was given to the tanks as per requirement during the rearing phase. Water quality parameters were measured at 5 d interval while data on water depth and gain/loss were enumerated once in every 10 d.

Table 11: Yield attributes after 20 d of rearing of spawn to fry of rohu in concrete tanks

Treatments (Water Depth)		Length at harvest (cm)	Weight at harvest (g)	SGR (% per day)	Survival(%)
T1	1.00 m	2.43±0.14^{a}	0.209±0.029^{a}	24.33±0.69^{a}	53.32±3.76^{a}
T2	0.75 m	2.42±0.014^{a}	0.178±0.021^{a}	23.57±0.39^{a}	47.40±2.98^{ab}
T3	0.50 m	2.24±0.09^{a}	0.135±0.009^{b}	22.17±0.24^{b}	44.97±3.39^{b}

Values with different superscript in a column differ significantly (P<0.05, n=3)

Table 12: Gross and consumptive water requirement with regard to fry production

		Water required (m^3)/ 1000 fry production.		Fry produced/m^3 of water	
Sl. No.	Treatment	Gross	Consumptive	Gross	Consumptive
1	T1	2.19^{a}	0.51^{a}	455.71^{a}	1974.75^{a}
2	T2	1.92^{b}	0.57^{a}	520.93^{b}	1742.82^{a}
3	T3	1.50^{c}	0.68^{a}	668.68^{c}	1474.39^{a}

Significant influence of water depth on fry growth and survival was observed in this study. Though the harvested length of fry did not differ among the treatments, T-3 with 0.5 m water depth in tank showed significantly lower survival, harvested body weight and specific growth rate then the other two treatments. However, tanks with 1.0 and 0.75 m water depths showed almost similar yield attributes (P>0.05).

Fig. 14: Soil collection

Fig. 15: Fertilizer application

Study on water use for production of every 1000 fry (Table 12) revealed significant reduction in gross water requirement with decreased water depth (P<0.05), while the consumptive water use in terms of water exchange and replenishment did not differ with regard to varied water depth

Study on water requirement during fry production of magur, *Clarias batrachus*

Study on water requirement during fry production of magur was carried out for three weeks in 12 circular FRP tanks filled with 80 L water to have depth of 20 cm each. The tanks were grouped to six treatments with two replications each. The six treatments received varied water exchange as mentioned in Table 1 during the seed rearing. All the tanks were stocked with four days old larvae (8.20±0.77 mm, 4.19±0.16 mg) at 400 larvae per

tank (5 larvae l-1) and were aerated continuously. The larvae were fed ad libitum with freshly collected live mixed zooplankton, predominantly consisting of rotifers, copepods and Daphnia throughout the experiment. Fecal matters were siphoned out from the tank at the time of water exchange.

Table 13: Influence of varied water exchange on growth and survival of *Clarias batrachus* during fry production

Treatment (water exchange)		Final Length (mm)	Final Weight (mg)	Fry output (Nos)	Survival %
T-1	Daily 25%	19.0 ± 0.6	47.7 ± 4.1	391 ± 9.9	98 ± 2.5
T-2	Daily 50%	19.5 ± 0.6	53.3 ± 7.3	396 ± 2.8	99 ± 0.7
T-3	Daily 75%	20.0 ± 0.1	56.2 ± 2.8	384 ± 8.5	96 ± 2.1
T-4	Daily 90%	19.3 ± 1.0	53.1 ± 0.6	361 ± 21.2	90 ± 5.3
T-5	75% in alternative days	19.1 ± 0.4	48.1 ± 1.5	374 ± 25.5	94 ± 6.4
T-6	75% once in three days	18.7 ± 0.6	53.9 ± 0.9	375 ± 7.1	94 ± 1.8

Values with different superscript in a column differ significantly (P<0.05, n=3)

Table 14: Gross and consumptive water requirement for *Clarias batrachus* fry production

Treatment	Fry harvested	Water use (L)		Water use (m^3)/1000 fry	
		Gross	Consumptive	Gross	Consumptive
T-1	391 ± 9.90	668	588	1.708	1.504
T-2	396 ± 2.83	1088	1008	2.747	2.545
T-3	384 ± 8.49	1508	1428	3.927	3.719
T-4	361 ± 21.21	1760	1680	4.875	4.654
T-5	374 ± 25.46	828	748	2.214	2.000
T-6	375 ± 7.07	556	476	1.483	1.269

The study revealed no significant difference in the length and weight attainment as well as survival of the fry among the treatments. In the present study, T-2 with 50% water exchange daily yielded the highest number of fry among the treatments (Table 13). In treatment groups with water exchange given on a daily basis, despite increase in the gross and consumptive water use from T-1 to T-4, the total fry production decreased in these treatments excepting T-2 where it was the highest (Table 14). However in terms of water use, while both gross and consumptive water use in T-6 were the lowest among the treatments, its fry yield was statistically similar to other treatments. Therefore, the study suggested T-6 among the above six treatments to be the ideal condition for seed rearing of magur.

Fig. 16: Magur fry

Effect of stocking densities on growth and survival of striped murrel, *Channa striatus* during fry rearing with minimal water exchange

A twenty days experiment was conducted to know the effect of different stocking densities on growth and survival during fry rearing of striped murrel, *Channa striatus* with minimal water exchange. Total of nine FRP tanks of 500 L capacity were filled with 200 L of water and grouped into three treatments. The three treatments T-1, T-2 and T-3 were stocked differently at 1, 2 and 4 spawn/lite, respectively. Growing fry were fed *ad-libitum* with zooplankton collected from the ponds of the Institute farm. Fecal matter was siphoned out from each tank on daily basis followed by replenishment of the water loss thereby incurred in each tank. The result of the short term experiment is presented below.

Table 15: Growth of murrel seed during fry rearing with minimum water use

Treatments	No. Stock	Final body length (mm)	Final body weight (g)	Survival (%)
T-1 (1sp. /l)	200	30.9	0.232	98.75
T-2 (2sp. /l)	400	29.7	0.228	96.25
T-3 (4sp. /l)	800	24.7	0.137	88.37

Table 16: Water use during fry rearing of murrel

Treatment (spawn/l)	No. stocked	No. of fry harvested	Water use (L)		Water use (m ^{3}/1000 fry)	
			Gross	Consumptive	Gross	Consumptive
T-1 (1 no.)	200	198	289	89	1.463	0.451
T-2 (2 no.)	400	385	304	104	0.790	0.270
T-3 (4 no.)	800	707	331	131	0.468	0.185

Growth in terms of length and weight attainment as well as survival in the fry were observed to increase with the decrease in the stocking density (Table 15). The gross water requirement was more in tanks with higher stocking density owing to greater volume of consumptive water used for exchange (Table 16). However, water use assessed in term of volume required per 1000 fry production revealed reduction of both gross and consumptive requirement with increase in the stocking density in the tanks.

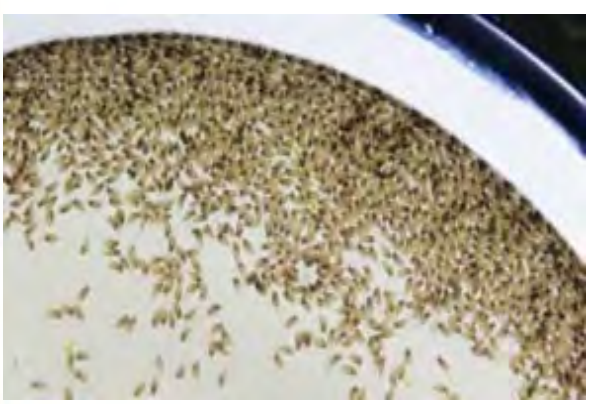


Fig. 17: Murrel larvae

Fig. 18: Murrel fry

Project Title	:	National network of Germplasm centre for conservation aquaculture
Project Code	:	E-96
Funding Agency	:	ICAR (XIIth Plan) ICAR- ACRP on Biodiversity (collaboration between CIFA and NBFGR)
Duration	:	September 2015 to March 2017
Project Personnel	:	P. C. Das (PI), S. K. Sahoo, S. Ferosekhan and S. P. Kamble

Two visits to Sambalpur and one visit to Sonepur made to survey availability of mahseer in the Mahanadi system. Approximately 80 kg of mahseer (60 no.) with 0.7-2.5 kgweight range along with 14 kalbasu and 8 fringed lipped carps were collected in two consignments. Fishes of the first consignment were released in a local farm at Sambalpur to acclimatize them to pond condition. However, injury during gill netting led to severe fungal growth in pond condition and subsequent mortality. In the 2nd consignment, though fungal attack was prevented through pond treatment of CIFAX and preventive chemical bath before release into pond, non-acceptability of artificial feed (snail, browsed algae and sand observed in gut content) added to gill netting and subsequent handling stress of the highly active fish led to death of 80% of those within a span of 8 days. The rest fishes (10-112 no.) are being maintained in the private farm pond which would be transported to CIFA later. Due to poor survival of the collected big fish, mostly due to the stress from gill netting, decision was made to collect them at seed stage (10-200g) through drag netting at the time of availability during April-June, 2016.

Project Title	:	AICRP on Plasticulture Engineering & Technology
Project Code	:	
Duration	:	Continuing from May 1988
Funding Agency	:	ICAR-AICRP on PET, Ludhiana
Project Personnel	:	PI: Dr B.C. Mohapatra, Pr. Scientist
Co-PI:	:	Dr B.B. Sahu, Sr. Scientist
		Mr. N.K. Barik, Scientist (SS)
		Mr. K. Anantharaja, Scientist
		Associate: Mr. D. Majhi, T-4

Design and development of Mobile Fish Vending Trolley

The AICRP on PET center at ICAR-CIFA, Bhubaneswar has designed and developed a prototype fish vending carriage to be fitted on a three wheeler trolley for enabling the fish vendors to sell more amounts of fish in the market in a single day and that too in a hygienic way (Fig.19). This can be used for vending maximum up to 100 kg fish in ice at any time of the day. Fibre Reinforced Plastic (FRP) is the base material for the carriage. It is 4′x2′9"x2′6" in terms of dimension. The specialty of the carriage is its unibody design as all the facilities and equipments are integrated in to it. An ice box of size 2′x2′9"x2′6" is integrated in the carriage box and packed with 1" thick Polyurethane Foam to serve the insulation factor. The cutting tool is made removable and more than one type of cutting tool can be used. There is also provision of water storage tank of around 20 liter capacity and waste collection crate chamber in the carriage. Tool box is also provided for keeping the cutting tools, money box and other items required during the marketing process.

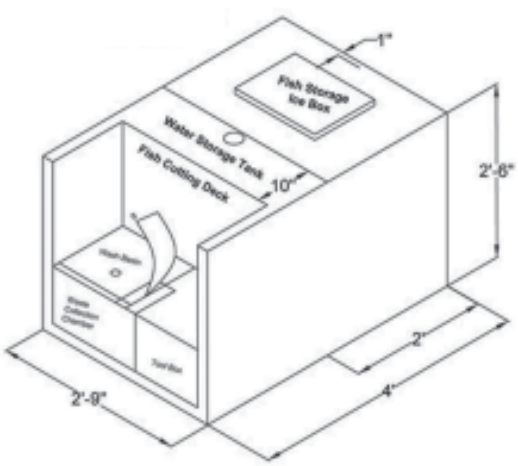


Fig. 19: Mobile Fish Vending Carriage

Modifications of the experimental setup for study of periphyton growth on different colored plastic sheets in freshwater ponds

In the previous reported experimental setup, iron rods were used to make the frame on which the colored plastic sheet was wrapped in a zig zag manner and the total frame was kept submerged inside the pond water for periphyton growth. Due to several corners in the frame, the normal movement of fish in to it for periphyton consumption was restricted to some extent. In the present design (Fig. 20), a floating sealed PVC pipe with hangers for holding colored plastic sheets was planned. A 6" dia sealed PVC pipe was selected to act as the float. Aluminum flats were used to make the hanger clamps for holding ½" PVC pipe from which the plastic sheets were hung. Another ½" PVC pipe was used to act as the sinker to help the plastic sheet hung to get submerged into the water column. Each unit held one colored plastic sheet and according to the requirement six units were fabricated. The experiment was carried out in two ponds of size 0.1 ha each at Running water site of ICAR-CIFA, Bhubaneswar. Each pond was stocked with 500 fingerlings of IMC in August 2015. The PVC floating hangers with different colored plastic sheets were installed in one pond and the other was kept without floaters and plastic sheets. Both the ponds were applied with floating fish feed @ 2% of the total fish biomass. Periphytic growth, fish growth and water parameters of each pond were monitored every month. By the end of the experiment, the fishes grew 15% (average) more in the ponds with plastic sheets. It was found that the red colour plastic sheet showed maximum periphytic growth in terms of volume followed by white, blue, black and green. As per the quantitative analysis, on red color sheet more growth was found followed by white, black, blue and green respectively.

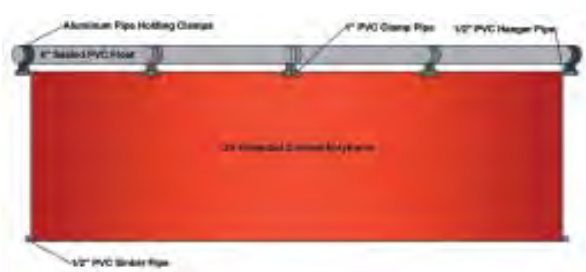


Fig. 20: Floating hanger for plastic sheet

As per the qualitative analysis the following genera were found on the plastic sheets:

Green Algae (*Botryoccoccus, Chaetophora, Microspora, Pediastrum, Navicula, Fragilaria, Protococcus, Cladophora*)

Blue -Green Algae (*Anabaena, Nostoc, Phormidium, Rivularia, Oscilatoria*)

Desmids (*Desmidium, Gonatozygon, Micrasterias, Mesotaenium, Closterium, Spirotaenia*);

Diatoms (*Cocconeis, Diatoms, Gyrosigma, Nitzschia, Pinnularia, Stephanodiscus, Synedra*)

Aquaponics Research

An aquaponics preliminary trial experiment was carried out in 10m^3 capacity trapezoidal water tanks for the growth and survivability of cauliflower plants at ICAR-CIFA, Kausalyaganga. Thermocol was used as a floating raft for this experiment. Six holes were made on the thermocol and net pots were fitted in the holes. The net pots were filled with small gravels and plant seedlings of cauliflower were planted into the gravels. The growth parameters of cauliflower plants were monitored every fortnight. In the control tank (C) only common carps were grown and in the treatment tank (T) cauliflowers were grown along with common carp. In control (C) and treatment tank (T), 50 nos. of common carp, *Cyprinus carpio* were stocked. The initial length and weight of common carp was 10.8 ± 1.54 cm and 19.5 ± 2.40 g respectively. After 45 days, the final length and weight of common carp were 14.92 ± 2.24 cm and 47.8 ± 5.24 g in treatment tank (T) and 13.21 ± 1.98 cm and 39.42 ± 6.84 g in control (C) respectively. The initial length of the cauliflower plant in treatment tank was 10.30 ± 1.41 cm and the final length reached in 45 days was 14.2 ± 2.80 cm

Dissemination of the demand feeder technology in farmer's pond

Demand fish feeder with hopper capacity 10 kg was installed in one pond (0.5 acre) of women beneficiaries (tribal village with 22 families) at Nigidhi, Satyabadi Block of Puri District, Odisha on 19 October 2015 for demonstration. Floating pellet feed was also supplied to the beneficiaries. The efficiency of the feeder was monitored during the period and found working efficiently for delivery of feed to the fish in the pond. It was estimated that the fish consumed 2% feed of their body weight from the demand feeder.

Project Title	:	Breeding and culture of tilapia for popularization and brood banking.
Project Code	:	I-80 (I)
Duration	:	3 Years (2013-2016)
Funding Agency	:	Institute
Project Personnel	:	PI: Dr. P. Routray, Principal Scientist Co-PI: Dr. P. K. Meher, Senior Scientist Dr. B.C. Mohapatra, Principal Scientist Dr. N. K. Barik, Senior Scientist Dr. Chandrakanta Mishra, Senior Scientist Dr. K. C. Das, Senior Scientist Dr. G.M. Siddaiah, Scientist (from December 2016) Dr. D. K. Verma, Technical Officer

Genetic and phenotypic variation among four tilapia populations using microsattellite and morphological features

Achievements

Phenotypic and genetic differences among the four tilapia populations collected from different locations of India viz. West Bengal population (WB), Gujarat population from Rudramata dam site of Bhuj reservoir (RM), Odisha state population (OD) and Gujarat pond population (GP) were studied. Tilapia with a broken lateral line and the most obvious characteristics of regular dark vertical stripes throughout the depth of its dark body was taken as identifying character of Oreochromis niloticus. Four morphometric variables (total length, body weight, depth at first dorsal fin, head length) were measured from each animal. Blood and fin samples were collected (n = 50 per population) for genetic characterization. Mean body weights (g) of tilapia after 5 months were: 351 ± 0.51, 281 ± 0.43, 395 ± 0.63 and 255 ± 0.82 for WB, RM, OD and GP respectively. ANOVA followed by Duncan multiple range test at 5% level of significance indicated higher body weight of WB and OD stock than RM and GP stock after five month of culture. Morphometric truss analysis showed RM and GP stock in one cluster and OD and WB in other clusters. Genetic variation using microsatellite markers indicated variation among populations. Eight heterologous primers were selected based on amplification, band quality, reproducibility and the presence of distinctive bands. Genetic variability among four different stocks of tilapia indicate that the possibility of breeding strategy to control inbreeding and develop a selective breeding programme among available species of tilapia in India.

B. Fish Genetics and Biotechnology

Sub-project	:	Development of single nucleotide polymorphism in *Labeo rohita* and *M. rosenbergii*
Project Code	:	I-59 (S)
Funding Agency	:	Institute-based
Duration	:	April 2013 - March 2016
Project Personnel	:	P. Das (PI), L. Sahoo, P. K. Meher, K. Murmu and P. L. Sanga

To enrich SNP data base in rohu ~30 GB of RNA-Seq data generated from three libraries constructed from RNAs isolated from growth selected, control and unselected groups and analysis is under progress. Further, ~28 GB of RNA-Seq generated from three cDNA libraries of rohu. Towards validation of putative SNPs identified through RNA-Seq analysis primers from the flanking region of 20 SNPs were designed and synthesized. Further, primers for 10 genic SSR loci was designed and synthesized.

Sub-project	:	Selective breeding of catla (*Catla catla*) for growth improvement and two traits (growth and disease resistance against aeromoniasis) selection and dissemination of genetically improved rohu (*Labeo rohita*)
Project Code	:	I-59 (U)
Funding Agency	:	Institute-based
Duration	:	April 2015 - March 2018
Project Personnel	:	K. D. Mahapatra (PI), J. N. Saha, Murmu, L. Sahoo, Priyanka Nandanpawar and Avinash Rasal

Production of Fullsib Families of Catla

For establishment of base population in catla both molecular marker data as well as growth evaluation data was used. A compromise solution between diversity and growth performance of different stocks considered while creating base population for catla. Ranking of stocks were made for base population establishment.

Table 17: Observed heterozygosity in different stocks of Catla

Stock	Observed heterozygosity
Nilu Ghosh hatchery	0.934783
Kumar Swamy hatchery	0.875
Sai Ram hatchery	0.842105
CIFA Farm	0.783784
Patna (Ganga stock)	0.758621
Subernarekha river (Balasore)	0.741935
Awalsidhi hatchery	0.727273
State Fisheries hatchery	0.7

Table 18: Growth evaluation of catla after one year culture for different stocks

Stock	Mean body weighting (Rank)
C01 (River Ganga lower)	3342 (1)
C07 (Sai Ram hatchery, AP)	2361 (2)
C04 (State Kausalyaganga hatchery)	2325 (3)
C05 (Kumar swamy hatchery, AP)	2216 (4)
C03(Awalsidhi hatcheryKolkata)	2175 (5)
C08 (CIFA farm)	2168 (6)
C06 (Nilu Ghosh hatchery, Kolkata)	2129 (7)
C09 (NBFGR, Ganga upper)	2069 (8)
C02 (Subernarekha river) stock, Balasore)	1960 (9)

Field evaluation of generation-1 catla

During 2015-2016 Catla spawn Production – 12.50 lakhs

Stocking – NFFBB– 4 lakh, CIFA Farm – 2 lakh West Bengal – 0.75 lakh, Andhra Pradesh – 0.25 lakh, Odisha (3Dist) – 5.5 lakh

On-farm trials catla (G01) fry/ fingerlings

- West Bengal
- Odisha (NFFBB)
- Tamil Nadu
- Andhra Pradesh
- Assam
- Bihar

Truss analysis for base population of *Catla catla*

Truss measurements of 35 adult catla (3 yrs old) from 8 stocks of catla base population have been recorded and following softwares were used:

1) tpsUtil

2) tpsDig

3) PAST

4) SAS

Measurements were taken on 10 points

2015 year class "Jayanti rohu" production and dissemination

During 2015, 61 fullsib families of improved rohu, control group and resistant line of rohu against aeromoniasis was produced and reared in nursery ponds for taggable size. Tagging was completed for all these groups and stocked in three replicate ponds for further growth evaluation.

During the year, 194.0 lakhs of improved rohu "Jayanti" spawn was produced apart from fullsib families.

Own stocking – 2 lakh

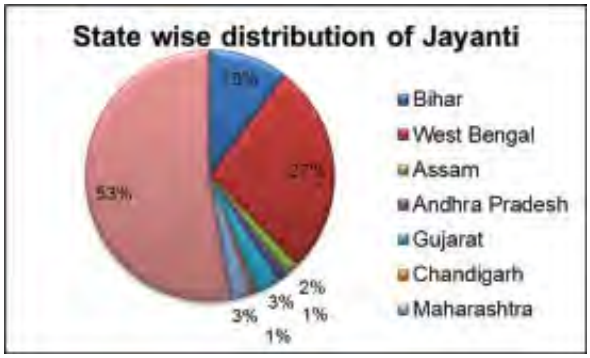
NFFBB– 18 lakh

CIFA Farm – 6 lakh

State wise -Bihar – 17 lakh

West Bengal – 45 lakh
Assam – 3 lakh
Andhra Pradesh – 2 lakh
Gujarat – 5.5 lakh
Chandigarh – 1lakh
Maharashtra – 4.5 lakh
Odisha (12 Districts) – 87 lakh
KVK (2 Districts) – 3 lakh

Fry and Fingerlings were also supplied to different states like Odisha, Tamil Nadu, West Bengal, Maharashtra and Jharkhand for breed improvement programs.



Sub-project	:	Transcriptomic profiling of the reproduction related tissues during transition from post-spawning regression to initiation of gonad activity in rohu (*Labeo rohita Ham.*)
Project Code	:	I-59 (n)
Funding Agency	:	Institute-based
Duration	:	April 2012 - March 2016
Project Personnel	:	S. Nandi (PI), P. K. Meher, J. K. Sundaray, P. Das, P. Routray and D. K. Verma

Identification of Gene regulatory network in brain, pituitary, liver and ovary controlling reproductive seasonality in rohu (*Labeo rohita* Hamilton)

Reproductive seasonality in fish is regulated by neuro-endocrine system controlled by BPGL (Brain-Pituitary-Gonad-Liver) axis. Gene regulatory networks (GRNs) describe the process of cell differentiation, metabolism, the cell cycle and signal transduction in a biological system. Understanding dynamics of these networks in these tissues can shed light on mechanism of reproductive seasonality. Transcriptome profiling was carried out to know the specific biological

Table 19: *De novo* **assembly statistics of rohu transcriptome in Trinity**

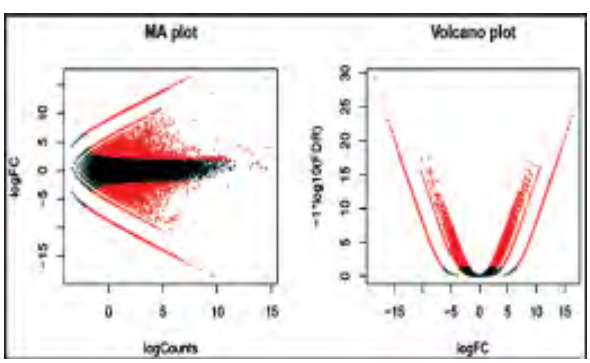
Total trinity transcripts	440665
Total trinity unigenes	336520
Percent GC	42.94
Contig N50	1850 bp
Minimum contig length	201 bp
Maximum contig length	19331 bp
Median contig length	381 bp
Average contig	867.45 bp
Total assembled bases	382252837

pathway operating in the four BPGL tissues in resting (*post-spawning* in winter) and initiation of gonad maturation (*pre-paratory* in summer) phases in female rohu. The paired end processed reads from Illumina for summer and winter season's brain, liver, ovary and pituitary tissues of rohu were pooled together for *de novo* assembly with default parameters using *trinity*.

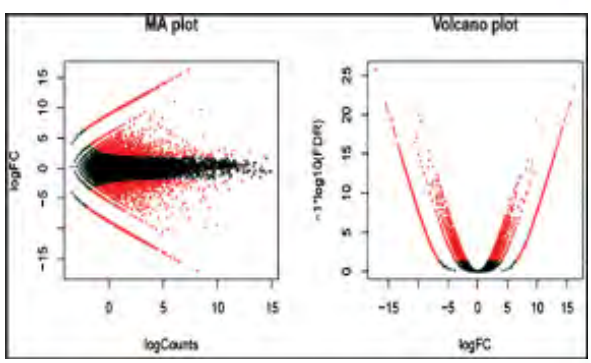
A total of 440665 transcripts were generated in Trinity at K-mer size 25 (Table 19). The minimum contig length was 201 bp and maximum of 19331 bp and average length of 867 bp. N50 was found to be 1850 bp and total GC content as 42.94%. *De novo* transcriptome analysis revealed 35840, 14558, 31097, and 21767 DEGs were identified for SumBR vs. WinBR, SumLIV vs. WinLIV, SumOVA vs. WinOVA, and SumPIT vs. WinPIT respectively (Table 20). MA and volcano plots showed differentially expressed genes as the red color dots (Fig. 21). KEGG analysis showed 131, 125, 131 and 127 pathways found in SumBR vs. WinBR, SumLIV vs. WinLIV, SumOVA vs. WinOVA, and SumPIT vs. WinPIT respectively.

Table 20 : Number of up and down regulated DEGs

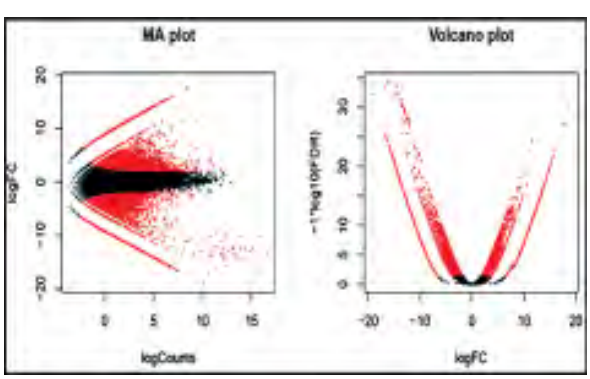
	Up regulated	Down regulated	Totals DEG's
SumBR vs. WinBR	14647	21193	35840
SumLIV vs. WinLIV	6786	7772	14558
SumOVA vs. WinOVA	17194	13903	31097
SumPIT vs. WinPIT	10050	11717	21767



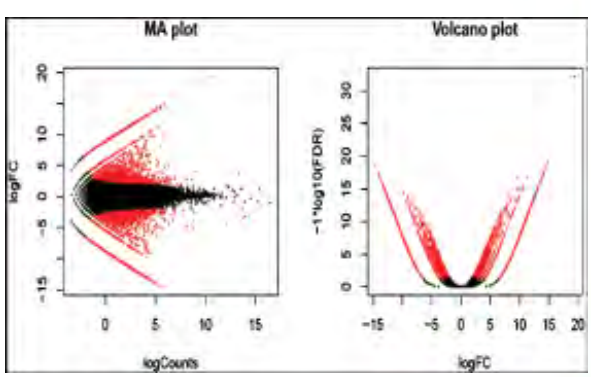
SumBR vs. WinBR



SumLIV vs. WinLIV



SumOVA vs. WinOVA



SumPIT vs. WinPIT

Fig 21: MA and volcano plots of differentially expressed genes

A total of 68140 SSRs and 59386 SNPs as putative DNA markers were also discovered. In tissues specific GRNs, 21, 36, 46 and 25 hub genes were identified in brain, pituitary, gonad and liver tissues respectively (Figs. 22,23,24,25).

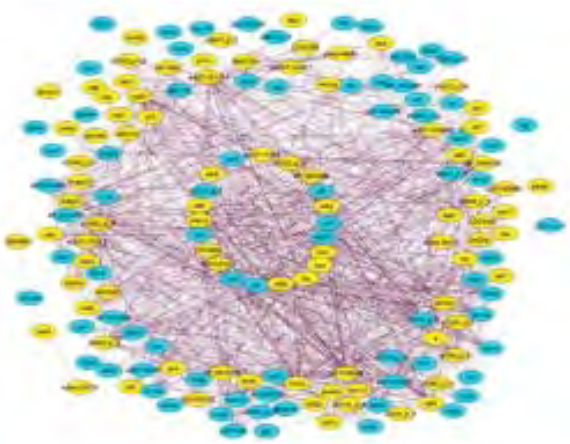


Fig. 22: Gene Regulatory Network (GRN) of Brain

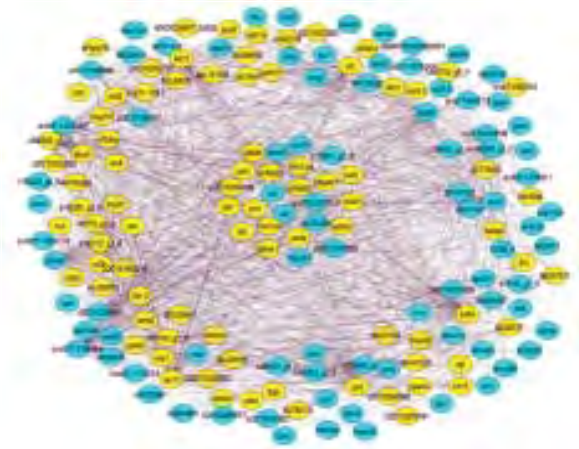


Fig. 23: Gene Regulatory Network (GRN) of Liver

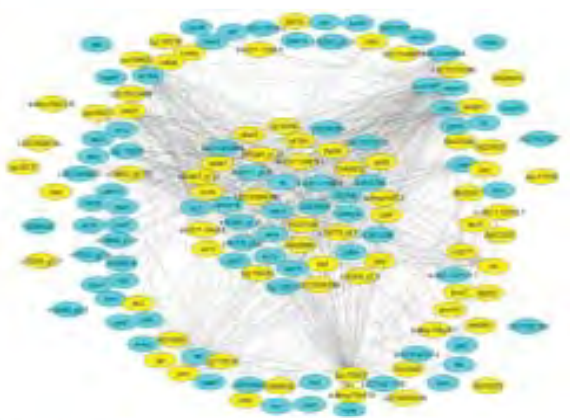


Fig. 24: Gene Regulatory Network (GRN) of Ovary

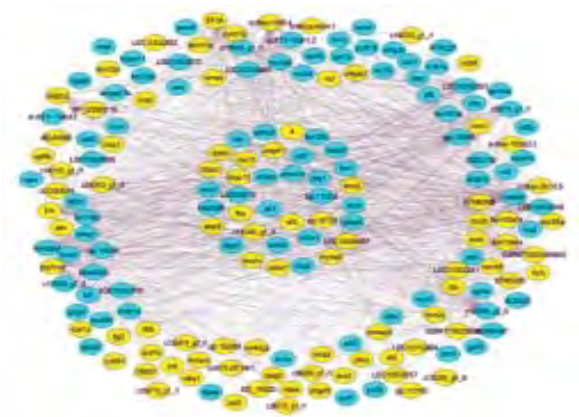


Fig. 25: Gene Regulatory Network (GRN) of Pituitary

Sub-project	:	Effect of CIFABROOD™ on the breeding performance and seed quality of *Jayanti* rohu (*Labeo rohita*)
Project Code	:	I-59 (T)
Funding Agency	:	Institute-based
Duration	:	April 2014 - March 2017
Project Personnel	:	S. Nandi (PI), J. N. Saha, K. D. Mahapatra, K. Murmu, J. K. Sundaray and Uday Kumar Udit

Breeding Performance

- 37 fullsib families of 2015-year class were produced from the brood fishes of experimental pond (CIFABROOD™ feed) and 7 families from control pond (normal feed)
- Percentage of fertilization as well as hatching rate was higher in experimental brood fishes than control during the family production
- Differences in swelled egg diameter between the two groups were negligible

Milt volume in experimental brood fishes was better and sufficient throughout the breeding season including late season on 7.9.15.

POND	Cell diameter (mm)		Fertilization rate (%)		Hatching rate (%)	
	Range	Average±SD	Range	Average±SD	Range	Average±SD
CIFABROOD™	4.488-4.935	4.84±0.198	84-97	95±2.44	70-80	78±8.24
CONTROL	4.295-4.816	4.75±0.213	80-92	80±3.86	62-75	65±9.66

Comparative study of Morphology, GSI and Histology of Control and experimental Fish

Fig. 26: Control group

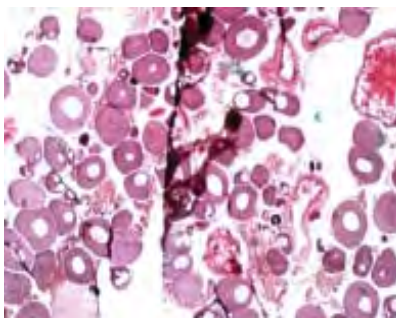


Fig. 27: Immature oocytes

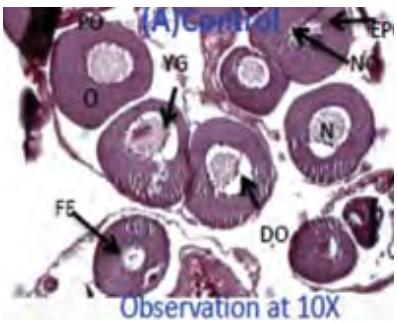


Fig. 28: Immature oocytes

Fig. 29: Experimental Group

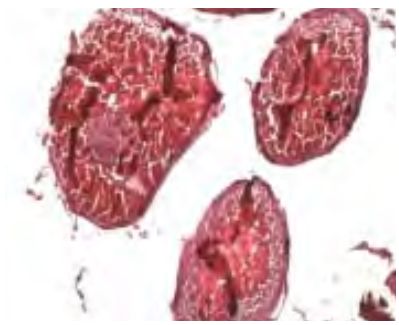


Fig. 30: Mature oocytes

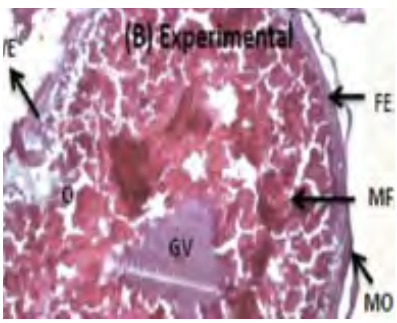


Fig. 31: Mature oocytes

Mature oocyte stage. Olympus CX41 Phase Contrast & Polarized Light Microscope 4X, 10x Hematoxylin & Eosin. Nucleus with dispersed and irregular chromatin. O-Ooplasm, ve-Vitellin envelope, Fe- Folliculer epithelium, MO- Mature ooctye, GV- Germinal Vesicle

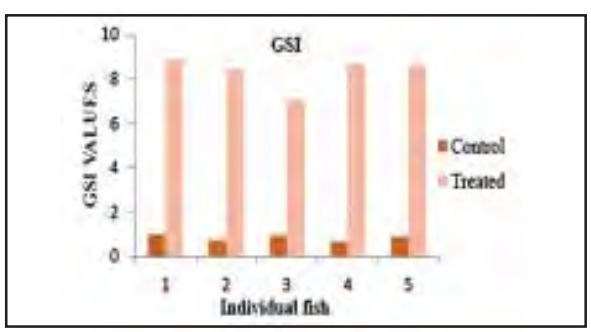


Fig. 32: Avg. GSI of experimental group was almost 10 times higher than the control group.

Conclusion

The present study reflects that CIFABROOD™ advances gonad growth and maturation, facilities early spawning and significantly increases spawning response and reproductive performance of Jayanti rohu.

Sub-project	:	Proteomic analysis of differentially expressed proteins in giant freshwater prawn, *Macrobrachium rosenbergii* in response to biotic stressors
Project Code	:	I-59 (O)
Funding Agency	:	Institute-based
Duration	:	April 2013 - March 2016
Project Personnel	:	J. Mohanty (PI), P. K. Sahoo and B. R. Pillai

During the period differentially expressed proteins in hepatopancreas from juveniles of freshwater prawn, *Macrobrachium rosenbergii* in response to *Vibrio harveyi* stimulation was studied by 2D gel electrophoresis and mass spectrometry. Juveniles (5-10 g size) of *M. rosenbergii* were collected from prawn hatchery, CIFA and were acclimatized in the wet laboratory prior to experimentation. The prawns were injected intramuscularly at dose of 0.1 ml of *V. harveyi* suspension (10^6 cells/ml) and hepatopancreas were collected after 24 h exposure. Protein samples prepared from bacteria exposed and unexposed controls were run in 2D gel electrophoresis. The first dimension IEF was run on 11 cm IPG strips of 4-7 pH range and the 2nd dimension SDS-PAGE was run on 12% acrylamide gel. The gels were stained with mass spectrometry compatible silver stain. Triplicate gels were run for each group. The 2D gels were scanned in ImageScanner III and the gel images were subsequently analyzed by Imagemaster 2D Platinum 7.0 software. The patterns of protein expression in unchallenged and *V. harveyi*-challenged prawns appeared largely similar but clear differences in protein expression levels of certain protein spots were evident. Expression differences between protein spots were analyzed based on ANOVA statistical test with *p* value less than 0.05 and a

fold change of more than 2.0 intensity. Among the total protein spots, 19 protein spots showed significant changes between the two groups. Out of 19 spots, 2 protein spots were up-regulated by >2-fold and 17 were down-regulated. All the 19 differentially expressed protein spots were excised from silver stained 2D gels and in-gel digestion of protein spots with enzyme, trypsin was carried out. The samples were then subjected to MALDI-TOF-TOF mass spectrometry and the proteins were identified through database searches. These proteins were found functionally related to immunity, reproduction, molting, hormones etc.

Project Title	:	Genetic upgradation of freshwater fish and shellfish
Project code	:	I-59
Sub-project	:	In vitro production of fertile sperms from the testicular cells of *Clarias batrachus*
Project Code	:	I-59 (m)
Funding Agency	:	Institute-based
Duration	:	April 2012 - March 2016
Project Personnel	:	H. K. Barman (PI) and S. K. Sahoo

In vitro production of fertile sperm from the cultivated spermatogonial stem cells of *Clarias batrachus*

In this study, the collagenase treated testicular cells of farmed catfish (*Clarias batrachus*) were purified by Ficoll gradient centrifugation followed by Magnetic activated cell sorting (MACS) using *Thy1.2 (CD 90.2)* antibody so as to enrich spermatogonial cell population. The purified spermatogonial cells counted about 3×10^6 cells from 6×10^6 cells of mixed population and are proliferative in nature. The purified cells were cultured *in vitro* for more than 2 months in L-15 media containing fetal bovine serum (10%), carp serum (1%), bovine serum albumin (0.5%), 1X N-2 supplement, glucose and other nutrients. The sorted cells proliferated forming clumps/colonies bearing typical characteristics of SSCs. The morphology of these cells looked like SSCs with the feature of larger nuclear compartment as compared to cytosolic compartment observed under microscope. The mRNA expression profile by qPCR documented that the enriched spermatogonial cells were *Plzf* $^+$ and *pou2* $^+$ indicating their undifferentiated features (Fig 33). After remaining 2 month in culture condition, the self-renewing population of magur spermatogonial cells produced motile sperms (in tune of 6×10^7 on day 75) *in vitro* through differentiation process. The *in vitro* produced sperms (2260 sperms/SSC) are motile in nature and free swimming inside the flask containing media. Out of those, 2% were capable of fertilizing so as to generate healthy fingerlings (Fig 1). Even though the rate of fertile sperm production is very low, our documented evidences provided a way of *in vitro* fertile sperm production from cultivable magur SSCs.

In conclusion, this is the first evidence of successful enrichment, characterization and *in vitro* propagation of magur (*C. batrachus*) spermatogonial cells in undifferentiated state. The *in vitro* sperm production could mitigate the problem of sacrificing the male magur during milt collection. Sperm could also be produced round the year, but not restricted during breeding season. Although the success rate of fertile sperm production is only 2%, but it provided the platform for basic and applied biology researches.

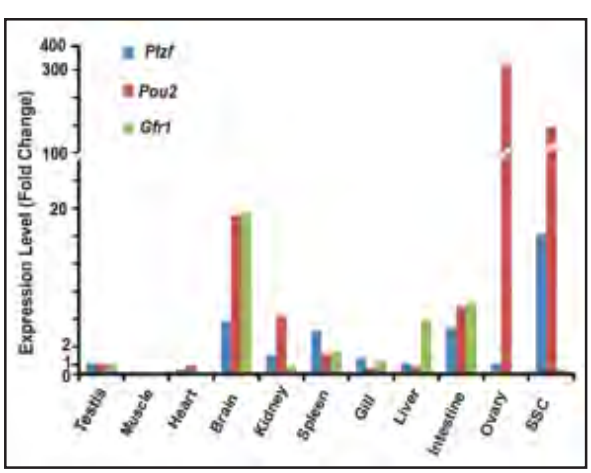


Fig. 33: q RT-PCR for gene expression study of *C. batrachus*. The heightened *mRNA* expression levels of *Pou2* and *Plzf* in enriched SSCs.

Sub-project	:	Establishment of base population and stock evaluation of Indian major carp, *Cirrhinus mrigala*
Project Code	:	I-59 (Q)
Funding Agency	:	Institute-based
Duration	:	April 2013 - March 2016
Project Personnel	:	Khuntia Murmu (PI), K. D. Mahapatra, J. N. Saha and L. Sahoo

Six stocks of *C. mrigal* (Table-21) collected from different geographical locations. Stocks were reared up to fingerling size in nursery ponds, Mrigal were tagged and reared communal pond. Propagation of pure stock of each populations were carried out. Mrigal stocks were also bred to propagate the individual populations (Table-22).

Table 21: Collection of live samples from different locations

Location for *C. mrigala*	No./Size
Brahmaputra (Assam)	50 (Fingerlings)
Ramsagar (W.B.)	100 (Fingerlings)
Beel stock (Assam)	100 (Fingerlings)
State Govt farm (Assam)	150 (Fingerlings)
CIFA KVK (Odisha)	200 (Fingerlings)
Ganga (Bihar)	150 (Fingerlings)

Table 22: Breeding Performance of *C. mrigala*

	Local stock	Ramsagar, WB	Assam Bheel
Brood stocks	M- 1.50 Kg Avg. F-1.75 Kg Avg.	M- 1.80 Kg Avg. F- 2.00 Kg Avg.	M- 2.00 Kg Avg. F- 2.50 Kg Avg.
No of pairs	2	2	1
Breeding strategy	Stripping and external artificial fertilization		
Volume of fertilized egg	1.0 lt/Kg	1.0 lt/Kg	1.0 lt/Kg
Percentage of fertilization	94 %	98 %	93 %
Egg incubation	Glass Jar hatchery		
No of spawn	200000	250000	150000
Avg. cell diameter (mm)	4.438	5.041	5.738
Hatching %	86.32	75.00	88.23
Hatchling length (mm)- 1st day	4.636	4.735	5.033
Hatchling length-2nd day	6.088	5.899	6.122

Sub-project	:	Establishment of base population for genetic improvement of *Labeo bata* (Hamilton, 1822)
Project Code	:	I-59 (P)
Funding Agency	:	Institute-based
Duration	:	April 2013 - March 2016
Project Personnel	:	P. K. Meher (PI), P. Das, L. Sahoo, P. Routray and J. K. Sundaray

The three stocks of *L bata* viz, Ramsagar (WB), Kalyani (WB) and Odisha stock collected from Jobra and Balkati were reared in isolation different ponds of CIFA for attainment of maturity. Random mating of the each stock was done to propagate the stocks by taking 20 males and 20 females in Chinese circular hatchery and happa breeding in ponds. 25000 of spawns from each stock were reared in separate ponds for development of base population. The length weight relationship of the body weight of *L. bata* was found to be isomeric. The breeding cycle of the *L. bata* was completed (Fig 34).

Table 23: Within-population Genetic Diversity in *Labeo bata*

Population	Microsatellite locus					
	Lr 3	Lr 10	Lr 14b	Lr 21	Lr 23	Mean
Ramsagar (20)						
A	2	10	3	12	7	6.8
Ho	0.0000	0.5714	0.1764	1.0000	0.3157	0.3827
H_E	0.4421	0.9880	0.2205	0.8970	0.7192	0.6089
F_{IS}	1.0000	0.4217	0.2000	-0.1148	0.5610	0.3715
Kalyani (20)						
A	3	13	5	14	6	8.2
Ho	0.0526	0.9166	0.3000	0.8421	0.2105	0.4269
H_E	0.3245	0.9431	0.3184	0.7441	0.5146	0.5367
F_{IS}	0.8378	0.0281	0.0579	0.1318	0.5909	0.2045
Balakati (20)						
A	7	18	12	7	9	10.6
Ho	0.3571	0.7058	0.6315	0.7142	0.7000	0.6309
H_E	0.7142	0.9540	0.8918	0.8049	0.8868	0.8591
F_{IS}	0.5000	0.2601	0.2918	0.1126	0.2107	0.2656
Jobra(11)						
A	7	5	4	5	7	5.6
Ho	0.2000	0.2000	0.1818	0.8571	0.5555	0.3809
H_E	0.8388	0.9500	0.7000	0.7857	0.8958	0.8191
F_{IS}	0.7616	0.7895	0.7403	0.0909	0.3798	0.5349
A in all populations	8	30	15	21	12	86/5 = 17.2 allele/ locus

Alleles detected (A), observed and expected heterozygosities (Ho, HE), inbreeding co-efficient (F is).

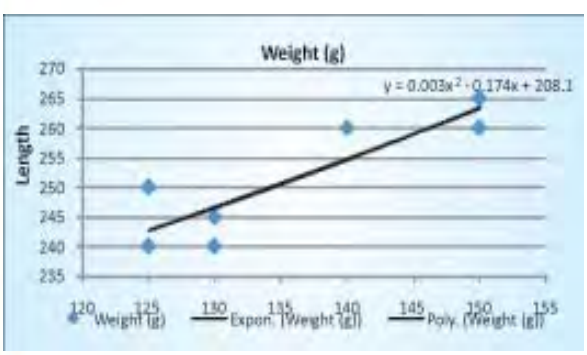


Fig. 34: Length-Weight relationship for *L. bata* Ramasagar stock sampled at 5 month of culture.

Sub-project	:	Development of genomics resources in Indian major carp, *Catla catla*
Project Code	:	I-59 (R)
Funding Agency	:	Institute-based
Duration	:	April 2013 - March 2016
Project Personnel	:	L. Sahoo (PI), P. Das, P. K. Meher, K. Murmu and J. K. Sundaray

Primers for 50168 number of microsatellite loci were designed using the software Batchprimer3. Out of this 500 primers were chosen randomly and synthesized from IDT. The PCR amplification of these primers was checked by taking the DNA from two wild catla individuals. Out of 400 primers checked for PCR amplification 300 were amplified with specific PCR band. So far 13 SSR loci were found to be informative in catla mapping population.

Sanger sequencing approach was followed for validation of previously identified putative single nucleotide polymorphism (SNP) markers. Primers from the flanking region of 20 SNP were designed and synthesized. The PCR amplification specificity was checked. All the primers for 20 SNPs showed a single PCR band. Towards validation of SNPs 20 DNA from unrelated catla individuals representing 5 mitochondrial haplotypes were chosen and PCR amplified with the 20 primers. The PCR products were purified and sent for sequencing.

To enrich SNP data base in rohu ~30 GB of RNA-Seq data generated from three libraries constructed from RNAs isolated from growth selected, control and unselected groups and analysis is under progress. Further, ~28 GB of RNA-Seq generated from three cDNA libraries of rohu. Towards validation of putative SNPs identified through RNA-Seq analysis primers from the flanking region of 20 SNPs were designed and synthesized. Further, primers for 10 genic SSR loci was designed and synthesized.

For it stocking of 2010-year class Jayanti rohu in two 0.1 h rearing ponds one each for feeding with CIFABROOD™ (experimental) and normal pelleted feed (control) were done for three months prior to breeding. The studied parameters at end of experimental period of 3 months were gonadal growth and maturation, brood performance, seed quality, larval survival and growth. Beside changes in serum hormonal level during pre-monsoon, monsoon and post-monsoon period were also accessed. The experimental fishes fed with CIFABROOD™ @ 3% of the total body weight in bags and the control fishes fed with normal commercial feed mill at the same rate. There were significant increase in gonadal weight (average 8 fold), and comparative histological study of control and experimental fish also shows significant differences in oocytes maturation. Milt volume of the brood male fish in control and experimental pond were 9-12 ml and 15-18 ml respectively. Percentage of fertilization and hatching percent in control and experiment group were 80 & 95 and 65 & 78 respectively. There were almost 1.36 time increase in serum estradiol and 1.74 time increase in serum progesterone level in experimental group compared to control. Breeding performances were better in experimental group as compared to control.

Perinucleolar stage of primary oocyte growth several nucleoli appear at the periphery of nucleus. Olympus CX41 Phase Contrast & Polarized Light Microscope 4X, 10X, Hematoxylin & Eosin. Po-Primary Oocyte, N-Nucleus, No- Nucleoli, O-Ooplasm, FE - Follicular Envalop, YG - Yolk granules, DO - Developing Oocytes,

Project Title	:	Stock improvement and quality seed production of important freshwater carp, catfish and prawn: prerequisite for National Freshwater Fish Brood Bank (NFFBB)
Project Code	:	E-80
Funding Agency	:	NFDB
Duration	:	February, 2013 - February, 2018
Project Personnel	:	K. D. Mahapatra (PI), P. K. Sahoo, Bindu R. Pillai, S. K. Sahoo, P. C. Das, J. N. Saha K. Murmu and B. Mishra

CIFA has supplied 18.0 lakhs of "Jayanti rohu" and 4.0 lakhs of catla (generation-1) to NFFBB, Kausalyaganga for further rearing and dissemination. Under this NFDB funded project, in collaboration with NFFBB, CIFA has directly supplied following minor carps to different states. i.e.

1. *P. sarana:* Produced- 79.0 Lakhs and disseminated 24.0 Lakhs to Odisha and West Bengal
2. *Labeo gonius:* Production- 9.0 Lakhs and supplied to west Bengal & Odisha 2.0 Lakhs Fry
3. *L. fimbriatus:* Supplied seed 1.34 Lakhs to West Bengal and Odisha
4. *L. calbasu*- 39,400 fry to Odisha

Creation of awareness for quality seed production

1. Farmer- Scientist interaction meet on "Quality seed and feed for Aquaculture development at Berhampore, Mursidabad, West Bengal on 7 May 2015. More than 110 fish farmers/ hatchery owners attened the program.
2. ICAR –CIFA and Fisheries College and Research Institute, Tamil Nadu Fisheries University, Tuticorin jointly organized Farmers' Scientists- interaction meet on 'Carp Broodstock Management and Quality Seed Production' on 22 September 2015 at Thanjavur, Tamil Nandu. The meet was attended by over 150 farmers from Chennai, Thanjavore, Tuticorin and nearby areas. Apart from farmers, entrepreneurs, seed producers,

representatives of feed companies such as Cargill, Biostadt were present. The Jayanti rohu seeds were stocked on 1st Jan 2015 in nursery ponds of the farm "Arvind Fish Farm" and periodic sampling showed encouraging results. A tripartite MoU was signed among the Tamil Nadu Fisheries University, ICAR-CIFA and Arvind Fish Farm for establishing a multiplier unit for Jayanti rohu in Tamil Nadu.

3. ICAR- Central Institute of Freshwater Aquaculture, Bhubaneswar in collaboration with NFDB, organized Farmer-Scientist-Interaction Meet on "Importance of quality fish seed in Aquaculture" on 23rd December 2015, at NAMKAHANA, West Bengal. More than 100 fish farmers attended the workshop. Growth evaluation of improved rohu "Jayanti" as well as catla was also initiated at low saline water of Namkhana area.

