ICAR-CIFA ANNUAL REPORT 2016-17

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ICAR

Annual Report
2016-17

CIFA

ICAR-CENTRAL INSTITUTE OF FRESHWATER AQUACULTURE

(An ISO 9001:2008 Certified Institute)

Kausalyaganga, Bhubaneswar-751 002, Odisha, India

ANNUAL REPORT

2016-17

ICAR-CENTRAL INSTITUTE OF FRESHWATER AQUACULTURE

(An ISO 9001:2008 Certified Institute)

(*Indian Council of Agricultural Research*)

KAUSALYAGANGA, BHUBANESWAR 751 002, ODISHA, INDIA

ICAR-CIFA
Annual Report
2016-17

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PREFACE

Greetings from Team ICAR-CIFA!

ICAR-CIFA has completed 30 years of its eventful journey in research and development activities related to aquaculture in India. The year 2016-17 was remarkable in terms of the works carried out on research, technology transfer and capacity building of different stakeholders. In the research front, captive breeding of hilsa, *Tenualosa ilisha* and its seed production was successfully accomplished which is of a national concern. Works on the risk analysis of introducing Pacu (*Piaractus brachypomus*) were carried out and reported. The Institute has made significant headway in breeding and seed rearing of non-conventional species *viz*., *Channa marulius, Mystus gulio, Anabas testudineus* and many others. Under selective breeding programme, generation 8 (G8) freshwater prawn (*Macrobrachium rosenbergii*) was produced exhibiting higher growth which is another milestone. Germ cells of Indian major carps were successfully isolated and DMSO as a cryoprotectant was found to give more than 70% viable GCs of rohu at concentration of 5-7.5% compared to other cryoprotectants. The Institute has completed mitochondrial genome sequencing of 15 commercially important freshwater species. *Plzf* gene promoter (Promyelocytic Leukemia Zinc Finger), a stem cell self-renewing marker gene of *Clarias batrachus* was characterized. A fry feed for rohu 'CIFAGROW2' was formulated and successfully tested which will be ready for commercialization. Out of 104.75 lakh '*Jayanti*' spawn produced during the year, 47.75 lakh were provided to six different districts of Odisha and 46 lakh to eight different states of India. Emerging bacterial fish pathogens like *Proteus mirabilis*, *Klebseilla pneumoniae*, and *Acinetobacter baumannii* were recorded and reported from outbreak cases. In addition to these two myxosporidean parasites *viz*., *Zschokkella auratis* and *Thelohanellus qadrii* were identified from fish. Further, two more new emerging viruses *i.e.,* CyHV-2 and carp edema virus from goldfish and koi carp, respectively were reported under National Surveillance Programme.

The Research Advisory Committee (RAC) headed by Dr A. G. Ponniah, former Director, ICAR-CIBA, Chennai reviewed the Institute's research activities and laid stress on technology packaging and dissemination to satisfy the mandates of the Institute. Work on metagenomics, matrix of technology development and nutrient dynamics suggested by RAC were duly attended to open new areas of research and development to be undertaken. The Institute organized a timely national seminar on the topic of aquaculture diversification during 1-3 December, 2016 which was attended by 250 participants across the country. Much emphasis is given by the Institute on species and system diversification with the aim of standardizing production systems for various stakeholders including farmers with limited resources.

Shri Dharmendra Pradhan, Hon'ble Union Minister for Petroleum and Natural Gas visited the Institute and its facilities on 3 September 2016. The Institute hosted 23rd Zonal Workshop of KVKs (Zone VII comprising Madhya Pradesh, Chhattisgarh and Odisha). This workshop aimed at providing a platform to strengthen linkage with research on one

hand and frontline extension on the other through the KVKs of the Zone VII.

The Institute is implementing development projects like Mera Gaon Mera Gaurav; Swachh Bharat; Farmers FIRST, Tribal Sub-Plan, Soil Health Card Scheme, Sansad Adarsh Gram Yojana, Cluster Demonstration of Oil seeds and Pulses and many others. The Institute has established its ambitious fifth Regional Research Centre at Bhatinda, Punjab and has started functioning with a set of mandate. A week-long celebration of *'Jai Kisan Jai Vigyan'* was observed by organizing various activities.

In order to boost implementation of official language in day-to-day activities, Hindi Pakhwada was observed. Sustainable livelihood development of tribal and disadvantaged communities has been one of the thrust areas of CIFA's R&D wing. The Institute has worked in several under-developed regions of Gujarat, Odisha, West Bengal, NEH states, Maharashtra, Chhattisgarh, etc. under few sponsored projects such as TSP and NEH, and has significantly contributed towards empowerment of poor through aquaculture interventions. The Institute organized Tribal Farmers' Mela at Kalyani, West Bengal (ICAR-CIFA's Field Station) where it showcased its technologies and products and generated awareness amongst 400 farmers, hailing from different North East Region. Sri S S Ahluwalia, Hon'ble Union Minister of State for Agriculture & Farmers' Welfare and Parliamentary Affairs, graced the Mela and appreciated the efforts of the Institute towards mainstreaming tribal communities.

Developing strategy for doubling farmers' income by the year 2022 is currently our set target and in association with other ICAR Institutes and Odisha University of Agriculture and Technology, Bhubaneswar the Institute has been working to achieve it. During this reporting period Agri Business Incubation (ABI) Unit of ICAR-CIFA has provided support to 37 entrepreneurs in developing business plans, securing credit and establishing business venture. KVK-Khordha under the administrative control of ICAR-CIFA in 2016-17 extensively worked on cluster demonstration of oil seeds and pulses covering an area of 180 ha benefitting 450 farmers in the district. Through adaptive trial results Purnobhog and PUSA 1612 have been identified as the best scented rice varieties with a production of 4.26 t/ha and 5.70 t/ha for Khordha district. With the support of Coconut Development Board, KVK trained 173 rural youths under the friends of coconut tree training programme focusing on employability (Coconut climbing machine) and advances in coconut cultivation.

The editorial committee headed by Dr P K Sahoo has done commendable job in bringing out the ICAR-CIFA Annual Report (2016-17) on time. Team CIFA is grateful to Dr T. Mohapatra Secretary, DARE and Director General, ICAR for his guidance and motivation in carrying out high quality research and forging linkage with stakeholders to take the development agenda forward. I am also thankful to Dr J. K. Jena, DDG (Fisheries Science), Dr S. Raizada, ADG (Inland Fishery) and Dr P. Pravin, ADG (Marine Fishery) of ICAR, New Delhi for their support and encouragement towards development of worthy technology packages and providing technical backstopping to the sector.

I expect that the forthcoming years for ICAR-CIFA will be fruitful to carry out research and development activities that are highly country specific and to accomplish the government's target of doubling farmers income by 2022 and the envisaged Blue Revolution.

Jitendra Kumar Sundaray
Director (Acting), ICAR-CIFA

CONTENTS

MANDATE

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

VISION

Making Indian freshwater aquaculture globally competitive through eco-friendly and economically viable fish production systems for livelihood and nutritional security

MISSION

Excellence in research for developing sustainable and diversified freshwater aquaculture practices for enhanced productivity, quality, water use efficiency and farm income

CIFA

Annual Report

2016-17

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 - 388 001, Gujarat

v) Regional Research Centre
Fish Market Complex, Jodhpur Romana,
Bathinda - 151 001, Punjab

c) KVK

Krishi Vigyan Kendra (Khordha)
Kausalyaganga, Bhubaneswar - 751 002,
Odisha

2. Budget (2016-17)

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
685.50	685.45	2524.00	15.00	2539.00	2511.19	15.00	2526.19

b) External sources (Rs. in lakhs)

Source	Amount
BTIS	Nil
Pension & other retirement benefits	155.37
ICAR/APA/IPR/NFBSFARA/KVK/NAIP (Plan Scheme)	256.71
Non-plan Scheme	97.74
P Loans & Advances	3.90
Externally funded projects	278.28
Total	792.00

c) Revenue generated (Rs. in lakhs)

Source	Amount
Farm produce	4.53271
Sale of fish and poultry	7.13404
Sale of vehicle/other machine tools	-
Sale of publications	-
Licence fee/water charges	-
Analytical testing fee	0.86000
Cost of tender forms	-
Services render	2.23100
Training	15.30444
Miscellaneous	17.53738
Interest on loans and advances	7.65015
Interest on TDR	21.61325
Others (Royalty, & Inst. Charges)	0.30850
Total	76.97147

3. Staff position (as on 31.3.2017)			
Category (Scientific)	Sanctioned	In Position	Vacant
Director	1	0	1
Head of Division	4	4	0
Principal Scientist	1	0	1
Sr. Scientist	10	09	1
Scientist	62	63	-1
Total	78	76	2
Category (Technical)	Sanctioned	In Position	Vacant
Sr. Tech. Officer	4	0	4
Tech. Asst.	23	13	10
Sr. Technician	3	3	0
Technician (including Driver)	21	13	8
Total	51	29	22
Category (Administrative)	Sanctioned	In Position	Vacant
Sr. AO	1	1	0
AO	1	1	0
F & AO	1	1	0
AAO	5	4	1
AF & AO	1	1	0
Security Officer	1	1	0
Private Secretary	1	1	0
Personal Assistant	3	3	0
Assistant	10	5	5
Upper Division Clerk	6	6	0
Jr. Steno-III	1	0	1
Lower Division Clerk	6	3	3
Total	37	27	10
Category (Skilled Support Staff)	Sanctioned	In Position	Vacant
SSS	120	76	44
Staff position of KVK, Khordha (as on 31.3.2017)			
Category	Sanctioned	In position	Vacant
Programme Co-ordinator	1	1	0
Subject Matter Specialist	6	3	3
Programme Assistant	3	2	1
Driver	2	2	0
Assistant	1	1	0
Jr. Steno-III	1	0	1
SSS	2	2	0
Total	16	11	5

4.	Research Projects		
a)	Institute-based	12	
b)	Externally-funded	28	
c)	Outreach activities	03	
d)	DST Women/DST Inspire Schemes	05	
5.	Training programmes conducted		
	Level	No. of programmes	No. of participants
	National	38	875
	International	01	01
	Total	39	876
6.	Manpower development		
	a) No. of persons trained at national level	128	
	b) No. of persons trained at international level	Nil	
7.	Workshops organized		
	National	11	
	International	Nil	
8.	Participation in symposia/seminars/workshops, etc.		
	Level	No. of participants	
	National	51	
	International	Nil	

9. Infrastructure development

- Construction of road adjoining office and guest house
- Construction of kitchen and dining hall facilities for farmers training center (civil & electrical) at RRC of ICAR-CIFA, Bengaluru
- Renovation of nursery ponds (15 nos, 20 m x 20 m) with desilting and dyke making under CRP-Water Project
- Renovation of field lab facility for seed rearing tanks and hatchery system under CRP-Water Project
- Making of a Technology Park multi-purpose shed under ABI project

10. Salient Research Achievements

- Successful breeding and culture of *Mystus gulio*, and maturation and captive breeding of the giant snakehead, *Channa marulius* were achieved.
- For the higher growth rate and survival of Mahanadi rita larvae in indoor condition, stocking of 2-3 larvae/l has been recommended.
- Under the selective breeding programme, generation 8 (G8) freshwater prawn *M. rosenbergii* has been produced for higher growth.
- A study suggests that *L. vannamei* culture in freshwater is not a viable option without addition of salt/minerals.

- Successful production of designer pearl from freshwater mussel in the farmer's pond at Balasore, Odisha and and KVK, located at Chitrakoot, Uttar Pradesh, respectively, were being undertaken.
- Biometric characterization of *Lamellidens marginalis* was established.
- Soil carbon storage and carbon foot print analysis of few aquaculture systems were carried out.
- Carp breeding, seed rearing and grow-out culture have been demonstrated in four blocks of Khordha District of Odisha under the livelihood development programme for SC/ST communities.
- The suitable temperature ranges for tilapia culture was derived; adaptation and mitigation strategies of climate change impact in freshwater aquaculture in some states of India are being looked into.
- Water exchange levels of 90% and 80% were found to be ideal for nursery and fingerling phases of carp seed production, respectively, in concrete seed rearing system.
- Continuous 28 h aeration with 28 h water flow has given significantly higher hatching percent (86%) in magur hatchling production.
- For the nursery rearing of *Anabas testudineus,* the stocking density of spawn at 10/l was found to be optimum.
- Germ cells of IMC were successfully isolated, and DMSO was found to give more than 70% viable GCs of rohu at concentration of 5-7.5% as compared to other cryoprotectants.
- Unfertilized matured oocytes (eggs) of rohu can be stored *in vitro* for 180 min without compromising the viability (fertilization and hatching) to a great extent in carp ovarian fluid (OF) and artificial carp ovarian fluid (ACOF).
- Identification of heterozygous SNPs may not be a suitable method for SNP marker discovery in aquaculture species.
- In total, 0.2 and 0.26 million of SNPs were identified in rohu and *M. rosenbergii*, respectively, along with 1,85,851 SSRs in *M. rosenbergii.*
- Towards enrichment of linkage map in rohu, 214 out of 770 SSR loci were found to be informative. Similarly, in magur, 203 informative loci were fluorescence labeled and genotyping for 115 loci in magur mapping family was completed.
- Complete mitochondrial genome sequences of 15 commercially important freshwater species were deciphered.
- *Plzf* gene promoter (Promyelocytic Leukemia Zinc Finger), a stem cell self-renewing marker gene of *C. batrachus* was characterized.
- The competitive inhibition of haemagglutination activity in serum samples of *M. rosenbergii* were evaluated with various sugars and glycoproteins, and only N-acetylneuraminic acid and fetuin were found to inhibit the HA activity at a minimum inhibitory concentration of 50 mM and 0.31 mg/ml, respectively.
- Out of 104.75 lakh "Jayanti" spawn produced during the year, 47.75 lakh spawn were disseminated to six different districts of Odisha and 46.00 lakh spawn disseminated to eight different states of India.

- CIFABROOD™ diet enhanced phenotypic and gonadal maturation of Jayanti rohu, and facilitated better spawning and growth of the larvae.
- The optimum protein and lipid requirements of *Osteobrama belangeri* fingerling were found to be 35% and 8%, respectively.
- A feed for rohu fry 'CIFAFRY' was developed.
- A strain of *Enterobacter cloacae,* CF-S27 significantly maintained undetectable amount of dissolved nitrogen throughout 30 days of zero water exchange prawn culture in laboratory condition.
- Lysozyme G gene and its recombinant protein were functionally characterized in rohu.
- Dietary ZnO and Se nanoparticles in rohu were found to be immunomodulatory in nature.
- B-cell activating factor (BAFF) gene of rohu was cloned and characterized showing its important role in immunoglobulin M (IgM) synthesis.
- Emerging bacterial fish pathogens *viz., Proteus mirabilis*, *Klebsiella pneumoniae*, and *Acinetobacter baumannii* were recorded and reported from outbreak cases. Also two myxosporidean parasites *viz., Zschokkella auratis* and *Thelohanellus qadrii* were identified from fish. Further, two new emerging viruses i.e. CyHV-2 and carp edema virus from goldfish and koi carp, respectively were reported under the National Surveillance Programme.
- Under the National Agriculture Innovation Foundation, three patents were obtained and two more were filed.
- Impact assessment of murrel and catfish aquaculture in India was studied.
- AFS as a model of farmer to farmer extension was looked into.
- Plastic based aquaculture gadgets *viz.,* acrylic respirometer, mobile fish vending trolley, nutrient film technique (NFT) aquaponics system, floating nurseries, etc. were developed and their efficacies in aquaculture systems are being looked into.
- Attempts have been made towards successful rearing of larvae of hilsa and its culture in freshwater pond.
- Risk analysis studies on pacu suggest low to moderate risk with regard to its introduction in Indian culture systems.
- During the period, 43 training programmes on different aspects of aquaculture, 27 field days, and 90 groups of farmers' visits were organized at this Institute.
- KVK in 2016-17 extensively worked on cluster demonstration of oil seeds and pulses covering an area of 180 ha benefitting 450 farmers in the district.
- Through adaptive trial results Purnobhog and PUSA 1612 have been identified as the best scented rice varieties with a production of 4.26 t/ha and 5.70 t/ha, respectively.
- With the support of Coconut Development Board, KVK trained 173 rural youths under the friends of coconut tree training programme focusing on employability (Coconut climbing machine) and advances in coconut cultivation.

1. 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 modest 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 in 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 in the country comprising over 380 ponds of assorted sizes and yard facilities 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 five 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); Regional Research Centre, Anand (Gujarat) and Regional Research Centre, Bathinda (Punjab).

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 organizations like Department of Animal Husbandry, Dairy and Fisheries (DAHD&F) and National Fisheries Development Board (NFDB) of Government of India.

ICAR-CIFA ORGANOGRAM

DIRECTOR

DIVISIONS AT HEADQUARTERS

- Aquaculture Production and Environment Division
- Fish Nutrition and Physiology Division
- Fish Genetics and Biotechnology Division
- Fish Health Management Division
- Social Sciences Section

AUXILIARY SERVICES

- Director's Cell
- Administrative Section
- Accounts and Audit Section
- Stores Section
- Library and Documentation Section
- Computer Section
- Vehicles Section
- PME Cell

- KVK, Khordha, Odisha

CENTRES

- Regional Research Centre, Rahara and Field Station, Kalyani, West Bengal
- Regional Research Centre, Vijayawada, Andhra Pradesh
- Regional Research Centre, Bengaluru, Karnataka
- Regional Research Centre, Anand, Gujarat
- Regional Research Centre, Bathinda, Punjab

RESEARCH ACCOMPLISHMENTS

A. Aquaculture Production and Environment

Project Title	:	Sustainable freshwater aquaculture
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 2017
Project Personnel	:	Shailesh Saurabh (PI), Rajesh Kumar, S. Adhikari, J. Mohanty, S. Pradhan and U. L. Mohanty

Length-weight, width-weight and height-weight relationship of cultured freshwater pearl mussel, *Lamellidens marginalis* (Lamarck)

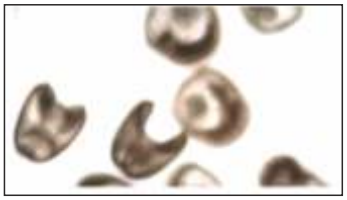
Lamellidens marginalis is one of the important candidate species for freshwater pearl production in India. In the present study, the length-weight, width-weight and height-weight relationship of freshwater mussel, *L. marginalis* were examined from January, 2015 to September, 2016. Monthly sampling was carried out and a total of 1015 samples were collected for the study. The length-weight, width-weight and height-weight relationships were $W= 0.0007L^{2.4908}$, $W = 0.0236L^{2.2675}$ and $W = 0.0103L^{2.225}$ whereas, the values of 'r' were estimated as 0.770, 0.739 and 0.676, respectively. The values of 'b' indicated the relative growth in body weight and superior physiological condition of the mussel. The relationship between length-weight, width-weight and height-weight was positive allometric and correlation was observed in length-weight and width-weight relationship.

Bio-diversity of pearl mussels in Terai region of Eastern Himalaya, India

A study was conducted on the Terai region of Eastern Himalayas, West Bengal, India. A total of 20 species belonging to two genus *Lamellidens* and *Parreysia* were recorded. The most dominant species among genus *Lamellidens* and *Parreysia* were *L. marginalis* and *P. triembolus*, respectively. Among the above observed bivalves species, *Lamellidens consobrinus* (L=11.2 cm, D=5.6 cm) was the largest in size and *Parreysia lima* (L=2.8 cm, D=1.5 cm) being the smallest. The results revealed that 6 species were Data Deficient and 14 species were considered as Lower Risk Least Concern. Also, the study revealed that 6 species were of relative abundance (+++) such as *L. marginalis, L. jenkinsianus obesus, L. corrianus, P. triembolus, P. favidens, P. favidens assamensis* and 5 species were of very less abundance (+) in the study areas and these included *L. jenkinsianus daceaensis, L. lenkinsianus, P. bonneaudi, P. pachysoma and L. phencoganjensis.* Although its abundant food value, several wild populations of bivalves have been suffering in vast reduction. Therefore, awareness programmes amongst the fishermen and local people needs to be developed to restrict its illegal collection of bivalves from rivers and water bodies.

Breeding of freshwater mussel, *L. marginalis*

An attempt was made to breed freshwater mussel, *L. marginalis* in captivity by environmental manipulations. The female mussels were



Glochidia Larvae

kept in a tub and chilled de-chlorinated water was added to it. The release of glochidia was usually observed within 1 h as water temperature raise to room temperature. The viable glochidia were observed under the light microscope.

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 2017
Project Personnel	:	P. Routray (PI), P. K. Meher, B. C. Mohapatra, N. K. Barik, C. K. Mishra, K. C. Das, G. M. Siddaiah, P. K. Patil and D. K. Verma

Culture of tilapia, *Oreochromis niloticus* was conducted in homestead and urban settings using six 1300 L circular tanks with minimal exchange of water up to 20% per week. Fingerlings of sex-reversed tilapia with mean weight of 30-40 g were stocked in these tanks with a stocking density of 40, 50 and 60/m^3, respectively. Water treatment methods consisted of aeration, water circulation (mixing), solids removal and nitrification in the water column. The fish were fed with *ad libitum* (28% protein) twice a day with a floating pellet. The stock assessment for overall biomass was done after completion of 180 days. A total production of 9.9 kg, 10.2 kg and 11.2 kg (weighing 200-300 g) were obtained from 1.3 m^3 water tanks with stocking densities of 40, 50 and 60 fingerlings, respectively. The FCR was found to be 1.4:1. The key to the success of these small aquaculture systems lies with the water filtration and purification systems. The nitrate-nitrogen concentration increased throughout the trials and reached 650 and 709 mg/l (after 7 days without exchange of water) in trials 1 and 2, respectively, which indicated a high rate of nitrification and the need for a denitrification treatment process to be added to this closed system. Removal of total suspended solids (TSS) through external filtration system improved the other water parameters and fish feeding response. A production of nearly 10 kg to a family in a year obtained in this experiment is an example that will add to the animal protein supplementation of Indian population besides increasing the per capita availability of fish.

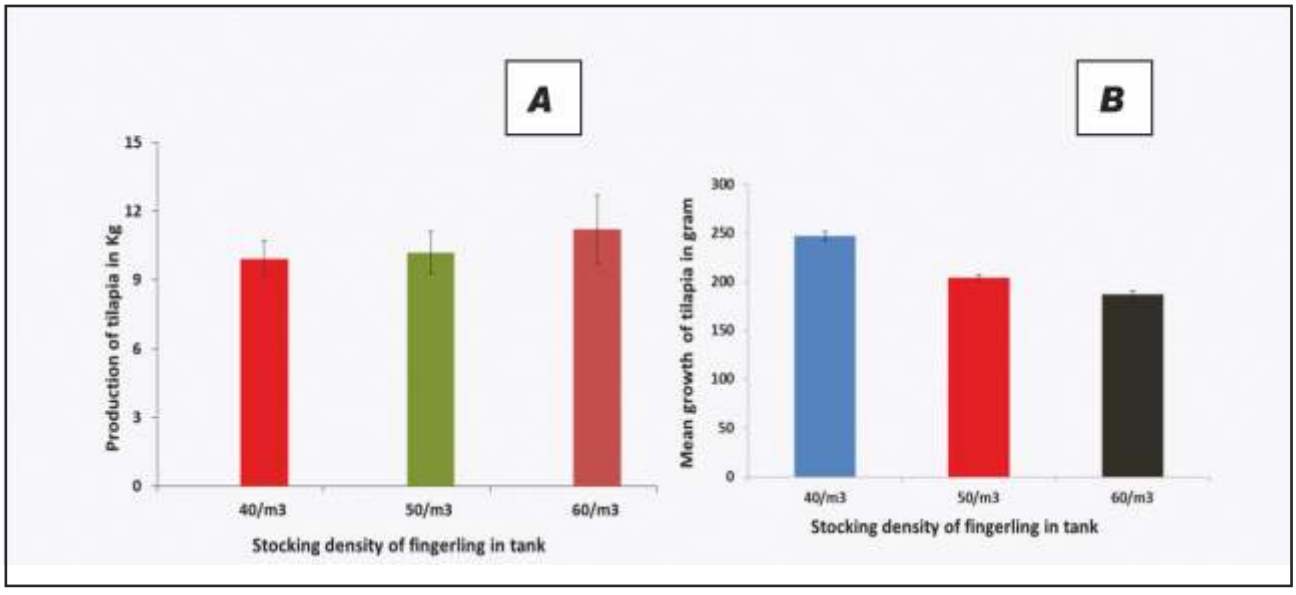


Fig. 1. Growth and production of tilapia, *O. niloticus*, A: total biomass harvested; B: mean growth achieved under different stocking densities. n=20.

Genetic variation in four populations of tilapia, *O. niloticus* using homologous primers

Genetic variations were checked using homologous microsatellite markers at seven loci (TL-01, TL-02, TL-04, TL-05, TL-07, TL-08, TL-09) for characterizing four tilapia (*O. niloticus*) populations collected from four different locations *viz.*, West Bengal (WB), Rudramata Reservoir of Bhuj district of Gujarat (RM), domestic tilapia population collected from ponds of Gujarat (GP), Odisha population (OD) which were earlier differentiated using heterologous rohu markers. Seven homologous microsatellite markers showed that West Bengal (WB) tilapia had the highest mean expected heterozygosity (H_e=0.813), while RM populations from the Bhuj reservoir had the lowest expected heterozygosity (H_e=0.666). The Odisha population (OD, *He*=0.74) and Gujarat pond (GP, *He*=0.72) population were not genetically very far away, while RM stock differed significantly from the other three tilapia stocks. Except for West Bengal, most of the other tilapia stocks exhibited remarkably significant homozygote excess relative to Hardy–Weinberg Equilibrium (HWE), suggesting some degree of inbreeding. The significance of these results may be taken as a starting point for future selective breeding programme and management of brood stocks.

Variations in the growth patterns of three populations of tilapia, *O. niloticus* during winter and summer months

This study was conducted to investigate growth variations among three tilapia populations collected from India; *viz.*, West Bengal population (WB), Gujarat population collected from Rudramata dam site of Bhuj reservoir (RM) and Odisha population (OD). Tilapia with a broken lateral line and the regular dark vertical stripes throughout the depth of its dark body was taken as identifying character of *O. niloticus*. Total length and body weight was taken initially during stocking and final harvesting. It was observed that there were clear differences in the growth rates between these three populations (n=100 per population). Mean body weights attained by tilapia after 180 days of culture were: 231 ± 10 g, 63 ± 8.5 g and 166 ± 7.2 g for OD, RM and WB, respectively during winter months. Similarly, mean body weights attained by tilapia after 180 days of culture during summer months were: 392 ± 12 g, 210 ± 10 g and 357 ± 8.2 g for OD, RM and WB, respectively. The statistical analyses indicated that the growth of all three populations were significantly different from each other. The growth pattern during summer and winter months are depicted in Fig. 2. Genetic viability among three different stocks of tilapia indicated that the possibility of breeding strategy to control inbreeding and develop a selective breeding programme among available species of tilapia in India.

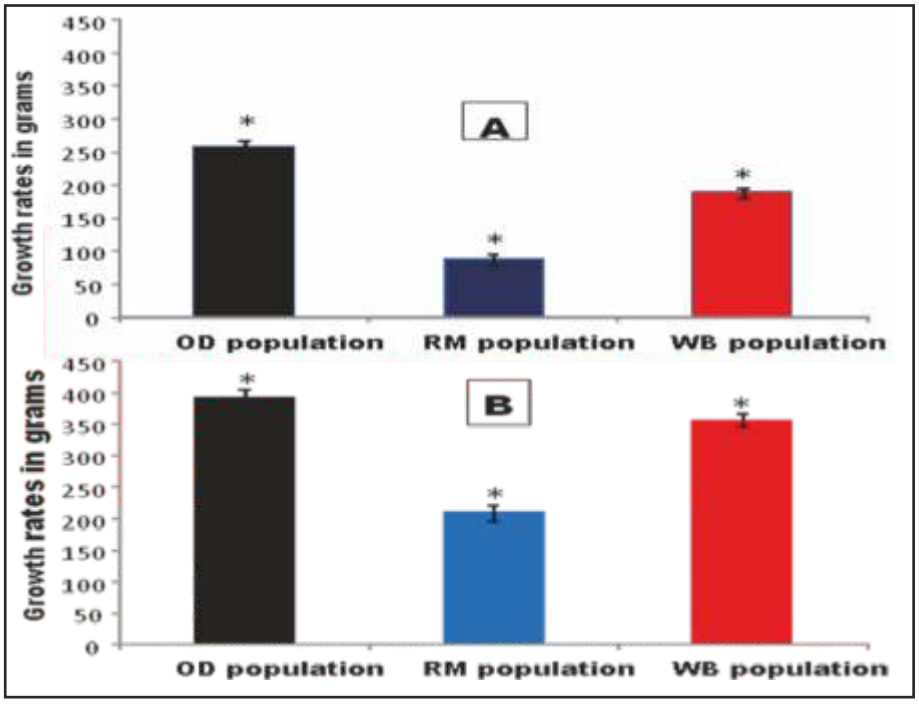


Fig. 2. Growth of three different populations of tilapia during winter (A) and summer months (B); culture period 180 days; n=100; Bars having asterisks differ significantly (P <0.05)

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

Monoculture of striped murrel in concrete tanks

An experiment was conducted to evaluate the growth and survival of striped murrel for monoculture in concrete tanks (15 m^2). Fishes of initial weight (20.22 ± 3.51 g) were stocked in different stocking densities at 10 (T_1), 15 (T_2) and 20 nos/m^3 (T_3). Fishes were fed pelleted sinking feed at 4-5% of body weight initially and gradually reduced to 2-3% twice daily. About 5-6 m^3 water was maintained throughout the experiment in each tank and total water exchange was done at weekly intervals. After 8 months of culture, the highest growth (284.4 g) and survival (78.5%) were observed in T_1 group.

Maturation of giant snakehead, *Channa marulius* in concrete tank and its captive breeding

The giant snakehead brood stock is being maintained round the year in concrete tanks with proper diet and habitat management. Brood fishes were fed exclusively on formulated pellet diet during September-January months and remaining periods fed with live feed (50%) in addition to pellet diet (50%). Fishes were fed at 2-3% of their biomass and total water exchange was done at weekly interval to maintain the water quality. In the month of July, matured female (1000 g) and male (700-800 g) fishes were selected for induced breeding. Both female and male fishes were given two injections of carp pituitary gland extract (CPGE) at 24 h interval. Fishes successfully spawned next day morning after second dose of CPGE injection. The fecundity was estimated to be 10,000-12,000 eggs/kg body weight of female. The average fertilization and hatching rates were 95% and 88%, respectively.

Grow-out study on incorporation of striped murrel in carp polyculture

An experiment was conducted to know the incorporation level of striped murrel in carp polyculture. In this experiment, pond size of 400 m^2 with standard carp stocking density of 10,000 fingerlings/ha was taken. The control group (C) consisted of *Puntius gonionatus* (33%), *Labeo rohita* (34%) and *Cirrhinus mrigala* (33%). In the treatment groups T_1, 8% of *C. mrigala* was replaced with *Channa striatus* and in T_2, 16% of *C. mrigala* was replaced with *C. striatus*. The initial weights of fishes were *P. gonionatus* (9.2±2.1 g), *L. rohita* (10±2.5 g), *C. mrigala* (8±1.4 g) and *C. striatus* (8.4±1.5 g). The result of the study up to 4 months of culture is presented in the Table 1.

Table 1. Growth of different species during the grow-out study on incorporation of striped murrel in carp polyculture. (Data represents mean ± standard error).

Treatments	*P. gonionatus*		*L. rohita*		*C. mrigala*		*C. striatus*	
	Length (cm)	Weight (g)	Length (cm)	Weight (g)	Length (cm)	Weight (g)	Length (cm)	Weight (g)
C	22.30±0.45	162.65±9.45	21.98±0.14	139.83±2.57	22.05±0.40	115.03±5.50	-	-
T1	22.04±0.60	157.11±8.07	22.51±0.17	152.14±5.50	22.05±0.80	114.24±6.36	23.83±0.31	98.40±2.85
T2	22.49±0.48	165.48±9.06	23.24±0.72	168.86±17.12	22.08±0.14	112.47±2.09	23.81±0.81	99.82±8.52

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 ideal incorporation levels of *O. belangeri* with major carps in grow-out culture

Six-month grow-out study on effect of varied incorporation levels of pengba, *Osteobrama belangeri* with Indian major carps, catla, rohu and mrigal has been initiated during February, 2017 in nine earthen ponds of 0.08 ha in ICAR-CIFA farm. The ponds were drained and sun dried for 15 days prior to filling water. Standard procedures of pre-stocking pond fertilization using cowdung (3 t/h) and single super phosphate (SSP) (30 kg/ha) were carried out 10 days prior to stocking. The three IMCs were stocked at combined density of 6000 juveniles/ha served as the control (C). With no change in the IMC density, juveniles of pengba were stocked additionally at 10% and 20% in two treatments T-1 and T-2, respectively. Fingerlings of all the species raised in ICAR-CIFA farm were stocked in these ponds. The average stocking sizes of the species were catla (24.3 cm and 232.7 g), rohu (19.5 cm, 114.4 g), mrigal (20.5 cm, 107.0 g) and pengba (21.3 cm, 120 g), respectively.

Water quality parameters such as temperature, dissolved oxygen, pH, total alkalinity, hardness and inorganic nutrients (ammonia, nitrite, nitrate and phosphate) are being measured in the laboratory following standard methods. Liming and intermittent fertilization are being carried out depending on the productivity status of the ponds. Fish growth is being assessed through monthly sampling (25 fish of each species) and the quantity of daily feed was calculated based on the average fish growth with an assumed 80% survival. Fish are being fed with commercial floating pellet (ABIS brand feed, 28% protein) at 4% of the biomass during initial two months which was reduced to 3 and 2% during 3rd and 5th months with modification of the daily ration as per consumption. The length and weight attainment of the three species in the treatments up to the end of 2nd month are presented in the following Table 2. The study would be completed in July, 2017.

Table 2. Length and weight attainment in the species during two months of culture

Species	DOC	Total length (cm)			Average body weight (g)		
		Control	T-1 (10% Pengba)	T-2 (20% Pengba)	Control	T-1 (10% Pengba)	T-2 (20% Pengba)
Catla	1	24.1±0.3	24.4±0.2	24.4±0.4	239.9±12.3	237.4±21	220.9±21.7
	30	28.7±1.8	29.3±0.7	29.0±0.5	322.7±28.8	326.7±29.2	334.0±0.9
	60	31.9±1.0	30.8±0.6	31.8±0.8	431.7±17.5	418.8±30.5	418.6±26.1
Rohu	1	19.3±0.2	19.3±0.2	19.9±0.6	113.1±4.1	111.0±0.6	119.2±0.4
	30	21.1±0.5	21.5±0.1	21.5±1.5	145.3±15.6	133.9±10.8	143.6±12.3
	60	23.6±2.1	24.2±0.4	24.6±0.5	210.4±3.3	204.6±4.5	205.3±10.5
Mrigal	1	20.4±0.6	20.4±0.3	20.7±0.8	100.9±1.5	104.2±4.7	115.9±3.3
	30	21.7±0.9	22.7±1.4	21.5±1.4	125.0±3.0	126.3±15.9	125.3±0.8
	60	23.1±2.0	23.5±2.2	23.3±0.6	140.6±0.8	143.3±8.7	147.0±5.7
Pengba	1	-	20.9±1.1	21.8±0.1	-	118.5±22.6	121.6±1.4
	30	-	22.8±1.7	22.8±0.3	-	166.3±0.3	155.7±10.0
	60	-	24.3±2.2	23.7±0.1	-	211.1±10.8	210.7±3.3

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 (up to November, 2016) and B. K. Das (up to July, 2016)

Rita chrysea is an indigenous catfish, endemic to the river Mahanadi of Odisha has good consumer preference and market demand fetching Rs.250-300/kg. The broodstock of 80-150 g were collected from the Mahanadi River, Jagatsinghpur. The wild caught *R. chrysea* fishes were sampled monthly to study the gonad maturity stages, gonado-somatic index (GSI) and gut content analysis. It was found that GSI and GaSI % of male and female is about 0.42 & 0.65% and 6.8% & 6.1%, respectively.

An experiment was conducted for a period of 40 days to ascertain the effect of stocking density on growth and survival of Mahanadi rita larvae in the indoor system. The experimental tanks were stocked with 2, 3, 4 and 6 larval numbers per litre water in the volume of 15 litre. The 6 days post-hatch larvae (7.46 mm and 2.05 mg) were stocked at the rate of 30, 45, 60 and 90 per experimental tank. The rearing tanks were provided with continuous aeration facility and the tanks were cleaned and water exchanged twice a day. The larvae were fed with *Artemia* nauplii twice daily after the water exchange. The study results showed that the larvae stocked at 2 nos/L had significantly ($P < 0.05$) higher weight gain (153.33 ± 1.88 mg) followed by 6 nos/L (144.74 ± 12.18 mg). The larval survival rate was recorded significantly higher ($P < 0.01$) in lower stocking density group 2/L (93%) & 3/L (87%) and the highest mortality was observed in 6/l (41%) stocking density group. This present study concludes that stocking of 2-3 larvae/L has shown higher growth and survival of Mahanadi rita larvae in indoor condition.