Project Title	:	Whole genome sequencing and development of allied genomics resources in two commercially important fish: *Labeo rohita* and *Clarias batrachus*
Project Code	:	E-85
Funding Agency	:	DBT, Govt. of India
Duration	:	September 2013 - September, 2016
Project Personnel	:	P. Das (PI), P. Jayasankar, L. Sahoo and P. K. Meher

The sequence data generated so far in rohu and magur was assembled using CLC bio workbench and Abyss. The genome coverage for rohu and magur was found to be 56.4%, 80% and 76% and 87% respectively for CL bio and Abyss. In addition to the multiplatform sequence data generated earlier another 26.06 GB of next generation data was generated employing Roche 454GS-FLX, Illumina MiSeq and PacBio RSII platforms.

Towards enrichment of microsatellite map in rohu 770 loci out of 2044 loci screened for PCR amplification showed good amplification. Informativeness screening of the above loci resulted 180 informative loci in rohu. In the similar way, primers for 1000 microsatellite loci were synthesized in magur. Three mapping families have been generated in magur and 300 F1 offspring from two best families have been sampled and preserved in -80 ^{0}C. Towards development of SNP markers in rohu 65 GB of paired end sequence data from 10 rohu populations were generated. Similarly, 30 GB of paired end sequence data from 3 magur populations were generated and being analyzed at ICAR-NBFGR.

Project Title	:	Molecular and computational approach to delineate metabolic path ways for better carbohydrate utilization in Labeo species
Project Code	:	E-90
Funding Agency	:	Network project on Agricultural Bioinformatics
Duration	:	November 2014 - March 2017
Project Personnel	:	J. K. Sundaray (PI), P. Jayasankar (PC), S. Nandi, P. K. Meher, L. Sahoo, K. D. Rasal, U. K. Udit, P. Nandanpawar, Avinash R. Rasal, (Co-Centre, ISARI: Dinesh Kumar (PI) M. A. Iquebal, Sarika and U. B. Angadi)

Glucose dose was standardized on *Labeo rohita* (average wt. =100±25 gm) by taking six different glucose concentrations at 100, 200, 300, 400, 500 and 600 mg/ml respectively, and among the doses 300 mg/ml was achieved as standard dose for experimental group size. The glycemic profile of *L. rohita, L. bata, L. fimbriatus & C. catla* shows that after glucose injection, the glucose concentration level is increasing up to a level and then decreasing. After two hrs of glucose administration, it shows that the blood glucose concentration in all four species is maximum where the *L. bata* shows the highest glucose utilization. *In-silico* characterization of insulin and its receptors by using bioinformatics tools was also carried out. The three dimensional structure of insulin of *Labeo rohita* was generated. The generated model shows the target protein sequence possesses 60.2% of helices, 48.1% of sheets and 9.3% of turns and domains span from 93-107 respectively. A total of 16 different isoforms of receptors of insulin were considered for analysis, out of which only 12 isoforms of receptors (iso1, iso2, iso3, iso4, iso5, iso6, iso7, iso8, iso9, iso10, iso11, iso12) were having exons, but the iso13, iso14, iso15 and iso16 were lacking of exons. Molecular modeling of these 16 isoforms and docking against the insulin of *L. rohita* were carried out which showed that iso10 has the strongest binding affinity where as iso5 has the weakest binding affinity.

Project Title	:	Three months national training programme in molecular biology and biotechnology for fisheries professionals
Project Code	:	E-91
Funding Agency	:	DBT, Govt. of India
Duration	:	February 2015 to February 2018
Project Personnel	:	J. K. Sundaray (PI), P. Jayasankar (PC) and P. Das

As it is training Project we have successfully carried out the DBT-HRD training programme 2 times with five no of participants in each Batch. The first Batch of DBT-HRD Training Programme was inaugurated on 15 May 2015. The total Training period was 90 days. The participants were Dr A. Chandrasekhar Rao from Dept. of Aquaculture, Sri V. V. University, Tirupathi, Andhra Pradesh, Mr. Sudipkumar Mohanta fromDept. of Zoology, B.D Mahavidyalaya, Rangamatia, Mayurbhanja, Odisha, Mr. Sikendra Kumar and Mr Saurav Kumar from ICAR-CIFE, Versova, Mumbai. The 2nd Batch of DBT-HRD Training Programme was inaugurated on 2 November 2015. The total Training period was 90 days. The participants were Dr. Pronob Das from ICAR-CIFRI, Assam, Ms. Sabita Sundi from Dept. of Zoology, Mahila College, Jharkhand, Mr. Manish Jayant and Dr. Mohd. Aklakur from ICAR-CIFE, Versova, Mumbai, Mr. Ravi Ranjan from BDA College, Pichhi Bermo, Bokaro, Jharkhand. Twenty Internal and External Faulty members of different disciplines of molecular biology and biotechnology were involved for both practical and theory classes for this training programme. After completion of 15 days theory and practical class the trainees have undergone a small project work.

Project Title	:	Deciphering gene structure and mechanism of Plzf gene expression in spermatogonial stem cells of *rohu* carp, *L. rohita*
Project Code	:	E-92
Funding Agency	:	SERB under DST
Duration	:	March 2015 to March 2018
Project Personnel	:	H. K. Barman (PI), J. K. Sundaray

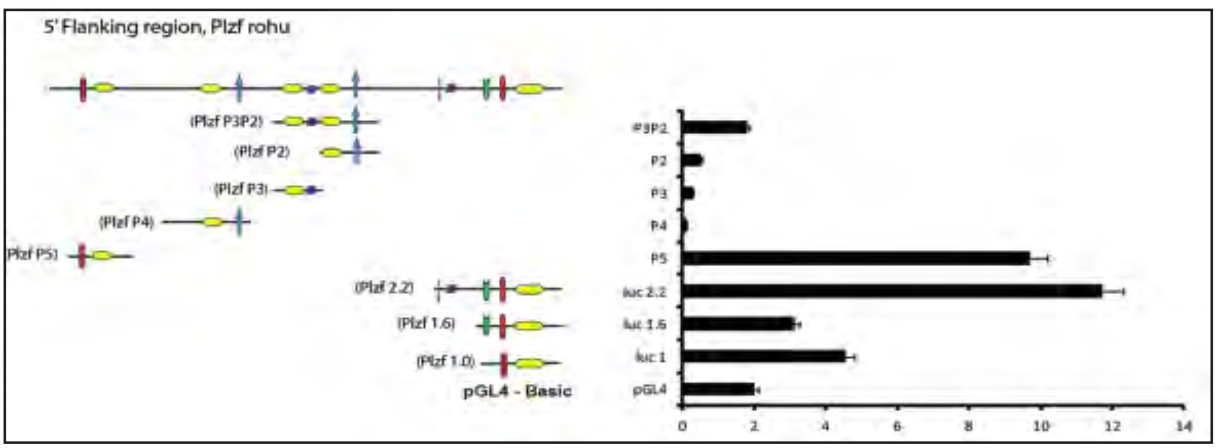
Promyelocytic leukemia zinc finger (*Plzf*), a transcriptional repressor, is involved in survival and maintenance of pluripotent stem cells including embryonic and spermatogonial stem cells in mammals. In teleost, the information on its promoter activity is lacking. Here, we have isolated, sequenced and performed the first characterization of regulatory elements for *Plzf* being expressed in proliferating spermatogonial stem cells of rohu (*Labeo rohita*). Interestingly, computational analysis detected several putative regulatory elements including TATA-box positioned in the first intron. Luciferase reporter assay was performed for serially deleted constructs to measure their promoter activities. The region containing putative TATA- and CAAT-boxes including GC-rich motif, positioned within first intron, was identified as a potential promoter; but its full promoter activity was dependent on upstream region containing a putative Evi-1-like element. Moreover, our findings also identified a region acting as transcriptional repressor. The human *Plzf* gene promoter was identified around 6kb upstream (Takahashi and Licht, 2002). Based on the published as well as our data, we presumed that the *Plzf* gene expression could be driven by the multiple promoter/regulatory elements in different organs. Keeping this in view, we cloned and sequenced around 8 kb from start codon of *Plzf* gene. Further bioinformatics analysis of the entire region was identified with several TATA/CAAT boxes, enhancers, repressor elements.

To examine the promoter/regulatory mechanism of *Plzf* gene expression, five constructs of 5'-flanking region containing promoter sequence were cloned in pGL4 luciferase plamid. The 5'-flanking region constructs are *Plzf*_P2 (1.0 kb, spanning from -1749 to -894), *Plzf*_P3 (0.4 kb spanning from -2321 to -1796), *Plzf*_P3P2 (1.4kb

spanning from -2321 to -894), *Plzf*_P4 (1.3 kb spanning from -3994 to -2322) and *Plzf*_P5 (0.8kb spanning from -6290 to -5490), respectively, from downstream to upstream. Among these, P5 showed the promoter activity based on the luciferase assay.

Our previously reported *Plzf* promoter in the first intron *vis-à-vis* our currently identified promoter located in -6290 to -5490 provided the clue that this *Plzf* gene expression is regulated by more than one promoter. It would be of interest to delineate the exact participatory role of each promoter in various organs including spermatogonial stem cells in future.

Mechanism of Plzf gene expression. Relative luciferase activity of different 5'-serially deleted Plzf promoter-reporter constructs



P3P2(-2321 to -894):TATA, TATA, MEF-2D, GATA, **No activity**

P2(-1749 to -894): TATA, MEF-2D, **No activity**

P3(-2321 to -1796): GATA, TATA, **No activity**

P4(-3994 to -2322): TATA, MEF- 2D, **No activity**

P5(-6290 to -5490): TATA, G/C rich, CAAT, **Prompter activity**

*Plzf***2.2(1st intron 2.2 kb):** TATA, CAAT, Gfi 1, GATA, **Promoter Activity**(luc)

Plzf **1.6(1st intron 1.6 kb):** TATA, CAAT, Gfi 1, **Promoter Activity** (luc)

Plzf **1(1st intron 1.0 kb):** TATA, CAAT, **Promoter Activity** (luc)

Project Title	:	Outreach activity on Fish genetic stock
Duration	:	2014 - 2017
Funding Agency	:	ICAR-Network mode
Project Personnel	:	P. Das (PI), J. K. Sundaray, L. Sahoo and S. K. Sahoo

Exploratory survey to Sambalpur was undertaken to assess the availability of assigned species e.g. *Tor khudree*, *Pangasius pangasius* and *H. fossilis.* Additionally, exploratory survey was carried out to Banki, Balogaon, Baidaswar and Naraj to assess the availability of Tor khudree and *Pangasius pangasius* in the river Mahanadi and tributaries and distributaries during different time of the year. Further, extensive survey and field tour were carried out to different parts of South India like Shimoga, Bellari, Cochin and Kollam and in total 68 *Tor khudree* samples were collected. Species reconfirmation of collected samples were carried out using mitochondrial COI gene.

Project Title	:	Isolation and molecular cloning of hypoxia tolerant genes in *Channa striatus*
Funding Agency	:	DST-WOS(A)
Duration	:	March 2014 to March 2017
Project Personnel	:	H. K. Barman (Mentor), Shibani Dutta Mohapatra (PI)

Molecular cloning, characterization and functional validation of hsp90β gene promoter

In order to define the mechanisms responsible for the regulated expression of a *channa striatus* HSP90β gene, we isolated, sequenced and performed the characterization of regulatory elements for gene encoding HSP90β in *C. striatus.* About 2.45kb of 5′ flanking region relative to ATG start codon was derived by genome walking including 1336 base pairs upstream of the transcription initiation site. The total length of the gene was determined as 8.4kb, consisting of

12 exons (including one non coding exon) and 11 introns obtained from genome walking strategy after construction of genome walking library (EcoRV, DraI, PvuII and StuI) using Genome Walker™ kit (Clontech) as per manufacturer's instructions. The coding exons range in size from 134 to 334 base pairs.

homology modelling using Modeller9.1. The predicted model evaluation along with stereo-chemical quality assessment was carried out by using the SAVES (Structural Analysis and Verification Server), (http://nihserver.mbi.ucla.edu/SAVES/). The ProSA (Protein Structure Analysis) web server (https://prosa.services.came.sbg.ac.at/prosa) was used for

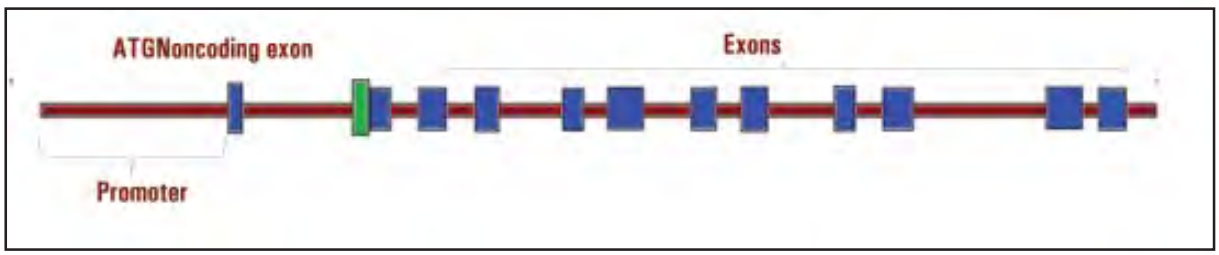


Fig. 35: Full length HSP90β gene (8.4Kb)

Analysis of the promoter region detected putative TATA and CAAT consensus sequences. The promoter activity was examined by constructing deleted constructs of plasmid containing the 52 -end of the HSP90β gene so as to drive a luciferase repoter gene expression. This plasmid was used to stably transfect HEK293 cells. The abundance of the transcripts increased the luciferase expression, demonstrating that the promoter region of this gene contains the *cis*-acting elements required for the transcriptional response Fig. 37. This is the first report of identifying HSP90â gene promoter of *C. striatus*; which would have future implications in understanding its adaptive response during stresses.

refinement and validation of HSP90 â protein structure.

OBJECTIVE:

- Elucidation of genomic organization of c-kit.
- Molecular cloning and characterization of 5'-flanking regions of c-kit gene.
- Delineation of promoter and other regulatory elements of c-kit in order to understand the mechanisms of its expression.
- Expression analysis of c-kit in different developmental stages of rohu spermatogonial cells.

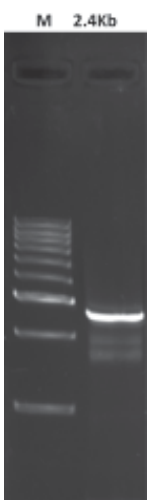


Fig. 36: 5′ Flanking region above ATG

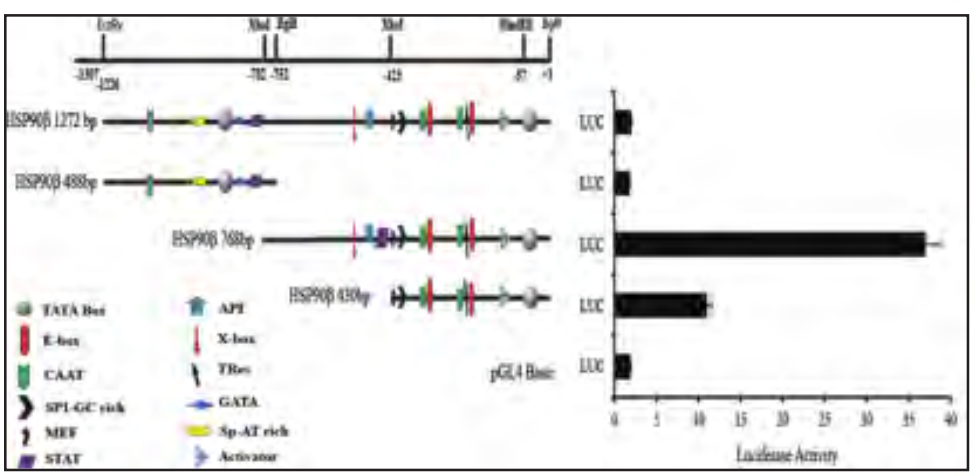


Fig. 37: Luciferase assay

Three dimensional structure prediction and quality assessment

In order to generate 3D structure for HSP90 â protein was retrieved from RCSB-PDB databank and used for

RESULT:

In order to generate sequence information of 5'-flanking region of c-kit, genome walking strategy was implemented. Based on this sequence

information, all the reverse primers (gene specific primer) for genome walking were designed and synthesized. The primers are enlisted in table 24.

To identify c-kit promoter in rohu carp, the 5'-flanking sequence was amplified from genomic DNA implementing PCR-based Genome Walking strategy using specific reverse primers, designed from the first coding-exon of rohu c-kit. Approximately, distinct 1.1kb upstream sequence from Xma I library and 600bp sequence from stu I library was obtained. These two amplified fragments are expected to be the 5'-flanking region of c-kit. To confirm it, these bands were gel extracted for bi-directional sequencing. DNA sequencing is being analyzed.

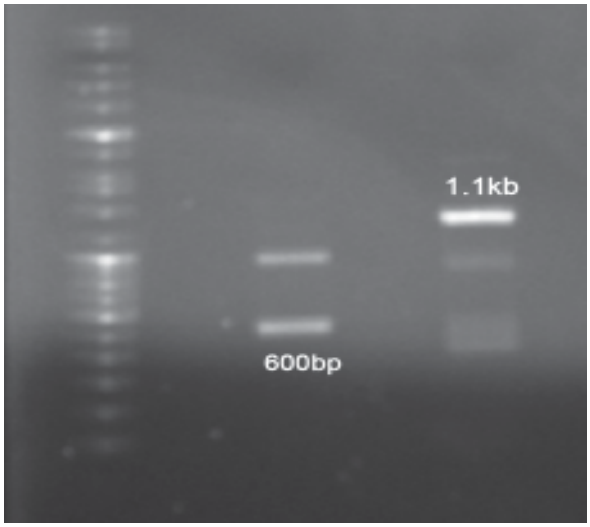


Table 24: Tabular Data Format (Primer details)

Name		Sequence	Length Tm	CG%	Q
R1	5'-tggaacggccttctcgcagcca-3'	22	64.9°C	63.6%	128
R2	5'-ccttcaggggtgatagtgggcctg-3'	24	64.0°C	62.5%	115
R3	5'-tggctgcagctctccggatcga-3'	22	64.0°C	63.6%	122

Project Title	:	Novel approaches towards vaccine development against argulosis in carps
Project Code	:	E-
Funding Agency	:	ICAR (Consortia Research Platform on Vaccines and Diagnostics)
Duration	:	August 2015 to March 2017
Project Personnel	:	J. Mohanty (PI), P. K. Sahoo, M. R. Badhe

In order to identify the immunodominant proteins of fish ectoparasite *Argulus siamensis*, the parasite proteins were run in 2D gel electrophoresis followed by western blotting. Adult *A. siamensis* parasites were collected from infected fish host maintained in wet laboratory. Protein sample preparation was carried out by triturating the whole parasites and collecting the supernatant after centrifugation. Precipitation of proteins was carried out by acetone-TCA precipitation method.

The precipitate was dissolved in rehydration buffer for running 2D electrophoresis. The protein concentration in sample for 2D gel electrophoresis was measured and adjusted to approximately 500 ug/ml in rehydration buffer. Sample of 125 µl (50 µg protein) was then used to rehydrate 7 cm IPG strips of pH 4-7. The IEF was run in IPGphor 3 (GE Healthcare, UK) for 10000 Vh. The second dimension SDS-PAGE was carried out in 12% gel at 150 V. Two duplicate gels were run in 2D electrophoresis. One gel was stained with Mass Spectrometry compatible silver stain. Western blot transfer was carried out with the 2nd gel. The blot was then immunostained with fish (rohu) antisera to *Argulus* whole homogenate. Fourteen corresponding spots to the immunostained spots were picked from the stained gel. Further studies are in progress to identify these proteins by mass spectrometry.

C. Fish Nutrition and Physiology

Project Title	:	Feed and nutrient evaluation in cultivable freshwater fish
Project Code	:	I-85
Funding Agency	:	Institute-based
Duration	:	April 2013 - March 2016
Project Personnel	:	S. S. Giri (PI), N. Sridhar, Saroj Toppo (up to May 2015), S. Adhikari, B. B. Sahu, S. C. Rath, S. Mohanty, B. Gangadhar, B. N. Paul, K. N. Mohanta, K. C. Das, S. Sarkar and S. K. Nayak
Sub-project Title	:	Status and impact of antioxidants in fish feeds
Project Code	:	I-85(a)
Funding Agency	:	Institute-based
Duration	:	April 2013 - March 2016

A feeding experiment of eight weeks duration was carried out in wet laboratory. The fingerlings of *Labeo rohita* were stocked in nine numbers of 200l capacity plastic tanks containing 12 fish in each. Mixed aqueous extract of duck weeds, azolla and water hyacinth were added to the extruded feed during production at the rate of 0, 1 and 2% respectively. The mineral mixture and vitamin were mixed with the control feed whereas only aqueous extract was mixed with experimental feeds (Feed 1 and 2). Aerators were used in each tank to provide sufficient oxygen and half of water was changed daily. Water quality parameters were also checked and found as optimum. The weight of total biomass was recorded at weekly interval and feed intake was recorded daily. Finally, the FCR and cost of the three floating feeds were calculated based on the ingredients cost purchased from the local market. The growth performance of rohu was recorded. Weight gain of fish in different groups did not differ significantly. Total intake of feed and FCR also did not differ significantly. This shows that, the plant extract could be the natural micronutrient supplement to be utilized in aquaculture as feed additive to produce quality feed.

Sub-project	:	Macronutrients requirement of the Peninsular carps, *Puntius carnaticus* fingerlings
Project Code	:	I-85(b)
Funding Agency	:	Institute-based
Duration	:	April 2013 - March 2016
Project Personnel	:	N. Sridhar (PI) and Gangadhar B.

Growth performance of *Puntius carnaticus* fingerlings in diets containing varied levels of lipid

Fingerlings of *P. carnaticus* (n=180) of average initial length 5.10 ± 0.37 cm and weight 1.40 ± 0.24 g were distributed into 15 groups of 12 fish each in plastic tubs (40 L). Five feeds were formulated with 35% crude protein and 40% NFE but varied levels of lipid (2.5-12.5%) using pure ingredients (Table 25). The experimental feed was fed at 5% of the biomass and it was gradually adjusted based on the observation of daily feed consumption. Fish were allowed to fed for 6 hours. The unconsumed feed was siphoned out at the end of the feeding period. On the following day, fecal matter was siphoned out. The feeding trial was conducted for a period of 60 days. Proximate composition of feed was analysed (AOAC 1995). Water quality parameters was analysed for pH, temperature, dissolved oxygen and total alkalinity at fortnightly intervals following standard methods (APHA 1998). The experiment is in progress.

Table 25: Ingredient proportion (%) and proximate composition (%) of experimental feeds

Ingredients used	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Casein	33.36	33.36	33.36	33.36	33.36
Gelatin	6.64	6.64	6.64	6.64	6.64
Dextrin	23	23	23	23	23
Cod liver oil	2.5	5	7.5	10	12.5
CM Cellulose	10	10	10	10	10
Agar	2.5	2.5	2.5	2.5	2.5
Vitamin mineral mix	4.5	4.5	4.5	4.5	4.5
Cellulose	17.5	15	12.5	10	7.5
Proximate composition (%)					
Moisture	3.24±0.07	3.14±0.01	2.34±0.01	4.33±0.06	4.92±0.02
Crude protein	35.03±0.24	35.12±0.96	34.90±0.55	34.96±0.56	34.84±0.74
Fat	2.10±0.21	4.63±0.53	7.02±0.45	9.51±1.20	11.53±0.96
Ash	6.28±0.03	6.28±0.04	6.36±0.04	6.00±0.05	5.84±0.02
Crude fiber	11.87±0.78	9.30±1.20	7.60±0.13	4.28±0.12	1.14±0.06
NFE	41.48±1.33	41.53±2.74	41.78±1.27	40.92±1.99	41.73±1.79
Gross energy (kJ/g)	1.59±0.03	1.69±0.04	1.78±0.06	1.86±0.05	1.95±0.04

Sub-project Title : Improving the protein use efficiency in carp diet
Project Code : I-85(c)
Funding Agency : Institute-based
Duration : April 2013 - March 2016
Project Personnel : K. N. Mohanta (PI), S. Adhikari and K. C. Das

Protein sparing effect of carbohydrate in *Jayanti* rohu fry using gelatinized carbohydrate

From the study undertaken last year on protein sparing effect of carbohydrate using raw carbohydrate, it was found that the optimum protein (CP) and carbohydrate (CHO) levels for *Jayanti* rohu fry were 35% and 22.5% respectively, when the raw starch was used as dietary carbohydrate source. Therefore, a diet containing 35% CP and 22.5% raw starch was developed and used as control diet (C). Diet containing 35% CP and 22.5% gelatinized starch was also kept as reference diet (R). Six experimental diets were prepared by reducing the CP level from 35% to 30 and 25% and increasing the gelatinized starch from 22.5% (Control) to 25.5%, 28.5% and 31.5%. The experimental diets are as follows, 35% CP and 22.5% gelatinized starch; Treatment-1 (T-1): 30% CP and 25.5% gelatinized starch; Tretament-2 (T-2): 30% CP and 28.5% gelatinized starch; Tretament-3 (T-3): 30% CP and 31.5% gelatinized starch; Treatment-4 (T-4): 25% CP & 25.5% gelatinized starch; Treatment-5 (T-5): 25% CP and 28.5% gelatinized starch; Treatment-6 (T-6): 25% CP and 31.5% gelatinized starch. The casein and gelatin were used as source of protein, maize (raw and gelatinized) as source of carbohydrate, carboxymethyl cellulose as binder and cellulose powder as filler. Diets were fed to *Jayanti* rohu fry (0.83-0.85 g) for a period of 60 days in triplicate with 10 fish in each. The fish were fed twice daily at 5% of their body weight. The growth and nutrient utilization of experiment are presented in Table 26.

Table 26. Growth and nutrient utilization of Jayanti rohu fry with different level of protein and carbohydrate.

Dietary treatment	Initial weight	Final weight	Weight gain	FCR	SGR	PER
C (35% CP & 22.5% Raw Starch)	0.84 ±0.01^{a}	3.55 ± 0.11^{c}	2.71 ±0.13^{c}	1.50 ±0.07^{de}	2.40 ±0.08^{c}	1.91 ±0.09^{de}
R (35% CP &22.5% Gelatinized Starch)	0.83 ±0.01^{a}	3.84 ±0.05^{b}	3.01 ±0.06^{b}	1.41 ±0.04^{e}	2.56 ±0.05^{b}	2.03 ±0.05^{cd}
T-1 (30% CP &25.5% Gelatinized Starch)	0.84 ±0.01^{a}	4.33 ±0.14^{a}	3.49 ±0.13^{a}	1.23 ±0.04^{f}	2.73 ±0.04^{a}	2.72 ±0.09^{a}
T-2 (30% CP &28.5% Gelatinized Starch)	0.84 ±0.00^{a}	3.52 ±0.13^{c}	2.69 ±0.13^{c}	1.56 ±0.03^{de}	2.39 ±0.06^{c}	2.15 ±0.04^{bc}
T-3 (30% CP &31.5% Gelatinized Starch)	0.84 ±0.02^{a}	3.46 ±0.06^{c}	2.62 ±0.06^{c}	1.64 ±0.02^{cd}	2.34 ±0.04^{c}	2.04 ±0.03^{cd}
T-4 (25% CP &25.5% Gelatinized Starch)	0.85 ±0.02^{a}	3.13 ±0.09^{d}	2.28 ±0.08^{d}	1.72 ±0.06^{c}	2.17 ±0.04^{d}	2.32 ±0.08^{b}
T-5 (25% CP &28.5% Gelatinized Starch)	0.84 ±0.01^{a}	2.96 ±0.03^{d}	2.12 ±0.03^{de}	2.02 ±0.07^{b}	2.09 ±0.02^{d}	1.98 ±0.07^{cde}
T-6 (25% CP &31.5% Gelatinized Starch)	0.84 ±0.01^{a}	2.67 ±0.10^{c}	1.83 ±0.09^{e}	2.22 ±0.05^{a}	1.93 ±0.05^{e}	1.81 ±0.04^{e}

From the table 26 it was found that significantly higher (P<0.05) weight gain, SGR, PER and lower (P<0.05) FCR were observed in Jayanti rohu fry fed 30% CP & 25.5% gelatinized starch. Therefore, the dietary protein level could be further lowered from 35 to 30% by using gelatinized starch at 25.5% instead of using the raw starch at 22.5% in Jayanti rohu fry. However, any further decrease in dietary protein level from 30 to 25% by increasing the gelatinized starch beyond 25.5% did not improve the growth and nutrient utilization in *Jayanti* rohu fry.

The effect of optimum and sub-optimum levels of dietary protein to improve the protein use efficiency in rohu grow out culture (Continued from last year experiment).

In a 7-months pond experiment, rohu fingerlings (8.0 g) were fed with 20% (sub-optimum level) and 25% (optimum level) of crude protein with following feeding protocol: Treatment-1 (T-1): 20% protein for 7 months; Treatment-2 (T-2): 20% protein for 4 months + 25% protein for 3 months; Treatment-3 (T-3): 200 g kg^{-1} protein for 3 months + 25% protein for 4 months and Control (C): 25% protein for 7 months. The fish were fed at 5% rate for the first month and reduced to 1-3% in the subsequent months, depending on the feed consumption and size of the fish. The growth, fish production and nutrient utilization of fish under different feeding protocols are presented in Table 27. Results indicated that the growth and fish production of T-2 was similar (P>0.05) to T-3; it was significantly higher (P<0.05) than T-1 and Control. However, there was no significant difference (P>0.05) found in FCR, SGR and PER of fish fed different feeding protocols. Although there was no significant difference (P>0.05) in weight gain and fish production between T-2 and T-3, the protein consumption was significantly higher (P<0.05) in T-3 as compared to T-2. From the study, it was found that in a 7 months pond culture of rohu, feeding the fish with sub-optimum level of protein (20% protein) for 4 months followed by optimum level of protein (25% protein) for 3 months is the most ideal feeding strategy to save the protein without hampering the growth and production of fish.

Table 27: Effect of feeding of optimum (25% protein) and sub-optimum (20% protein) levels of dietary protein on growth, nutrient utilization and production performance of *Labeo rohita*.

Parameters	Treatment-1 (20% protein for 7 months)	Treatment-2 (20% protein for 4 months + 25% protein for 3 months)	Treatment-3(20% protein for 3 months + 25% protein for 4 months)	Control-C (25% protein for 7 months)
Initial weight (g)	8.2±0.23^{a}	7.8±0.37^{a}	8.0±0.30^{a}	7.6±0.52^{a}
Final weight (g)	565.69±13.96^{c}	658.47±17.50^{ab}	691.05±17.97^{a}	623.98±11.96^{b}
Weight gain (g)	557.49±14.00 ^{c}	650.63±17.60^{ab}	683.05±18.06^{a}	616.35±12.11 ^{b}
Net fish production (kg/pond)	185.13±2.70^{c}	226.80±6.24^{a}	229.46±6.02^{a}	205.04±6.08 ^{b}
Net fish production (kg)/ha	3702±54.01^{c}	4536.0±124.88^{a}	4589.13±120.58^{a}	4100.73±121.69^{b}
Protein consumption/pond	70.18±1.94^{c}	96.40±2.73^{b}	109.13±5.15^{a}	94.37±2.46^{b}
FCR	1.78±0.07 ^{a}	1.85±0.02 ^{a}	1.95±0.09 ^{a}	1.74±0.02^{a}
SGR	2.12±0.02^{a}	2.22±0.04^{a}	2.23±0.03^{a}	2.20±0.04^{a}
PER	2.64±0.10 ^{a}	2.35±0.05 ^{a}	2.11±0.10 ^{a}	2.17±0.03 ^{a}

Sub-project Title	:	Detoxification and use of plant based non-conventional ingredients in carp feeds
Project Code	:	I-85(d)
Funding Agency	:	Institute-based
Duration	:	April 2013 - March 2016
Project Personnel	:	S. C. Rath (PI), Saroj Toppo, B. N. Paul and S. Sarkar

Rain tree pod (*Samanea saman*) (RTP) is identified as a potential non-conventional feed ingredient which can be used as fish feed. The resource is plentily available in our country. It is a low cost ingredient to replenish costly oil cakes in carp feeds. A complete protocol was developed to incorporate the raintree pod as a low cost protein rich co-ingredient in the carp feed in different forms such as mash, sinking pellets and floating pellet.

Protocol for incorporation

Rain tree pod is rich in protein (252 g/kg $^{-1}$) and energy (20 KJ). The each pod is about 10 g and bears 5-6 seed. The pod is mucilaginous, moist and sticky. Raw RTP can be safely incorporated in carp fed up to 30% level. As a new ingredient no literature is found regarding any suitable method of incorporation. The protocol developed at CIFA is as follows:

- The ripe deciduous pod in bulk quantity is collected locally under the canopy of tree.
- Pods are sun dried for 2 days, on a poly lining.
- Pods are broken to pieces (1-2 cm) and again sun dried for 2 days.

- As the pods are mucilaginous it is difficult to mill to powder.
- The broken pod pieces are mixed with rice bran in 1:1 ratio by weight.
- Pod-bran mixture is ground to debris by a hammer mill.
- Hammer milled content is passed through the grinder/pulvoriser to form the pod-bran ready mix powder.
- Proximate composition of pod –bran ready mix is determined before developing any feed.

Pond experiment with RTP containing feed

Feed of 25% CP with RTP as one of the ingredient Vs. Feed of 25% CP without RTP was evaluated in pond with IMC species (Table 28).

Ponds in triplicate were stocked with IMC @ 250/ha. Routine pond management was being done as per semi-intensive aquaculture practices. Supplementary test feed was given @ 2% of the body weight and growth parameters were studied. Result indicated that RTP can be incorporated in carp feed which replaces edible oil cake partly without compromising growth and survival (Table 29).

Table 28. Feed developed with incorporation of RTP and without RTP

FEED 1 with RTP

Ingredient	CP	CL	% Incorporation in feed	% contribution to feed	% CP % CL contribution to feed	Cost of ingredient (Rs/Kg)	Cost contribution To feed (Rs).
RTP	25	2	28	7.0	0.56	15.00	4.20
RB	11	10	44	5.28	4.4	10.00	4.40
GOC	42	07	28	11.76	1.96	40.00	11.20
Total	—	—	100	24.04	6.92		19.80

Feed 2 without RTP

Ingredient	CP	CL	% Incorporation in feed	% contribution to feed	% CP % CL contribution to feed	Cost of ingredient (Rs/Kg)	Cost contribution To feed (Rs).
RB	11	10	56	6.16	5.6	10.00	5.60
GOC	42	07	44	18.48	3.08	40.00	17.60
Total	--	--	100	24.64	8.68		23.20

Table 29: Growth parameters comparison of fish in feed 1 and feed 2

Growth parameters	Feed 1	Feed 2	'P' value
Mean Initial body wt (g)	154.1 ± 0.74	149.8 ± 0.99	P<0.05
Mean Wt. gain (g)	219.8 ± 7.6	210.1 ± 7.9	P>0.05
Mean Wt gain %	142.6 ± 5.1	140.6 ± 4.4	P>0.05
Mean Specific growth rate	0.590 ± 0.01	0.584 ± 0.01	P>0.05

Sub-project	:	Effect of some processing conditions on quality of extruded floating feed for Indian major carps
Project Code	:	I-85(e)
Funding Agency	:	Institute-based
Duration	:	April 2013 - March 2016
Project Personnel	:	K. C. Das (PI) K. N. Mohanta, B. B. Sahu, S. Mohanty and S. K. Nayak

Growth experiment

The experiment was carried out in earthen ponds. Ponds (0.06 ha each) were stocked in triplicate with 250 rohu fingerlings each for two feeds based on till oil cake (TOC). Floating feed of 1 mm size was prepared on two different extrusion temperatures (130 ^{0}c and 150 ^{0}c) and fed *ad libitum*, once daily. Ponds were managed by routine carp culture practices. The sampling of fish was done once in every month and experiment was continued for 3 months. There was no significant difference in the growth rate and feed conversion ratio (FCR) of fishes fed on floating feed prepared on two different extrusion temperatures. Earlier research indicated that higher extrusion temperature (170 ^{0}C) degrades protein of floating feed. The intake of feed and floating percentage of the feed was also reduced at 110 °C extrusion temperature. Though 130-150 ^{0}C extruded temperature was found to be normal temperature for feed production, electric energy consumption is high if higher extruded temperature is maintained. So the extrusion temperature of 130 ^{0}C and moisture 20 percent is appropriate for production of TOC based floating feed for carp.

Fig. 38: A til oil cake based floating feed prepared during the experiment

Microbial population in GI tract

The total bacteria population in GI tract of fish was done by plate count method. Whole GI tract of fish was weighed and homogenized with physiological saline. Serial dilutions and agar plate methods were used to count TPC. All the colonies developed on the agar plates were counted and counts per gram of sample were calculated. The result showed that there was no significant difference of extrusion temperatures of floating feed on microbial population of GI tract.

The present research showed that the floating feed developed incorporating TOC are superior to floating feed prepared by inclusion of only soyabean meal. This is economical for the farmers. TOC based floating feed is prepared by maintaining the extrusion temperature of 130 ^{0}C and moisture of 20%.

Sub-project Title	:	Neuroendocrine regulation of gonadal maturation through environmental manipulation during out of breeding season in catla
Project Code	:	I-89
Funding Agency	:	Institute-based
Duration	:	April 2014 - March 2017
Project Personnel	:	Ashis Saha (PI), S. C. Rath and P. C. Das

Photothermal manipulation for gonadal maturation during non-breeding season in catla

Catla brood were maintained in the brood-rearing pond. Matured male and female brood were induced to breed during the month of June. Spent brood was kept in the cement cisterns in the indoor rearing facility of the Climatology laboratory from last week of July 2015. Fishes were exposed to two different conditions: a) long photoperiod (photoperiod hours is more than that of natural photoperiod) in combination with water temperature above than ambient temperature (treatment) in the indoor condition and b) natural photothermal as prevailed in pond (control). The progress of gonadal development was monitored by assessing secondary sexual characteristics as well as measuring gonadosomatic index (GSI). Sampling during last week of October revealed slight roughness of pectoral fin of male brood in the treated group that indicated initiation of maturation in treatment group. But in the control group there was no such development. Similarly, female brood in the treated group also showed slight bulging of abdomen, which indicated that maturation process fed begun but, in the control group there was no such development. GSI of male and female brood in treated group reached up to 1.12 ± 0.04 and 11.14 ± 0.21, respectively (Fig. 39). This growing GSI value gives a clear picture of gonadal development due to photothermal intervention during non-breeding season in catla. However, due to some accidental electrical problem mass mortality occured in the experimental tanks which compelled to terminate the experiment.

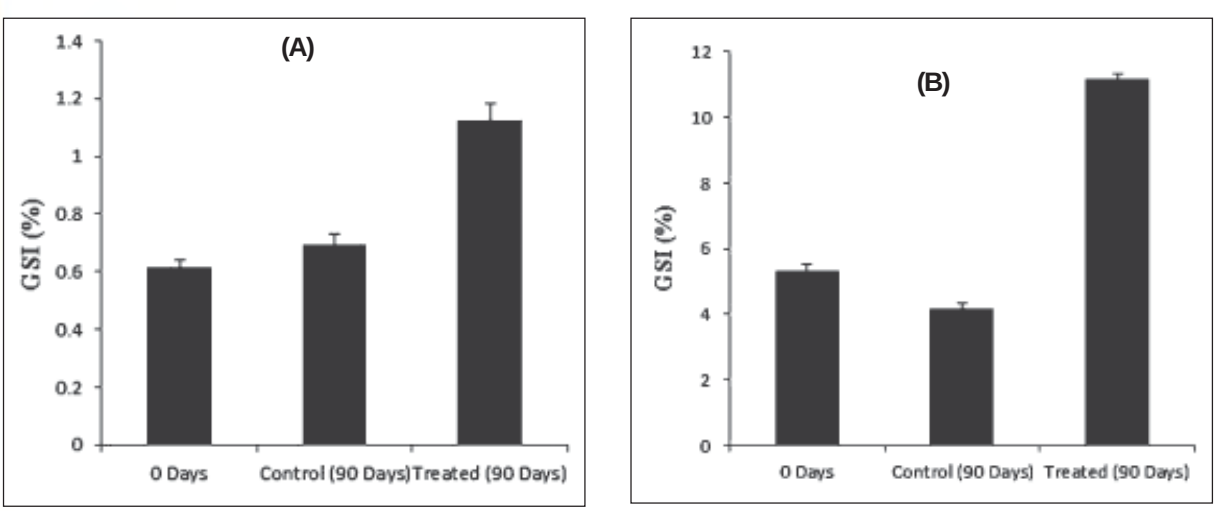


Fig. 39: Changes in gonadosomatic index (GSI) value (%) of male (A) and female (B) catla under different photothermal regime

Project Title	:	Regulation of Kisspeptin and GnRH in reproduction of rohu (*Labeo rohita*) under varied environmental conditions
Project Code	:	E-81
Funding Agency	:	DBT
Duration	:	August, 2013 - July, 2016
Project Personnel	:	Ashis Saha (PI) and L. Sahoo

Molecular characterization of two kiss genes and their expression in rohu (*Labeo rohita*) during annual reproductive cycle

Kisspeptin is an important regulator of reproduction in mammals and presumably non-mammalian species. In the Indian subcontinent, rohu (*Labeo rohita*) is a commercially important seasonal breeder freshwater fish species. So far the expression of kisspeptin gene during different phases of annual reproductive cycle of rohu has not been investigated. To address this, we cloned and characterized kiss1 and kiss2 full-length cDNA by RACE (rapid amplification of cDNA ends), and analyzed their expressions in brain–pituitary–gonad (BPG) axis by quantitative real time PCR (qRT-PCR) assay at various gonadal developmental stages during annual reproductive cycle (Fig. 40 and 41). Full-length rohu kiss1 and kiss2 cDNA encodes 116 and 125 amino acids, respectively. In the adult fish, they were widely expressed in brain, pituitary, gonad, liver, muscle, kidney, intestine and eye. In male, kiss1 mRNA in brain and testis showed the highest level of expression during meiosis division of the gonad. The kiss2 mRNA revealed the highest expression during recrudescence stages in the brain, spermiation stages in pituitary and post-spawning stages in testes. Females showed significantly ($p<0.05$) higher level of kiss1 transcript expression in brain and ovary during full grown oocyte stages, whereas during pre-vitellogenic and vitellogenic stages in pituitary. The kiss2 gene expression was almost similar at various gonadal developmental stages in the brain and ovary, but, the highest expression was detected in full grown oocyte stages in the ovary. The result together suggests that the involvement of two kiss genes in the control of seasonal gonadal development in rohu.

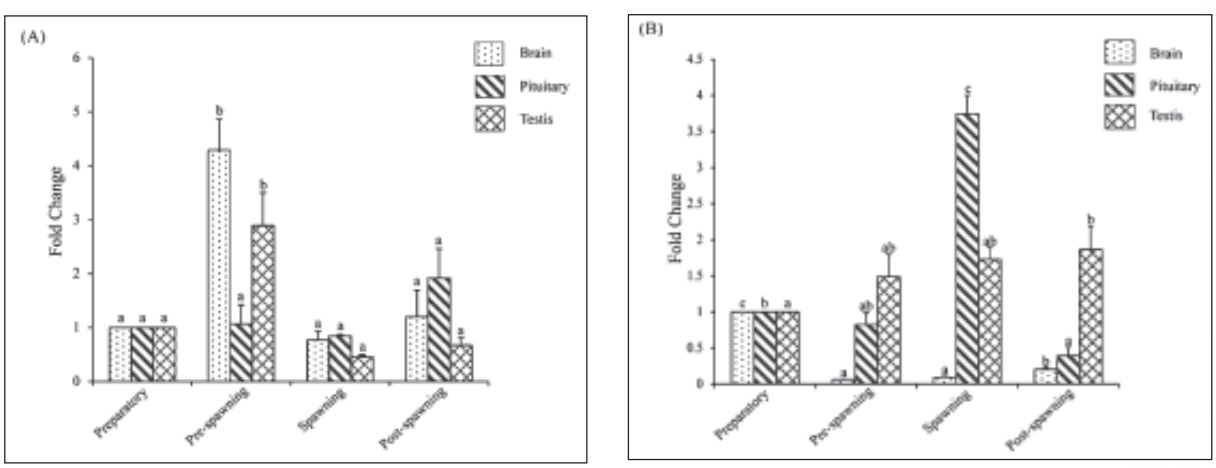


Fig. 40: Relative changes in *kiss 1* (A) and *kiss 2* (B) mRNA Expression in the brain- pituitary-gonad axis of male rohu at preparatory, pre-spawning, spawning and post-spawning phases in an annual reproductive cycle. Expression of *kiss1* and *kiss2* mRNA transcripts were represented as a ratio relative to elfα (internal control) levels in the same sample, *kiss1* and *kiss2* expression at the preparatory phase was chosen as the calibrator (1) and the relative expression of *kiss1* and *kiss2* in other phase were represented as fold changes from the calibrator. Values are mean ± SEM (n=6). Different alphabets above the bars indicate significant differences among phases of reproductive cycle.

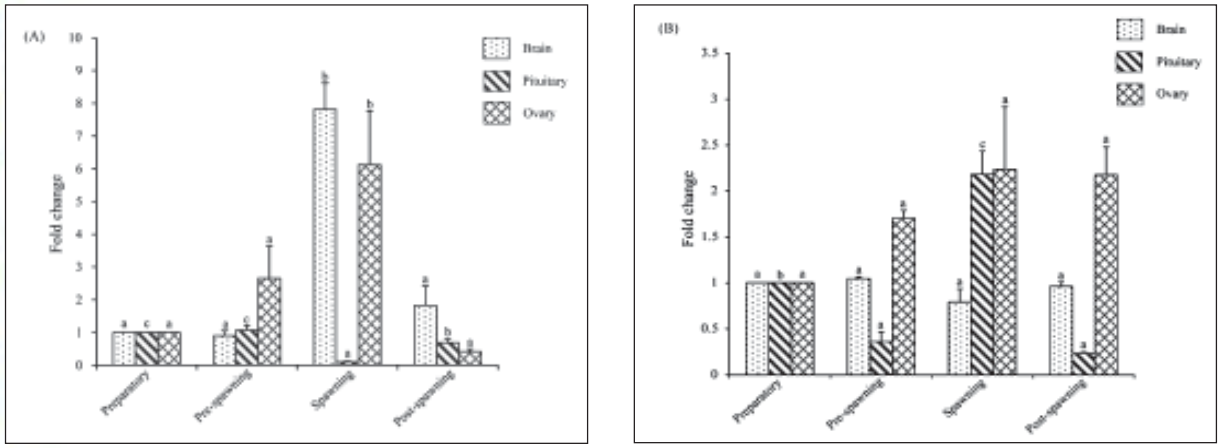


Fig. 41: Relative changes in kiss1 (A) and kiss 2 (B) mRNA expression in the brain-pituitary-gonad axis of female rohu at preparatory, pre-spawning, spawning and post-spawning phases of annual reproductive cycle. Expression of kiss1 and kiss2 mRNA transcripts were represented as a ratio relative to elfα (internal control) levels in the same sample, kiss 1 and kiss 2 expression at the preparatory phase was chosen as the calibrator (1) and the relative expression of kiss1 and kiss2 in other phase were represented as fold changes from the calibrator. Values are mean ±SEM (n=6). Different letters above the bars indicate significant differences among phases of reproductive cycle.

Project Title	:	Outreach activity on 'Fish Feed'
Funding Agency	:	ICAR
Duration	:	April 2012- March 2017
Project Personnel	:	S. S. Giri (PI), S. C. Rath, S. K. Sahoo, P. V. Rangacharyulu, N. Sridhar, B. N. Paul, K. N. Mohanta, and K. C. Das

Feed mill

The pilot scale feed mill of CIFA was utilised for training, demonstration and production of floating and sinking feed for carp, catfishes and prawn. During the current year over 200 farmers, entrepreneurs, students, scientists and policy makers visited the mill. Implant trainees of fishery college (OUAT) and participants of 'National Workshop and Training on Feed and Feed Technologies for Responsible Aquaculture were trained in the feed mill. Apart from the training and demonstration activities about 10 tons of feed of different types were produced and spared among various research units to feed their fishes.

Farm made feed

To popularize the use of low cost farm made feed, 13 awareness programmes, two training-cum-demonstration programmes (Nagaland and West Bengal), 4 All India Radio talks and two television programmes were delivered.

Training on feed management to enhance aquaculture production in Nagaland

ICAR-CIFA organized two days training programme in Phek district of Nagaland in collaboration with Krishi Vigyan Kendra-Phek of NRC, Mithun. The programme had four major components i.e

Fig. 42: Interaction with farmers

demonstration, live exhibition, and class room teaching and farmers interaction.

There was a demonstration of farm feed preparation using locally available ingredients and farm feed dispensing systems. A demonstration of floating feed application in the pond using 'Feed Frame' was made in KVK owned pond at Porba. Tribal women farmers took lead in 'learning by doing' demonstration.

Over 70 participants joined in the event and the teaching medium was English and Hindi. A local interpreter was assigned the job to interpret the lessons in tribal language (Nagamese) for those who did not understand either of these languages.

Demonstration of farm feed performance with low cost locally available ingredients at Belur Math

An off-campus grow out carp culture demonstration programme with low cost farm made feed was undertaken in Belur Math campus of Ram Krishna Mission (RKM), West Bengal. The objective of this programme was to train the vocational trainees of Samaj Sevak Shikhan Mandir of RKM in 'learning by doing mode'. Locally available low cost feed ingredients were identified, feeds were formulated and prepared at the pond site with the help of CIFA scientist and vocational students. Growout demonstration of Indian major carps with farm made feed was continued for eight months (July, 2015 to Feb 2016) in two selected ponds (Samaj Sevak Sikhan Mandir and Shilpamandira) of RKM. For greater visibility of this learning process and to create awareness among progressive farmers, a Workshop-cum-Training Programme on Farm Made Fish Feeds was organised during 24-25 Feb 2016. Within a period of eight months catla and rohu could grow as much as 2.2 kg and 1.6 kg, respectively. On the final workshop the specific feed formulae which was used in Belur Math campus was revealed in public and passed on to RKM for further dissemination programmes.

Project Title	:	Outreach activity on Nutrient profiling of fish
Funding Agency	:	ICAR
Duration	:	April 2013 - March 2017
Project Personnel	:	B. N. Paul (PI), S. S. Giri and N. Sridhar

Fish samples of bata, pabda, punti, channa, tangra, wallago, pangas, calbasu, reba and fimbriatus of different weight ranges were collected from Barasat, Kharibari, Malancha, Doperia, Rahara, Nilgaunge, Pansila, Burdwan, Bud Bud, Howrah and Bally fish market of West Bengal, RRC-CIFA, Rahara farm and RRC-CIFA, Bangalore farm. The samples were processed and analyzed as per the standard methodology to generate nutritional information (Tables 30 and 31).

The fatty acid profile of the analyzed fish samples revealed that both EPA and DHA are present in those freshwater fishes. The mineral content of 10 freshwater fish species was analyzed and the iron content varied from 0.25 to 0.68 ppm, manganese content varied from 0.15 to 0.43 ppm, copper content ranged from 0.01 to 1.71 ppm and the zinc content ranged from 0.21 to 1.75 ppm. The amino acid profiles of six Indian freshwater fish species viz., reba, pabda, tangra, calbasu, channa and wallago were assayed. Histidine content ranged from 0.05 to 0.79 (mg/100 g protein) in the analyzed fish samples. The glutamic acid was maximum among other amino acids and it ranged from 0.39 to 9.07 (mg/100 g protein). The tryptophan content ranged from 0.13 to 2.06 and leucine content varied from 0.14 to 0.42. Among the essential amino acids histidine, leucine and tryptophan were predominant and among the non-essential alanine, asparagine and glutamic acid were predominant.

Table 30: Proximate composition (% w/w basis) of freshwater fish

Species	Particulars			
	Moisture	Protein	Fat	Ash
L. bata	68.92-77.94	13.44-21.89	1.91-5.33	1.72-4.63
O. bimaculatus	68.88-79.51	11.50-16.44	1.85-5.36	1.71-3.24
P. javanicus	64.69-79.78	14.08-21.94	2.50-5.62	2.68-4.27
C. striata	71.40-77.93	12.71-15.69	1.75-4.07	1.99-2.82
M. vittatus	67.10-77.99	12.30-16.25	3.47-10.96	1.73-3.07
W. attu	67.03-80.22	11.42-18.32	2.67-4.02	1.50-2.88
P. sutchi	72.38-79.14	11.24-18.34	2.41-6.85	1.91-3.68
L. calbasu	72.76-77.92	12.84-15.92	1.95-5.83	1.81-2.60
C. reba	70.05-77.40	13.78-21.44	2.10-4.46	1.78-3.36
L. fimbriatus	73.28-76.78	16.62-17.33	1.48-1.98	2.51-3.02

The moisture content of freshwater fish ranges from 64.69 to 80.22(%), protein content ranges from 11.24-21.94%, fat content ranges from 1.48-10.96% and ash content ranges from 1.50-4.63%.