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 (up to 2016), P. K. Jesna and B. Mishra

Grow-out of Generation 7 (G7) and production of Generation 8 (G8) of selectively bred freshwater prawn *Macrobrachium rosenbergii.* Grow-out rearing of 7th generation selectively bred *Macrobrachium rosenbergii* was carried out in large nylon hapas (5 m x 2 m x 1 m) fixed in 100 m^2 concrete tanks or ponds. The nursed juveniles from each of the 58 families (140 individuals) were stocked in two hapas per family. All prawns were fed at 10% of the biomass initially which was subsequently modified based on prawn sampling. All hapas were sampled once every three weeks to observe the growth and health of the stocked prawns. During sampling all surviving prawns were collected, counted and restocked into the hapas. Samples of 30 prawns were measured (length and wet weight) to determine the growth and revise the feed rate. One family was lost due to mortality. Final data collection was done from each of the 114 hapas at 260 days post hatch. During final data collection all surviving individuals were measured for all parameters mentioned earlier. Sex and morphotype were also noted. Ten heaviest males and 20 heaviest females were selected from each of the 57 families and tagged with VIA tag. After tagging prawns were restocked to hapas for their possible use as parents for the next generation. Final body weight of different families of G7 is given in Fig. 3.

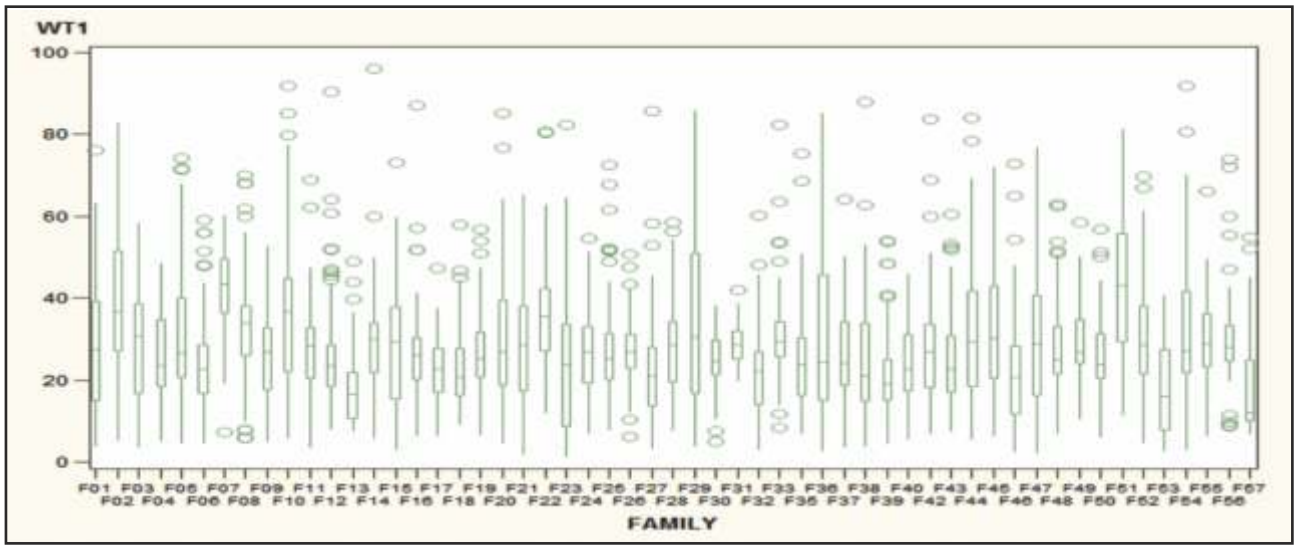


Fig. 3. Box plot of final body weight of G7 after grow-out

Mate allocation and breeding of 7th generation of selectively bred giant freshwater prawn *M. rosenbergii* was carried out during April to October 2016 and 55 full-sib families of generation 8 (G8) were produced. Post larvae (PL) from all the 55 full-sib families were nursed up to taggable size in nylon hapas (2.5 m x 1 m x 1.0 m; 110 hapas). The PL were fed daily with pellet feed in crumble form, and growth and survival of the stocked PL were checked once every 3 weeks. During the sampling all PL were removed from hapas, counted, group weighed and returned to a new hapa. After nursing for 80 to 90 days, the nursed juveniles (140 individuals) from each of the 58 full-sib families were stocked in two large nylon net hapas (5 m x 2 m x 1 m) for grow-out. These hapas were fixed in 100 m^2 concrete tanks or ponds. During final data collection all survived prawns were collected and classified by sex and male morphotypes. All prawns were individually measured for carapace length, standard length, total length and individual weight. Ten to 12 largest male and 15-20 largest female prawns were selected from each hapa and tagged with VIA tag and returned back to hapas. Once in every three weeks all hapas are replaced with new hapas and growth and survival of the prawns are monitored. Selected brood prawns were being maintained family-wise till mate allocation for the production of next generation was finalized. The final overall survival of 55 families of G8 after grow-out rearing was 72.9% and it ranged from 26.3 to 93.1% in different families of G8 (Fig. 4).

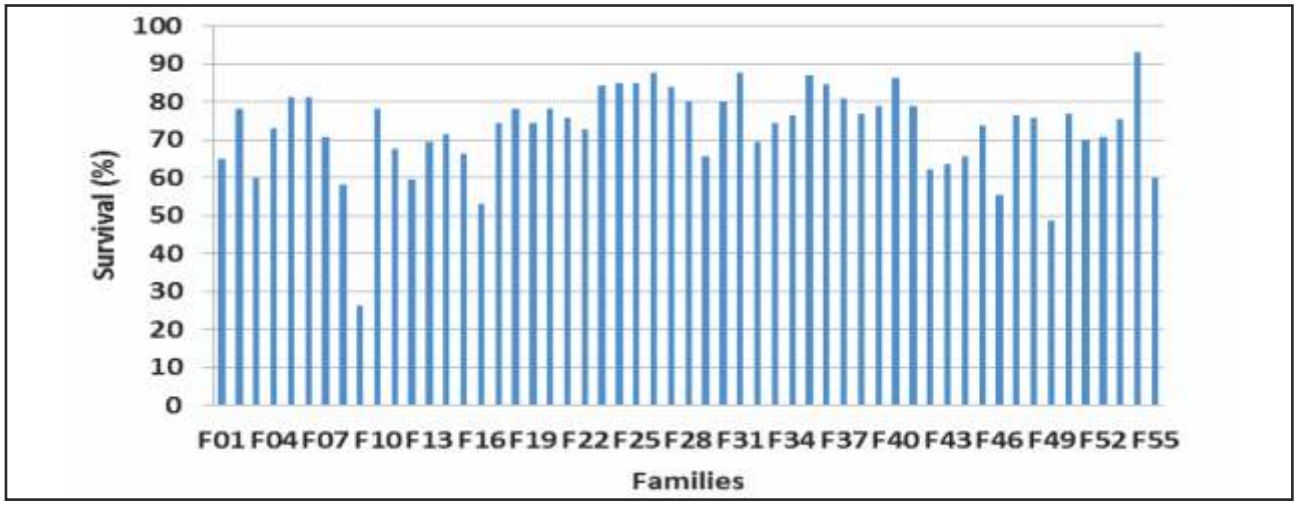


Fig. 4. Survival (%) of different families of G8 after grow-out rearing

Sub-project title	:	Evaluation of the performance of white leg shrimp, *Litopeneaus vannamei* (Boone, 1931) in freshwater culture systems and refinement of culture practices
Project code	:	I-91(F)
Funding Agency	:	Institute-based
Duration	:	April 2016 – March 2018
Project Personnel	:	B. R. Pillai (PI), C. K. Mishra, Ramesh Rathod, S. Sarkar, I. Sivaraman, Ajit . Chaudhari, Sunil Kumar Ail, D. Panda and J.H. Bhat (SMS, KVK-Devataj, AAU, Anand)

Survey on the status of *Litopenaeus vannamei* farming in low saline waters in Andhra Pradesh

A survey was conducted in the East Godavari, West Godavari, Krishna and Guntur districts of Andhra Pradesh to know the current status of *L. vannamei* farming in low saline waters and freshwater. The survey revealed that *L. vannamei* is cultured in both monoculture and polyculture systems in brackish water/low saline areas. Monoculture of *L. vannamei* was widely practiced in Guntur and Krishna Districts. In monoculture systems, the salinity of the water ranges from 3 to 9 ppt. Farmers mix the canal water and ground water to achieve a resultant salinity of around 3-5 ppt. The farmers observed that salinity fluctuation was common during the rainy season. The stocking density is around 25 post-larvae/m^2. The culture period ranges from 90-120 days. Most of the farmers could achieve two crops per year with stocking in February-March and later in September-October. On an average, the farmers use around 214 kg of commercial mineral mix formulations as mineral supplementation. The average FCR is found to be in the range of 1.3 to 1.5. The average shrimp production is around 4.5 to 5 t/ha. In a healthy shrimp culture operation, farmers get thirty count size shrimps (>33 g weight) in 120 days, which is most preferred by the buyers. Few farmers prefer to sell at 50 count size, which can be achieved in 90 days.

Polyculture is practiced in East and West Godavari districts. In polyculture, the salinity of the water ranged from 0-5 ppt with an average salinity of 2 ppt. The stocking density of shrimp post-larvae is very less. Ponds were stocked with around 8 post-larvae/m^2 followed by stocking of major carps (rohu and catla) at a density of 5000 fingerlings per ha at the ratio of 9:1. Fingerlings of 100 g size are most preferred by the farmers. Polyculture farmers also apply commercial mineral mix. Carps are fed to satiation with the pelleted feed/GNOC-RB mix. Around half an hour later, the shrimps are fed with commercial sinking pellet feed. On an average, the shrimp grows up to 40 count size in 110 days with a mean survival of 65%. The average shrimp production from the polyculture system is around 730 kg. The shrimp is harvested partially through repeated cast netting. After the harvest of the shrimp the pond management is focused on the carp culture. The carps are harvested nine months after stocking when rohu and catla attain one kg and two kg body weight, respectively. The average production of carp is estimated to be 5.2 t/ha in polyculture system. The survey indicated that the current practice of culturing vannamei in freshwater by adding bore-well water of high salinity may lead to salinization of nearby freshwater areas in the long run.

Evaluation of growth and survival of *L. vannamei* in low saline brackishwater and salt amended freshwater

Nine different media were evaluated using 30-day-old PL (PL 30) to evaluate the survival of *L. vannamei*. No survival of PL 30 was recorded in the second week in freshwater (T3) or in treatments where freshwater was fortified with common salt (NaCl) to increase the salinity to 5 ppt and 2 ppt (T1 and T2, respectively); freshwater with calcium, magnesium (Ca+Mg; hardness 400 ppm (T4) and Ca+Mg+ K; hardness 400 ppm (T5). However, the PLs could survive in medium

with mixture of sodium, calcium, magnesium and potassium salts (T6) up to 3 weeks. However, the highest survival (60%) was observed in 5 ppt followed by 2 ppt (48%) sea water (Table 3). The results revealed that even one month old PL could not able to survive neither in freshwater nor in water deficient with sodium, calcium, magnesium, potassium ions.

The growth and survival of *L. vannamei* was also studied in two identical freshwater and salt amended ponds (120 m^2) with mixture of sodium chloride, potassium chloride, potassium sulphate, calcium chloride, magnesium chloride and magnesium sulphate salts to raise the salinity to nearly 1.0 ppt. Forty-five day old PL (PL 45) were reared at 10, 20 and 30 nos./m^3 in 10 m^3 hapas in freshwater pond as well as in fortified pond. No survival was recorded after one week in hapas installed in freshwater pond for all stocking densities. The highest survival (81%) and growth (0.59 g/week) were observed in 10 nos/m^3 followed by 79% and 0.45 g, and 66% and 0.43 g in survival (%) and growth at 20 and 30 nos./m^3 in hapas installed in salt amended pond. The present results revealed that neither PL 30 nor PL 45 could survive more than a week in freshwater without any salt supplement. Hence, *L. vannamei* culture in freshwater is not a viable option without addition of salt/minerals. Higher survival and growth of *L. vannamei* could be achieved by adding calculated amount of selected limiting ions in freshwater.

Table 3. Survival of *L. vannamei* (PL 30) reared in different medium

Treatment (T)		Survival (%)			
		1st week	2nd week	3rd week	4th week
T1	NaCl (5 ppt)	0	0	0	0
T2	NaCl (2 ppt)	44	0	0	0
T3	Freshwater	18	0	0	0
T4	Ca+Mg (hardness 400 ppm)	12	0	0	0
T5	Ca+Mg+K (hardness 400 ppm)	44	0	0	0
T6	Na+Ca+Mg+K (5 ppt)	86	86	56	0
T7	Na+Ca+Mg+K (2 ppt)	84	68	0	0
T8	Sea water (5 ppt)	78	70	60	60
T9	Sea water (2 ppt)	78	70	54	48

Sub-project title : Captive breeding of Narayan Barb, *Pethia narayani* of Western Ghat

Project code : I-91(H)

Funding Agency : Institute-based

Duration : April 2016 – March 2019

Project Personnel : M. K. Bairwa (PI), S. K. Swain, B. K. Das (up to September, 2016)

Narayan barb, *Pethia narayani* were collected from the river Sita, located in Shimoga District, Karnataka, India with an average weight 1.0 g and length 2.5 cm

Pethia narayani collected from river Sita

in the month of August, 2016. Initially, feeding was done with live zooplankton for a period of one week and later along with zooplankton, 2 mm commercial Spirulina-based floating feed (35% protein) was given. Bimonthly sampling was done and average weight and length of fishes were 1.7 g and 5.0 cm, respectively. The mean weight gain of *P. naranyani* was 83.34 mg/month and average length gain of 0.41 mm. Sexes were identified based on their colouration and body shape. The male has reddish colour slender body, dorsal fin larger and upper region dark reddish, while the female is pale yellowish, oval shape body and smaller dorsal fin than male and upper region being light reddish. Male and female fishes were reared separately in aquaria for further broodstock development.

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), S. Sarkar and B. Mishra

Soil carbon storage (SOC) of different aquaculture systems and its chemical composition. The soil organic carbon (SOC) storage in the pond soil from different districts of West Bengal under different water management practices varied from 4.72 mg/ha/yr to 46.17 mg/ha/yr (Fig. 5).

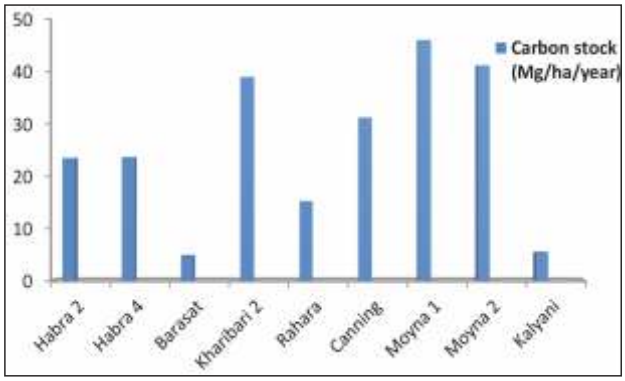


Fig. 5. Comparison of SOC storage in different pond soils of aquaculture practices

The three types of combined humus carbon (loosely, stably and tightly combined) are shown in Figs. 6A, 6B, 6C and Table 7. The carbon contents of loosely, stably and tightly combined humus ranged from 2.40 to 7.87 g/kg (Fig. 6A), 0.27 to 0.96 g/kg (Fig. 6B), and 3.30 to 11.02 g/kg (Fig. 6C), respectively. The combined humus forms were arranged on the basis of C content in the following order: tightly > loosely > stably combined humus C (Figs. 6). However, the proportion of three combined humus C showed no significant differences (P>0.05) among the different soils (Table 4).

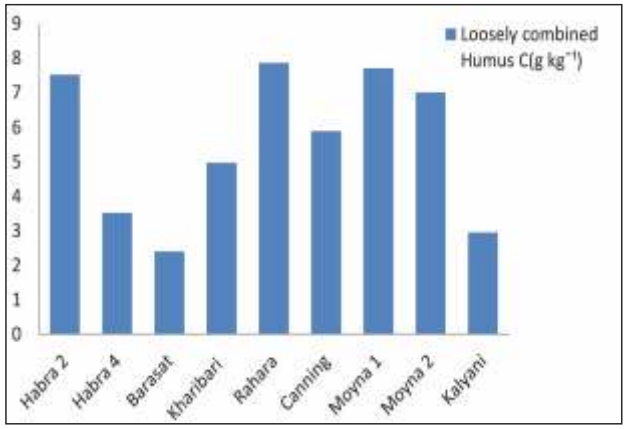


Fig. 6A. Comparison of the C contents of loosely combined humus C (g/kg)

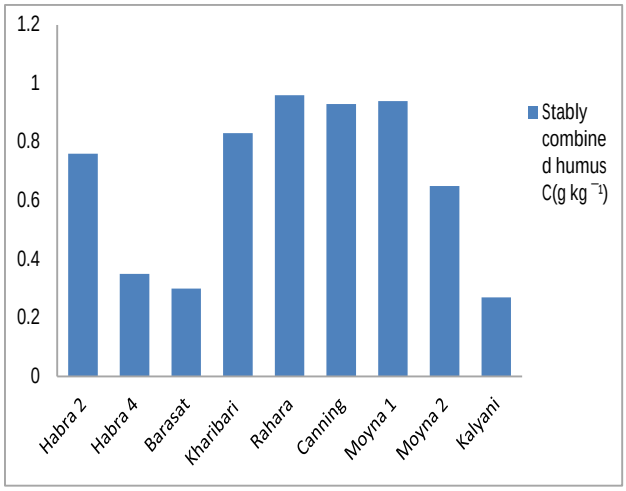


Fig. 6B. Comparison of the C contents of stably combined humus

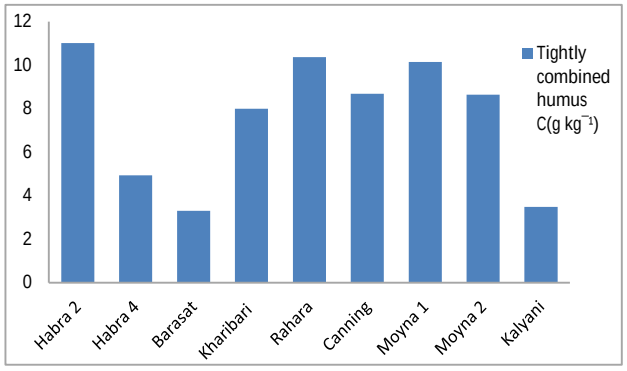


Fig. 6C. Comparison of the C contents of tightly combined humus

Table 4. Proportions of combined humus C at different places (% soil organic carbon)

Location	Loosely combined humus	Stably combined humus	Tightly combined humus
Habra 2	39	4	57
Habra 4	40	4	56
Barasat	40	5	55
Kharibari	36	6	58
Rahara	41	5	54
Canning	38	6	56
Moyna 1	41	5	54
Moyna 2	43	4	53
Kalyani	44	4	52

The E_{465}/E_{665} values of the loosely combined humus (2.60 to 4.46) were higher than that of the stably combined humus (1.50 to 3.62) (Figs 7A & B). Thus, the E_{465}/E_{665} of loosely combined humus can be considered a more suitable index rather than that of the stably combined humus for identifying the aromaticity and humification degree of soil organic carbon.

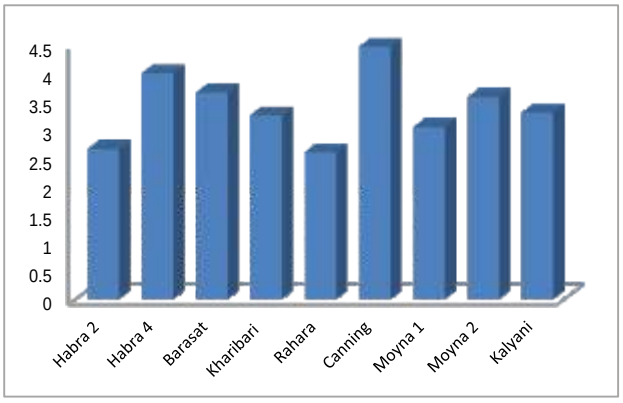


Fig. 7A. E_{465}/E_{665} ratio of loosely combined humus

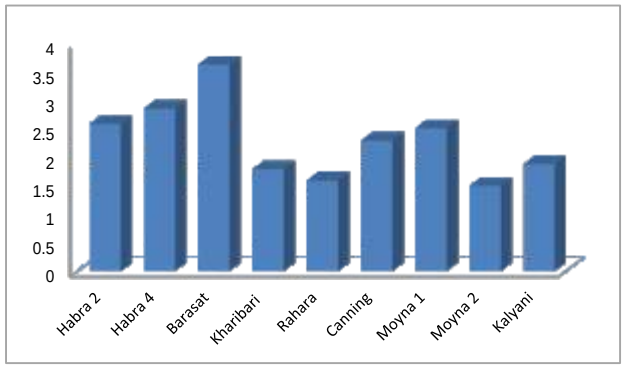


Fig. 7B. E_{465}/E_{665} ratio of stably combined humus

The soil organic carbon storage in the pond soils of *Macrobrachium rosenbergii* culture of the Institute ranged from 0.56 to 4.74 mg/ha while the same was 0.82 to 10.83 mg/ha in the pond soils of carp culture of Ganjam District, Odisha. Considering 1.0 cm depth, the SOC storage in the sewage-fed pond soils of Rahara Fish Farm was 1.02±0.50 mg/ha while the same was 0.80±0.22 mg/ha in the pond soils of Kalyani Fish Farm, West Bengal.

Carbon footprint studies of some aquaculture systems

The carbon footprint analysis showed that the total inputs in mixed culture of rohu, catla, mrigal, bata and *P. monodon* in North 24 Parganas, West Bengal varied from 1314 to 2067 (1659±337) kg CE (carbon equivalent) /ha/6 months with an output of 4366 to 5912 (5305±673) kg/ha/6 months and the output/input ratio was 2.86 to 4.28. The same for catfish and tilapia in South 24 Parganas was 842 kg/ha/6 months with an output of 4200 kg/ha, and the output/input ratio was 4.99 (Fig. 8).

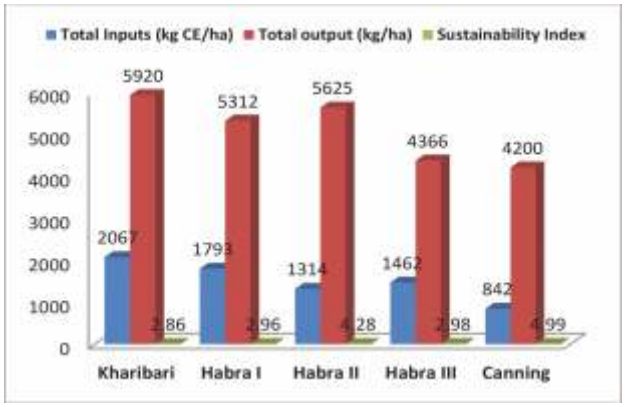


Fig. 8. Carbon foot-print analysis in some aquaculture systems of West Bengal

The carbon footprint analysis showed that the total inputs in carp culture practices in Anand, Ahmedabad, Vadodara, and Kheda districts of Gujarat ranged from 8.6 to 90 (28.6±22.6) kg CE/ha/yr with an output of 125 to 1500 (896±476) kg live weight/ha/yr under lime, feed, fertilizer, and manure systems (Fig. 9).

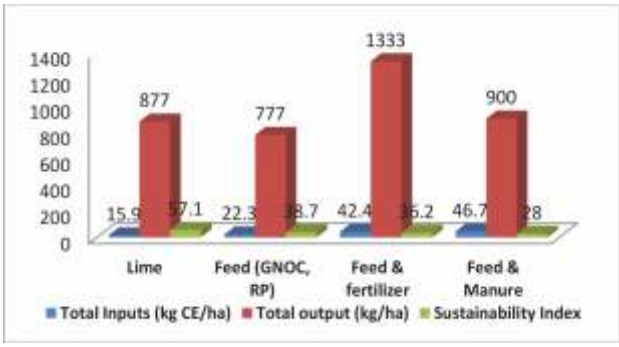


Fig. 9. Carbon foot-print analysis in some aquaculture systems of Gujarat

The carbon footprint analysis showed that total inputs in *M. rosenbergii* culture at the Institute was 580 kg CE/ha with an output of 672 kg/ha and the output/ input ratio was 1.15. The same for IMC culture at Moyna, East Midnapur, W.B. was 7160 to 9448 kg CE/ha with an output of 4500 to 10000 kg/ha and the output/ input ratio was 0.50 to 1.40.

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 project proposal is directed to raise the livelihood of some selected farmers of scheduled caste (SC), scheduled tribe (ST) and weaker section of three Community Development Blocks (CD Blocks) from Khordha District of Odisha. The beneficiaries of four Blocks were (Cluster 1 - Balipatana; Cluster 2 - Banapur; Cluster 3 – Begunia) identified for implementation of the project mandate.

Selection of beneficiaries and ponds

A total of 192 (SC-53, ST-121, OBC-11, General-7) beneficiaries having 9.19 ha pond (17 nos.) area were selected for adoption of the project objectives. Most of the farmers are under-educated and their primary occupation is paddy cultivation and daily wages.

Establishment of FRP carp hatcheries

Three FRP carp hatcheries have been installed and operated for carp seed production in three CD Blocks. These places are 1. Puranapadhan, Balianta Block (3 ponds, 0.8 ha water area, 10 beneficiaries), 2. Kantabada, Begunia Block (3 ponds, 0.6 ha water area, 15 beneficiaries) and 3. Aranga, Banapur Block (1 pond, 0.2 ha water area, 7 beneficiaries).

Carp breeding programme in FRP hatchery

The FRP carp hatchery of Puranapadhan was operated 23 times and the hatchery of Kantabada once. In the monsoon of 2016, at Puranapadhan Village, 21.5 million carp spawn (catla 2.8 million; rohu 12.45 million; mrigal 4.35 million; common carp 1.0 million and grass carp 0.9 million) were harvested, at Aranga 0.4 million and at Kantabada, 0.6 million rohu spawn were harvested from carp breeding operations. Out of total spawn production, 16 million were sold and rests were reared by the farmers. The carp breeding operation data are given in Table 8.

Seed rearing for fry, fingerling and yearling production

In Puranapadhan, fry production was conducted in three batches in 2 ponds of size 0.2 ha each. Total 8 lakh rohu fry (survival 41.03%) was harvested by rearing 19.5 lakh spawn; 7 lakh mrigal fry (survival 37.84%) by rearing 18.5 lakh spawn; 3.5 lakh catla fry (survival 35.8%) by rearing 8 lakh spawn; 1.2 lakh common carp fry (survival 40.0%) by rearing 3 lakh spawn; and 0.7 lakh grass carp fry (survival 35.0%) by rearing 23 lakh spawn. Out of those harvested fry, 164 lakh (catla 20, rohu 105, mrigal 25.0, common carp 7.0 and grass carp 7.0 lakhs) were sold by the beneficiaries and rest were kept for fingerling production. For fingerling production, 5 lakh rohu, 4 lakh mrigal and 2 lakh common carp fry were stocked

again in the same 2 ponds. After 70-90 days of stocking, 0.26 lakh rohu (survival 52%), 0.25 lakh catla (survival 50%), 0.21 lakh mrigal (survival 53.16%), 0.2 lakh common carp fingerlings (survival 50%) and 0.14 lakh grass carp (survival 49.73%) were harvested. Out of this, 0.15 lakh rohu, 0.12 lakh mrigal, 0.15 lakh catla, 0.05 lakh common carp and 0.10 lakh grass carp fingerlings were sold and rest were kept for yearling production.

In Kantabada Village, 3.0 lakh fry (survival 50%) were harvested out of 6.0 lakh spawn from a 0.2 ha pond. Out of that 1.8 lakh fry were sold and rest 1.2 lakh fry were reared for fingerling production and harvested 0.6 lakh (survival 50%). Out of that 0.45 lakh were sold and rest kept for yearling production. In Aranga village 1.0 lakh fry (survival 50%) was harvested out of 2.0 lakh spawn. Out of that 0.5 lakh fry (survival 50%) were kept for fingerling production and out of that 0.28 lakh (survival 56.14%) fingerlings produced, and from that 0.20 lakh sold and rest 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 at 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, Dolagobinda Nuasahi, Beguniasahi and Silingpada Villages of Cluster-2. Normal culture practices of ICAR-CIFA was followed. Floating pelleted feed was provided to the farmers for feeding the fish in ponds.

At Naroda Village of Balipatana Block fish seed were stocked (at 10,000 fry/ha) in the month of August, 2015 and better management practices were followed for increase of fish production. Partial harvesting was conducted on 20 September, 2016 and the harvested fishes were sold by the SC/ST group (with 30 members) on that day. The total weight of partially harvested fish was 400 kg of IMC (150 kg of rohu, 230 kg of catla and 20 kg of mrigal). The size ranges of individual fish harvested was catla 2.3-3.8 kg, mrigal 0.5-0.6 kg and rohu 0.2 - 0.4 kg.

At Banpur Block (Cluster-2) fish seed was stocked in the month of September, 2015 and the harvesting was conducted in the month of February- March 2016. In 4 adopted villages, a total of 2.5 tons fish was harvested.

At Jemamantadeipur village, Begunia Block the IMC and grass carp seeds were stocked (at 10,000 fry/ha) in a 6.0 acre community pond in November, 2015 and harvested in the month of June, 2016. In 8 months of culture period 1925 kg fish were harvested from the pond. The average size of fish recorded was rohu, 500 g; catla, 2.5 kg; mrigal, 450 g and grass carp, 2.5 kg. From the harvested fish, 1600 kg were sold by the tribal farmers of the village (61 farm families) and 325 kg was consumed by them. The fish production achieved was 3609 kg/ha/yr from the community pond (Table 5).

Table 5. Growth of fish in adopted ponds

Block	Species	Initial stocking		Growth at the time of harvest	
		Length (mm)	Weight (g)	Length (mm)	Weight (g)
Cluster-1	*C. catla*	25-38	1.3-2.6	190-395	2340-3806
	L. rohita	22-33	0.5-1.6	150-190	205-440
	C. mrigala	26-40	0.4-2.1	160-235	513-685
Cluster-2	*C. catla*	43-82	3.0-6.4	210-250	1350-1640
	L. rohita	42-77	3.1-5.6	150-210	255-350
	C. mrigala	40-84	2.4-5.2	160-190	240-530
Cluster-3	*C. catla*	46-82	3.4-6.6	200-250	1800-2500
	L. rohita	42-77	3.1-5.2	185-230	460-750
	C. mrigala	40-84	2.7-5.1	140-200	395- 568
	C. idella	39-54	3.0-6.4	193 - 296	1760-2670

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: pH 7.0-8.3, conductivity 449-958 mili mho/cm, total alkalinity 62-130 mg/L and total hardness 50-120 mg/L. The adopted ponds were found less productive in terms of plankton volume 0.8-2.2 mg/50 L water and number of different species were recorded 13-17 nos./50 L water. The plankton species found in the adopted ponds in all clusters were phytoplankton: blue green algae (*Anabaena*, *Rivularia*,); green algae (*Ankistrodesmus*, *Protococcus*, *Microspora*, *Botryoccous*); diatoms (*Melosira*, *Diatoma*, *Navicula*, *Synedra, Frustulia*) and zooplankton (*Diaptomous, Daphnia, Copepods, Cladocerans, Cyclops, Monia*). All the ponds were found suitable for fish rearing with BMP advices.

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, Gangadhar Barlaya, A. S. Mahapatra, Ramesh Rathod, I. Sivaraman, Ajit Chaudhari

Growth and survival of tilapia spawn at different temperatures

The growth of tilapia spawn (0.0988 ± 0.0012 g) was studied at five different temperatures, *viz*., control (28), 34, 36, 38 and 40° C. The results showed that the growth in terms of body weight was significantly higher (P<0.05) at 34° C after 16 days compared to other higher temperatures (Fig. 10). The growth in terms of length was also significantly higher (P<0.05) after 16 days at 34° C compared to 28, 36, 38 and 40°C (Fig. 11).

The mortality rate in tilapia spawn was mostly effective at 38 C and 40° C. The rate of mortality of tilapia spawn was 33° and 88% at 38 and 40° C, respectively. No mortality occurred at 34 and 36° C.

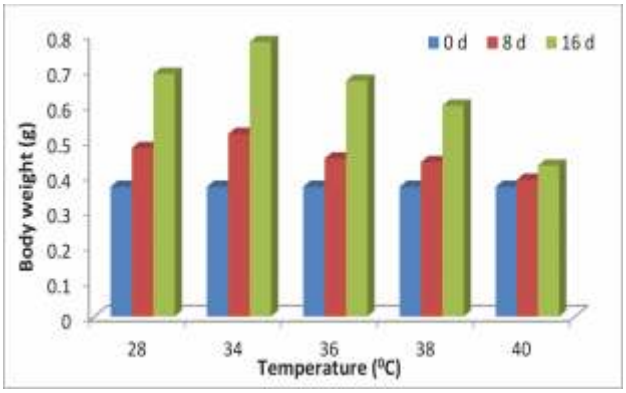


Fig. 10. Average body weight of tilapia fry in (g) under 8 and 16 days

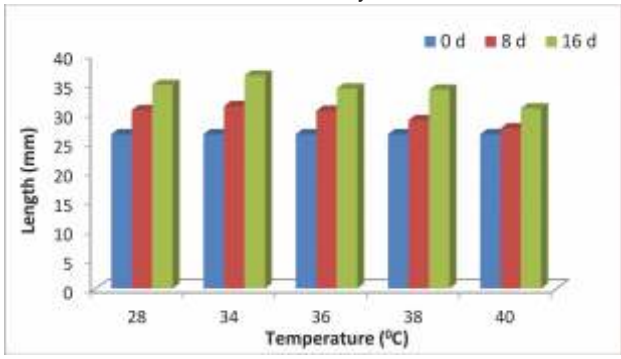


Fig. 11. Average body length of tilapia spawn (cm) at 08 and 16 days

Growth and survival of tilapia fry at different temperatures

The growth of tilapia fry (0.3771±0.003 g) was studied at five different temperatures, *viz*., control (28), 34, 36, 38 and 40°C. The results showed that the growth in terms of body weight was significantly

higher (P<0.05) at 34°C after 8 and 16 days compared to other higher temperatures (Fig. 12). The growth in terms of length was also significantly higher (P<0.05) after 16 days at 34°C temperature compared to 28, 36, 38 and 40° C (Fig. 13).

The mortality rate of tilapia fry was mostly effective at 40° C compared to 38° C. The rate of mortality of tilapia fry was 5 and 35% at 38 and 40° C, respectively. But there was no mortality of tilapia fry at 34 and 36° C.

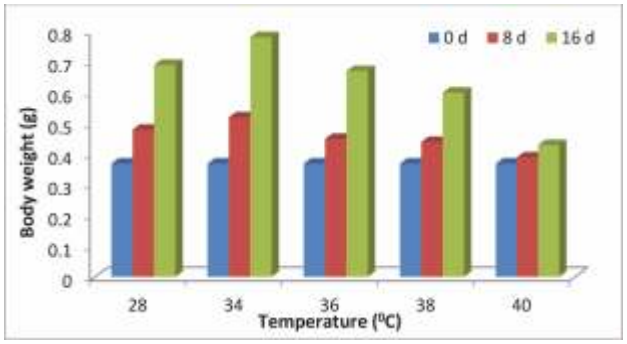


Fig.12. Average body weight of tilapia fry in (g) at 8 and 16 days

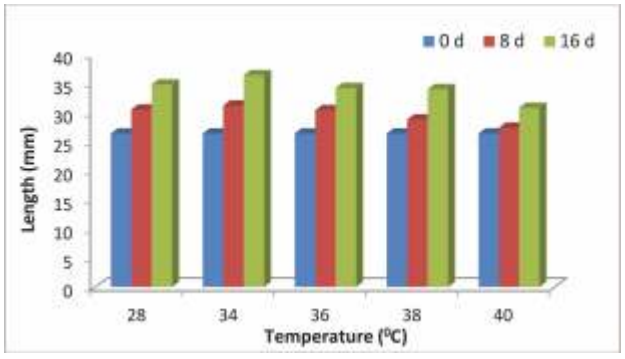


Fig.13. Average body length of tilapia fry (cm) at 8 and 16 days

Plankton at different water depth during summer

Plankton was measured in ponds of different depths during summer. It was observed that number of zooplanktons were more in partially fertilized ponds having 5 to 6 ft water depth compared to the ponds having 3 to 3.5 ft water.

Phytoplankton and zooplankton concentrations in the pond in summer (surface water temperature: 32 to 39°C) were more than monsoon (22-34°C) seasons. In both the cases, the concentrations decreased in depth of the water column though the decrease rate was not linear in most of the time.

Mitigation of surface water temperatures of fish ponds under different covers

Surface water temperatures were measured three times a day during the month of May, 2016 in some ponds of Puri and Keonjhar Districts, Odisha with different covers. Ponds were selected with shaded half/partial with trees in the bundh of the pond, half covered with weeds and half/partial open of the same ponds and completely open ponds (no cover/shade, no weeds). It was observed that the surface water temperature was reduced to 2 to 5 ^{0} C in the half/partial shaded ponds compared to the completely open ponds at 11:00 to 15:00 h. The surface water temperature was lesser to the extent of 2 to 3 ^{0}C in the ponds partially covered with weeds than the open area of the same pond. The surface water temperatures of all these ponds were more or less same at 10:00 h and 16:00 h of a particular day irrespective of any shade/cover.

Adaptation and mitigation strategies of climate change impact in freshwater aquaculture in some states

Survey has been carried out in selected states, viz., Andhra Pradesh, Karnataka, Gujarat, Odisha and West Bengal to document the adaptation and mitigation strategies of climate change impact in freshwater aquaculture.

About 43% of farmers are pumping freshwater to cool down the temperature of fish culture ponds.. When there is low rain fall, 56% farmers maintain water level by pumping in water from their bore wells. While 75% farmers never experienced any disease problem, 25% reported such incidence and among them 50% apply lime in case of appearance of disease symptoms. In case of drought, 25% of the farmers reported that they have made early harvest irrespective of the fish growth and others never stock the ponds. In case of flood, 30% of farmers used to prevent fish escape by using mesh like structures in pond bunds to prevent fish escape, while 10% pump out water using their pumps. Some farmers have resorted to stocking advanced fingerlings for faster growth in early drying ponds. Some farmers have resorted to cultivation of fodder grass in the dried ponds (which require less irrigation compared to aquaculture) for feeding their livestock during non-availability of sufficient quantity of water for aquaculture

Project Title	:	Consortia research platform on water: ICAR-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- ACRP on Water (collaboration between ICAR-CIFA and ICAR-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

Influence of different water exchange rates on growth performance and survival of rohu (*Labeo rohita*) during nursery phase

A study on influence of different water exchange rate on the survival and growth performance of rohu fry during nursery phase was evaluated in a set of 12 large outdoor concrete tanks (50 m^2 each). The four treatments evaluated were: control (C), T-1, T-2 and T-3 with 0, 30, 60 and 90% water exchange, respectively, given equally in 3 splits on 6th, 10th and 13th day of culture. Each tank was filled up to 0.75 m water level. After proper pre-stocking tank preparation, each tank was stocked with 50,000 spawn of rohu with a stocking density of 1,333 spawn/m^3 (10 million spawn/ha area). Powdered mixture of GOC and rice polish at 1:1 ratio was used as supplementary feed. Supplementary feeding started with 225 g per tank (approximately 300% of the spawn biomass) on 1st day and increased by 35 g in every subsequent days. (Table 6)

The water quality parameters in the tanks varied largely depending on the volume of water exchange given in the tanks during the rearing phase. In general, reduction in water pH and dissolved oxygen were observed in water sample collected prior to each water exchange, which was improved following the exchange. However, the parameters such as alkalinity, hardness, nitrate and TAN showed gradual build up, mostly in the second half of the rearing phase (8-15 d) while phosphate level reduced in the first half phase of rearing. Further variations in these parameters largely depended on the quantum of water exchange.

Table 6. Growth attributes of rohu during fry rearing with varied water exchange

Treatment (% water exchange)	Total length (cm)	Harvested body weight (g)	Survival (%)	SGR (%/day)
C(0%)	2.33±0.00	0.26±0.04	33.34±1.31	33.96±0.97
T-1 (30%)	2.23±0.09	0.21±0.02	40.88±1.53	32.47±0.59
T-2 (60%)	2.21±0.17	0.18±0.01	43.33±2.05	31.47±0.33
T-3 (90%)	2.19±0.03	0.17±0.01	50.73±2.24	30.90±0.46

The fry survival was significantly higher ($P<0.05$) in 90% exchange which was 7.4, 9.9 and 17.4% higher than those of 60, 30 and 0% exchange levels, respectively. The total length of harvested fry did not get much affected by the water exchanges rates ($P > 0.05$), while the final body weight and specific growth rate (263 ± 38 mg and 33.34 ± 1.31%) found to be significantly higher ($P<0.05$) in fry reared with 0% water exchange (control). Though, final weight and specific growth rate did not differ significantly ($P < 0.05$) among 30, 60 and 90 % water exchange rates, relative decrease in these attributes were observed with increasing water exchange level, resulted to the higher fry survival in the tanks. Since number of fry produced is the important criterion in carp seed production, the study recommends 90% of water exchange level to be ideal for nursery phase of carps in concrete seed rearing system.

Table 7. Water requirement for fry rearing of rohu in concrete seed rearing system with varied water exchange schedule

Treatment	Water use (m^3)		Water required (m^3)/1000 fry		Fry produced/m^3 of water (Number)	
	Gross	Consumptive	Gross	Consumptive	Gross	Consumptive
C	37.50	0.00	2.25±0.09	0.00	445±17	0
T-1	48.75	11.25	2.39±0.09	0.55±0.02	419±16	1817±68
T-2	60.00	22.50	2.77±0.13	1.04±0.05	361±17	963±45
T-3	71.25	33.75	2.81±0.13	1.33±0.06	356±16	752±33

The gross water requirement to produce each 1000 fry was increased with water exchange up to 60% (Table 8), but remained almost similar between 60 and 90% levels which might be attributed to the higher fry survival in the later. However, only 7.4% higher fry survival in T-3 over T-2 was not enough to reduce the consumptive water requirement in the former. Such observation indicated necessity of further study to improve the seed survival in the nursery to reduce the consumptive water use. (Table 7)

Effect of different water exchange rates on growth performance and survival of Indian major carps during fingerling production

Influence of different water exchange rate on the growth and survival of fingerlings of Indian major carps was evaluated in a 90 days study, conducted in a set of 15 large outdoor concrete tanks (50 m^2 each) in the seed rearing complex of ICAR-CIFA. Tanks (15 nos.) were grouped into five treatments based on the water exchange schedule received during the 90 days rearing phase. Tanks under T-1, T-2, T-3 and T-4 received total water exchange of 40, 60, 80 and 100%, respectively equally in 4 phases at fortnight intervals skipping the 1st one (30th, 45th, 60th and 75th day of culture). Tanks under control (C) though did not receive any exchange; water was added after each fortnight to compensate the evaporation loss.

Fry of catla (4.12 cm, 1.8 g), rohu (4.63 cm, 1.6 g) and mrigal (5.72 cm, 1.4 g) raised in the Institute farm were stocked at equal ratio in each tank at a combined density of 30 fry/m^3 (1500 fry/tank). Sampling of water in the tanks was carried out at fortnight intervals prior each water exchange to measure water temperature, pH, dissolved oxygen, free CO_2, total alkalinity, total hardness and inorganic nutrients *viz*., total ammonia nitrogen (TAN), nitrite, nitrate and phosphate. The water quality mainly pH and dissolved oxygen was again measured on the next day of each sampling and liming with $CaCO_3$ at 1 kg/tank (200 kg/ha) and fertilization with urea (10 kg/ha)+SSP (15 kg/ha) was done as per requirement of tank to maintain the water quality. The fry were fed with powdered mixture of groundnut oil cake (GOC) and rice polish at 1:1 ratio. The daily ration was provided at 8% of the initial biomass during the 1st month followed by 6 and 4% of the estimated biomass during 2nd and 3rd months. Fish sampling was carried out at fortnight intervals. Length and weight of randomly selected 20 fish of each species in every replicate tank were recorded and accordingly the biomass was estimated considering 80% survival level. Fingerlings were harvested after 90 days by repeat netting followed by complete draining and were counted individually for each species.

Table 8. Growth attributes of rohu during fingerling rearing with varied water exchange

Treatment (% water exchange)	Harvested total length (cm)	Harvested body weight (g)	Survival (%)	Net weight gain (g)	Biomass (g)
Catla					
C	8.94±0.065^{a}	8.69±0.045^{a}	51.40±3.14^{bc}	7.11±0.045^{a}	2233.45±145.2^{a}
T-1	8.57±0.072^{a}	6.16±0.067^{b}	55.53±3.97^{b}	4.58±0.067^{b}	1710.43±121.6^{c}
T-2	8.64±0.061^{a}	6.34±0.087^{b}	60.40±2.00^{ab}	4.76±0.087^{b}	1914.68±95.6^{b}
T-3	8.69±0.049^{a}	6.51±0.036^{b}	67.60±2.60^{a}	4.93±0.036^{b}	2200.38±143.8^{a}
T-4	8.82±0.071^{a}	6.76±0.038^{b}	68.40±2.78^{a}	5.18±0.038^{b}	2311.92±134.6^{a}
Rohu					
C1	2.84±0.039^{a}	13.00±0.083^{a}	59.13±2.80^{c}	10.86±0.083^{a}	3843.67±273.1^{ab}
T-1	12.89±0.047^{a}	8.14±0.077^{b}	73.33±3.53^{b}	6.00±0.077^{b}	2984.67±186.3^{c}
T-2	12.99±0.052^{a}	8.83±0.065^{b}	76.07±2.21^{b}	6.69±0.065^{b}	3358.34±336.6^{b}
T-3	12.91±0.041^{a}	9.32±0.081^{b}	78.00±2.84^{ab}	7.18±0.081^{b}	3634.80±385.6^{ab}
T-4	12.81±0.044^{a}	9.78±0.065^{b}	82.47±4.70^{a}	7.64±0.065^{b}	4032.62±234.4^{a}
Mrigal					
C1	3.24±0.021^{a}	14.32±0.094^{a}	61.20±2.91^{c}	11.76±0.094^{a}	4381.92±106.3^{a}
T-1	13.21±0.033^{a}	9.08±0.071^{b}	68.53±3.78^{b}	^{c}6.52±0.071^{b}	3111.41±234.2^{c}
T-2	13.19±0.039^{a}	9.32±0.064^{b}	70.40±1.91^{b}	6.76±0.064^{b}	3280.64±301.3^{c}
T-3	13.17±0.025^{a}	9.87±0.069^{b}	76.00±3.17^{ab}	7.31±0.069^{b}	3750.60±298.5^{b}
T-4	13.25±0.038^{a}	10.46±0.051^{a}	79.33±3.36^{a}	7.90±0.051^{b}	4149.13±211.8^{a}

Fingerling survival in all the three species increased with increasing water exchange up to 80% level while no significant difference ($P > 0.05$) was observed between 80 and 100% water exchange in any species. The overall survival of IMC fingerlings with the 100% water exchange was 19.5, 10.9 and 7.8% higher ($P < 0.05$) than the control, 40 and 60% water exchange, respectively. In all three species, the harvested total length of the fingerlings were similar ($P>0.05$) in all treatments including control ($P>0.05$). However, the harvested body weight of catla (8.69 ± 0.058 g), rohu (13 ± 0.056 g) and mrigal (14.32±0.038 g) in control tanks were significantly higher ($P<0.05$), while the same did not differ significantly ($P>0.05$) among the other treatments despite the varied water exchange schedule. With such results of similar length and weight attainment of fingerlings in different treatments and similar survival between 80 and 100% exchange level, the study recommends 80% water exchange to be the ideal during fingerling production of IMC in concrete tanks.

Table 9. Water requirements for fingerling production of rohu in concrete tanks

Treat-ment	Fingerling produced (no)	Water use (m^3)		Water use /1000 fingerling (m^3)		No. fingerling produced/ m^3 water	
		Gross	Consumptive	Gross	Consumptive	Gross	Consumptive
C	902	66.88	16.88	74.14	18.71	13.5	53.5
T-1	1095	72.75	22.75	66.44	20.78	15.0	48.1
T-2	1142	82.00	32.00	71.80	28.02	13.9	35.7
T-3	1212	94.75	44.75	78.18	36.92	12.8	27.1
T-4	1232	103.00	53.00	83.60	43.02	12.0	23.3

Table 9 represents the water requirement at the various water exchange level for the fingerling rearing. As recommended in the study, the gross and consumptive water requirement at 80% exchange level was estimated at 78.18 and 36.92 m^3 for production of each 1000 fingerlings of the Indian major carps.

Water budgeting for hatchlings production of magur, *Clarias magur*

A study was conducted to estimate the water requirement for production of magur hatchlings. The breeding experiment was conducted at the Catfish Unit of the Institute. The male and female brood fishes (150-160 g) were selected for breeding operation and breeding was carried out as per standard protocol. The male and female were bred 1:1 sex ratio. The fertilized eggs (egg weight: 2.03 mg) were weighed and counted for experiment purpose. The eggs were incubated in hatching tubs (dimensions: 35 cm dia x 7 cm height; water volume- 6 L). The experiment was designed with the following treatment group (W1- 14 h aeration; W2- 28 h aeration; W3- 14 h water flow; W4- 28 h water flow; W5- 28 h aeration + 28 h water flow and W6- No aeration + No water flow). The fertilized eggs were stocked at the rate of 920 eggs/tub. After 28 h of incubation, unfertilized eggs, the viable and deform hatchlings were counted for analysis.

Water samples from each tub were measured for every 7 h between 9.00 am to next day 1.00 pm to record the pH, dissolved oxygen, total alkalinity, free CO_2, ammonia, nitrite and nitrate. The data were subjected to one-way ANOVA and Duncan's multiple range tests ($P<0.05$). All the data values were expressed as mean ± SE. (Table 10)

Table 10. Water requirement during the hatchling production of *Clarias magur*

Treatment	Hatching (Viable) (%)	Hatching (Deform) (%)	Total hatching (%)	Water requirement for 1000 hatchlings production (L)
14 h aeration (W1)	0^a	0^a	0^a	0^a
28 h aeration (W2)	52.82 ± 5.74^b	13.40 ± 2.01^b	66.23 ± 3.73^c	12.67 ± 1.50^a
14 h water flow (W3)	0^a	37.89 ± 5.75^c	37.89 ± 5.75^b	0^a
28 h water flow (W4)	79.67 ± 3.51^c	3.95 ± 0.72^a	83.62 ± 3.79^d	563.67 ± 24.33^c
28 h aeration + 28 h water flow (W5)	86.15 ± 1.89^c	2.10 ± 0.64^a	88.26 ± 2.01^d	519.76 ± 11.36^b
No aeration + No water flow (W6)	0^a	0^a	0^a	0^a

It was observed that the treatment group 28 h aeration + 28 h water flow could produce significantly higher ($P<0.05$) hatching percent (86%) compared to other treatment groups.

Effect of stocking densities on growth and survival of climbing perch *Anabas testudineus* spawn under minimal water exchange

A 21 days experiment was conducted to know the effect of different stocking densities on growth and survival during fry rearing of climbing perch with minimal water exchange. Total 12 FRP tanks of 500 L capacity were filled with 200 L of water and grouped into four treatments. The four treatments T-1, T-2, T-3 and T-4 were stocked differently at 5, 7.5, 10 and 12.5 spawn/L, 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. A total of 320% water exchange was done during the experimental period. The result of the experiment is presented in Table 11.

Table 11. Growth and survival of *Anabas testudineus* seed during fry rearing with minimum water use

Treatments (spawn/l)	No of spawn stocked	Final body length (mm)	Final body weight (g)	No. of fry harvested	Survival (%)
T-1 (5)	1000	17.558	0.099	874	87.4
T-2 (7.5)	1500	16.692	0.083	1149	76.6
T-3 (10)	2000	15.267	0.068	1526	76.3
T-4 (12.5)	2500	16.575	0.074	1363	54.5

Table 12. Water use during fry rearing of *A. testudineus*

Treatment (spawn/l)	No. of fry harvested	Water use (l)		Water use (m^3/1000 fry)		Fry production/m^3	
		Gross	Consumptive	Gross	Consumptive	Gross	Consumptive
T-1 (5)	874	840	640	0.961	0.732	1040	1366
T-2 (7.5)	1149	840	640	0.731	0.557	1368	1795
T-3 (10)	1526	840	640	0.550	0.419	1817	2384
T-4 (12.5)	1363	840	640	0.616	0.470	1623	2130

The study revealed the highest survival in T-1 with the lower spawn density of 5/L, while it was the lowest in T-4 when spawn stocked at 12.5/L. Survival in T-2 and T-3 remained similar at 73.3 and 76.6%, respectively, however, the fry yield in term of number was the highest in the later. Since the number of fry yield is the most important criteria during nursery phase, T-3 is proven to be ideal density for the nursery phase. In terms of water use, T-3 also showed the highest number of fry yield per cubic meter of gross as consumptive water use among the treatments. Therefore, the study recommends a spawn stocking density of 10/L for the nursery rearing of *Anabas*. (Table 12)

Project Title : National network of 'Germplasm Centre for conservation aquaculture'

Project Code : E-96

Funding Agency : ICAR- ACRP on Biodiversity (collaboration between CIFA and NBFGR)

Duration : September, 2015- March, 2017

Project Personnel : P. C. Das (PI), S. K. Sahoo, S. Ferosekhan and S. P. Kamble

With foundation of last year studied information about Mahanadi mahaseer, live fish collection and further rearing in confinement was undertaken as the major activity during 2016-17. Survey on the availability of Mahanadi mahaseer was continued in the Mahanadi stretches of Boudh and Sonepur districts of Odisha. Survey was also conducted for availability of *Puntius sarana, Labeo calbasu* and *Labeo gonius* in the tributaries of Mahanadi in Puri districts (Daya River stretches). Collection of Mahanadi rita and *Bagarius bagarius* were also attempted in the Mahanadi stretches in Cuttack district.

Live fish collection

Total nine visits made in the year during which, primary information collected from the local people on availability, feeding and breeding aspects of the different species listed in the project. Seeds of the following species were collected from the different stretches of Mahanadi in Sonepur, Boudh and Cuttack districts during the year. The following seeds were collected in live condition as presented in the following Table 13.

Table 13. Live fish collected from different locations

Sl. No	Collection Site	Species	Size	No. of fish collected
1	Tel river at Sonepur, Mahanadi stretch at Kudasing, Boudh	*Tor mosal mahanadicus*	Fingerling	1870
2.	Pipili canal on Daya river, Puri	*Puntius sarana*	Fingerling	748
		Labeo calbasu	Fingerling	419
		Labeo gonius	Advance fingerling	26
3.	Mahanadi stretch at Munduli, Cuttack	*Rita chrysea*	Juveniles (80-110 g)	23
4.	Mahanadi stretches at Munduli, Cuttack	*Bagarius bagarius*	Juveniles (70-350 g)	25

Raising of the collected seed of Mahanadi mahseer

The Mahanadi mahseer collected during the 1st and 3rd attempts was maintained in the concrete tanks in the seed rearing complex of Institute farm. The tanks were provided with sand and gravels in the corners. Due to non-availability of information on suitable feed for the fish, different feed supplements such as boiled rice, dough of groundnut oil cake (GNOC), rice bran and fish meal, zooplankton collected from the pond and crushed snails were tried during acclimatization. The combination of crushed snail and boiled rice/sinking fish feed helped in survival of the fish. The fishes were maintained up to 45 days and they reached 12-16 cm and 26-30 g.

Since mahseer is a fast swimmer and may require larger space, it was planned to transfer these fishes to a 0.08 ha earthen stone pitched pond. The pond was prepared as per the standard protocol. Further, bamboo poles were provided in this pond both horizontally and vertically to promote periphyton growth. Pond was covered with 80 mm mesh size monofilament net to prevent predation. Initially, survival of mahseer was checked by fixing hapa in the pond. Fishes were released in the hapa, fed regularly for 4 days. After observing no mortality in hapa, total of 192 fingerlings (12-16 cm, 26-30 g) were released in the pond after due acclimatization. Regular feeding of sinking as well as floating pellets was done in this pond. Occasional observation of fish at surface and feeding on the periphytic substrate grown on the bamboo pole were observed periodically in the pond. However, despite all these activities and observation, no fish was found in the pond in the next sampling conducted in after two months. Such observation indicated the need to study the reason for such mass disappearance of the fish in the confined pond environment. It was further decided that seed collected in the next attempt would be raised in the concrete tank environment to as much larger life stage possible.

During the next season of seed availability, *i.e.,* March, 2017, approximately 1500 mahseer fry/fingerings collected from Mahanadi stretches at Sonepur and Boudh districts, out of which 1200 seed survived after transportation, At present, these seed are being maintained in the concrete tanks.

Raising of the collected seed of *P. sarana, Labeo calbasu* and *L. gonius*

Regular visit to the Pipili canal command for 15 days in the Puri district during middle November, 2016 have yielded collection of sufficient number of these species. At present, these species are being maintained in an earthen pond with regular feeding and maintenance of the water quality.

Raising of the collected fishes of *Bagarius bagarius*

Due to poor availability of this species in the Mahanadi system, only 25 live specimens (150-400 g) have been collected till date out of which 19 survived and are at present maintained in the farm.

Advance fingerling of *Bagarius bagarius*

Project Title	:	Carp seed production and integrated fish farming technology for livelihood development of Phailin affected tribal farmers of Ganjam district, Odisha
Project Code	:	E 102
Duration	:	July, 2016-2019
Funding Agency	:	DST, Govt. of India
Project Personnel	:	B.C. Mohapatra (PI), N. K. Barik and G. S. Saha

Four C.D. Blocks were surveyed for implementation of the project objectives. Those were Kukudakhandi, Sanakhemundi, Digapahandi and Khallikote. In Kukudakhandi, one village namely Kumbhajhari having 40 nos. of ST farmers and 2 nos. of ponds (0.5 acre water area each), and 1 MIP of 4 ha water area were surveyed. Other village namely Nuapada from the same block having 25 nos. of tribal farmers with 2 nos. of ponds (0.4 and 0.5 acres) were also surveyed.

In Sanakhemundi Block, Daseipur village is having one women SHG namely Maa Behera Patra PFWCS with 62 nos. tribal lady members having 4 nos. of ponds (brood ponds: 0.7 and 5.0 acres are; nursery ponds: 0.5 and 0.4 acre area, respectively). In Digapahandi Block, Ambapur village having 2 SHGs namely Maa Gramadevati SHG and Maa Bankeswari SHG were surveyed. Total 17 nos. of farmers were identified. They are having 4 ponds (2 nursery ponds: 0.5 acre area each) and 2 nos. of brood ponds (1.0 and 0.6 acre), respectively. In Khalikote Block, Sujana Sahi having one SHG namely Maa Chandeswari with 30 members were identified under this project. They are having 2 nos. of nursery ponds (0.5 acre each) and 1 brood stock pond (1 acre).

Project Title	:	Cryopreservation of embryonic stem cells and primordial germ cells for transplantation and surrogate fish production
Project Code	:	E-103
Duration	:	May, 2016- April, 2019
Funding Agency	:	DST, Govt. of India and Ministry of Science and Technology, Argentina under INDIA– ARGENTINA Inter-governmental Programme of Cooperation in Science and Technology
Project Personnel	:	P. Routray (PI) and D. K. Verma

Isolation and cryopreservation of fish embryos, blastomeres and PGCs

Isolation and *in vitro* culture of fish embryonic stem cells, blastomeres and male and female germ cells of rohu were carried out to assess the possibility of using those in microinjection for further surrogate fish production. Further, tilapia and rohu embryos were injected with 10% DMSO by microinjection. The microinjected embryos were stored at -20 C for further cryoprocessing. It was noticed that rohu embryos could not sustain the toxicity and no hatching took place. However, only 5% tilapia embryos hatched.

Under this programme, Dr Leandro Andres Miranda, Professor, University of San Martin, Buenos Aires, Argentina visited the Institute. He delivered a talk about Aquaculture in Argentina with special reference to fish reproduction. Further, Dr. P. Routray, Principal Scientist of this Institute visited the laboratory at IIB-INTECH, University of San Martin, Argentina to learn few techniques of micromanipulation of fish embryos. The technique of microinjection using fish embryos of Patagonian pejerrey (*Odontesthes bonariensis*) was conducted. The embryos of the pjerrey were cryopreserved and tested for their viability and hatching.

Project Title	:	Upgradation and dissemination of striped murrel, *Channa striatus* seed production technology
Project Code	:	E-104
Duration	:	July 2016-June 2019
Funding Agency	:	NFDB
Project Personnel	:	Rajesh Kumar (PI), S.Ferosekhan, Mukesh Kumar Bairwa, P. B. Bhakat and U. L. Mohanty

Induced breeding and seed production of striped snakehead, *Channa striatus*

The breeding of striped snakehead, *Channa striatus* was done in the month of July and August 2016 using pituitary gland extract (PGE). The fresh PGE was prepared, and female and male brooders in sex ratio 1:1 were injected at 30 mg/kg body weight and 20 mg/kg body weight, respectively. Hormone injected fishes were released into breeding pool having 40-50

cm of water, but without water circulation. Fishes spawned 16-20 h after the hormone injection. The free floating mustard shaped eggs were collected from top through plankton net and kept for hatching in hatching tank (FRP/concrete). Fecundity of bred fish ranged from 19,210 to 31,621 eggs/kg body weight of female fish. Fertilization and hatching rate ranged from 82-90 and 69-80%, respectively during July and August, but towards the end of the August, the breeding performance started to reduce gradually and breeding could be taken till mid-September.

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

The ICAR-CIFA has developed induced breeding and seed production technology of striped murrel in hatchery condition and trained several prospective fish farmers/entrepreneurs across the country. One such entrepreneur, Mr. Venkata Subramanian from Puducherry had undergone the training program during 26-30 August, 2016. After receiving the hands-on training, Mr. Venkata followed the techniques learnt from this institute and initiated breeding trials with existing murrel broodstock with him. He successfully induced bred striped murrel with HCG injection. In breeding trials, female brood fish weighing about 1 kg spawned 5000-10,000 eggs. The fertilization and hatching rates were 80 and 60%, respectively. The survival of hatchlings after 1 month was between 20 -70% for different batches. Prior to the training, he was struggling to breed striped murrel and post-training he is confident of its breeding and seed production.

DST-Inspire Scheme

Project Title	:	Cryopreservation of male and female germ cells of fish for transplantation
Funding Agency	:	DST-Inspire Scheme
Duration	:	2011-2016
Project Personnel	:	Sunita Patra and P. Routray (Mentor Scientist)

Toxicity and chilling sensitivity of different cryoprotective agents to germ cells of rohu, *Labeo rohita*

Systematic information on the effect of factors likely to influence the GCs cryopreservation such as cryoprotectant toxicity, chilling sensitivity of cells to different temperature regimes was lacking in IMC. In this trial, four permeating CPAs (DMSO, PG, glycerol and EG) were tested. Germ cells of IMC were successfully isolated and DMSO as a cryoprotectant was found to give more than 70% viable GCs of rohu at concentration of 5.0-7.5% compared to other cryoprotectants.

Project Title	:	Development of storage protocol for fish oocyte and their fertilization for seed production
Funding Agency	:	DST-Inspire Scheme
Duration	:	2012-2017
Project Personnel	:	Gayatri Mishra and P. Routray (Mentor Scientist)

In vitro storage of fish oocytes: effect of storage temperature, media conditions and storage duration on fertilization and larval hatchability of Indian major carp, rohu (*Labeo rohita*)

The viability of matured oocytes stored *in vitro* were assessed using carp ovarian fluid (OF) and artificial carp ovarian fluid (ACOF) under different temperature regimes (4, 24, 26, 28 and 30°C) for different storage durations (0, 60, 120, 150 and 180 min). Significantly higher ($P < 0.05$) fertilization (74%) was achieved when the oocytes were stored using ACOF and 65% in OF after 180 min at 28°C. Similarly, the hatching rates of larvae were significantly higher

(P < 0.05) in the ACOF and OF, that is, 64 and 47%, respectively, after 180 min of storage. The oocytes kept in the storage containers with ACOF having 65% moisture level showed a significantly higher (P<0.05) fertilization rate than the 59% moisture level. This study demonstrated that unfertilized matured oocytes (eggs) of rohu can be stored *in vitro* for 180 min without compromising the viability (fertilization and hatching) to a great extent in OF and ACOF.

Project Title	:	Factors affecting germ cell proliferation and maturation in fish
Funding Agency	:	DST-Inspire Scheme
Duration	:	2014-2019
Project Personnel	:	Bibekananda Panda and P. Routray (Mentor Scientist)

Effect of temperature on the survival and germ cell proliferation of tilapia (*Oreochromis niloticus*)

Elevated water temperature was found to be depleting the germ cells of tilapia and carps. Further evaluation of haematological parameters of different populations of tilapia (*O. niloticus*) collected from three different geographical locations of India *viz.*, Odisha population, West Bengal population (WB) and Gujarat population from Rudramata Dam site of Bhuj reservoir (RM) showed that there was no significant difference (P<0.05) in the survival patterns of different populations of tilapia raised at elevated water temperature.

Project Title	:	Ecology, spawning and culture possibilities of small indigenous fish species, *Amblypharyngodon mola*
Funding Agency	:	DST-Inspire Scheme
Duration	:	2015-2020
Project Personnel	:	Suchismita Nayak and P. Routray (Mentor Scientist)

Challenges in breeding and culture possibilities of a nutrient rich small indigenous fish (SIF), *Amblypharyngodon mola*

Mola (*Amblypharyngodon mola*) commonly known as mola carplet is a nutrient-dense, indigenous small freshwater fish found almost in all freshwater water bodies including seasonal water bodies. In our study, we aimed to domesticate this species in indoor systems and bred them in captivity. Total 1500 numbers of live mola were collected from different locations of Puri and Khorda districts of Odisha and transported to ICAR-CIFA hatchery under oxygenated polyethylene packaging. As they are delicate and small, a mortality of more than 50% was noticed after first day of rearing after transport. A growth attainment of 2.5 g was attained after a culture period of 3 months from the initial stocking size of 0.9 g. The fishes were reared in a small re-circulatory aquaculture system for auto-breeding. However, it was noticed that spawning did not took place. So the males and females were separated and mated after 10 days. This resulted in egg release and successful spawning. However, in the absence of a protective environment such as weed or glass balls, eggs were eaten up by the parents very quickly.

B. Fish Genetics and Biotechnology

Project Title	:	Genetic upgradation of freshwater fish and shellfish
Project code	:	I-59
Sub-project	:	Development of genomics resources in Indian major carp, *Catla catla*
Project Code	:	I-59 I
Funding Agency	:	Institute-based
Duration	:	April 2013 – March 2017
Project Personnel	:	Laxman Sahoo (PI), P. Das, P. K. Meher, K. Murmu and J. K. Sundaray

Towards development of linkage map in catla, SSR loci were subjected to informativeness screening. Out of 300 loci screened, 93 loci were found to be informative. Validation of heterozygous SNP markers detected earlier in catla was performed employing Sanger's sequencing. Out of 20 SNP loci, sequence data for 17 loci were obtained. Out of 17 heterozygous SNP loci subjected to validation, only one locus was found to be true SNP. The result of the present study demonstrated that identification of heterozygous SNPs may not be a suitable method for

SNP marker discovery in aquaculture species. The genomics resources developed so far would facilitate generation of genetic linkage map and identification of quantitative trait loci in this species.

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 2017
Project Personnel	:	P. Das (PI), Laxman Sahoo, P. K. Meher, K. Murmu and P. L. Sanga (up to 2016)

Restriction associated DNA (RAD) sequencing technique was adopted towards identification of single nucleotide polymorphism markers in *Labeo rohita* and *M. rosenbergii*. Approximately 30 GB and 40 GB of RAD sequence data were generated for rohu and *M. rosenbergii,* respectively. In total, 0.2 million and 0.26 million of SNPs were identified in rohu and *M. rosenbergii*, respectively. To enrich the above database, ~28 GB of RNA-Seq data (trait specific) were generated. Additionally, 1,85,851 SSRs were identified in *M. rosenbergii* and primers for 500 SSRs have been synthesized for linkage map construction. Out of 500 loci, 366 loci produced unambiguous PCR product. Informative screening in the mapping parents is in progress. The SNP resources developed would pave the way towards development of SNP genotyping array in these two species.

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

Male and female Jayanti rohu of 2^{+} years old from the 2012 year class, weighing 1.46 –1.47 kg having no external symptoms of gonadal maturity were stocked in two 0.1 ha earthen ponds with an average water depth of 2 m at 2500 kg/ha (170 fish/pond). They were fed twice daily at 3% of body weight for 90 days during 19th February to 18th May 2016 to compare the effects of brood stock diet, "CIFABROOD™" with a control commercial diet on reproductive performance of rohu females. Analysis of water quality showed most of the parameters remained within normal range, except dissolved oxygen 2.60±0.34 (mg/L) in control pond and 2.26±0.61 (mg/L) in the experimental one. Histological observation of ovary after 45 days in first sampling showed oocytes in previtellogenic stages (stage II) with GSI value of 1.6±0.62 in control pond, while the fishes in the experimental pond had reached to vitellogenic stages (stages III) and the GSI value was 3.5±0.56. Higher levels of estradiol (845.66±183.6 pg/ml) and progesterone (1.72±0.27 ng/ml) were observed in CIFABROOD™ fed females as compared to 432.16±117.3 pg/ml and 0.82±0.24ng/ml in control. At end of experiment, fish fed on CIFABROOD™ showed the higher GSI value (11.77±0.58) over control (10.15±0.44) and ovaries were at the final maturation with mature oocytes and yolk globules in both treatments. Estradiol level increased to 648.12±166.8 pg/ml in control pond compared to 462.68±151.3 pg/ml in CIFABROOD™ while progesterone level was higher (0.54±0.09 ng/ml) in CIFABROOD™ pond as compared to control (0.27±0.05 ng/ml). Spawning response was observed with shorter (5 h) latency period in CIFABROOD™ fed fish compared to 8 h in case of control diet. Average egg diameter was 4.71±0.31 mm and 4.66±0.179 mm in CIFABROOD™ and control diet, respectively. Average milt output was 8.75±1.89 ml in CIFABROOD™ fed group compared to 7.87±1.60 ml in the control males. Higher average length of 4.6±0.1 mm for the freshly hatched larvae was obtained in CIFABROOD™ fed fishes compared to 4.0±0.2 mm in the control. Fertilization and hatching rates were 92.0±1.8 % and 71.50±9.19 % in CIFABROOD™ compared to 89.0±3.56% and 63.62±13.19 %, respectively, in the control diet. In conclusion, the

present study has demonstrated that CIFABROOD™ diet enhanced phenotypic and gonadal maturation, and facilitated better spawning and growth of the larvae.

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 (Upto 28 February, 2017), P.K. Sahoo, K. Murmu, L. Sahoo, Priyanka Nandanpawar and Avinash Rasal

Production and dissemination of 2016 year-class improved catla spawn

Out of 2.75 lakh spawn produced, 0.75 lakh improved Catla spawn were supplied to NFFBB, Kausalyaganga. Further, 2.00 lakhs improved spawn have been disseminated to 4 districts (Cuttack, Khurdha, Jajpur and Jagatsinghpur) of Odisha and Tamil Nadu for growth evaluation.

Jayanti rohu production and dissemination in the year 2016

Fifty-one improved rohu fullsib families and resistant line of rohu against aeromoniasis were produced in the year 2016 taking sire and dam were from 2013 and 2012 year-class improved rohu. They were reared in nursery ponds for taggable size. After tagging with Passive Integrated Transponder tag, the tagged fishes were stocked in three replicate ponds (Communal rearing) for further growth evaluation. Apart from the fullsib families produced, 104.75 lakh "Jayanti" spawn were produced during the year.

Dissemination

Under the dissemination program, 47.75 lakh spawn were disseminated to six different districts of Odisha and 46.00 lakh spawn disseminated to eight different states that includes West Bengal, Chhattisgarh, Tamil Nadu, Andhra Pradesh, Assam, Bihar, Kerala and Maharashtra. Advanced fingerlings were also supplied to different states like Gujarat and Karnataka for breed improvement programs. (Table 14)

Table 14. Details of dissemination of *Jayanti* rohu spawn in India during this year

State	No. of spawn disseminated (lakh)
Odisha	47.75
West Bengal	12.00
Chhattisgarh	0.75
Tamil Nadu	1.00
Andhra Pradesh	6.00
Assam	8.75
Bihar	13.00
Kerala	1.00
Maharashtra	3.50
Total	93.75

Disease resistance against *A. hydrophila* infection

Under the disease resistance against aeromoniais program, 25 rohu families and resistant group were challenged with *A. hydrophila* during May, 2016. Total 440 numbers of individuals were challenged in duplicate. Survival (%) in first challenge experiment ranged from 0-76.9% within families with 55.76% total survival. Survival (%) in second challenge experiment ranged from 0-80% within families with total survival of 69.96%. The peak period of mortality was 7-10 h after injection. Average survivability varied from 25-85% (Fig.14). The survived individuals (255 nos.) after treatment with antibiotics were transferred to the separate rearing pond. Sire and dam of the challenged families were also included in the data analysis. Tissue collection was done from muscle for further genotyping.

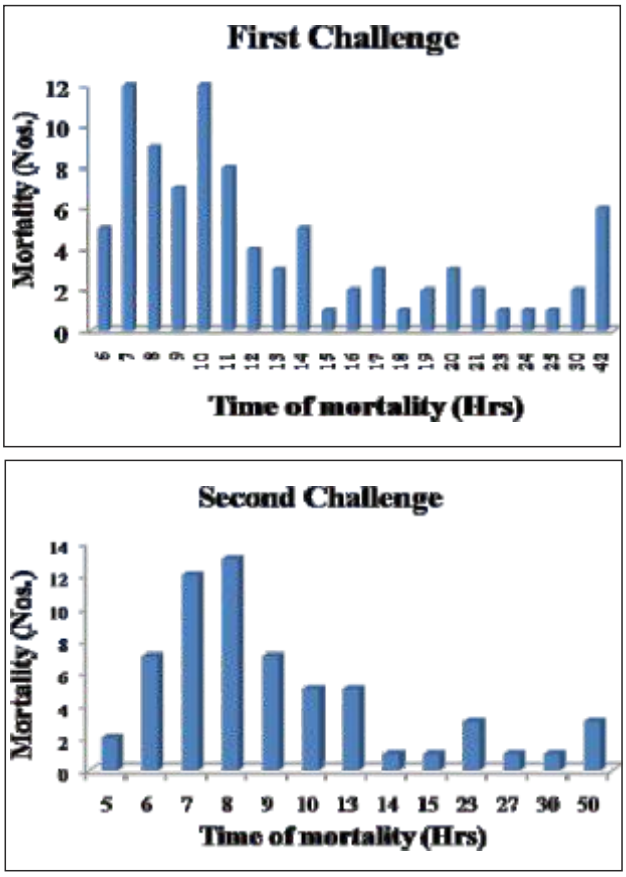


Fig. 14. Results of challenge studies against *A. hydrophila*

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

ICAR-CIFA is continuing the breeding programs of Jayanti rohu, improved catla and freshwater prawn, and supplying seed to NFFBB for further rearing and dissemination. Further, under the project, medium carps and *C. batrachus* seed were also provided to the broodbank for further dissemination.