Table 31: Fatty acid profile (%) of freshwater fish

Species	Particulars				
	SFA	MUFA	PUFA	EPA	DHA
L. bata	36.32-45.11	34.76-44.73	18.97-30.13	3.57-7.17	4.74-8.74
O.bimaculatus	34.37-60.37	20.44-52.98	12.91-19.19	0.95-3.21	4.32-6.67
P. javanicus	52.43-64.81	21.70-38.79	8.78-13.48	0.65-0.91	1.57-5.39
M. vittatus	76.60-84.32	6.18-6.95	9.51-16.25	1.84-2.36	2.09-2.65
L.calbasu	46.84-47.15	35.16-36.84	16.69-17.71	0.40-0.67	0.55-0.91
L. fimbriatus	87.44-87.57	5.95-6.18	6.38-6.49	0.28-0.29	0.74-0.89

SFA-Saturated Fatty Acid; MUFA-Monounsaturated Fatty Acid; PUFA-Polyunsaturated Fatty Acid; EPA-Eicosapentaenoic Acid; DHA-Docosahexaenoic Acid

D. Fish Health Management

Project Title	:	Integrated disease management in freshwater aquaculture
Project Code	:	I-88
Sub-project Title	:	Characterization of gill associated fish pathogens and development of methods for their diagnosis and control measures
Funding Agency	:	Institute-based
Duration	:	April 2014 - March 2017
Project Personnel	:	S. S. Mishra (PI), B. K. Das, P. Swain, P. K. Sahoo, S. K. Swain, S. Adhikari, M. Samanta, Rakesh Das, P. Choudhary, Ananda Kumar and Ramesh Rathod

Study was conducted to isolate and characterize the gill associated bacteria of diseased goldfish (*Carassius auratus*) and koi carp (*Cyprinus carpio* var. koi) that showed gross pathological changes in the gills and symptoms on the body surface according to the stage of disease; viz., detachment of the scales, large irregular hemorrhages on the body surface, ulcers on the skin varying from shallow to deep necrotizing ulcers, fin erosions and whitish gills. Diseased fish samples were collected from Ornamental Fish Unit, ICAR-CIFA and Odisha State Fisheries Farm, Kausalyaganga in different time periods throughout the study duration. Gills were aseptically excised and subjected to bacterial isolation and characterization. Results of the study revealed that *Pesudomonas pseudocaligenes* CCCGP1 (GenBank Accession No. KT261756), *Bacillus cereus* CCGA3 (GenBank Accession No. KT261755), *Citrobacter freundii* CCAGC1 (GenBank Accession No. KT429602), *Pseudomonas putida* CCAGP2 (GenBank Accession No. KT429603) and Aeromonas *hydrophila* CCAGA2 (GenBank Accession No. KT429604) species were present in the infected gill tissue. The present study would be helpful to give brief idea on gill associated bacteria for developing pathogen specific control measures in future days.

Sub-project Title	:	Development of biocontrol agents against important fish pathogens and their application in aquaculture
Project Code	:	I-88(b)
Funding Agency	:	Institute-based
Duration	:	April 2014 - March 2017
Project Personnel	:	B. K. Das (PI), S. S. Mishra, Rakesh Das, P. Chaudhury and Anand Kumar

A study was conducted to isolate and characterize a novel bacterial strain which has anti-bacterial activity against common fish pathogenic bacteria. A total of six strains were isolated and one strain among them showed antibacterial efficacy in *in vitro* conditions. The isolated bacterial species was identified as *Clostridium bifermentans CPSS2* (GenBank Accession No. KT367517). The bacterial inhibitory activity of *C. bifermentans* CPSS2 was evaluated against pathogenic strains of *Flavobacterium columnare* ATCC 49513, *Staphylococcus aureus* JQ429749, *Aeromonas hydrophila* JQ687063 and *Edwardsiella tarda* JX280148 using the agar well diffusion method (Fig. 43) and was validated by a broth co-culture assay with their kinetics plots. Extracted intracellular proteins of *C. bifermentans* CPSS2 exhibited significantly ($p<0.05$) high antagonistic effect against *S. aureus* JQ429749 followed by *F. columnare* ATCC 49513 and *A. hydrophila* JQ687063 and least effective against *E. tarda* JX280148 (Fig. 44).The results of co-culture plate counts inferred that increasing count of *C. bifermentans* CPSS2 colonies positively antagonistic against the fish pathogenic bacteria. The result of phylogenetic study revealed that the isolated strain of *C. bifermentans* is closely related to *C. bifermentans E079*. The screening of inhibitory compounds from bacterium have clearly demonstrated that whole and intracellular proteins of *C. bifermentans* CPSS2 would be one of the promising bio-control agents against common fish pathogens in freshwater aquaculture sector.

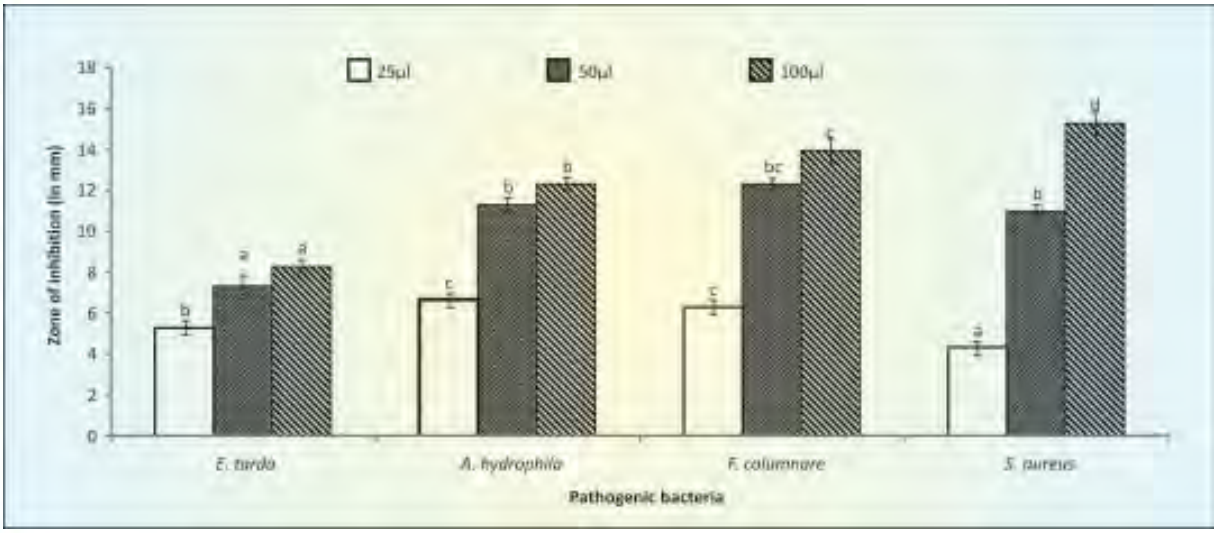


Fig. 43: Antagonistic effect measured in zone of inhibition (in mm) of varied amount of live *Clostridium bifermentans* CPSS2 against some selected fish pathogenic bacteria. The data presented with different superscripts differ significantly ($p<0.05$) and expressed as mean±SE.

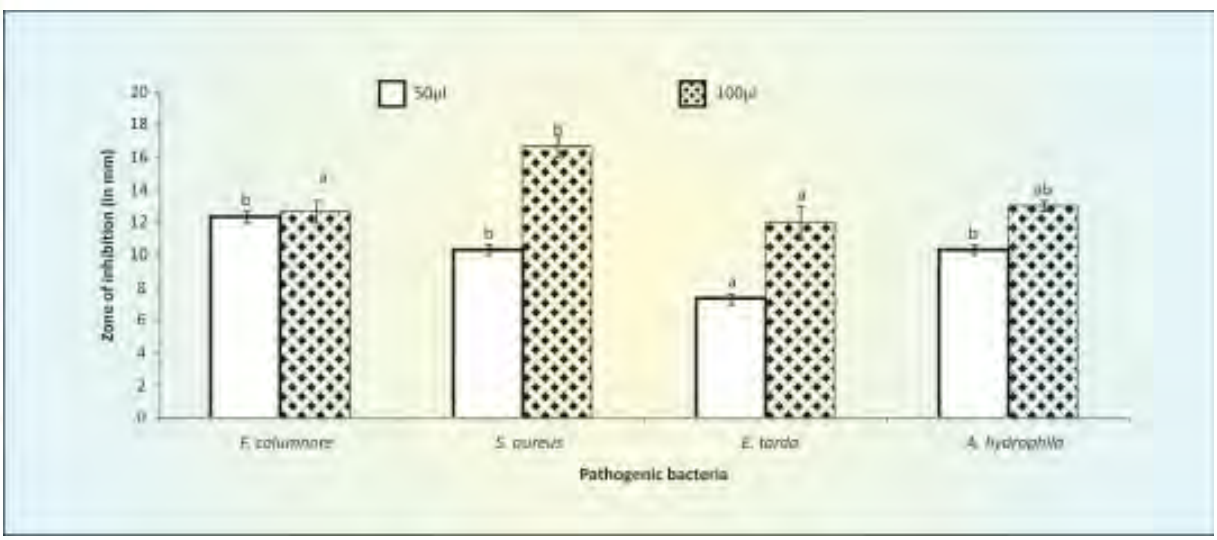


Fig. 44: Zone of Inhibition (in mm) formed by varied amount of intracellular proteins of *Clostridium bifermentans* CPSS2 against some selected fish pathogenic bacteria. The data presented with different superscripts differ significantly ($p<0.05$) and expressed as mean±SE.

Sub-project Title	:	Bacterial bioremediation of inorganic pollutants with special reference to ammonia and lead from freshwater ecosystem
Project Code	:	I-88(c)
Funding Agency	:	Institute-based
Duration	:	April 2014 - March 2017
Project Personnel	:	N. K. Maiti (PI), S. Mohanty, Bindu R. Pillai and S. Adhikari

To assess the functional aspects, bacteria were isolated from different waste water samples and identified by16S rDNA sequencing and gyrB gene sequencing. Three functional aspects *viz.*, nitrogen removal rate in presence of different carbon sources i.e. acetate (2 carbon), succinate (4 carbon) and glucose (6 carbon); visual aggregation and whole-cell hydrophobicity, and lead tolerance of 10 different isolates were tested. In presence of glucose as carbon source, all isolates except *Staphylococcus sciuri* CF-S20, *Serratia* sp. and *Citrobacter amalonaticus* CF-S8 showed significant nitrogen utilization from NH_4, NO_2 or NO_3. Similarly, in presence of acetate, all isolates except *Providencia vermicola* CF-S9and *Providencia vermicola CF*-S13 showed utilization ofNH_4, NO_2 and NO_3. In presence of succinate as carbon source, *Pseudomonas aeruginosa* CF-S1, *P. vermicola* CF-S13 and *P. aeruginosa* CF-S6 did not show any significant nitrogen utilization. Nitrification

activity of the isolates was tested by estimating NH_4^+-N removal rate in presence of different carbon source. Total nitrogen was removed successfully within 12-48h of incubation by most of the isolates with *Pseudomonas fluorescens* CF-S2 showing the best nitrification activity (Fig. 45). Similarly, denitrification activity of the isolates tested by estimating NO_3^--N or NO_2^--N removal rate showed that the total nitrogen was removed successfully within 9-96h of incubation by most of the isolates and *P. fluorescens* CF-S2 and *Pseudomonas otitidis* CF-S3 showed highest removal rate (Fig. 46 & 47). *P. fluorescens* CF-S2, *P. otitidis* CF-S3 and *P. aeruginosa* CF-S6showed maximum EPS production in visual aggregation and whole-cell hydrophobicity assay (Fig. 48). In addition, 7 isolates showed high tolerance to lead (100mg/l).

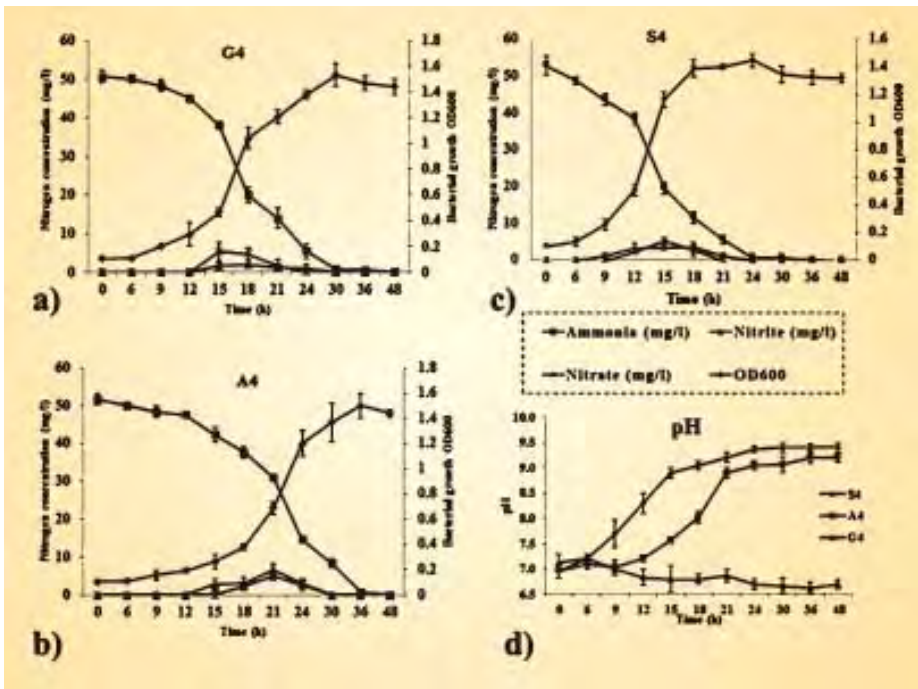


Fig. 45: Ammonium-N removal at different carbon source by *Pseudomonas fluorescens* CF-S2

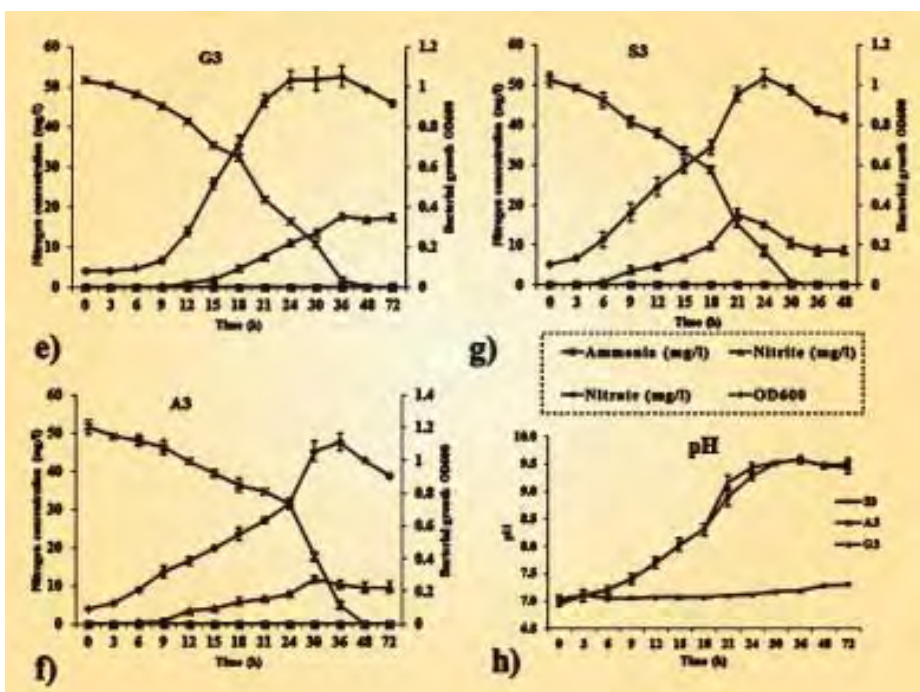


Fig. 46: Nitrate-N removal at different carbon source by *Pseudomonas fluorescens* CF-S2

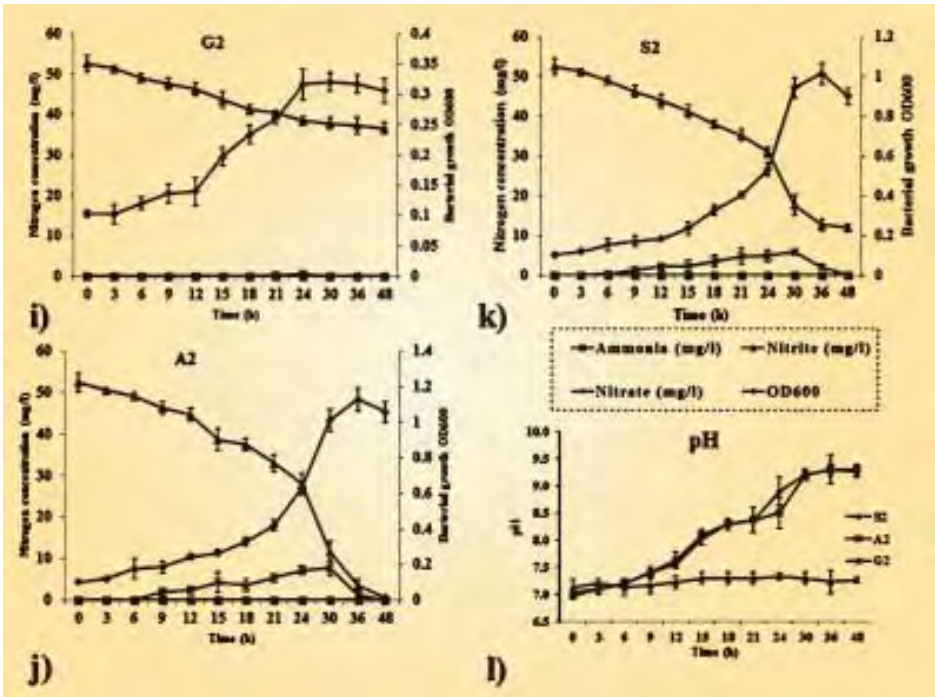


Fig. 47: Nitrite-N removal at different carbon source by *Pseudomonas fluorescens* CF-S2

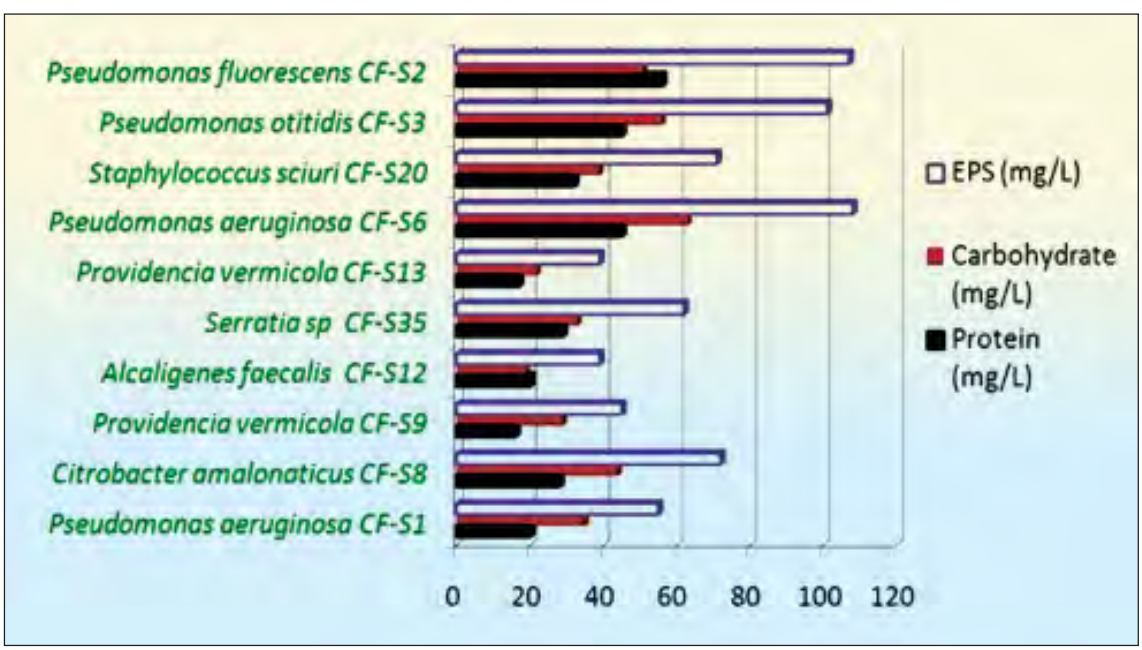


Fig. 48: Visual aggregation and whole-cell hydrophobicity assay of the isolates

Project Title	:	Development of novel immunopotentiator molecules from fish host and pathogens for broad spectrum disease control in freshwater aquaculture
Project Code	:	E-71
Funding Agency	:	ICAR National Fellow Scheme
Duration	:	April, 2011 to April, 2021
Project Personnel	:	P. K. Sahoo (PI)

Apolipoprotein A-I in *Labeo rohita*: Functional characterisation reveals its broad spectrum antimicrobial property, and indicates significant role during ectoparasitic infection

Apolipoprotein A-I (ApoA-I) is the most abundant and multifunctional high-density lipoprotein (HDL) which has a major role in lipid transport and potent antimicrobial activity against a wide range of microbes. The expression kinetics of ApoA-I was studied in three different pathogen

models to understand its functional role. Its expression was up-regulated in anterior kidney of rohu post-infection with *Aeromonas hydrophila*. Similarly, following poly I:C (poly ionosinic:cytidylic) stimulation the transcript levels increased in both anterior kidney and liver tissues. Significant up-regulation of rohu ApoA-I was observed in skin, mucus, liver and anterior kidney of rohu challenged with the ectoparasite, *Argulus siamensis*. Recombinant rApoA-I (rec ApoA-I) was produced in *Escherichia coli* BL21 (DE3) expression system and its immunomodulatory effect was demonstrated against *A. hydrophila* in vivo. Rohu injected with rec ApoA-I at a dose of 100 µg and challenged with *A. hydrophila* 12 h post immunization, showed a survival of 66% in comparison to 25% shown in control group (Table 32). The heightened expression levels of ApoA-I post-infection reflects its involvement in immune responses against bacterial, viral as well as parasitic infections. Our results also suggested that recombinant ApoA-I could be used as a potential immunostimulant against *A. hydrophila* infection in rohu.

Table 32: Mortality (%) at different time points post-exposure rohu injected with graded levels of rec ApoA-I and challenged with *A. hydrophila*

Dose of rec ApoA-I (µg)per fish	Mortality (%) at different time points post exposure to rec ApoA-I			
	0 h	6 h	12 h	24 h
50	50	0	0	0
100	0	0	0	0
200	75	25	0	25

Transcriptional analysis of immune-relevant genes in mucus of *Labeo rohita* following *Argulus siamensis* infection

An experiment was conducted to analyse the gene expression patterns in *Argulus siamensis* infected *Labeo rohita* mucus. *L. rohita* were challenged with 100 metanauplii of *A. siamensis*/fish and mucus samples were collected at 0 h, 12 h, 24 h, 3 d, 7 d, 15 d and 30 d by sacrificing four fish from the infected group and four fish from the control group at each time point. Important immune-related genes were selected according to our previous studies and their expression levels were examined using reverse transcription real-time quantitative PCR. Notably, expression levels of most of the genes examined changed significantly following parasite challenge in comparison to control fish. All the interleukins studied here (IL6, IL15 and IL1â) showed significant up-regulation in *A. siamensis* infected fish compared to respective control samples. IL15 and IL1â levels were found to significantly peak as early as 24 h post-infection and 12 h post infection, respectively. In addition to the cytokines, molecules involved in pathogen recognition, toll like receptor 22 (TLR22) and pathogen presentation, â2 microglobulin (â 2M) were also found to be significantly up-regulated compared to control samples throughout the study. The up-regulated expression of lysozyme G at all time points in the experiment points to the early activation of acute phase responses in mucus of *L. rohita* post-infection. Further, anti-oxidant gene natural killer cell enhancing factor B (NKEF-B) expression was studied and found to be more compared to control like other immune factors. Taken together, our results expand our understanding of mucosal immunity in reponse to *A. siamensis* infection and provide early insights for development of control methods against the parasite by immunological interventions.

Immune responses in various sizes of *L. rohita* to *A. siamensis* infection

Three different sizes of rohu (fingerling, 6.33±0.18 g; juvenile, 81.67±2.24 g, and pre-adult, 288.33±3.10 g) were used in this experiment. The fish of different sizes were maintained in single tank in triplicate along with appropriate control. The fish were challenged with *A. siamensis* at a dose of one adult parasite per 4 g body weight of fish. The parasite load on individual fish of each group was determined at 5 days interval for a period of one month. On 20th day post-infection when the load of parasite on adult fish was visually high along with detectable skin damage, skin tissues were collected from infected and control fish for immune gene expression analysis and histopathology.

The pre-adult fish showed significantly higher load of infection at each time point in comparison to other two stages of fish (Table 33). The fingerlings and juveniles showed higher load of infection at 30 dpi only in comparison to earlier periods.

Table 33: Argulus load on different sizes of fish at different days post-challenge

Size of fish	5 dpi	10 dpi	15 dpi	20 dpi	30 dpi
Fingerling	$1.66\pm0.33_{ab}^{x}$	$1.33\pm0.33_{ab}^{x}$	$1\pm0.0_{a}^{x}$	$0.33\pm0.33_{a}^{x}$	$2.66\pm0.33_{b}^{x}$
Juvenile	$6.33\pm2.02_{a}^{x}$	$6.33\pm1.76_{a}^{x}$	$7.33\pm0.88_{a}^{x}$	$5.66\pm3.17_{a}^{x}$	$25.33\pm0.88_{b}^{x}$
Pre-adult	$29\pm6.02_{a}^{y}$	$36.33\pm12.41_{a}^{y}$	$30\pm4.04_{a}^{y}$	$29\pm10.69_{a}^{y}$	UC_{b}^{y}

*dpi: days post infection, UC: Uncountable
x, y represents significance difference (P<0.05) between different sizes of fish at same time period.
a, b represents significance difference (P<0.05) between different time periods of same size fish.

On histopathology, the pre-adult fish revealed mild inflammatory reaction at the infected site in spite of carrying higher load of parasites, whereas the inflammatory reaction was prominent with massive myositis, congestion of blood vessels and migration of blood cells towards the attachment sites of parasite in the juveniles and fingerlings. The severity of infection was inversely proportional to degree of inflammation and size of fish. The same was well correlated with presence of high level of pro-inflammatory cytokine IL-8 and natural killer enhancing factor (NKEF) transcripts and lower level of anti-inflammatory cytokine (IL-15) in fingerling stages in real-time gene expression analysis of infected skin samples of different stages of fish.

Project Title	:	Nano-technology in aquaculture: an alternative approaches for fish health management and water remediation
Project Code	:	E-72
Funding Agency	:	ICAR National Fellow Scheme
Duration	:	April 2011 - March 2016
Project Personnel	:	P. Swain (PI)

Algicidal properties of metal and metal oxide nanoparticles

Algal strains (such as *Microcystis* sp., *Anabaena* sp., *Oscillatoria* sp., *Odogonium* sp., *Tribonema* sp.) were isolated from the freshwater aquaculture ponds and fisheries gadgets of ICAR-CIFA, Bhubaneswar. In this study, ZnO nanoparticles showed a negative effect on freshwater algae; such as growth inhibition, reduced chlorophyll content and cell structure alteration, cell aggregations and leakage and degradation of organelles occurred in all the species of alga irrespective of doses of nano-ZnO (Figs.49, 50 & 51).

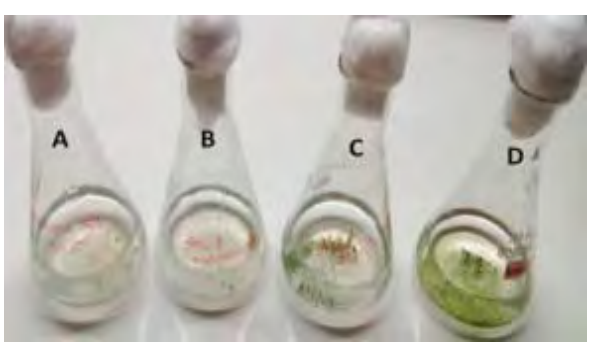


Fig. 49: Growth inhibition and cellular de-pigmentations of *Anabaena* sp. after 7 days of incubation period. Each flasks with exception control (D) were added zinc oxide nanoparticles at different conc. (A) 1 mg/ml, (B) 0.1 mg/ml and (C) 0.01mg/ml

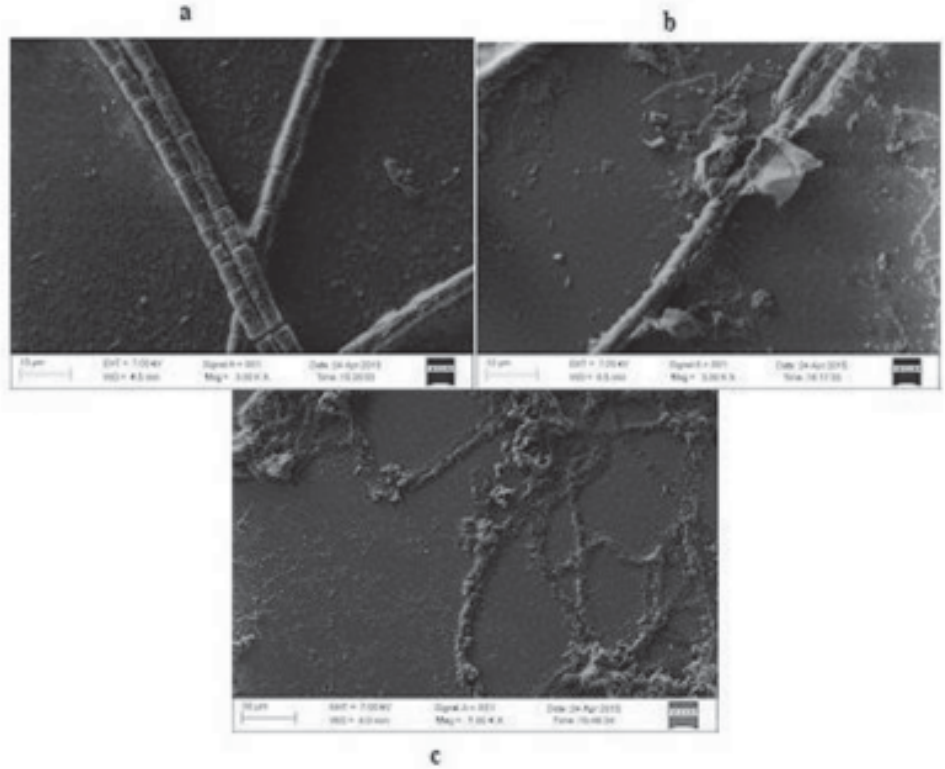


Fig. 50: The typical light microscopy images of *Tribonema* sp. cells treated with nano-ZnO (20mg/L) at different time intervals (a: 6 h, b: 3 h, and c: 0 h).

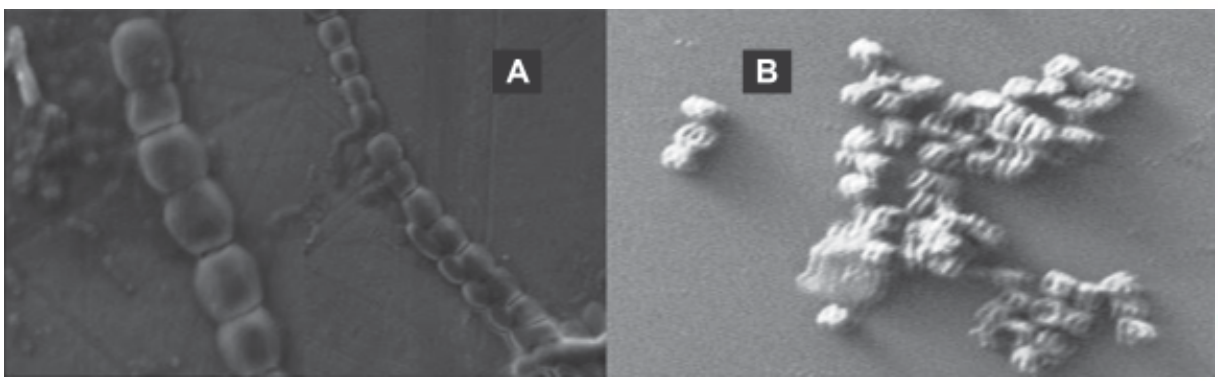


Fig. 51: SEM images of filaments of *Anabaena* sp. (a) control (untreated); (b) nano-ZnO (100mg/L) treated algal cells after 1 day

Aquatic exposure of zinc oxide nanoparticles induces developmental toxicity and oxidative stress in embryo *of Labeo rohita*

Since zinc oxide nanoparticles are widely being used in various industrial and commercial applications, its toxicological impact was assessed with regard to oxidative stress in rohu carp (*Labeo rohita*). It was found to exert dose-dependent toxicity in embryos as well as larvae of *L. rohita*, in terms of reducing the hatching rate (up to 50%) and survivability (up to 75%); within the dose range of 5 mg/L to 40 mg/L. ZnO exposures also led to inducing malformations such as curved tail, reduce body length, etc. as compared to control group (Fig. 52). Moreover, the transcriptional expression of mitochondrial inner membrane genes related to ROS production, such as Ucp2 and SOD were significantly up-regulated at 10 and 20 mg/L (4 and 2-folds, respectively for Ucp2, and 2 and 3-folds, respectively for SOD) whereas no significant expression were detected in case of 5 mg/L and 40 mg/L (Fig. 53 A&B). However, the transcriptional expression of Bcl-2 was significantly down-regulated in all the ZnO nanoparticles treated

groups except 20 mg/L which up regulated by 2.6 fold (Fig. 53 C). The possible explanation is that the reduction of Bcl-2 gene expression played an important role in the resistance of the enhanced oxidative stress.

In conclusion, nano-ZnO induced developmental toxicity and oxidative stress in fish, *L. rohita* embryo and larvae at dose 10mg/L and 20 mg/L . The data generated from this study may have immense applications in understanding the beneficial and toxicity effects of ZnO nanoparticles in fish.

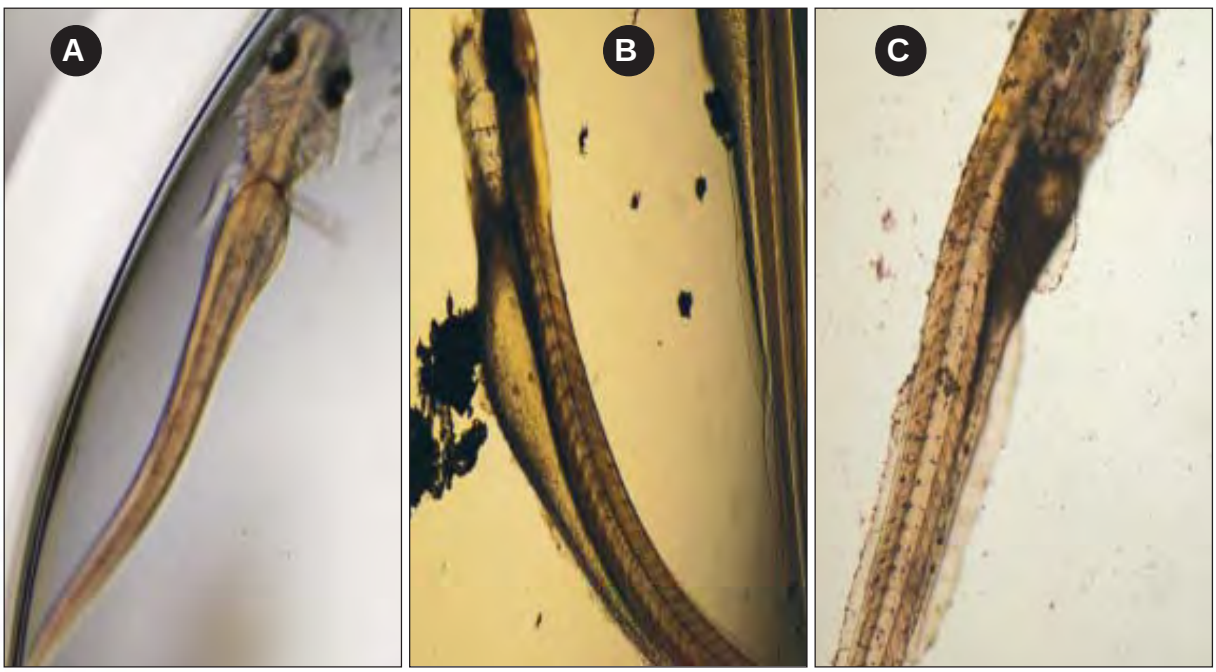


Fig. 52: Malformations (e.g., body convolution, edema and tissue ulceration) induced by nano-ZnO @ 40 mg/L at 96 h of post-hatching. (A) control fish larvae (B); fish larvae with body convolution (C); with edema

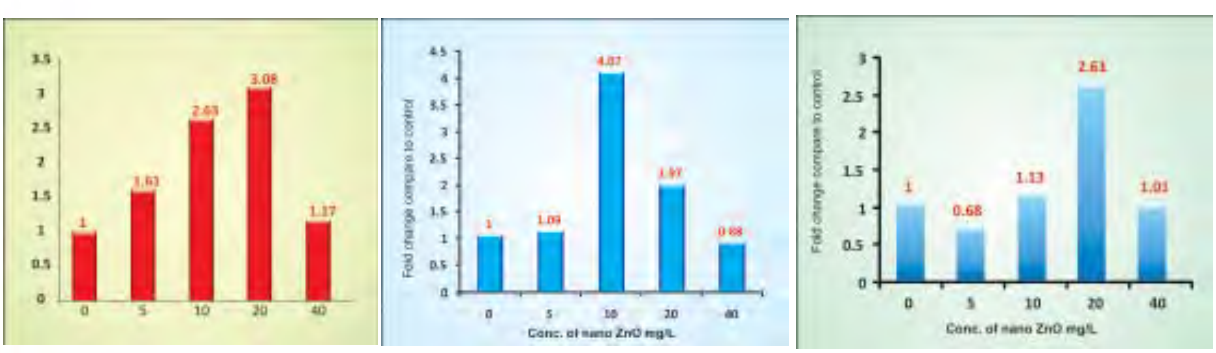
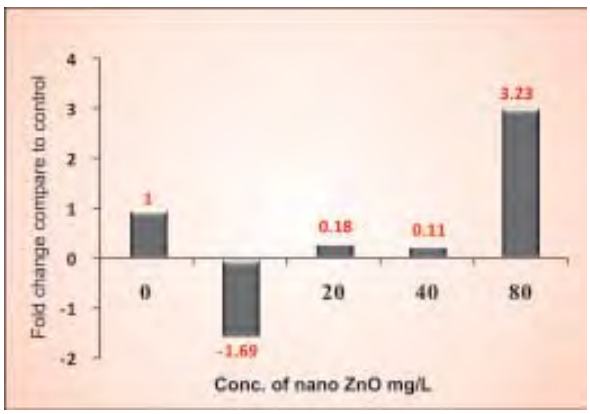
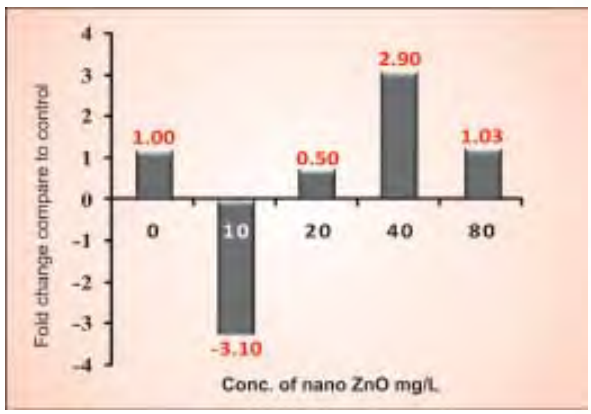


Fig. 53: Expression of (A), SOD; (B), Ucp-2 and (C), Bcl-2 genes in embryo and larvae were determined by real- time PCR. Results are presented as means ± SE, and expressed as fold increase in relative mRNA expression. Experimental groups consisted of ~200 embryos were analyzed in triplicate. *Statistically significant differences in the expression levels (compared to controls) (ANOVA $p < 0.025$).





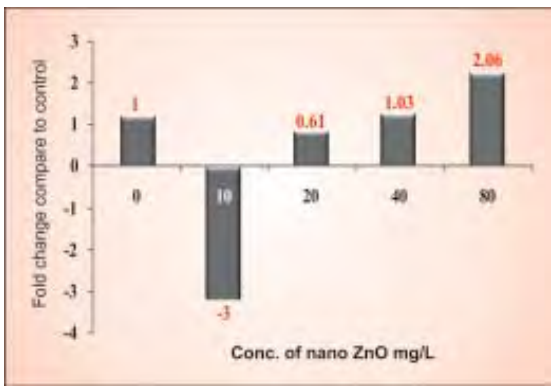


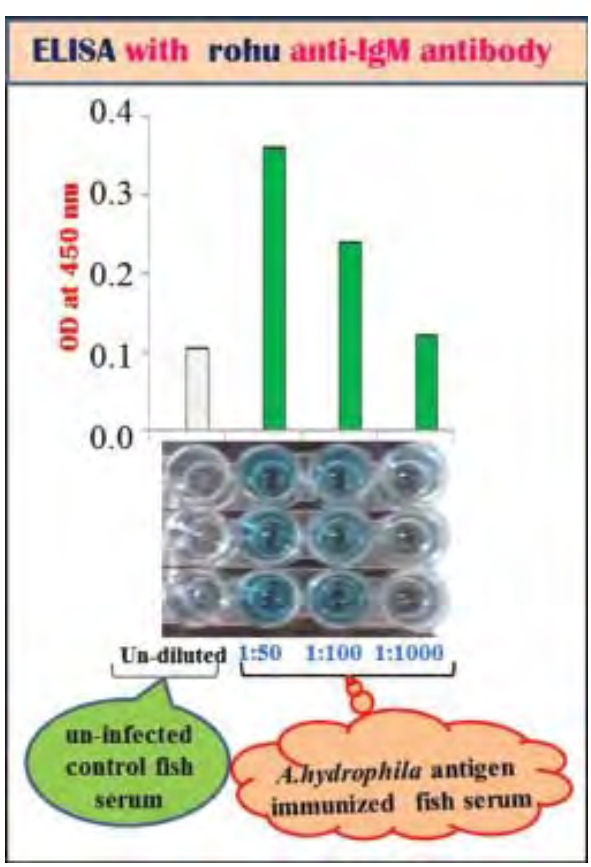
Fig. 54: The effect of nano-ZnO exposure on the mRNA levels various genes encoding antioxidant proteins of such as (A) SOD, (B) UCP2 & (C) BCL2 in liver tissue were determined by RT-qPCR.

Dietary exposure of ZnO nanoparticles

The ZnO nanoparticles at dose of 10, 20, 40, 80mg/kg of diet were fed to *L rohita* yearlings and developmental toxicity including expression of oxidative stress genes was investigated. The SOD, Ucp2 and Bcl 2 genes were up-regulated at doses of 40mg/kg, 80 mg/kg and 80 mg/kg, respectively and down regulated at dose 10 mg/kg in all treated groups (Figs. 54 A,B & C).

Project Title	:	Diversity and synthesis of immunoglobulins in the Indian major carps
Project Code	:	E-83
Funding Agency	:	ICAR-NASF
Duration	:	April 2013 - March 2017
Project Personnel	:	M. Samanta (PI)

Immunoglobulin (Ig) Z and IgD – heavy chain of rohu have been cloned and sequenced. In *Aeromonas hydrophila* infection, tissue specific expression of IgM, IgD and IgZ gene has been investigated by quantitative real-time PCR assay suggesting its important role in bacterial infection. For the detection of rohu-IgM, immunoblot and ELISA has been standardized.



Project Title	:	National surveillance programme on aquatic animal diseases (Sub-Project 2: Surveillance of freshwater fish and shellfish diseases in Odisha and Andhra Pradesh and Sub-Project 26: National Referral Laboratory for Freshwater Fish Diseases)
Project Code	:	E-86
Funding Agency	:	NFDB
Duration	:	April 2013 - March 2017
Project Personnel	:	P. K. Sahoo (PI) and B. K. Das

The districts covered for both passive and active surveillance were Jagatsinghpur, Cuttack, Jajpur, Kendrapara, Puri, Khurda, Nayagarh, Sambalpur and Baragarh for the state Odisha, and East Godavari, West Godavari, Krishna, Guntur and Nellore for the state Andhra Pradesh.

Total number of farms visited and farmers met

During the period, base-line data of additional 245 farms (West Godavari: 08; East Godavari: 03; Nellore: 01; Jagatsinghpur: 38; Balasore: 14; Puri: 24; Khurda: 01; Nayagarh: 09; Baragarh: 02; Sambalpur: 02; Jajpur: 26; Kendrapara: 58; Bhadrak: 13; Cuttack: 46) were generated. A total of 4 meetings/scientist-farmers' interactions, particularly on farmers' awareness about the programme and disease related issues were organized in two states.

Diseases reported and samples collected:

The farmers were mostly facing diseases viz., argulosis, other parasitic infestations like *Trichodina* sp., *Dactylogyrus* sp., *Myxobolus* sp. *Lernaea* sp., and bacterial disease due to *Plesiomonas shigelloides*. The available medicines are being suggested for their control measures.

Under active surveillance programme, the following details are being achieved after screening the samples received or collected from different places using level III diagnosis. Out of 144 farms visited for sampling, a total of 864 samples were collected and out of which 618 samples are already screened for koi herpes virus (KHV) and spring viraemia of carp virus (SVCV). Out of the above screened samples, 297 samples were found to be negative for SVCV, and 321 negative for KHV. In general, there was no incidence of either KHV or SVCV infections in the sampled regions.

During the period, in National Referral Laboratory, 55 numbers of samples from Odisha, Jharkhand, Andhra Pradesh and West Bengal were received for analysis. The details of cases and pathogens detected are given hereunder.

Sl. No.	Sample location	Brief case history	Diagnosis
1	Bengalpara, Howrah,	Mortality in goldfish, few brooder were collected with assumption that it may the carrier of cyprinid herpesvirus-2	Negative for CyHV-2
2	Chakgaria, Kolkata	Mortality in Anabas, showing clinical signs similar to lymphocystis. About 10% of the fish were infected with varied level of severity. Cumulative mortality was about 2-3% in 4 months time.	Negative for Irido virus
3	Govt. Fish Farm, Kausalyaganga	Mortality (33%) observed in goldfish, showing typical haemorrhagic ulcers, gill necrosis, abnormal swimming, swimming near surface and anorecta	*Plesiomonas shigelloides* followed by secondary *Trichodina* infection
4	College of Fisheries, Rangailunda, Odisha	Samples were received from College of Fisheries, Rangailunda, Odisha	*Aeromonas sobria*
5	Padma fish farm, Hazaribag, Jharkhand	Mortality in *Anabas* co-cultured with IMCs showing typical haemorrhagic ulcers	*Aeromonas hydrophila*

6	Patratu dam site, Ramgarh, Jharkhand	Morality (25-50%) in Pangasius cages stocked with 4000 numbers with haemorrhagic ulcers all over body, operculum; protruded and haemorrhagic anus; empty gut, peritoneal adhesion, mottled inflammed liver, body covered with fungal growth	*Aeromonas hydrophila* followed by secondary *Saprolegnia* infection
7	Bundu reservoir, Jharkhand	Typical fungal ulcers with massive haemorrhages on *Channa*; haemorrhages and ulcers on grass carp, protruded and haemorrhagic anus; Pangas fingerlings revealed fugal outgrowth on oneside of pectoral fin cultured in cages	*Aeromonas hydrophila* followed by secondary *Saprolegnia* infection
8	Tilaiya dam site, Koderma, Jharkhand	Pangas showing haemorrhages at the base of operculum, fins, suspected for myxosporidean infection on skin, haemorrhagic mouth and protruded and haemorrhagic anus	*Aeromonas hydrophila* followed by secondary myxosporidean infection in gills in skin
9	Near Rangacharyulu, Kandrika, Nellore, Andrha Pradesh	Mortality in rohu (35%) showing signs of bleached gills and also mortality in *L. vannamei* (200 kg) in a pond of 4.0 acres. Poor water quality i.e., high concentration of ammonia (2.30 ppm) observed in water.	Negative for KHV. Poor pond environment

Project Title	:	Intellectual Property and Technology Management (IP & TM) (renamed as "National Agriculture Innovation Foundation (NAIF)"
Project Code	:	E-93
Funding Agency	:	ICAR-NAIF
Duration	:	April 2015 - March 2017
Project Personnel	:	P. Swain (PI), K.D. Mahapatra, P. Das, P. Routray, B. K. Das, N. K. Barik and K. C. Das

Intellectual property rights	Process/products
Trademarks No. 1368991 (Renewal for ten years) in class 31 at Kolkata	Jayanti Rohu
Designs registered, Design No. 218326 in class 22-05 at Kolkata	Harvest Trolley

Signing of MoU

- Preparation of modified MoU for selling of FRP carp hatchery to M. R. Aquatech, B-63, Ashok Market, Bhubaneshwar, Odisha 751009 through ABI, ICAR-CIFA.

Technologies processed for commercialisation

- Dot-ELISA kit
- Spot agglutination kit
- A PCR based rohu catla Hybrid Identification detection kit
- FRP demand fish feeder
- ARGULUS - PCR Detection Kit for *A. siamensis* and *A. japonicus*
- White tail disease diagnostic kit
- Spring viraemia of carp PCR- based diagnostic kit
- Koi Herpes Virus (KHV) PCR-based diagnostic kit

Project Title	:	Development of vaccine against *Flavobacterium columnare*
Project Code	:	E-98
Funding Agency	:	ICAR-CRP
Duration	:	April 2015 - March 2017
Project Personnel	:	B. K. Das (PI), P. Swain, M. Samanta and Rakesh Das

Flavobacterium columnare strains maintained in the Fish Health and Management Division showed small, smooth, rhizoid, and yellowish colour colony on TSA plates. Amplification of 16S rRNA of the all seven *F. columnare* isolates were found to be effective in tracing the evolutionary history of the bacteria using forward primer- 5' AACCCTGGATAAAGCCCTGT 3' and reverse primer- 5' GGTTAGCCTGAGCCAGTACG 3'. Seven strains of *F. columnare* were identified based on 16S rRNA profiling having GenBank accession number KF051085, KF051086, KF051087, KF051088,

KF051089, KF051090 and KF051091. BLAST analysis of 16S rRNA of *F. columnare* showed 72% to 85% similarity with previously submitted *F. columnare* 16S rRNA partial sequence. Three strains from catla, two strains from rohu, one strain from goldfish and one strain from anabas were used for Clustal W analysis to check the similarities between them. Different strains isolated from gill (CFCCG62), operculum (CFCCO41) and skin lesions of catla (CFCCSL66) showed 74% to 75% similarities. The strains from operculum (CFCCO41) of catla showed 96% and 98% similarities with the gill (CFCCG62) and skin lesion of catla (CFCCSL66). Strains isolated from the ventral side (CFCRVB43) and gill (CFCRG55) of rohu showed 73% to 74% similarities. The strain from rohu ventral side (CFCRVB43) showed 81% similarity with the rohu gill (CFCRG55) strain. Strains isolated from the gills of goldfish (CFCGFG50) and caudal region of anabas (CFCACR72) showed 76% to 77% similarities. The gill strain from goldfish (CFCGFG50) was similar (93%) to that from caudal region of anabas (CFCACR72).

Whole cell bacterial products of *F. columnare* strain (CFCCO41) were separated into Outer Membrane Protein (OMP), Extracellular Protein (ECP), Cell Membrane Protein (CMP) for the study. Protein profiles of WCP, OMP, CMP and ECP of the above strains showed protein bands ranged from 9.6 kDa to 112.4 kDa. The number of protein bands in ECP were in the range of 10.6-43.3kDa. The CMP of the same strain contained 6 bands and were in the range of 9.6 kDa to 66.3 kDa. The hyper immune sera was raised against OMP to study its immunogenic property to show it as a vaccine candidate.

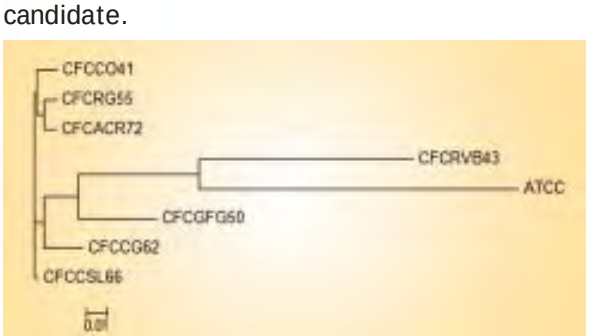


Fig. 55: Phylogenetic tree of *F. columnare* from gill, operculum, skin lesions of catla (*C. catla*), gill, and ventral belly of rohu (*L. rohita*), gill of goldfish (*C. auratus*) and caudal region of anabas (*A. testudineus*) ATCC 49513

Project Title	:	All India Network Project on Fish Health
Project Code	:	E-99
Funding Agency	:	ICAR
Nodal Institute	:	ICAR-CIBA
Duration	:	July 2015 - March 2017
Project Personnel	:	B. K. Das (PI), S. S. Mishra, Rakesh Das and N. K. Barik

The objective of the project is to collect the information on aquaculture medicines/drugs/chemicals used for aquaculture based on a questionnaire survey in 4 different states (Odisha, Chhattisgarh, Jharkhand, three districts of Andhra Pradesh) in order to develop a database on aquaculture medicines/kits used for testing; setting standards and dose rate for use of aqua medicines by evaluating their efficacy; Conducting workshop and training programs as a measure for BMPs; Determining the withdrawal period ofdifferent drugs; analysis of residues in aquatic biomass and environment; economic loss assessment in aquaculture, etc. Data collected from the different sources by following standard questionnaire format which was provided by nodal Institute. In Odisha following district were covered like Angul, Dhenkanal, Cuttack, Khordha, Puri, Ganjam, Balasore, Bhadrak, Nayagarh, Mayurbhanj, Sambalpur, Jajpur, Baragarh, Sundargarh, Koraput,Kalahandi, Rayagada and Deogarh, etc. It was found that around 150 numbers of medicines/drugs/chemicals are used for aquaculture production and management by the farmers. Out of this, 25 are used as disinfectants and sanitizers of aquatic habitat; 40 are used as antimicrobial/antiparasitic agents; 10 are used as probiotics, 30 are used as feed supplement or growth promoters; 8 are oxygen purifier or supplier and 10 are meant for growth and development of phytoplanktons. During Chattisgarh survey, an interaction meet was carried out with State Department to sensitize the objectives and expected outcome of the present project work followed by meeting with number of innovative and progressive fish farmers in Durg and Raipur area. It was noticed that there was no established or registered aqua medicine shops but progressive farmers were using different chemicals/formulations in the culture system by procuring from different supplier from outside the state. Survey data revealed that around 20 nos. of chemicals/disinfectants/probiotics/sanitizers/supplements were used by the farmers as per the guidelines provided by suppliers/sellers.

E. Social Sciences

Project Title	:	Aquaculture development through participatory approach
Sub-project Title	:	Mainstreaming gender concerns in freshwater aquaculture development: An action research
Project Code	:	I-84 (a)
Funding Agency	:	Institute-based
Duration	:	April, 2012 - March, 2016
Project Personnel	:	P. Jayasankar (PI), B. B. Sahu, H. K. De, P. N. Ananth, A. K. Das, N. Panda, U. L. Mohanty, P. R. Sahoo, S. Behera and D. P. Rath

During the year hands on training was imparted to women SHGs on preparation of bio-fertilizer using fish waste and molasses (50:50, W/W) adding very small quantity (1%) of yeast using old plastic drums or any narrow opened container. The project team in consultation with the beneficiaries identified a suitable place near their ponds/farm where a small unit may be installed for bio-fermenting of the fish wastes to be procured from nearby fish market and households. Three such units were established at Jaipur, Fakirpada and Paribasudeipur. During installation, a stakeholders' meet was also organised in which farmers, state department officials and NGOs participated.

Training was imparted to 65 women beneficiaries of Fakirpada and Paribasudeipur villages on fish pickle preparation. Pickle preparation was done by the members under the technical supervision and guidance of the team at the project site too. Three recipes were made: 1. Pickle with tomato sauce; 2. Pickle with tamarind paste; and 3. Pickle with mustard kasundi. The women picked up skill and learnt the technology of value addition. Vacuum packing and branding are few measures suggested by the team for better marketing. Composite carp culture was continued at all the adopted ponds during the year. Beneficiaries were exposed to seed rearing practices through training and demonstration at KVK, Khordha. As a result of this, beneficiaries put three small ponds under carp seed rearing. The project provided women in adopted villages better access to aquaculture technologies and thereby paving the way for uplifting socio-economic condition.

CIFA-Fish Planktofert and CIFA-Fish Biofert hands on training, in small scale production by self Help Groups intervention was undertaken in three villages, Paribasudeipur and Fakirpada in Balipatana Block of Khorda district and also Jeipur in Satyabadi Block of Puri District. Around 150 members from 10 SHG were exposed to fish waste bio fertilizer production and application.

Bio-fertilizers from fish waste

Fish processing wastes constituting around 50% in a fish are not commonly used by human for

feeding and most often they are disposed off. Considering this impact of improper disposal that resides on environment and seeking suitable technological alternatives for a nobler use, the following approach was undertaken both for economic potential and social applications.

Biofertilizer from fish waste is a novel means of processing to convert the underutilized fish wastes and by-products into more marketable and accepted form as nitrogen and carbon source for biomass and metabolite production.

Industrial application of the process wastes generated from fish processing including viscera, head, frames were chopped in a mincer and sugarcane molasses were added to have a mixtures of 50:50 (w/w).

Cold fermentation at ambient temperature (37 ± 5^{0}C) was initiated with a starter material consisting of yeast and papain (1%) in plastic tubs with perforated cover of 200 L capacity. During fermentation the silages were stirred twice a day, morning and afternoon for 28 days.

The liquid portion was transferred into the hydrolysate drum and solid portions were sundried for 1 week till 10% final moisture was achieved. The solid portion was grinded in a hammer mill and the end product in the hydrolysate meal.

ICAR-CIFA has developed a novel method of utilizing the fish processing waste. In fisheries and aquaculture wastes constitute around 30-40% during primary processing. Huge quantity of fish waste is also generated during trawling in a marine sector.

Municipality and Corporation fish markets also generate huge quantity of waste and when it is not disposed off properly it creates environmental pollution. The low cost environmental safe and a sustainable recycled product was developed utilizing a innovative cold and natural fermentation technology using equal quantity of molasses and starters.

Studies conducted at CIFA indicates that use of Planktofert at 0.05 ml/L in pond water produced 3 ml of plankton and it goes up to 6-7 ml/ L at the end of 15 days. The average plankton production required for good aquaculture is 2 ml/L water. This indicates that fish Planktofert is an enhancer. The dose of Planktofert for pond aquaculture has been standardized to be 20 L/Acre-Meter water body.

Table 34: Physico-chemical, macro and micro elements analysis of CIFA fish Hydrolysate and CIFA fish Biofert

Sl. No.	Constituent	Unit	Results	
			Fish Hydrolysate (FH)	Fish Biofert (FB)
1	Lead	ppm	0.1	1.255
2	Cadmium	ppm	0.006	0.123
3	Arsenic	ppm	Not Detected	Not Detected
4	Chromium	ppm	0.47	21.08
5	Nickel	ppm	0.25	7.08
6	Copper	ppm	0.12	13.61
7	Magnesium	ppm	268.1	1180
8	Manganese	ppm	10.72	285.60
9	Iron	ppm	121.3	991.8
10	Zinc	ppm	17.91	55.79
11	Sodium	g%	0.1348	0.06
12	Potassium	g%	0.2752	0.49
13	Calcium	g%	0.3955	0.51
14	Cobalt	ppm	0.21	1.11
15	Selenium	ppm	0.24	0.44
16	Aluminium	ppm	20.12	925.4
17	pH	-	4.17	6.78
18	Mercury	ppm	0.003	0.018
19	Organochlorine pesticides	-	Not Detected	Not Detected

Table 35: Test methods used

Test Method	Sl. No. in the table
AOAC 2012	1-17
USEPA method 200.7	18
APHA 2012	19 (Fish Hydrolysate)
Gregor Arh, Simona fras, Tomaz Polak, Bozidar Zlender, Marjan Veber & Matevz pompe, "*Modification of method for the Determination of organochlorine pesticides in meat samples*" Acta Chim.slok 2009, 56, 920-926.	19 (Fish Biofert)

Table 36: Fatty acid analysis of CIFA fish Biofert and Planktofert

Fish hydrolysate (FH)		Fish Biofert (FB)	
Fatty acid	% of FA in terms of total fatty acid	Fatty acid	% of FA in terms of total fatty acid
C6	11.85	C6	2.03
C8	0.92	C8	0.22
C10	0.46	C14	0.61
C14	4.62	C14:1	0.57
C14:1	0.95	C15	0.24
C15:1	0.23	C15:1	0.10
C16	25.33	C16	12.64
C16:1	8.10	C16:1	1.88
C17	1.07	C17	0.34
C17:1	1.08	C17:1	0.10
C18	4.19	C18	16.37
C18:1	22.27	C18:1	23.78
C18:2	8.72	C18:2	22.87
C18:3	3.99	C18:3	3.07
C20	0.47	C20	0.94
C20:3	2.52	C20:1	1.16
C20:4	0.33	C20:2	0.43
C20:5	0.49	C20:3	0.30
C22:6	2.40	C21	0.27
		C20:4	1.94
		C20:5	7.66
		C22:2	0.32
		C23	0.22
		C22:6	1.68
		C24:1	0.24

Sub-project Title	:	Impact of catfish and murrel aquaculture in India
Project Code	:	I-84 (d)
Funding Agency	:	Institute-based
Duration	:	April, 2013 - March, 2016
Project Personnel	:	N. K. Barik (PI), P.P. Chakrabarti and Rajesh Kumar

The project worked towards estimation of the ex-ante impact of magur in Assam, Pabda in Tripura and Murrel in Odisha and constraints in the adoption of these technologies. It was found that despite high profitability the level of adoption is low. A strategy paper for the adoption of the technology is under preparation. There is an increasing trend in the adoption of the technologies in these states but as the growth

trend was very low, it can be considered as the early stage of adoption.

Murrel: The murrel adoption was located in the the Khorda district around Chilka lake. Traditionally few farmers were stocking the murrel seed from the naturally collected seeds. CIFA has adopted few of these farmers to up-grade and undertake scientific methods of farming. Over a period of time, the adoption has achieved a modest rate of 12 farmers which can at best be considered as early stage of adoption.

Table 37: Production and dissemination of murrel seed from CIFA and natural collection

Year	Seed produced (th fry)	Adopted farmers (th fingerlings)	Area under culture (ha)	No of ponds	No of farmers
2009-10	6.0	5.0	0.5	5 ponds	3 SHG
2010-11	8.0	6.0	0.5	6 ponds	3 SHG, 1 NGO
2011-12	20.0	9.0 (+5.0 NC)	1.2	10 ponds	5 SHG, 4 farmers
2012-13	30.0	12.0 (+8.0 NC)	5.0	15ponds	2 SHG, 8 farmers
2013-14	40.0	10.0 (+ 12.0 NC)	5.0	18 ponds	2 SHG, 12 farmers
2014-15	45.0	3.0 (+15.0 NC)	4.0	12 pond	3 SHG, 9 farmers
2015-16	25.0	1.0 (+25.0 HP, +15 NC)	4.0	12.0	2 SHG, 10 farmers

Magur: Training on magur has been carried out by CIFA in Northeastern (NE) state since 2005 and FRP hatchery developed by the institute has been given to NE states with importance being given to Assam from 2008. Till today 38 no. of hatchries have been given to NE states with Assam receiving the maximum of 21 nos. Out of which KVK (3), Directorate of Fisheries (1) and Private enterprenuers (17) are operating these hatcheries.

Pabda: The state of Tripura has taken pro-active steps to popularize pabda production in the state. At present 4 nos of hatcheries are producing seed. The available seed was distributed to 250 farmers (150-200 nos) during 2013-14, 300 farmers in 2014-15 and 350 farmers in 2015-16. Farmers are growing under polyculture condition without application of specific management measures like specialized feed for pabda.

Table 38: Magur hatchery in Northeastern states

State	Magur hatchery
Assam	21
Manipur	11
Mizoram	1
Meghalaya	3
Tripura	0
Nagaland	2

Table 39: Seed production of pabda in Tripura

Year	Seed production (Tripura)
2010-11	5000
2011-12	12000
2012-13	37000
2013-14	6000*
2014-15	57,000
2015-16	70,000

* (closure of Melaghar hatchery)

Table 40: Level of adoption of pabda in Tripura

Sl No	Year	Total seed produced	Distribution among farmers	
			No of Farmers	No of Seed
1	2004-05	225 NOS	-	
2	05-06	4007	23	2257
3	06-07	4460	30	3900
4	07-08	11429	45	8929
5	08-09	8516	54	7906
6	09-10	13369	41	8900
7	10-11	14,112	56	11,755
8	11-12	73,677	334	72,090
9	12-13	31,690	150	30,000
10	13-14	8000	250	6000
11	14-15	57,000	300	50,000
12	15-16	70,000	350	60,000

The constraints in adoption: The technical difficulties especially knowledge and skill in the management are the most important constraints in the adoption of the technology. The low level of seed availability from the hatcheries were identified as limitations for the adoption of the technologies. Other constraints like Difficulties in harvesting and handling, Non availability of seed and feed in the market, Higher cost of production compared to IMC, low demand in local market, Lack of support from government was found.

Table 41: Constraints in adoption of catfish and murrels

	Murrel	Pabda	Magur
Technical difficulties	✓	✓	✓
Hatchery bred seed availability	✓	✓	✓
Difficulties in harvesting and handling	✓	×	✓
Non availability of seed and feed in the market	✓	✓	✓
Higher cost of production compared to IMC	✓	×	✓
Low demand in local market	✓	×	×
Lack of support from government	✓	✓	✓

Strategy for higher adoption: The factors like availability of seed and feed for life cycle, public Investment in hatcheries, handholding, capacity building, market intelligence and information of niche market, capacity building and technical support in value addition and processing and support to attain minimum scale of production are suggested for higher adoption.

Sub-project title	:	Study of dynamics of Aquaculture Field School
Project Code	:	I-84 (e)
Funding Agency	:	Institute-based
Duration	:	April, 2013 - March, 2016
Project Personnel	:	G. S. Saha, A.S. Mahapatra and N. Panda

During the year data were collected from the farmers of Rajnandgaon District of Chhattisgarh and were analysed. An interface meet with the farmers was organized on 18 September 2015 at Aquaculture Field School (AFS) of CIFA established in the farm of Mr. Surendra Belchandan at Tirga, Durg, Chhattisgarh. A total of 74 farmers including 39 women from 5 remote tribal villages of Rajanandgaon district participated in the Interface Meet.

The fish farmers visiting AFS, Tirga, Durg, Chhattisgarh were mostly in the age group of 40-50 years. Sixteen percent of the fish farmers who visited the AFS were women. Most of the visiting farmers (32%) were in primary level of education followed by middle level of education (26%). Agriculture and Fishery - are the primary occupation of 68% of the farmers. Most of the fish farmers are attending the AFS since its inception and some have been attending even before establishment of AFS. Fifty-eight percent of the fish farmers came to know about AFS from FEO and were motivated by him. Frequency of visit for most of the fish farmers was quarterly. Around 32% of the visiting fish farmers are having water area less than 1 ha and 26% of the fish farmers possess ponds with water area more than 3 ha. The fish farmers are practicing carp polyculture. The farmers attending AFS, Durg could exchange new ideas among each other in addition to getting

timely and proper technical guidance from the operator of AFS. There was significant increase in fish production in farmer's pond after attending AFS, Durg.

AFS has become a place of learning and exchange of ideas among farmers. The operator is the Instructor, who in turn is guided by scientists of ICAR-CIFA. During the current financial year, AFS, Sarakana organised two farm field schools sponsored by the State Department of Fisheries. Each school is of 6-months duration for 25 fish farmers with minimum 6 classes where the facilitator demonstrates step by step key practices for ease of learning by trainee-farmers. The Department had provided Rs. 30,000/- for organizing each school.

Project Title	:	Assessment of Socio-Economic Impact of FMD and its control in India
Project Code	:	E-89
Duration	:	2014-2016
Funding Agency	:	NIVEDI, ICAR, Bangalore
Project Personnel	:	P. N. Ananth (CC-PI), G. Govindaraja (PI) and B. K. Banja

The project aimed towards assessing the socio economic impact of Foot and Mouth Disease (FMD) and its control in India. The work done by KVK-Khordha partnering centre is on the survey for 7 districts of Odisha viz., Khordha, Nayagarh, Kendrapara, Cuttack, Sambalpur, Keonjhar and Koraput. The sample farmers of the study comprised of 1100 from 280 villages. Primary data were collected using a pre-tested interview schedule developed by the lead centre. Secondary data relevant to the study were collected from the Extension and, Research and Development Centres of Odisha working on FMD. The results indicated that the farmers under the study were middle aged and majority possessed high school level of education with dairying as their major occupation. It was also observed that indigenous cattle population is high among all the bovine species reared in the study area. In majority of the sample farms the disease persisted for 15-30 days, while in other farms it persisted for 30-45 days and in few other farms it persisted for 45-60 days. The pooled results of different districts revealed that in crossbred cattle, the highest loss was milk yield tuned to be Rs.12,031/per animal followed by treatment cost of Rs.733/- and labour engagement to Rs.1,564/-. The results indicated that the total projected loss due to FMD in Odisha during 2015 was Rs.69.44 crores. Of these losses, major loss was from milk loss which accounts for 84 per cent of total loss followed by extra labour engaged for nursing the animal (11%) and treatment cost (5%).

F. Field Station, Kalyani

Project Title	:	Sustainable freshwater aquaculture
Project Title	:	Studies on technical and economic feasibility of integrated crop livestock fish farming system involving *Mystus gulio, E. vacha, C. reba, P. sarana* and *O. niloticus* along with carps
Project code	:	I-91(E)
Funding Agency	:	Institute-based
Duration	:	April 2015 – March 2018
Project Personnel	:	P. P. Chakrabarty(PI), Arabinda Das, R. N. Mandal and Ajmal Hussan

Seed production and culture technology of *M. gulio*

Mystus gulio (Hamilton-Buchanan, 1822), commonly known as long whiskered catfish, is a euryhaline fish of the family Bagridae, occurring mostly in freshwater and has also been found to thrive in backwaters of low salinity. It has good consumer preference and market demand due to taste and high nutrient profile fetching Rs.250-500/kg. Number of workers have studied the biology of this fish species; few studied induced breeding and fry rearing in laboratory conditions; but no technology package has been developed for farmers. Due to high market demand in some states, its culture has been practiced in coastal areas with seed collected from natural sources or enters along with tidal waters.

Induced breeding of *M. gulio*

During July 2015, captive stocks of *M. gulio* have been successfully induced bred in freshwater by injecting commercially available inducing agent, gonadoprim under two different experiments conducted in rectangular FRP tanks. Fishes of 25-82 g were selected for induced breeding. In first experiment, variable doses were injected to males and fixed dose to females. In the second experiment, fixed dose applied to males whereas variable doses were injected to females. The eggs were adhesive, demersal (when not attached to any substrate) and transparent. The eggs hatched out in 23-26 hours at 26-27 ^{0}C. All pairs except two pairs responded to hormonal injection. After 10 days of rearing in breeding tanks, the mean density of larvae found was 20 per litre of water. The 10-days old larvae harvested were varied from 1548 to 3777 numbers per tank/female fish.

Rearing of *M. gulio* larvae

Different experiments were conducted in glass and FRP tanks to find out the suitable stocking density for larval rearing. Survival (%) and growth of larvae fed *Tubifex* worm and mixed zooplankton were evaluated. In the first experiment conducted in glass tanks with variable stocking densities (5, 10, 20 and 30 per 10 L water), early fry of 15 days old (mean weight 0.05 g) attained size of 0.5 to 1.2 g in weight and 3.4 to 4.4 cm in length during 30 days of rearing period. The survival percentage ranged between 80-100%. When fed *ad libitum* with Tubifex worm, no significant difference of mean survival (%) was observed among different treatments. Mean weight gain of larval groups got decreased with the increase of stocking density and was found strongly correlated. However, mean total weight gain of larval groups increased with the increase of stocking density and was also found strongly correlated, and maximum biomass achieved when the stocking density of larvae was 3 numbers per litre of water (Fig. 56)

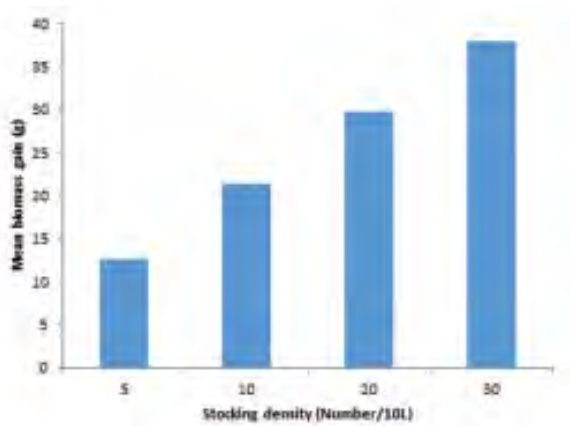


Fig. 56: Mean biomass gain (g) of larvae in different stocking densities

Fig. 57: Stocking of *M. gulio* with IMCs in grow-out polyculture system)

In the second experiment, larvae of 14 days old were reared in circular FRP tanks for 35 days with variable stocking densities (4, 8 and 12 numbers per litre of water or 810, 1620 and 2430 numbers/ m2). When fed with mixed zooplankton, mean survival (%) of T1 groups (stocking density- 4 per litre water) was significantly higher than other groups, however, mean weight gain of T2 and T3 larval groups was significantly higher than T1 groups ($P<0.05$). The mean total weight gain of M. guliolarvae increased significantly with the increase of stocking density ($P<0.05$) and was found strongly correlated (Fig. 58).

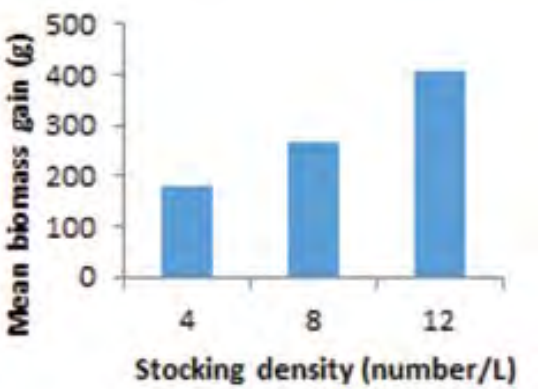


Fig. 58: Mean biomass gain (g) of larvae in different stocking densities

In the third experiment, effect of different types of hide-outs/ shelters viz. *Enhydra fluctuans* (aquatic plant), PVC pipes and broken earthen pots, and date palm leaves on survival and growth of M. gulio larvae were studied. When fed with mixed zooplankton for one month, no significant difference in mean survival (%) was found among different experimental groups ($P>0.05$), however, the mean survival (%) was highest in tanks with date palm leaves as hide-out and lowest in tanks without hide-out (Fig.59). There was no significant difference of mean body weight and mean biomass of M. gulio larvae among different experimental groups. However, the lowest mean body weight was observed in tanks with date palm leaves as hide-out. A total of around 0.18 lakh fry/ fingerlings (2 months old) have been produced during the reporting period from different experiments

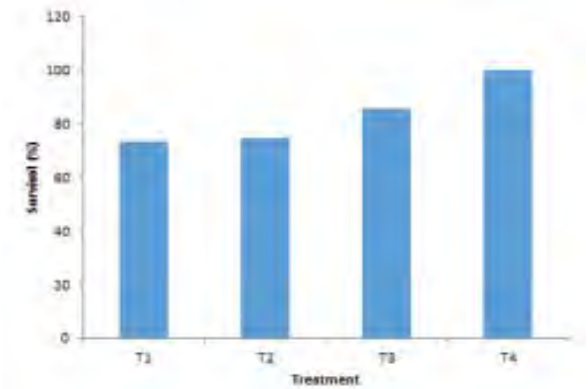


Fig. 59: Mean survival (%) of larvae in tanks with different hide-outs

Studies on biological parameters of *E. vacha*

Collection and stock development

A total of around 500 numbers of *E. vacha* were caught along the bank of the river Ganges. A traditional gear was used to catch *E. vacha* selectively. Selection of suitable site for operation of the gear is considered key to the selective catch of *E. vacha*. The transportation mortality of *E. vacha* was found to be 30-50%. Mean length recorded was 10.51 cm & mean weight 7.44 g. After 2 months of rearing in earthen ponds with boiled chicken viscera, the mean weight gain recorded was 10.41 g and after 4 months of stocking the mean weight gain observed was 23.88 g

Fig. 60: Collection and stock development of *E.vacha*

Some biological parameters of *E. vacha*

E. vacha showed positive allometric growth. The co-efficient of determination (r2) was found 0.98. Mean condition factor of wild caught fish after 4 months of rearing in earthen ponds got increased from 0.57 to 0.65 (n=30). The RGL values of E. vacha ranges from 0.59 to 1.10, thus indicates its carnivorous feeding habit. Studies on hepato-somatic index, gonado-somatic index and gonad development is under progress.

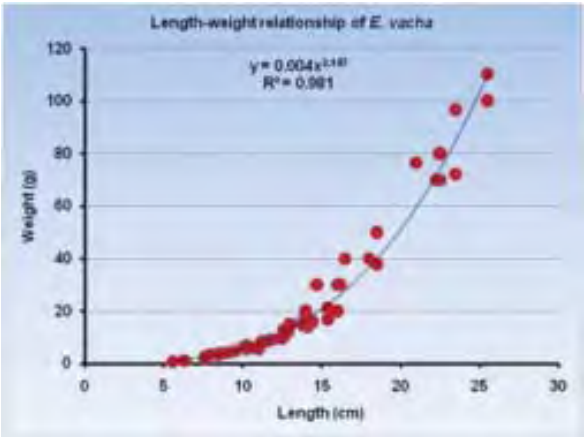


Fig. 61: Length-weight relationship of *E. vacha* in captive condition

Project Title	:	Evaluation of increasing production of safe fish with feed in sustainable waste water aquaculture
Project code	:	I-93
Funding Agency	:	Institute-based
Duration	:	April 2015 – March 2018
Project Personnel	:	R. N. Mandal (PI), P. P. Chakrabarty, B. N. Paul, Arabinda Das and B. K. Pandey

In sewage fed aquaculture, water is considered to be a partially polluted. Basic principle of sewage fed aquaculture is that nutrients are recovered from sewage and utilized for production of plankton used as fish food. Eventually, nutrients contained in sewage are transformed into fish biomass. That supplementary feeding is, at all, required to fish needs to be examined, with maintenance of sustainable environment in such culture. If feed required, how much amount of feed to be applied for optimal growth of fish is to be standardized. With all these queries, the experiments studied the following;

Fish survival

Four treatments (C, control; T1, 0.25% of feed; T2, 0.5% of feed and T3, 0.75% of feed) were conducted in yard experiment for 90 days (Fig.5), with three replicates of each treatment. Feeds were applied @ 0.25%, 0.5% and 0.75% of fish biomass in T1, T2 and T3 daily basis, while no feed was applied in C (control). After 90 days rearing, Rohu showed 100% survival in control, 83.3% in both T2 & T3 and 66.67% in T1. Mrigal survived 100% in both control & T3 and 83.3% in T1 & T2. Survival (%) of fish across the species was recorded maximum in control.Catla exhibited poor survival as 16.67% in all three treatments, and no survival in T3. This experiment suggests that rearing of fish is found more suitable in sewage fed water (control) than in the supplementary feeding conditions, though the experiment requires repetitions before reaching conclusion.

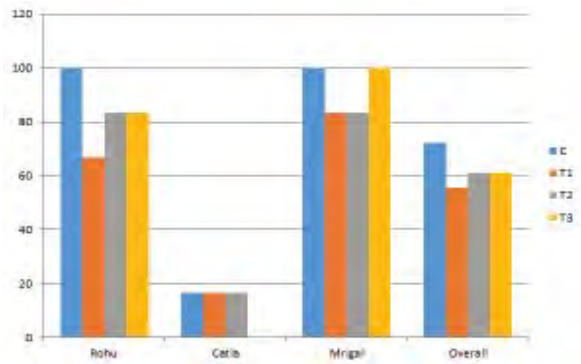


Fig. 62: Survival (%) of fish across the species in different treatments


Fig. 63: survival and growth of IMCs in sewage fed rearing system

Mean weight gain

A total number of 6 fishes comprising catla, rohu and mrigal with ratio as 1:1:1 was reared in 800 litters of sewage fed water in each FRP tank (Table 42). Mean initial weight of mixed fish varies in the range of 11.44-12.44 g. After 90 days, mean weight gain ranged from 9.26g -12.46, with an increasing order as 12.72g in T2> 12.46 in T3 > 11.93gin C > 9.26g in T1. However, no significant mean weight gain was recorded in different treatments. This experiment suggests that supplementary feeding may not be required to obtain desirable fish growth.

Table 42: Fish growth in different species

Treatments	Number stocked	Survival %	Mean initial wt. (g)	Mean final wt. (g)	Mean gain (g)
Control	18.00	72.22	12.22	24.15	11.93
0.25% feed	18.00	55.56	11.44	20.70	9.26
0.50% feed	18.00	61.11	12.28	25.00	12.72
0.75% feed	18.00	61.11	12.44	24.91	12.46

In this experiment, no treatment exhibited significantly higher fish growth (Fig. 61). Rohu showed maximum weight gain as 18g in T3 and 10.25g in T1 being minimum, whereas Mrigal showed maximum weight gain as 22.0g in T2 and 9.67g in T3 being minimum. This study suggests that mean weight gain of fish across the species was found not significant in different treatments.

There was significant differences in the mean net primary productivity (mgC/m3/h) and mean zooplankton density (nos/l) among different treatments ($P<0.05$). The mean NPP (mgC/m3/h) and mean zooplankton density (nos/l) was found highest in the control. However, the amount of total coliform was found ranging in between 8-28 (cfu/ml × 10^3), which seems to be safe in sewage fed system.

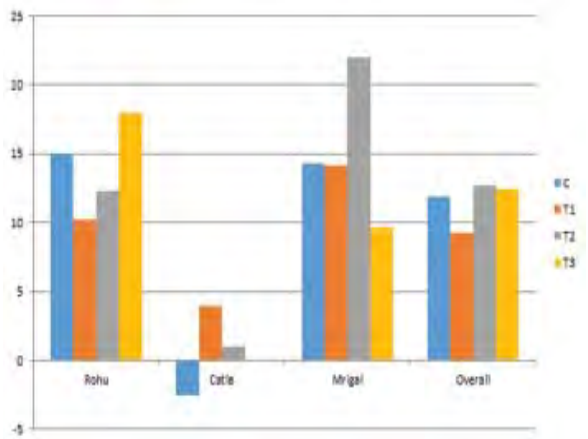


Fig.64: Mean weight gain of fish across the species in different treatments.

Table 43: Hydro-biological analyses

Treatment	Do mg/l	GPP mgC/m^3 /h	NPP mgC/m^3 /h	Zooplankton (nos./l)	BOD (nos./l)	AN mg/l	P_2O_5 mg/l	Total coliform cfu/ml ×10^3 (range)
C	6.7 ±0.7	118b±4.4	76c±3.1	47370d ±1200	19 ±0.6	0.30 ±0.06	0.30 ±0.06	5-25
T1	6.1 ±1.1	88a ±4.4	47a ±3.7	22320a ±1222	16 ±1.0	0.23 ±0.03	0.30 ±0.06	8-18
T2	6.7 ±1.3	108b±1.5	66b ±2.3	32600b ±1361	15 ±1.2	0.27 ±0.03	0.27 ±0.03	18-28
T3	5.4 ±1.1	109b±5.1	66b ±0.9	39050c ±548	16 ±1.2	0.20 ±0.06	0.28 ±0.07	12-18

G. Regional Research Centre, Rahara

Project Title	:	Stock characterization, captive breeding, seed production and culture of hilsa *(Tenualosa ilisha)*
Project code	:	I-80(a)
Funding Agency	:	NFBSFARA
Duration	:	November, 2012 – November, 2017
Project Personnel	:	V. R. Suresh (PI), CIFRI (CO-PIs: B. K. Behera, R. K. Manna, Sajina A. M., K. M. Sandhya); D. N. Chattopadhyay (CCPI), CIFA (CO-PIs: R.N. Mandal, A. Das); S. Dasgupta (CCPI), CIFE (CO-PI: G.H. Pailan); R. Ranjan (CCPI), CMFRI (CO-PI: S. Ghosh, B. Dash); D. De (CCPI), CIBA (CO-PI: S. Anand, P. Kumar); V. Mohindra (CCPI), NBFGR (CO-PIs: K. K. Lal, R. K. Singh, S. Mandal, J. K. Jena); S. Bhattacharya (CCPI), VBU (CO-PIs: S. Saikia,R. Kundu)

Artificial fecundation of hilsa

Hilsa has been successfully bred in three breeding trials in the river Hooghly at Godakhali, West Bengal during February 2016. Brood fish both male and female were collected from fishermen and breeding operation was conducted on boat itself by dry stripping (DS). Drinking water supplied from Hooghly River water treatment plant at Godakhali was used for egg fertilization after heavy aeration. The details of breeding trials and water qualities used for egg fertilization are given in Table 44.

Table 44: Brood size, fertilization (%) and qualities of water used for fertilization of hilsa eggs in different breeding trials.

Parameters	Breeding Trials		
	Trial-I (23.02.16)	Trial-II (24.02.16)	Trial-III (25.02.16)
Size of female	236 mm/130.3 g	320 mm/352.6 g	300 mm/341.6 g
Size of male	230-272 mm/ 192.3-260 g	210 mm/276 mm/ 170-265.3g	245-280 mm/ 220-238 g
Fertilization (%)	94.55	90.56	96.75
Water qualities			
Temperature (0C)	26.6	25.6	27.1
pH	7.80	7.78	7.70
DO (ppm)	8.56	8.60	8.32
Free CO2 (ppm)	Nil	Nil	Nil
Total Alkalinity (ppm)	154	164	158
Total Hardness (ppm)	296	280	272
Conductivity (?S/cm)	1164	1329	1414
TDS (ppm)	610	699	745
Salinity (ppm)	411	448	501

Fig. 65: Stripping of eggs

Fig. 66: Eggs of hilsa

Fig. 67: Egg incubation in laboratory

Fig. 68: Egg incubation in FRP hatchery

Egg incubation and larval production

The fertilized eggs were transported to RRC, CIFA, Kalyani and hatched in steel and glass trays using sand filtered Hooghly river water. Hatchlings were transferred to glass aquaria and incubated further in same water up to 4-days.

Trial for incubation of eggs was also done in FRP hatchery after suitable modification of the operational procedure to reduce stress of developing embryos and tiny larvae. In hatchery, pond water was used (Table 45) and larval survival after 4-days was 44% of fertilized eggs. From the three breeding trials, 48,000 numbers of 4-day old larvae were produced.

Table 45: Qualities of water used for hatching in trays and larval incubation in aquarium and hatching pool upto 4 days

Parameters	Hooghly river water near Kalyani	Farm pond water	Farm pond water in hatching pool
Temperature (0C)	24-25	24-25	24-25
pH	7.6	7.35 ± 0.05	7.95 ± 0.05
DO (ppm)	7.4	7.4 ± 0.2	8.0 ± 0.04
Free CO2 (ppm)	Nil	Nil	Nil
Total Alkalinity (ppm)	150	198 ± 2	199 ± 1
Total Hardness (ppm)	160	351 ± 1	349 ± 1
Conductivity (?S/cm)	342	605.5 ± 2.5	604.5 ± 0.5
TDS (ppm)	240	315.5 ± 2.5	315.5 ± 0.5
Salinity (ppm)	161	132 ± 1	133.5 ± 0.5

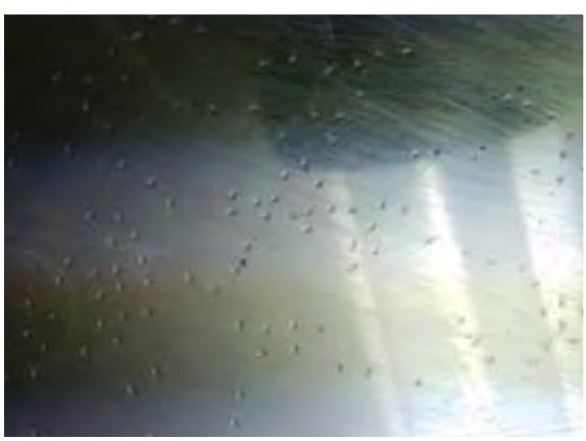


Fig. 69: Newly hatched hilsa larvae

Fig. 70: Incubation of hilsa hatchlings in aquaria

Hatching rates of eggs

Experiment-I : The fertilized eggs after 1 hour of transportation to field camp (Dostopur near Diamond harbour) were hatched in different freshwater sources having different water qualities (Table 46). Hatching rates of fertilized eggs (66.7-86.7%) did not vary significantly in different sources of water viz. settled Hooghly river water from Godakhali (T1), drinking water supplied from Hooghly River water treatment plant at Godakhali (T2), packaged drinking water (T3), underground water from Dostopur near Diamond harbour (T4).

Experiment II : The hatching rate of fertilized eggs after 5 hours of transportation to RRC, CIFA, Kalyani were studied using different freshwater sources having different water qualities (Table 47). Hatching rates of fertilized eggs (60-71%) did not vary significantly in

Table 46: Hatching rate and water qualities in different water sources.

Parameters	Water Source			
	T 1 (settled Hooghly river water from Godakhali)	T 2 (drinking water supplied from Hooghly River water treatment plant at Godakhali)	T 3 (packaged drinking water)	T 4 (underground water from Dostopur near Diamond harbour)
Hatching (%)	78.67	66.67	86.67	74.67
Water qualities				
Temperature (0C)	26.07	26.17	26.23	26.2
pH	7.8	7.78	7.99	7.51
DO (ppm)	8.36	8.29	8.25	8.5
Free CO2 (ppm)	Nil	Nil	Nil	Nil
Total Alkalinity (ppm)	167	156	23	300
Total Hardness (ppm)	**294**	**297**	**14**	**434**
Conductivity (?S/cm)	**1358.5**	**1166**	**41.5**	**2113.5**
TDS (ppm)	**711.5**	**611.5**	**24**	**1121.5**
Salinity (ppm)	**505**	**411**	**19.5**	**909**

different sources of water viz. filtered underground water (T1), filtered farm pond water (T2) and filtered Hooghly river water near Kalyani (T3).

Table 47: Hatching rate and water qualities in different water sources

Parameters	Water Source		
	T1 (filtered underground water)	T2 (filtered farm pond water)	T3 (filtered Hooghly river water near Kalyani)
Hatching (%)	71.1	67.8	60
Water qualities			
Temperature (0C)	24-25	24-25	24-25
pH	7.33	7.36	7.6
DO (ppm)	7.4	7.4	7.4
Free CO2 (ppm)	Nil	Nil	Nil
Total Alkalinity (ppm)	298	198	150
Total Hardness (ppm)	336	350	160
Conductivity (?S/cm)	868	604	342
TDS (ppm)	688	310	240
Salinity (ppm)	418	110	161

Experiment III: The fertilized eggs after 7 hours of fertilization were kept in pond water with different salinities (0.1, 1, 2, 3, 4, 5, 10, 15, 20 and 25 ppt) to study the embryonic survival and hatching rate. The embryonic survival of fertilized eggs after 12 hours of incubation was 54-81% (lowest at 25 ppt and highest at 1 ppt). The hatching rate varied from 14.1-71.4% (lowest at 25 ppt and highest at 1 ppt).

Rearing of larvae

Experiment I: One day old larvae were kept in different sources of water with variable water quality parameters viz. filtered farm pond water (T1), filtered farm pond water + rain water (1:1) (T2), filtered rain water (T3) and farm pond water with added Ca-Mg salts (T4) to study the survival over a period of one week (Table 48). The mean survival of larvae upto 3rd day was 95-100% in all tested waters. Although the larval survival after one week decreased (63.3-83.3%) in all waters, asignificantly higher survival (83.3%) was found in filtered farm pond water (T1) than in other waters (T2-T4).

Table 48: Larval survival and water qualities in different water sources

Parameters	Water Source			
	T1 (filtered farm pond water)	T2 (filtered farm pond water + rain water (1:1)}	T3 (filtered rain water)	T4 (farm pond water with added Ca-Mg salts)
Larval survival (%) after 7 days Water qualities	83.3	73.3	63.3	66.7
Temperature (0C)	24-25	24-25	24-25	24-25
pH	7.5	7.2	7.1	7.5
DO (ppm)	7.8	7.5	7.4	7.4
Free CO2 (ppm)	Nil	Nil	Nil	Nil
Total Alkalinity (ppm)	200	117	42	192
Total Hardness (ppm)	340	190	47	458
Conductivity (?S/cm)	589	346	56.2	800
TDS (ppm)	302	201	42.5	395
Salinity (ppm)	112	80	33	247

Experiment II : The larvae produced in freshwater were kept in pond water with different salinities (0.1, 1, 2, 3, 4, 5, 10, 15, 20 and 25 ppt) to study the survival over a period of 9 days. Larval survival was 100% at 0.1-5 ppt during 9 days observation. No larvae survived after 7 days at 10 ppt, 3 days at 15 - 20 ppt and 1 day at 25 ppt.

Experiment III : The larvae produced from three breeding trials conducted in February, 2016 were stocked in outdoor FRP tanks and concrete reservoir for further rearing at different stocking densities to study survival, growth performance and feeding behaviour.

Green water technology was adopted for rearing of hilsa larvae, in which microalgae particularly chlorella was separately cultured in outdoor FRP tanks and fed to first feeding larvae. Chlorella was being supplied daily starting from their age of 4 days as a starter food and is being continued. From the age of 6 to 10 day, Brachionus (177- 194 micron) feeding was started and the quantity of Brachionus supply was doubled from the age of 11 to 25 day along with continuous supply of green water. Mixed phytoplankton (diatom, pandorina, scenedesmus, closterium etc.) was also supplied to the larvae from 8 to 25 day of their age. From the age of 26 days old and onwards, mixed zooplankton (Rotifers, Cyclops, diaptomus, nauplius, diaphanosoma) comprising different life stages are being provided along with continuous supply of green water. The culture is in progress.

Experiment IV : The enzymatic activities of 7 day old larvae that start feeding from their 4th day of age and 21 day old larvae were studied. It was observed that in 21 day old larvae, the activity of amylase, protease and lipase increased than that of 7 day old larvae, whereas, cellulase activity was found to decrease in 21 day old larvae than that of 7 day old larvae. In the larvae of 7 and 21-day old, the activity of enzymes was respectively, 0.18 and 0.22 units in amylase (1 unit = 1 mg maltose liberated/mg protein/

minute), 48 and 82 units in protease (1 unit = 1µg tyrosine liberated/mg protein/min.), nil and 33 units in lipase (1 unit = 1 µ mole free fatty acid liberated/mg protein/min.) and 0.48 and 0.31 units in cellulase (1 unit = 1 mg glucose liberated/mg protein/min.). The pattern of enzyme activity in the study may be useful for studying nutritional requirement and digestibility in different ages of their growth.

Experiment V:The four day old hilsa larvae (4.87 mm / 0.00054 g) obtained from artificial breeding conducted during February, 2015 at Godakhali, were reared in FRP tanks and nursery ponds at different stocking densities. The survival and growth performance of hilsa larvae during one-month rearing are presented in Table 49 and 50.

Table 49: Survival and growth of hilsa larvae during one month rearing in FRP tanks.

Experiment	Rearing system (No./ m^3)	SD	Survival (%)	Size (Final)
I	Rectangular FRP Tank (soil base, pond water, 2.7 m^3)	100	0	-
		300	27.9	17-49 mm/0.02-0.81g
		600	0	-
II	Circular FRP Tank (soil base, pond water, 1.6 m^3)	100	42.5	24-41 mm/0.13-0.42 g
		300	31.5	20-23 mm/0.07-0.1 g
		600	31.2	12-26 mm/0.01-0.16 g
III	Circular FRP Tank (without soil base, underground water, 2.7 m^3)	100	9.9	25-43 mm/0.13-0.766 g
		200	6.7	20-34 mm/0.06-0.36g
		300	13.2	19-42 mm/0.05-0.65 g

Table 50: Survival and growth of hilsa larvae during one month rearing in nursery pond.

Rearing system	SD (lakh/ha)	Survival (%)	Size (Final)
NP- I (cemented, soil base, 200 m^2)	1.5	2.23	44-65 mm/0.77-2.45 g
NP- II (earthen, 200 m^2)	2	0.15	51-58 mm/1.16-2.01 g
NP- III (earthen, 200 m^2)	5	0	0

Rearing of hilsa fry (fry-fingerlings)

An experiment was conducted with the hilsa fry produced from the breeding trials conducted during February, 2015, in rectangular FRP tank (soil base, underground water, 3 m3) to study the effect of flow, aeration and flow with aeration on the survival and growth of hilsa fry (29.44 ± 4.32 mm / 0.30 ± 0.12 g) for 1-month culture period at 12/m3 stocking density. Average survival (26-39%), length (58-60.5 mm) and weight (1.81-2.0 g) did not vary significantly among the treatments (Table 8).

Pond culture of hilsa

Grow out culture: The wild caught hilsa seed (81.11 ± 1.88 mm/ 5.4 ± 0.4 g) were stocked @ 20,000 nos/ha in freshwater pond (0.1 ha area, 1.9 m depth) where they grew to 259 mm / 160 g during 19 months' culture period (Fig. 71). Total 130 adult fish were harvested and restocked in another pond (0.1ha, 1.9 m depth) for their management to raise brood.

Broodstock culture: In brood stock pond (0.1ha, 1.9 m depth), Hilsa are being fed with supplementary feed and zooplankton viz., Daphnia, Moina, Cyclops, rotifer collected from cultured cisterns/tanks, circular earthen trench and other ponds. Fish grew to274.2 mm / 186.3 g from the initial size of 259 mm / 160 g at a stocking density of 1300 nos./ha in six months (Fig. 72). Culture is in progress. The water qualities of grow out and broodstock pond are given in Table 52.

Table 51: Survival and growth of fry under flow, aeration and flow with aeration

Parameters	Treatment		
	Flow	Flow + Aeration	Aeration
Survival (%)	38.9 ± 8.33a	31.5 ± 10.92a	25.9 ± 5.63a
Final length (mm)	58 ± 2.16a	59.1 ± 3.16a	60.5 ± 1.15a
Final weight (g)	1.81 ± 0.22a	1.9 ± 0.3a	2.0 ± 0.15a
Water qualities			
Temperature (^{0}C)	32.43 ± 0.33	32.19 ± 0.28	31.86 ± 0.21
pH	8.75 ± 0.14	8.77 ± 0.17	8.77 ± 0.17
DO (ppm)	9.08 ± 0.81	9.07 ± 0.85	9.89 ± 1.13
Free CO2 (ppm)	Nil	Nil	Nil
Alkalinity (ppm)	198.22 ± 4.38	197.33 ± 2.77	205.78 ± 4.88
Hardness (ppm)	218.44 ± 11	216.67 ± 8.65	233.11 ± 10.25
Salinity (ppm)	195.11 ± 7.34	191.11 ± 4.94	204.78 ± 7.76
Conductivity (µS/cm)	399.89 ± 15.66	391.78 ± 10.61	422.33 ± 15.51
TDS (ppm)	291 ± 10.42	286 ± 7.34	313.11 ± 8.88

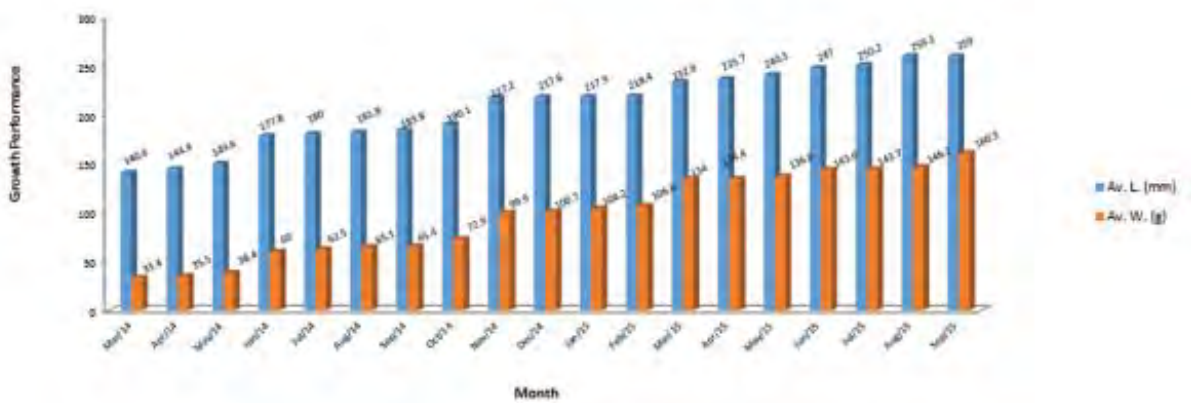


Fig. 71: Growth performance of wild caught hilsa in freshwater grow out pond

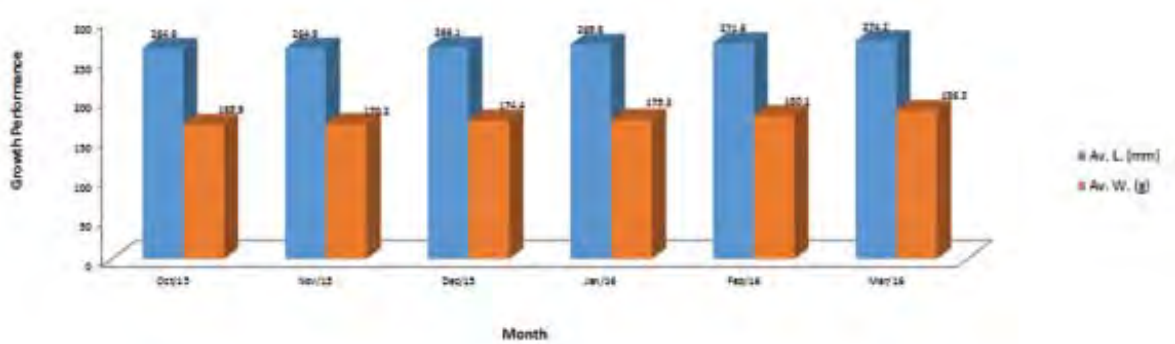


Fig. 72: Growth performance of wild caught hilsa in freshwater Brood Stock pond

Table 52: Water quality parameters of grow out and brood stock ponds

Parameters	Grow out Pond (Mar, 14-Sep, 15)	Brood Stock Pond Sep, 15-Mar, 16)
pH	8.45 ± 0.10	8.46 ± 0.13
DO (ppm)	8.48 ± 0.29	8.53 ± 0.08
Free CO_2 (ppm)	Nil	Nil
Alkalinity (ppm)	141.35 ± 5.28	174.57 ± 17.06
Hardness (ppm)	148.37 ± 6.23	223 ± 29.39
Salinity (ppm)	142.01 ± 8.08	207.43 ± 30.41
Conductivity (µS/cm)	288.78 ± 18.19	423.77 ± 61.18
TDS (ppm)	207.61 ± 12.03	302.71 ± 43.81

Fig. 73: Daphnia is being fed to hilsa brood stock culturedin freshwater pond

Fig. 74: Moina (left) and Daphnia (right)produced in FRP tanks for feeding hilsa brood stock

Fig. 75: A haul ofhilsa brood stock cultured in freshwater pond at Kalyani centre of CIFA

Transportation of eggs, hatchlings and seed of hilsa

Experiment I: Comparison on the survival rate between tank reared (44.42 mm/0.73 g) and wild caught (46.4 mm/ 0.98 g) hilsa seed during acclimatization under laboratory condition (Table 10) and transportation (Table 11) in motor van for 6 hours both in air filled and oxygen filled plastic packets showed 100% survival of tank reared seed and 0% survival of wild caught seed that survived upto 20 minutes.

Table 53: Qualities of water during acclimatization experiment of reared seed and river seed.