Table 15. Seed supplied to NFFBB, Kausalyaganga from ICAR-CIFA during the year 2016-17

Name of the species	Quantity of seed supplied (lakh)
Jayanti Rohu (*Labeo rohita*)	4.00
Improved catla (*Catla catla*)	0.75
Puntius gonionotus	0.03
Magur	0.01
Scampi (*M. rosenbergii*, 7th generation)	0.01

From the supplied seed, NFFBB has disseminated fingerlings to different parts of the country in collaboration with ICAR-CIFA as details below.

Table 16. Dissemination of ICAR-CIFA's improved fingerlings through NFFBB (in nos)

State	Jayanti rohu	Improved catla
Odisha	1700	1200
Telangana	750	
Andhra Pradesh	20,000	29,000
Total	22,450	30,200

ICAR- CIFA in collaboration with NFDB, Hyderabad has organized awareness workshop on "Importance of quality fish seed and growth evaluation of Jayanti rohu in low saline water" on 27 February, 2017 at Madanganj, Kakdwip, West Bengal. The awareness workshop was conducted to sensitize the fish seed

Growth evaluation of Jayanti rohu in low saline water (4-6 ppt)

producers, fish hatchery owners, farmers, and other stakeholders on the importance of quality fish seed and adoption of Jayanti rohu in low saline water to increase the farm production. ICAR-CIFA being breeding nucleus has supplied Jayanti rohu spawn to Mr. Debaki Nandan Patra, fish farmer from Madanganj. After one year, it was observed that in low saline water (4-6 ppt) Jayanti rohu grew 1.5 kg and above in comparison to normal rohu 0.8-0.9 kg in the same period. Interestingly no incidence of disease particularly argulosis to Jayanti rohu in low saline water was reported.

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 2017

Project Personnel : P. Das (PI), P. Jayasankar (up to January, 2017), L. Sahoo and P. K. Meher

In an attempt to improve the genome assembly of rohu and magur, different software/programs were evaluated and MaSuRCA was found to be suitable for whole genome assembly of rohu and magur. The program SSPACE was used for scaffolding of the contigs generated by MaSuRCA. The number of contigs, N50, largest contig and mean contig size were 284908, 80342, 9890444, 4499 and 282137, 61864, 3736085, 3912 in rohu and magur, respectively. The assembly statistics were presented in the below tables. An additional data of ~30 GB (paired end) generated in rohu had no noticeable improvement in assembly quality.

Table 17. Assembly statistics of rohu and magur

Assembly details	Rohu	Magur
No. of contigs	284908	282137
No. of bases in contigs	1,281,928,643	1,103,951,620
N50	80342	61864
Largest contig	9890444	3736085
Mean contig size	4499	3912
Largest contig (Len > 500)		
No. of contigs	183787	182594
No. of bases in contigs	1212211356	1063204338
Mean contig size	6595	5822

Towards enrichment of linkage map in rohu, 214 out of 770 SSR loci screened were found to be informative. The 214 informative loci were fluorescently labeled and genotyping of the mapping panel with fluorescently labeled primers are in progress. Additionally, primers for 1000 SSR loci were designed and synthesized. Similarly, in magur 203 informative loci were fluorescence labeled and genotyping for 115 loci in magur mapping family was completed. Linkage analysis of genotyping data of 42 SSR loci resulted in 10 linkage groups. Number of loci in linkage groups ranged from 2 to 3. In addition to the above work primers for 500 loci were designed and synthesized. Various tissues of magur were collected and kept in -80^{0}C for further processing,

Project Title : Molecular and computational approach to delineate metabolic pathways 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 (up to January, 2017), S. Nandi, P. K. Meher, L. Sahoo, K. D. Rasal, U. K. Udit, P. Nadanpawar, Avinash R. Rasal, (Co-Centre, IASRI: Dinesh Kumar (PI) M. A. Iquebal, Sarika and U. B. Angadi)

In total, 50 tissue samples (brain, muscle, kidney, liver and intestine) were collected from different groups of feeding trials processed for transcriptome sequencing on Illumina Nextseq 500 next generation sequencing platform and 350 GB (PE) data has been generated. The assembly and analysis of data are under progress. In addition to this, miRNAs and their targets were investigated by high-throughput sequencing of 10 liver tissues of rohu and bata of the same feeding experiment. Total RNA was extracted and small RNA sequencing libraries were prepared and sequenced on Illumina NextSec500. In total 451 known and 354 novel miRNAs were identified and 19 miRNAs exhibited differential expression (11 up-regulated and 8 down-regulated). The targets of differentially expressed miRNA were found to be genes involved in metabolic pathways such as ATP/GTP binding, glucose-6-phosphate isomerase activity, fatty acyl-CoA binding, phosphopyruvate activity, NAD activity, etc. At the same time, in continuation of earlier work on rohu insulin assay commercially available kit, antibody failed to detect any binding with the rohu serum. Hence, two peptides were designed against the most potent epitopes in rohu insulin sequence (predicted). The peptides were synthesized and antibodies raised in rabbit. However, no cross reactivity was observed with rohu serum either in indirect or sandwich ELISA, although the antibodies produced showed strong signal with the peptides injected. Therefore, the nucleotide sequence was codon optimized for recombinant expression in *E.coli* with pET28a expression vector. Six histidine codons were inserted at the N-terminal end of the recombinant insulin insert synthesized by GenScript. Once again the ligated insert failed to show detectable levels of insulin protein expression. Finally, the insulin template has been synthesized putting His-tag codons at the C-terminal end, ligated with the vector and the expression trial is presently under progress.

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 (up to January, 2017) and P. Das

The third batch consisting of five trainees has successfully completed the training during 2 May, 2016 to 1 August, 2016. The fourth batch consisting of five trainees has started on 15 February 2017 and is continuing. Faculty members of different disciplines of molecular biology and biotechnology were involved in both theory and practical classes for this training programme. The broad area of theory and practical classes were application of Biotechnology in Fisheries and Aquaculture. The participants who had undergone training in previous batches have been designing their own training plans and programs, and also motivated others to participate as well. The training has helped them to stimulate creative thinking along with their personal growth in different aspects of biotechnology. (Table 18)

Table 18. Participants of 3rd & 4th batch training programme and assigned projects

Sl. No.	Name & designation	Research work completed
1.	Dr. Sunita Nayak, Assistant Professor IMS & SUM Hospital, SOA University, Bhubaneswar, Odisha	Molecular diagnosis of Sickle cell anaemia of adolescent tribal girls
2.	Dr. Kamlesh Shukla, Assistant Professor, Pandit Ravishankar Shukla University, Raipur, Chattisgarh	DNA barcoding of selected Indian eel species
3.	Mr. Kaustubh Bhagawati, Assistant Professor, College of Fisheries, Assam Agricultural University, Assam	Genome walking technique of PLZF gene in *Labeo rohita*
4.	Miss. Husne Banu Scientist, ICAR-CIFE, Mumbai, Maharastra	Molecular diagnosis of *beta-noda* virus in Asian seabass

5.	Dr. Nityananda Das Associate Professor, College of Fisheries, OUAT, Rangailunda, Berhampur, Odisha	Molecular diagnosis of KHV, SVCV and different bacterial pathogens
6.	Dr. Mahesh Chandra Sahu, Postdoctoral Fellow, Directorate of Medical Research, IMS & Sum Hospital (Faculty of Medical Sciences), Siksha 'O' Anusandhan University, Kalinga Nagar, Bhubaneswar, Odisha	Development of molecular markers for early detection of amoxyclav and ciprofloxacin resistant strains
7.	Dr. Arun Sharma, Scientist(Fish Health), CIFE Kakinada Centre, Freshwater Fish Farm, Kakinada Port, Kakinada, Andhra Pradesh	Application of DNA based tools in disease diagnosis in aquaculture
8.	Dr. Thongam Ibemcha Chanu, Scientist(Aquaculture), CIFE Kakinada Centre, Freshwater Fish Farm, Kakinada Port, Kakinada, Andhra Pradesh	Different approaches of application of nanoparticles in aquaculture
9.	Mr. Managobinda Rath, Computational Biologist, Imgenex India (P) Ltd.,Bhubaneswar- 751024, Odisha, India	Pharmacophore design by Schrodinger
10.	Dr. Purushottam Mishra, Manager, Goat Breeding Farm, Salapada, Keonjhar- 758020, Odisha, India	Genetic diversity of goat populations of Keonjhar and adjoining areas

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 – March 2018
Project Personnel	:	H. K. Barman (PI), J. K. Sundaray

Molecular cloning, characterization and functional validation of Plzf gene promoter of *L. rohita*

In continuation with the previous year, the multiple promoter activity of Plzf gene of *L. rohita* was verified through dual luciferase activity test. The P5 construct which was present 6 kb upstream to the ATG start codon had the activity along with 2.2 kb fragment found earlier. In order to define the mechanisms responsible for the regulated expression of *L. rohita* Plzf gene, we had also attempted to validate the multiple promoters by means of transgenic approach. For this purpose, two TOL2-Plzf constructs (such for P5 and 2.2 kb fragments) were made available using Transposon system. The sequence information for those constructs were verified by bi-directional sequencing. Experiments were being undertaken to micro-inject these Tol2 constructs in zebrafish so as to measure the reporter gene (GFP) expression level. Along with these, we could successfully prepare three new deleted reporter vector constructs of P5 (0.97 kb, 0.8 kb and 0.7 kb)

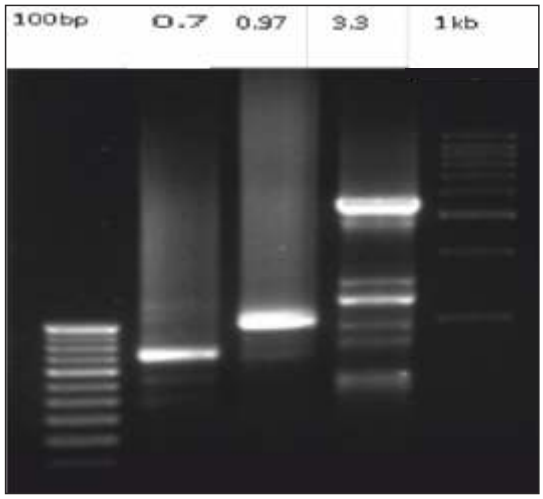


Fig. 15. Agarose gel electrophoresis of newly synthesized fragments

and another new reporter vector constructs of size 3.3 kb. *XhoI, KpnI*, *NheI* and *HindIII* restriction enzymes were being used to digest the newly synthesized fragments as well as digestion of PGL4 vector for construct preparation. These four new constructs were being amplified with *EcoRV* genome walking library using Genome Walker™ kit (Clontech) as per manufacturer's instructions.

Project Title	:	Novel approaches towards vaccine development against argulosis in carps
Project Code	:	E-97
Funding Agency	:	ICAR (Consortia Research Platform on Vaccines and Diagnostics)
Duration	:	August, 2015 –March, 2017
Project Personnel	:	J. Mohanty (PI), P. K. Sahoo, M. R. Badhe

The immunodominant proteins of fish ectoparasite, *Argulus siamensis* were investigated by 2D gel electrophoresis followed by western blotting. The blot was developed immunologically with fish (rohu) antisera against *Argulus* whole homogenate. Fourteen corresponding spots to the spots developed in the blot were picked from a silver-stained 2D gel for mass spectrometric analysis by MALDI-TOF-TOF (MS/MS). Identification of proteins was carried out by databank search using Mascot search engine against NCBIprot database (taxonomy: other metazoa). Antigenicity of the identified proteins was bioinformatically analysed by online VaxiJen server for antigenicity (threshold: 0.5). Also, the amino acid similarities of these proteins were checked with teleost fishes in BlastP with an objective to distinguish the parasite proteins from host proteins. Based on above analyses, six proteins were identified for further bioinformatics analysis for selection of antigenic epitopes. The proteins were analyzed by Immune Epitope Database (IEDB) resource for predicting linear B cell immune epitopes and one peptide was identified as a potential candidate for vaccine against argulosis in carps.

Project Title	:	Development of a RNA interference-based silencing approach targeting *lectin (s)* gene transcripts in freshwater prawn, *Macrobrachium rosenbergii* and its implications as a biothe-rapeutant
Project Code	:	E-106
Funding Agency	:	DBT
Duration	:	September 2016 – September 2019
Project Personnel	:	J. Mohanty (PI), B. B. Pattanaik (TACT, Bhubaneswar)

Serum samples from adult prawn *M. rosenbergii* were collected and preserved at -20 °C. The haemagglutination (HA) test with serum samples were standardized with rabbit RBCs and the HA titre was found to be 32. The calcium ion dependency of this serum haemagglutinin was studied by HA test and found that the haemagglutin was completely dependent on calcium ion for its binding to erythrocytes. Thus, the haemagglutinin present in prawn serum samples is possibly a C-type lectin. The pH and thermal stability of the haemagglutinin in serum samples were also studied by HA. The serum haemagglutinin was found to be quite resistant to temperature as up to 40 °C and to a wide pH range of 5 to 10. The competitive inhibition of HA activity in serum samples were evaluated with various sugars and glycoproteins, and only N-acetylneuraminic acid and fetuin were found to inhibit the HA activity at a minimum inhibitory concentration of 50 mM and 0.31 mg/ml, respectively.

OUTREACH PROJECT

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

In total, 72 fin samples of *Tor khudree* from Periyar, Kerala (15), Kanhan, Maharastra (30) and Shivmoga,

Karnataka (27) were collected and preserved in 95% alcohol. In addition to this, 42 fin samples of *Pangasius pangasius* were collected from River Mahanadi. So far, high molecular weight genomic DNA from 15 samples from River Periyar, Shivmoga (27) and 21 samples from River Kanhan were isolated and quantified followed by species reconfirmation using the mitochondrial COI gene. Out of 15 samples collected from River Periyar, 6 were found to be *Tor malabaricus* and rest 9 were *Tor khudree*. Similarly, DNA from 42 samples of *Pangasius pangasius* from River Mahanadi was isolated and quantified. Genetic diversity analysis of *Tor khudree* samples collected from Bellary and Shivmoga using mitochondrial ATPase 6/8 gene showed significant genetic differentiation (F_{ST} 0.57646) between the two populations. The project also deciphered complete mitochondrial genome sequences of 15 commercially important freshwater species (Table 19).

Table 19. Complete mitochondrial genome sequences of 15 commercially important freshwater species

Sl. No.	Species	GenBank accession number
1.	*Mastacembelus armatus*	KX950697
2.	*Anabas testudineus*	KX950694
3.	*Cirrhinus reba*	KX950695
4.	*Channa striatus*	KX177965
5.	*Etroplus suratensis*	KU301747
6.	*Horabagrus brachysoma*	KU870467
7.	*Labeo bata*	KX950696
8.	*Mystus cavasius*	KU870465
9.	*Mystus aor*	KX950699
10.	*Mystus vittatus*	KX177968
11.	*Tor khudree*	KX950700
12.	*Tor mosal mahanadicus*	KU870466
13.	*Macrognathus pancalus*	KX177966
14.	*Pangasius pangasius*	KX950698
15.	*Puntius pulchellus*	KX177967

Women and DST Inspire Scheme

Project Title	:	*In vitro* propagation of spermatognoial stem cells (SSCs) of *Clarias batrachus* and production of fertile sperms from the propagating SSCs
Funding Agency	:	DST Inspire Scheme
Duration	:	2014-2018
Project Personnel	:	Swapnarani Nayak, H. K. Barman (Mentor Scientist)

In continuation with the previous year, the successful enrichment of the Magur SSC was carried out. The sorted cells were capable of proliferating *in vitro* conditions. The morphometric characteristics revealed typical features of spermatogonia forming clumps, remained loosely attached to the surface, as observed under microscope. In teleost, the evidence regarding *plzf* promoter and its activity was lacking except that of rohu (*Labeo rohita*). Attempt was made to characterize the *Plzf* gene promoter (Promyelocytic Leukemia Zinc Finger) known to be stem cell self-renewing marker gene of *C. batrachus*. The promoter sequence containing regulatory elements of *Plzf* gene was found out. To isolate promoter, the 5'-upstream region of the *Plzf* gene was amplified using Genome WalkerTM kit (Clontech) as per manufacturer's instructions. Briefly, the genomic DNA was extracted from magur liver. Four restriction-enzymes (*Dra*I, *Eco*RV, *Pvu*II and *Stu*I) libraries were constructed using PCR based Genome Walker Universal Kit (Clontech, USA) and amplified with a gene specific reverse primer (5'-ctgattggccttgtgcagcagcgca -3') followed by a nested reverse primer (5'- aacgtctccgtaacccgccaggccaa -3') following manufacturer's protocol. Finally, *Stu*I library generated a single band of *3.6 kb that was gel-excised, purified, cloned into pGEMT-Easy vector (Promega, USA) and bi-directionally sequenced. About 3.6 kb sequence of 5' upstream region relative to ATG start codon was generated by genome walking using gene specific primers and confirmed by sequencing. Data analysis showed that the 5'-UTR region having a transcriptional start site (TSS)

comprises of non-coding exons. For analyzing regulatory elements in the putative promoter region, MatInspector tool (http://www.genomatix.de/) and TFSEARCH (http://www.cbrc.jp/ research/ db/TFSEARCH.html) were applied together to make a comprehensive prediction. Interestingly, computational analysis revealed several important putative elements like vertebrate TATA binding protein factor (VTBP), myeloid transforming protein (Evi-1), myoblast determining factors (MyoD), AT-binding transcription factor (ATBF), myocyte-specific enhancer binding factor (MEF2), special AT-rich binding protein (SATB), activator/repressor binding to transcription initiation site (YY1F), general transcription factor IID initiator (TFIID), cell cycle regulator/ cell cycle dependent element (CDEF), RNA polymerase II transcription factor II B, recognition element (TFIIB) lye in the upstream sequence above transcriptional start site (TSS) and identified as potential promoter. Growth factor independence transcriptional repressor (Gfi1) was also found downstream to the TSS, which functions as the negative regulator of *Plzf* gene expression. Along with CAAT boxes, GATA binding factor, Krueppel like transcription factors (KLFS) were situated downstream to the TSS.

Verification of *Plzf* promoter activity

Taking clues from the computational analysis, attempts were made to verify the promoter activity *in vivo* of *Plzf* gene of *C. batrachus*. For this purpose, various deleted constructs of regulatory regions were prepared by fusing to a luciferase gene (*luc2* gene) of pGL4-basic vector (Promega, USA). The reporter construct (Plzf_3.0/luc4) contained all elements (full length) of the regulatory region ?996/+1967 from an amplified fragment (*3.6 kb fragment found earlier is used as template for all the construct fragment amplification) designated as construct 1 (C1). Seven other deleted constructs spanning from?996/?6 (Plzf_1.0/luc4),?659/+5 (Plzf_0.7/luc4), +228/+1967 (Plzf_1.7/luc4), +833/+1967 (Plzf_1.1/luc4), +1331/+1967 (Plzf_0.6/luc4), ?1001/+1654 (Plzf_2.7/luc4) and ?656/+1654 (Plzf_2.3/luc4) were prepared using different primer combinations and designated as C2, C3, C4, C5, C6, C7 and C8 respectively (Table 20). The above constructs were made from PCR amplified products. Desired restriction enzyme sites were incorporated in the primers by modifying bases (as underlined within restriction sites). All the amplified construct fragments were digested with fast digest restriction enzymes *Kpn*I-*Hind*III, *Sac*I-*Hind*III, *Sac*I-*Hind*III, *Sac*I-*Hind*III, *Sac*I-*Hind*III, *Xho*I-*Hind*III and *Xho*I-*Hind*III (Thermo fisher Scientific, USA) and ligated into the specific respective sites of the pGL4-Basic vector to prepare the respective constructs for dual luciferase assay. The right orientations of promoter constructs were validated by bidirectional sequencing.

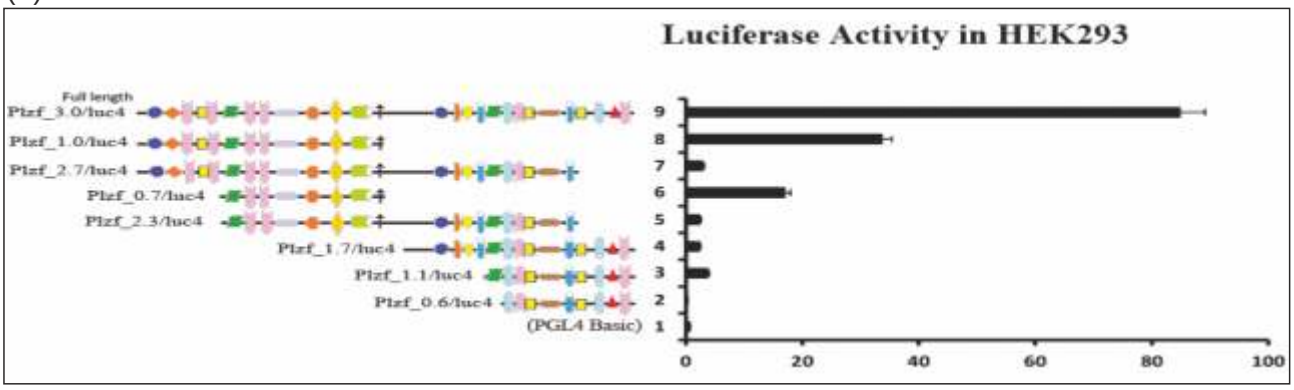
Luciferase reporter assay was performed for various deleted constructs (as above) to measure their independent promoter activity. After transfection with HEK293 (Human Embryonic Kidney cells) cell line the construct Plzf_0.7/luc4 displayed *luc* activity (24-fold), having promoter driving capability. This fragment contained TATA Box (VTBP), SATB, YY1F, TFIID, CDEF, TFIIB regulatory elements and lye in the upstream sequence above transcriptional start site. The promoter activity for the Plzf_1.0/luc4 construct increased up to 48-fold than Plzf_0.7/luc4 construct, indicating the presence of enhancer element. This is possible since it contained a putative Evi-1 like factor present upstream to the transcriptional start site, which has proven to be pertaining to Plzf promoter enhance. The construct Plzf_3.0/luc4 is the full length promoter, comprising of above two element, showed maximum promoter activity since luciferase expression was heightened by 121-fold as compared to Plzf_0.7/luc4 and Plzf_1.0/luc4 respectively. The possible reason could be due to the presence of additional positive regulatory elements such that of Evi-1, MyoD, TATA Box, SATB, MEF2, YY1F, TFIID, CDEF, TFIIB, CAAT boxes, GATA binding factor, Krueppel like transcription factors (KLFS) (Fig. 16).

Moreover, we could identify the region acting as a transcriptional repressor (Gfi1), since the construct Plzf_2.7/luc4 and Plzf_2.3/luc4 containing Gfi1 element displayed minimal luciferase expression level.

Table 20. Construct details used to study *Plzf* promoter activity

Sl. No	Construct Name	Size (Kb)	Position	Forward Primer	Reverse Primer
C1.	Plzf_3.0/luc4	3.0	?996/+1967	acaggtaccagagattgttgcctc *KpnI*	tgatccgagttacagtgtgcca
C2.	Plzf_1.0/luc4	1.0	?996/?6	*acaggttggagagctcgttgcctc*	*Sacl*tacagagcgaagcttca cagtaccc *HindIII*
C3.	Plzf_0.7/luc4	0.7	?659/+5	atgcgtgagctcgagcagaa	*Sacl*gactcaagcttacagagcgca *HindIII*
C4.	Plzf_1.7/luc4	1.7	+228/+1967	*SacI* site present within the mentioned position of *3.6 kb sequence	*HindIII* site present within the mentioned position of *3.6 kb sequence
C5.	Plzf_1.1/luc4	1.1	+833/+1967	acgtgtttcgtgcgagctccaaa	*Sacl*tgcgaaccctgaaagtgttgcat
C6.	Plzf_0.6/luc4	0.6	+1331/+1967	ttgtgagctctataagcctaaaa gggcatt *SacI*	tgcgaaccctgaaagtgttgcat
C7.	Plzf_2.7/luc4	2.7	?1001/+1654	acaggctcgagagattgtt gcctc *XhoI*	caacagtgtaagctttggtgt *HindIII*
C8.	Plzf_2.3/luc4	2.3	?656/+1654	atgcgtgaactcgagcagaa *XhoI*	caacagtgtaagctttggtgt *HindIII*

(A)



(B)

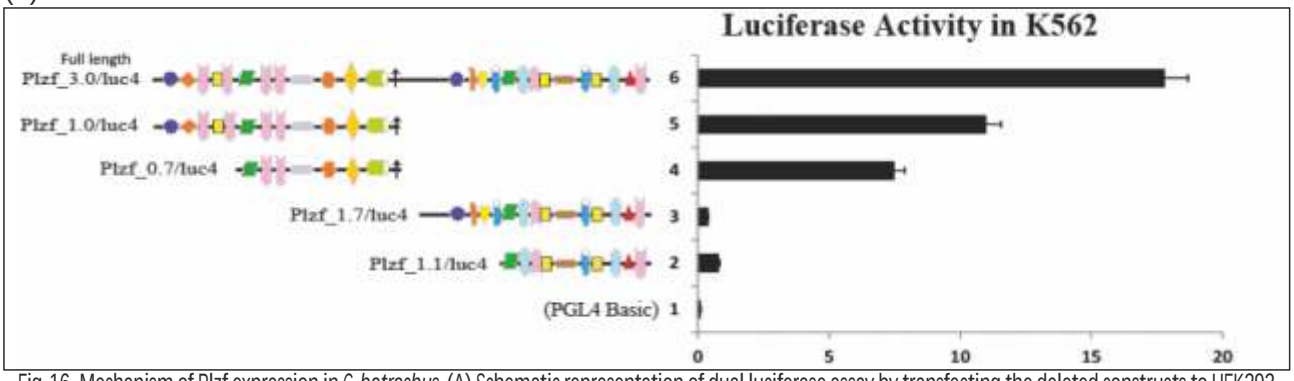


Fig. 16. Mechanism of Plzf expression in *C. batrachus*. (A) Schematic representation of dual luciferase assay by transfecting the deleted constructs to HEK293 cell line (B) Dual luciferase assay by transfecting the deleted constructs to K562 cell line. All the experiments were performed in triplicates and the mean value was taken for representation of data. Different transcription factors are mentioned and the expression level of each construct is pictorially represented at the right side.

TOL2 construct preparation

In order to define the mechanisms responsible for the regulated expression of a *C. batrachus Plzf* gene, we have also attempted to validate the promoter activity by means of transgenic approach. For this purpose, one TOL2-*Plzf* construct (of C2) was made available using Transposon vector system. The sequence information for this construct was verified by bi-directional sequencing. Experiments are being undertaken to micro-inject these Tol2 constructs in zebra fish so as to measure the reporter gene (GFP) expression level.

Phylogenetic Analysis

The BTB domain of *Plzf* protein is highly conserved across the species showing almost complete homology. To gain insight into phylogenetic relationships of *Plzf* protein, the deduced aa sequence of *C.batrachus* was analyzed with its full-length homologs in other species as shown in Fig. 17. Bootstrap analysis and consensus trees obtained from Neighbor Joining analysis showed clear genetic separation of fishes from mammals (Fig. 17). All mammalian species clustered together. *Plzf* sequence of *C. batrachus* is clustered in between *L. rohita* and *Gallus gallus*.

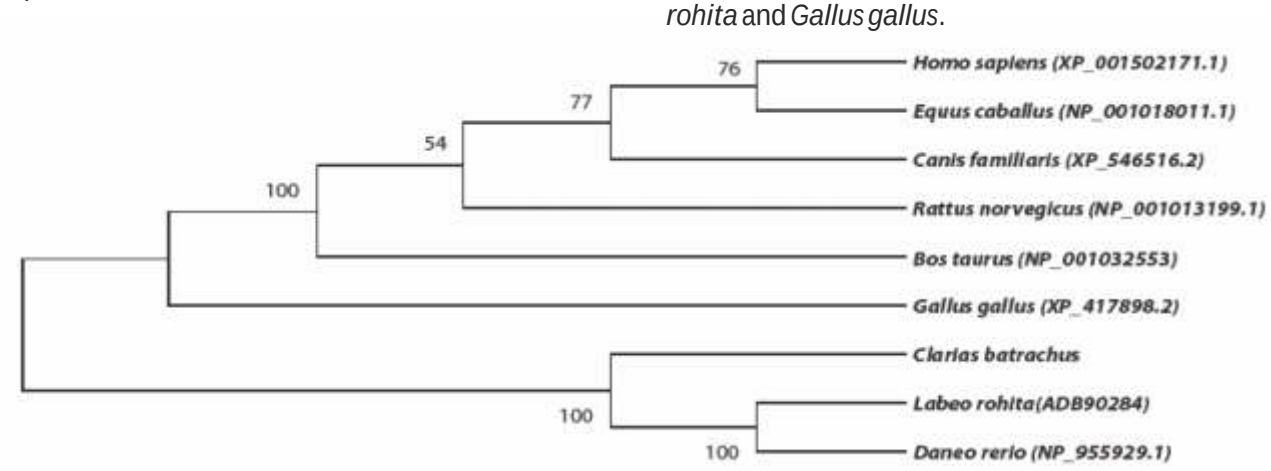


Fig. 17. Neighbor joining consensus tree of predicted aa sequences of *Plzf* for mammals, rodents, chicken and fish generated using Maximum Composite-Likelihood method with 1000 replicates for bootstrap analysis. GenBank accession numbers are indicated in parentheses.

C. Fish Nutrition and Physiology

Sub-project	:	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 brooders were maintained in the brood-rearing pond. Matured male and female broods 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 in 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, 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 begun, however, 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. 18). 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 occurred in the experimental tanks that forced to discontinue the experiment.

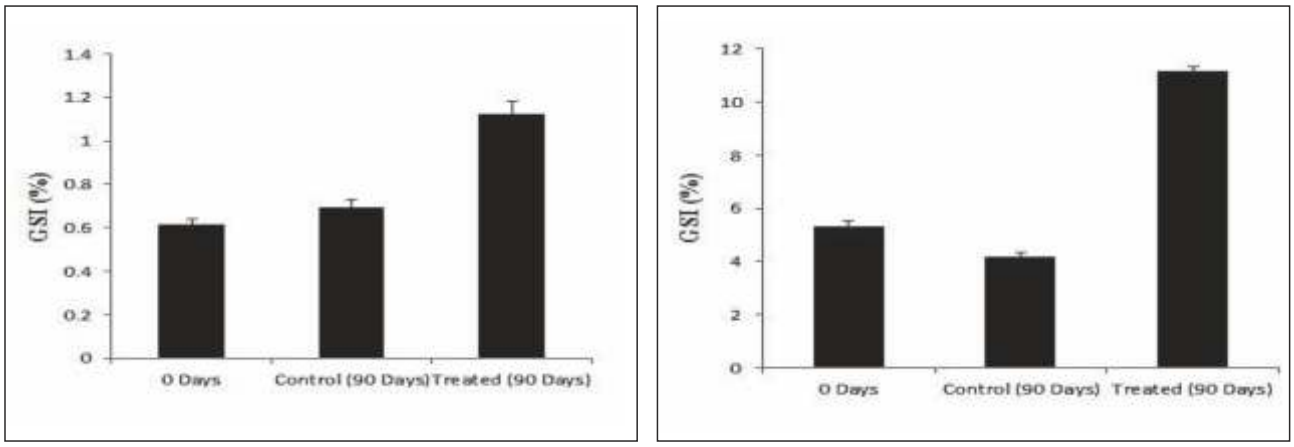


Fig. 18. Changes in gonadosomatic index (GSI) value (%) of male (A) and female (B) catla under different photothermal regimes.

Project	:	Nutritional intervention and feeding strategies in freshwater aquaculture
Project Code	:	I-95
Sub Project	:	Study on nutrient requirement and feed development for Pengba, *Osteobrama belangeri*
Sub Project code	:	I-95 (a)
Funding Agency	:	Institute-based
Duration	:	April 2016 – March 2019
Project Personnel	:	K. N. Mohanta (PI), P. C. Das, K. C. Das, Rakhi Kumari, G. M. Siddaiah

A 90 days indoor experiment was conducted to determine the optimum protein and lipid requirements of *O. belangeri* fingerlings. Nine semi-purified experimental diets were prepared with three levels of protein (30, 35 and 40%) and three levels of lipid (6, 8 and 10%). The pengba fingerlings (average body weight 0.83 ± 0.01 g) were stocked in 27 FRP tanks (15 fish/tank) in triplicate groups for each dietary treatment. Flow-through FRP tanks (40 L water volume) with a flow rate of 0.5 L/min was used for rearing the fish. The growth and feed utilization with respect to different dietary protein and lipid are given in Table 21. From the weight gain, FCR and SGR, the optimum protein and lipid requirements of *O. belangeri* fingerling was found to be 35% and 8%, respectively.

Table 21. Effect of different levels of protein and lipid on growth and nutrient utilization of Pengba, *O. belangeri* fingerlings

Nutrient level (%)	Initial weight (g)	Final weight (g)	Weight gain (g)	FCR	SGR (%/day)
T-1 (30% P & 6% L)	0.81±0.00^{a}	6.20±0.14^{e}	5.39±0.13^{e}	2.30±0.01^{e}	2.26±0.021^{a}
T-2 (30% P & 8% L)	0.82±0.01^{a}	7.61±0.09^{d}	6.78±0.09^{d}	2.23±0.01^{d}	2.47±0.005^{c}
T-3 (30% P & 10% L)	0.85±0.00^{a}	6.35±0.09^{e}	5.50±0.08^{e}	2.29±0.01^{e}	2.23±0.010^{a}
T-4 (35% P & 6% L)	0.84±0.01^{a}	8.36±0.22^{c}	7.52±0.20^{c}	2.17±0.01^{c}	2.55±0.015^{d}
T-5 (35% P & 8% L)	0.84±0.00^{a}	10.39±0.16^{a}	9.54±0.16^{a}	2.01±0.01^{a}	2.78±0.018^{f}
T-6 (35% P & 10% L)	0.82±0.00^{a}	9.00±0.13^{b}	8.18±0.13^{b}	2.11±0.01^{b}	2.66±0.012^{e}
T-7 (40% P & 6% L)	0.84±0.01^{a}	7.28±0.11^{d}	6.44±0.12^{d}	2.39±0.00^{f}	2.39±0.025^{b}
T-8 (40% P & 8% L)	0.84±0.00^{a}	9.16±0.13^{b}	8.32±0.13^{b}	2.11±0.02^{b}	2.65±0.011^{e}

*(P=protein, L=lipid)

Sub Project	:	Evaluation of mahua oil cake as a non-conventional ingredient and its use in carp feed
Sub Project code	:	I-95 (b)
Funding Agency	:	Institute-based
Duration	:	April 2016 – April 2019
Project Personnel	:	S. C. Rath (PI), K. C. Das and S. Sarkar

Mahua (*Bassia latifolia*) oil cake (MOC) is rich in protein (24%) having energy (19.0 KJ g^{-1}) and fatty acid consists of saturates: 45%, monoenes: 42% and PUFA (n-6): 7%. Saponin, phenol and flavonoids were the main metabolites (Table 22). Raw mahua oil cake can be incorporated in carp feed at 20-30% as growth promoter.

Table 22. Chemical composition of mahua oil cake (% dry matter basis)

Nutrients on dry matter basis (%)					
Moisture	Crude protein	Crude lipid	Crude fiber	Ash	NFE
9.22 ± 0.56	23.49 ± 0.62	9.44 ±0.55	8.6±0.11	6.23±0.25	52.4±0.39
Phytochemicals					
Saponin	Phenol	Tannin	Flavonoid	Alkaloid	Glycoside
++++	+++	++	+++	+	++
Fatty acids (%)					
∑SFA	∑MUFA	∑PUFA n-6	∑PUFA n-3	Total	
45.07±1.72	42.39±0.23	6.72±0.11	0.63±0.08	94.78±1.28	

\+ detected, ++ moderately detected, +++ adequately detected, ++++ strongly detected.

Evaluation of mahua oil cake as non-conventional feed resource in *Labeo rohita* fry

A 30 days feeding trial was conducted to evaluate the effect of mahua oil cake incorporated diet on growth and survival of *Labeo rohita* fry. Six iso-nitrogenous test diets (D1-D6) were formulated with different ingredients where mahua oil cake was a co-ingredient (Table 23). Results indicated that survival rate in all the diets were statistically similar (P>0.05), however, specific growth rate in D4 was found to be better (P<0.05) than other dietary groups (Fig. 19).