Parameters		Water qualities				
		Reared seed			River seed	
	Initial	Final		Initial	Final	
		Oxygen filled	Air filled		Oxygen filled	Air filled
Temperature (^{0}C)	30.3	29.13 ± 0.03	29.17 ± 0.03	29.6	29.13 ± 0.03	29.67 ± 0.07
pH	8.75	8.62 ± 0.13	8.77 ± 0.003	8.49	8.52 ± 0.02	8.51 ± 0.01
DO (ppm)	7.12	18.01 ± 0.59	6.59 ± 0.02	6.78	18.07 ± 0.11	6.29 ±0.01
Free CO_2 (ppm)	Nil	Nil	Nil	Nil	Nil	Nil
Alkalinity (ppm)	170	169.33 ± 2.91	168.67 ± 0.67	120	122 ± 0.00	120.67 ± 0.67
Hardness (ppm)	176	182.67 ± 2.91	175.33 ± 0.67	148	149.33 ± 0.07	150.67 ± 0.67
Salinity (ppm)	149	161.33 ± 6.92	150 ± 0.00	163	163 ± 1	164 ± 0.58
Conductivity (µS/cm)	336	331 ± 12.74	312.33 ± 2.91	333	319.2 ± 4.31	317 ± 4.04
TDS(ppm)	239	237.33 ± 9.39	231.33 ± 0.88	235	226.57 ± 1.49	218.67 ± 2.03

CIFA

Table 54: Qualities of water during transport experiment of reared seed and river seed

Parameters	Initial	Water qualities				
		Reared seed		River seed		
		Final		Initial	Final	
		Oxygen filled	Air filled		Oxygen filled	Air filled
Temperature (^{0}C)	29.1	33.6 ± 0.06	33.47 ± 0.03	29.6	30.67 ± 0.07	31.2 ± 0.06
pH	8.65	8.69 ± 0.02	8.69 ± 0.02	8.49	8.58 ± 0.02	8.45 ± 0.01
DO (ppm)	6.52	18.97 ± 0.43	5.97 ± 0.08	6.78	18.44 ± 0.07	6.36 ± 0.02
Free CO_2 (ppm)	Nil	Nil	Nil	Nil	Nil	Nil
Alkalinity (ppm)	176	168.67 ± 1.33	170.67 ± 2.40	120	118.67 ± 0.67	120.67 ± 0.67
Hardness (ppm)	188	192.67 ± 1.76	191.33 ± 2.40	148	144 ± 1.15	146.67 ± 0.67
Salinity (ppm)	171	172.67 ± 1.20	177.67 ± 2.91	163	160.67 ± 0.33	163.67 ± 1.45
Conductivity (µS/cm)	354	357.67 ± 1.76	367.33 ± 6.44	333	332.83 ± 2.31	339.67 ± 2.73
TDS(ppm)	251	254.67 ± 0.88	266.27 ± 1.90	235	235.2 ± 1.40	240 ± 0.58

Experiment II: Comparison on the survival rate of tank reared hilsa seed (60.5 mm/2.0 g) during acclimatization under laboratory condition and field condition under direct sun light both in air filled and oxygen filled plastic packets showed 100% mortality of fish kept under field condition within one & half hours when the temperature reached at 37^{0}C; in laboratory condition at 31.8^{0}C fish kept in air filled plastic packets survived upto 4 h 29 min and that kept in oxygen filled plastic packets survived upto 20 h 10 min. The water qualities during the experiment are given in Table 55.

Table 55: Qualities of water during acclimatization experiment of reared seed in closed plastic packet under laboratory and field condition.

Parameters	Initial	Final			
		T1	T2	T3	T4
		(Oxygen filled, in lab)	(Oxygen filled, in field, under direct Sun)	(Atm. air filled, in lab)	(Atm. air filled, in field, under direct Sun)
pH	**8.64**	**8.17 ± 0.04**	**8.48 ± 0.06**	**8.46 ± 0.05**	**8.51 ± 0.55**
DO (ppm)	**7.2**	**16.77 ± 1.05**	**12.41 ± 0.12**	**4.87 ± 0.47**	**6.29 ± 0.07**
Free CO_2 (ppm)	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**
Alkalinity (ppm)	**200**	**213.67 ± 2.73**	**203 ± 2.52**	**198.33 ± 1.45**	**199.33 ± 0.67**
Hardness (ppm)	**248**	**260.33 ± 3.93**	**239.67 ± 1.20**	**259 ± 2.08**	**241 ± 1.53**
Salinity (ppm)	**223**	**238.67 ± 8.76**	**230.67 ± 3.18**	**229 ± 3.21**	**231 ± 3.6**
Conductivity (µS/cm)	**461**	**501 ± 11.53**	**480 ± 5.51**	**473 ± 6.66**	**482 ± 7.02**
TDS (ppm)	**327**	**350 ± 11.53**	**345 ± 5.69**	**330.67 ± 2.73**	**339.67 ± 4.1**

Experiment III : During February, 2016 the fertilized eggs were transported from Godakhali to Kalyani centre covering 120 km in 5 hours duration in oxygen filled plastic packets. In three trials, the average transport mortality of fertilized eggs was 14.56% (6.4-28.75%). The quality of water used during transport is presented in Table 56.

Table 56. Water qualities during egg transport.

Parameters	Mean
Temperature (^{0}C)	26.43 ± 0.44
pH	7.76 ± 0.03
DO (ppm)	8.49 ± 0.09
Free CO_2 (ppm)	Nil
Total Alkalinity (ppm)	158.67 ± 2.91
Total Hardness (ppm)	282.67 ± 7.06
Conductivity (µS/cm)	1302.33 ± 73.39
TDS (ppm)	684.67 ± 39.62
Salinity (ppm)	453.33 ± 26.12

Plankton culture for feeding hilsa

Mass culture of Chlorella, Pandorina, Brachionus, Daphnia, Moina and Cyclops was done in outdoor

FRP tanks, cemented cisterns and earthen circular trench. Chlorella was fed to Brachionus, Daphnia, Moina,Cyclops and hilsa larvae. Brachionus and Pandorina were fed to larvae whereas Daphnia, Moina and Cyclops were fed to brood stocks that are being cultured in freshwater pond at Kalyani centre. The protocols for the production of those planktons have been developed.

Fig. 76: Hilsa larvae are being fed with Chlorella (left and middle) and rotifer (right) grown in FRP tanks

Fig. 77: Mass culture of plankton in circular earthen raceway

H. Regional Research Centre, Bangalore

Project Title	:	Species diversification in aquaculture: Development of sustainable practices for introduction of peninsular fishes in culture systems
Project code	:	I-86
Funding Agency	:	Institute-based
Duration	:	April 2013 – March 2016
Project Personnel	:	N. Sridhar (PI), M. Raghunath, Hemaprasanth, B. Gangadhar and C. H. Raghavendra

Brood stock development, breeding and larval rearing of *Puntius carnaticus*, and *Puntius pulchellus*

The growth and maturity of the farm bred P.carnaticus under culture conditions were monitored. The females weighed between 440 to 730 gms with no visual sign of maturity. The first attempt of breeding farm bred *P. carnaticus* in the month of July,2015 was not successful as the eggs released due to the induced breeding procedure were found to be immature. The maturity of females expected in the month of November as per the previous experience with wild females was delayed in the farm bred females belonging to F1 generation. This delay in maturity is anticipated when a species is domesticated for the first time. However, the males are in the state of Perpetual reproductive phase releasing milt from the weight of about 150 g and throughout the year. A specific feed based on the nutritional requirement studies was developed and the broodstock are being fed with the same to enhance maturity in females.

Fig. 78: Brooder of *Puntius carnaticus*

Puntius pulchellus is endemic to the western ghats region and currently classified as Critically Endangered (Possibly Extinct) by IUCN redlist was induced bred August,2015.A female with swollen belly(1.6kg) and two readily milting males(1.935 and 2.050 kg) were injected with a combination of Pituitary extract and a commercial hormone preparation. After 18-20 h the female was stripped and the eggs, mixed with milt obtained from the males. Hatchlings were obtained from the orange coloured eggs(Fig. 78) between 54-72h in an indigenous hatchery specially designed for the purpose(Fig. 79). The heavily yolk laden larvae were then transferred to an aquarium provided with aeration for further development. The hatchlings measured 4mm (TL)and weighed 3.6 mg. The growth and development of the fingerlings were monitored regularly. The spawn reared in the aquarium till 117 DAH measured 35.9 mm in length and 425 mg in weight (Fig. 80). Around 35 DAH a known number of fry were transferred to Cement tanks and reared. On 117 DAH these specimens measured 32 mm in length and 377 mg in weight. Some of the specimens (Shooters)recorded an increased growth and these measured 52 mm in length and 1778 mg in weight on 117DAH.(Fig. 81). The growth of the farm bred fingerlings in the cement tanks and in ponds are being monitored periodically.A comparison were also made on the growth of the fingerlings of *P. pulchellus* caught from wild and reared in cement tanks. The fingerlings from the river grew from 12.28 cm in length and 23.55g in weight to 18.02 cm and 76.23 g in six months (Fig.82).

Fig. 79: Developing eggs of *P. pulchellus*

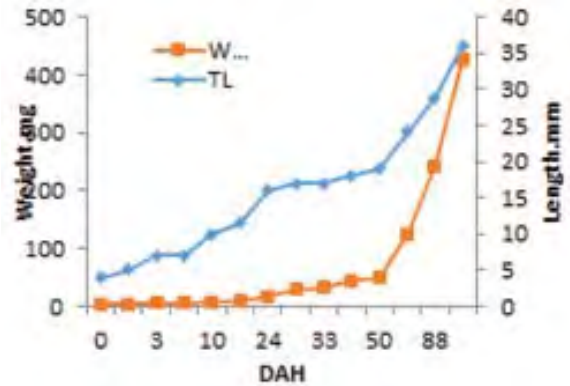


Fig. 80: Growth of *P. pulchellus* sapwn to fry in aquariums

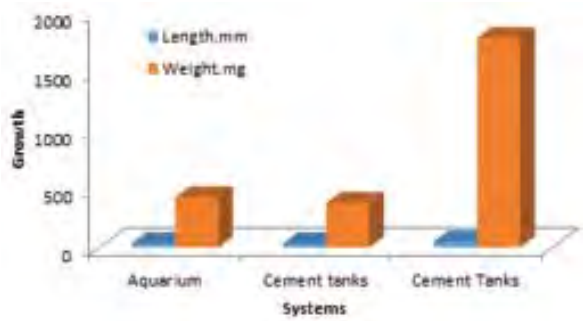


Fig. 81: Growth of *P. pulchellus* fry in Different systems

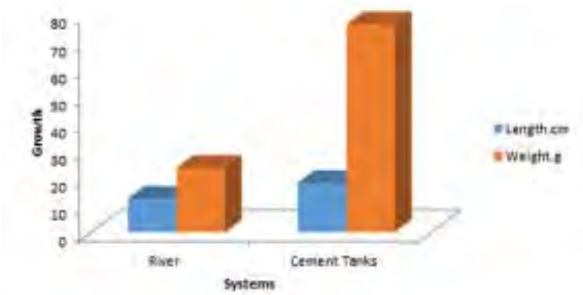
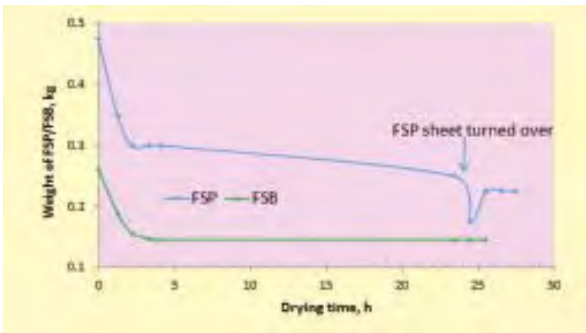


Fig. 82: Growth of *P. pulchellus* fingerlings (Wild) in culture systems

Value added products from medium and small indigenous fish species

The shelf-life of the Fish chutney powder developed was planned for evaluation. But as critical chemicals could not be procured, a new product was developed. A fish soup powder base (FSP base), that takes advantage of the faster drying process when cooked fish meat is co-dried with starch based carriers was standardized. It was seen that by blending cooked fimbriatus/ rohu meat picked free of bones with either corn flour, rice flour or semolina and salt (58:38:0.03), high drying rates of 0.1 to 0.12 kg water evaporated/kg dry matter/ h could be realized in the first 5h of drying even at a relatively low temperatures of 40-50°C. The drying process was essentially complete after 5h with a residual moisture content of only 10 and 6% at 40 and 50°C drying temperatures respectively. The type of starch material used for co-drying did not affect the drying characteristics.



Using the fish soup powder base developed, the traditional process of making fish soup powder (FSP) was evaluated with the modified process using FSP base. In the traditional mode of preparation wherein the cooked and picked fish meat is blended into a thick paste with other ingredients including fried onions, drying was found to be very slow even at 70°C, as moisture from the bottom layers of the paste did not diffuse readily to the top layers for evaporation. As a result, at a loading of 4.5 kg/m^2, drying was incomplete after 48h and the semi-dry sheet of FSP had to be turned over after 20h and broken up to evaporate the remaining moisture. Even when the loading was reduced to 1.93 kg/m2 by increasing the drying area the turning over of the sheet was needed to fully dry the FSP. In comparison, the FSP base could be dried at a much lower temperature of 50°C within 5h. Further by using dehydrated onion powder, use of fat for frying of onions was obviated. Overall, the modified process FSP preparation could be completed within 6h at 50°C compared to 10-14h at 70°C in the traditional method and the yield was also higher (61 vs 45%).

Studies on Argulus infection pattern in peninsular carps subsequent upon their introduction to culture systems with an aim on development of prophylactic and control measures

Efficacy of combination of Ivermectin and UV attenuated metanaupli in preventing Argulus infection

Study was undertaken to evaluate the efficacy of

a combination of Ivermectin and UV attenuated metanaupli in preventing Argulus infection in *L.fimbriatus*. Fingerlings of *L.fimbriatus* were exposed on day 1 to UV attenuated metanaupli of Argulus along with an aqueous suspension of Ivermectin. These fingerlings were again administered booster dose of UV attenuated metanaupli and ivermectin at the same dose on day 15. Thereafter, fishes were divided in to groups and challenged on days 7, 15, 30, 45and 60- post booster dose with lethal dose of Argulus metanaupli. *L. fimbriatus* fingerlings not exposed to attenuated metanauplii and ivermectin, but challenged with lethal dose of metanauplii served as infected control. Results indicate protection against Argulus infection till 45 days' post booster dose. However, fish challenged on day 60 post booster dose developed symptoms of argulosis on day 2 of challenge, which continued till day 14, but the symptoms and pathological signs started to disappear from day 16 post challenge and the parasites did not develop further in to adult. In comparison, in infected control, symptoms of argulosis appeared from day 2 of challenge followed by mortality of the host fish at regular intervals with 100% mortality by day 17 post challenge. Based on this study it is concluded that administration of UV attenuated metanaupli along with Ivermectin followed by a booster dose on D-15 protected *L.fimbriatus* from acquiring Argulus infection for45 Days.

Efficacy of Insect Growth Regulators (IGR) and avermectin against Argulus

Efficacy of oral administration of Novaluron, Buprofezin (Insect growth regulators (IGR), specifically chitin synthesis inhibitors) and Emamectin benzoate (avermectin) in preventing establishment of Argulus infection in fingerlings of *L.fimbriatus* was evaluated. In the first experiment, Novaluron was administered orally through feed @ 1mg/kg bwt for seven days (D1-7) to *L.fimbriatus* fingerlings and these fishes were challenged on days 4, 14, 21, 28 and 37 with lethal dose of metanaupli of Argulus. In fish challenged on day 4, typical symptoms of argulosis viz; hemorrhages at fin base develops by day 5, which continued till day 13. Thereafter symptoms became milder and fish recovered completely by day 17. Challenges on days 14, 21, 28 and 37 did not develop in to adult parasites nor did symptoms appear in any of these groups, indicating that initial prophylactic treatment with Novaluron for 7 days before exposure to the parasite prevents establishment of Argulus infection till 30 days post the last drug dose administered.

In the second experiment Buprofezin was administered orally through feed @1mg/kg bwt for sevendays(D1-7)to *L.fimbriatus* fingerlings and were subsequently challenged on days 2, 4 and 14.Challenges on days 2 and 4 resulted in hemorrhage and associated symptoms of Argulosis in fish a day after challenge. These symptoms, however disappeared by days 6 and 8 post challenge in respective groups and the challenge were not able to develop to adult parasites. Challenge on day 14 did not result in any symptoms or pathology and no parasites from the challenge established on the fish host.

In another study, efficacy of an avermectin, *viz*; emamectin benzoate in preventing establishment of Argulus infection in *L.fimbriatus* fingerlings was evaluated. Emamectin benzoate was orally administered to *L.fimbriatus* fingerlings @ recommended dose of 50mg/kg bwt for 7 days (days 1-7). These fish were challenged on days 2, 8, 14, and 21 with lethal dose of Argulus metanauplii. Groups administered emamectin from days 1-7 and challenged on days 2, 8 and 15 did not develop any symptoms of Argulosis and parasites were not able to establish on the host. However, fish challenged on day 21 developed symptoms of Argulosis on day 4 post challenge, which continued till day 20. By day 25 post challenge, fish became free of infection and symptoms disappeared completely. This study established the prophylactic efficacy of emamectin benzoate in preventing establishment of Argulus infection form a subsequent challenge till day 14 post last drug dose.

Project Title	:	Periphyton enhancement – a sustainable technology for efficient nutrient utilisation in seed rearing and grow-out culture of carps with special reference to the peninsular carp *Labeo fimbriatus*
Project code	:	E-79
Funding Agency	:	DBT
Duration	:	19 September, 2012 – 18 August, 2015
Project Personnel	:	GangadharBarlaya (PI) and N. Sridhar

Evaluation of the influence of commonly used fertilizers on the growth and nutrient composition of periphyton

A study was conducted in 4x4x1 m soil-based (10 cm) out-door cement tanks. Locally available manures cow dung (CD), poultry manure (PO) and press mud (PM) were used for evaluation. Cow dung was used at the recommended dose for carp culture. Poultry manure and press mud were applied to provide equal quantity of nitrogen as that of cow dung. The nitrogen content of the manures was determined following AOAC (1995). Sugarcane bagasse was suspended vertically using nylon rope at 2 t/ha for periphyton growth. The tanks were filled with water from a bore well and the level in the tanks maintained at 90±2 cm. Evaporation loss was compensated fortnightly.

Different water quality parameters were estimated on weekly basis. Periphyton samples were collected and analysed for chlorophyll-a, biomass (dry weight) and proximate composition parameters. Planktonic biomass of the tank water was also analysed at fortnightly intervals. This experiment was conducted for 63 days.

All the water quality showed significant variation during the period of study. Water pH showed a general increasing trend with the experimental duration. Tanks applied with cow dung showed lower (P>0.05) pH and those with poultry manure showed higher (P>0.05) phosphate content. Other parameters did not show any significant variation among the different treatments. Total pigment content, biomass (dry matter) of periphyton and biomass (dry matter) of plankton recorded in different treatments showed higher values in poultry manure treatment (Fig. 83). Press mud treatment recorded lower periphyton and plankton dry matter.

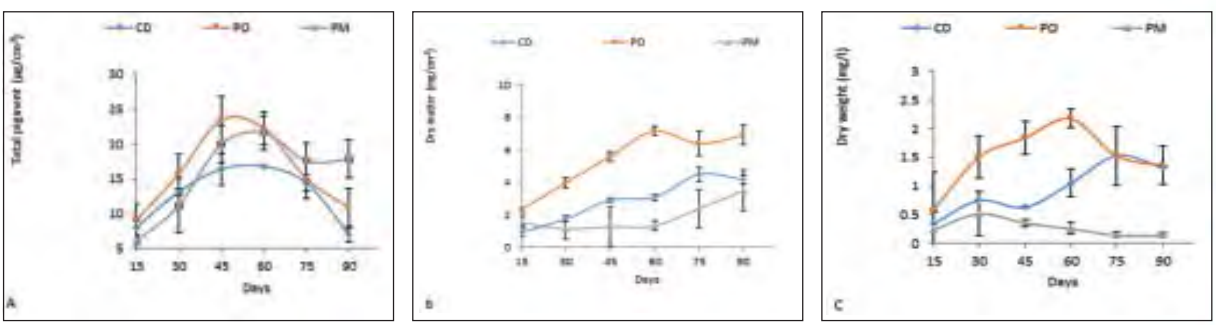


Fig. 83: Total pigment content (A), biomass (dry matter) of periphyton B and Biomass (dry matter) of plankton (C) (mean ±SD) recorded in different treatments with manures

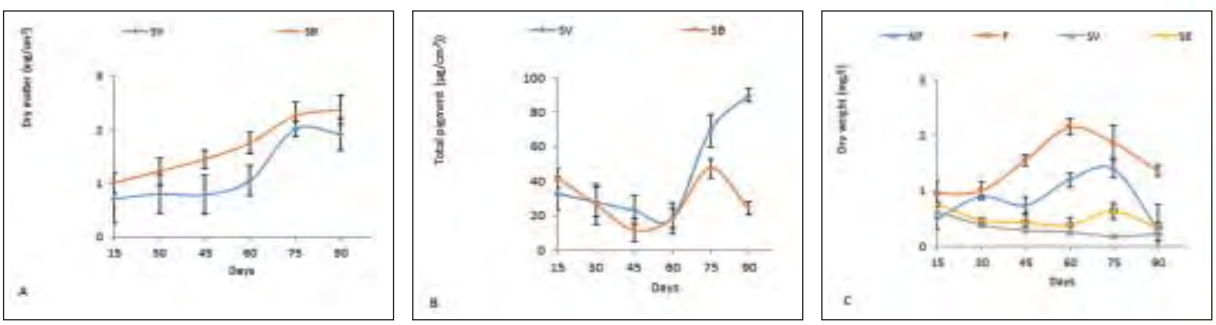


Fig. 84: Dry matter (A), and chlorophyll content (B) in periphyton and dry matter content (C) in plankton during the experimental duration

Data of proximate composition analysis of periphyton and plankton is given in Tables 57 A& B. Crude protein content was higher in periphyton from poultry manure treatment. Other parameters showed no difference (P>0.05) among periphyton from different treatments. The proximate composition of plankton, however, showed higher crude protein, fat and ash values both in poultry manure and cow dung treatments.

Table 57 (A) : Proximate composition (%, wet weight basis) of periphyton

Manure	Moisture	Crude protein	Crude fat	Ash	Crude fibre	NFE
Cow dung	81.75±8.23a	4.81±0.13a	0.37±0.07a	7.16±0.10a	1.02±0.07a	4.57±0.12b
Poultry manure	81.93±5.16a	5.26±0.04b	0.43±0.01a	7.21±0.03a	0.83±0.03a	3.99±0.03a
Press mud	82.04±7.31a	4.63±0.09a	0.32±0.02a	7.40±0.05a	0.83±0.11a	4.45±0.13b

Table 57 (B): Proximate composition (%, wet weight basis) of plankton

Manure	Moisture	Crude protein	Crude fat	Ash	Crude fibre	NFE
Cow dung	87.75±7.01a	4.09±0.25b	0.52±0.10b	2.90±0.12b	0.47±0.01a	4.26±0.23b
Poultry manure	88.75±6.66a	3.96±0.26b	0.60±0.09b	3.43±0.15b	0.81±0.04b	2.45±0.12a
Press mud	93.04±6.05a	2.86±0.38a	0.33±0.02a	1.48±0.05a	0.38±0.02a	1.91±0.09a

Evaluation of the growth performance of *L. fimbriatus* in culture tanks with sugarcane bagasse as periphyton substrate in water column and bottom

An experiment was conducted 4x4x1 m soil-based, out-door cement tanks using standard fertilization schedule. Treatments were Feed, Substrate, Substrate + Feed and Substrate in tank bottom + Feed. Sugarcane bagasse was hung vertically at 2t/ha, except in Substrate in tank bottom + Feed, where it was applied at the tank bottom. Fingerlings of *L. fimbriatus* were stocked at 10,000/ha, 10 days after manuring and bagasse application. The feed consisted of groundnut cake, rice bran, finger millet (binder) and vitamin mineral mixture. Major water quality parameters were estimated once in a week. Different water quality parameters were estimated on weekly basis. Periphyton samples were collected and analysed for chlorophyll-a, biomass (dry weight) and proximate composition parameters. Planktonic biomass of the tank water was also analysed at fortnightly intervals. Additional periphyton samples were also collected for species enumeration. This experiment was conducted for 97 days.

The planktonic genera recorded in periphyton from Substrate-vertical treatment was 58 compared to 51 from Substrate-bottom treatment. More zoo plankton genera (4) were recorded from substrate –bottom treatment compared to Substrate vertical (2). Both the dry matter and ash-free dry matter contents of periphyton showed no difference (P>0.05) between the substrate orientations (Figure 6). The total pigment content was however, higher when the substrate was in vertical position.

The growth and survival of *L. fimbriatus* in grow-out culture did not vary when substrate was provided in vertical and bottom orientations and were comparable with those receiving feed (Table 58).

Table 58: Growth and survival of *L. fimbriatus*

	Final weight (g)	Weight gain (g)	SGR (%)	Survival (%)	Biomass (g/tank)
No feed	33.50±2.12^{a}	26.94±2.56^{a}	1.81±0.14^{a}	90.63±4.42^{a}	486.50±54.45^{a}
Feed	44.49±5.42^{b}	38.47±5.29^{b}	2.21±0.11^{b}	90.63±4.42^{a}	643.26±47.18^{b}
Substrate Vertical	48.44±6.63^{b}	42.03±6.41^{b}	2.24±0.11^{b}	100±0^{b}	774.96±106.01^{c}
Substrate Bottom	49.57±2.02^{b}	43.17±2.24^{b}	2.27±0.08^{b}	96.88±4.42^{ab}	767.62±3.71^{c}

Carcass of fish in Substrate –bottom treatment had higher moisture and lower crude protein and fat contents. Activity of majority of the digestive enzymes in the gut of *L. fimbriatus* was higher when substrate was provided compared to no substrate treatments.

I. Regional Research Centre, Vijayawada

Project Title	:	Establishment of Hatchery and Seed Production facilities for the Striped Catfish *(Pangasianodon hypophthalmus)* in Andhra Pradesh
Project code	:	E-68
Funding Agency	:	NFDB
Duration	:	February, 2011 – January, 2016
Project Personnel	:	B. S. Giri (PI) and P. V. Rangacharyulu

Pangasianodon hypophthalmus, an exotic species of freshwater catfish has been introduced into India and is adopted for culture in states like West Bengal, Andhra Pradesh and Bihar in view of various reasons *viz*., (i) faster growth rate of achieving 1.5 kg in 6 months, (ii) low cost of production, (iii) less sensitive to DO stress and other factors. States like Jarkhand and Chhattisgarh have given impetus on culture of striped catfish in cages in various reservoirs. Rapid development in culture of Pangassius has created many challenges such as dearth of quality seed, inconsistent management practices, prevalence of stress imposed diseases, glut in the market and acute decline in the farm gate price. These problems have warranted the need for developing a sustainable hatchery technology, production of quality seed and standardization of nursery and rearing practices.

Breeding of *P. hypophthalmus* was achieved successfully at Regional Research Centre (ICAR-CIFA), Vijayawada during 2013 following induced breeding techniques using pituitary gland extract (PGE). Further breeding technology has been standardized in the subsequent years for commercial production of *P. hypophthalmus* seed. Equilibrated sex ratio of 1:1 was found to yield optimum results in breeding experiments. Ova collection by dry stripping was found to be effective method of egg collection while milt was introduced through direct contact technique without the intervention of extender solution. Rate of fertilization of eggs ranged from 80 to 90% as against 60 to 70% of hatching percentage depending on environmental conditions as also on the age of the fish. A healthy male could yield 30 to 40 ml of milt whereas females yield 1.5 lakh eggs/kg BW during monsoon seasons. In case of males there is drastic reduction in quantum of milt during late monsoon while in females, although there was no reduction in quantum of eggs during late monsoon season, the rate of fertilization was 0-5% at the end of breeding season. Breeding of striped catfish was remarkably significant during August-September months when South-West monsoon was advancing.

Hatchlings to fry, and fry to fingerling rearing of the striped catfish were found to be most crucial part in the life cycle of *Pangasianodon hypophthalmus*. Hatching of fertilized eggs was completed after an incubation period of 20 to 28 hrs depending on temperature and water quality parameters. Hatchlings actively feed on supplementary feeds even without completing the absorption of yolk sac. Hatchlings can be fed with Casein milk protein during the early stages till they are released into the rearing ponds. Hatchlings need continuous aeration till they develop accessory respiratory organs as also to reduce cannibalism. Seed gradually get accustomed to carbohydrate based diet after 10 days and further for a period of 15 days before they were administered formulated feeds from 25to 30 days of hatching. Survival rates of 20% could be obtained from hatchling to fry stage. Diurnal dynamics of water quality parameters in *Pangassianodon hypophthalmus* seed rearing ponds and broodstock ponds revealed that water quality parameters such as NH_3-N was detrimental during brood stock management as against other parameters. Rate of fertilization, hatching percentage were found to be directly proportional to Dissolved Oxygen content in comparison to other parameters.

Project Title	:	Risk and benefit assessment on an illegally introduced fish species Pacu *(Piaractus branchypomus)* in India
Project code	:	E-90
Funding Agency	:	Collaborative with NBFGR
Duration	:	April, 2014 – January, 2016
Project Personnel	:	B. S. Giri (PI) and P. V. Rangacharyulu

Although *Piaractus branchypomus* is one of the exotic species that is being cultured in Andhra Pradesh in an area of 1000 Hectares, its compatability with Indian Major Caprs in mixed/ poly culture has not been fully understood. Hence, a survey is initiated in collaboration with National Bureau of Fish Genetic Resources, Lucknow to study the impact of Paku and its suitability in freshwater aquaculture in Andhra Pradesh. Pacu is mostly cultivated in Inland coastal areas of West Godavari and Krishna Districts with low productive soils. In most of the areas Pacu is cultured in combination with Rohu (*Labeo rohita*) at a stocking density of 7000 and 500 per hectare respectively with total production levels of 12-15 MT/Ha. Cost of production was high when Pacu was cultivated in monoculture system than when cultivated along with Rohu. Although disease incidence was low in Pacu, it was found to be highly sensitive to DO stress. Consumer preference for Pacu was found to be good owing to hard and consolidated nature of meat. Unlike other exotic species such as *Pangasianodon hypophthalmus* (Tiger Shark), Pacu has limited value as ornamental fish.

Project Title	:	Development of low cost feeds for *Macrobrachium rosenbergii* culture
Project code	:	1-90
Funding Agency	:	Institute based
Duration	:	April, 2014 – March, 2017
Project Personnel	:	P. V. Rangacharyulu (PI) B. S. Giri, P. L. Lalrinsanga and Ramesh Rathod

To reduce the cost of cultureof *M. rosenbergii,* costly protein ingredients were replaced with cheaper sources of protein in feeds and fed to PL of 0.08g under pond culture conditions for 170 days. Cheaper protein source diet has given similar growth compared to control diet.

Table 59: Growout culture (170 Days)

	Control diet	Exp. feed
Initial weight (g)	0.08	0.08
Final weight (g)	32.43	31.60
Growth	32.35	31.52
Survival	36%	38%
FCR	2.14	2.19

Table 60: Water quality parameters observed during the experiment

Parameters	Control pond	Experimental pond
pH	7.20	7.10
Temp ^{0}C	23.0	23.0
Transparency (cms)	21	18
DO(ppm)	4.96	5.26
Free CO_2 (ppm)	nil	NT
Alkalinity (ppm)	375	365
Total Hardness (ppm)	335	365
Calcium Hardness (ppm)	56.12	61.24
NH_3 (ppm)	1.10	1.20

J. Regional Research Centre, Gujarat

Project Title	:	Exploring potential of freshwater aquaculture technology intervention in Gujarat
Project code	:	1-79
Funding Agency	:	Institute-based
Duration	:	April 2012 – March 2015
Project Personnel	:	C. K. Mishra (PI),Subhas Sarkar and Ajit Chaudhari Keshav

Demonstrations on successful FRP Carp hatchery operation was undertaken on Farmers field at village Pij, block Nadiad district Kheda and at village Moraj, block Tarapur district Anand of the state of Gujarat. The farmers of these two districts were provided with complete technical knowhow on carp broodstock management, induced breeding, FRP carp hatchery management and nursery management. The farmers could build up their skill on induced breeding and FRP carp hatchery management. Earlier the farmers were dependent on seed from external sources of Public and private seed farms in the state of Gujarat and other states namely West Bengal. The farmers under demonstration could produce ten lakh rohu spawn with good fertilization rate of 93 ± 2 % and hatching rate of 97 ± 2 % in a single operation. Subsequently, the farmers raised the seed under nursery management practices and could get an average fry survival of 4.8 ± 0.6 lakh.

Project Title	:	Evaluation of optimum stocking density for nursery raising of *Labeo rohita* spawn under hapa system (multi-location trial) in village ponds of middle Gujarat
Project code	:	I-94
Funding Agency	:	Institute-based (collaborative)
Duration	:	April 2015 – March 2018
Project Personnel	:	C. K. Mishra (PI), J. H. Bhatt (CC-PI) and Chaudhari Ajit Keshav

The experiment was conducted with six different stocking densities such as 100, 250, 500, 750, 1000 and 1500 (nos. rohu spawn/m^3) in fixed hapa at two different village ponds of middle Gujarat. The maximum average final weight, weight gain, average final length, length gain, specific growth rate and survival were recorded in hapa stocked with 100 nos. rohu spawn/m3 while the minimum average final weight, weight gain, average final length, length gain, specific growth rate and survival were recorded in hapa stocked with 1500 nos. rohu spawn/m3. During the experimental period water quality parameters were within permissible limit and did not show any remarkable variation.

TECHNOLOGY TRANSFER, WORKSHOPS, TRAININGS AND FARMERS MEETS

Training programmes of the Institute

The Institute offered several short-term training courses during the year for capacity-building of field-level functionaries, who in turn would transmit advanced technical know-how to the end-users. The programmes were demand-driven and the delivery was based on the principle of 'learning by doing' with adequate background in theory and sufficient hands-on practical exercises. Extension officers in the state department of fisheries, college/university teachers, students, entrepreneurs and NGO officials were benefited from the courses. Training programmes conducted this year are presented in Table 59.

Table 59: Training programmes conducted

Sl. No.	Title	Venue	Duration	No. of participants
1.	Farming Systems in Freshwater Aquaculture	CIFA, HQ	11-15 May, 2015	37
2.	Molecular Biology & Biotechnology for Fisheries Professionals	CIFA, HQ	15 May – 15 August, 2015	05
3.	International Training on Fish Breeding Technology (Leading to Diploma)	CIFA, HQ	28 May- 29 September, 2015	02 (Nigerian)
4.	Induced Breeding and Seed Production of Murrel and Anabas in Hatchery Condition	CIFA, HQ	01-06 June, 2015	12
5.	Induced Fish Breeding (rural youth of RMSSSM, Belur Math)	RRC, Rahara	06-12 June, 2015	31
6.	Summer School on Advance Tools for Genetic Improvement of Aquaculture Species: an Integrated Approach	CIFA, HQ	10-30 June, 2015	20
7.	Hands on Training on Molecular Techniques in Fish Disease Diagnosis	CIFA, HQ	22-27 June, 2015	13
8.	Recent Advances in Freshwater Aquaculture	CIFA, HQ	30 June – 04 July, 2015	30
9.	Second National Training Programme on Installation and Operation of FRP Carp Hatchery	CIFA, HQ	07-10 July, 2015	53
10.	Breeding of Small Indigenous Fish Species (SIFs) with Emphasis on Pabda & Reba	RRC, Rahara	11-17 July, 2015	15
11.	Summer School on Aquaculture Diversification towards Boosting Pond Productivity and Farm Income	CIFA, HQ	08-28 July, 2015	25

12.	Soil & Water Quality Management in Fish Ponds with Special Reference to Carbon Sequestration	CIFA, HQ	17 –22 August, 2015	11
13.	Application of Nanotechnology in Aquaculture Fisheries	CIFA, HQ	24-28 August, 2015	16
14.	Skill Development in Freshwater Aquaculture for Fish Farmers of Darbhanga, Bihar	CIFA, HQ	07-11 September, 2015	31
15.	Freshwater Pearl Farming for Entrepreneurship Development	CIFA, HQ	21-26 September, 2015	12
16.	Ornamental Fish Breeding and Culture	CIFA, HQ	23-28 September, 2015	14
17.	Model Training Course on Improved Disease Management Practices in Freshwater Aquaculture	CIFA, HQ	23-30 September, 2015	27
18.	Molecular Biology & Biotechnology for Fisheries Professionals	CIFA, HQ	02 November, 2015 - 31 January, 2016	05
19.	Short course on Molecular Approaches in Diagnosis and Control of Emerging & Transboundary Diseases of Freshwater Fish & Shellfish	CIFA, HQ	17-26 November, 2015	13
20.	Freshwater Ornamental Fish Culture	RRC, Anand	17-19 November, 2015	23
21.	National Workshop and Training on Feed & Feed Technologies for Responsible Aquaculture	CIFA, HQ	18-19 November, 2015	66
22.	Skill Development in Freshwater Aquaculture for Fish Farmers of East Champaran, Motihari, Bihar (In Hindi)	CIFA, HQ	23-28 November, 2015	26
23.	Training Program on Breeding and Larval Rearing of *Dawkinsia tambraparniei*	RRC, Bengaluru	05 January, 2016	15
24.	Culture and Seed Production Technology of Carps, Catfishes & Prawns	F. S., Kalyani	11-15 January, 2016	19
25.	Freshwater Aquaculture as a Livelihood Option for Tribal Youths of Assam Sponsored by Mahar Regiment, Assam	CIFA, HQ	13-16 January, 2016	20
26.	Fish Farming for Rural Development- An Option for Livelihood Development (for Farmers of Madhubani, Bihar)	CIFA, HQ	02-06 February, 2016	34
27.	International Training on Brood Stock Management and Milt Cryobanking of Carps	CIFA, HQ	15-25 February, 2016	10

Field Days conducted by CIFA

A total of 23 Field Days were organized for the farmers of various districts of Odisha and other states covering many fish farmers including farm women (Table 60). The field days included aquaculture farm visits, laboratories and other facilities. The farmers visited the learning stations which include hatchery and culture facilities for carps, air-breathing species and catfishes, freshwater prawns, ornamental fishes, flow through system, cage culture, feed mill, aquarium, Krishi Vigyan Kendra (KVK), Agricultural Technology Information Centre (ATIC) and others. They also engage in focused group interactions with the scientists who provide practical solutions to their operational difficulties. Many hands-on activities like fish breeding, soil and water quality management, fish health and nutrition etc. were also explained to them with the help of videos.

Table 60: List of field days conducted

Sl. No.	Date	Particulars	Participants		
			Male	Female	Total
1	07.04.15	Fish farmers from Korea district of Chhattisgarh guided by Mr. Pravin Sharma, Fishery Inspector	37	0	37
2	27.04.15	Farmers under IWMP, Sundergarh district, Odisha guided by M.L. Das, WMT, Social	3	49	52
3	03.06.15	Students of Mothers' Public School, Unit-I, Bhubaneswar	06	00	06
4	04.06.15	M.Sc., Zoology (IV Semester) Students, The University of Burdwan, Golapbag, Burdwan-713104, WB guided by Dr. Koushik Ghosh, Professor	05	05	10
5	24.06.15	Young Trainees o f different Blocks of Dhenkanal district under Asst. Fisheries Officer, Dhenkanal	22	08	30
6	24.06.15	Beneficiaries under USSEP-2014-15 guided by Asst. Fisheries Officer, FTI, Balugaon	21	00	21
7	27.06.15	Fish farmers from Govt. of Puduchery, Dept. of Fisheries guided by Mr. P. Govindaswamy, State Fishery Officer	27	03	30
8	03.07.15	Students from Manipur and Nagaland guided by Indira Devi, Fishery Inspector, Dept. of Fishery, Govt. of Manipur	16	06	22
9	27.07.15	Beneficiaries under Skill Upgradation Training Programme 2014-15, guided by Ms. Monalisha Parida, AFO, FTI, Balugaon	19	05	24
10	26.08.15	Beneficiaries under Skill Upgradation Training Programme 2014-15, guided by Ms. Monalisha Parida, AFO, FTI, Balugaon	30	03	33
11	08.10.15	Beneficiaries under Skill Upgradation Training Programme 2014-15, guided by Mr. S. N. Mishra, AFO & Tanuja Kumar Mallik, JFTA, FTI, Balugaon	28	03	31
12	05.11.15	Trainees & Trainers of Centurion University of Technology & Management, Ramchandrapur, Jatani, guided by Mr. Rajib Lochan Patnaik, Assessor	07	02	09
13	17.11.15	Students of North Bengal University, Dept. of Zoology, Siliguri guided by Prof. Sudip Barat	18	13	31
14	22.12.15	Farmers under ATMA guided by Sanjaya Kr. Mishra, FEO, Training, Murshidabad, West Bengal	42	00	42
15	28.12.15	Students of Pratapsasan High School, PGN Public School and SSVM, Balakati for Scientist-Student interaction as a part of Jai Kisan Jai Vigyan Prog.	30	32	62
16	29.12.15	Student (B.F.Sc.III yr), College of Fisheries, Kawardha, Chhattisgarh guided by Pabitra Barik	12	02	14
17	11.01.16	B.F.Sc. Students from College of Fisheries, GADVASU, Ludhiana	04	05	09

18	27.01.16	Farmers under ATMA guided by Prabir Kumar Khan, DFO, Training, Murshidabad, West Bengal	58	00	58
19	02.02.16	Zoology Students of Govt. E.R.R. PG Science College, Bilaspur, Chhattisgarh	14	17	31
20	22.02.16	Farmers of Bilaspur & Mungeli under Office of the Deputy Director of Fisheries, Bilaspur, C.G.	35	00	35
21	14.03.16	Fish farmers of Mahasamund district of Chhattisgarh	14	00	14
22	15.03.16	B.F.Sc. III yr Students of College of Fishery Science, Jabalpur, M.P.	09	02	11
23	16.03.16	Fish farmers of Surajpur district, Chhattisgarh	10	00	10
		Total Visitor:	**467**	**155**	**622**

Exposure visits to CIFA

The social science section organized 55 group visits comprising students, practicing farmers, farmwomen, extension workers and others (Table 61). Duration of the visits were mostly one day, and in few cases 2-3 days. Visitors were taken around the farm facilities, museum, and selected laboratories and ATIC. Educational videos are screened for the visitors. Interactive sessions with farmer groups were also organized for addressing various queries.

Table 61: Details of the group visits organized

Sl. No.	Date	Particulars	Participants		
			Male	Female	Total
1	07.04.15	Farmers guided by Daitary Satapathy, Instructor, RITE, Rangeilunda, Ganjam	58	22	80
2	22.04.15	Students of College of H.Sc.C.S.Azad Agriculture University, Kanpur, UP Guided by Dr. Mithilesh Verma	2	34	36
3	19.05.15	Farmers from Bhanapur, Khurda,Odisha guided by Mr. Arabinda Dash, O.W.S.	11	09	20
4	22.05.15	Farmers from Daspalla, Nayagarh, Odisha guided by Mr. Pravakar Pradhan, B.T.M.	35	00	35
5	26.05.15	Trainees from FTI, Balugaon, Khurda, Odisha guided by Mr. S. N. Mishra, AFO	20	00	20
6	30.06.15	Fish farmers & farmwomen from Erasama Block of Jagatsinghpur district guided by Mr. Nimain Ch. Barria, Asst. Fisheries Officer	20	50	70
7	09.07.15	Fish farmers & farmwomen from Jagatsinghpur Block of Jagatsinghpur district guided by Mr. Sadasiv Behera, AAO, Jagatsinghpur	30	00	30
8	15.07.15	Farmers of Maharastra, Telengana and Odisha under IMAGE guided by Mr. Neelkantha, RRA, Fishery Node	18	07	25
9	21.08.15	Fish farmers of Mandla, Madhya Pradesh guided by Mr. M.K. Rai, Rural Agri. Extn. Officer, Naivjun, Mandla, MP	42	00	42
10	25.08.15	Fish farmers of Shahdol, Madhya Pradesh guided by Mr. B.K.Sharma, DDA, Shahdol, M.P.	56	00	56
11	08.09.15	Fish farmers from Ranchi, Jharkhand guided by Mr. Gosai Karmakar, Training Co-ordinator, MASS	25	00	25
12	15.09.15	Farmers guided by Mayadhar Mishra, & Ashok Satpathy, Foundation for Ecology Security of Amalapada, Angul	21	00	21
13	24.09.15	Fish farmers from Athamalik Block, Angul districts, Odisha, D.F.O. Angul & FES, Angul guided by Mr. Ashok Satapathy	21	00	21

14	29.09.15	Farmers from Jagannath Prasad, Ganjam, Odisha guided by Abhijit Pradhan, BTT Convener, FIAC Mr. J N Prasad, Ganjam	25	00	25
15	01.10.15	Students of Kamala Nehru Women's College, Unit-I, Bhubaneswar, Odisha guided by Dr. Tara Krusna Maharana, Sr. Lecturer	00	25	25
16	03.10.15	Nursery Students of DAV School, Pokhariput, Bhubaneswar guided by Mrs. Prativa Mohanty, Supervisor			181
17	06.10.15	Farmers of Malkangiri, Odisha guided by Mr. Rajesh Roshan Pattnaik, PO(CB), OTELPPLVS, ITDA, Malkangiri	50	08	58
18	08.10.15	Students of Microbiology, Midnapore College, Midnapore, W.B. guided by Mr. Akhil Pandey, Asst. Professor	07	07	14
19	13.10.15	Students of A.B.N. Seal College, PO & Dist: Coochbehar, West Bengal, guided by Prof. Debajyoti Dutta, Asst. Prof under WBFS, Dept. of Zoology	06	18	18
20	28.10.15	Fish Farmers of Dhenkanal, Odisha guided by Mr. Mrutunjaya Jena, AFO, Dhenkanal, Odisha	12	04	16
21	31.10.15	Students of DAV Public School(CBSE Z), Pokhariput, Bhubaneswar, Odisha	--	--	52
22	05.11.15	Students of B.J.B.E.M, Bhubaneswar guided by Mr. Pranab Kishore Mishra, Asst. Teacher	70	35	105
23	06.11.15	Students of B.J.B.E.M, Bhubaneswar guided by Mr. Pranab Kishore Mishra, Asst. Teacher	58	44	102
24	17.11.15	Field Agents under DAFP, Odisha, Bhubaneswar (CCKN-IA, IMAGE Campus) guided by Mr. Biswajeet Mishra, CFA Coordinator	25	02	27
25	27.11.15	Students of DAV Public School, Kalinga Nagar, Bhubaneswar guided by D. Ashis Ratha, PGT(Bio)	05	04	09
26	27.11.15	Students of St. Xavier International School, Patia, Bhubaneswar guided by Mr. Swatish Ranjan Sahu, PGT	--	--	126
27	28.11.15	Students of K.S. Mahavidyalaya, Singhpur, Jajpur, guided by Mrs. Saswati Panda, HOD, Zoology	06	12	18
28	11.12.15	Students of College of Fisheries, Shirgaon, Ratnagiri, Maharastra guided by Mr. Suhas M. Wasare, Asst. Prof.	18	19	37
29	11.12.15	Fish farmers from Jaleswar, Balasore guided by Mr. Jayanta Kumar Dey R.P.OLM J/s Block	48	6	54
30	18.12.15	Farmers & Officer, Office of Chief Agriculture Officer-cum-Project Director, Bathinda, Punjab guided by Dr. Bahadur Singh Sandhu, Agriculture Officer	05	00	05
31	18.12.15	Students of OUAT, Rangeilunda, Ganjam	20	15	35
32	19.12.15	Students of SSB College, Mahakalpara, Kendrapara, Odisha guided by Mr. Kailash Chandra Das, Demonstrator	18	44	62
33	23.12.15	Students (Zoology Dept) of Cachar College, Silchar 788001, Assam guided by Dr. Sanat Ranjan Datta, Associate Professor & Head.	04	08	12
34	29.12.15	Farmers from Khaira Block, Balasore, Odisha under Odisha Livelihood Mission guided by Mr. Rabindra Kumar Jena, Block Project Manager	70	00	70
35	31.12.15	Farmers from Balrampur & Ramanujan districts of Chhattisgarh guided by Mr. Siddharth Pd Sukla, AFO	10	00	10
36	06.01.16	Students from Betanoti College, Betanoti, Mayurbhanj, Odisha guided by Mr. Sanjukta Jee, Reader	20	20	40

37	11.01.16	Students from DKS College of Agriculture & Research Station, Bhatapara, C.G. guided by Mr. Sharad Shroff, Asst. Prof.	27	11	38
38	13.01.16	Farmers from Balod district of Chhattisgarh guided by Mr. Sharad Verma, Fishery Inspector	13	00	13
39	18.01.16	Farmers under Odisha Livelihood Mission, Jaleswar Block, Balasore guided by Mr. Padmalochan Pradhan, Ohm Accountant	51	02	53
40	21.01.16	Students of ANIT College, Khurda, Odisha guided by Mr. J.K. Sethy, Lec. of Biotech	26	22	48
41	21.01.16	Student (IV B.F.Sc.), Fisheries College & Research Institute, Thoothukudi, Tamil Nadu guided by Mr. Ravi Kumar	23	16	39
42	27.01.16	Staff of Office of DDA, Jhabua, Madhya Pradesh guided by Mr. S.S. Maurya, ADA	11	00	11
43	01.02.16	Farmers under Deputy Director of Fisheries, Training Centre Nowgeng, Chhatarpur, M.P. guided by Mr. G. K. Meshram	12	04	16
44	03.02.16	Children under Viswar Jyoti Child Development Center, Bhubaneswar-1, Khruda, Odisha	80	50	130
45	09.02.16	Students from Ramnagar College, Depal, Purba Medinipur, West Bengal	51	09	60
46	10.02.16	Zoology Students from P.N. (Auton.) College, Khordha, Odisha guided by Mr. Chinmayee Mohanty, Reader (Zoology)	12	28	40
47	16.02.16	Farmers from Surguja district of Chhattisgarh guided by Mr. L. R. Sahu, Fisheries Inspector	10	00	10
48	20.02.16	Farmers from Og Block, district-Janjgirichopa, Chhattisgarh	39	00	39
49	24.02.16	Students of Mary Gladys St. Josephs' Girls' High School, Cuttack, Odisha	00	139	139
50	27.02.16	Persons under CYSD, Bhubaneswar, Odisha guided by Mr. Anurag Kumar Shukla, Programme Executive	08	01	09
51	02.03.16	Fish farmers under Office of Deputy Director of Fisheries, Durg, Chhattisgarh guided by Mr. B.L. Velnag, Asst. Fy. Officer	06	00	06
52	15.03.16	Fish farmers of Bemetara district of Chhattisgarh guided by Rajendara Prasad Verma, Asst. Fisheries Officer	08	00	08
53	16.03.16	Fish farmers from Marshghai, Kendrapara, Odisha guided by Dibyajyoti Parida, SRF (NICRA), KVK, Kendrapara	50	00	50
54	16.03.16	Fish farmers from Srikakulam, Andhra Pradesh guided by Mr. P. Puathi, AO, FTC	00	30	30
55	17.03.16	Students of Raja N. L. Khan Womens' College, Midnapur, W.B. guided by Dr. Angsuman Chanda, Asst. Prof.	00	10	10
		Total Visitor:	**1263**	**715**	**1978**

Table 62: Exposure visits to RRC, Rahara and Field Station, Kalyani

Sl. No.	Purpose of visits	Trainees from	Duration	No. of participants
1.	To acquire knowledge on various aspects of SIFS breeding and culture, integrated farming & climate resilient aquaculture during low rainfall	Dept. of Fisheries, Govt. of W.B.	21 May, 2015	47
2.	To acquire knowledge on pond preparation, fish breeding and hatchery operation	Dept. of Adult Education, University of Kalyani	11-12 June, 2015	30
3.	Training-cum-demonstration on Cryopreservation of fish milt		16 July, 2015	30
4.	Sewage fed aquaculture		11 Aug, 2015	67
5.	To acquire knowledge on pond preparation, fish breeding and hatchery operation	Dept. of Adult Education, University of Kalyani	3& 13 Oct, 2015	65
6.	Rural entrepreneurship through farming, value addition and marketing	Dept. of Adult Education, University of Kalyani	19-20 Nov, 2015	30
7.	Rain fed aquaculture	MANAGE, Hyderabad	19 Nov, 2015	30
8.	Fish culture	Charuchandra College	20 Jan, 2016	34
9.	Fish culture	Bangabashi College	21 Jan, 2016	32

Farmers-scientist interface meet at RRC of ICAR-CIFA, Anand, Gujarat

A Scientist-Farmer Interface Meet on "Aquaculture in village ponds" was held on 6 November, 2015 at RRC of ICAR- CIFA, Anand in which 30 farmers participated. The farmers were sensitized on the effect of sewage on freshwater aquaculture. Controlled application of sewage water on aquaculture ponds is beneficial which helps in productivity of the pond and thereby good growth of fishes. Issues like low dissolved oxygen in several ponds due to heavy weed biomass, maintenance and control of floating weeds using bamboo poles in the periphery of ponds and importance of racking of ponds after each crop were also discussed.

Field Day conducted by RRC of ICAR-CIFA, Anand

Field day was conducted by RRC of ICAR-CIFA, Anand, Gujarat to demonstrate the low cost technology of raising the carp spawn to fry in hapa production system in the village pond leased by fish farmer located at village Napa Vanta taluka-Anand, District- Anand Gujarat. Rohu spawns were stocked in the hapa mesh size of 1/40 inch at a rate of 750 nos spawn/m^3 in each hapa. Spawns were grown in the hapa production system utilizing the natural fish food organisms of the pond and with supplementary feeding with mixtures of rice bran and groundnut oil cake for 20 days at a rate of 8 times the total biomass of the seed in hapa. Fry survival of 58% with an average size of 32 ± 4 mm was noticed at the end of 20 days of raising the spawn to fry. The fry were grown in other hapa mesh netting materials of 1/8 inch at a rate of 100 nos/m^3 for a period of 2 months with the natural fish food organisms of the pond and with the supplementary feed mixtures of rice bran and groundnut oil cake at a rate of 5% total body weight of fish.

Exposure visits to RRC of ICAR-CIFA, Anand

Ten farmers from Jalgaon district of Maharastra were explained in detail about freshwater aquaculture technologies of ICAR-CIFA during their exposure visit to the Gujarat research centre of ICAR-CIFA on 13 November 2015.

Agricultural Technology Information Centre (ATIC)

The Agricultural Technology Information Centre as a sub-component of the "Innovations in Technology Dissemination" under National Agricultural Technology Project (NATP) has been established at the Institute to provide technology products, services and information through a single window system to farmers and entrepreneurs. During this year, 2953 visitors visited ATIC and CIFA facilities. This Centre has generated revenue of Rs.10,000/- from sale of books and CDs; Rs.5,34,421/- from sale of fish and Rs.5,320/- from sale of other farm produce. A large number of pamphlets/booklets were also distributed to the visitors.

SPECIAL DAY CELEBRATIONS

National Fish Farmers' Day

The Institute, in collaboration with Department of Fisheries, Govt. of Odisha observed National Fish Farmers' Day at the Zilla Parishad Conference Hall in Angul District, Odisha on 10 July 2015. On this very day way back to 1957, the first ever successful induced breeding of carp fishes was accomplished by Dr H. L. Chaudhury and Dr K. H. Alikunhi, the doyens of Indian Fisheries. To commemorate this revolutionary feat, a memorial plaque was installed at the embankment of the pond in the Government fish farm, Angul, where the first ever induced breeding was successfully carried out. The plaque was unveiled by Mrs. Girijanandani Sahoo, President, Zilla Parishad, Angul and Sh. Bishnupada Sethi, IAS, Commissioner-cum-Secretary, Fisheries and ARD Department, Govt. of Odisha and Dr. P. Jayasankar, Director, ICAR-CIFA, in presence of other dignitaries and farmers. On this occasion, in a special function, ICAR- CIFA felicitated ten progressive fish farmers from different parts of Angul for having adopted institute's scientific practices and providing leadership to the community leading to enhancing fish farm productivity. As a part of the celebration a 'scientists-farmers-officers' interface was conducted wherein several queries of farmers with regard to fish farming were addressed by the scientists and state govt. officers. Later, in the afternoon, Director and scientists of the Institute visited the farm of Mr. Ajit Dehury in Angul and inaugurated his eco-hatchery for carp seed production. Over 200 persons comprising fish farmers (including 50 tribal farmers), scientists, development officers and others attended the programme.

The National Fish Farmers Day was also organized at RRC of CIFA, Bangalore.The Chief Guest was Dr. C.K. Murthy, Joint Director, Department of Fisheries, Govt. of Karnataka. The function was attended by about 30 farmers from different parts of the State.

The RRC of ICAR-CIFA, Anand, Gujarat organized the National Fish Farmers Day at AAU, Gujarat. The President on the occasion was Dr. N. C. Patel, Vice-Chancellor, Anand Agricultural University, Anand; Chief Guest was Shri N. R. Patel, Deputy Commissioner of Fisheries, Gandhinagar, Govt. of Gujarat and guests of honour were Dr. K.B. Kathiria, Director of Research, AAU, Anand, Dr. A.M. Thaker, Principal & Dean, Faculty of Veterinary Science & Animal Husbandry, AAU, Anand, Dr Sujata Bhatt, Head, Department of Bioscience, S.P. University, Anand, Dr. R.V. Borichangar, Associate Professor, Navasari Agricultural University (NAU), Navasari and Shri J. N. Muniya, District Fisheries Officer, Anand and Shri S. D. Rathod, District Fisheries Officer, Dahod and Dr. G.G. Patel, Programme Coordinator, KVK, Devataj. Progressive fish farmers were felicitated on that occasion and a framers-scientist interaction meet was organized.

International Women's Day

The Institute observed International Women's Day on 8 March, 2016. The theme for 2016 International Women's Day is "Planet 50-50 by 2030: Step it up for Gender Equality". The theme lays emphasis on achieving gender equality and empowering women. It also focuses on new commitment under UN Women's Step It Up initiative on women's human rights. Dr. P. Jayasankar, Director, CIFA welcomed the dignitaries, Smt. Rukmani Panda, noted social activist and Smt. Leena Patnaik, Senior Advocate and mentioned that during the last 15 years the Institute had operated a number of sponsored projects with women as beneficiaries. He expressed his heartfelt thanks to Women Cell of ICAR-CIFA for organizing the programme. In his welcome address he emphasized the contribution of this institute in empowering women through aquaculture. Appropriate aquaculture technologies like carp seed production, carp poly culture, ornamental fish farming and value addition of carp fish etc. are said disseminated among women for uplifting their socio-economic status.

Programmes undertaken by Hindi Cell

Hindi Divas '*Pakhwada*' was observed at the Institute during 14-29 September, 2015. Various competitions like debate, dictation and essay writing were organized among Staff and research Scholars of CIFA and also among the wards of the staff members' of CIFA. Prizes for the various competitions held during the period were distributed on 30th sept 2015 by Dr P. Jayasankar, Director.

Two batches of Staff were sent to Hindi training Institute, New Delhi for training on use of official language in administrative work. Six training programme were conducted in the Institute exclusively in Hindi language for the farmers from North and defense personnel

Vigilance Awareness Week

Vigilance Awareness Week was observed at the Institute during 26-31 October, 2015 with the theme 'Preventive vigilance as a tool of good governance'.

SUCCESS STORIES

Demonstration of climbing perch breeding and seed production technologies at Mangalajodi, Khordha, Odisha

Climbing perch, *Anabas testudineus* is an indigenous fish having high consumer preference and fetches a good market price (Rs 350-500/kg) in many states of India. This fish is also known for its medicinal value as it is rich in minerals (iron and copper), unsaturated fatty acids and essential amino acids. Due to depleting stock in the wild,it is rarely found in the market. This Institute took the initiative to train and impart skills to the different stakeholders for taking up its breeding, seed production and farming. A training programme was conducted on "Induced breeding and seed production of Murrel and *Anabas* in hatchery condition" during 1-6 June, 2015 at this Institute. Mr.Kiran Kumar, a participant, who is a diploma in Mechanical Engineering has taken 11 ponds (18 acres) on lease at Mangalajodi, District Khordha, Odisha. In addition to his formal training, he visited this Institute many times to get sufficient knowledge about the practical aspects of seed production and rearing. He started collection of *Anabas* brooders from his old ponds as well as from the market and kept in concrete tank. After getting training, Mr. Kumar was confident and bred *Anabas* successfully on 15 June, 2015 in plastic container. The initial success boosted his confidence further and he took a number of breeding trials during June 2015. Mr. Kumar has already produced about 5 lakhs spawn by the end of June 2015. He has received more than 5 lakh *Anabas* seed demand from fish farmers of Odisha. In addition to *Anabas* seed sale, he will be going for grow-out culture of the species in water area of 4 acres. Mr. Kumar feels that success in induced breeding and seed production of *Anabas* will lead to a surge in its grow-out farming in coming years.

Mr Kiran Kumar observing Anabas spawn

Early maturity of Indian Major Carps in farmer's field by using CIFABROOD™

A progressive farmer, Md. Amir Ali owner of Raja Hatchery, Murshidabad District, and West Bengal started fish seed production in1972 for Indian and Chinese carps, common carp, bata, punti, pangas and other fishes. Fish breeding has become a family profession through generations. Mr. Ali uses about 30 acres of land area with different pond sizes for rearing of brood stock throughout the year. Presently he produces 6 million spawn per day during breeding season (15 April to 15 August). Early breeding, particularly in March-April is highly preferred as spawn is sold for almost triple the price than in the breeding season (June-August), as there is a very high customer demand. While visiting ICAR-CIFA on an occasion, his son Rittwik Amir heard about the brood stock diet CIFABROOD™. In 2014, they decided to use CIFABROOD™ in one pond on experimental basis particularly to reduce the brood fish management time by early maturity and to see the quality of spawn. The feeding trial in a four acres pond could not lead to a good experience in the 1st year. There was initial development of the females, but later failed to achieve the target due to severe ammonia gas formation in the pond and several brood fishes died due to unhygienic condition.

However, in the next trial during 2015, they received 200 kg of CIFABROOD™ feed under RKVY scheme along with guidelines to be followed. They started feeding from 30 Jan 2015 in one acre pond at the rate of 3% of body weight. The pond was a new one prepared with mahua oil cake treatment before stocking of brood fish and stocked with about 60 kg catla, 60 kg rohu and 80 kg mrigal. The feed was provided by perforated poly bag in three different areas of the pond. Within 38 days the 1st batch of female fishes showed early maturity and were ready for breeding, but males were not oozing. Hence, they could not start breeding with the first female batch, but in the next batch after 48 days, both the males and females were ready for breeding and started breeding on 18 March 2015. The major difference they observed in catla and mrigal was that the quantity of eggs is significantly more than earlier and the quality of spawn was also very good in terms of survival. He was very happy and satisfied about the performance of CIFABROOD™. He has thanked Department of Fisheries, Govt. of West Bengal for providing the feed under RKVY scheme along with the critical guidelines. The farmer is considering applying the feed in the next year also, but feels the price should decrease to some extent.

ICAR-CIFA Trained Entrepreneur Successfully Produce Striped Murrel Seed

Striped murrel, *Channa striatus* is an indigenous air breathing fish having high consumer demand and fetch good market price (Rs 300-600/Kg) in many states of India. Its flesh has medicinal value as it contains sufficient level of arachidonic acid, a precursor for prostaglandin and thromboxin, which is responsible for blood clotting and the fusion of endothelial tissue during normal healing. It can thrive well in weed infested shallow water with low oxygen due to presence of accessory respiratory organ. India is endowed with vast area of derelict and swampy shallow water bodies and such unproductive water resources can be exploited for murrel culture to improve nutritional security and income generation of small and marginal farmers. The ICAR-CIFA, Bhubaneswar has developed and standardized the induced breeding and hatchery technology of striped murrel and trained several prospective hatchery operators from across the country. One such farmer, Mr. Kiran Kumar from Mangalajodi, District Khordha, Odisha successfully bred the fish in June 2015. Subsequently, he continued the breeding and produced more than 20,000 early fingerlings by November 2015. This success has given him a major boost to his confidence to produce more and more striped murrel seed in coming years.

Development of ornamental fish village- a success story

CIFA has developed a concept of "Ornamental Fish Village" at Barkote Block (Deogarh Dist.) of Odisha, where technical support is provided to the resource poor farmers of selected villages to enhance their skill on livelihood development through farming of ornamental fish especially for livebearers and some egg layers. The Institute has supported the farmers through input provisioning under NAIP project (2013-14) by providing tanks and other accessories. The constant technical support by ornamental fish culture unit of CIFA had built the knowledge of these farmers in successful breeding and rearing of ornamental fishes from their backyard units as well as the capacity building on aquarium

making had widened the scope for better financial benefit. The success of the farmers of Landijhari village has attracted the farmers of Saruali, Nuagaon and the adjacent villages to join in this endeavour for livelihood support. The average additional income of Rs. 7000 - Rs. 9000/8 months with an investment of Rs. 4000 - Rs. 6000 thousand has contributed significantly for building their confidence and helped in reducing drudgery for livelihood. Farmers (50 nos), who have been enriched with inputs like FRP tanks and other accessories, could able to raise their income to Rs. 10,000 to Rs. 15,000 in 8 months. The ornamental fish hub developed at Barkote has done a business of Rs 2.5 lakhs during the year 2015-16 from sale of fish, aquarium, dry feed and other accessories. Two farmers from Landijhari have acquired knowledge on aquaria making and trading has made an average business of Rs 1.5 lakhs from sale of Aquaria to different houses and offices. Women SHG (2 groups) in Landijhari and Nuagaon have acquired the expertise of feed preparation and aquaria making which also enhanced their income in addition to their regular fish sale. Due to the popularity made by the Institute, nearby villages have acquired not only knowledge but also started keeping aquarium in their houses. During this project (2012-16) a complete awareness have been made on ornamental fish farming and trade which proved to be successful. Department of Fishery, District administration and other Govt. institutions like ATMA also appreciated this concept and ready to support at their end. More than 100 farmers comprising of 70% women are getting benefit by adopting this technology and the adoption rate is increasing in a progressive manner day by day.

WORKSHOPS

State Level Interaction Workshop on Freshwater Aquaculture Development in Odisha

The Institute in collaboration with Department of Fishery, Govt. of Odisha organized a Collaborative state level Research-Industry-Farmer-Extension Interaction workshop on Freshwater Aquaculture Development in Odisha at Kausalyaganga during 27-28 June, 2015 to draw up a strategic plan for fisheries development in Odisha. While inaugurating the workshop, Sri Pradeep Maharathy, Hon'ble Minister for Agriculture, Fisheries & ARD, Govt. of Odisha said that the state fisheries department has set a target

to double the fish production in next five years. Shri Bishnupada Sethi, Commissioner-cum-Secretary, Fisheries and Animal Resources Development Department said that the interaction workshop was a unique opportunity, wherein research scientists and development administrators are meeting with a single agenda of developing fisheries in Odisha.

Dr P. Jayasankar, Director, ICAR-CIFA said that the workshop would look forward to assess and document the research and development needs of 10 agro-climatic zones of Odisha and develop a strategy for strengthening Research-Industry-Farmer-Extension linkage for aquaculture development. CIFA profile, CIFA Annual Report (2014-15), Technology handouts in Odia and Policy brief were released on the occasion. Dr. J. K. Jena, Director, ICAR-National Bureau of Fish Genetic Resources, Lucknow; Shri P. Krishna Mohan, Director of Fisheries, Odisha; Scientists; officers from Directorate of Fisheries, Cuttack; Deputy Directors of different Zones, District Fishery Officers, representatives of farmers, bank, feed industry, state fishery departments from Jharkhand, Assam, West Bengal and Andhra Pradesh participated in the workshop. The workshop was attended by around 180 delegates. Sri J B Dash, Addl. Director Fisheries, Odisha proposed vote of thanks.

Following were the major recommendations of the interaction workshop:

- Capacity building programme for the officials and farmers of the state shall be arranged by the department in collaboration with ICAR-CIFA.
- For aquaculture diversification, brood seeds of diversified species will be made available from ICAR-CIFA to the state department hatcheries.

- The ongoing resource mapping study should be expedited integrating with ICT.
- A dedicated scheme should be implemented by the Odisha State Fisheries Department to encourage the seed growers especially to produce the quality fingerling/yearling.
- State should initiate the hatchery accreditation process with the technical support of ICAR–CIFA and ICAR-NBFGR.
- Awareness programmes should be organized for the use of feed in aquaculture to increase the productivity and use of farm made feed should be encouraged for small and marginal farmers.

Workshop on Feed and Feed Technologies for Responsible Aquaculture

A National Workshop on Feed and Feed Technologies for Responsible Aquaculture was organized at the Institute during 18-19 November 2015. The programme was inaugurated by Shri T. Prasad Rao Dora, Vice-President, FISHCOFED, and President of FISHFED, Government of Odisha. He highlighted the need of such an important programme for the country in general and the State of Odisha in particular. He added that feed was the most essential component to enhance the aquaculture production. Dr. P. Jayasankar, Director, ICAR-CIFA, in his welcome address reemphasized the need for supplementary feeding based on sound technology and management for doubling fish production in about 5 year time. He also mentioned about the efforts initiated by ICAR-CIFA in popularizing feed technology among fish farmers. Over 100 participants comprising of researchers, extension functionaries, fish feed industries, aquaculturists, progressive fish farmers, financial institutions, and other developmental agencies across the country have participated in the event.

Workshop on Improving Technical Support, Extension and Demonstration Services to the Farmers for Eastern Plateau and Hill Agro-climatic Region

The ICAR organised a Workshop on Improving technical support, extension and demonstration services to the farmers for Eastern Plateau and Hill Agro-climatic Region on 23 November, 2015 at ICAR-CIFA in collaboration with ICAR-Agriculture Technology Application Research Institute, Jabalpur, Madhya Pradesh. The programme was organized with the direction from Prime Minister's Office to develop strategies to improve technological services to the farmers of the region which comprising of Odisha, Chhattisgarh and Jharkhand. All the stakeholders involved in agriculture development i.e., Research Institutes, State Agricultural Universities and Departments of Agriculture, Horticulture, Soil conservation, Forestry, Fisheries and Animal Husbandry participated in the programme.

The programme was chaired by Dr. A. K. Singh, Deputy Director General (Agriculture Extension), ICAR, New Delhi. Dr. S. D. Singh, Assistant Director General (Inland Fisheries) of ICAR gave the welcome address and objectives of the programme followed by address of Dr. Manoranjan Kar, Vice-Chancellor, Orissa University of Agriculture Technology, Bhubaneswar. The issues and concerns of the regions with respect to the fisheries and livestock sector were presented by Dr. P. Jayasankar, Director, ICAR-CIFA, while the issues affecting agriculture, horticulture, natural resource management, farm mechanisation and forestry were dealt with by Dr. Anupam Mishra, Director, ICAR-ATARI, Jabalpur, Madhya Pradesh.

The state specific issues of three states i.e. Chhattisgarh, Odisha and Jharkhand were raised

by respective state departments. The Dean/ Director Extension of four agricultural universities i.e Indira Gandhi Krishi Vishwya Vidyalaya, Raipur; Chhattisgarh Kamdhenu Vishwya Vidyalaya, Durg; Birsa Agriculture University, Ranchi and Orissa University of Agriculture Technology, Bhubaneswar made their presentations on the technological and extension gaps in the agricultural development of the region. Experts in the areas of climate change, Agronomy, Horticulture, Fisheries, Forestry, Animal Husbandry and Natural Resource Management provided their inputs on the issues and technological options available for sorting out the problems.

The farmers' community was represented by 20 progressive farmers from the three states who raised the concerns of the community. Other important stakeholders of the sector i.e., NGO's, Corporates, Programme Coordinators, Scientists were also present, and contributed in developing the roadmap for improving services to the farmers.

The plenary session was instrumental in developing recommendations and roadmap for agriculture development and improvement of the technological services to the farmers of the region.

National Consultation on "Off-season spawning in carps towards year round availability of seed"

A National Consultation on "Off-season spawning in carps towards year round availability of seeds" was organized by the Institute on 9 March, 2016. One of the options to meet the increasing demand of carp seed of the country is through off-season gonadal maturation and spawning, which would potentially ensure round the year seed availability. Prof. R. C. Patra, Dean, College of Veterinary Science and Animal Husbandry, OUAT, Bhubaneswar, while inaugurating the consultation programme highlighted on the importance of such attempts and hoped for a road map with the help of scientists, entrepreneurs and officers from line department. Dr. P. Jayasankar, Director, ICAR-CIFA emphasized on the requirement of quality seed production for further growth of the aquaculture sector, and opined that the photo thermal manipulation technology of the institute would be suitable for adoption on entrepreneurship mode. Dr. S.S Giri, Head, Fish Nutrition and Physiology Division, ICAR-CIFA outlined the role of nutrition in brood rearing as well as seed production during off-season months of the year. The others who attended the consultation were Dr K. Samantaray, Director, College of Fisheries, OUAT; Prof. S. K. Maitra, Visva Bharati University; Dr. S. Dasgupta, Sr. Scientist, ICAR-CIFE; Dr. M. Kailasam, Pr. Scientist, ICAR-CIBA; and Dr. Arun Padiyar, a well-known aquaculture entrepreneur. There was an interface among state fisheries officials, hatchery owners, research students, entrepreneurs and scientists.

The consultation has inferred that the seasonality for carp seed production differs in different states across the country. It is high time to corroborate the seasonality, multiple breeding and offseason breeding to produce the carp seed round the year. However, technology transfer through farmer-friendly approach is the need of the day.

FISH HEALTH CAMP AND FARMERS' MEET

A "Fish Health Camp and Farmers' Meet" was organized by Fish Health Management Division at Tangi Block Office, Khordha District of Odisha on 10 June 2015, in which around 60 fish farmers participated. The aim of the programme was to sensitize the farmers about the different diseases that are occurring in the fish culture practices and their preventive and remedial measures and to have sustainable production. Pond water fish samples brought by farmers were analyzed at the spot and necessary recommendations were given for rectifying the pond water quality and maintaining health status of fish in culture conditions. The scientists briefed the fish farmers about how they would be benefitted from the ICAR-CIFA for various technological inputs in scientific fish culture. It was learnt from the farmers that each farmer in that area was having a land holding ranging from 1 ha to 5 ha with assorted pond sizes. The participants included Mr. Rashmi Ranjan Sahoo, BDO, Tangi Block and Shri Amiya Ranjan Sahoo, AFO, Tangi Block who co-ordinated the entire programme from state government side.

A "Fish Health Camp and Farmer's Meet" was organized at Ishaniberhampur Grampanchayat, Nischintakoili Block, Cuttack District of Odisha on 30 July, 2015. The aim of the programme was to sensitize the fish farmers about the different types of fish diseases that are occurring in the semi-intensive and intensive fish culture practices and their preventive and remedial measures. A total of 72 farmers from Kantapada, Samantarapur, Ishaniberhampur, Khental, Sirlo, Johanpur villages participated in the programme. Analysis of water quality parameters and health check-up of fish samples were done and remedial measures suggested by the scientific team. The programme was attended by District Fisheries Officer, Assistant Fisheries Officers and progressive fish farmers.

Date	Place(s) visited	Purpose(s)	Participant(s)
2 April, 2015	Baliput, Dist. Puri, Odisha	Farmers field to investigate the disease and to collect the diseased sample	Dr. B.K. Das Mr. Rakesh Das
10 June, 2015	Tangi Block, Khordha district, Odisha	To conduct Fish Health camp & farmers' Meet	Scientists from FHMD
30 July, 2015	Nishcintakoili Block, Cuttack, Odisha	To conduct Fish Health camp & farmers' Meet	Scientists from FHMD
5 August, 2015	Baliput, Gop, Puri dist., Odisha	Farmers field to investigate the disease and to collect the diseased sample	Dr. B.K. Das Mr. Rakesh Das

Farmer-scientist interaction meet

ICAR-CIFA and Assistant Director of Fisheries, Mursidabad, Department of Fisheries, Govt. of West Bengal organized a Farmer-scientist interaction meet on "Quality seed and feed for aquaculture development at Berhampore, Mursidabad, West Bengal on 7 May 2015 to sensitize the hatchery owners, farmers, planners and other stakeholders on the importance of quality seed and feed to increase the production with particular reference to Mursidabad.The Institute, in collaboration with other stakeholders is working towards stock improvement and quality seed production across the country. In this effort, state of West Bengal holds the prime position for being the largest supplier of fish seed in the country and Mursidabad district holds the promise to develop more aquaculture for area availability. The workshop was organized at Meen Bhavan, Berhampore, Mursidabad and more than 105 participants which included hatchery owners, seed growers, and seed traders from Nadia, Birbhum and Mursidabad Districts. Mr. Jayanta Kumar Pradhan, Assistant Director of Fisheries, Mursidabad welcomed the participants.The scientists from ICAR-CIFA interacted with the partricipants. Dr Anindya Ghosh, Deputy Director, Govt. of West Bengal and Mr. Y Ratnakar Rao, IAS, District Magistrate and Collector, Mursidabad spoke on the occasion.

The farmers and other stakeholders raised many questions on ensuring quality seed production, which were answered by the experts from ICAR-CIFA and Department of Fisheries, Govt. of West Bengal. It was felt that the farming communities still lack knowledge on BMP in seed production and

brood management. There is an urgent need for development of more awareness on importance of quality seed production and its impact on aquaculture productivity.

The following major recommendations were drawn by all stakeholders:

- Avoiding mix spawning in same breeding pool and reduction of inbreeding depression of hatchery stocks.
- Regulation on indiscriminate use of antibiotics and some banned chemicals during fish breeding hatchery operation.
- Hatchery network in the district level to develop more awareness on avoiding inbreeding and also for uniform pricing of fish seed during breeding season.
- Government support for developing brood stock facilities at farm level on scientific lines
- Inclusion of genetically improved variety of carps for quality seed production.
- Vigorous implementation of existing guidelines of Government of India in the newly accredited hatchery of West Bengal.
- Anthropogenic pressure on the water bodies with reference to plastic.

Summer School on Advance tools for genetic improvement of aquaculture species: an integrated approach

The Institute conducted a 21 days summer school on 'Advanced tools for genetic improvement of aquaculture species: An integrated approach' during 10-30 June 2015 under capacity building program by Agricultural Education Division of ICAR, New Delhi. The inaugural session was chaired by Prof. S.P. Adhikary, Vice-Chancellor, Fakir Mohan University, Balasore, Odisha, Dr. P. Jayasankar, Director, ICAR-CIFA and Dr. J.K. Sundaray, HoD, Fish Genetics and Biotechnology Division, ICAR-CIFA. Director, ICAR-CIFA in his speech mentioned about the necessity of genetic and biotechnical tools for combating the future challenges in agriculture and fisheries. The participants were from various institutes, *viz.*, from agricultural universities (3), deemed universities (2), traditional universities (3), engineering colleges (3), autonomous colleges (3), 1 each from KVK and RGCA, and 3 research associates from research institutions. The programme was completed on 30th June, 2015. Dr A. G. Ponniah, Emeritus Scientist, ICAR-CMFRI and former Director, ICAR-CIBA addressed the trainee and talked about inter-disciplinary research and collaboration among all stakeholders to lead the aquaculture sector for better productivity. Dr J. K. Sundaray, HoD and Course Director emphasized the need of quality human resources in the field of biotechnology,

2nd National Training Programme on "Portable FRP Carp Hatchery installation and operation"

The 2nd National Training Programme on "Portable FRP Carp Hatchery Installation and Operation" was inaugurated on 7 July 2015 at ICAR-CIFA, Bhubaneswar, Odisha by Dr. Pradeep Kumar Panigrahi, Hon'ble Minster of State (Ind.), Higher Education, Science and Technology and MoS Rural Development (Rural Water Supply), Government of Odisha. The Guest of Honour of this programme was Dr. P.S.G. Krishnan, Principal, Central Institute of Plastics Engineering and Technology (CIPET), Bhubaneswar. Dr. P. Jayasankar, Director, ICAR-CIFA welcomed the delegates and participants of the programme. He described the portable carp hatchery as one of the epoch making technologies of ICAR-CIFA which has been disseminated to all parts of the country. More than 60 participants from 11 states (Andhra Pradesh, Karnataka, Maharashtra, Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Jharkhand, West Bengal, Assam including Bodoland, Manipur and Odisha) of the country participated in this training programme. This is the second such training programme where the advanced farmers, trainers, state officials, subject matter specialists of KVKs and Assistant Professors of colleges had participated. The programme had the primary objective of providing advanced knowledge, skill and technique of fish seed production using portable hatchery technology. The participants learnt how to install, operate and maintain a FRP hatchery and also brood stock maintenance, seed rearing and fish culture. This was a very fruitful programme for the participants because most of the curriculum were practical based.

Summer school on "Aquaculture diversification towards boosting pond productivity and farm income"

The Institute organized a 21 days ICAR sponsored summer school on "Aquaculture diversification towards boosting pond productivity and farm income" during 08-28 July, 2015. There were 18 participants comprising of Scientists, Assistant Professors and Technical Officers from the Research Institutes and Krishi Vigyan Kendras from four states. Lectures included breeding and culture of minor carps, barbs, major carps, tilapia, magur, pangasius, climbing perch, murrel, prawn and ornamental fishes; freshwater pearl culture; selective breeding of carps; integrated fish farming; water and soil management; fish nutrition and feed management; and fish health management, etc. The trainees were imparted hands on practical training on the induced breeding, seed rearing and grow-out culture management of diversified species.

Training-cum-interface programme on ornamental fish farming at Barkote block of Deogarh District

The Institute along with State Fisheries Department, Odisha organized two days (8-9 September, 2015) training-cum-interface programme on ornamental fish farming at Barkote Block of Deogarh District, Odisha in which 84 people (64 women and 20 men) from Landijhari, Nuagaon, Saurali and Daanra villages participated. ICAR-CIFA has developed these villages as "ornamental fish village" through Institute based Projects and later through NAIP project.

Farmers-scientists-interaction meet on 'Carp broodstock management and quality seed production'

The Institute in collaboration with Fisheries College and Research Institute, Tamil Nadu Fisheries University, Thoothukudi and NFDB organized a Farmers-scientists-interaction meet on 'Carp broodstock management and quality seed production' on 22 September, 2015 at Thanjavur, Tamil Nadu. The interaction meet was conducted to sensitize the hatchery owners, farmers, planners and other stakeholders on the importance of quality seed and feed to increase fish production with particular reference to Thanjavur. Dr. K. Karal Marx, Professor and coordinator of the interaction meet welcomed the gathering and spoke about the importance of holding the meet in Thanjavur. The meet was chaired by Prof. Baskaran Manimaran, Vice-Chancellor, TNFU, and attended by Dr. P. Jayasankar, Director, ICAR-CIFA, Dr. G. Sugumar, Dean (I/C), and Head and other scientists, Fish Genetics and Biotechnology Div., ICAR-CIFA. Over 150 farmers from Chennai, Thanjavur, and Trichy and nearby areas, entrepreneurs, seed producers, and representatives of feed companies participated in the meet. A MoU between TNFU and ICAR-CIFA was signed for technology dissemination and future research collaboration. On this occasion, two farmers from Thanjavur District *i.e.,* Mr. S. Pugalandhi, Chola Fish Farm and Mr. S. Ravichandran, Arvind Fish shared their experiences on technology transfer by ICAR-CIFA and TNFU and benefits reaped from the association. They were awarded for their significant contribution towards aquaculture in Thanjavur district. Prof. Manimaran in his address stressed the need of better utilization of natural resources in the Tamil Nadu region for increasing freshwater fish culture. The program concluded with the following recommendations:

- Need for district level micro survey on water availability in Cauvery Delta region.
- Assessment of superiority of new broodstock over older ones in hatcheries of Thanjavur District.
- Introduction of genetically improved rohu for better seed quality and production.
- Fixing of fish seed price and standardization of seed size.
- Fisheries journal in regional language exclusively for the farming communities.

Farmers' Point

A single window system for servicing visitors to the Institute is operationalized. It is established at the main building (Room 109). Visitors are received, their requirements are understood and they are guided to the respective units/sections/ divisions. Samples are received at this Farmer's Point and user fees collected for soil analysis, disease diagnosis and feed analysis etc. Level of satisfaction of the customers are also recorded. Digitization of visitor's particulars is being done. Sale of priced publications and distribution of free literature are streamlined. In short, visiting farmers/ entrepreneurs are given utmost attention to ensure that their requirements are satisfied.

ASRB Examination Conducted

- Assistant Grade (DR) Main Examination – 2014 on 18 October 2015
- Online ARS Preliminary Examination and NET – 2015 from the 04 December 2015 to 10 December, 2015

Fish Disease Diagnosis Services

Nine fish farmers from Puri, Khordha, Pipli and Cuttack district of Odisha visited for disease diagnosis services. At the institute diseased fish samples were screened for external parasitic infections as well as case history of the pond was recorded. The laboratory diagnosis concluded that out of nine samples, five were identified as mortality due to bacterial infections and in four samples mortality was due to poor water quality parameters. On the basis of etiological agents diagnosed and available pond water area and depth; farmers were advised to follow the suggested treatment or remedial measures to prevent further loss due to diseases.

Jai Kisan Jai Vigyan Week

ICAR-CIFA observed '*Jai Kisan Jai Vigyan*' Week during 23-29 December 2015 to mark the birth anniversary of Late Sri Chaudhuri Charan Singh and Sri Atal Bihari Vajpayee, Former Prime Ministers for their immense contribution in promoting use of science for farmers' welfare. As a part of this celebration ICAR-CIFA in collaboration with NFDB, organized Farmer-Scientist Interaction Meet on "Importance of quality fish seed in Aquaculture" on 23 December 2015, at Kakdwip, West Bengal to sensitize the fish seed growers, farmers and other stakeholders on the importance of quality seed to increase the production and to improve hatchery practices to avoid inbreeding. Officials from Department of Fisheries, Govt. of West Bengal and scientists from other ICAR Institutes and over 150 farmers attended the meet. On this occasion, 15 progressive farmers were felicitated by Dr. P. Jayasankar, Director, ICAR-CIFA.

A Scientist-Student interaction was held on 28 December, 2015. Around 60 students of Paratap Sasan High School, PGN Public School and Saraswati Sishu Vidya Mandir, Balakati, Khordha participated in the meet and visited facilities of ICAR-CIFA like carp culture unit, feed mill and aquarium, and were shown videos on aquaculture. Dr. P. Jayasankar, Director and scientists of ICAR-CIFA interacted with the students and explained to them about career opportunities in fisheries sector. A kit containing few books/literatures on aquaculture was presented to all the school children.

On 29 December, 2016 the institute in collaboration with KVK-Khordha and Radio Kisan (90.8 FM) organized farmer- scientist interaction at Athantar village, Balipatna Block, Khordha District, which was attended by over 100 farmers

and farm women. Fifteen progressive farmers were honoured on this occasion. The Institute also put up an exhibition to showcase its technologies and noticeable publications. During scientist farmer interaction, scientists of the institute and KVK addressed queries from farmers in local language. Representatives of Radio Kisan, ATMA, State departments and IFFCO attended the programme.

An Aquaculture Field Day was organized for a group of 42 progressive fish farmers accompanied by Departmental officers namely Sri Sanjoy Kumar Misra, F.E.O and others of the office of the Assistant Director of Fisheries, Murshidabad, West Bengal during 20-26 December, 2015. Their visit coincided with the maiden celebration of *Jai Kissan Jai Vigyan* Week. The farmers got exposed to almost all the promising technologies of the Institute in its sprawling fish farm and laboratories with some practical demonstrations and had several rounds of interactions with the scientists. A visit was arranged to the Aquaculture Field School (AFS) of ICAR-CIFA established in the farm of Mr. B. K. Sahoo, a skilled and knowledgeable fish farmer at Sarakana Village, Khordha District with the technical guidance of the Institute.

Farmer-Scientist Interaction Meet on Importance of quality fish seed in aquaculture

The Institute in collaboration with NFDB, Hyderabad organized a Farmer-Scientist Interaction Meet on **'**Importance of quality fish seed in Aquaculture' on 23 December 2015, at Ukilirhat, Kakdwip, South 24 Paraganas, West Bengal. The Interaction meet was conducted to sensitize the fish seed producers, fish hatchery owners, farmers, planners and other stakeholders on the importance of quality seed to increase the production and to improve hatchery practices to avoid inbreeding with particular reference to South 24 Parganas districts. The meet was presided by Dr. P. Jayasankar, Director, ICAR-CIFA and Mr. Surjit Bag, Assistant Director of Fishery, DOF, Govt. of West Bengal participated as Special guest. The meet was attended by over 150 farmers and hatchery owners from Kakdwip, Sagar, Namkhana and Pather Pratima Block of South 24 Parganas, West Bengal. Mr. Surjit Bag, in his address talked about the policy and new initiatives like programme for quality seed i.e., 'Seed Certification' taken by department of Fisheries and urged the farming communities to know more about changing scenario of climate and how the farmer should equip him/herself to changing need for resilient farming producing high quality seed and increasing the fish production. Dr. T. K. Ghoshal OIC, KRC-CIBA, Kakdwip also spoke on the occasion. Extension brochures in Bengali entitled 'Importance of quality seed for sustainable aquaculture Production' and *Jayanti* flyers were released on the occasion. During the meet, farmers from Madanganj Maschya Samabaya Samiti Limited felicitated Dr. P.Jayasankar, Director, Dr. (Mrs) K.D. Mahapatra, Principal Scientist and Dr. J. N. Saha, Senior Scientist, ICAR-CIFA for their contributions towards the field of aquaculture specifically for success of improved variety of rohu (*Jayanti*). Four progressive farmers (Mr. Debaki Nandan Patra, Namakhan, 24 Paraganas South, Mr. Ritwik Aamir, Mursidabad, Berhamaopre, Mr. Amlesh Chatterjee, Hoogly, Mr. Saifulla Mondal, Gangadharpur, 24 Paraganas South) shared their experiences on *Jayanti* rohu and successful aquaculture entreprenuership in the interaction meet.

On this occasion, 15 farmers from West Bengal were felicitated by Director, ICAR-CIFA under the aegis of ICAR *Jai Kisan Jai Vigyan* for their significant contributions to aquaculture. This was followed by a technical session in which the scientists explained the scientific breakthroughs in freshwater aquaculture and advised the farmers to adopt these techniques.

During the meet, the following issues were raised and discussions were held for scientific solutions.

- Availability of quality fish seed including that of Jayanti rohu in 24 Paragana district,
- Prevention of inbreeding in hatcheries,
- Technology package for low saline aquaculture of freshwater fish species,
- Availability of quality fish feed and
- Disease and health management during grow out stage

Inter-State Horticulture Fair at Bargarh, Odisha

The Institute participated in the Inter State Hortifair at Bargarh, Odisha organized by National Horticulture Board, New Delhi and ICAR-NRRI, Cuttack, Odisha during 20-22 February, 2016. ICAR-CIFA showcased promising aquaculture technologies on Freshwater Aquaculture developed by the Institute on the occasion of visit's by Hon'ble Prime Minister Shri. Narendra Modi and Hon'ble Union Agriculture and Farmers Welfare Minister Shri. Radha Mohan Singh to address the Farmers' Convention at Bargarh, Odisha. The Inter State Hortifair was inaugurated by Shri. Radha Mohan Singh, Hon'ble Minister. The other dignitaries who visited ICAR-CIFA pavilion were Shri Jual Oram, Hon'ble Union Minister for Tribal Affairs, and Shri Dharmendra Pradhan, Hon'ble Union Minister for Petroleum.

The exhibits in the following areas were displayed:

- Aquaculture as Business Enterprises
- Diversification of Species and Systems
- Application of Cutting Edge Technology
- Productivity Enhancement.
- Farmer FIRST

A Farmers-Scientist Interaction meet was organized under the chairmanship of Hon'ble Union Minister for Agriculture and Farmers Welfare on 20.02.2016 at ICAR-NRRI, Cuttack. All the ICAR Institutes located in Bhubaneswar participated in the meet.

Table 63: RADIO TALKS/TELEVISION PROGRAMMES

Name	Date	Programme
Dr. B.K. Das & Dr. P.C. Das	08.05.2015	Talk on Doordarshan on Machachasare Adhika labha Paiba Kipari
Dr. S.C.Rath	12.06.2015	Resource person in Rural Programme subject committee, AIR, Cuttack
Dr. S.C.Rath	11.09.2015	Resource person in Rural Programme subject committee, AIR, Cuttack
Dr. S.C.Rath	22.09.2015	Talk in AIR Puri
Dr. S.C.Rath	14.10.2015	Resource person in Rural Programme subject committee, DDK, Bhubaneswar
Dr. S.C.Rath	16.11.2015	Talk in DDK Bhubaneswar
Dr. P.P. Chakrabarti	02.01.2016	Talk on Soil & water qualities for broodstock management
Dr. J.N. Saha	03.01.2016	Radio talk on Broodstock management of fish
Dr. B.K.Das	07.01.2016	Talk on Vannamei Chingdi Chasa aur roga
Dr. B.K.Das	11.01.2016	Radio talk on Roga and Tahara Pratikara
Dr. S.C. Rath	21.01.2016	Talk in AIR Cuttack
Mr. Arabinda Das	22.01.2016	Talk on Tangra fish (*Mystus* sp.)
Mr. S.C. Mondal Dr. P.P. Chakrabarti	23.01.2016	Talk on Pabda breeding and culture
Mr. Arnab Ghosh Dr. P.P. Chakrabarti	24.01.2016	Talk on Integrated farming system research with high value crops and fish
Dr. S.C.Rath	01.02.2016	Talk in AIR Puri
Dr. B.N.Paul	25.02.2016	Talk in AIR Kolkota
Dr. S.S.Giri	04.03.2016	Talk in AIR Puri
Dr. S.C.Rath	10.03.2016	Resource person in Rural Programme subject committee, AIR

Video films

- A documentary film on "ornamental fish farming for livelihood security" has been recorded as a part of "Mass Media Support for Agriculture Extension" by Doordarshan Kendra, Bhubaneswar dedicated to "Kissan channel". The technical guidance for this programme was provided by Dr Saroj Kumar Swain and Mr Mukesh Kumar Bairwa.
- The Field Station of Kalyani, ICAR-CIFA participated in 5 episodes of *Annadata* of ETV News, Bangla.

Publicity through Print Media

The Social Science Section of the Institute is involved in highlighting the achievements of the Institute in the print and electronic media. During 2015-16, large numbers of news items were published in various newspapers in English, Hindi and Oriya.

INTERNATIONAL COLLABORATION

Visit of team from World Fish Centre, Malaysia

A team from World Fish Centre, Malaysia comprising of Dr. Michael Philips, Director, Aquaculture and Genetic Improvement; Ms Shakuntala Haraksingh Thislsted, Senior Nutrition Advisor and Dr. Vinshumurthy Mohan Chadag, Senior Scientist, Aquaculture and Genetic Improvement visited the Institute along with officers from State Fisheries Department, Govt. of Odisha during 14-15 May, 2015. They held discussions on future collaborations with ICAR-CIFA and also visited the farm facilities.

Collaborative International project

A collaborative International project entitled "Cryopreservation of embryonic stem cells and primordial germ cells for transplantation and surrogate fish production" under bilateral scientific and technological cooperation between the Dept. of Science and Technology, Ministry of Science and Technology of the Indian Republic and the Ministry of Science, Technology and Productive Innovation of the Argentine Republic has been initiated w.e.f. 26 October, 2015.

International training on 'Fish Breeding Technology'

An International training programme on "Fish Breeding Technology" was organized at the Institute during 29 May - 28 September, 2015. This programme was coordinated by Agriinnovate India and implemented by ICAR-CIFA under a WAAP funded scheme. Two Nigerians participated are Mr. Eze Stanislaus Sunday, Principal Technical Officer and Mr. Yahaya Shehu Mohammed, Higher Technical Officer from the National Institute of Freshwater Fisheries Research, New Bussa, Nigeria. Upon successful completion of the training, they were awarded Diploma in Fish Breeding Technology. Under this programme they were taught different aspects of fish breeding and hatchery management of finfish and shellfish. Dr. P. Routray, Principal Scientist was the Course Director of the programme.

Second International Symposium on Genomics in Aquaculture (ISGA-II)

The 2nd International Symposium on Genomics in Aquaculture (ISGA-II) was held at the Institute during 28-30 January, 2016. This important Symposium was organized by ICAR-CIFA in colaboration with Association of Aquaculturists, Bhubaneswar and Asian Fisheries Society, Indian Branch (AFSIB), Mangalore, India. The chief guest on the occasion was Dr. J. K. Jena, Deputy Director General (Fisheries Science), ICAR and Chairman, AFSIB. The International participants were Dr. B. Venkatesh, Professor, Institute of Molecular and Cell Biology, A*STAR, Biopolis, Singapore. Dr. Nicholas Robinson, Research Scientist, NOFIMA (Norwegian Institute of Food, Fisheries and Aquaculture Research) and Senior Lecturer, Flinders University, South Australia and Dr. Victor Martinez, Associate Professor, Faculty of Veterinary Sciences, University of Chile, Santiago. Eminent speakers from within the country included senior researchers from ICAR and CSIR Institutes as well as leading companies on bioinformatics solutions. The other participants were Directors, Scientists and Students from the various Fishery Research Institutes and Universities, representatives from the National Fisheries Development Board, Scientists from Department of Biotechnology, Department of Science and Technology and others.

Dr. J. K. Jena, Deputy Director General (Fisheries Science), ICAR and Chairman, AFSIB released the compendium of 'Lead Lecturers and Abstracts' of the symposium. Dr. P. Jayasankar, Director, ICAR-CIFA said that this Institute was engaged in research towards producing selectively bred fish and simultaneously generating genomic resources such as mapping populations, DNA markers, linkage and QTL maps, whole genome sequence, etc. The first ever genetic linkage maps in rohu are published. Dr. J. K. Sundaray, Head, Fish Genetics and Biotechnology Division, ICAR-CIFA said that this symposium was organized from the impetus obtained after successful completion of ISGA-I held during 22-23 January, 2013. Others who spoke on the occasion were Dr. Gopal Krishna, Director and Vice Chancellor (Acting), ICAR-CIFE, Mumbai; Dr. A. K. Singh, Director, ICAR-DCFR, Bhimtal and Prof. B. Venkatesh, IMCB, Singapore.

NORTH-EAST REGION DEVELOPMENT

Under the North Eastern Development programme the following activities were undertaken by CIFA during the year 2015-2016.

Assam

As a part of aquaculture development programme of NEH states, a team of scientists with Dr. Mridul Deka, Programme Coordinator and Mr. Sonmoina Bhuyan, Subject Matter Specialist (Fisheries) of KVK, Nalbari District visited some areas in Nalbari of Assam on 16 June, 2015. The purpose of the visit was to inspect farmers' sites of those who had submitted proposals for the supply of ICAR-CIFA FRP hatcheries through KVK, Nalbari. Prior to the field visit, the team had a meeting with Dr. Deka and Mr. Bhuyan to have an idea about the requirement of carps and *C. batrachus* seed in the Nalbari District. Initially, the team visited some sites as proposed by the KVK, Nalbari for the supply of FRP hatcheries. Later, the team also visited some FRP magur hatcheries supplied by ICAR-CIFA few years back to know the present operational status. The team was satisfied with the efforts and the performance of the local farmers in magur seed production. Some farmers are using these low cost indigenous hatcheries for the production of magur seed. Due to the high demand for magur (Rs.600-1000/kg) and magur seed (Rs.8-10/piece), the area can be considered as suitable for development as a magur seed hub through technological intervention.

A training programme on "Efficient water, land and waste utilization in integrated fish farming systems" was organized at Kalaigaon, Udalguri District, Bodo Territorial Council, Assam during 17-18 June 2015, which was attended by 134 farmers. The training was conducted to motivate fish farmers to adopt integrated fish farming systems for higher profit through better water, land and waste utilization in aquaculture. A survey among the participants was also conducted to know the present status and adoption level of integrated fish farming systems and the barrier(s) for non-adoption.

BTC-proposed water bodies covering four districts namely Baksa, Udalguri, Tangla and Cheklang have been visited for inspection of sites for composite fish culture. Demonstration of composite fish culture in 8 ha water bodies has been initiated.

Arunachal Pradesh

A two days training programme on "Management of FRP hatcheries and fish culture in seasonal ponds" was conducted in collaboration with the Department of Fisheries, Govt. of Arunachal Pradesh in a private fish farm of Er. Tana Nikam Tara at Sonajuli, Papum Pare District, Arunachal Pradesh during 19-20 June, 2015. The training which was conducted to motivate the progressive fish farmers to take up fish farming on large-scale to enhance the fish production, focused on fish breeding and seed production, management of FRP hatcheries and proper utilization of seasonal ponds. Total of 54 farmers attended the training programme. Mr. J.Taba, Director of Fisheries, and the District Fisheries Officer, Papum Pare, Arunachal Pradesh also spoke on the occasion.

A training programme on "CIFA technologies & recent advances in aquaculture" was organized by ICAR-CIFA in collaboration with the Department of Fisheries, Govt. of Arunachal Pradesh at District Fisheries Training Centre, Emchi, Papumpare District, Arunachal Pradesh during 6-8 October, 2015. A total of 20 fish farmers and 30 officials from the Department of Fisheries, Govt. of Arunachal Pradesh attended the training programme. A small exhibition was arranged for the trainees and they were taken to the ICAR-CIFA adopted fish farm at Midpu, Doimukh for practical demonstrations. The Assistant Director of Fisheries and the District Fisheries Officer, Papum Pare, Arunachal Pradesh also spoke on the occasion.

Demonstration of "Brood stock development of carps" was initiated in collaboration with the Department of Fisheries, Govt. of Arunachal Pradesh in the ponds of Mr. Tana Nikom Tara (at Sonajuli Village) and Mr. Tana Akin Tara (at Midpu Village, Doimukh) of Papum Pare District during 6-8 October 2015. A total of 400 kg carp feed, 170 kg lime, 250 kg urea, 250 kg SSP and 200 kg mustard oil cake were distributed between these two farmers. Prospective brood fish of Indian major carps weighing 50 kg was released in both the ponds under demonstration.

Demonstration programme on "Integrated fish-crop-pig farming system"was initiated in collaboration with the Department of Fisheries, Govt. of Arunachal Pradesh in a pond of Mr. Tana Nikom Tara covering water spread area of 0.2 ha at Sonajuli, Papum Pare District during 6-8 October 2015. A total of 2500 IMC fingerlings were stocked in the pond and 200 kg carp feed, 6 piglets, 4 packets vegetable seed, 117 kg pig feed and 2 numbers vermin-compost unit were supplied to Mr. Nikom for the purpose.

Meghalaya

ICAR-CIFA and Department of Fisheries, Govt. of Meghalaya jointly organized the training program on "Brood stock management and installation of FRP hatchery for carp seed production" at Meghalaya State Fisheries Research and Training Institute, Mawpun during 4-6 November 2015. A total of 50 participants including hatchery owners, fish growers and progressive farmers from different districts attended the program. It was inaugurated by Mr. David B Kharwanlang, Principal, MSFRTI, Mawpun. He spoke on the issues related to fish seed production and fish health management, and requested ICAR-CIFA team to assist in arranging fish health camp, and soil and water quality management in the state. The training program covered the promising aquaculture technologies of ICAR-CIFA, such as - CIFABROOD™, improved variety rohu (Jayanti), CIFAX and concept of Aquaculture Field School (AFS). Participants from different parts of Meghalaya raised many queries on fish breeding and fish grow-out which were answered by the experts of ICAR-CIFA team by using audio visual mode and lecture notes.

Nagaland

A training programme on "Feed management to enhance aquaculture production" was organized in collaboration with Krishi Vigyan Kendra - Phek of National Research Centre at Mithun in Phek District of Nagaland State during 2-3 November 2015. The programme had four major components *i.e.,* demonstration, live exhibition, class room teaching and farmers interaction. Scientists of ICAR-CIFA and KVK-Phek visited the nearby villages of Porba of Nagaland and interacted with villagers about their livelihood. The farmers in their paddy field in hilly terrain hold water in small ponds to sustain the crop. They utilize it for fish culture for some additional income or own consumption. Apart of their paddy field ponds, they also possess few village ponds, may be owned by a person or community. Villagers are mostly Naga Tribes. They do not have sound knowledge on freshwater fish culture. Villagers were invited to participate in the ICAR-CIFA conducted training-cum-demonstration on fish feed at KVK complex.

The class room lesson was given with audio-visual and power point presentations. Fish culture scenario of the locality was placed by Dr R.K. Singh, Senior Scientist and Head, KVK followed by four presentations by the resource scientists from ICAR-CIFA. The teaching medium was English and Hindi. A local interpreter was assigned the job to interpret the lessons in tribal language (Nagamese) for those who do not understand either of these languages.