Table 23. Formulated diet with and without mahua oil cake

Ingredients	Ingredient compositions (% dry matter basis)					
	D1	D2	D3	D4	D5	D6
Fish meal	10	10	10	10	10	10
Soybean	40	11.5	15.5	22	15.5	17.75
Groundnut oil cake	11.5	40	11.5	22	15.5	17.75
Til oil cake	0	0	40	5	0	14.25
Mahua oil cake	0	0	0	22	0	10
Mustard oil cake	11.5	11.5	0	5	40	14.25
Deoil rice bran	12	12	8	5	8	6
Maize	11	11	7	5	7	6
Vit. Min. premix	2	2	2	2	2	2
Vegetable oil	2	2	2	2	2	2
Total	100	100	100	100	100	100

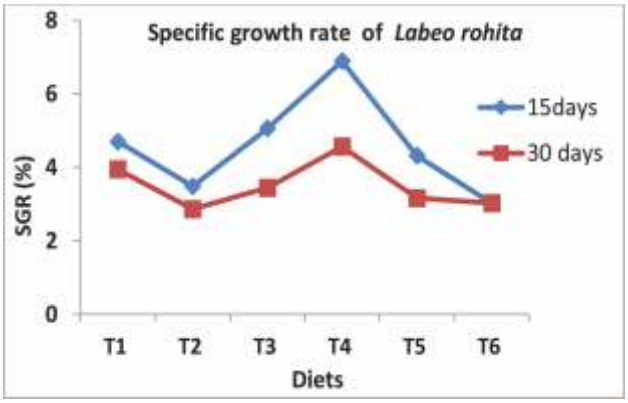


Fig. 19. Specific growth rate of *L. rohita*

Sub Project	:	Evaluation of some fish feed processing technology by use of local feed ingredients for enhancing aquaculture production
Sub Project code	:	I-95 (c)
Funding Agency	:	Institute-based
Duration	:	April 2016 – March 2019
Project Personnel	:	K. C Das (PI), K. N. Mohanta, P. Swain, B. B. Sahoo and S. K. Nayak

Availability of cost effective local feed ingredients in the market were surveyed and potential of using the ingredients for floating feed production were estimated. Four ingredients *i.e.* til oil cake (TOC), mahua oil cake (MC), mustard oil cake (MOC) and babool seed (BS) were selected for incorporation for floating feed production. Five iso-nitrogenous (28% CP) fish feeds (Feed I, Feed II, Feed III, Feed IV and Feed V) were formulated for rohu (*Labeo rohita*) by inclusion of locally available feed ingredients i.e. til oil cake (TOC), mahua oil cake (MC), til and mahua oil cake (TOC+MC), mustard oil cake (MOC) and babool seed (BS), respectively at different levels along with traditional ingredients. The above feeds were produced through extrusion technology and the extrusion temperature was maintained at 130 ^{0}C with a pressure of 6.5 kg/cm^2 at a moisture level of 20 percent. All the five types of feed contained 28 percent protein and the floating percentage was 100 percent. The experiment is in progress.

Different types of floating feeds prepared during the experiment

CIFAFRY – A feed for rohu fry

Fry feed for rohu was developed by using high quality fish feed ingredients viz., maize, soybean meal, rice bran, groundnut oil cake, fish meal, oil, minerals and vitamin mixture in the feed mill of ICAR-CIFA. The ingredients were pulverized, mixed, extruded and dried. The feed was then ground into suitable size, packaged and stored for feeding the fish. The chemical characteristics of CIFAFRY Feed revealed the nutrient contents was as per the standard fixed by BIS. The chemical characteristics of CIFAFRY is mentioned in Table 24.

Table 24. Chemical characteristics of CIFAFRY Feed (% on DM basis except moisture)

Composition	Percentage
Moisture	10.00
Crude protein	35.58
Crude fibre	4.62
Total ash	10.74
Ether extract	6.10
Nitrogen free extract	42.96
Energy (Kcal/g)	3.61

Growth and FCR of rohu fry using CIFAFRY Feed

The experiment was conducted in three earthern ponds at ICAR-CIFA for 90 days. Fertilized ponds were stocked at 4000 nos of spawn having 2.81 g average weight. CIFAFRY was fed daily at 5% biomass and sampling of the fish was done at monthly interval. The weight of the fish and feed consumption in every month were used for calculating the FCR (Table 25).

Table 25. Growth and FCR using fry feed

Parameters	Spawn stage	30 days	60 days	90 days	Overall
Feed intake (g/fish/day)	-	4.43	12.04	33.6	50.07
Weight (g/fish)	2.81	15.11	23.38	33.27	33.27
Weight gain (g)	-	12.30	8.27	9.89	30.46
FCR	-	0.36	1.45	3.39	1.64

Sub Project : Ontogeny of digestive system of selected catfish species and its implications on larval feed development
Sub Project code : I-95 (d)
Funding Agency : Institute-based
Duration : April 2016 – March 2019
Project Personnel : Rakhi kumari (PI), K. N. Mohanta, S. Ferosekhan and G. M. Siddaiah

Fifty-five numbers of *Mystus vittatus* were collected from wild population and kept in captivity for broodstock development. Formulated diet containing 35% crude protein and 8% lipid was being fed at 3% body weight for attaining maturity of the fish before further use in the experiment.

Sub Project : Amelioration of heat stress in *Labeo rohita* through dietary intervention
Sub-Project code : I-95 (e)
Funding Agency : Institute-based
Duration : April 2016 – March 2019
Project Personnel : C. Devaraj (PI), Ashis Saha and S. C. Rath

An experiment was conducted for 30 days in indoor condition to assess the physiological and biochemical responses of *Labeo rohita* fingerlings reared at different temperature regimes *viz.*, 30, 32, 34, 36 and 38°C. Haematological (erythrocyte and leucocyte counts, and haemoglobin concentration), biochemical (total protein, glucose and cortisol levels), growth performance (weight gain, FCR and SGR) and survival (%) were studied. Erythrocyte and leucocyte counts, and haemoglobin levels were decreased significantly ($p<0.05$) on exposure to higher temperature. The highest count was recorded in 30°C followed by 32°C group. The lowest count was recorded at 38°C followed by 36°C group. Total protein in plasma was significantly decreased ($p<0.05$) with increasing temperature. High level of total plasma protein was recorded at lower temperature (30°C group). Blood glucose and plasma cortisol level were found to be significantly higher ($p<0.05$) in the high temperature groups (38°C). The final body weight, weight gain and SGR of rohu fingerlings reared at 30°C was higher than that of fish reared at 32 to 38°C. FCR of rohu fingerlings was increased significantly ($p<0.05$) with increasing temperature. This study indicated that haematology, biochemical parameters and growth of rohu fingerlings were affected at high temperatures.

OUTREACH PROJECT

Project Title : Outreach activity on 'Fish Feed'
Funding Agency : ICAR
Duration : April 2012- March 2017
Project Personnel : K. N. Mohanta (PI w.e.f. November 2016), S. C. Rath, S. K. Sahoo, P. V. Rangacharyulu, N. Sridhar, B. N. Paul, and K. C. Das, Rakhi Kumari, SIddaiah, G.M., and N. Chandan

Feed mill

The pilot scale feed mill of CIFA was utilized for training, demonstration and production of floating and sinking feed for carp, catfishes and prawn. During the current year, over 260 farmers, entrepreneurs, students, scientists and policy makers visited the mill.

Implant trainees of College of Fisheries (OUAT), Berhampur and College of Fisheries, Chhattisgarh; Students of Fish Nutrition and Feed Technology Division of ICAR-CIFE, Mumbai and participants of the two 'National Workshop and Training on Feed and Feed Technologies were trained in the feed mill. Apart from the training and demonstration activities, about 6.0 tons of experimental feed of different

types were produced and distributed to scientists of different divisions. The feed mill also was utilized for the research on fish feed processing technology.

Feed Testing and Referral Laboratory

In total 58 feed ingredients, 38 feed samples and 32 fish carcass samples were analyzed during the period.

Popularization of farm made feed

To popularize the use of low cost farm made feed, 06 awareness programmes, two training-cum demonstration programmes and 3 All India Radio talks were delivered.

Technical help extended to establish feed mills in Assam, West Bengal, Chhattisgarh and Bihar

Technical help was rendered to establish fish feed mills in Assam, West Bengal, Chhatisgarh and Bihar. Starting from the construction of building for housing the feed mill, procurement of machineries used for feed mill, processing of the ingredients, production of feed, quality evaluation, packaging and storage methods were taught to the farmers/entrepreneurs who seek the advice from the Institute.

Demonstration of rain tree pod based feed in farmer's pond

Rain tree (*Samanea saman*) is the fastest growing tropical tree of family Fabacae, commonly used in agro-forestry and avenue plantation programme and thus available in plenty in tropical climate. Rain tree pod (RTP) is a good source of protein (252 g/kg) and energy (20 KJ/g). TRP contains ∑ SFA, ∑ MUFA, ∑ PUFA n-6, and ∑ PUFA n-3, at 30%, 25%, 41% and 3%, respectively. Complete protocol has been developed at ICAR-CIFA to incorporate this non-conventional ingredient in carp feed.

A demonstration programme was taken up at farmer's field to witness the performance of RTP

based feed against an iso-nitrogenous feed without RTP. Although the final harvest is yet to be done, the performance of both the feed are at par with each other. This observation concludes that rain tree pod as a non-conventional ingredient that can partially substitute the edible oil cake in carp feed.

Project Title	:	Outreach Research Project on Nutrient Profiling of Fish
Duration	:	April 2013- March 2017
Funding Agency	:	ICAR
Project Personnel	:	B.N. Paul (PI), S.S. Giri (up to May, 2016) and N. Sridhar

Comparative evaluation of nutrient profiling of 10 important health food fishes viz. *L. bata, O. bimaculatus, P. javanicus, C. striata, M. vittatus, W. attu, P. hypophthalamus, L. calbasu, C. reba* and *L. fimbriatus* of different weight ranges were completed. Fishes were collected from seven places of West Bengal and from one place of Karnataka (RRC-CIFA, Bangalore farm).

The amino acid profile of four fish species viz., *Labeo bata*, *Labeo fimbriatus*, *Pangasianodon hypophthalamus* and *Puntius javanicus* were assayed. Histidine content ranged from 0.07 to 4.45 (g/100g protein) in the analyzed fish samples. The methionine was maximum among other amino acids and it ranged from 11.9 to 14.12 (g/100 g protein). The threonine content ranges from 0.95 to 2.05 and arginine content varied from 0.45 to 1.96. Among the non-essential, aspartic acid and asparagine were predominant. The mineral contents (ppm) of fish species were analyzed and the iron content varied from 0.28 to 1.57, manganese content varied from 0.08 to 0.85 and zinc content ranged from 0.05 to 2.25. The sodium and potassium contents (ppm)

ranged from 20.77 to 71.20 and 72.05 to 183.97, respectively in the analysed fish samples. Proximate composition and vitamin content of 10 fish species are shown in Table 26 and Fig. 20 and fatty acid profile of six fish species are shown in Table 27. The vitamin A content was maximum in *O. bimaculatus* and followed by *M. vittatus* and *L. bata* however, vitamin D content was maximum in *M. vittatus* followed by *C. reba*, *L. bata* and *L. fimbriatus.* The EPA and DHA content were maximum in *C. striata* and O. *bimaculatus*.

Table 26. Proximate composition (% w/w basis) of freshwater fish

Species	Particulars			
	Moisture	Protein	Fat	Ash
Labeo bata	62.96-78.48	12.28-18.28	1.83-6.21	2.15-2.80
Labeo calbasu	73.70-77.81	13.01-14.54	2.04-3.96	1.78-2.60
Cirrhinus reba	68.27-75.82	10.66-15.60	2.62-7.82	1.97-2.68
Puntius javanicus	65.05-74.06	13.07-18.77	3.53-5.79	2.04-3.25
Ompok bimaculatus	60.68-84.50	12.12-18.81	2.40-7.28	1.23-4.26
Mystus vittatus	68.12-84.15	12.31-17.81	4.52-9.17	1.69-4.04
Channa striata	75.81-78.67	11.95-13.71	0.95-2.21	1.45-2.10
Wallago attu	63.82-76.31	10.76-16.22	2.42-7.62	1.11-3.10
Pangasianodon hypophthalamus	57.30-75.26	10.32-21.07	6.81-14.55	0.78-2.40

Table 27. Fatty acid profile of freshwater fish (% of total fatty acid)

Species	SFA	MUFA	PUFA	EPA	DHA
L. calbasu	47.66-54.90	27.21-32.23	11.34-25.14	0.48-3.26	0.23-0.38
L. fimbriatus	30.82-37.92	38.78-39.51	20.53-29.13	0.44-0.77	0.81-2.51
C. reba	23.84-55.16	23.84-24.91	17.46-19.45	1.02-1.1	30.56-0.87
O. bimaculatus	39.10-49.08	21.44-26.25	29.45-33.82	3.39-3.97	1.94-2.93
C. striata	32.40-33.55	29.60-35.33	32.29-36.87	5.27-10.81	6.97-13.00
W. attu	40.11-57.57	23.52-35.42	17.08-26.74	0.32-5.30	0.46-5.56

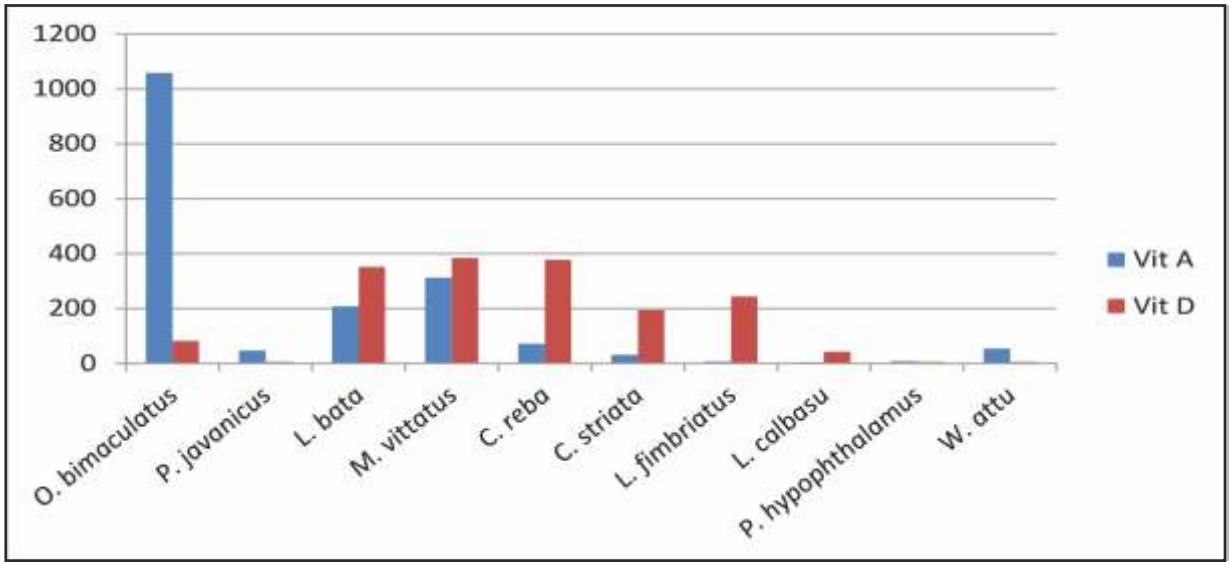


Fig. 20. Vitamin content of freshwater fish (I.U./100 g fish)

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
Sub-project code	:	I-88(a)
Funding Agency	:	Institute-based
Duration	:	April 2014 – March 2017
Project Personnel	:	S. S. Mishra (PI), B. K. Das (up to July, 2016), P. Swain, P. K. Sahoo, S. K. Swain, S. Adhikari, M. Samanta, Rakesh Das, P. Choudhary, Ananda Kumar and Ramesh Rathod

Survey was conducted to isolate and identify different bacterial, fungus and parasites affecting gills of fish. Samples brought by the farmers to the laboratory were also screened. In total of 62 cases were analyzed, 16 cases of *Dactylogyrus* sp., 18 cases of *Argulus* infestation, 9 *Myxobolus* sp,. 6 *Trichodina* sp., 2 *Lernea* sp. and 18 cases were of mixed parasitic infections. A total of 12 bacterial isolates could be isolated and identified. The bacterial isolates were further confirmed by series of biochemical tests. Furthermore, the antibiogram profile of bacterial isolates were studied against several antibiotics. The study revealed that the bacterial isolates were highly sensitive to ciprofloxacin followed by ofloxacin and nitrofurantoin. Antimicrobial activity of 12 nanoparticles, synthesized in the laboratory were tested against selected eight bacterial pathogens and results are presented in the Table 28. It was observed that Ag, ZnO and CuO were more sensitive against all bacterial isolates tested. The pathogenicity of *Citrobacter freundii* CCAGC1 *(*KT429602), previously isolated from goldfish gill was studied. To screen the virulence activity, bacteria was injected into healthy goldfish weighing around 20 g each which were collected from aquarium tank where no previous record of infections or diseases found. After wet lab experiment, it was found that the said strain was able to create significant mortality when injected to healthy individuals (goldfish) at 100 microliter (10^7 cells/ml). *Edwardsiella tarda* isolated from cases of disease was identified using biochemical testes followed by 16SrDNA sequence analysis. PCR amplification for *Dactylogyrus* sp. using Primer DGR45 F/R was standardized for detection and differentiation of as *Dactylogyrus catlaius*. The survey was also conducted in selected regions of Andhra Pradesh, Karnataka and Gujarat. In Gujarat, occurrences of disease with gill fluke or skin parasitic infestations were recorded in many cases. Seasonal variation in occurrence of disease were recorded as: gill diseases during November-December (catla), gill fluke during November-December (rohu, catla & tilapia), Bacterial red disease during October – November (mrigal & rohu), Argulus infections during October-November & April–May (in IMC) and mortality in *Pangasius* reported during November months. Many cases of mortality due to low DO was also recorded during April – May and November.

A case of disease outbreak involving crustacean ectoparasitic infection was observed in the rainfed public tanks of Tumkur district of Karnataka affecting the fish species stocked under polyculture system. The fish species in increasing order of parasite infestation was cattla>common carp>tilapia. The sites of infestation were mainly gill arch, gills, buccal cavity and pectoral fins. Parasites were found firmly attached to the gill arches with legs and sucking large amount of blood with mouth parts. Water quality parameters of the pond water with parasite infestation were found to be pH: 7.19; NO_3:3.29 ppm, PO_4: 0.022 µg/L; alkalinity: 126 mg $CaCO_3$/L; hardness: 120 mg/L and CO_2:3.2 mg/L which were found to be adequate for fish growth. On visible examination, the crustacean parasite was found to be an *Isopoda* sp. The parasite could be an Isopod, *Alitropus typus* (Fig. 21) belong to Family Aegidae / Trachea species which needs further confirmation.

Rohu showing heavy infestation with gill fluke *Dactylogyrous* species

Fish parasite Isopod, *Alitropus sp.*

Catla gill infested with flukes

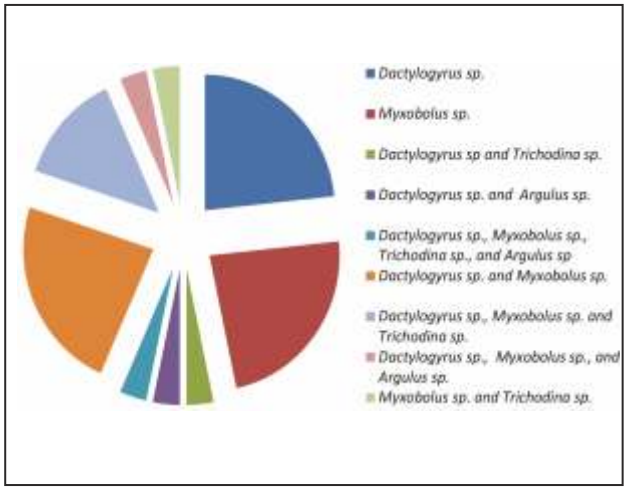


Fig. 21. Parasite prevalence in gills of fish during 2016-17

Table 28. Antimicrobial activity of nanoparticles selected bacterial strains

Bacteria	Nanoparticles used											
	Ag	ZnO	CuO	Se	CaO	$Ca(OH)_2$	$CaCO_3$	MgO	Mn	Mo	Co	Fe
V. parahaemolyticus	+	+	+	-	-	-	-	-	-	-	-	-
F. columnare	+	+	+	-	-	-	-	-	-	-	-	-
E. tarda	+	+	+	+	-	-	-	-	-	-	-	-
C. freundii	+	+	+	-	-	-	-	-	-	-	-	-
B. subtilis	+	+	+	+	-	-	-	-	-	-	-	-
Streptococcus sp.	+	+	+	-	-	-	-	-	-	-	-	-
A. hydrophila	+	+	+	+	-	-	-	-	-	-	-	-
P. aeruginosa	+	+	+	-	-	-	-	-	-	-	-	-

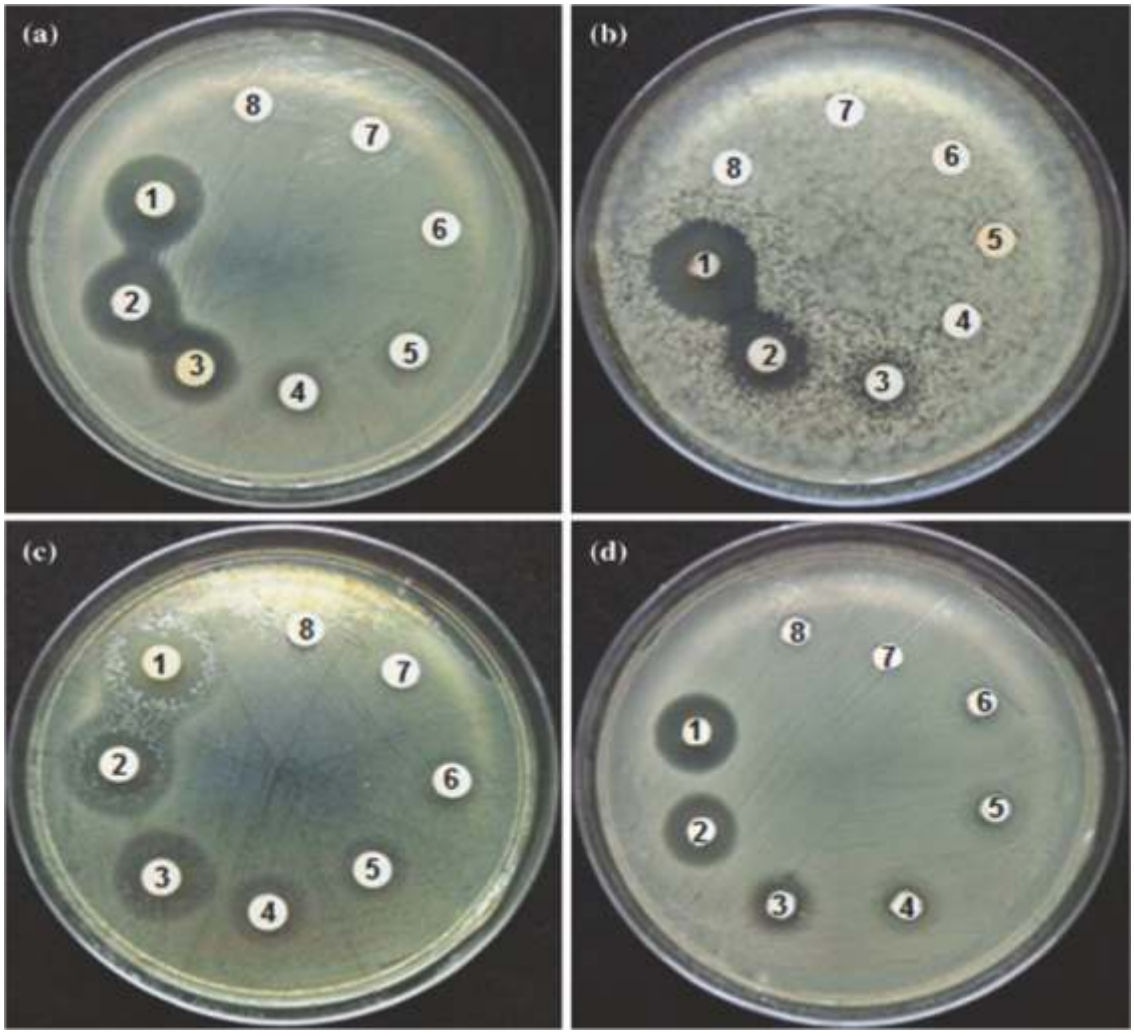


Fig. 22. Disc diffusion assays showing zone of inhibition exhibited by various nanoparticles against different bacterial isolates. a) *B. subtilis;* b) *P. aeruginosa;* c) *E. tarda;* d) *A. hydrophila.* Numerical numbers in the individual disc of individual plate (a–d) represent different types of nanoparticles 1) CuO (synthesized), 2) CuO (commercial), 3) ZnO (synthesized), 4) ZnO (commercial), 5) Ag (synthesized), 6) Se (synthesized), 7) Mo (synthesized), 8) Mn (synthesized)

Sub-project title	:	Development of biocontrol agents against important fish pathogens and their application in aquaculture
Sub-project code	:	I-88(b)
Funding Agency	:	Institute-based
Duration	:	April 2014 – March 2017
Project Personnel	:	B. K. Das (PI up to July, 2016), S. S. Mishra (PI, *w.e.f.* August, 2016), Rakesh Das, P. Chaudhury and Anand Kumar

The selected bacterial consortium which had been used as bio-control agent was studied at wet-lab condition where 150 healthy rohu (*Labeo rohita*) fingerlings were randomly distributed into three treatment groups (n=3) with two replicates. Two different doses of bio-control product (0.5 g; 1.0 g/ kg biomass) were added to the water of tanks. Fishes in the treatment groups showed higher ($p<0.05$) total protein and serum bactericidal assays compared with control groups. The results of lysozyme assay, and NBT activity of blood were higher ($p<0.05$) in the

treated biocontrol product group. So, it could be concluded that bio-control agent has positive effect on fish immune parameters mainly improvement of non-specific immune parameters in Indian major carp, *Labeo rohita*.

Sub-project title	:	Bacterial bioremediation of inorganic pollutants with special reference to ammonia and lead from freshwater ecosystem
Sub-project title	:	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 observe the effect of externally added hydroxylamine (NH_2OH) on nitrogen removal process of heterotrophic bacterium, *Enterobacter cloacae* CF-S27, 100 and 200 mg of NH_2OH were added to different nitrogen containing growth media at initial log phase without change in initial C-N ratio 1:3. The addition of high concentration of NH_2OH (200 mg) displayed an increase in consumption rate of NH_2OH as compared to 100 mg of NH_2OH added cultures. The maximum hydroxylamine removal rate was observed in nitrate and ammonium media after 1 h and 30 min of NH_2OH addition while in nitrite containing media, this rate was observed between 1 h 30 min to 3 h of NH_2OH addition. This result indicated that even though bacterial strain present in nitrite medium had taken a long period to acclimatize with external NH_2OH, but at the same time, the removal rate of NH_2OH was doubled with the increase in NH_2OH concentration as compared with other two media (nitrate & ammonia). In the presence of NH_2OH in ammonia containing medium, the initial logarithmic pattern of bacterial growth was stagnant while a smooth growth was observed in medium without NH_2OH. This indicates inhibition of the enzyme ammonia monooxygenase by NH_2OH during initial log period (initial NH_2OH removal period) whereas the final log phase was achieved after complete removal of NH_2OH. This observation suggests that the cellular process which involves nitrite utilization might have been down regulated in presence of external NH_2OH. The strain *Enterobacter cloacae* CF-S27 significantly maintained the undetectable amount of dissolved nitrogen throughout 30 days of zero water exchange prawn culture experiment.

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)

Lysozyme G in rohu and its characterization

The full sequence information of an important innate immune molecule, lysozyme G was obtained from liver cDNA samples of *L. rohita* using self-designed primer pairs. The nucleotide sequence was deposited in the NCBI nucleotide database (GenBank accession number: lysozyme G: KC934746).

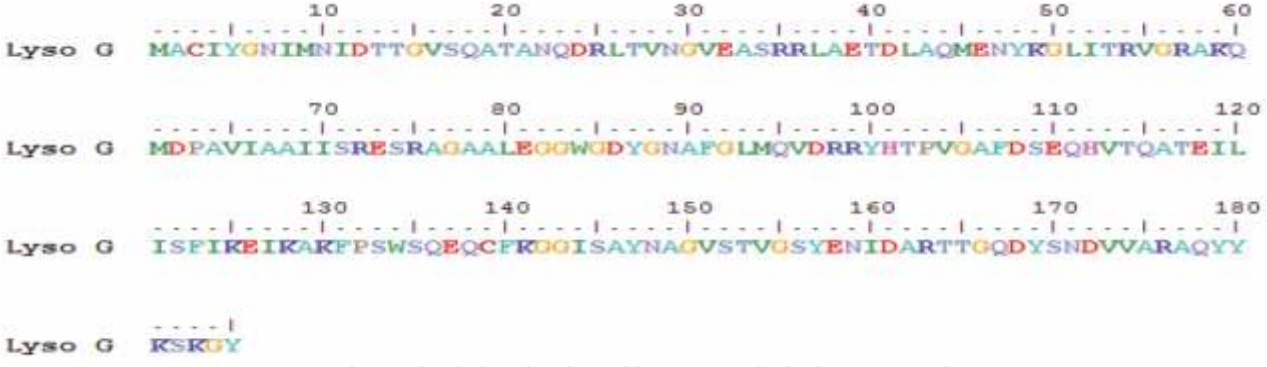


Fig. 23. The deduced amino acid sequence of rohu lysozyme G cds

To study the role of lysozyme in bacterial/viral/parasitic infections, rohu juveniles were exposed to *Aeromonas hydrophila,* polyionosinic:cytidylic (poly I:C) and of *Argulus siamensis,* and tissues from liver and anterior kidney were collected from control and induced/infected fish at different time periods. Lysozyme G expression was highly up-regulated at 48 h in liver tissue after *A. hydrophila* infection. In kidney tissue up-regulation was observed at 3 h, 48 h and 15 d of post-infection. During parasitic infection in rohu, lysozyme expression was increased in liver at 7 d only. In anterior kidney tissue, mild rise in expression was noticed at 24 h of post-infection onwards. In case, of poly I:C stimulated fish the expression pattern increased at 1 h of post infection and thereafter a down regulation was marked after 3 h onwards in liver tissue (Fig. 24).

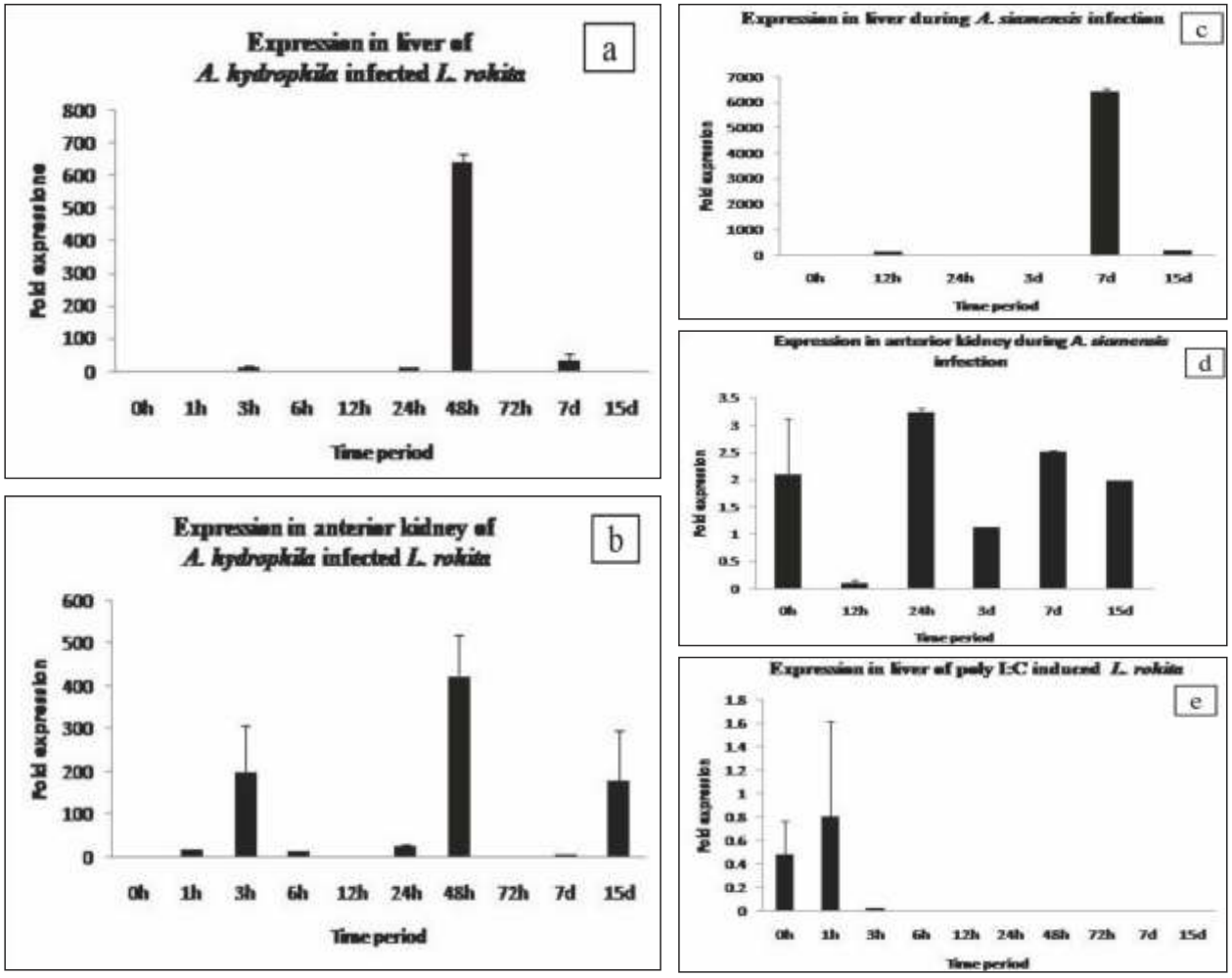


Fig. 24. Expression of lysozyme gene in liver (a), anterior kidney (b) tissues of rohu at different time periods post-challenge after *Aeromonas hydrophila* infection; in liver (c) and anterior kidney (d) tissues of rohu at different time periods post-challenge after *Argulus siamensis* infection and in liver (e) tissue of rohu at different time periods post-induction (h: hours post-challenge; d: days post-challenge) with poly I:C stimulation. The fold difference was calculated as 2^{-DDCq}, where DDCq = (DCq sample - DCq calibrator) and DCq = (Cq value of ApoA-I – Cq value of β-actin). The average Cq value of 0 h post-challenge (control) was used as the calibrator in the analysis.

The recombinant lysozyme G was expressed in the soluble fraction in *E.coli*. The recombinant protein was purified using affinity chromatography. A total of 5 mg of recombinant lysozyme G protein was purified. An indirect ELISA assay was performed to determine the normal serum lysozyme G concentration in rohu. The standard curve was made using purified recombinant lysozyme along with its antibody developed in rabbit (Fig. 25). The normal range of lysozyme g in rohu serum was found to be 0.12 -0.15 µg/ml in indirect ELISA.

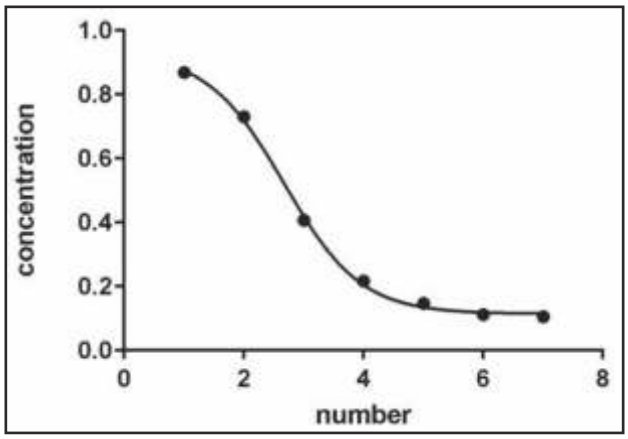


Fig. 25. Standard curve used for quantification of lysozyme G with its specific antibody developed in rabbit by indirect ELISA.

The optimal pH and temperature of the recombinant lysozyme g was determined by turbidimetric assay. The lytic activities of recombinant lysozyme g were detected at pH ranging from 5 to 8. The suitable range was detected as 6.5 to 7.5 and optimal pH was 7. Similarly, lytic activity was found at different temperatures ranging from 25 to 60°C. The optimal temperature was found to be 35°C. The antimicrobial activity of recombinant lysoG was tested and found against *Micrococcus lysodeikticus, Aeromonas hydrophila*, *Edwardsiella tarda* and *Staphylococcus aureus* at a concentration of 100 µg/ml.

Cuticle protein of parasite *A. siamensis* as vaccine candidate

The cuticle protein of parasite *A. siamensis* is an important gene helps for development and maturation of parasite. From the transcriptome data developed earlier we generated full CDs of cuticle protein 6 (CP6). The CP6 gene was cloned into pUC57 cloning vector and recombinant CP6 was expressed in *E.coli* in the soluble fraction. SDS-PAGE analysis of both the uninduced and induced culture showed appearance of a very faint band at the expected size of 26.12 kDa. The recombinant protein (around 5 mg) was purified using affinity chromatography.

The recombinant CP6 protein at a dose of 1.5 µg/g of body weight (200 µl in PBS: mineral oil suspension) was used to vaccinate rohu juveniles with two boosters at 14 and 28 days. The efficacy of recombinant CP6 as a vaccine antigen to control *A. siamensis* infection was evaluated by challenge of the immunised rohu with *A. siamensis* metanauplii 7 days post 2nd immunization. There was no significant difference between the parasite load in vaccinated versus control groups, and mortality of fish was also observed in both groups. The mean number of parasites remained comparable in both the groups. Hence, it needs to restandardize the protein for its vaccine efficacy.