An exhibition of fish feed ingredients, commercial fish feed and farm feed appliances was inaugurated by the Chairman of the Village Committee during the training programme. Extension pamphlets and booklets on fish feed in Hindi and English were distributed to the farmers and visitors. Demonstration was given on farm feed preparation using locally available ingredients and farm feed

dispensing systems. Demonstration of floating feed application in the pond using 'Feed frame' was made in KVK-owned pond at Porba. Women farmers of Naga tribes took lead in 'learning by doing' operation of the demonstration. Over 70 participants joined in the event and univocally requested ICAR-CIFA to conduct more training programmes in the future.

Tripura & TTAADC

Training programme on "Broodstock development & quality seed production of carps"

For the fish farmers of Tripura Tribal Areas Autonomous District Council (TTAADC), a three-days training on "Broodstock Management and Quality Seed Production of Carps" was organized during 17-20 January, 2016 by ICAR-CIFA in collaboration with the Department of Fisheries, Government of Tripura at Fish Farmers' Training Centre, Office of the Superintendent of Fisheries, Kanchanpur, North Tripura. The main objective of the training programme was to make the farmers aware about the broodstock management and quality seed production of carps through provision of quality broodstock feed (CIFABROOD™) developed by ICAR-CIFA, suitable larval feed and feeding management, and improving hatchery practices to avoid inbreeding. More than 100 fish farmers from North Tripura, Dhalai and Unakoti Districts attended the programme.

The training programme was inaugurated by Shri Khagendra Jamatia, Honourable Minister for Cooperation, Fisheries and Home (Fire Service), Government of Tripura. In his inaugural address, he appreciated the role of ICAR-CIFA for enhancing the fish production in the state. He also appealed the fish farmers to increase the average fish production from the present level of 2.6 to 4.0 ton/ha/year through the application of recent advances in aquaculture in order to meet the future demand of the state, for which availability of the quality fish seed of required quantity is the need of the hour. Shri Santanu Jamatia, Honourable Executive Member (Fisheries), TTAADC presided over the function. He emphasized present status and future strategies to increase the fish production of TTAADC. The other dignitaries who graced the occasion were Shri Rajendra Reang, Honourable Member of Legislative Assembly, Kanchanpur; Shri Lalit Debnath, Honourable Member of District Council, TTAADC; Shri Nikhil Majumder, Deputy Director of Fisheries, Department of Fisheries, Government of Tripura; Shri Swapan Das, Principal Officer (Fisheries), TTAADC; and Shri Haran Chandra Roy, Superintendent of Fisheries, Kanchanpur Sub-Division. Extension brochure entitled 'CIFABROOD™ as carp broodstock diet' was released on the occasion.

In the technical session, Dr. P. P. Chakrabarti, Principal Scientist and Chairman, NEH Program, ICAR-CIFA highlighted the work taken by the Institute in all 8 North Eastern States of the country; briefed about the technologies developed by ICAR-CIFA and then discussed about the soil and water quality management of carp broodstock ponds. Dr S. Nandi, Principal Scientist spoke on importance of broodstock management and the application of broodstock diet CIFABROOD™ in quality seed production of Indian major carps. Dr K.N. Mohanta, Principal Scientist explained about feed and feeding management of carp broodstock and seed. Mr Arabinda Das, Scientist and State Coordinator (Tripura) under NEH program discussed about the concept of quality fish seed, status of carp hatcheries in Tripura, induced breeding and hatchery management of carps. Mr. Ajmal Hussan, Scientist, ICAR-CIFA explained about the broodstock and rearing pond management of carps.

During the valedictory function, certificates were awarded to the participants. A report was published in local newspaper Desher Katha and CIFA's website.

Demonstration on broodstock development using CIFABROOD™:

A proposal has been received from the Department of Fisheries, Government of Tripura for demonstration of CIFABROOD™ in Government farms and for supply of 300 litres of CIFAX for distribution among the farmers of the state. A total of 58 litres of CIFAX has been supplied by the ICAR-CIFA. For demonstration of CIFABROOD™, a team of scientists from ICAR-CIFA comprising Dr. P.P. Chakrabarti, Dr. S. Nandi, Dr. K.N. Mohanta, Mr. Arabinda Das and Mr. A. Hussan surveyed few Government and private farms of Tripura and acquired basic information such as broodstock availability, size, maturity and management practices, hatchery practices, farm history, etc. The demonstration of CIFABROOD™ for early maturity and quality seed production will shortly be started in all selected farms.

MoU signed between ICAR-CIFA and BTC

A Memorandum of Understanding was signed between ICAR-CIFA and Bodo Territorial Council (BTC) on 23 October 2015 for scientific freshwater aquaculture demonstration and training by the institute in BTC during 2015-16. It was inked by Dr P. Jayasankar, Director for ICAR-CIFA and Dr P. Hazarika, Nodal Officer for BTC in the presence of Dr J.K. Sundaray, HoD, FGBD; Dr B.C. Mohapatra, Principal Scientist & Co-Chairman, NEH Programme; Mr. N.K. Barik, Nodal Officer for BTC from ICAR-CIFA; Mr K.C. Das, Sr. AO and Mr. NVRN Murty, F&AO.

Establishment of new Regional Research Centre, Bathinda, Punjab

Efforts were made to expedite the establishment of the new Regional Research Centre of ICAR-CIFA at Bathinda, Punjab. The draft lease agreement for transfer of Punjab Govt. land to ICAR in connection with establishment of proposed RRC of ICAR-CIFA at Bathinda, Punjab was sent to the Director & Warden (Fisheries), Department of Fisheries, Chandigarh, Govt. of Punjab; Asst. Director of Fisheries, Govt. of Punjab, Bathinda and DDG (Fisheries Science), ICAR. After the agreement for transfer of land is finalized, the activities to initiate establishment of the Centre will be carried out.

Director ICAR-CIFA visited Sri Muktasar Sahib, Bathinda on the invitation of Director and Warden (Fisheries), Govt. of Punjab and attended the 8th Livestock Championship and Expo 2016 and delivered a talk on 'Recent technological developments in freshwater fish farming' on 10 January 2016. Scientists from RRC of ICAR-CIFA, Anand, Gujarat also attended the event and organized an exhibition on the latest technology developments in freshwater aquaculture and interacted with the farmers.

Krishi Vigyan Kendra-Khordha

Mandatory activities of KVK-Khordha

Along with the mandatory activities of Technology Assessment, Refinement and Demonstration, KVK-Khordha under the administrative control of ICAR attempted towards larger visibility through mass extension methods. Four Mega events with the support of ICAR, New Delhi in 2015-16 has given the KVK a large visibility in the district. Technology transfer for agriculture in the mandated Khordha district was performed through On Farm Trial (OFT), Frontline Line Demonstration (FLD) and Training, the details of which are presented in table below:

S.No	Activity	Number of activity	Beneficiaries
1.	OFT	15	163
2.	FLD	18	395
3.	Trainings	40	900
4.	Sponsored trainings	15	589

Technology Assessment

KVK undertook technology assessment of different new varieties, package of practices and other identified technologies. The different OFTs under taken in crop production, horticulture, animal science, fisheries and home science are presented below:

Discipline	Technology Assessed
Crop Production	Aromatic rice Var. Ketakijuha
	Integrated Nutrient Management in paddy
	Cropping System for Bio-intensification
	Mustard Var. BR-9
Horticulture	Ginger Var. Suprava in semi-shaded backyard places
	Fertilizer Management in papaya var. Red lady
	Panchagavya enhancing production in vegetables
Animal Science	Tissue Culture Banana
	Oral pellet vaccine against Ranikhet Disease management in backyard poultry
	Dual purpose CB ducks (WP cross KCB) under free range for meat and egg production
	Low input dual type chicken Kaveri in rural and tribal areas
	Hand operated Milking machine
Fisheries	New species in carp polyculture system
Home Science	Storage of green gram sand covered safe storage of pulses using sand layer
	Honey bee cultivation under backyard condition
	Low cost poly house technology for cultivation of paddy straw mushroom in off - season
	Baby corn HM-4 maize variety

KVK trails out Nagavya

An organic product, "Nagavya" that can play a potential role in promoting plant growth, increase in yield and quality in fruits and vegetables was prepared by KVK with the formulations learnt from Tamilnadu Agricultural University, Coimbatore. It is produced by blending nine components viz., Cow dung, Cow urine, Milk, Ghee, Curd, Tender Coconut Water, well ripened banana, Sugarcane juice and Grape Juice, was tested in Watermelon, Cucumber, Tomato and Okra. It was observed that there was an increase in yield, colour development in fruits along with taste. The best thing about the technology is that it is easy to prepare, eco-friendly

and farmers can produce at their farm itself as the components are available locally. The performance of Nagavya in Okra and Tomato is presented below:

Performance on Application in Okra

Crop	Flowering initiation (DAS)		No. of fruits/Kg		Fruit Wt (gm)		Fruit Length (cm)		Yield (q/ha)	
	FP	RP	FP	RP	FP	RP	FP	RP	FP	RP
Okra	40-45	35-40	45-47	40-43	20.25	21.30	16.85	16.90	147.2	161.5

Performance on Application in Tomato

Crop	Flowering initiation (DAS)		No. of fruits/Kg		Fruit Wt (gm)		Fruit Length (cm)		Yield (q/ha)	
	FP	RP	FP	RP	FP	RP	FP	RP	FP	RP
Okra	30-32	25-27	15-20	13-17	61.7	66.3	15.24	15.68	293.6	361.8

KVK introduces Ginger Var. Suprava in Semi-shaded backyard places

The semi-shaded backyard places owned by majority of farm families particularly in rainfed blocks of Khordha district remains fallow throughout the year due to its unsuitability for raising any crop. KVK trailed out to raise ginger crop var. Suprava in these semi-shaded places by convincing farmers due to its high price and market demand. The performance of the crop was satisfactory which accounted yield of 122.09 q/ha with average fresh rhizome wt (gm/clump) 173.06 and net return of Rs 1,94,284/ha. KVK plans to demonstrate this practice as FLD in 2016-17.

Oral Pellet Vaccine introduced in the district

High mortality in backyard poultry due to Ranikhet Disease (RD) outbreak was observed by KVK in the district. Ranikhet is not a seasonal disease and can affect birds of any age. Hence in case of an outbreak, an entire flock of birds can die within 48 hours, leading to production loss. An oral pellet vaccine developed by Tamilnadu Veterinary and Animal Sciences University, Chennai was trailed out by KVK and have recorded that during the post vaccination period of 180 days no outbreak of RD was recorded in the vaccinated chickens. The vaccine contains live D58 isolate of Ranikhet disease virus in pellets made up of lactose, starch and amaranthus dye. Farmers informed that it is easy to administer as the vaccine is prophylactic. This vaccine is mainly meant for backyard chickens, which act as source of virus spread to commercial poultry. The KVK is planning to make available this vaccine in all local veterinary medicine shops in the district.

Approach of Best Practice to Best Fit

KVK-Khordha over the years have assessed and

demonstrated agriculture and allied sector technologies. During 2015-16 an attempt was made to document the feasible 25 technologies suitable for agriculture development in the district. The documentation was made towards informing the district development actors for scaling up the feasible technologies. KVK organised a District level Workshop on Sharing Technologies towards Agriculture and allied sector development in Khordha district. More than 65 extension workers attended the workshop. Dr. P. Jayasankar, Director, ICAR-CIFA welcomed the gathering in the presence of Dr. S. K. Rout, Dean, Directorate of Extension Education, OUAT, Mr. Athare, Scientist from ATARI, Jabalpur and Mr. K. N. Jena, DDA cum PD, ATMA-Khordha.

Dr. P. N. Ananth, Senior Scientist and Head of KVK presented the 25 feasible technologies to the state actors and also informed that it is essential not only to document. The best practices but also to ensure that it fits into the development framework of the district. A compendium of 25 feasible technologies was released and circulated. Presentations were also made by Development Departments on the prevailing state schemes. The workshop ended with a session on mapping out possibilities by the state actors to take into consideration of these 25 technologies into the state schemes for better reach.

KVK organises Zilla Krushak Sammelan for Pre-Kharif

KVK organized Zilla Khushak Sammelan-2015 on 20 July 2015th at was inaugurated by Mr. Shashi Bhushan Behera, Hon'ble Member of the Legislative Assembly, Jayadev Constituency of Odisha. He appreciated KVK for its efforts to conduct such an Agriculture fair in the District to enrich the scientific knowledge of the farming community. He emphasised natural farming techniques and also aquaculture development as prime focus in the district. Mr. N. Sahu, District Collector and Magistrate informed the importance of development department's role in agriculture as being a state subject.

Dr. P. Jayasankar, Director, ICAR-CIFA in his address informed that the central government has sanctioned a budget of Rs.3900 crores to continue and strengthen KVKs. Dr. P.N Ananth, Senior Scientist and Head provided an insight of the Sammelan and emphasis the role of KVK in the past and future initiatives for wider adoption of Agricultural technologies for higher production. During the sammelan farmers were distributed with soil health cards, Leaf Colour Charts, Fish seed of different species and a booklet on 'Agricultural Technologies for farmers'. The sammelan had 16 exhibitors includes KVK, ICAR institutes, ATMA and private agencies. More than 1000 farmers attended the fair, farmer-scientist interaction and live demonstrations. The interaction was focussed on Soil health, water management, integrated farming system and climate resilient agriculture technologies.

KVK as FET Centre for ICAR-NAARM

KVK was identified as the Field Experience Training (FET) Centre for the 103rd FOCARS of ICAR-NAARM, Hyderabad. Seven newly joined ARS scientists of ICAR-NAARM were attached to KVK and had their village experience from KVK adopted village Rajas of Balipatna block, Khordha district. As part of the

programme, a village level and an institute seminar were organised to complete the field experience training. Dr. P. N. Ananth, Head of KVK and Dr. B. K. Banja were the local FET coordinators.

World Soil Health day and Pre-Rabi Sammelan

KVK observed the World Soil Health Day and conducted the Pre-Rabi Sammelan on 5th December, 2015. During 2015-16 KVK has been intensively working on soil campaigns in Khordha district towards collecting soil samples and associated with Paradeep Phosphates Limited to distribute soil health cards to farmers of Khordha district. Observing the sail health day was based on UN declaration of the year 2015 as International Year of Soils and the Soil Heath card Scheme of Government of India.

KVK conducted this event jointly with Paradeep Phosphates Ltd, Bhubaneswar. Prof (Dr) Prasanna Kumar Patasani, Member of Parliament of Bhubaneswar constituency inaugurated the function. Dr. P. Jayasankar, Director, ICAR–CIFA welcomed the gathering and highlighted the works of KVK-Khordha and ICAR-CIFA in preparation of soil health cards. Dr. P.N. Ananth, Senior Scientist and Head of KVK spoke about the declaration of 2015 as the International Year of Soils. Based on the guidelines, 1000 soil cards jointly prepared by KVK and Paradeep Phosphates Ltd. were distributed to farmers. About 800 farmers and other associated stakeholders from different blocks of the district participated and benefitted from 21 exhibitors from the Government, NGOs and private agencies working on soil enrichment activities.

Farmer Interaction Meet at KVK during the visit of Minister of State, Ministry of Agriculture and Farmers Welfare, Government of India

Shri. Mohanbhai Kalyanjibhai Kundariya, Hon'ble Minister of State, Ministry of Agriculture and Farmers Welfare, Government of India inaugurated the farmer's interaction meet at KVK during his visit to ICAR-CIFA. Dr. P. N. Ananth, Senior Scientist and Head of KVK and all SMSs of KVK explained activities of KVK through an exhibition. The Minister appreciated the interventions that KVK has under taken to moot agriculture development in the district. During the interaction meet, the Minister interacted with 120 KVK benefited farmers including 30 women self group members and entrepreneurs. The Minister also distributed soil health cards, critical inputs like Jayanti rohu seeds, liquid bio fertilizer, fruit fly traps, soil health card, Navagavya, Pro tray nursery rearing etc. to the farmers. He elaborated the different Government schemes like Mudra Yojana, Fasal Yojana and Krishak Yojana during the interaction. He also assured the farmers for providing different subsidies/schemes in collaboration with state government for enhancing livelihood of farmers.

IFFCO Joins with KVK-Khordha for Agricultural Development Interventions

IFFCO, the giant in cooperative sector dealing with fertilizers, has joined hands with KVK for envisaging agricultural development interventions. KVK has joined with IFFCO to trail out their soil enrichment products especially the bio fertilizers, water soluble fertilizers and IFFCO speciality fertilizers. A three

day training and visit programme was organised on 12 January 2016 by IFFCO at KVK that was inaugurated by Dr. P. Jayasankar, Director, ICAR-CIFA in the presence of Mr. K. N. Jena, DDA cum Project Director, ATMA-Khordha; Mr. Sri S. N. Parida, Senior Area Manager, Sri S. Chattopadhyay, State Marketing Manager, Mr. Ganesh Prasad Padhy, Field officer of IFFCO and Dr. P. N. Ananth, Senior Scientist and Head of KVK . The training was attended by farmers from 13 districts of Odisha. The topics covered were on advances on agriculture and allied sectors along with exposure visit of farmers to progressive farmer's field.

Sansaad Adarsh Gram Yojana

KVK is working on Saansad Adarsh Gram Yojana scheme of the Central government. Pariorada is the adopted gram panchayat of Khordha district by the Member of Parliament of Bhubaneswar constituency under this scheme. An action plan on agriculture and allied sector development was drafted by KVK for the village and presented before the community. KVK approached the villagers, mapped out the resources and identified development interventions to be undertaken. The different activities undertaken by KVK were on stocking community ponds, introduction of backyard poultry strain "Kaveri" and cluster demonstration of oil seeds. In association with ATMA-Khordha, the KVK demonstrated Hybrid Watermelon.

KVK as a part of the Preparation of Comprehensive District Agriculture Plan (CDAP)

KVK was member in the preparation of Comprehensive District Agriculture Plan (CDAP) of Khordha district initiated by OUAT, Bhubaneswar. Mr. A. K. Dash, SMS (Horticulture) of KVK was nominated as the nodal officer from KVK to prepare the plan jointly with other partners. KVK supported in preparation of CDAP with works done and strategic plan prepared.

KVK Case study leads to Policy Brief with the guidance of IIRR-Philippines

The case study submitted on the small holder carp hatcheries developed by KVK was selected by International Institute for Rural Reconstruction and Access Development Services. Dr. P. N. Ananth, Senior Scientist and Head KVK presented the case study at the IIRR, Philippines in partnership with ACCESS Development Services; New Delhi Writing Clinic in New Delhi in June 2015. They can study written during the writing clinic has emerged as a Policy brief, which was published and released.

KVK trains 370 progressive farmers of Khordha district

KVK was approached by District Agriculture Office to train 370 progressive farmers from 10 blocks of Khordha district sponsored by RKVY 2015-16. With

this programme KVK has linked up with progressive farmers of Khordha district identified by the District Agriculture Office, Khordha. The switable technologies assessed and demonstrated by KVK were the core focus of the programme.

Success story of a landless rural youth

Out of many youth motivated by KVK, Mr. Debaraj Behera, a 33 year old middle level educated rural youth, son of Mr. Narayan Behera from Kantia village of Jatni Block in Khordha District is exceptional. He belongs to a landless farm family possessing only 0.02 ha homestead land as parental property. His father used to cultivate paddy in 1.2 ha land during Kharif on contract basis from which 45-50 quintal paddy is produced worth Rs 49,500-55,000 to accomodate the family. Mr. Debaraj supports his father in cultivation of paddy apart from a low paid private company service from which he was hardly earning Rs 5000 per month to support his family livelihood. He left the job during the year 2013 and ventured to start vegetable cultivation in partnership with another youth of his village in 0.6 ha land area taken on rent basis for self-employment. Together they cultivated Cucumber, Ridge gourd, Hybrid Okra, Onion during Rabi season from own source and little input support from the Pani Panchayat of his village. Due to lack of knowledge and experience they faced loss in their endeavour and the partnership was also broken.

It was in that instance that KVK was working with the Pani Panchayat of Kantia to provide Agricultural Livelihood Support Service (ALSS) activities by signing MOU with Orissa Community Tank Management Project (OCTMP) and later on adopted the village Kantia in 2014. Mr. Debaraj Behera attended a tank level training on vegetable cultivation organized by KVK during Rabi 2014. He was introduced by an extension worker to KVK Scientist and discussed his problems with a request to provide technical support and advice for vegetable cultivation. In the same year Mr. Behera cultivated Hybrid Okra Var. Samrat adopting improved crop management practices in 0.2 ha during December 2014 with technical guidance from KVK through field visit and telephonic advisory services. By seeking advice from KVK and also by adopting scientific management practices he was able to get a profit of Rs. 40,000 from okra cultivation. This was the key for self-motivation to march forward with vegetable cultivation. Mr. Debaraj Behera has earned Rs. 1,86,272 within a period of 15 months accounting to a net income of Rs. 12,418 per month from vegetable cultivation. With the earnings Mr. Behera has purchased agricultural tools and machineries to support his farm activities. As a standing crop, Mr. Behera is cultivating Ridge gourd Var. Rama and Bitter gourd Var. Nakhara Improved in an area of 0.18 ha and is still in touch with KVk for technical advice.

Vegetable cultivation is not common in Kantia however, being practiced by few farm families. Today there are farmers cultivating vegetables in the village by seeing the success of Mr. Behera and through his consultation. The story of Mr. Behera indicates that continuous hard and sincere effort besides adoption of scientific management practices in vegetable cultivation has changed his wellbeing and social outlook and to be self employed. In his recent interaction with KVK he uttered that "Hard and sincere labour, earns reward".

Year wise vegetable cultivation and income

Season/Month/Year	Crop Variety	Area(ha)	KVK Activities	Expenditure (Rs)	Net return (Rs)
Kharif/June/2015	Hybrid Okra Var. Samrat	0.2	OFT, Field Visit, Telephonic Advisory	15,660	62340
Rabi/October/2015	Cowpea Var. Maharani	0.2	Field Visit, Telephonic Advisory	14,700	75300
Rabi/December/2015	Capsicum Var. Indra	0.02	FLD, Field Visit, Telephonic Advisory, Extension Literature	1000	5182
Rabi/December/2015	Cucumber Var. Barapatta	0.04	Field Visit, Telephonic Advisory	750	3450

Meetings attended by KVK staff

Events	Venue	Duration	Participant (s)
District Agricultural Strategy Committee Meeting of Khordha District for Kharif 2015	ATMA-Khordha	28 April 2015	A K. Dash
Attended District Mission Committee Meeting on Horticulture	Department of Horticulture, Govt of Odisha	12 May 2015	A K. Dash
Attended ZREAC Meeting organized by RRTTS, Coastal Zone, OUAT, Bhubaneswar	RRTTS, Coastal Zone, OUAT	15 May 2015	A. K. Dash
Annual Action Plan Workshop 2015-16	Directorate of Extension Education, OUAT	18-19 May 2015	P. N. Ananth
Writing Clinic to Share Knowledge More Effectively	International Institute for Rural Reconstruction, Philippines and Access Development Services, New Delhi	1-5 June 2015	P. N. Ananth
9th National Conference on KVKs	ICAR-National Research Complex, Patna, Bihar	25-26 July 2015	P. N. Ananth S. Singh B. K. Banja
District Level Monitoring Team (DLMT) Meeting of Khordha District under BGREI 2015-16 on	ATMA-Khordha	30 June and 29 July 2015	A. K. Dash
XXII Zonal Workshop of KVK of Zone VII	KVK-Ujjain, Madhya Pradesh	9-11 September 2016	P. N. Ananth
Group meeting cum orientation workshops on cluster demonstration on Oilseed and Pulses	Directorate of Extension Education, OUAT	6 October 2015	P. N. Ananth S. Singh
Review meeting on the Preparation of Soil Health Card by KVKs of Odisha	Directorate of Extension Education, OUAT	30 October 2015	P. N. Ananth S. Singh
District level Executional Committee Meeting on Soil Health Card Scheme	Special Circuit House, Bhubaneswar	29 January 2016	P. N. Ananth
Capacity Building Conclave	NFDB, Hyderabad	25-26 February 2016	P. N. Ananth
Workshop on District Level Consolidation and Writeshop for preparing draft of CDAP of Khordha district	College of Agriculture, OUAT, Bhubaneswar	7-9 March 2016	A. K. Dash
District level Implementation Committee under Pratan Mantri Krushi Sinchayee Yojana	District Collectorate, Khordha	21 March 2016	P. N. Ananth A. K. Dash

Exhibitions Participated by KVK

Exhibition	Venue	Duration
District level Krishi Mahostov (organised by District Agriculture Office, Khordha)	Sports Stadium, Khordha	28-29 February 2016
"Farmers' Fair, Agricultural Exhibition & Technology Awareness Programme-Kharif 2015" (Organised by KVK-Puri, OUAT)	Brahmagiri Village, Puri District	28 September 2015
District Level Pani Panchayat Fortnight	Majana, Khordha District	20 January 2016

EDUCATION AND INFORMATION SYSTEM

Library

Dr. Hiralal Chaudhuri Library of the Institute has a good collection of books and journals on Fisheries and Aquaculture. It has around 7049 books/ monographs, 2900 back volume journals and other reference materials. The library has more than 200 members viz., scientists, technical officers and research scholars. During the period 4166 users visited the library for different purposes. This includes staff of the Institute and visitors from outside organizations.

The library is a proud partner of the NAIP's e-Granth project. Under this project, the Institute library implemented the Koha software, a fully automated library management software.

The Library is also a part of IDEAL platform. IDEAL is a ready platform for Agricultural Libraries of Indian National Agricultural Research and Education System (NARES), which enables them to adopt Integrated Library management system for day to day operations of their library functionalities. This software platform is built on 'Software as a Service'(SaaS) concept to provide hassle free, ready to use, international standards based on platform for sharing library holdings through an union catalogue (AgriCat).

The users of the Library extensively used the Consortium of E-resources on Agriculture (CeRA). A user awareness programme on the CeRA was organized by the library during the year. In addition to online access in CeRA, the library is providing Document Delivery services to various institutions (including the SAUs) under the NARS.

The Library subscribed to 9 International Journals for the year 2015-16 and Rs 9.11 lakhs was spent for subscription of the foreign journals.The library has been recognized as the FAO Depository Library and has a good collection of FAO Publications related to Fisheries and allied agricultural sciences.

To keep abreast of the current developments, it also provides monthly 'Current Contents' service by compiling content pages of current journals received. It also provides the photocopying facility to the staff of Institute and visitors from other organizations. The library mails Institute's publications to all ICAR Institutes, other Research Organizations, State Fisheries Departments, Fisheries Colleges, KVKs, Entrepreneurs and Farmers to keep them abreast with latest developments in Freshwater Aquaculture. It sends important articles both to the internal users of the Institute as well as scientists and researchers from outside. It also circulates news clippings about the fisheries and aquaculture sector to the internal users.

Prioritization, Monitoring and Evaluation (PME) Cell

During the year under report, the Prioritization, Monitoring and Evaluation Cell undertook the following activities:

- Documentation and dissemination of research, extension and training activities of the Institute through CIFA Newsletter, Annual Report and other publications
- Organizing monthly meetings of senior officers to discuss the monthly progress of various activities of the Institute including research, teaching, training, publications and other administrative and financial matters. The proceedings were prepared and follow-up actions monitored.
- Assistance provided for conducting IRC and RAC meetings
- Correspondence with the ICAR Headquarters, ICAR Fisheries Institutes, SAU's and other organizations on various research issues
- Maintenance of Research Project Files
- Action taken reports on recommendations of ICAR Regional Committee Meetings
- Responses to Parliament queries on freshwater aquaculture

Publications

- Annual Report of the Institute for 2014-15 (in English & Hindi)
- CIFA News Vol. 22 (No. 2, 3, 4); Vol. 23 (No. 1)
- Research Project Proposals – 2015-16
- Leaflets and Brochures

Communication of reports

- Material for DARE-ICAR Annual Report 2015-16
- Action taken report on proceedings of the meeting of Directors of ICAR Institutes
- Monthly, quarterly and half-yearly progress reports to the Council
- Replies to Parliament queries
- RFD and strategic plan document

AWARDS AND RECOGNITIONS

Recipients	Award	Venue	Year
B.C. Mohapatra and Team	Best Paper Award, for presenting the paper "Portable FRP Carp Hatchery: A Tool for Biodiversity Conservation in Fisheries" in NSBC-2015 from Andaman Science Association	ICAR-CIARI, Port Blair	17-19 April, 2015
Rakhi Kumari S. Ferosekhan	Best Publication of the Year Award	ICAR-CIFE, Mumbai	06 June, 2015
B. N. Paul	Oral presentation in the Technical Session IV of the 3nd Biennial National Conference of Indian Academy of Veterinary Nutrition and Animal Welfare (IAVNAW)	Palampur, H.P	04 -05 November, 2015
H. K. Barman	Best poster presentation (1st prize) at 2ndInternational Symposium on Genomics in Aquaculture	ICAR-CIFA, Bhubaneswar	28-30 January, 2016
Banya Kar, A.Mohapatra, J. Mohanty P. K. Sahoo	First position in Best Poster Award: Poster entitled 'Search for Argulus vaccine candidates: from mining genomic information for vaccine target screening to in vitro and in vivo trials using a novel hidden antigen' at 2ndInternational Symposium on Genomics in Aquaculture	ICAR-CIFA, Bhubaneswar	28-30 January, 2016
Kiran D. Rasal	Felicitated as a young scientist by The Zoological Society Kolkata during Young Scientists' Meet 2016	CRNN,Kolkata	05-06 February, 2016
Rakesh Das	Felicitated as a young scientist by The Zoological Society Kolkata during Young Scientists' Meet 2016	CRNN,Kolkata	05-06 February, 2016
B. N. Paul	Best Poster in the Technical Session Feed Quality and Safety Aspects at XVI Biennial Animal Nutrition Conference	Karnal	06-08 February, 2016
Lakshman Sahoo	AZRA-Young Scientist award-2016 from AZRA at International symposium on "Advances in life sciences" organized by Applied Zoologist Research Association	Chennai	11-13 February, 2016

Academic Accomplishments

A paper entitled "Beneficial effects of dietary probiotic mixture on hemato-immunology and cell apoptosis of *Labeo rohita* fingerlings reared at higher temperatures" authored by S. Mohapatra, T. Chakraborty, A.K. Prusty, K. Paniprasad and K.N.Mohanta was adjudged as Best Publication of the Year Award-2015 from CIFE, Mumbai and a certificate of Merit was received from Director & Vice-Chancellor, CIFE, Mumbai. This was a Ph.D research paper of Ph.D student, Dr. S. Mohapatra (Guide: Dr K. N. Mohanta) who completed her Ph.D from CIFE, Mumbai.

CIFA Annual Day

The 29th Annual Day of CIFA was celebrated on 1 April, 2015 at its headquarters at Kausalyaganga. Unique feature of this year was simultaneous celebration of the great day by its Regional Research Centres. Dr P. Jayasankar, Director, ICAR-CIFA gave a comprehensive and informative account of the Institute's overall growth and highlighted some of its notable technologies, products and future plans. He conferred life time achievement awards upon 20 retired employees of the Institute including scientific, technical, administrative and supporting personnel, in recognition of the meritorious service rendered by them. The chief guest on the occasion was Prof. M. Kar, Vice Chancellor, OUAT, Bhubaneswar. He presented ICAR-CIFA annual awards to its staff and scholarships to their meritorious children. Other esteemed dignitaries included Professor A. K. Mahapatra, Director, AIIMS, Bhubaneswar and Dr. S.K. Ambast, Director, ICAR-Indian Institute of Water Management, Bhubaneswar. The function was attended by over 300 persons. A colourful cultural programme in the evening enthralled everybody.

The programme at RRC Gujarat was inaugurated by Dr. N.C. Patel, Hon'ble Vice-Chancellor, Anand Agricultural University (AAU), Anand, who highlighted the need of collaborative research on the priority area like value added fish product and low cost fish feed production between CIFA and Anand Agricultural University, Anand. Dr. Jitendra Kumar, Director, ICAR-DMAPR, Anand, Gujarat and Dr. K.B. Kathiria, Director of Research, AAU, Anand also addressed the audience as guests of honour of the programme. Many other distinguished personnel from the locality attended the function.

A function to mark the Annual Day was also organized at the RRC of CIFA, Rahara which was attended by several distinguished retired scientists, technical, administrative and supporting staff of Rahara-Kalyani centre.

The CIFA Day celebration at Bengaluru RRC was attended by esteemed personnel like Dr. D. M. Dass, Director, Department of Animal Husbandry and Veterinary Services, Government of Karnataka, Dr. T. Manjunatha Rao, Director, IIHR and Dr. P. S. Mahesh, Director, Central Poultry Development Organization and Training Institute, Bangalore.

At the RRC of Vijayawada the day was celebrated in farmer's field in a benefitting manner.

The CIFA Annual Awards (for the year 2014) were presented to the following:

Best Division/Section/Unit/ Research Groups	:	Aquaculture Production and Environment Division (APED)
Best Scientist	:	Dr Lakshman Sahoo, Scientist (FGBD)
Best Technical Staff member	:	Dr B. K. Banja, SMS (A.Sc.), KVK, CIFA
Best Administrative Person	:	Sri Arijit Panda, LDC (MACP) – Bill and Cash Section
Best Skilled Support Staff/Field Staff	:	Mr M. Narshimhulu, SSS (FGBD)
Award for Hindi work	:	Dr Shailesh Saurabh, Scientist (APED) and team (Dr D. K. Verma, Dr Rajesh Kumar and Dr P. Jayasankar)
Best Extension Worker	:	Sri A. K. Dash, SMS (Horticulture), KVK, CIFA
Best Research Scholar	:	Ms Truptimayee Behera, RA (FHMD) (PI: P. Swain) Mr Subrat Swain, Technical Assistant, (FGBD) (PI: P. Das)
Awards for School Children Best girl child award for the highest scorer in class X in 2014 Best boy child award for the highest scorer in class X in 2014	:	Mr Aditya Adhikari (S/o Dr S. Adhikari, Pr. Scientist) Mr Ashis Abhisek (S/o Sri A. K. Prusty, Assistant)

CIFA has instituted two scholarships for promoting academic excellence among the children of the staff. One, with a donation of Rs. 1,20,000 by Dr Hiralal Choudhuri in the memory of his father is named as 'Girish Chandra Chaudhuri Memorial Scholarship' and the other with a donation of Rs. 60,000 by Dr S. Ayyappan in the name of his mother and is named as 'Smt. S. Susheelamma Scholarship'. Applications are invited every year from the staff wards and the scholarship is given on the basis of merit. Two more awards i.e., Dr T. Ramaprabhu Memorial and Dr B.R. Mohanty Memorial for research scholars were instituted with donations respectively from Ms Ramaprabhu, and parents of Dr B.R. Mohanty and his mentor scientist colleagues.

The recipients of the above awards are as follows:

Girish Chandra Chaudhury Memorial Scholarship

Name	Class	Amount (Rs)
Abhib Abhinash	Graduation	3000.00
Ankeeta Priyam	Graduation	3000.00
Saswati Mohapatra	XI-XII	2400
Swapnedu Sarkar	XI-XII	2400

Smt. S. Susheelamma Scholarship

Name	Class	Amount (Rs)
Sourav Sarkar	IX-X	1800.00
Ashis Abhisek	IX-X	1800.00
Priyadarshini Mohapatra	VII-VIII	1200.00
Bineet Bhanja	VII-VIII	1200.00

Dr T. Ramaprabhu Memorial Award

Name	Designation	Amount (Rs)
Ms Banya Kar	SRF (Argulosis Project) PI: Dr. P. K. Sahoo	6000.00

Dr B.R. Mohanty Memorial Award

Name	Designation	Amount (Rs)
Ms Sweta Das	SRF (Disease Resistant Rohu Project) PI: Dr. P. K. Sahoo	3000.00

Apart from these awards, prizes were also distributed to winners of various sports and cultural events organized by the Institute.

RESEARCH COORDINATION AND MANAGEMENT

Research Advisory Committee

The Research Advisory Committee (RAC) meeting was held during 6-7 April, 2015 under the Chairmanship of Dr K. K. Vass, Ex-Director, CIFRI. The Members who attended were; Dr S. D. Singh, ADG (I.Fy), ICAR, New Delhi, Dr P. Keshavnath, Former Dean, College of Fisheries, Mangalore, Mr Kripan Sarkar, Progressive Farmer, Cooch Bihar, West Bengal. The major recommendations of the Committee are as follows:

- ICAR-CIFA should strengthen ornamental fish research.
- Transgenic research should continue.
- North Eastern Region fishes to be explored for breeding and culture.
- RRC is the mirror of headquarter, so should be strengthened.
- Aim farmers before starting any research.
- Need to focus on 2-3 states for technology dissemination.
- "Fish for all and farmer first" should further be emphasized.
- More attention is required in documentation and publicity of the work done at the institute.
- Data generated should be translated into useful information.
- The research project should be aimed to address the problems faced by the farmers.

The new Research Advisory Committee (RAC) of the Institute was constituted for a period of three years w.e.f. 1.2.2016 to 31.1.2019. The first meeting of this committee was held during 18-19 March, 2016 under the Chairmanship of Dr A. G. Ponniah, Former Director, ICAR-CIBA; Dr I. Karunasagar, Former Prof. and Head, Dept. of Fishery Microbiology and Biochemistry, College of Fisheries, Mangalore; Dr C. G. Joshi, Prof. and Head, Dept. of Animal Biotechnology, AAU, Gujarat; Dr H. K. Vardia, Dean, Fisheries College, Chhattisgarh, Kamdhenu Visva Vidyalaya, Raipur; Dr P. Jayasankar, Director, ICAR-CIFA (Members), and Dr (Mrs) K. D. Mahapatra, Principal Scientist, ICAR-CIFA (Member Secretary).

Institute Research Council

The annual IRC meeting was held during 8-10 April, 2015 with Dr P. Jayasankar, Director as Chairman and Dr B. K. Das, Member Secretary. Discussions were held on the ongoing 14 institute based projects, 3 outreach projects, 25 externally funded projects, and other research programme including women scientist projects funded by DST. A total number of 9 new projects were approved by the competent authority for 2015-16. The Mid-term IRC meeting was held on 16 December, 2015.

Institute Management Committee

The 39thInstitute Management Committee meeting was held on 29 February, 2016 under the Chairmanship of Dr P. Jayasankar, Director, ICAR-CIFA. It was attended by Shri S. K. Das, F&AO, ICAR-NRRI, Cuttack and Dr J. K. Sundaray, HoD, FGBD, ICAR-CIFA as Members; Sri N.V.R.N. Murty, F&AO, and Dr S. S. Mishra, HoD, FHMD, ICAR-CIFA as Member-Invitees; and Shri K. C. Das, Senior Administrative Officer, ICAR-CIFA as Member-Secretary. Agenda items included confirmation of proceedings of 38th Institute Management committee; Discussion on R&D highlights and a few Research Programs of the Institute; Procurement of equipment during FY 2015-16 under Plan Budget; Execution of Works during FY 2015-16 and FY 2016-17 under Plan Budget; Execution of Works (repair/renovation and maintenance under Head ICAR-CIFA-Non-Plan carried out during FY 2014-15 and to be carried out during FY 2015-16); Execution of Works at RRC of ICAR-CIFA, Rahara and Kalyani Field Station; and Enhancement of security budget.

Institute Joint Staff Council

The Second General Body Meeting of 9th Institute Joint Staff Council (IJSC-Staff side) was held on 9 September, 2015.

TRAINING AND CAPACITY BUILDING

Foreign Assignments

Sl. No.	Event/Training	Venue	Period	Participant(s)
1.	26th Governing Council Meeting (GCM-26) of Network of Aquaculture Centres in Asia Pacific (NACA)	Bali, Indonesia	05-07 May, 2015	P. Jayasankar
2.	Endeavour Post-Doctoral Research Fellowship Award sponsored by Dept. of Education, Employees & Workplace Relations, Govt. of Australia	The University of Newcastle, Australia	08 Jun-07 Dec, 2015	Subhas Sarkar
3.	FAO-NACA Regional Workshop on 'Documentation and dissemination of successful practices of sustainable intensification of aquaculture in Asia-Pacific'	Bangkok, Thailand	16-18 June, 2015	K.D. Mahapatra
4.	Workshop on Feasibility study of a proposed aquaculture professional exchange programme under auspices of FK, Norway	NACA, Bangkok, Thailand	11-15 October, 2015	N.K. Barik
5.	FAO Consultancy service under the United Nations Development Projects entitled 'Broodstock management and genetic selection of tilapia'	Namibia	26 December 2015-14 January, 2016	P. Routray

Training undergone by the staff members of the Institute as part of the human resources development initiative

Scientific Category

1.	Quantitative techniques for analysis of breeding experiments	ICAR-NAARM Hyderabad	02-07 November 2015	B.R. Pillai Khuntia Murmu
2.	ICAR sponsored short course on molecular approaches and in diagnosis and control of emerging and transboundary diseases of freshwater fish and shellfish	ICAR-CIFA, Bhubaneswar	17-26 November 2015	Rakesh Das Mohan R. Badhe
3.	MDP on 'Managerial Leadership and Team Effectiveness'	IIM, Kolkata	01-05 February 2016	J. Mohanty P.K. Sahoo
4.	National Level Young Scientist Meet 2016	Kolkata University, West Bengal	05-06 February 2016	Kiran Rasal Rakesh Das
5.	Antibiotic residue analysis in Aquatic Environment	ICAR-CIFT, Kochi	11-12 February 2016	B.K Das
6.	CAFT Programme on Computational Tools and Techniques for Molecular Data Analysis in Agriculture	ICAR-IASRI, New Delhi	11 February 02 March, 2016	Rakesh Das
7.	Training on Histo - Techniques in life science Research	OUAT, Bhubaneswar	03-04 March, 2016	U. K. Udit
8.	Nanotechnology in Aquaculture	TNVASU, Chennai	10-20 March 2016	C. Devaraj
9.	Hindi Training and Workshop	National Institute of Animal Nutrition and Physiology, Bangalore	21- 23 March, 2016	B.S. Ananda Kumar
10.	Interactive Co-learning Workshop on Psychology, Method and Ethics in Science	CMFRI Regional Centre, Visakhapatnam	22-24 March 2016	Laxman Sahoo
11.	HR Metrics & Analytics	IIM, Trichy	24-25 March 2016	I. Sivaraman

Technical Category

Sl. No.	Event/Training	Venue	Duration	Participants
1.	Field-cum-Exposure Visit	RRC of ICAR-CIFA, Vijayawada	7-13 February 2015	Arun Ku. Behera Debendra Tarai
2.	Quantitative Techniques for Scientists & Business Managers	ICAR-NAARM, Hyderabad	07-12 September 2015	Nirupama Panda
3.	National Workshop on Effective Management of e-resources in Research Libraries	ICAR-CMFRI, Kochi	12-17 October 2015	Sisir Ku. Mohanty
4.	MS Power Point	ISTM, New Delhi	30 November-2 December 2015	Debendra Tarai
5.	Hindi Karyasala	Central Hindi Training Institute, New Delhi	07-11 March 2016	Aruna Ku. Behera

Administrative Category

Sl. No.	Event/Training	Venue	Duration	Participants
1.	Workshop on Special Recruitment Drive to Fill up Vacancies for Persons with Disabilities	Institute of Public Administration, Ministry of Social Justice and Empowerment, New Delhi	08 August 2015	Jairam Biswal
2.	MS-Power Point	ISTM, New Delhi	30 November - 2 December 2015	Loknath Senapati Prakash Parida
3.	Pay Fixation	ISTM, New Delhi	18-20 November 2015	Tapas Mishra
4.	Principle of Natural Justice	ISTM, New Delhi	07 December 2015	I. Muduli
5.	Hindi Karyasala	Central Hindi Training Institute, New Delhi	07-11 March 2016	M.D.Das Golap Bhanja

Skilled Support Staff Category

Sl. No.	Event/Training	Venue	Duration	Participants
1.	Organizational Behaviour, Soft Skill & Service Rules	ICAR-CIFA, Bhubaneswar	7-8 January 2016	Ramesh Ghadei Golekh Behera Dusmanta Sahoo Rama Mallick Maharaga Majhi R. K. Sahoo Debahari Behera Saroj parida Sibananda Bhuian Trailokya Nath Pradhan Damodar Ghadei Gopal Mahapatra Gayadhar Behera Jayakrushna pallai Kalandi Biswal Baikuntha Nayak Kedar Jally Pitambar Swain Lokanath Swain C. H. M. Ray B. K. Deo Prahallad Swain Sridhar Kahali Bhagban Swain Basudeb Routray Bhikari Bhoi Murali Bhoi Sudam Behera Nabaghan Ghadei Trinath Pradhan Rajan Swain Kapilash Barik Sarat Chandra Barik Satrughan Bhoi Kailash Jena Sarat Barik

2.	Training-cum-Exposure Visit	RRC of ICAR-CIFA, Vijayawada	7-13 February 2016	Manoj Jena Ulash Bhoi Jagannath Ojha M. Narasimhalu Bauri Bandhu Pradhan Gundicha Prusty Baja Muduli Premananda Bisoi Aruna Muduli H.K. Behera Prasana Behera Mahendra Behera Purna Bhoi Jagannath Ghadei Tanaya Barik Budhia Behera

Participation of Scientists/Technical Officers in Workshops/Seminars/Symposia/ Conferences/ Meeting in India and abroad

Events	Venue	Duration	Participant(s)
Seminar on "Harmonizing biodiversity and climate change: challenges & opportunity"	ICAR-CIARI, Port Blair	17-19 April, 2015	P. P. Chakrabarti B. C. Mohapatra N. K. Barik
Review Meeting of NFBSFARA/NASF, ICAR by the Empowered Committee	NASC Complex, NASF, ICAR	20 April, 2015	D.N.Chattopadhyay
Writeshop on Fish vaccinology	CIFE, Mumbai	24-25 April, 2015	P.K. Sahoo
International Conference on Low Temperature Science and Biotechnological Advances	NASC Complex, New Delhi	27 April, 2015	P. Routray D. K. Verma
Seminar on Innovation and opportunities in fisheries sector	Mahatma Gandhi Labour Institute, Gandhinagar, Gujarat	5 May, 2015	C. K. Misra
17th Meeting of National committee on introduction of Exotic aquatic species into Indian waters	ICAR, New Delhi	7 May, 2015	B. R. Pillai
Meeting of Directors of Fisheries Science Division, ICAR	NAAS Complex, New Delhi	14 May, 2015	P. Jayasankar
ICAR's Directors Conference	NAAS Complex, New Delhi	14-16 May, 2015	P. Jayasankar
Outreach demonstration on fish feed	Belurmath, Kolkata	28-29 May, 2015	S. S. Giri
4th Annual Review Workshop of the NASF, ICAR	NASC Complex, New Delhi	28-29 May, 2015	D.N.Chattopadhyay
Visit to RRC, ICAR-CIFA, Kalyani, and West Bengal and discuss with all scientists about research programe. Visit to Belur Math to discuss on forthcoming intervention.	RRC, ICAR-CIFA, Kalyani, West Bengal & Belur Math, Kolkata	6-8 June, 2015	P. Jayasankar
EEP on Management of Technology & Innovation	IIM, Banaglore	15-17 June, 2015	J. K. Sundaray
MDP on Leadership Development	ICAR-NAARM, Hyderabad	16-27 June, 2015	K.N. Mohanta
Technical Advisory committee meeting of DBT	New Delhi	27 July, 2015	P. Jayasankar P. Das K. D. Mahapatra J. K. Sundaray
World Nature Conservation day celebration	Research Centre of IISWC, Vasad, Gujarat	3 August, 2015	C. K. Misra Chaudhari Ajit Keshav

5th Advisory committee Meeting	CIFRI, Barrackpore	6-7 August, 2015	D.N.Chattopadhyay R.N.Mandal
7th meeting of Scientific Panel for fish and fisheries product	FSSAI, New Delhi	19 August, 2015	P. Jayasankar
Visit to Bathinda (Punjab) for initiating aquaculture activities and for making ground work to set up RRC of ICAR-CIFA in the State of Punjab	Bathinda, Punjab	1-3 September, 2015	P. Jayasankar
Scientific Advisory Committee meeting of KVK, Puri	OUAT, Bhubaneswar	3 September, 2015	S. C. Rath
XXII Zonal Workshop of KVKs	KVK, Ujjain, ZoneVII	9-11 September, 2015	P. Jayasankar P. N. Ananth
Workshop of ICAR-AICRP on Plasticulture Engineering and Technology	Sher-e-Kashmir University of Agricultural Sciences and Technology, Kashmir, Srinagar	10-12 September, 2015	B. C. Mohapatra K. Anantharaja
FAO TCP/INT/3502 Re-echo Seminar on 'Reducing and managing the risk of acute hepatopancreatic necrosis disease of cultured shrimp'	NBFGR, Lucknow	14-15 September, 2015	P.K. Sahoo
Round table conference on AHPND National Action Planning	NBFGR, Lucknow	16 September, 2015	P.K. Sahoo
Interface meeting with farmers of Chhattisgarh	AFS, Durg	18 September, 2015	G. S. Saha, H. K. De, N. Panda
ICAR Regional Committee Meeting-II	CIFRI, Barrackpore	19 September, 2015	P. Jayasankar
Workshop on Importance of quality seed increasing production	Thanjavur	22 September, 2015	P. Jayasankar J. K. Sundaray K. D. Mahapatra S. Nandi J. N. Saha
Meeting with DDG (Fy), ICAR	ICAR, New Delhi	27-28 September, 2015	P. Jayasankar
Project review meeting of NFDB funded projects	NFDB, Hyderabad	29-30 September, 2015	B.R. Pillai
Dissemination workshop on Odisha fisheries policy	Bhubaneswar	8 October 2015	P. Jayasankar J. K. Sundaray S. C. Rath
Workshop on 'Breeding, Farming, Management Practices of Striped Murrel, *Channa striatus*'	NFDB, Hyderabad	9 October 2015	Rajesh Kumar
Rural Advisory Committee of Doordarshan Kendra	Bhubaneswar	14 October 2015	S. C. Rath
Zonal Research Extension and Advisory committee meeting	Anand Agricultural University	14 October 2015	C. K. Misra Chaudhari Ajit Keshav
National Workshop on Effective Management of E-Resources in Research Libraries	CMFRI, Cochin	12-17 October, 2015	S.K. Mohanty
Survey programme	Nanak Sagar, Uttrakhand	20-22 October 2015	P. Jayasankar B. S. Giri
Review of TSP activities	RRC, Anand, Gujarat	25-26 October 2015	P. Jayasankar

Training delivered to line department officials of Gujarat, Maharashtra, Chhattisgarh, Himachal Pradesh on "Climate change-Impact and mitigation in Fisheries and Aquaculture"	EEI, AAU, Anand	3 November, 2015	C. K. Misra
Meeting at ASRB	ICAR, New Delhi	4-5 November 2015	P. Jayasankar
3nd Biennial National Conference of IAVNAW	Palampur, H.P.	4-5 November, 2015	S. S. Giri B. N.Paul
Sustainable CSR practices- shared ideas	Hotel Excellency, Bhubaneswar	6 November, 2015	H K De
Workshop on Quantitative Techniques for Analysis for Breeding Experiments	NAARM, Hyderabad	2-7 November 2015	B. R. Pillai K. Murmu
Hindi workshop	ICAR-NAAS Complex	7 November 2015	S. Saurabh
Meeting on Common platform for the way forward to achieve the excellence in Higher fisheries education	CIFE, Mumbai	10 November 2015	P. Jayasankar
National Seminar on 'Hilsa conservation and propagation'	CIFRI, Barrackpore	18 Nov, 2015	D.N. Chattopaddhay R. N. Mandal Arabinda Das
Review meeting of Vigilance Officers	NAARM, Hyderabad	19 November 2015	S. K. Swain
Discussion with the Principal Secretary, Dept. of Fisheries with regard to development of freshwater aquaculture in the state	Thiruvananthapuram, Kerala	27 November 2015	P. Jayasankar
International Symposium on Cage Aquaculture in Asia	CMFRI, Kochi	25-28 November 2015	P. Jayasankar S. Ferosekhan Nitish K. Chandan
National Symposium on "Challenges and advances in disease diagnosis of livestock, poultry and fish: Redefining the role of Veterinary Pathologists"	Department of Veterinary Pathology, NTR college of Veterinary Science, SVVU, Gannavaram	3-5 December, 2015	P.K. Sahoo
8th meeting of scientific panel on Fish and fisheries product of FSSAI, New Delhi	ICAR, New Delhi	8 December 2015	P. Jayasankar
Seminar on Science and technology for indigenous development in India (organized by ISCA, Bhubaneswar Chapter)	KIIT, Bhubaneswar	9-11 December, 2015	U. L. Mohanty N. Panda D. P. Rath
Workshop on 'Scientific fish farming' organized by State Fisheries Department, Government of Gujarat	Nadiad, Gujarat	11 December, 2015	Chaudhari Ajit Keshav
National Seminar on "Science and Technology for Indigenous Development in India"	KIIT University - Bhubaneswar	9-11 December, 2015	N. Panda
Sensitization workshop on Biological Diversity Act and Rules for scientist and academicians	Bhubaneswar	19 December, 2015	B.R. Pillai P.C. Das Rajesh Kumar
Farmers meet and inauguration of FRP Hatchery at tribal area in Patashpur village	Digha, West Bengal	20 December, 2015	P. Jayasankar P. P. Chakrabarty B. C. Mohapatra R. N. Mondal Arabinda Das Ajmal Hussain