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)

The immunological expression and growth of Indian major carp, *Labeo rohita* were studied through feeding of ZnO and selenium nanoparticles over a period of six months.

Immune response studies

The non-specific immune parameters of fish after feeding with ZnO and Se nanoparticles at 2, 3, 4 and 6 months were measured. All these parameters i.e., lysozyme, myeloperoxidase, respiratory burst, haemagglutination, hemolytic activities and bacterial agglutination titer were significantly higher ($p < 0.05$) in treated groups than the control. The nanoparticle treated groups showed a better specific growth rate (1.35) than control group (1.25).

Serum biochemical enzyme assays

Serum stress enzymes i.e. acetyl choline esterase (AChE), alkaline phosphatase (ALP), Lactate dehydrogenase (LDH) and superoxide dismutase (SOD) level of *L. rohita* varied significantly ($P < 0.05$) with dietary ZnO and Se-NP supplementation (Fig. 26). The ALP and LDH concentration in response to the ZnO and Se-NP-enriched diet showed a decreasing trend, whereas SOD and AChE levels were significantly higher ($P < 0.05$) as compared to control groups.

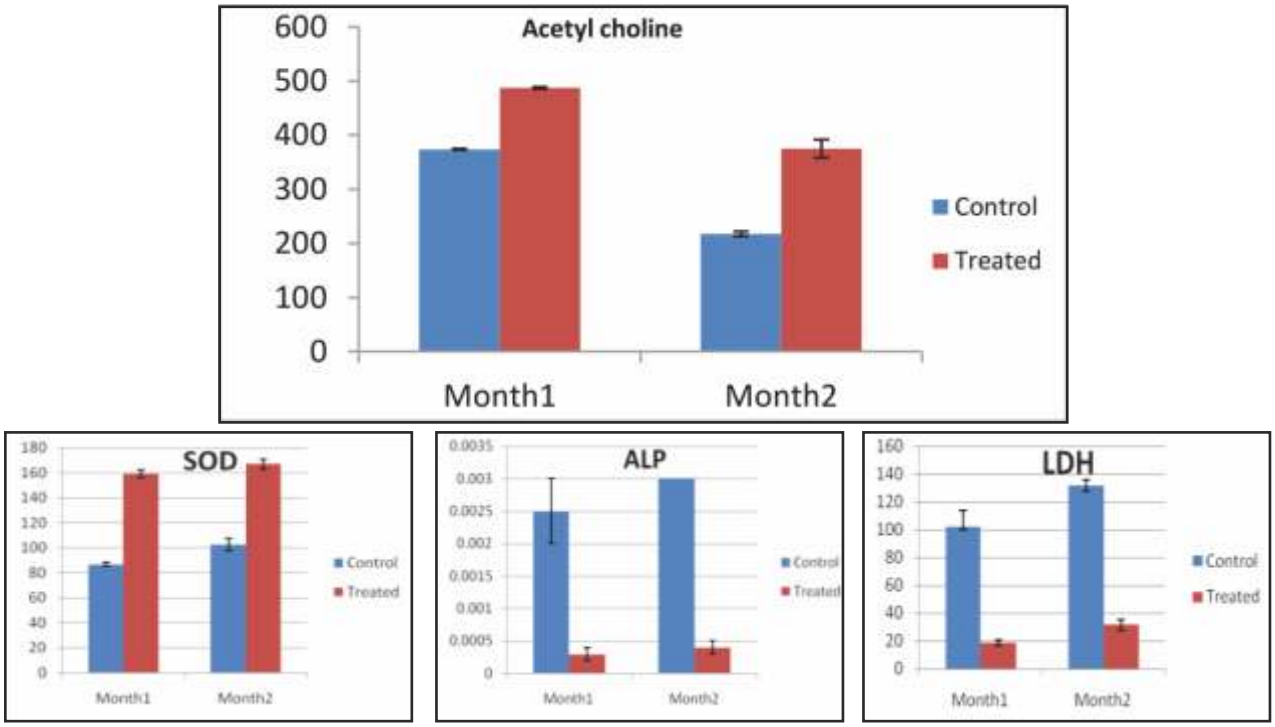


Fig. 26. Serum enzyme activities in L. rohita fed with ZnO and Se nanoparticles

Synthesis of nanoparticles

Different mineral nanoparticles, including different micronutrients were synthesized, using chemical and green synthesis methods (Table 30) and characterized (Figs. 27a&b).

Table 29. Nanoparticles synthesized

Serial	Nanoparticles synthesized	Process
1.	CaO	Chemical
2.	CaO	Green
3.	$Ca(OH)_2$	Chemical
4.	$Ca(OH)_2$	Green
5.	$CaCO_3$	Chemical
6.	$CaCO_3$	Green
7.	Mo	Chemical
8.	Mn	Chemical
9.	Mg	Chemical
10.	Co	Green
11.	Fe	Green

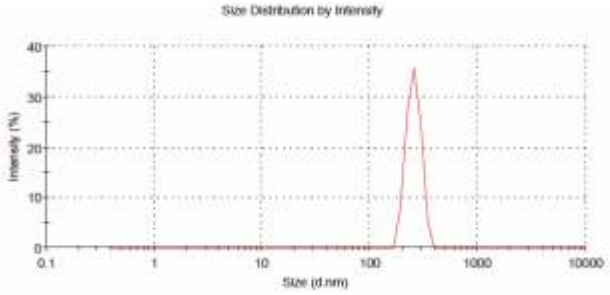


Fig. 27(a). Dynamic light scattering analysis of CaO nanoparticles

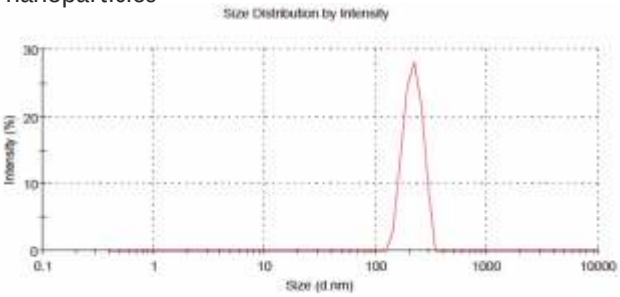
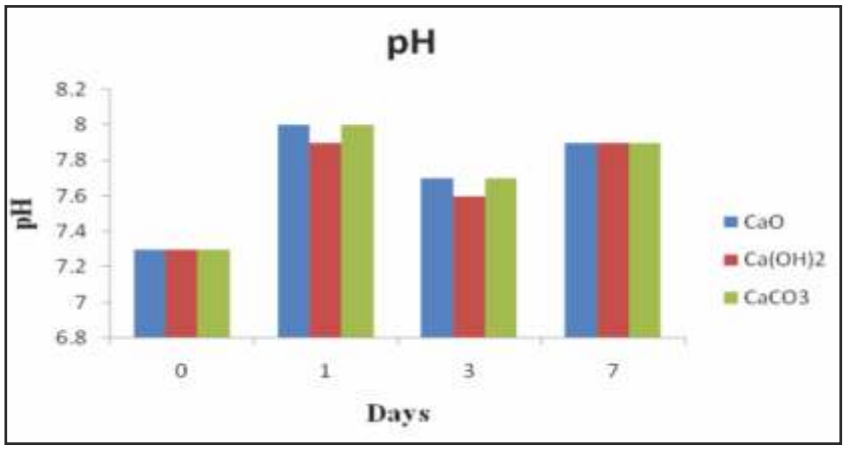
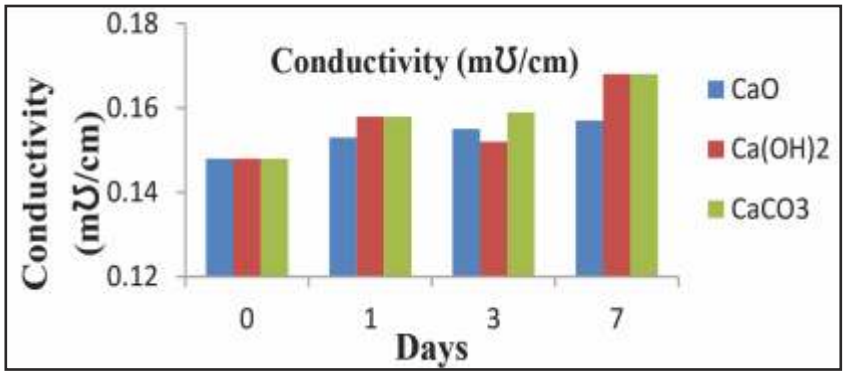


Fig. 27(b). Dynamic light scattering analysis of MgO nanoparticles

Application of Calcium nanoparticles to improve alkalinity of pond water

Calcium oxide, calcium hydroxide and calcium carbonate nanoparticles were synthesized and added to pond water and their effects on pH, conductivity and alkalinity were studied. The experiment was carried out in 1 litre jars. The outcome of the experiments is presented below (Fig. 28).





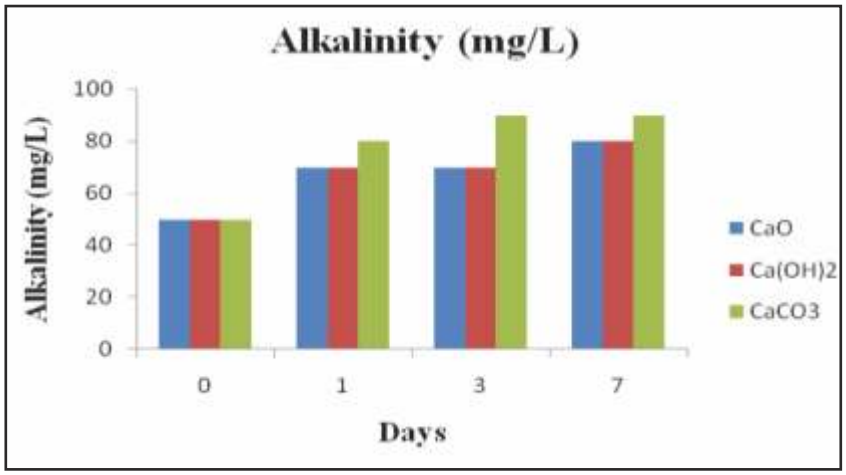


Fig. 28. pH, conductivity and alkalinity of nanoparticles treated pond water

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

B-cell activating factor (BAFF), an important member of the tumor necrosis factor superfamily, plays critical roles in the modulation of B-cell functions and enhancement of immune response in the host. In rohu, full-length BAFF- (Lr-BAFF) cDNA has been cloned and it comprised of 804 bp nucleotide long ORF, encoding 267 amino acid residues, and shared high structural similarity with human-BAFF. It was expressed in the embryonic developmental stages suggesting its key role in immune response at the early life of fish. In *Aeromonas hydrophila* infection and rhabdoviral antigen stimulation, BAFF-gene expression in rohu was induced across the organs/tissues. Stimulation of un-treated healthy rohu fish leukocytes, and viral or bacterial or BSA (bovine serum albumin) antigen stimulated rohu fish leukocytes with recombinant-BAFF (r-BAFF) resulted in enhanced expression of immunoglobulin (Ig)M. Both *in-vitro* and *in-vivo* treatment with toll-like receptor (TLR)- ligand (poly I:C) or nod-like receptor (NLR)-ligands (iE-DAP and MDP) resulted in TLR and NLR activation and BAFF-gene expression. This is the first report showing BAFF-expression by innate immune receptor-ligands and its critical role in enhancing adaptive immune response in fish (Fig. 29).

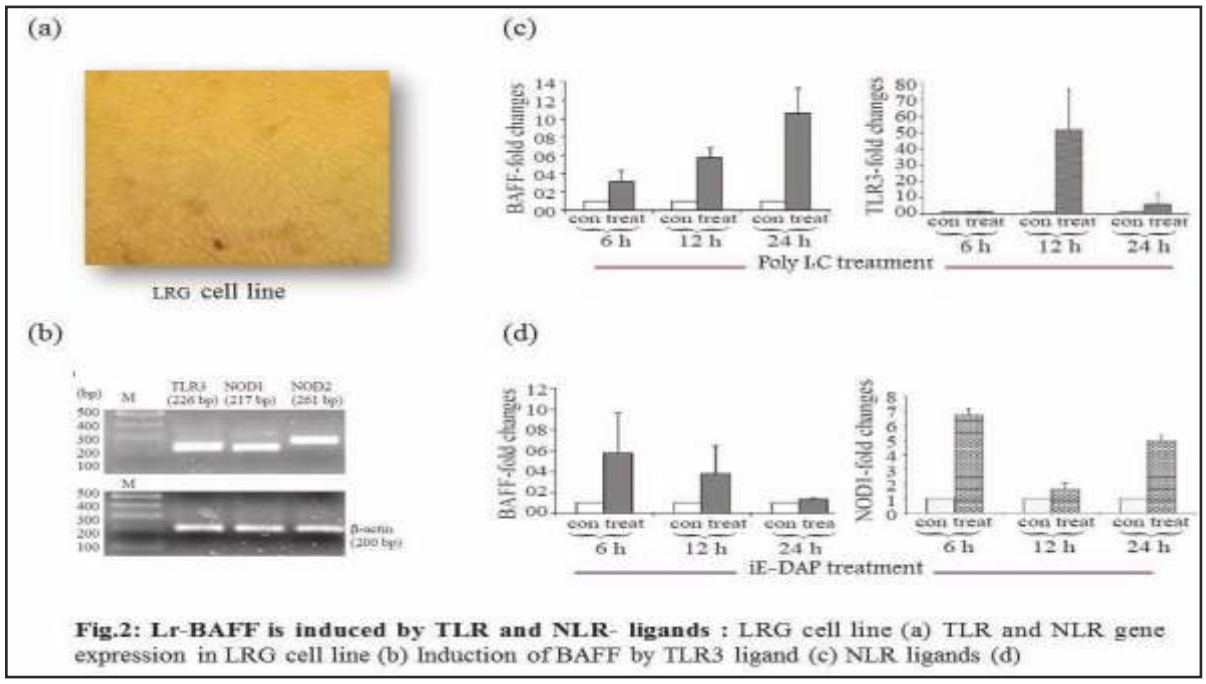


Fig.2: Lr-BAFF is induced by TLR and NLR- ligands : LRG cell line (a) TLR and NLR gene expression in LRG cell line (b) Induction of BAFF by TLR3 ligand (c) NLR ligands (d)

Fig. 29. Lr-BAFF is induced by TRL and NLR- ligands: LRG cell line (a) TLR and NLR gene expression in LRG cell line (b) Induction of BAFF by TLR3 ligand (c) NLR ligands (d)

Project Title	:	National surveillance programme for 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 – February, 2018
Project Personnel	:	P. K. Sahoo (PI), B. K. Das (upto July, 2016), A. Paul (wef August, 2016)

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. During the period, 469 numbers of fish farmers and 74 numbers of state fisheries officials were sensitized about fish disease surveillance by organizing 12 different programmes in the targeted regions. During each programme, the water and diseased fish samples bought by the farmers were analysed on the spot and remedial measures were suggested. Besides, the farmers were also provided with knowledge on modern scientific aquaculture technologies, common diseases in aquaculture - their immediate control and management measures. Baseline information with GPS coordinates of 487 farms were generated during the year that led to a total of 1,271 numbers of baseline data from the two states, Odisha and Andhra Pradesh. Under active targeted surveillance, samples from both states were collected and processed for two viruses KHV and SVCV, and a total of 1017 individual samples (486 pools of samples) were collected during the period for KHV and SVCV. A total of 1548 individual samples (954 of this year and 594 of previous year) were screened {includes a total pooled samples of 837 nos. (444 nos. of pools of this year and 393 pools of previous year)} during the period. All this samples were found negative for KHV and SVCV. In addition, 68 numbers of samples received/collected under passive surveillance were screened for causative agents, and medications with

health management measures were timely provided to the farmers. This year five days long two hands on

Hands-on training programme on "Diagnosis of Freshwater Fish Pathogens for Disease Surveillance" under NSPAAD project for the Odisha state fisheries officials

During the period, in National Referral Laboratory, 79 samples were received/collected from Andhra Pradesh, Odisha, West Bengal and Maharashtra. Total 28 cases were screened under level III diagnosis. Emerging bacterial fish pathogens like *Proteus mirabilis*, *Klebseilla pneumoniae*, and *Acinetobacter baumannii* were recorded and reported from outbreak cases. Also two myxosporidean parasites *viz., Zschokkella auratis* and *Thelohanellus qadrii* were identified from fish. Further, two new emerging viruses i.e. CyHV2 and carp edema virus from gold fish and koi carp, respectively were reported.

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 (up to July, 2016), N. K. Barik and K. C. Das

Patent Granted

1. Competitive ELISA for diagnosis and seromonitoring of microbial infections in cultured freshwater fishes (Patent No- IN277740, Date of grant: 29.11.2016)
2. A process for differential sero-diagnosis of gram-negative bacterial infections and detection of their toxins in human food in reference to fish and fish products using polyclonal antibodies to their less cross reacting and highly specific extra cellular products antigen (Patent No- IN277749, Date of grant: 29.11.2016)
3. A method and an apparatus for developing gonodal maturity in carp (Patent No- 275820, Date of grant: 22.09.2016)

Patent Processed

1. Purified recombinant Gial cell-derived Neurotropic Factor(GDNF) of rohu carp, *Labeo rohita* (Application filed 201631036694)
2. An improved aeration device for large aquaculture ponds (Application filed 2325/DEL/2008)
3. An eco-friendly cost effective apparatus for efficient pearl mussel implantation (Application on process)

Signing of MoU

Technology processed for commercialisation

Annexure-I

1. Dot-ELISA kit
2. Spot agglutination kit
3. A PCR based Rohu-Catla Hybrid identification detection kit
4. FRP demand fish feeder
5. ARGULUS - PCR Detection Kit for *A. siamensis* and *A. japonicus*
6. White tail disease diagnostic kit
7. Spring Viraemia of carp PCR- based diagnostic kit
8. 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, upto July 2016), M. Samanta (PI, w.e.f. Sept, 2016) P. Swain, and Rakesh Das

Samples from diseased rohu, catla and goldfish were screened for the isolation and identification of *F. columnare.* Staining, morphological characterization and biochemical tests have been completed and it presumably confirms the bacteria as *F. columnare.* To confirm it further, 16s rRNA gene has been cloned (Fig. 30).

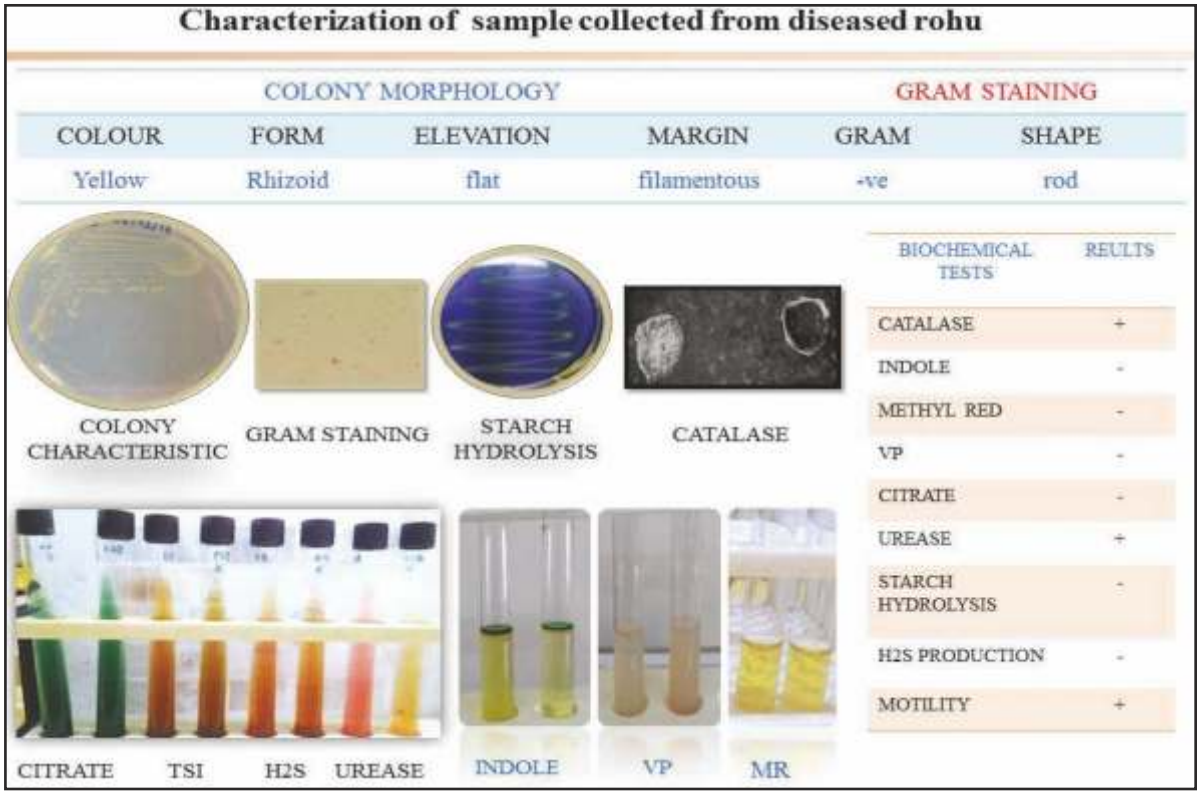


Fig. 30. Characterization of sample collected from diseased rohu

Project Title	:	All India Network Project on Fish Health
Project Code	:	E-99
Funding Agency	:	AINP on Fish Health
Duration	:	July 2015 – March 2017
Project Personnel	:	B. K. Das (PI, up to July, 2016), S. S. Mishra (PI, w.e.f. August, 2016), Rakesh Das and N. K. Barik

Questionnaire based survey was undertaken in selected freshwater aquaculture areas in Odisha, Chhattisgarh, Jharkhand and Andhra Pradesh, to assess the prevalence and availability of different types of aqua-drugs, chemicals or formulations being used for fish production. After thorough survey, it was found that different categories of products are being used for maintaining the water quality parameters (13.11%) and removal of toxic gas problem or water sanitizer (8.67%) during the culture

period. There was list of chemicals or formulations used as growth promoters (21.48%), pond probiotics (16.67%) and feed probiotics (7.78%). Therapeutic agents to combat the infectious diseases were antibiotics (2.96%), anti-parasitic (11%), and other anti-bacterial or antimicrobials (16.11%). The use of hormones as inducing agent for fish breeding was also found (2.22%). All the collected information was submitted online portal of ICAR-CIBA network platform for making the compendium on aqua drugs or medicines.

Experimental study was conducted to evaluate the efficacy of formalin, emamectin benzoate (EB) and common salt in bath treatment against gill associated parasites *viz*., gill flukes (*Dactylogyrus* spp.), protozoans (*Myxobolus spp*., Trichodina spp. and *Ichthyophthirius* spp.). The dose was selected in the entire treatment group with different ranges in (ppm or %) where equal number (n=20) of rohu juveniles, collected from farmers field with much more similar level of parasitic load and infestations. After 10 days, it was observed that common salt (1%-5%) bath treatment (for about 1 min) significantly reduced the parasitic load on fish compared to EB and formalin. This indicated application of salt or salt treatment can be one of the finest ways to combat the parasitic infection in the Indian major carp, *Labeo rohita*.

E. Social Sciences

Project Title	:	Aquaculture development through participatory approach
Sub-project title	:	Impact of catfish and murrel aquaculture in India
Project Code	:	I-84 (d)
Funding Agency	:	Institute-based
Duration	:	April 2013 – March 2017
Project Personnel	:	N. K. Barik (PI), P.P. Chakrabarti and Rajesh Kumar

The project aimed at identifying constraints in adoption of the catfish and murrels in India. It estimated ex-ante impact of adoption of murrel, magur and pabda in the states of Odisha, Assam and Tripura, respectively. The highlight of the research project is as below.

- Demand for catfish is very high.
- Predicted future price is higher in absence of rapid expansion of aquaculture.
- Lower expansion of price in carps is due to aquaculture.
- The cost of production is favorable to undertake catfish aquaculture.
- Constrained by technology/technical knowledge
- Need a comprehensive programme of technology transfer
- Cluster based approach is a recommended strategy.

Market assessment

The market for the freshwater fishes receive supply from the wide range of sources like ponds, reservoirs, rivers and wetlands. The supply can be broadly categorized as aquaculture products and capture based products. Most of the freshwater species are available from the capture fisheries sources but aquaculture provides only few selected species like Indian major carps and Pangassius. The supply of catfishes and murrels from the aquaculture sources are very limited and therefore, their role in determining market trends is not very significant. For the purpose of present analysis, the carps and pangassius can be considered as aquaculture products while catfish and murrels as capture fisheries sources. The capture fisheries sources are dependent upon the natural processes like natural breeding, auto-stocking, natural feeding etc, hence, faces the constraints of expanding supply in both long and short term. Highly inflexible nature of supply leads to increasing scarcity value and upward

trend of prices. In absence of aquaculture of catfish and murrel it is assumed that the trend of price of these fishes will be upward compared to carps.

To test these hypothesis the market trends of fishes in Delhi market and all India prices is compared over a period of 12 years (2004-2016) for Delhi market and 10 years (2006-2016) for All India market. It was found that the price of catfishes has grown at the rate of 15.0% while carps grown at the rate of 8.7% annually during this period. There is clear trend of rise in the prices of the catfishes compared to carps during last 12 years indicating supply constraints and gap in the demand and supply. (Fig. 31 & 32)

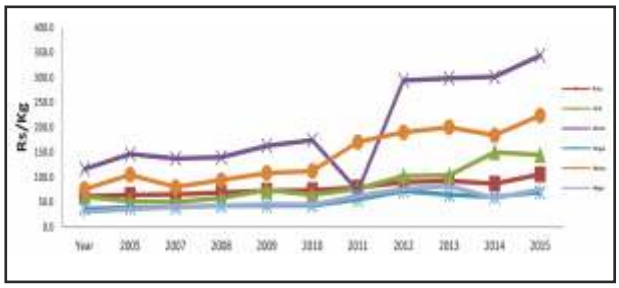


Fig. 31. Price trend of important fish species in Delhi market

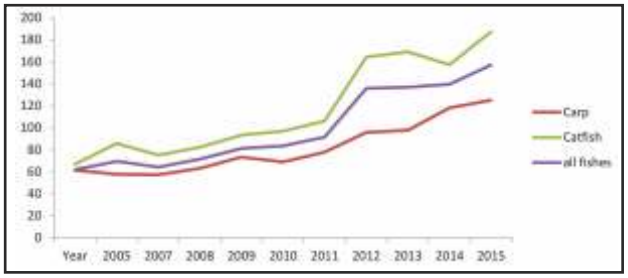


Fig. 32. Price trend per kg of fish of carps, catfishes and all fishes in Delhi market

Impact assessment

Ex-ante impact of these species over a long period horizon of 30 years is estimated and presented in the table below (Table 30). It was found that the adoption of these species for aquaculture will lead to higher income and return to investment in research over a period of time.

Table 30. The major constraints in the adoption of these technologies and reasons thereof .

Constraints	Reasons
Compared to carp, the breeding technology is difficult manage	Male sacrifice, synchronization, stripping of female, lower fecundity, mortality in the in early stages
Choice of food is limited and costly	Live feed, high protein feed, formulated feed
Cumbersome management requiring higher level of skill	Screening, shorting, providing shades, feeding management
Non-availability of skilled manpower	Broodstock management, brooder selection, identification, male female maturity stages, handing of the animal
Quick disposal of seed leads to higher mortality	Farmers need to wait for at least 1 month to sell the seed and compared to carp it cannot be stocked at a very early stage
Compared to carp 1 pair of catfish results much lower spawns	Up to fingerlings stages only 20-25 % fingerlings will be obtained after proper management e.g fingerlings per pair of brood carps - 50,000; Pabda -15,000; Magur- 2000; Murrel - 1500
Fish can be stocked in the water bodies with specific attributes	Smaller water bodies, lower depth, lower temperature, partial shading etc

Difficult to differentiate gariepinus and magur in early stage	Looks similar and farmers may be cheated
Complete package of technology not available	Seed, feed, knowledge
Non-compatibility with carp hatcheries Poorly developed market chain	Risk of escape to carp spawn area Critical mass of seed production, lack of market information, limited traders operating, regional variation in price very high
Risk and uncertainties Gaps in state policies	Technology, survival, skilled manpower, recovery, marketing Treat similar to carps; no specialized attention; no additional incentives; feed production and supply
Higher investment per kg of fish	Compared to carp investment is much higher

Future strategy

The strategy for higher adoption of the technology is as below:

- Increasing number of hatcheries
- Training of hatchery operators and seed growers
- Development of catfish clusters
- Development of feed and feeding protocol
- Establishment of small scale customized feed mill
- Programme based approach with specific funding
- Incentives for innovation and production
- Risk coverage for mortality and loss

Sub-project title	:	Scaling up of AFS as a model of farmer to farmer extension
Project Code	:	I-84 (E)
Funding Agency	:	Institute-based
Duration	:	April 2016 – March 2019
Project Personnel	:	G. S. Saha (PI), H. K. De, A. S. Mahapatra, N. K. Barik, I. Sivaraman and N. Panda

Aquaculture Field School (AFS) is a school without walls for improving decision making capacity of fish farming community. It is a participatory approach whereby fish farmers are given the opportunity to make choices in the method of aquaculture production system through discovery based approach. AFS is composed of a group of farmers who regularly have a gathering for problem solving interaction. Typical group strength should have 20-25 aqua-farmers. The principle of AFS falls in the line of Farmers Field School (FFS) implemented in agriculture. Here the entrepreneurs/aqua-farmers after being trained by a research institute in turn train other small farmers in that area about the scientific practices of aquaculture. ICAR-CIFA has established three field schools. These pilot scale AFSs would be studied and their performance would be measured by conducting survey of farmers. Based on the learning of existing AFS, a detailed scheme on AFS would be developed for funding by banks, line departments and other stakeholders. The study would come out with a strategy for scaling up AFS as model of farmer-to-farmer extension.

During the year 2016-17, scouting of potential entrepreneurs for replicating the AFS was initiated. Discussions were held with Shri Akshaya Kumar Sahu of Boisinga, Mayurbhanj district, Odisha and an MoU was also signed with the farmer. Primary data on impact of AFS has been collected from 97 fish farmers attending the AFS, Sarakana & Bhatpadagarh of Khordha district, Odisha and Tirga, Durg, Chhattisgarh with the help of a well-structured questionnaire. Data was collected on the following aspects: purpose of visiting AFS; frequency of visiting AFS; distance from their pond to the AFS; total water

area under culture; fish yield before and after attending AFS; total annual income from aquaculture before and after attending AFS; demonstration of farm technologies given by the AFS; explanation of the technologies in detail; receiving telephonic advice from AFS operator; sharing of experiences among the fellow farmers; recommendation to any other farmer for attending the AFS.

Preliminary analysis of the data

Most of the fish farmers (48%) attending AFSs are in the age group of 40-50. Few farmers (15%) are over 50 years. Fish farmers attending AFS are having agriculture, horticulture and fisheries as their primary occupation and they visit AFS quarterly sometimes in groups sponsored by State Govt. They visit AFS to buy seeds and to discuss and learn more about aquaculture. They opined that demonstration of farm technology given by the AFS is very good and the technologies explained in detail are also very good. They contact the operator of the AFS telephonically at the time of emergency. All fish farmers expressed their satisfaction while attending AFS through exchanging new ideas among themselves. Some fish farmers suggested technical training to be conducted twice or thrice in a year.

Project Title	:	Promoting improved agriculture and allied sector technologies in Khordha district through Farmer First Approach
Project Code	:	E-105
Duration	:	October 2016 - September 2018
Funding Agency	:	FFP of KVK scheme of ICAR
Project Personnel	:	H. K. De (PI), P.C. Das, S.C. Rath, S. Sarkar, S. Kamble, I. Sivaraman and R. Das

The Farmer First approach considers putting the farmer in driver's seat in matters of problem identification, prioritization, and conduct of experiment and it management. Strong partnership with farmer for developing location specific, demand driven farmer friendly technology option is the guiding principle. It has four components – enhancing farmer-scientist interface; economically viable technology options; partnership and institution building and e-enabled knowledge sharing. This project is unique in its approach which creates a platform for all the scientists irrespective of their disciplines, to get an opportunity to regularly interact to the rural farm environment and thus, collect valuable feedback on problems, priorities, opportunities and status of agriculture and agricultural technology at the ground level and develop suitable technology modules for different farm situations. The project focus will be on enriching knowledge and integrating technologies in the farmer's conditions and to enhance farmers-scientist interface. Emphasis of the project will be on farmers' farm, innovations, resources, science and technology. Small holders, landless and farm women will be specially addressed through technology integration modules.

The project has covered 4 villages in Khurdha district i.e., Kantia Talasahi, Kantia Uparasahi, Jaganathpur (Block-Balianta) and Dorbanga (Block-Balipatna). Before the intervention in the selected areas a survey was conducted using Participatory Rural appraisal (PRA) tools. Interactions held with officials of line departments, panchayat and village leaders and beneficiaries were selected for interventions. Small and marginal farmers belonging to SC & ST categories and women are given priority during implementation of the project. In total the project has involved 400 beneficiaries. Modules on improved technologies on crop, horticulture, livestock and fishery are being demonstrated. Skill training and technical backup are being provided to the beneficiaries. Afterwards, the result of each village was noted to study the performance level.

During the current (2016-17) rabi season, cultivation of green gram (var. TARM 1) in rice fallow, introduction of improved variety of pointed gourd (var. Swarna Alaukik), capsicum (var. Ayesha) and improved strain of poultry bird (Kaveri) are being taken up in around 100 acres. Scientific carp culture and integrated fish farming and for gender mainstreaming SHG based intervention on backyard poultry and mushroom are being implemented.

F. Application of plastic in aquaculture

Project Title	:	AICRP on Plasticulture Engineering and Technology Centre at ICAR-CIFA
Project Code	:	E-03
Funding Agency	:	AICRP on PET
Duration	:	From May 1988 and continuing
Project Personnel	:	B. C. Mohapatra (PI), B. B. Sahu, N. K. Barik, K. Anantharaja and D. Majhi

Growth of periphyton on different plastic materials

Experiments were conducted in the laboratory to observe periphytic growth on four types of plastic sheets such as polyethylene (PE), polypropylene (PP), fiber reinforced plastic (FRP) and acrylic placed inside the glass aquaria filled with fertilized freshwater for 45 days. Observations were made on every 15th day for growth of periphyton both qualitatively and quantitatively on the plastic sheets and physico-chemical properties of aquaria water were recorded during periphyton samplings. Significant difference ($P<0.05$) in periphyton quantity per unit area of the plastic sheets was found among the treatments and the volume from FRP sheet was higher (7.10 ± 0.26 ml/0.1 m^2) than the polyethylene (4.43±0.35 ml/0.1 m^2), polypropylene (3.35 ± 0.20 ml/0.1 m^2) and acrylic sheet (2.32 ± 0.31 ml/0.1 m^2). Total 38 periphytic microalgae (Chlorophyceae – 4 types, Cyanophyceae – 11 types, Bacillariophyceae – 15 types and Desmidiaceae – 8 types) were recorded from these sheets. Polyethylene sheet had more types of Cyanophyceae and Bacillariophyceae attached on to it and the acrylic had fewer types. On all sheets Bacillariophyceae (Diatoms) had developed more in numbers and *Navicula* was the dominant type. FRP sheets can be used as a substrate in aquaculture system for periphytic growth on them, which can be utilized by fishes as natural food.

Floating nurseries for different stages of carp seed rearing

The technology of floating cage nursery with the dimensions of (1 m x 1 m x 1m) for different stages of carp seed rearing was started in the year 2016 with the objective to rear carp seed from spawn to fingerlings stage in the designed floating nurseries in reservoirs. The set up consisted of cages with different mesh size nets attached to the PVC pipe frame structures constructed to float in water. The experiments were conducted and the carp spawn (3000 nos/cage) were reared up to fry stage in the cages tied with mesh screens of 1/40", 1/60" and 1/80" mesh, where one set of cages (3 nos with 1/40", 1/60" and 1/80" mesh) were provided with water showers and the other set (3 nos) were without showers. The data are being analyzed to find the suitable mesh size for the carp seed rearing. It was found that survival was higher in the cages without water shower. The shower velocity was 9.4857 m/s, which might have affected the spawn survival in the cages provided with shower. The highest survival was found in the 1/40 mesh cage without shower. (Table 31)

Table 31. Survival of carp seeds in cages

	With water shower			Without water shower		
Cage mesh size	1/40"	1/60"	1/80"	1/40"	1/60"	1/80"
Survival (nos)	490	395	368	770	565	530
Survival (%)	16.33	13.16	12.26	25.66	18.83	17.66
Weight of fry (g)	0.18	0.25	0.28	0.12	0.16	0.17

Design, development and testing of aquaponics system

AICRP on PET centre at ICAR-CIFA has designed and developed a nutrient film technique (NFT) aquaponics system comprising of fish culture tank (3400 L capacity), submersible water pump, trickling filter and 4 hydroponic HDPE grow pipe of 3.0 m long and 6" diameter. A timer circuit was also installed in the system to automatically run the submersible pump everyday at the interval of every 2 h for 10 min. The performance of the developed system has been evaluated. Growth and survival of *Anabas testudineus* were studied in the Aquaponics system. The *Basella alba* (locally known as *poi sago*) were planted in the aquaponics system. The initial height and weight of *poi sago* were 10.80 ± 1.10 cm and 9.17±1.60 g, respectively. *A. testudineus* was stocked at the density of 75 nos. per m^2 in each tank having the water volume of 2000 L. The initial length and weight of *A. testudineus* was 5.60 ± 0.57 cm and 3.2 ± 0.63 g, respectively. During the growing period, no changes were made in the flow of water. The fishes were fed two times daily with floating pellet feed. At the end of 6 weeks of experimental duration, the height and wet weight of the *poi sago* at final harvest were 34.40 ± 3.0 cm and 80.40 ± 2.88 g, respectively. The concentration of total ammonia in the water was lower in treatment compared to control at the end of the experiment. The final average length and weight of *A. testudineus* were 9.02 ± 0.54 cm and 14.36 ± 2.01 g in the treatment tank and in control tank it was 8.19 ± 0.59 cm and 10.69 ± 1.80 g, respectively. The survival of fish was higher (91%) in the aquaponic system compared to control (89%). The yield of fish was higher in treatment compared to the control. The aquaponic system used less water compared to control. Water was recycled after absorption of nutrients by the plant in a closed-loop system which conserved water. The control of N-compounds especially ammonia was given more priority in the experiment. The aquaponics offers a solution to remove the nitrogen and phosphorous compounds from the system and improves the overall efficiency of the culture system.