National Workshop on Electron Microscopy & Allied Techniques (NWEMAT) - 2015	University of Delhi	21- 23 December, 2015	M. Samanta
CIFA -NFDB collaborative farmer-scientist interaction meet on 'Importance of quality fish seed in aquaculture'	Namkhana, Kakdwip, West Bengal	23 December, 2015	P. Jayasankar J.K. Sundaray K. D. Mahapatra P. P. Chakrabarty J. N. Saha Khuntia Murmu Arabinda Das Ajmal Hussain Avinash Rasal
Seminar on Resource based Agriculture and Rural Development: Opportunities and Challenges	Centre of Integrated Rural Development and Management, Ramkrishna Mission Vivekananda University, West Bengal	15 January 2016	J. K. Sundaray
National seminar on 'Resources management: Challenges and perspective'	Ramakrishna Vivekananda University, Narendrapur	15-16 Jan, 2016	R. N. Mandal
11th National Symposium on Innovation in Coastal Agriculture- Current status and Potential under changing environment	IIWM, Bhubaneswar	16-17 January 2016	J. K. Sundaray Mohan Badhe Avinash R. Rasal
National Consultation on Managing *Enterocytozoon hepatopenaei* (EHP) infections in brackishwater aquaculture in India	CIBA, Chennai	19 January, 2016	P.K. Sahoo
Workshop on 'Scientific fish farming' organized by State Fisheries Department, Government of Gujarat	Anand, Gujarat	20 January, 2016	Chaudhari Ajit Keshav
National seminar on Fisheries and Aquaculture: Livelihood security, Sustainability and Conservation	College of Fisheries, Agartala (CAU)	19-21 January 2016	S. C. Rath K. N. Mohanta
National Seminar on Fisheries and Aquaculture: Livelihood Security, Sustainability and Conservation	Lembucherra, Tripura	21-22 January 2016	K. N. Mohanta Rakesh Das Uday Kumar Udit
International Conference- Towards a Sustainable Blue Economy: Production, Strategies and Policies- TaSBE - 2016	Kochi, Kerala	04-06 February, 2016	Hemaprasanth Raghavendra C.H.
Young scientist meet	ZSI, Kolkata	04-06 February, 2016	H. K. Barman Rakesh Das K.D. Rasal
XVI Biennial Conference on the theme "Innovative Approaches for Animal Feeding and Nutritional Research" conducted by Animal Nutrition Society of India	ICAR-NDRI, Karnal	06-08 February, 2016	N. Sridhar, B.Gangadhar B. N. Paul K. C. Das
Workshop on "Recent advancement in Breeding and Seed production of Native Freshwater Fishes of India"	Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi	08-09 February, 2016	Rajesh Kumar
Second Annual Review Meeting of NASF	NASC Complex, New Delhi	11 February, 2016	D.N. Chattopadhyay M. Samanta

XV AZRA International Conference	Ethiraj College for Womens, Chennai	11-13 February, 2016	J.K. Sundaray P. Das Lakshman Sahoo
Fish Hatchery Operation and Management	Bihar Agriculture Management & Extension Training Institute (BAMETI), Patna	17 February, 2016	Shailesh Saurabh
Meeting of the State Level Steering Committee for Implementation of the Odisha Fisheries Policy, 2015	Secretariat Odisha, Bhubaneswar	20 February, 2016	G. S. Saha
International Symposium on Microbiome in health and disease	National Institute of Animal Nutrition and Physiology, Bangalore	23-25 February, 2016	B. S. Ananda Kumar
Zonal Agricultural Research and Extension Council Meeting of Anand Agricultural University, Anand, Gujarat	AAU, Anand	25 February, 2016	C. K. Misra Chaudhari Ajit Keshav
12th Research Sub-committee meeting of Animal production and Fisheries	Veterinary College, Anand, Gujarat	26-27 February, 2016	C. K. Misra Chaudhari Ajit Keshav
Scientific advisory committee meeting	Arnej, Gujarat	3 March, 2016	C. K. Misra
Seminar on Ornamental fish farming - an option for income generation	ICAR Research Complex for NEH Region, Meghalaya	4-6 March 2016	S. K. Swain
Workshop on "Awareness generation on intellectual property rights"	Odisha Bigyan Academy, Bhubaneswar	11 March, 2016	P. Swain
Annual Convention and National Symposium of Society for Veterinary Biochemist and Biotechnologist	OUAT, Bhubaneswar	11-12 March, 2016	Lakshman Sahoo
National Symposium on Advances in Proteomics	Institute of Life Sciences, Bhubaneswar	15 March 2016	J. Mohanty
National Symposium and Workshop on Advances in Proteomics	ILS, Bhubaneswar	15-18 March, 2016	Mohan Ramesh Badhe
Hindi workshop	ICAR-DMAPR, Gujarat	16 March 2016	S. Sarkar
International Conference on Water Environment, Energy & Society-2016	AISECT University, Bhopal	15-18 March, 2016	K. N. Mohanta
Interactive Co-learning workshop on Philosophy, Methods and Ethics in Sciences	Regional centre of ICAR-CMFRI, Visakhapatnam	22-24 March, 2016	Lakshman Sahoo

EXHIBITIONS

The Institute participated in the following exhibitions during 2015-16:

Sl. No	Exhibition	Venue	Period
1.	Horti Fair 'Horti-Sangam-2015'	Gandhi Maidan, Motihari, Bihar	10-12 April, 2015
2.	69th Foundation day and Dhan Diwas of CRRI, Cuttack	CRRI, Cuttack, Odisha	23 April, 2015
3.	Krishi Mahostav - 2015 (participation by RRC, Anand)	Lunawada, District: Mahisagar, Gujarat	30 April - 1 May, 2015
4.	6th Krishi Fair-2015, organized by Shree Shrikshetra Soochana (SSS), Puri	Sardhabali, near Sri Gundicha Temple, Puri, Odisha	25-29 May, 2015
5.	District-level Farmers' Meet (Zilla Krushak Sammelan) & Exhibition	CIFA Campus, Kausalyaganga Bhubaneswar, Odisha	20 July, 2015
6.	Agriculture Exhibition	Seema Suraksha Bal (SSB) Ground, Main Highway, Pipra Kothi, Motihari, Bihar	20-21 August, 2015
7.	Krishi Mela-2015 (organiged by RRC, Bangalore)	University of Agricultural and Horticultural Sciences, Shimoga	3- 6 October, 2015
8.	National Workshop on "Coldwater Endemic Fishes of North Himalayas".	ICAR-DCFR, Bhimtal organized at Gangtok, Sikkim	5-6 November 2015
9.	Krishi Mela-2015 (organiged by RRC, Bangalore)	University of Agricultural Sciences, Bangalore	19-22 November, 2015
10.	International Symposium on Cage Aquaculture in Asia (CAAS)	CMFRI, Kochi, Kerala	25-28 November 2015
11.	Women in Agriculture Day	ICAR-Central Institute for Women in Agriculture, Bhubaneswar	4 December 2015
12.	International Soil Day	KVK, Khordha, CIFA Campus, BBSR Bhubaneswar, Odisha	5 December 2015
13.	Workshop-cum dairy entrepreneurs-scientists interaction meet (organized by RRC, Kalyani)	NDRI-ERS, Kalyani	12 December, 2015
14.	8th National Livestock championship & Expo-16 organized by FICCI	Sri Muktsar Saheb, Punjab	8-12 January, 2016

15.	National symposium on "Innovations in Coastal Agriculture- Current Status and Potential under Changing Environment"	IIWM, Bhubaneswar, Odisha	14-17 January, 2016
16.	National Seminar on "Aquaculture and Fisheries: Livelihood Security, Sustainability and Conservation"	College of Fisheries, CAU, Lembucherra, Tripura	21-22 January, 2016
17.	4th ICAR Institutes-SAU-State Departments Interface Meet	OUAT, Bhubaneswar, Odisha	27-28 January, 2016
18.	2nd International Symposium on Genomics in Aquaculture	ICAR-Central Institute of Freshwater Aquaculture, Kausalyaganga, Bhubaneswar, Odisha	28-30 January, 2016
19.	Matsyamela-2016 (organiged by RRC, Bangalore)	University of Agricultural Sciences, Raichur	30 January - 1 February, 2016
20.	An International Conference 'Towards a Sustainable Blue Economy: Production, Strategies- TaSBE - 2016'	Kochi, Kerala	4-6 February, 2016
21	On the occasion of Hon'ble Minister of State for Agriculture & Farmers Welfare, Govt. of India	KVK-CIFA, Bhubaneswar, Odisha	11February, 2016
22	International Conference on Aquatic Resources and Sustainable Management	Science City, Kolkata	17-19 February, 2016
23	Inter State Horti Fair at Bargarh	Bargarh, Odisha	20-22 February, 2016
24	Fish Festival, Odisha: 2016 & Krushi Mahotshav, 2016	Biju Pattnaik Play Ground, Baramunda, Bhubaneswar, Odisha	11-14 March, 2016
25	Krishi Unnati Mela 2016	IARI Main Campus, New Delhi	19-21 March, 2016

BUDGET

A. Provision from the ICAR (2015-2016)

Sl.No.	Sub-head	Govt. grant	Non-Plan					Plan	
			Allocation internal + additional amount provided by Hqrs out of council's share	Total allocation (col 3+4)	Exp. out of Govt. grant	Exp. out of revenue generation	Total Exp. (col 6+7)	Allocation	Exp.
1	2	3	4	5	6	7	8	9	10
1.	Capital Exp.								
a)	Land	-							
b)	Building							23.00	23.00
c)	Equipments	3.00	2.00	5.00	-	-	-	23.00	22.93
d)	Furniture/Fixture							4.00	2.41
e)	Info. Tech.							10.00	10.00
f)	Vehicle/Vessels							-	-
g)	Library Books							10.00	10.00
2.	Revenue Exp.								
a)	Estt. Charges	1685.00	100.00	1785.00	1684.98	100.00	1784.98		
b)	Wages	65.00	-	65.00	64.63	-	64.63		
c)	OTA	0.40	-	0.40	0.28	-	0.28		
d)	Pension & Other Retirement benefits	72.00	50.41	122.41	52.12	36.81	88.92		
3.	Loans & Adva.								
4.	TA	10.00	-	10.00	9.98	-	9.98	25.00	24.89
5.	Other Charges								
a)	Res. Expenses	51.00	10.00	61.00	20.91	10.00	30.91	98.57	98.57
b)	Operational Expenses	122.00	30.31	152.31	152.08	30.31	182.39	186.43	186.43
c)	Admn. Expenses	77.00	65.00	142.00	76.55	63.45	140.00	100.00	100.00
d)	Misc. Expenses	5.70	4.00	9.70	5.68	3.69	9.37		
6.	HRD	-						15.00	14.99
7.	NEH	-						65.00	63.37
8.	TSP	-						30.00	29.85
	TOTAL	**2091.1**	**261.72**	**2352.82**	**2067.21**	**244.25**	**2311.46**	**590.00**	**586.44**

DISTINGUISHED VISITORS

Kausalyaganga, Bhubaneswar

- Hon'ble E.M. Sjt. Shyam Sundi, Minister of Bodoland Territorial Council (BTC) visited the Institute on 7 May, 2015 and held an interactive discussion with the Director and Scientists of the Institute regarding NEH programme of ICAR-CIFA in BTC, Assam. He was accompanied by Sri P. K. Hazarika, Nodal Officer, BTC, Central Govt. Scheme, Planning and Development of Aquaculture and Animal Husbandry.
- Dr A. G. Ponniah, Former Director, ICAR-CIBA and Emeritus Scientist, ICAR-CMFRI visited the Institute and delivered a lecture on 'Collaborations for successful research outcome' on 30 June, 2015.
- Dr Pradip Kumar Panigrahi, Hon'ble Minister for Higher Education, Science and Technology, Govt. of Odisha visited the Institute on 7 July, 2015 as Chief Guest on the occasion of training programme on 'Installation and operation of FRP carp hatchery'.
- Sri K. N. Kumar, Chief Executive, NFDB visited the Institute on 4 August, 2015.
- Dr. A.S. Ninawe, Advisor, DBT, Govt. of India visited FRP carp hatchery site at Kantabad village, Begunia Block, Khordha District, Odisha on 13 August, 2015. He appreciated the ongoing project work of DBT SC/ST operating at ICAR-CIFA, Bhubaneswar after observing rohu spawn in the hatchery.
- Dr B. Senthilkumaran, Professor, DBT-TATA fellow, Dept. of Animal Biology, School of Animal Sciences, University of Hyderabad delivered a talk on 'Sexual plasticity in teleosts' on 21 August, 2015.
- Dr H. K. Mahapatra, Director, AIIMS, Bhubaneswar visited the Institute on 24 August, 2015 and inaugurated the training programme on 'Nano-technology'.
- Dr B. B. Das, Former Deputy Director, Vikram Sarabhai Space Centre, ISRO, Trivandram visited on 28 August, 2015 and delivered a lecter on 'Mission Mangalayan (MARS): the pride of India'.
- Dr Anupam Kumar Patnaik, IPS (Retd.) former DG of Police (Vigilance), Govt. of Odisha visited the Institute on 31 October, 2015.
- Shri Jual Oram, Hon'ble Minister of Tribal Affairs, Govt. of India visited the Institute to review the Tribal Sub-Plan (TSP) activities on 24 September, 2015 and held an interactive discussion with the Director and Scientists of the Institute and also visited the field facilities. He was accompanied by Sri Pradip Purohit, MLA, Padampur, Odisha.

Regional Research Centre of CIFA, Anand

- Dr. Nitin Akolkar, Dean of Fisheries faculty, Kamdhenu University, Gandhinagar, Gujarat visited, RRC, Anand on 19th November, 2015.

Regional Research Centre of CIFA, Rahara and Field Station, Kalyani

- Dr. J.K. Jena, DDG (Fisheries), ICAR visited RRC Rahara and its Field Station Kalyani on 18 February, 2016.

PUBLICATIONS

Research papers

Bandyopadhyay, P., S. Mishra, B. Sarkar, S.K. Swain, A. Pal, P. P. Tripathy and S.K. Ojha, 2015. Dietary *Saccharomyces cerevisiae* boosts growth and immunity of IMC *Labeo rohita* (Ham.) juveniles.*Indian J. Microbiol.*,55(1): 81–87.

Basu, M., M. Paichha, B. Swain, S. S. Lenka, S. Singh, R. Chakrabarti and M. Samanta, 2015. Modulation of TLR2, TLR4, TLR5, NOD1 and NOD2 receptor gene expressions and their downstream signaling molecules following thermal stress in the Indian major carp catla (*Catla catla*). *3 Biotech*:1021–1030.

Basu, M., M. Paichha, S. S., Lenka, R. Chakrabarti and M. Samanta, 2016. Hypoxic stress: impact on the modulation of TLR2, TLR4, NOD1 and NOD2 receptor and their down-stream signalling genes expression in catla (*Catla catla*). *Mol. Biol. Rep*. 43:1–9.

Chanda, S., B. N. Paul, K. Ghosh and S. S. Giri, 2015. Dietary essentiality of trace minerals in aquaculture-A Review. Agri. Review, 36(2):100-112.DOI:10.5958/0976-0741.2015.00012.4

Das, A., A. Mohapatra and P.K. Sahoo, 2015. Cloning and characterization of antimicrobial peptide, hepcidin in medium carp, *Puntius sarana. Int. J. Pept. Res. Ther.*, 21: 139-147.

Das, K. C., S. Toppo, T. K. Mohanty, C. Pradhan, K. N. Mohanta and S. S. Giri, 2015. Cost effective floating feeds for Indian Major Carps (IMC) by replacement of soyabean meal with alternative feed ingredients. *Indian J. Ani. Res.* Print ISSN:0367-6722/ Online ISSN:0976-0555

Das, P. C., B. Mishra, B. K. Pati and S. S. Mishra, 2015. Critical water quality changes responsible for seed mortality during closed system fry transportation of *Labeo rohita* (Hamilton). *Indian J. Fish.*, 62 (2): 39-42.

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CIFA

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Sri Debendra Tarai

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Sri Debabrata Sahoo

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Sri Dinabandhu Pradhan, T-2
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Sri N. V. R. N. Murty

Asst. Finance and Accounts Officer
Sri S. S. Mahapatra

Private Secretary
Sri M. D. Das

Assistant Administrative Officers
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Sri P. K. Sethy

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Sri Jitendranath Jena
Sri T. K. Mishra
Sri Majoj Ku. Mohapatra
Sri Loknath Senapati

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Sri Sukanta Sarkar
Sri R. K. Behera
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Staff transferred from Regional Research Centre of CIBA, Puri

Sri P. C. Mohanty, T-2 (Driver)
Sri Maharaga Majhi
Sri Premananda Bisoi

LIST OF APPROVED ON-GOING PROJECTS

Institute-based projects

Sl. No.	Institute Project Code	Project title	Principal Investigator	Duration
1.	I-59	Genetic upgradation of freshwater fish and shellfish	J. K. Sundaray	
		m) In-vitro production of fertile sperm from the testicular cells of *Clarias batrachus*	H. K. Barman	1.4.2012-31.3.2016
		n) Transcriptomic profiling of the reproduction related tissues during transition from post spawning regression to initiation of gonad activity in rohu (*Labeo rohita* Ham.)	S. Nandi	1.4.2012-31.3.2016
		o) Proteomic analysis of differentially expressed proteins in giant freshwater prawn, *Macrobrachium rosenbergii* in response to biotic stressors.	J. Mohanty	1.4.2013-31.3.2016
		p) Establishment of base population for genetic improvement of *Labeo bata* (Hamilton, 1822).	P. K. Meher	1.4.2013-31.3.2016
		q) Establishment of base population and stock evaluation of Indian major carp, *Cirrhinus mrigala*.	K. Murmu	1.4.2013-31.3.2016
		r) Development of genomics resources in Indian major carp, *Catla catla*.	Laxman Sahoo	1.4.2013-31.3.2016
		s) Single nucleotide polymorphism discovery in *Labeo rohita* and *Macrobrachium rosenbergii*	P. Das	1.4.2013-31.3.2016
		t) Effect of 'CIFABROOD' on the breeding performance and seed quality of Jayanti rohu (*Labeo rohita*)	S. Nandi (w.e.f. Nov, 2015)	1.4.2014-31.3.2017
		u) Selective breeding of catla (*Catla catla*) for growth improvement and two traits (growth and disease resistance against *aeromoniasis*) selection and dissemination of genetically improved rohu (*Labeo rohita*)	K. D. Mahapatra	1.4.2015-31.3.2018

2.	I-79	Exploring potential of freshwater aquaculture technology intervention in Gujarat	C. K. Mishra	1.4.2012-31.3.2016
3.	I-80	Sustainable freshwater aquaculture		
		a) Breeding and larval rearing of *Puntius tambraparniei* Silas, 1954 an indigenous ornamental fish from the Western Ghats of India	Rajesh N	1.4.2012-31.3.2016
		b) Germ cell proliferation in deficient gonads after cellular transplantation and maturation in carps.	P. Routray	1.4.2012-31.3.2016
		h) Refinement of freshwater pearl culture technology for sustainable production of pearls in confined conditions	Shailesh Saurabh	1.4.2013-3.1.3.2016
		i) Breeding and culture of tilapia for popularization and brood banking	P. Routray	1.4.2013-3.1.3.2016
4.	I-84	Aquaculture development through participatory approach		
		a) Mainstreaming gender concerns in freshwater aquaculture development-An action research	P. Jayasankar	1.4.2012-31.3.2016
		b) Development of Ornamental fish village, Landijhari and Sarauli in Deogarh district of Odisha	S. K. Swain	1.4.2012-31.3.2016
		d) Impact assessment of cat fish & Murrel aquaculture in India.	N. K. Barik	1.4.2013-31.3.2016
		e) Study of Dynamics of Aquaculture field schools.	G.S. Saha	1.4.2013-31.3.2016
5.	I-85	Feed and Nutrient evaluation in cultivable freshwater fish.	S. S. Giri	
		a) Status and impact of antioxidants in fish feeds.	K. C. Das	1.4.2013-31.3.2016
		b) Macronutrients requirement of the peninsular carp *Puntius carnaticus* fingerlings.	N. Sridhar	1.4.2013-31.3.206
		c) Improving the protein efficiency in fish diet.	K.N. Mohanta	1.4.2013-31.3.2016
		d) Detoxification and use of plant based non-conventional ingredients in carp feeds.	S.C. Rath	1.4.2013-31.3.2016
		e) Effect of some processing conditions on quality of extruded floating feed for Indian major carps.	K.C. Das	1.4.2013-31.3.2016
6.	I-86	Species Diversification in Aquaculture: Development of Sustainable Practices for Introduction of Peninsular Fishes in Culture Systems	N. Sridhar	
		a) Brood stock development, breeding and larval rearing of *Puntius carnaticus, and P. pulchellus*	N. Sridhar	1.4.2013-31.3.2016
		b) Value added products from medium and small indigenous fish species.	M. R. Raghunath	1.4.2013-31.3.2016
		c) Studies on Argulus infection pattern in peninsular carps subsequent up on their introduction to culture systems with an aim on development of prophylactic and control measures.	Hemaprasanth	1.4.2013-31.3.2016

7.	I-87	Demonstration and Dissemination of Freshwater Aquaculture Technologies for Tribal Farmers of India (TSP)	B. C. Mohapatra	1.4.2013-31.3.2016
8.	I-88	Integrated disease management of freshwater aquaculture	S. S. Mishra	
		a) Characterization of gill associated fish pathogens and their diagnosis and control measures	S. S. Mishra	1.4.2014-31.3.2017
		b) Development of biocontrol agents against important fish pathogens and their application in aquaculture	B. K. Das	1.4.2014-31.3.2017
		c) Bacterial bio-remediation of inorganic pollutants from freshwater ecosystem	N. K. Maiti	1.4.2014-31.3.2017
9.	I-89	Neuroendocrine regulation of gonadal maturation through environmental manipulation during out of breeding season in catla	Asish Saha	1.4.2014-31.3.2017
10.	I-90	Development of low cost feeds for *Macrobrachium rosenbergii* culture	P. V. Rangacharyulu	1.4.2014-31.3.2017
11.	I-91	Diversification towards sustainable development	B. R. Pillai	
		a) Development of protocol for seed production and grow out culture of some important snakeheads	Rajesh Kumar	1.4.2015-31.3.2018
		b) Standardization of grow out production technology of Pengba, *Osteobrama belangiri*	P. C. Das	1.4.2015-31.3.2018
		c) Development of captive breeding and seed rearing technique of Mahanadi Rita, *Rita chrysea*	S. Ferosekhan	1.4.2015-31.3.2018
		d) Genetic improvement of freshwater prawn *Macrobrachium rosenbergii (de man)* in India-Phase-III	B.R. Pillai	1.4.2015-31.3.2018
		e) Studies on technical and economic feasibility of integrated crop livestock fish farming system involving *Mystus gulio, E. vacha, C. reba, P. sarana* and *O. nilotics* along with carps	P.P. Chakrabarti	1.4.2015-31.3.2018
12.	I-92	Carbon sequestration and carbon footprint in some aquaculture system	S. Adhikari	1.4.2015-31.3.2018
13.	I-93	Evaluation of increasing production of safe fish with feed in sustainable waste water aquaculture	R. N. Mandal	1.4.2015-31.3.2018
14.	I-94	Evaluation of optimum stocking density for nursery raising of *Labeorohita* spawn under hapa system (multi location trail) in village of middle Gujarat	C. K. Misra	1.4.2015-31.3.2018(Collaborative)

Externally funded projects

Sl. No.	Project code	Title	Funding Agency	Pr. Investigator	Duration
1.	E-03	Application of plastics in aquaculture - plant environment control and agricultural processing (ICAR)	ICAR-All India Coordinated Research Project (AICRP) on "Plasticulture Engineering & Technologies	B. C. Mohapatra	Continuous (from May 1988)
2.	E-68	Establishment of hatchery and seed production facilities of *Pangasianodon hypophthalmus* (striped catfish in Andhra Pradesh) New title: Better management practices for stripped catfish, *Pangasiodon hypophthalamus* farming in India	National Fisheries Development Board, Hyderabad	B. S. Giri	February, 2011-28 February, 2016
3.	E-71	Development of novel immunopotentiator molecules from fish host and pathogens for broad spectrum disease control in freshwater aquaculture	ICAR National Fellow Scheme	P. K. Sahoo	8 April, 2011 -7 April, 2016
4.	E-72	Nano-technology in aquaculture: An alternative approach for fish health management and water remediation	ICAR National Fellow Scheme	P. Swain	8 April, 2011 -7 April, 2016
5.	E-76	Molecular characterization of gonadotropin and gonadotropin receptors and their regulations during photothermal manipulation of reproduction in rohu (*L. rohita*)	Science and Engineering Research Board (SERB)	Ashis Saha	April, 2012 - July, 2015
6.	E-78	Stock characterization, captive breeding, seed production and culture of hilsa (*Tenualosa ilisha*)"	National Fund for Basic, Strategic and Frontier Application Research in Agriculture (NFBSFARA)/ NASF, ICAR	D. N. Chattopadhyay (CCPI)	1 Nov 2012 - 30 Nov, 2017
7.	E-79	Periphyton enhancement - a sustainable technology for efficient nutrient utilization in seed rearing and grow-out culture of carps with special reference to the peninsular carp *Labeo fimbriatus*	DBT, Ministry of Science and Technology, Govt. of India	G. Barlaya	September 2012 - September, 2015
8.	E-80	Stock improvement and quality seed production of important freshwater carps, catfish and prawn: prerequisite for NFFBB	NFDB	K. D. Mahapatra	February 2013 - February, 2018
9.	E-81	Regulation of Kisspeptin and GnRH during reproduction in Labeo rohita under varied environmental condition (RGYI)	DBT, Ministry of Science and Technology, Govt. of India	Ashis Saha	August 2013 - July 2016

10.	E-83	Diversity and synthesis of immunoglobulin in the Indian major carps	NASF-ICAR	M. Samanta, (multi-institu. project)	April 2013 March 2017
11.	E-85	Whole Genome Sequencing and development of allied genomic resources in two commercially important fish *Labeo rohita* and *Clarias batrachus*.	Department of Biotechnology, Govt. of India	P. Das,	September 2013- September 2016
12.	E-86	National Surveillance programme on aquatic animal diseases	NFDB-NBFGR	P. K Sahoo	2013- March, 2018
13.	E-88	Carp seed production in FRP hatchery and development of integrated rearing system for livelihood development of SC/ST communities in Khurda district of Odisha	Ministry of Science and Technology, DBT	B. C. Mohapatra	15 July 2014 - 14 July 2017
14.	E-89	Assessment of the socio-economic impact of FMD and its control in India	National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI Formerly PADADMS, ICAR, Bangalore	P. N. Ananath	June 2014- March 2015 (extn upto Mar 2016)
15.	E-90	Molecular and computational approach to delineate metabolic pathways for better carbohydrate utilization in Labeo species	Network project on Agricultural Bioinformatics	J. K. Sundaray	10 November, 2014 - 31 March, 2017
16.	E-91	DBT Sponsored 3 months national training programme in molecular biology and biotechnology for fisheries professionals	DBT	J. K. Sundaray	February, 2015- February, 2018
17.	E-92	Deciphering gene structure and mechanism of *Plzf* gene expression in spermatogonial stem cells of rohu carp, *L. rohita*	Science and Engineering Research Board (SERB) under DST	H. K. Barman	March 2015 - March, 2018
18.	E-93	Intellectual Property and Technology Management (IP & TM) (renamed as " National Agriculture Innovation Foundation (NAIF)"	ICAR- NAIF	P. Swain	April, 2015 - March, 2017
19.	E-94	Adaptation and mitigation strategies in fisheries and aquaculture to climate change with special reference to freshwater aquaculture	ICAR-NICRA-National Initiative on Climate Resilient Agriculture	S. Adhikari	June, 2015-March, 2017
20.	E-95	Consortia research platform on water: CIFA component 3.2: Water budgeting and enhancing water productivity by multiple use of water in different aquaculture production system	ICAR (XIIth Plan) IIWM and CIFA ICAR- ACRP on Water	P. C. Das	December, 2015 - March, 2017

21.	E-96	National network of Germplasm centre for conservation aquaculture	ICAR (XIIth Plan) ICAR-ACRP on Biodiversity NBFGR & CIFA	P. C. Das	September 2015 - March, 2017
22.	E-97	Novel approaches towards vaccine development against argulosis in carps	ICAR (CRP on vaccines and diagnostics)	J. Mohanty	.....31.03.2017
23.	E-98	Development of vaccine against *Flavobacterium columnare*	ICAR (CRP on vaccines and diagnostics)	B. K. Das	.....31.03.2017
24.	E-99	All India network project on fish health	AINP on fish health	B. K. Das	.....31.03.2017

Outreach Project

Sl. No.	Title	Funding Agency	Pr. Investigator	Duration
1.	Outreach Activities on Fish Feed	ICAR	Dr. S.S.Giri	April 2008 - March 2017
2.	Outreach Activity on Nutrient Profiling and evaluation of fish as a dietary component	ICAR	Dr. B. N. Paul	April 2013 – - March 2017

Women Scientist Scheme (DST, Govt. of India)

Sl. No.	Title	Funding Agency	Pr. Investigator	Duration
1.	Isolation and molecular cloning **of hypoxia tolerant genes in** *Channa straitus*	Dept. of Science **and Technology, Govt. of India**	Ms. Shibani Dutta **Mohapatra (H.K. Barman: Mentor Scientist)**	2014-2017

DST-INSPIRE Scheme

Sl. No.	Title	Funding Agency	Mentor Scientist	Duration
1.	Cryopreservation of male and female germ cells of fish for transplantation	DST-INSPIRE	P. Routray	2011-2016
2.	Development of storage protocol for fish oocyte and their fertilization for seed production	DST-INSPIRE	P. Routray	2012-2017
3.	In vitro propagation of spermatogonial stem cell (SSCs) of *Clarias batrachus* and production of fertile spawns from the propagating SSCs	DST-INSPIRE	H.K. Barman	March 2014 – March 2019
4.	Factors affecting germ cell proliferation and maturation in fish	DST-INSPIRE	P. Routray	2014-2019

SUMMARY IN HINDI

२०१५-१६के दौरान मुख्य उपलब्धियाँ

वर्ष२०१५-१६मत्स्य क्षेत्र के लिए चुनौतीपुर्ण वर्ष रहा है और सीफा सभी हितधारकों के मांग को पूरा करने में सक्षम हुआ है। संस्थान नें कई संस्थागत और बाह्य वित्त पोषित परियोजनाओं में काम किया है और मुख्य उपलब्धियां इस प्रकार रहा है।

- महानदी रीटा का कैप्टीव प्रजनन और बीज उत्पादन को मानकीकृत किया गया है। अंडजनन क्षमता लगभग 9,000-12,000 अंडे प्रति १०० ग्राम शारीरिक वजन था।
- गोदाखाली, पश्चिम बंगाल के हुगली नदी में तीन प्रजनन परीक्षणों में सुखी स्ट्रीपींग विधि द्वारा सफलतापूर्वक हिलसा (*टीनुलोसा इलिशा*) का प्रजनन कराया गया।
- *मिस्टस गुलिओ* के कैप्टीव स्टॉकों को गोनाडोप्रिम इंजेक्शन के द्वारा मीठाजल में सफलतापूर्वक उत्प्रेरित प्रजनन कराया गया।
- कैप्टीव स्थिति में विशालकाय स्नेकहेड *चन्ना मारुलियस*का निषेचन और हैचिंग दरें क्रमश: ७५-८५ प्रतिशत और ६०-७० प्रतिशत के साथ सफलतापूर्वक उत्प्रेरित प्रजनन कराया गया।
- वर्तमान में आईयुसीएन रेड लिस्ट द्वारा गंभीर खतरा के रुप में वर्गीकृत मछली,*पुनटीयस पलचेलस*को क्षेत्रीय अनुसंधान केंद्र, बैंगलुरु में उत्प्रेरित प्रजनन कराया गया।
- चुनिंदा प्रजनित विशाल मीठाजल झींगा *मैक्रोब्रेकियम रोजनवर्गी* के सात पीढ़ी (जी७) के अंठावन फुल सिब फैमिली का उत्पादन किया गया। मादा में विकास गुण के लिए आनुवांशिकता अनुमान पुरुष की तुलना में अधिक था। हलांकि नर एवं महिला आनुवंशिकता के बीच उच्च आनुवांशिक संबंध भी था।
- उन्नत रोहू (*लेबिओ रोहिता*) के एकसठ फुलसिब फैमिली, कंट्रोल समूह और ऐरोमोनिएसिस के खिलाफ रोहू की प्रतिरोधी लाइन का वर्ष के दौरान उत्पादन किया गया था। संस्थान ने १८ लाख जयंती रोहू और ४ लाख कतला (*कतला कतला*) (पीढ़ी -१) को आगे की संवर्धन और प्रसार के लिए एनएफडीबी, कौशल्यागंग को आपूर्तिकिया।
- माइक्रोसेटेलाइट मार्करों के उपयोग से तिलापिया, *ओरियक्रोमिस निलोटीकस*के चार विभिन्न स्टाकों के बीच प्राप्त आनुवांशिक परिवर्तनशीलता ने संकेत दिया कि भारत में अंत: प्रजनन को नियंत्रित करने के लिए प्रजनन रणनीति को विकसित करने और तिलापिया के चयनित प्रजनन कार्यक्रमों की शुरुआत करने की संभावना है।
- रोहू की हिमकृत जर्म कोशिकाओं की ट्रांसप्लांटेशन पात्रता को उनकी व्यावहार्यता और एलोजेनिक मेजबान (*कतला कतला*) में कोलोनिजेसन क्षमता के लिए परीक्षण किया गया और 70%से अधिक जर्म कोशिकाएं व्यवहार्य पाए गए।
- एमएसीएस का अनुसरण करते हुए टीएचवाइ१+ (एक फिनोटाइपिक मार्कर) एंटीबॉडी का उपयोग के द्वारा मांगुर स्पर्मेटोगोनियल स्टेम कोशिकाए (एसएससीएस) का सफल शुद्धिकरण किया गया। टीएचवाइ१+ हल कोशिकाएं एसएससीएस की स्वयं रिन्युनिग आबादी होना प्रतीत होता है और पाया गया कि प्राकृति में सिर्फ २ प्रतिशत ही उपजाऊ थे।

- १२-१५ मीट्रिक टन/हेक्टेयर की अनुमानित उत्पादन स्तर के साथ पाकु को रोहू के साथ संयोजन में क्रमश: ७००० और ५०० संख्या प्रति हेक्टेयर की संचय घनत्व के साथ पालन किया जा सकता है।
- कार्बोहाइड्रेट की प्रोटीन स्प्रेइंग प्रभाव ने संकेत दिया कि जंयती रोहू फ्राइ का इष्टतम प्रोटीन और कार्बोहाइड्रेट (जिलेटाइनिज्ड स्टार्च) के आवश्यकता का स्तर क्रमश: 30% और 25.5% था।
- कार्प आहार में प्रोटीन उपयोग दक्षता में सुधार हेतु कार्प ग्रो-आउट पालन में आहार प्रोटीन के ईष्टतम (२५ प्रतिशत क्रूड प्रोटिन) और सह इष्टतम (२० प्रतिशत) स्तर के साथ मत्स्य को आहार खिलाने के लिए एक आहार रणनीति को विकसित किया गया
- रेन ट्री पॉड (*सामानीइया समन*) प्रोटीन और उर्जा का एक अच्छा श्रोत है जिसे कार्प के लिए एक गैर पारंपरिक आहार सामग्री के रुप में इस्तेमाल किया जा सकता है। कार्प आहार में महंगा तेल खल्ली घटक अतार्थ मूंगफली तेल खल्ली के आंशिक बदलाव करके कम लागत की प्रोटीन समृद्ध सह सामग्री के रुप में रेन ट्री पॉड को शामिल कर एक पूर्ण प्रोटोकॉल विकसित किया गया है।
- बाटा, पाबदा, पुन्टी, चन्ना, टेंगरा, वालागो, पंगस, कालबासु, रेबा और फिमब्रीएटस के पोषक तत्व की रुपरेखा को तैयार किया गया।
- १०००रोहू फ्राई के उत्पादन के लिए पानी के उपयोग पर अध्ययन से पता चला कि घटते जल गहराई के साथ सकल पानी की आवश्यकता में महत्वपूर्ण कमी (पी <0.05) का पता चला जबकि जल के आदान प्रदान और आपूर्ति के मामले में तपेदिक पानी का उपयोग विभिन्न पानी की गहराई के संबंध मे अलग नही था।
- नैनो जिंक आक्साइड १० मिग्रा /लिटर ओर २० मिग्रा/लिटर खुराक मछली, *एल.रोहिता* भ्रूण और लार्वा में विकासात्मक विषाक्तता और ऑक्सिडेटिव तनाव प्रेरित किया।
- *चन्ना स्ट्रैटस*के हाईपोक्सिया सहिष्णुता ट्रांसक्रिप्ट का पहचान और लक्षण वर्णन हासिल किया गया।
- रोहू इम्युनोग्लोबुलिन (आईजी) जेड और आईजीडी की एच (हैवी) चेन को क्लोन और सिक्वेसं किया गया।
- फुल लेंथ रोहू किस१ एवं किस२ सीडीएनएएस क्रमश: ११६ और १२५ एमिनो एसिड को इनकोड करते पाया गया। विभिन्न ऊत्तकों में दोनों जीनो की अभिव्यक्ति के स्तर से पता चला कि रोहू में मौसमी जननांगों के विकास के नियंत्रण में दो किस जीन की भागीदारी पायी गई।
- रोहू के बीपीजीएल (मस्तिक-पिट्युटरी-जनानंग-लिवर) एक्सिस में जीन विनियामक नेटवर्क (जीआरएनएस) के अध्ययन के लिए ट्रांसक्रिप्टोमिक रुपरेखा तैयार किया गया। ट्रिनिटी में कुल ४४०६६५ ट्रांसक्रिप्ट उत्पन्न किया गया। न्युनतम कोटिंग लेंथ २०१ बीपी और अधिकतम १९३३१ बीपी था। ऊत्तक विशिष्ट जीआरएनएस में मस्तिष्क, पिट्युटरी , जनांनग और लिवर ऊत्तकों में क्रमश: २१, ३६, ४६ और २५ हब जीन की पहचान की गई।
- रोहू के पूर्ण जीनोम डेटा को सीएलसी बायो के साथ साथ एबायस सॉफ्टवेयर का उपयोग कर इकट्ठा किया गया परिणामस्वरुप क्रमश: ५६.४ प्रतिशत और ७६ प्रतिशत जीनोम कवरेज था जबकि मांगुर के लिए संबंधित जीनोम कवरेज ८० प्रतिशत और ८७ प्रतिशत था।

- *आरगुलस सियामेनसिस* संक्रमण के बाद *एल.रोहिता* के म्यूकस में प्रतिरक्षा प्रासंगिक जीन के ट्रांसक्रिपसनल विश्लेषण प्रतिरक्षात्मक हस्तक्षेप से परजीवी के खिलाफ नियंत्रन के तरीकों के विकास के लिए जल्दी अंतरदृष्टि प्रदान करता है।
- कार्यात्मक लक्षण वर्णन एपोलिपोप्रोटीन ए- I (एपीओए-I) से इसकी व्यापक स्पेक्ट्रम रोगाणुरोधी गुणों का पता चलता और बाह्य परजीवी संक्रमण के दौरान महत्वपूर्ण भूमिका का संकेत दिया। रोहू में *एरोमोनास हाइड्रोफिला* संक्रमण के खिलाफ एक संभावित इम्युनोएस्टिमुलेंट के रुप में इस्तेमाल किया जा सकता है।
- जीवाणु से निरोधात्मक यौगिकों की स्क्रीनिंग से स्पष्ट है कि *क्लोस्ट्रिडियम बाइफरमेनटस*सीपीएसएस२ के पूर्ण और इंटरासेलुलर प्रोटीन मीठाजल कृषि के क्षेत्र में आम मत्स्य रोगजनक के खिलाफ होनहार जैव नियंत्रण एजेंट में से एक हो सकता है।
- राष्ट्रीय निगरानी कार्यक्रम के तहत प्रमुख रोगों अतार्थ आरगुलोसिस, अन्य परजीवी संक्रमण जैसे ट्रिकोडिना प्रजाति. डेक्टिलोगयरस प्रजाति, मिक्सोबोलसद प्रजाति, लरनिया प्रजाति और जीवाणु रोग *प्लेसिओमोनास शिगीलोआयडस*के कारण ओडिशा और आंध्र प्रदेश में दर्ज किए गए।
- एक प्रोटोटाइप मछली वेंडिंग गाड़ी स्वच्छ तरीके से एक दिन मे बाजार में मछली की अधिक मात्रा (१०० किग्रा) को बेचने के लिए विकसित किया गया है।
- एफ आर पी हैचरी में कार्प बीज उत्पान और एकीकृत मत्स्य पालन प्रणाली का विकास ओडिशा के खोर्धा जिला में अनुसूचित जनजाति समुदायों के आजीविका विकास में २५ लाख आईएमसी फ्राई और १.५ लाख कॉमन कार्प फ्राई का उत्पादन कर सफल रहा है।
- मरैल और कैटफिश के लिए ओडिशा, असम और त्रिपुरा जैसे राज्यों में प्रौद्योगिकियों को अंगीकरण में एक बढ़ती हुई प्रवृति पायी गई।
- केवीके , खोर्धा ने ओडिशा के खोर्धा और अन्य जिलों में २०४७ लाभर्थियों के लिए कुल ८८ गतिवियां चलाई गई जिसमें ओएफडी, एफएलडी और प्रशिक्षण भी शामिल है। इसके अलावा १००० मृदा कार्ड केवीके और पारादीप फॉस्फेटस लिमिटेड द्वारा संयुक्त रुप से तैयार कर इस अवधि के दौरान कृषक समुदाय को वितरित किए गए।
- कुल २७ प्रशिक्षण कार्यक्रम को संस्थान में मत्स्य प्रजनन, जलियकृष , आनुवांशिक और आणविक जीव विज्ञान के विभिन्न पहलुओं में हितधारकों एवं उद्यमी के लिए चलाए गए और ४२५ हितधारकों लाभान्वित हुए।
- भारत में प्रथम उत्प्रेरित मत्स्य प्रजनन के योगदान को चिंहित करने के लिए संस्थान ने १० जुलाई, २०१५ को अंगुल, ओडिशा के जिला प्रशासन के द्वारा अंगुल मत्स्य प्रक्षेत्र को राष्ट्रीय विरासत स्थल के रुप में घोषित करने की पहल की।
- संस्थान ने दो आसपास के जिलों खोर्धा और पुरी के ७५ गांवों में मेरा गांव मेरा गौरव योजना को लागू किया ।

MERA GAON MERA GAURAV SCHEME

ICAR- CIFA is implementing the Mera Gaon Mera Gaurav Scheme in two adjacent districts viz., Khordha and Puri. Groups of Scientists (four scientists/group) would implement the scheme in five adjacent villages. Fifteen groups was formed adopting 75 villages in the target area. Besides, the Scientists working in the Regional Research Centres have selected further 25 villages for implementing the scheme. The implementation will be in a phased manner of having a visit in month and progression of activities would be based on problems identified and development interventions designed. The scheme was launched on 3rd Sept., 2015 at this Institute. All the 20 groups of scientists (at HQ and RRCs) visit their villages regularly and update the villages about new farming practices, varieties and Government schemes. Forging convergence with line departments/KVK/banks/SHGs/NGOs etc. was being emphasized for implementation of the scheme. Need based interventions were also being made by the team of scientists in their selected villages. Kisan gosthis were organized at Astarang, Puri on 1 Dec 2015 and on 22 Jan 2016 at Sarat, Khurda.

The Institute organized a "*Kissan Gosthi*" at Barapada, Astarang, and Puri in collaboration with ICAR-CMFRI, Puri Field Centre and District Administration, Puri on 01 December, 2015. More than 340 participants including 250 farmers and farm women from Asana, Naiguan, Barapada, Derunia, Athatira, Astarang and Alasahi participated in the "*Kissan Gosthi*" programme. Shri Pradipta Kishore Satapathy, Project Director, DRDA, Puri, inaugurated the *Kissan Gosthi*. Practical problems of farmers in agriculture, horticulture, fisheries, livestock management etc. were addressed by the resource persons from ICAR-CIFA, ICAR-CMFRI, district officials of Puri & other line departments, banks, agencies like Reliance Foundation Mumbai, Godrej Agrovet Ltd. Kolkata and other stakeholders.

Dr. P. Jayasankar, Director, ICAR- CIFA in his presidential address mentioned the importance of the programme *Mera Gaon Mera Gaurav* launched by the Hon'ble Prime Minister of India in order to have direct interaction of farmers with the scientists of ICAR and Agriculture Universities in the field. The concerned scientists would provide information on farming technologies, crop varieties, market price, weather forecast etc. ICAR-CIFA has adopted 75 villages in Khordha and Puri districts under the scheme. The scientists of CIFA have demonstrated liming, stocking of *Jayanti* Rohu seeds in community pond, feed preparation etc. and explained to the farmers the benefit of scientific fish rearing. Dr. Reeta Jayasankar, scientist-in-charge, ICAR-CMFRI, Puri Field Centre, has given some initiatives in community forestry in 700 acres flood affected village of Asana, inland aquaculture and cage farming in Devi river which is connected to the sea. Six progressive farmers were felicitated for their successful adoption of scientific farming practices. Among others who spoke were Smt. Kalyani Pattnaik, BDO, Astarang; Swadhin Kumar Nayak, Chairman, Astarang and scientists from ICAR-CIFA.

Under the "*Mera Gaon Mera Gaurav"* a 'Field Day in Paddy' (under BGREI(Bringing Blue Revolution to Eastern India) was conducted in collaboration with ICAR-IIWM, Bhubaneswar, KVK-Khordha and state Dept. of Agriculture, Balipatna at Sarat Village, Balipatna Block, Odisha on 22 January 2016. About 300 farmers including farm women from Sarat, Taradapada and Darbanga village participated in the training programme. The programme was inaugurated by Chairman, Mr Sashibhusan Patra, Balipatna Block in presence of Mr Brajaraj Jena, Sarpanch, Pampalo, Dr Bindu R. Pillai, HoD, APED, ICAR-CIFA; Dr S. Mohanty, Sr. Scientist, ICAR-IIWM, Dr P. N. Ananth, Sr. Scientist & PC, KVK- Khordha and Mr. K. N. Jena, DDA, Khordha. In the technical session, Dr P. C. Das, Pr. Scientist, ICAR-CIFA gave a detailed talk in Odiya on "Fish production in community ponds"; Dr. Mousami Ray Chaudhary, Pr. Scientist, ICAR-IIWM explained about "soil health management"; Mr. A. K. Dash explained about "preparation and use of by-products in Agriculture". After that a farmers-scientists interaction was conducted in which practical problems of farmers in fisheries, agriculture, horticulture, soil and water management etc. were addressed by the resource persons from ICAR-CIFA, ICAR-IIWM, KVK-Khordha and district agriculture officials of Khordha.

CIFA

SWACHH BHARAT ABHIYAN

ICAR – CIFA has implemented the national pledge "Swatch Bharat Abhiyan" actively during the year 2015-16. All the staff members were enthusiastically participated in this initiative with a motto to keep our environment clean and tidy. Staff members voluntarily devoted at least six hours a week to clean, the campus & premises. With specific two goals such as towards "Zero Plastic Zones" and Green Manures, staffs were sensitized to reduce the plastic usage and complete removal of plastics from the campus as well as the farm wastes were recycled to produce "Green Manures". This not only keeps the environment clean but it develops the awareness among all on the benefit of the clean environment. The program was monitored by the Dr P. Jayasankar, Director, ICAR-CIFA and Dr S.C. Rath, Principal Scientist & Dr J.K. Sundaray, Principal Scientist were served as the coordinators for the program and Mr I. Sivaraman, Scientist & Dr D.K. Verma, Technical Officer were the Co-coordinators for the program.

SUPERANNUATIONS

- Sri Banamali Mallick, SSS w.e.f. 31 August, 2015.
- Sri B. B. Pandit,SSS w.e.f. 31 August, 2015.
- Sri P. K. Nayak, SSS w.e.f. 30 September, 2015.
- Sri Chandramani Muduli, SSS w.e.f. 30 November, 2015.
- Mrs Sandhyarani Ghosh, SSS w.e.f. 31 December, 2015.
- Sri B. K. Behura,T-5 (Driver) w.e.f. 29 February, 2016.
- Sri Paresh Samanta, SSS w.e.f. 29 February, 2016.
- Sri Trinath Pradhan, SSS w.e.f. 29 February, 2016.
- Sri Resam Bahadur, SSS w.e.f. 29 February, 2016.
- Basudev Routray, SSS w.e.f. 29 February, 2016.

APPOINTMENTS

- Sri Dilip Kumar Singh (Fish Nutrition) w.e.f. 1 April, 2015.
- Sri Avinash Rambhau Rasal (Fish Genetics & Breeding) w.e.f. 7 April, 2015.
- Sri Sunil Kumar S. Ail (Fisheries Resource Management) w.e.f. 9 April, 2015.
- Mrs Pushpa Choudhury (Fish Helath) w.e.f. 10 April, 2015.
- Mrs Jesna P. K. (Aquaculture) w.e.f. 10 April, 2015.
- Sri Ajmal Hussain (Fisheries Resource Management) w.e.f. 10 April, 2015.
- Sri Lokanath Senapati, Assistant joined the Institute on 2 June, 2015 on transfer from ICAR-CTRI, Rajahmundry.
- Sri K. C. Das joined as Senior Administrative Officer w.e.f. 19 August, 2015
- Mr Siddaiah G.M., Scientist (Fish Nutrition) joined ICAR-CIFA on 12 October, 2015 on transfer from ICAR-CIFT, Kochi.






CIFA in News

ମାଛ ଉତ୍ପାଦନ ୧୩% ବୃଦ୍ଧି

'ସିଫା'ରେ ରାଜ୍ୟସ୍ତରୀୟ କର୍ମଶାଳା ଉଦ୍‌ଘାଟିତ

ଅନୁଗୋଳରେ ଜାତୀୟ ମତ୍ସ୍ୟଚାଷୀ ଦିବସ

CIFA honours dc of Indian fisherie

ಮೀನು ಉತ್ಪಾದನೆಯ ಅಧಿಕರಿಕ್ಕಬಹುದು

ಸಿಫಾದಲ್ಲಿ "ಬಹುಜನ್ಯ ಎಫ್.ಆರ್.ಪಿ. ಕಾರ್ಪ್ ಹಾಚ್ ಮತ್ತು ಪರಿಚಾಲನಾ" ಇದರ ತರಬೇತಿ ಕಾರ್ಯಕ್ರಮ ಉ

ગામ તળાવોમાં 'જયંતી રોહુ' માછલીના ઉછેર અંગેનું નિદર્શન યોજાયું

Portable hatcheries tech promotes blue revolution

BY USING NEW TECHNOLOGY, FISH FARMERS ARE GETTING HIGH-QUALITY SEEDS IN ABUNDANCE

BENEFITS OF FRP CARP TECH

- Light weight so plastic is used in hatcheries
- Easy to install, operate and repair
- Less water consumption in breeding, spawn production
- Requires less space for installation
- Durable for at least 15 years

State produced 4.6L onne fish in 2014-15

FA, Fisheries pt to draw plan double output in five years

ମୀଠାଜଳ ଜଳୀୟ କୃଷି ପର ପ୍ରଶିକ୍ଷଣ କାର୍ଯ୍ୟକ୍ରମ

Training on advanced aq

CIFA

RESEARCH LOCATIONS

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(Indian Council of Agricultural Research)

(An ISO 9001:2008 Certified Institute)

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