In another experiment, the growth and survival of tilapia in the Nutrient Film Technique (NFT) type aquaponics system were studied. The seeds of Nile tilapia *Oreochromis niloticus* were stocked at the density of 100 nos./m^3 in the aquaponics fish culture tank. Marigold plants were grown in the hydroponic pipes. The fishes were fed two times daily with floating pellet feed. Water was recycled after absorption of nutrients by the plant in a closed-loop system which conserved water. The plants were grown healthy in the NFT aquaponic system. In the aquaponics system, there were 450 flowers harvested from 36 plants during experimental period of 3 months. The average weight of the marigold flower was 9.94 g. The aquaponic system used less water compared to control. Water was recycled after absorption of nutrients by the plant in a closed-loop system which conserved water.

Testing of mobile fish vending trolley

The feasibility test of the mobile fish vending trolley developed at ICAR-CIFA by AICRP on PET was carried out. The tests were conducted to study the melting rate of ice inside the insulated box. The outside and inside temperatures along with the ice melting rate were monitored at hourly intervals for 8 h from 9.30 am – 5.30 pm in a sunny day (35.0 – 39.0 ^{0}C). It was found that the inside temperature of the ice box was proportionate with the atmospheric temperature and ice melting rate was found to be quite low (0.75 – 2.50 L/h while ice box contained 60 kg of ice. It was recorded that the ice box maintained 9.0-12.0 ^{0}C lower temperature than the atmospheric temperature.

Design of respirometer and its operation

A simple and novel respirometer in acrylic material has been designed and developed to study the oxygen consumption by fry, fingerling and advanced fingerling stages of fishes. The instrument is transparent, can be completely sealed air-tight, and can store water and fish for experimentation. Water can be filled or drained manually at desired intervals and the inlet and outlet hubs are fixed with screens to protect the fish seed to escape out of the

respirometer during experimentation or water flow. Two models of respirometer were fabricated having dimensions of 10"x 10"x 10" and 11"x 11"x 11" with 18 L and 22 L water storage capacities, respectively. The components of the respirometer are the transparent water tank with outlet hub containing drainage valve, transparent covering lid with inlet hub containing inlet valve and airway cap. The airway cap is provided in the lid to make a way for air to pass into the tank while draining water or out of the tank during filling of the water. The operation of the respirometer involves filling the tank with water, stocking the fishes, covering it with the lid, taking water samples for oxygen estimation in the start and end of the experiment.

Experiments were conducted in laboratory conditions during July-August 2016 for determination of oxygen consumption of advanced fry, fingerlings and advanced fingerlings of Indian major carps (IMC) such as *Catla catla* (catla), *Labeo rohita* (rohu) and *Cirrhinus mrigala* (mrigal) in freshwater medium of total alkalinity varying between 150-154 mg/L, total hardness 130-140 mg/L, pH 7.5-8.0, carbon dioxide 5.6-12.0 mg/L and temperature 31-35°C. Experiments were conducted in acrylic respirometers designed and developed for this purpose. The oxygen consumption values for advanced fry, fingerlings and advanced fingerlings of catla were 634 ± 9, 565 ± 27 & 516 ± 28; rohu 549 ± 26, 459 ± 41 & 374 ± 38 and mrigal 532 ± 24, 449 ± 28 & 343 ± 30 mg/kg body weight/h, respectively. In all stages, the oxygen consumption values of catla varied significantly ($p<0.05$) from rohu and mrigal, whereas no significant differences ($P>0.05$) were found between rohu and mrigal. Oxygen consumption was found to be more in all experimented stages of catla than the similar stages of rohu and mrigal. In all fishes, the oxygen consumption was reported to be higher in advanced fry stage than the fingerling and advanced fingerling stages. The lower critical tolerance limits of oxygen in water for survival of advanced fingerlings of catla, rohu and mrigal were found to be 0.4, 0.32 and 0.32 mg/L, respectively.

G. Field Station, Kalyani

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, Ajmal Hussan, S. Adhikari, Farhana Hoque

Collection, transportation and broodstock development of *Mystus gulio*

A total of 920 *Mystus gulio* adults were collected from natural sources of low salinity areas in West Bengal, transported to the Kalyani Field Station with

100% survival, and developed as broodstock in a small earthen pond. A total of about 180 brooders were used for induced breeding operations.

Development of breeding technology of *M. gulio*

Eight different experiments/trials were conducted during July and August, 2016 on induced breeding of *M. gulio* in variable doses, mode of injections, egg substrates with different shapes and sizes of experimental units, etc. Three inducing agents *viz*., gonadoprim, ovatide and HCG were tested. Out of 94 females injected in different experiments, 54 responded and a total of approximately 7.75 lakh larvae produced. Fertilization and hatching rate were found to be above 90% in different experiments. The eggs were adhesive, demersal and transparent.

Matured male and female *M. gulio*

Development of seed rearing technology

The seed rearing technology has been developed by conducting experiments/trials in glass tanks, FRP tanks and cement cisterns to find out the suitable stocking density, the effect of size variations on cannibalism, the effect of light intensity on hatching and seed rearing. Survival and growth of post-larvae and fry fed with *tubifex* worm, zooplankton and commercial feed were evaluated in different systems (FRP tanks- 300, 400, 3000 L capacity & cement cisterns 9000 L capacity, and comparatively large concrete rearing tanks of 20 m^3 and 180 m^3 sizes). In circular FRP tanks of 3 m^3 capacity, the survival rate of post-larvae with different stocking densities ranged from 31 - 44%, whereas in small glass tanks survival was 50-70%. Further, 74–100% survival was recorded in fry to fingerling rearing phase.

M. gulio: (a) One month old fry, (b) Three months old fingerlings

Development of grow-out culture technology of *M. gulio*

The grow-out culture of *M. gulio* is going-on in different systems: monoculture in concrete tanks with different stocking densities (total volume 276 m^3) and polyculture in earthen ponds with rohu and catla (total 0.15 ha). In monoculture, *M. gulio* attained 8-15 g after 15 weeks.

Dissemination of induced breeding and seed rearing technology of *Ompok* and *Mystus*

- Hands-on training on "Breeding and seed production of small indigenous catfishes with emphasis on Pabda (*Ompok* sp.) and Tengra (*Mystus* sp.)"

  A 7-day training on "Breeding and seed production of small indigenous catfishes with emphasis on Pabda (*Ompok* sp.) and Tengra (*Mystus* sp.)" was conducted at Kalyani Field Station during 14-20 July, 2016. A total of 18 fish farmers, hatchery operators, State Govt. officials, Asst. Professors and students from West Bengal, Assam, Bihar and Tripura attended the programme.

- Distribution of farm-reared broodstock of *Mystus gulio* to the fish farmers

  A total of 280 brooders (female 50-80 g and male 40-50 g) were distributed to 7 (ICAR-CIFA Kalyani trained farmers of six districts of West Bengal and one from Bihar) self-motivated fish seed growers (20 male and 20 female fish to each).

Distribution of *M. gulio* brooders to fish seed producers

Integrated fish farming with carps, duck and high-value horticulture crops as components

A study is in progress to identify the profit of integrated Duck-High value crop-Fish (carps and catfish in polyculture system) farming. High value horticulture crops- broccoli, red cabbage, Chinese cabbage and lettuce; Duck variety Khaki Campbell and fishes catla, rohu, mrigal and *Mystus gulio* were selected for the study. One pond of 0.2 ha was selected with one side duck home and three land sides (0.02-0.07 ha) for high value winter crops for experiment with IMC fingerling culture. High value crop culture in the dykes utilizing pond water and external organic fertilizers resulted a total gain of Rs. 12935/= with benefit-cost ratio of 1.87. Droppings of ducks were directly drained to the pond after washing the duck house floor in regular intervals and ducks were also allowed to swim in the pond during day time. Excreta produced by each duck was 7-10 g/day. Ducks were fed with commercial feed along with geri-gugli (*Bellamya bengalensis*) and cooked food comprised of broken rice, rice bran and waste part of vegetables. After six months of rearing, ducks attained an average weight of 1.4 kg and few ducks started laying eggs from February, 2017. In 5 months, carps attained an average weight of about 270 g, while *M. gulio* attained about 9 g.

Another experiment is in progress for evaluation of Poultry-High value crop-Fish (carps and catfish in poly-culture system) farming system. High value horticulture crops- Broccoli, Cherry tomato, Strawberry and Capsicum; poultry variety Banaraja (layer variety) and fishes catla, rohu, mrigal and *Mystus gulio* were selected for the study. For this experiment, 3 ponds were selected with water spread of 0.21 ha and dyke area of 0.09 ha. High value crop production in the dykes resulted a total gain of Rs. 20139/= with benefit-cost ratio of 1.57. In six months of rearing, poultry attained an average

weight of 2.2 kg. Poultry litter was used in the ponds at regular interval as fertilizer. Fishes were stocked maintaining proper ratio and provided with commercial feed at 1% of the body weight. In 5 months, carps attained an average weight of 300 g, while *M. gulio* attained about 12 g.

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

Fish growth across species, evaluated without (T-I, control) and with feed (T-II-IV, treatments) in sewage fed system, exhibited higher in lower SD (stocking density) than in higher SD, with 95% survival (Fig. 34). Rohu showed the highest growth irrespective of treatments followed by mrigal and catla (Fig. 35). The effect of different quantity of supplementary feed on fish growth of different species was not significant (P>0.05) as compared to fish growth on natural food from sewage water origin. No difference (P>0.05) was observed in fish species grown in sewage fed system with and without feed.

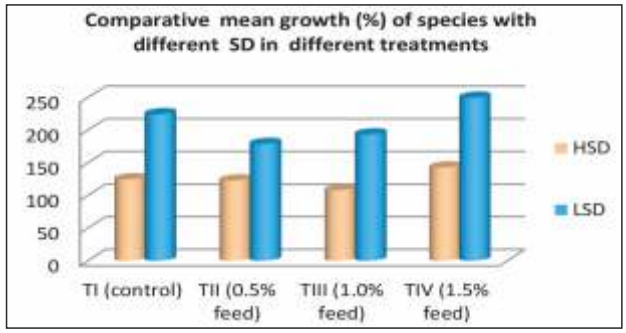


Fig. 33. Comparative mean growth (%) of species with different SD (HSD, high stocking density and LSD, lower stocking density in different treatments)

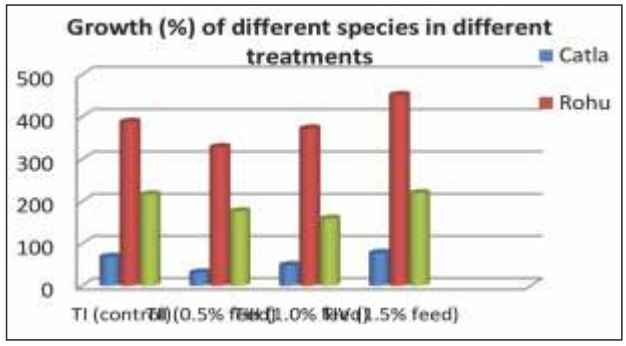


Fig. 34. Mean growth (%) of different species in different treatments

Histopathological study of gill showed three distinct features in *L. rohita* grown in different treatments: (i) normal secondary lamellae (SL) and primary lamellae (PL) with minor hyperplasia in freshwater culture (Fig. 35a), (ii) slight epithelial lifting, hyperplasia and aneurism at few places in wastewater fed culture (without feed) (Fig. 35b), and (iii) blood congestion, vasodilation, hypertrophy of primary lamellae, aneurism and necrosis in wastewater fed culture (with feed) (Fig. 35c).

Fig. 35a. Gill section of rohu grown in freshwater

Fig. 35b. Gill section of rohu grown in sewage fed aquaculture without supplementary feed

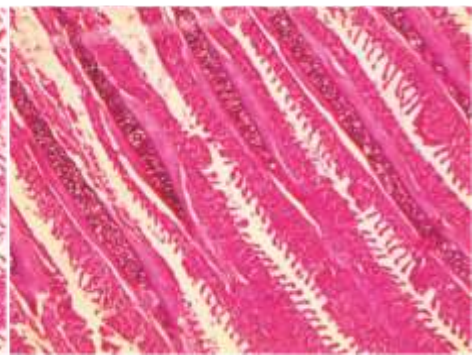


Fig. 35c. Gill section of rohu grown in sewage fed aquaculture with feed

In ecological study, there were no significant differences (P>0.05) in water productivity (mg C/m^3/h) in different treatments (TI-TIV), though net primary productivity was the highest in control. BOD value (ml/L) recorded as 14, 16, 16 and 20 in TI, TII, TII and TIV indicated that increasing BOD is related to increasing feed amount. Sewage fed aquaculture has been ideal system for equilibrium of nitrogen budget in terms of input and output ratio in relation to fish growth as compared to sewage fed aquaculture with feed. The amount of nitrogen loss increased with the increase of feed application, which in turn facilitated the growth of algal mat as compared to fish growth (Fig. 36).

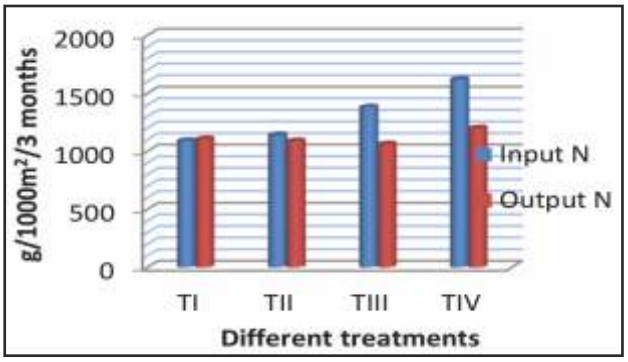


Fig. 36. Nitrogen budget in sewage fed aquaculture

Microbial load across the strain decreased in order in sewage fed system as follows: raw sewage > inlet > culture pond > outlet and also in treatments: TIV > TIII > TII > TI, with decreasing trend from December to February (Fig. 37). Total viable bacterial count was the highest in intestine, followed by gill and skin across species (Fig. 38a). Total viable bacterial count across different organs was the highest in mrigal followed by catla and rohu (Fig. 38b).

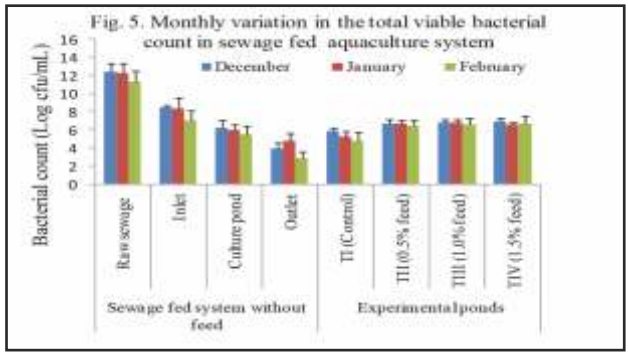


Fig. 37. Monthly variation in the total viable bacterial count in sewage fed aquaculture system

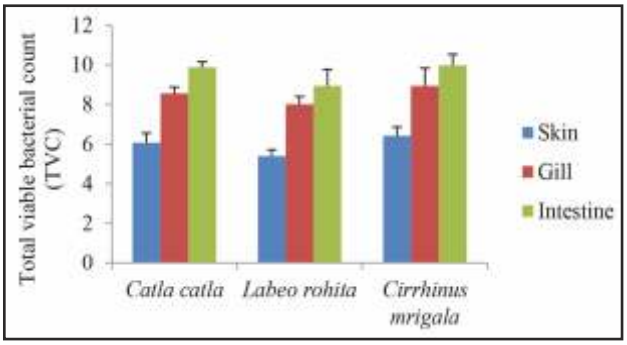


Fig. 38a. Total viable bacterial count in sewage fed Indian major carps

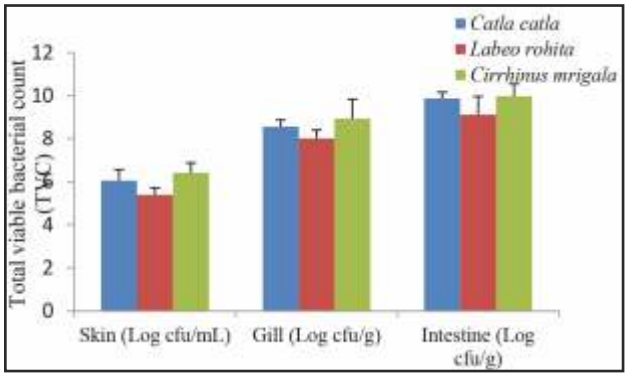


Fig. 38b. Total viable bacterial count in different organs of sewage fed Indian major carps

H. Regional Research Centre, Rahara

Project Title	: Stock characterization, captive breeding, seed production and culture of Hilsa (*Tenualosa ilisha*)
Project Code	: E-78
Funding Agency	: NFBSFARA, ICAR, New Delhi
Duration	: November 2012 – November 2017
Project Personnel	: V. R. Suresh (PI), ICAR-CIFRI (Co-PIs: B. K. Behera, R. K. Manna, Sajina A. M., K. M. Sandhya); D. N. Chattopadhyay (CCPI), ICAR-CIFA (Co-PIs: R. N. Mandal, A. Das); S. Dasgupta (CCPI), ICAR-CIFE (Co-PI: G.H. Pailan); R. Ranjan (CCPI), ICAR-CMFRI (Co-PI : S. Ghosh, B. Dash); D. De (CCPI), ICAR-CIBA (Co-PI: S. Anand, P. Kumar); V. Mohindra (CCPI), ICAR-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

Artificial fecundation of wild caught hilsa was conducted in the river Hooghly at Godakhali, West Bengal during February 2017. The average fertilization rate in dry and wet stripping was 98% in pond water, underground water, Hooghly river water, treated Hooghly river water of water treatment plant and packaged drinking water. The eggs were transported to RRC, CIFA, Kalyani and incubated in the laboratory in glass aquaria using hapa filtered pond water. A total number of 5800 larvae of 4-day old were produced which are being reared in FRP and cemented tanks at the Centre for fry production.

Larval rearing

The four-day old hilsa larvae obtained from artificial breeding conducted during February, 2016 at Godakhali, were reared in outdoor FRP tanks in three experimental systems each at different stocking densities (300, 600 and 1200 m^{-3}). During 46 days of rearing period, larval survival was achieved up to 61.3% at the lowest stocking density. Survival was higher in circular tanks than that of rectangular tanks in each stocking density.

Pond culture

Hilsa is being cultured in two ponds of 0.1 ha each at 15,000 and 30,000/ha stocking density, where fish grew to 134.71 mm/24.63 g and 119.7 mm /14.64 g, respectively, from the initial size of 29.5 mm/0.27 g during 300 days of culture period. Hilsa fry could be weaned to accept artificial feed under pond culture condition.

Transportation

Transportation trial of eggs and larvae of hilsa at different stocking densities were conducted during 5 and 2 h durations, respectively. The survival rate of eggs at 100, 300, 500, 700 and 100 nos./L were 80.32, 67.36, 73.13, 41.97 and 32.83%, respectively. The survival rate of 6 day old larvae of hilsa at 50, 100, 200, 300 and 400 nos./L were 98, 99.67, 97, 98.45 and 98.75%, respectively.

Culture of rotifers

An outdoor experiment on the comparative evaluation of RCD, chlorella and yeast in different combinations for the production of rotifers was conducted for feeding hilsa larvae, where the highest production of rotifers was obtained by supplying chlorella and yeast.

Project Title	:	Productivity and production enhancement of freshwater ponds through BMP and aquaculture for livelihood development of the Aila affected ST/ST communities of Islands of the Sundarbans, West Bengal
Project Code	:	E-101
Funding Agency	:	DBT, Govt. of India
Duration	:	March 2016 - March 2019
Project Personnel	:	P.P. Chakrabarti (PI), B. C. Mohapatra, R.N. Mandal and N. K. Barik

During monsoon, paddy-cum-fish culture is one of the traditional farming practices of Sundarbans incorporating Indian major and minor carps, however, with poor fish production. To enhance the production and profitability, monosex tilapia was introduced for the first time in Bali Island by adopting 6.34 ha paddy field of 16 nos. beneficiaries. Availability of advanced fingerling in summer is major problem in both Bali island and Chunakhali and it affects the production of the culture ponds adversely. To overcome this situation and to introduce the practice/business of seed rearing, 16 nos. and 12 nos. beneficiaries were adopted at Chunakhali and Bali island, respectively, having total 1.66 ha waterbody. Good quality seed of catla, mrigal, bata and improved variety of rohu, *Jayanti* were distributed among those beneficiaries. Advanced fingerlings of rohu, catla, mrigal and bata of average size 68.1, 73.6, 74 and 23.25 g, respectively were available after winter for culture in about 3 ha water body.

To overcome the unavailability of good quality fish seed, induced breeding of rohu, catla and bata was

successful and about 0.8 million spawn production was achieved by operating the FRP carp hatchery. To motivate them in fish based integrated duck-poultry to increase alternative livelihood of poor SC/ST people, 89 nos. families were provided Vanaraja variety of poultry at Chunakhali and Bali Island. Constant monitoring, vaccination, medication for de-worming, etc. were done by involving the beneficiaries. Several training programmes and expert visits for disease control were organized. Average weight of Vanaraja attended 838.8 g after 11 weeks at Chunakhali. All the inputs were provided with geo-tagging.

Table 32. Training and farmers' meet in the Island

Sl. No.	Title	Duration	Venue	No of Participants
1.	Carp breeding and operation of FRP hatchery	23-24 July, 2016	Bali Island	20
2.	Basics of composite fish culture	19-20 September, 2016	Bali Island	58
3.	Basics of composite fish culture	26-27 September, 2016	Chunakhali	57
4.	Nutrient management in post-winter composite fish culture in Sundarban deltaic region	21-22 February, 2017	Bali Island	36
5.	Nutrient management in post-winter composite fish culture in Sundarban deltaic region	4-5 March, 2017	Chunakhali	21
6.	Management of Vanaraja chicks	21 March, 2017	Bali Island	81

Project Title	:	Risk and benefit assessment of an illegally introduced fish species pacu, *Piaractus brachypomus* in India
Project Code	:	E-108
Duration	:	30 March 2017 – 31 October 2017
Funding Agency	:	NFDB, Hyderabad
Project Personnel	:	P. K. Pradhan (PI, ICAR-NBFGR), P. P. Chakrabarti, V. Basheer, B. S. Giri

Assessment of the present distribution and culture status of pacu in West Bengal and Andhra Pradesh

All districts of West Bengal have been surveyed during this period and it was found that 38-40 pacu hatcheries are available in the districts of Bardhaman, Hooghly, Mursidabad, Nadia, North 24 Parganas, South 24 Parganas. Naihati and adjoining area in North 24 Parganas is the major hub, where almost 90-95% pacu seed are produced and marketed to the different parts of the country. Andhra Pradesh is the largest buyer of pacu seed.

Assessment of maturity, reproduction, breeding, seed production and propagation

During the survey it was found that in most of the cases pacu attains maturity in 4 years when they attain about 2-5 kg. Pacu has a long breeding period of 6-7 months (March-September). The farmers generally use the brooders at 3-4 years of age after their sexual maturity. The farmers practice induced breeding of this fish through pituitary gland extract with 2 doses having a gap of 5-6 h and after dry stripping, and hatching takes place after 16- 18 h. After a period of 96 h in the hatchery, the spawn is released in to well prepared nursery pond for fry production.

Determination of the culture status, culture type, food and feeding, diseases and production levels

During 2015, about 30-35 crore numbers of seed was produced and sold all over the country. Fish seeds are being sold at different stages like spawn, fry and fingerling stages, but demand of fry stage seed is maximum. It is reported by the farmers that a disease symptom has been seen with redness of anal fin and

Different pacu hatcheries

at the operculum in the fry stage (when they are 10-12 days old), but in adult stage no specific disease has been reported till now.

Analysis of culture benefits and market trends

During last 5 years, the pacu production has almost doubled as because farmers are getting high price by selling pacu in comparison to IMCs. Highest price of pacu seed has gone up to Rs. 5000/50,000 nos. seed, whereas, for IMC it is only Rs 1200. During peak monsoon, the price of IMC is reduced to Rs. 300-350/ 50,000 nos. seed, whereas, for pacu, the rate is not less than Rs. 2000-2500. During the hatchery operation, the cost of labor, electricity, fish feed remains same for IMC and pacu hatcheries, but profit margin is about 20 times higher than IMC by selling of 1 million pacu seed. Hence, there is a shift in trend towards pacu and pangas hatchery.

Survey at Galyff Street, Kolkata for pacu for aquarium purpose

During the survey, it was found that pacu (*Pyaractus brachypomus*) being available with 5 out of 300

Pacu at Galyff Street, Kolkata for aquarium purpose

hawkers. The fish sellers informed about selling of pacu since last 15 years. The preferable size by the customer ranges from 2-4 inch in length. The present price varies from Rs. 15-60/pieces according to the size. The total fish sold in the market is about 500-600 numbers in every week. But, when they were asked for the source of the fish seed, they denied disclosing it. The source of seed could not be ascertained.

Availability of pacu in natural water bodies

For the availability of pacu in natural water bodies, survey was made in different river systems of West Bengal, East Kolkata Wetland (EKW) and Beels nearby Naihati area. Some accidental occurrence of this fish have been found in different times for last 10 years, but there was no report of natural breeding and damage to the other native fishes.

P. branchypomus is one of the exotic species that is being cultured in Andhra Pradesh in an area of 1000 ha in Krishna-Godavari Delta. Survey conducted to understand the compatibility of pacu with Indian major carps revealed that in most of the areas pacu is cultured in combination with rohu (*Labeo rohita*) at a stocking density of 7000 and 500 per ha, respectively with total production levels of 12-15 mt/ha. Cost of production was recorded to be high when monoculture of pacu was adopted 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), the pacu has limited value as ornamental fish. Risk analysis studies on pacu suggest low to moderate risk with regard to its introduction in Indian culture systems.

I. 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
Sub-project: I-86a	:	Broodstock development, breeding and larval rearing of *Puntius carnaticus* and *Puntius pulchellus*

Adust *Puntius carnaticus*The induced breeding of *P. carnaticus* was successfully carried out twice during August and October, 2016 and the fry/spawn being reared in cement tanks. Males of *P. carnaticus* are in the state of perpetual reproductive phase releasing milt all the time as observed before. The attempt to breed *P. pulchellus* was not successful, though males responded positively under two different feeding conditions. At different day after hatching (DAH), a group of shooters out-performed the normal group in terms of growth. When reared for 117 DAH in cement tanks, *P. pulchellus* fingerlings attained a length of 32 mm and weight of 377 mg compared to the shooters (52 mm and weight of 1778 mg). Reared in ponds for 327 DAH, the fish attained a length of 15.8 cm and weight of 89.4 g. Rearing in ponds for 370 days resulted in a length of 18.48 cm and weight of 132.55 g compared to 25.8 cm and 259.33 g of shooters (Fig. 39).

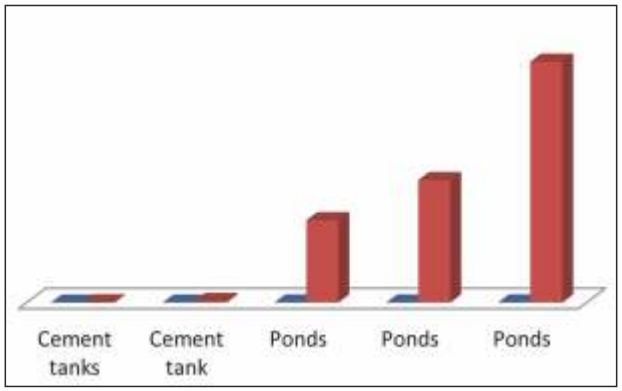


Fig. 39. Growth of *P. pulchellus* fingerlings in aquaculture system (normal vs. shooters)

Polyculture of catla with Peninsular carps

An experiment of 90 days duration was conducted in outdoor earthen ponds (36 m^2). Catla was reared with either *P. pulchellus*/*P. carnaticus*/*L. fimbriatus* in equal ratio at a total stocking density of 10,000/ha. The fish were fed with pelleted feed (30% crude protein) at 3% of the body weight. The water quality

parameters recorded during monthly samplings were in the range of dissolved oxygen: 3.4-10.6 mg/L; temperature: 21.3-26.7 °C; pH: 7.21-9.61; total alkalinity: 198-284 mg/L; hardness: 184-272 mg/L.

The fish growth parameters at harvest are given in the Table 34. Higher increment in fish biomass was recorded when catla reared with carnaticus as compared to pulchellus and fimbriatus. (Table 33)

Table. 33. Fish growth parameters at harvest

Treatment	Species	Initial wt. (g)	Final wt. (g)	Increment in growth (g)	Survival (%)	Total biomass increment per tank (g)
Catla+*Pulchellus*	Catla	94	120	31	92	6353
	Pulchellus	45	80	35	100	
Catla+*Carnaticus*	Catla	92	117	22	86	7592
	Carnaticus	74	127	57	100	
Catla+*Fimbriatus*	Catla	91	110	19	100	6100
	Fimbriatus	61	103	42	100	

Sub-project: I-86b: Value added products from medium and small indigenous fish species

Two instant Fish Soup Powders (FSP), one prepared by a modified process using co-drying and another by the classical process, developed in the seventies by ICAR-CIFT were evaluated for their shelf-life after packing both in 12µ plain polyester/50µ cast polypropylene pouches and storing under ambient conditions. The modified FSP had lower fat, protein and ash contents than the classic, while the N.F.E. was higher. The proximate composition indices did not change significantly (P>0.05) during storage of more than 120 d. Modified FSP always had higher soup viscosity which increased during storage, initially in both soups, but decreased later. Sensory scores for smell, taste and mouth-feel were not significantly different (P>0.05) between the two soups at any single storage time, but overall and mouth-feel scores were slightly higher (P<0.05) and stable for the modified FSP through storage period. Rancid smell was evident after 90 d in the classic FSP.

Sub-project: I-86c: 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

The efficacy of oral administration of an avermectin was evaluated at recommended dose of 50 g/kg body weight for 7 days and two chitin synthesis Inhibitors at two doses, *i.e.*, 1 mg and 0.5 mg kg body weight for 7 days as prophylactic/therapeutic agents in preventing/controlling *Argulus* infection in *L. fimbriatus* fingerlings. In case of prophylactic efficacy studies, these drugs were administered from day 1 to 7, followed by challenge with lethal dose of *Argulus* metanaupli on days 2, 4, 7, 14, 21 and 30. Therapeutic efficacy was evaluated by challenge with lethal dose of *Argulus* metanaupli on day 0, followed by drug administration from days 2, 4 and 7 and 14 post challenge.

Prophylactic administration of chitin synthesis inhibitors for 7 days before exposure to the parasite prevented establishment of *Argulus* infection till 21 days post the last drug dose administered. Lower doses of chitin synthesis inhibitors (0.5 mg/kg body weight) were equally effective as higher doses (1 mg/kg body weight) evaluated. Similarly, the avermectin prevented establishment of Argulus infection form a subsequent challenge till day 14 post last drug dose. Therapeutic efficacy studies revealed that all these drugs were effective as a therapeutic agent only when administered on days 2 and 4 post-challenge and not when administered on days 7 and beyond, resulting in 100% mortality of the host (similar to infected controls). Based on the study it is concluded that prophylactic use of these drugs is best suited to prevent *Argulus* infection. Therapeutic use has to be initiated immediately after infection and at any case within 7 days of acquiring the infection. Dosage recommended based on the study: avermectin at 50 g/kg body weight and chitin synthesis inhibitors at 0.5 mg/kg body weight of fish.

Project Title	:	Production of plant sourced mannan oligosaccharides for improving the productivity of freshwater aquaculture
Project Code	:	E-109
Funding Agency	:	DBT
Duration	:	June 2015-May 2018
Project Personnel	:	N. Sridhar (PI), B. Gangadhar and Hemaprassanth

Feeding trials with mannan oligosacchararides (MOS) from a commercial source

Feeding trial was initiated with the mannan oligosaccharide (MOS) obtained from a commercial source. The basal diet consisted of fishmeal, soya, groundnut cake, rice bran, finger millet (binder) and vitamin-mineral mixture which served as the control. To the basal diet, MOS was added at two levels of 0.5 and 1.0%. Fishmeal, soybean meal, groundnut oil cake, rice bran and finger millet were procured locally. Groundnut oilcake, soybean meal, and finger millet were dried and powdered. All the ingredients were sieved through a fine meshed screen (0.5 mm). The required quantity of the ingredients was mixed with hot water to make a dough and pressed through a hand pelletiser to get uniform sized pellets (2 mm). The pellets were sun dried and packed in polythene bags till further use. Proximate composition of feed was determined following standard methods (AOAC, 1995) (Table 34).

The experiment of 90 days duration is initiated in 1000 L outdoor circular FRP tanks in order determine the growth, digestive enzyme activities and Immune status of the fish. Twelve fingerlings each of *L. fimbriatus* (average weight 49.7±12.5 g) were maintained in 12 aerated FRP tanks and acclimatised to conditions for a period of fifteen days. Each diet was fed to fish in quadruplicate FRP tanks every morning at 10.00 h at (1-1.5%) body weight. The fish were allowed to feed for 2 h. The pelleted feed was siphoned out at the end of the feeding period for calculation of FCR at the end of the experiment.

Table 34. Ingredient proportion (%) and proximate composition (%) of experimental feeds

Ingredients used	Control	0.5% MOS	1% MOS
Fish meal	5	200	175
Soya	21	200	175
Groundnut oil cake	30	45	45
Rice bran	33	50	100
Ragi10			
Vitamin	1	5	5
Mannan oligosaccharide	0	0.5	1%
Proximate composition (%)			
Moisture	4.21±0.03	6.25±0.114	5.1±0.112
Crude protein	30.07±0.43	29.45±0.04	29.57±0.57
Fat	6.91±0.023	6.12±0.012	6.82±0.291
Ash	905±0.0437	9.89±0.388	8.98±0.427
Crude fiber	9.39±0.88	9.32±0.014	9.5±0.008
NFE	40.37±1.51	38.77±0.69	40.03±0.89

Water quality parameters were analysed once in 15 days starting from the day of stocking following standard methods (APHA, 1998). Sampling of the fish is done once in 15 days to monitor the growth. At the end of the experiment, the digestive enzyme concentrations *viz*., amylase, total protease trypsin, chymotrypsin and lipase were measured. Further, blood was collected to measure that innate immune status of fish by measuring superoxide production, serum myeloperoxidase and lysozyme levels and the data is presented in Table 35.

Table 35. Basal Values of innate immune parameters

Parameter	*L. rohita*	*L. fimbriatus*
Nitroblue tetrazolium test (NBT)	0.245±0.022	0.31±0.021
Myeloperoxidase activity (MPO)	0.226±0.018	0.937±0.038
Lysozyme activity (OD at 450 nm)	8.205±0.176	6.445±0.365

J. Regional Research Centre, Vijayawada

Project Title : Development of low cost feeds for *Macrobrachium rosenbergii* culture
Project Code : I-90
Funding Agency : Institute based
Duration : April 2014 – March 2017
Project Personnel : P. V. Rangacharyulu (PI), B. S. Giri, P. L. Lalrinsanga (up to 2016) and Ramesh Rathod

To develop low cost feed for *M. rosenbergii* culture, some of the traditionally used protein rich ingredients were replaced with low cost alternate protein source ingredients in the feed formula. The control and experiment feeds were prepared and fed to post larvae (PL) of *M. rosenbergii* under pond culture conditions for 180 days. During early stages, PL were fed with 35% protein diet for 30 days, then 30% for another month and during last 4 months culture period 28% protein was fed twice a day. Monthly sampling was done to record growth of animals and to adjust feed quantity. The results indicated that 17-20% of cost can be reduced in culture period using the prepared feed during a period of 180 days.(Table 36)

Table 36. Growth performance of *Macrobrachium rosenbergii* fed with low cost feed

Parameters	Control diet	Experimental diet
Initial weight (g)	0.12	0.12
Weight (g, 180 days)	37.23	36.87
Growth (g)	37.11	36.75
FCR	2.06	2.12
Survival (%)	37	38

Project Title : Comparative studies on primary productivity and plankton communities with reference to fish production and productivity in different fish farming systems in Krishna-Godavari Delta, Andhra Pradesh
Project Code : I-91 (g)
Funding Agency : Institute based
Duration : April 2016-March 2019
Project Personnel : B. S. Giri (PI), P. V. Rangacharyulu and Ramesh Rathod

Survey conducted in representative fish culture ponds and white-leg shrimp ponds revealed principal classification of freshwater aquaculture system in Andhra Pradesh into (i) system diversification, (ii) species diversification, (iii) practice diversification and (iv) ecological diversification systems. Present study aimed to study primary productivity in different pond culture systems and also feeding practices. Study revealed that although white-leg shrimp culture is gradually expanding in inland culture areas owing to high economic returns, carp culture remained to be dominant aquaculture system in the region. Species diversification included cultivation of exotic species *viz*., *Pangassianodon hypopthalmus* and *Piaractus brachypomus* in freshwater. Inter-ecological culture of *Litopenaeus vannamei* is expanding in inland areas due to high economic returns while culture of seabass (*Lates calcarifer)* could not be established due to marketing problems. Cage farming is still confined to open sea waters. However, farmers interest towards cage farming needs motivation in freshwater areas. Stocking of zero point seed continues to dominate over other seed stocking practices in carp farming. Role of mineral nutrition in aquaculture is assuming importance in recent times as it is promising in reducing the culture period. Biofloc system has proven to be highly beneficial and increasing seed survival rate in different culture systems.

Project Title : Upliftment of tribal community through scientific adoption of aquaculture technologies for the improvement of their livelihood and socio economic status in selected districts of Andhra Pradesh and Telangana states

Project Code	:	E-107
Funding Agency	:	DBT, Govt. of India
Duration	:	April 2016–March 2019
Project Personnel	:	Ramesh Rathod (PI), P. V. Rangacharyulu, and B. S. Giri

Training-cum-demonstration programme was conducted on carp nursery management practices at Atmakur Village of Macherla Block of Guntur District in Andhra Pradesh state during 27-28 October, 2016. Thirty-five participants from different tribal fishermen societies of local area attended the training programme. Pre-socio economic survey was conducted for the tribal fishermen societies to know their family size, main source of income generation and allied activities. An awareness was created to the fishermen societies on basic concept of fish culture practices to improve their livelihood and demonstrated pond preparation and seed stocking into the ponds. Detailed various management practices of nursery rearing during pre- and post-stocking in carp culture were discussed. A similar programme was organized at Dosillapalli Village of Charla Block of Badradri Kothagudem (earlier part of Khammam Dist.) District in Telangana State during 03-04 November, 2016 for 40 participants.

Interaction with the tribal beneficiaries in Macherla

Socio economic status of the tribal women self-help groups and unemployed youths of different fishermen societies were studied to know their livelihood status and income generation sources. An ornamental fish culture unit was set up in the Gudipadu Village, Macherla Block, Guntur Distirct of Andhra Pradesh for demonstration purpose. Two days awareness-cum-training programme was conducted for the women SHG's. The ornamental fish culture, breeding and management practices of live bearer were demonstrated for their easy understanding and to develop entrepreneurs within the SHGs. Fifty members from different women SHG's participated in two different training-cum-demonstration programmes on ornamental fish culture and breeding in different blocks of Guntur District of Andhra Pradesh and Badradri Kothagudem District of Telangana State.

Interaction with tribal women SHGs

K. Regional Research Centre, Anand

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 Devataj and Chansi, Dist. Anand of central 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 numbers rohu spawn/m^3 while the maximum total biomass was recorded in hapa stocked with 500 and 750 numbers rohu spawn/m^3 at Devataj and Chansi village ponds, respectively. During the experimental period, water quality parameters were within permissible limit.

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. Besides, extension officers in the state department of fisheries, college/ university teachers, students, entrepreneurs and NGO officials were also benefited from the courses. Training programmes conducted this year are presented in Table 37.

Table 37. Training programmes conducted

Sl.No.	Title	Venue	Duration	No. of participants		
				Male	Female	Total
1.	International Training (Uganda) on Breeding Management Approaches of Carps with Reference to Broodstock Diet	CIFA HQs	01 April-31 August, 2016	01	00	01
2.	Training on Molecular Biology & Biotechnology for Fisheries Professionals	CIFA HQs	02 May - 01 August, 2016	03	02	05
3.	Training on Freshwater Pearl Farming for Entrepreneurship Development	CIFA HQs	05-12 May, 2016	12	01	13
4.	National Training on Freshwater Pearl Farming for Entrepreneurship Development	CIFA HQs	24-31 May, 2016	12	01	13
5.	Hands on Training in Multiple Breeding and Cryopreservation of Gametes of Carps	CIFA HQs	04-08 July, 2016	12	13	25
6.	Induced Breeding of Fish for the Rural Unemployed Youth of West Bengal	RRC, Rahara	4-10 July, 2016	30	06	36
7.	Collaborative Training on Hands on Training on Analysis of Biological Data using Computational Tools	CIFA HQs	05-14 July, 2016	12	24	36
8.	Breeding and Seed Production of Small Indigenous Catfishes with Emphasis on Pabda (*Ompak* sp.) & Tengra (*Mystus* sp.)	Field Station, Kalyani	14-20 July, 2016	15	03	18
9.	3rd National Training Programme on Installation and Operation of FRP Carp Hatchery	CIFA HQs	15-17 July, 2016	21	01	22
10.	Training on Hatchery Seed Production of Murrel & Anabas	CIFA HQs	19-23 July, 2016	13	01	14

Sl.No.	Title	Venue	Duration	No. of participants		
				Male	Female	Total
11.	Summer School on Application of Nanotechnology and Molecular Diagnostics in Fisheries & Aquaculture	CIFA HQs	20 July - 09 August, 2016	13	06	19
12.	NFDB and Meghalaya Sponsored Training on Freshwater Aquaculture as a Livelihood Option	CIFA HQs	20-25 July, 2016	18	00	18
13.	Breeding, Seed Production and Culture of Asian Catfish (Magur), *Clarias batrachus* (For Fishery Officers of Tamil Nadu)	CIFA HQs	02-06 August, 2016	18	04	22
14.	Breeding and Culture of Freshwater Prawns	CIFA HQs	16-20 August, 2016	06	00	06
15.	Seed Production of Anabas, Magur and Murrel (For Fishery Officers of Thiruvananthapuram)	CIFA HQs	26-30 August, 2016	04	04	08
16.	Entrepreneurship Development in Aquaculture Value Chain of Madhya Pradesh (Batch-I) under TAAL Consultancy Project of ABI, CIFA	CIFA HQs	01-04 September, 2016	30	10	40
17.	Hands-on-Training in Fish & Shellfish Health Management (sponsored by NFDB through Tamil Nadu State Fishery Department)	CIFA HQs	5-9 September, 2016	20	04	24
18.	Entrepreneurship Development in Aquaculture Value Chain of Madhya Pradesh (Batch-II) under TAAL Consultancy Project of ABI, CIFA	CIFA HQs	20-22 September, 2016	25	00	25
19.	Advances in Fish Nutrition and Feed Technology	CIFA HQs	21-23 September, 2016	23	01	24
20.	Freshwater Pearl Farming for Entrepreneurship Development	CIFA HQs	07-11November, 2016	23	00	23
21.	Pisciculture and Allied Farming Practices for Tribal Farmers of North-eastern India (jointly organized by Regional Research Centre of ICAR-CIFA, Rahara and Bharatiya Kisan Sangha)	RRC, Kalyani	26-29 November, 2016	97	01	98

Sl.No.	Title	Venue	Duration	No. of participants		
				Male	Female	Total
22.	Hands on Training in Fish & Shelfish Health Management for officials Tamil Nadu State Fisheries Department	CIFA HQs	05-09 December, 2016	19	04	23
23.	Hands on Training on Next Generation Sequence Data Analysis	CIFA HQs	06-11 December, 2016	04	05	09
24.	Fish Feed Production and Feeding Management in Aquaculture	CIFA HQs	07-09 December, 2016	20	00	20
25.	Fish Farming: for Sustainable Livelihood (for farmers from Patna, Bihar)	CIFA HQs	12-17 December, 2016	25	00	25
26.	Freshwater Pearl Farming for Entrepreneurship Development	CIFA HQs	13-17 December, 2016	19	02	21
27.	Hands on Training on Diagnosis of Freshwater Fish Pathogens for Disease Surveillance (for Andhra Pradesh State Officials)	CIFA HQs	20-24 December, 2016	10	00	10
28.	Entrepreneurship Development in Freshwater Aquaculture (for farmers from Katihar, Bihar)	CIFA HQs	09-13 January, 2017	30	00	30
29.	Freshwater Pearl Farming for Entrepreneurship Development	CIFA HQs	09-13 January, 2017	19	00	19
30.	Hands on Training on Diagnosis of Freshwater Fish Pathogens for Disease Surveillance	CIFA HQs	17 -21 January, 2017	05	05	10
31.	Freshwater Pearl Farming for Entrepreneurship Development	CIFA HQs	23-28 January, 2017	14	00	14
32.	Ornamental Fish Breeding and Culture	CIFA HQs	11-12 February, 2017	10	25	35
33.	ICAR Sponsored Winter School: Current Trends in Molecular Diagnosis for Better Health Management in Aquaculture	CIFA HQs	15 February – 7 March, 2017	08	08	16
34.	National Training in Molecular Biology & Biotechnology for Fisheries Professional	CIFA HQs	15 February - 15 May, 2017	03	01	04

Sl.No.	Title	Venue	Duration	No. of participants		
				Male	Female	Total
35.	Recent Advances in Freshwater Aquaculture (For Progressive Fish Farmers of Lakhisarai, Bihar)	CIFA HQs	07-11 March, 2017	18	00	18
36.	Skill Development in Murrel Farming	CIFA HQs	23-25 March, 2017	13	03	16
37.	Multiple breeding and cryopreservation of gametes of carps	CIFA HQs	23-27 March, 2017	19	06	25
38.	Training on Indian Patent Filing Producedure	CIFA HQs	24 March, 2017	52	09	61
39.	Training on Freshwater Aquaculture	CIFA HQs	25-28 March, 2017	30	00	30

Field Days

A total of 24 Field Days were organized for the farmers of various districts of Odisha and other states covering many fish farmers including farm women. The field days include aquaculture farm visits, laboratories and other facilities. The farmers visit the learning stations which include hatchery and culture facilities for carps, air-breathing fish 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. are also explained to them with the help of videos (Table 38).

Table 38. Field days organized

Sr. No	Date	Particulars	Visitors		
			Male	Female	Total
1	18.04.16	Students (M.Sc. 4th Semester) from Zoology Dept. of Pandu College, Pandu, Guwahati-781012	01	06	07
2	02.05.16	IV B.F.Sc. students from College of Fisheries, Mangalore, Karnataka guided by Dr. Ganapathi Naik M. Prof. & Tour Leader	33	10	43
3	09.06.16	Students of Diploma in Animal Husbandry and Dairying, ICAR-NDRI, ERS, Kalyani, W.B.	15	02	17
4	25.06.16	Beneficiaries under Skill Upgradation Training Programme 2015-16, guided by Ms. Monalisha Parida, AFO, FTI, Balugaon	34	00	34
5	29.06.16	Farmers under ATMA, Narayangarh Block, Pachim Medinipur, West Bengal	50	00	50
6	18.07.16	Trainees of Inland Fisheries Training Centre, Lamphel, Imphal, Manipur	09	07	16
7	26.07.16	Beneficiaries under Skill Upgradation Training Programme 2015-16, guided by Ms. Monalisha Parida, AFO, FTI, Balugaon	17	01	18
8	22.09.16	Students from College of Fisheries, G.B.Pant Univ. of Agriculture and Technology, Udham Singh Nagar, Uttarakhand	06	14	20
9	09.10.16	Fish Farmers from Chakapada Block of Phulbani district of Odisha	04	04	08

Sr. No	Date	Particulars	Visitors		
			Male	Female	Total
10	19.10.16	Aquaculture Field Day at Sarakana AFS, Sarakana, Khordha, Odisha	47	01	48
11	28.10.16	Farmers from Garhshankar, Hoshiarpur, Punjab	12	00	12
12	09.11.16	Farmers from Kabisuryanagar, Ganjam guided by BTT Convenor, FIAC	08	02	10
13	18.11.16	Asst. Fisheries Officers of State Govt. of Madhya Pradesh guided by T. K. Roy, AFO	08	06	14
14	24.11.16	Farmers under Netaji Jubak Sangha, Balipokhari, Paramanandapur, Akhuapada, Bhadrak	20	00	20
15	25.11.16	Farmers under Skill Upgradation Training Programme from FTI, Balugaon, Khordha, Odisha	22	00	22
16	23.12.16	Farmers under Skill Upgradation Training Programme from FTI, Balugaon, Khordha, Odisha	30	00	30
17	10.01.17	Progressive Fish Farmers of Nadia district of West Bengal (ATMA sponsored)	20	00	20
18	17.01.17	Fishery Students of P.N. College, Khordha	13	08	21
19	27.01.17	Skill up gradation training prgramme, FTI, Balugaon, Khurda, Odisha	17	00	17
20	10.02.17	Fish farmers from Chhattisgarh under Asst. Fishery Office, Balarampur district of Chhattisgarh	10	00	10
21	28.02.17	Fish farmers from Surajpur, Chhattisgarh guided by Santosh Kumar Bhimte, FI	10	00	10
22	03.02.17	Farmers under ATMA from Khajuripada Block, Odisha guided by Jagannath Barik, Asst. Agril. Officer	09	00	09
23	20.03.17	Students(BSc, Zoology), Dept. of Zoology, Kirori Mal College, Univ. of Delhi, Delhi	12	16	28
24	24.03.17	Skill up gradation trainees from Fishery Training Institute, Balugaon, Khordha, Odisha	17	00	17

Exposure visits

The Social Science Section organized 60 group visits comprising students, practicing farmers, farmwomen, extension workers and others. Duration of the visits were mostly one day, in few cases 2-3 days. Visitors were taken around the farm facilities, museum, selected laboratories and ATIC. Educational videos are screened for the visitors. Interactive sessions with farmer groups were also organized for addressing various queries.

Table 39. Details of the group visits to ICAR-CIFA

Sr.No	Date	Particulars	Visitor		
			Male	Female	Total
1	08.04.16	Students, P.G. Dept. of Zoology, Utkal University, Bhubaneswar guided by Dr. A. K. Patra, Emeritus Professor (UGC)	04	13	17
2	15.04.16	Farmers from Mandla district of M.P. guided by Dilip Hiwse, Asst. Dire. Agril, O/o DDA, Mandal, M.P.	33	00	33
3	16.05.16	Students, Dept. of Zoology, Univ. of Burdwan, West Bengal guided by Koushik Ghosh, Asst.Prof.	08	08	16
4	25.05.16	Staff, SBLC, Bhubaneswar, Khordha, Odisha guided by Susanta Kumar Sahu, Manager	16	03	19
5	25.05.16	Students of Zoology, Dumduma H. B. Colony, Bhubaneswar, Khordha	04	00	04
6	10.06.16	Trainee from CIFNET, Beach Road, Visag -530001, Andhra Pradesh guided by Pradeep K, Instructor (FT)	27	00	27
7	25.06.16	Students from CVSC & AH, OUAT, BBSR, Khurda, Odisha	18	29	47
8	12.07.16	Students of KIIT School. of Rural Management, KIIT University, Bhubaneswar, Khordha, Odisha guided by Prof. Avijit Majumder, Asst. Prof .	27	06	33
9	21.07.16	Staff of UCO Bank, RTC, Bhubaneswar guided by Arun Kumar Sahoo, Sr. Manager	35	34	69
10	22.07.16	Farmers from Surguja, Chhattisgarh under Govt. Livestock Development, Chhattisgarh guided by Dr. Ritesh Jaiswal, Vert. Officer	43	00	43
11	22.07.16	Students from College of Fishery Science Muthukur, SPSK, Nellore, A.P. gu ided by N. Jesnthar, Asst. Prof essor	11	11	22
12	10.08.16	Students of St. Xaviere High School, Khandagiri, Bhubaneswar guided by Deepa Das, PGT	45	20	65
13	11.08.16	Students of St. Xaviere High School, Khandagiri, Bhubaneswar guided by Deepa Das, PGT	26	14	40
14	26.08.16	Zoology Students of Nimapara College, Nimapara, Puri, Odisha guided by Syama Ch. Mishra	06	12	18
15	26.08.16	Students of KIIT International, Bhubaneswar, Khurda, Odisha guided by Suprava Sahu	30	12	42
16	09.09.16	Students, Zoology Dept. of Utkal University, Bhubaneswar, Khordha, Odisha guided by Gunanidhi Sahoo	08	19	27

Sr.No	Date	Particulars	Visitor		
			Male	Female	Total
17	29.09.16	Farmers from Khordha, Odisha guided by Subhashree Mishra, Asst. Fisheries Officer, Khordha	17	08	25
18	28.09.16	Students from Dept. Zoology, Banaras Hindu University, Varanashi, Uttar Pradesh guided by Dr.Radha Chaube	17	39	56
19	29.09.16	Students from Dept. of Zoology, CBSH, OUAT, Bhubaneswar, Khordha guided by Dr. Rojalin Pattanayak, Asst. Professor	04	20	24
20	05.10.16	Farmers from Basna, Mahasmund, Chhattisgarh guided by Dr. D. N. Patel, Vety. Astt. Surgeon, Vety. Hospital, Basna, CG	16	00	16
21	13.10.16	Farmers under ATMA, Khariar, Nuapada, Odisha guided by B. K. Sahani, BTM, Khariar, Odisha	16	00	16
22	18.10.16	Students of OUAT, Bhubaneswar, Khordha	35	09	44
23	05.11.16	Students of DAV College, NTPC, Talcher, Angul, Odisha guided by S. Nayak, PGT English	34	27	61
24	22.11.16	NABARD Officers, International Training Institute (STTI), Jaydev Vihar, Bhubaneswar guided by Sailendra Padiyar,DDM	22	02	24
25	26.11.16	Students from Gayatri College, Ganjam, Odisha guided by Gyanendra Pradhan, lecture	12	33	45
26	30.11.16	Farmers under Tihidi Block, Bhadrak, Odisha guided by Premjit Swain BTM, FIAC- Tech. O/o AAO WMBTT Convenor, FIAC Tihidi, Bhadrak	14	00	14
27	03.12.16	Students from College of Fisheries, Shirgaon, Ratnagiri, Maharshtra guided by Mr. Vinayak V. Vishwasrao	26	10	36
28	05.12.16	Students from Utkal University, Bhubaneswar, Odisha guided by Sushanta Kishore Khuntia, Asst. Prof. Agribusiness	32	12	44
29	06.12.16	Students of Karanjia Autonomous College, Karanjia, Mayurbhanj, Odisha guided by Ajay Kumar Das, HoD, Dept. of Zoology	16	32	48
30	06.12.16	Farmers from Nashik, Gangapur Road, Maharstra guided by Prakash mate, Ex-Mayer	04	00	04
31	14.12.16	Students from COF, Milon, Mangalore, Karnataka guided by Dr A.T.R. Naik, Tour Leader	23	11	34
32	14.12.16	Students from College of Fisheries, OUAT, Rangeilunda, Berhampur, Odisha guided by Dr Saumendra Nanda, Professor (Aquaculture)	17	27	44

Sr.No	Date	Particulars	Visitor		
			Male	Female	Total
33	16.12.16	Farmers from Bemetara District of Chhattisgarh guided by K. P. Verma, Fisheries Inspector	10	00	10
34	17.12.16	Students from U.N. Public School, Rench sasan, Rench, Nimapara, Puri, Odisha guided by Sitanath Hota	80	50	130
35	17.12.16	Students from Salipur Autonomous College, Salipur, Cuttack, Odisha guided by Dr Prabhat Kumar Routray, Head Dept. of Zoology	21	37	58
36	23.12.16	Students from Sri Sathya Sai College for Women, Khordha, Odisha guided by Mrs. Bindulata Panda, HoD, Dept. of Zoology	48	02	50
37	03.01.17	Students, College of Fisheries, GADVASU, Ludhiana, Punjab guided by Dr. Abhed Pandey, Asst. Prof.	09	08	17
38	16.01.17	Students of NYU Steinhardt, New York	02	18	20
39	19.01.17	Students of College of Fisheries, Kawardha, Kabirdham, Chhattisgarh guided by Dr. N. Sarang, Asst. Professor	18	07	25
40	21.01.17	Fish farmers from Korea district of Chhattisgarh guided by Pravin Sharma, Fishery Inspector	12	00	12
41	28.01.17	Fish farmers from Balod district of Chhattisgarh guided by Shayad Verma, C/o ADF, Balod, C.G.	13	00	13
42	02.02.17	Students of FPT, FC&RI, Tuticorin, Tamil Nadu guided by Dr P. Vecayotham, Professor & Head	23	18	41
43	13.02.17	Students under Academy of Management & Information Technology (AMIT), 66/67, IIB, Centre, Khordha guided by Jitendra Kumar Sethi	20	17	37
44	15.02.17	Farmers from Janjgir, Champa, Chhattisgarh under Asst. Director of Fisheries guided by S. L. Lahere, FI	49	00	49
45	22.02.17	Farmers from Raipur, Chhattisgarh under Joint Director of Fisheries guided by R. G. Bohre,FI	12	00	12
46	23.02.17	Farmers from Kabirdham, Chhattisgarh guided by V. K. Chandrakant, FI	25	00	25
47	27.02.17	Farmers from Jagannath Prasad, Ganjam, Odisha guided by Narayan Choudhary, BTT, FIFAC	12	00	12
48	28.02.17	Farmers from Kabisuryanagar, Ganjam, Odisha guided by Purnahuti Panda, BTM	16	04	20

Sr.No	Date	Particulars	Visitor		
			Male	Female	Total
49	03.03.17	Students from PG Dept. of Zoology, Raja N L Khan Womens' College, Midnapur, Paschim Medinipur, West Bengal guided by Dr. Angsuman Chanda	02	15	17
50	07.03.17	Farmers from Bodew, Nuapada, Odisha guided by Dusmanta Ku Sahani, BTM	16	04	20
51	07.03.17	Farmers under Pani Panchayat,RKVY, Banapur, Khordha, Odisha guided by Paritosh Mishra	60	00	60
52	09.03.17	Farmers under Pani Panchayat,RKVY, Banarpal, Angul, Odisha guided by Mamata Grahacharya	28	25	53
53	20.03.17	Farmers under ATMA, Chaibasa, West Singhbhum, Jharkhand guided by Manoj Ku. Shit, BTM	40	14	54
54	20.03.17	Farmers under Asst. Fisheries Office, Bilaspur, Chhattisgarh guided by R. K. Sen	26	00	26
55	20.03.17	Farmers under Asst. Fisheries Office, Mungeli, Chhattisgarh guided by V. K. Bhilwa	12	00	12
56	20.03.17	Students from Zoology Dept., Vidyasagar University, Midnapore, West Bengal	25	19	44
57	22.03.17	Farmers under Asst. Fisheries Officer, Jagatsinghpur guided by Jitendra Ku. Behera	23	00	23
58	27.03.17	Students from College of Fisheries, Rangeilunda, Ganjam	12	09	21
59	27.03.17	Farmers from Balodabazar-Bhatapara, Chhattisgarh	21	00	21
60	28.03.17	Farmers under Pani Panchayat from Hindol, Dhenkanal, Odisha	10	00	10

Extension activities at Regional Research Centre, Rahara and Field Station, Kalyani

Dissemination of seed production technology of euryhaline catfish *Mystus gulio*

Considering high commercial value and suitability for farming in both freshwater and brackish water, ICAR-CIFA have developed the breeding, seed production and grow-out culture techniques of *M. gulio* at its Kalyani Field Station. Under its technical objective of dissemination of seed production technology of euryhaline catfish *Mystus gulio* to different parts of West Bengal a total of 280 *Mystus gulio* brooders (female 50-80 g & male 40-50 g) were distributed to CIFA Kalyani trained self-motivated seven fish seed growers (20 male and 20 female to each) from six districts of West Bengal and one district of Bihar: 1) Mr. Rezual Haque, North 24 Parganas; 2) Mr. Monoranjan Chatterjee, Nadia; 3) Mr. Amalesh Chatterjee, Hooghly; 4) Mr. Shyamal Kanti Ghosh, Durgapur; 5) Mr. Rittwik Amir, Murshidabad; and 6) Mr. Kripan Sarkar, Jalpaiguri from West Bengal, and 7) Mr. Partha Kumar Das, Kishanganj, Bihar.

Table 40. Exposure visits (Rahara)

Sl. No.	Purpose of visits	Trainees from	Duration	No. of participants
1.	Sewage fed aquaculture	Students of Mangalore Fishery college, Mangalore	3.5.16	43
2.	Sewage fed aquaculture	Farmers of KVK, Burdwan, W.B.	10.11.16	40
3.	Induced Breeding of fishes	Students of Ramakrishna Mission Boys Home High School of Rahara, North 24 Parganas.	22.09.2016	67

Table 41. Group visits to Field Station, Kalyani

Sl. No.	Visitors	Date of Visit	Sent by	No. of visitors
1.	Farmers from Bihar	23.06.2016	ICAR-CIFRI	25
2.	Farmers from Bankura	12.07.2016	Adult Education Department, University of Kalyani	29
3.	P.G. (M. Sc Zoology / Fish and Fisheries) Students of P.K. Roy Memorial College, Dhanbad, Vinod Bhihari University	17.07.2016	ICAR-CIFRI	18
4.	Farmers from Birbhum	20.07.2016	Adult Education Department, University of Kalyani	28
5.	Farmers from Bihar	25.07.2016	ICAR-CIFRI	22
6.	Farmers from Bihar	06.08.2016	ICAR-CIFRI	24
7.	M.F.Sc. Students of FRM, ICAR-CIFE, Mumbai	09.08.2016	ICAR-CIFR	I8
8.	W.B. Farmers	23.08.2016	Adult Education Department, University of Kalyani	8

Sl. No.	Visitors	Date of Visit	Sent by	No. of visitors
9.	Farmers from Bihar	25.08.2016	ICAR-CIFRI	25
10.	Farmers from Bihar	06.09.2016	ICAR-CIFRI	25
11.	Farmers from Bihar	19.09.2016	ICAR-CIFRI	27
12.	Farmers from U.P.	19.09.2016	ICAR-CIFRI	22
13.	Students of WBUAFS	21.09.2016	Faculty of Fishery Sciences	24
14.	Farmers from Katihar, Bihar	14.11.2016	ICAR-CIFRI	27
15.	Farmers from Assam and Tripura under Tata trust	16.11.2016	Tata Trust	13
16.	Farmers from Araria, Bihar	21.11.2016	ICAR-CIFRI	24
17.	Asst. Fishery officers from MP.	23.11.2016	ICAR-CIFRI	16
18.	Students of APC college, New Barrackpore and Darbhanga College, Bihar	28.11.2016	ICAR-CIFRI	28
19.	Farmers from Kishanganj, Bihar	07.12.2016	ICAR-CIFRI	23
20.	Farmers from Kaliaganj and Ithar, East Dinajpur, WB	07.12.2016	Adult Education Department, University of Kalyani	26
21.	Students and farmers from Krishnanagar and Karimpur, WB	16.12.2016	Adult Education Department, University of Kalyani	14
22.	Farmers from Bhagalpur, Bihar	20.12.2016	ICAR-CIFRI	26
23.	Farmers from Jhargram and jambani Block, WB	20.12.2016	Adult Education Department, University of Kalyani	30
24.	Officers and Farmers from Mayurganj, Odisha	26.12.2016	ICAR-CIFRI	26
25.	Farmers from Begusarai, Bihar	07.01.2017	ICAR-CIFRI	29
26.	Farmers from Sheikhpura, Bihar	28.01.2017	ICAR-CIFRI	23
27.	Farmers from ACABC programme sponsored by MANAGE, Hyderabad	31.01.2017	NSRICM, Kalyani	18
28.	Students of V.B.U, Hazaribag, Jharkhand	18.03.2017	ICAR-CIFRI	31

Extension activities at RRC of ICAR-CIFA, Anand, Gujarat

Interactive discussion-cum-awareness programme on 'Effect of climate change on Aquaculture'

The Regional Research Centre of ICAR-CIFA, Anand, Gujarat organized an one day interactive discussion-cum-awareness programme on 'Effect of climate change on Aquaculture' on 1 March, 2017 at Anand, Gujarat. More than 50 participants including fish farmers, post graduate students from Kamdhenu University, officers from line departments, scientists, academicians, etc participated in the event. Various technical aspects of climate change and its impact and mitigation measures including effect of temperature on water logged areas, effect of

temperature on water quality, impact of climate change on aquaculture and production, overview of aquaculture in Gujarat in relation to climate change, etc. were covered by the scientists of ICAR-CIFA and AAU, Kamdhenu University.

Participants of the awareness programme

Demonstration of diversified fish seed rearing

Successful demonstration on diversified fish seed rearing to the tribal farmer group, Jogni Sanjukth Khethi Shakari Manadali, Kalak Village, Jambusar Taluka, Bharuch district, Gujarat was undertaken.

Field Days at Village Chansi, Taluka-Anand, District-Anand, Gujarat

The tribal farmers of the group were provided with technical support through demonstration on rearing of good quality seeds of different fish species such as grass carp, common carp, silver carp, pangasius, genetically improved seed of rohu '*Jayanti',* etc. This demonstration included pre-stocking management measures such as removal of unwanted weeds and weed fishes, manuring and fertilization, etc; stocking management measures such as appropriate stocking density, acclimatization procedures and suitable time of stocking, etc.; and post stocking management measures such as feeding, water quality management, etc.

Training-cum-demonstration on supplementary feeding management in carp polyculture for tribal farmers of Gujarat

Regional Research Centre of ICAR-CIFA, Anand conducted a three days training-cum-demonstration under tribal sub-plan programme during 9-11 January, 2017 on "Supplementary feeding management in carp polyculture" at Kalak village, Jambusar, Bharuch district, Gujarat. Twenty-two tribal farmers of Jambusar Taluka of Bharuch district residing in different villages of Gujarat such as Kalak, Daliya, Dahegaon, Sigaon, Asarsa and Magnad attended the programme. The programme covered interactive discussion on various aspects of supplementary feeding in carp polyculture.

Field Days

- Organized two field days on 21 September, 2016 and 29 September, 2016 in collaboration with KVK, Devataj at Chansi and Duniya village ponds.

Table 42. Exposure visits at Anand

Date	Particulars	Participants		
		Male	Female	Total
29.12.16	Farmers of Pachora block, Dist. Jalgaon, Maharashtra	31	-	31
03.03.17	Farmers of Dist. Navasari, Gujarat	11	09	20

Extension activities at RRC of ICAR-CIFA, Vijayawada

Demonstration of breeding and hatchery development initiated in Bihar and Jharkhand

- Breeding of *Pangassionodon hypopthalmus* was taken up for 2 cycles in Siwan District, Bihar (Shri Himanshu Kumar Singh, Goriahat, Siwan, Bihar). Breeding operations were undertaken using canal water and ground water to assess the suitability of various waters for achieving successful breeding.

Table 43. Trainings conducted

Programme	Category of trainees	Venue	Duration	No. of participants
Training-cum-demonstration on Fish culture practices in Scientific methods	Tribal fishermen societies of Andhra Pradesh	Macherla block, Guntur Dist., Andhra Pradesh	27-28 October, 2016	35
Training-cum-demonstration on Fish culture practices in Scientific methods	Tribal fishermen societies of Andhra Pradesh	Bhadrachalam block, Khammam Dist, Telangana	03-04 November, 2016	40
Training-cum-demonstration on Ornamental fish culture and breeding	Tribal women SHG's	Macherla block, Guntur Dist., Andhra Pradesh	09-10 February, 2017	50
Training-cum-demonstration on Ornamental fish culture and breeding	Tribal women SHG's	Bhadrachalam block, Khammam Dist, Telangana	24-25 March, 2017	45

Agricultural Technology Information Centre (ATIC)

The ATIC 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 the year 2016-17, total 3334 visitors visited ATIC and CIFA facilities. This Centre has generated revenue of Rs.27,650/- from sale of Books & CDs; Rs. 6,27,491/- from sale of fish and Rs.15,039/- from sale of other farm produce. A large number of pamphlets/booklets were also distributed to the visitors. HELPLINE services has been initiated wherein a group of experts attend to telephonic queries on fixed days of the week.

Farmers' Point

A single window system for servicing visitors to the Institute is operationalized. It is established at the main building (Room No.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, feed analysis etc. Level of satisfaction of the customers are also recorded. Digitization of visitor's particulars is being done. Sale of priced publication, distribution of free literature are streamlined. In short, visiting farmers/entrepreneurs are given utmost attention to ensure that their requirements are satisfied.

SPECIAL DAY CELEBRATIONS

International Day of Yoga

The International Day of Yoga 2016 was observed at the Institute on 21 June, 2016 with wholehearted participation of all staff members. The event was conducted with the guidance and instruction of an eminent yoga expert, Shri Surendra Nath Tripathy. Shri Tripathy explained the benefits of different *pranayams* and asanas of yoga to the body and mind. Dr. P. Jayasankar, Director, ICAR-CIFA, Bhubaneswar thanked Shri Tripathy for guiding the staff to the wonderful health *mantra* and assured that efforts would be taken to make Yoga a part of everyone's daily life.

National Fish Farmers' Day

The Institute observed the 16th National Fish Farmers' Day on 10 July, 2016. Prof Surendranath Pasupalak, Vice Chancellor, OUAT, was the Chief Guest on this occasion. Dr. A. K. Nayak, Director (I/c), ICAR-NRRI was the guest of honour. Around 80 fish farmers from Odisha were present at the event. Thirteen fish farmers and entrepreneurs from different parts of India were felicitated for their contributions to the development of freshwater aquaculture. The awardees also shared their experience in fish farming with the audience. A scientist-farmer interaction session was organized on the day aiming at providing solutions to the problems faced by the farmers in pisciculture. The event was also celebrated at the RRCs of ICAR-CIFA at Bengaluru, Rahara, Vijayawada and Anand.

Rashtriya Ekta Diwas

The birth anniversary of Sardar Vallabhbhai Patel was observed as *Rashtriya Ekta Diwas* (National Unity Day) on 31 October, 2016.

Vigilance Awareness Week

Vigilance Awareness Week was observed at the Institute during 31 October – 5 November, 2016.

Communal Harmony Campaign Week

Communal Harmony Campaign Week was observed at the Institute during 19-25 November, 2016.

Jai Kisan Jai Vigyan Week

The Institute launched the celebration of *Jai Kisan Jai Vigyan* Week on 23 December, 2016 to commemorate the birth anniversary of former Prime Ministers Shri Atal Bihari Vajpayee and Late Shri Chaudhary Charan Singh. Ten progressive farmers who have successfully adopted latest technologies and made contribution in wide scale adoption of technologies by farmers were honored.

Dr. P. Jayasankar, Director, ICAR-CIFA while welcoming talked about doubling the farmers' income, science based and technology led farming. Prof (Dr) Damodar Parida, Rtd. Assistant Director for Research, OUAT, Bhubaneswar and Dr. (Mrs.) Jatinder Kishtwaria, Director, ICAR-Central Institute for Women in Agriculture, Bhubaneswar graced the launch workshop on 23 December, 2016. The week-long celebration had trainings, interaction meet and demonstration of new technologies and other extension activities involving farmers of Khordha district. The final day of the celebration week on 29th December had a formal meeting with 120 farmers. Dr. S. K. Rout, Ex-Dean, Extension Education, OUAT was the chief guest, Dr. S. R. Das, Honorary Professor

of OUAT delivered a special address on the occasion in the presence of Dr. P. Jayasankar, Director, ICAR-CIFA who also delivered a special address to the gathering. Ten exhibitors displayed their wares in the exhibition. A farmers-scientists interaction was also held during the occasion.

National Science Day

The National Science Day was observed at the Institute with the theme on "Science and Technology for Especially Abled Persons". The week long celebrations comprised of organising series of quiz competitions and elocutions for staff members and research scholars of the Institute. The valedictory function of the National Science Day was held on 28 February, 2017. Dr. (Er.) Subhendu Kumar Pattnaik, Deputy Director, Pathani Samanta Planetarium, Bhubaneswar was the guest of honour. During the valedictory address Dr. (Er.) Subhendu Kumar Pattnaik spoke on the importance of celebration of National Science Day in the country. He motivated the audience comprising of invited students from Louis Braille School of Blind, Bhubaneswar who were visually impaired.

International Women's Day

The Institute observed International Women's Day on 8 March, 2017. The theme for 2017 International Women's Day was "Be Bold For Change". Dr. (Mrs) Bindu R. Pillai , HoD, APED & Chairperson, Women's Cell, ICAR-CIFA described the various activities undertaken by the Cell. Dr. J. K. Sundaray, Director, CIFA mentioned that during the last 30 years the Institute had operated a number of sponsored projects with women as beneficiaries. He expressed his heartfelt thanks to Women's Cell of ICAR-CIFA for organizing the programme. He stressed on meaningful participation of women in aquaculture. The dignitaries who graced the occasion were Prof. Sangamitra Mohanty, President, Odisha Bigyan Academy and former Vice chancellor, North Odisha University as Chief Guest and

Smt. Lopamudra Mohanty, Addl. Sub-Collector, Puri. Few competitions (rangoli, essay) were conducted to mark the occasion and prizes distributed to the winners.

Blood Donation Camp

A Blood Donation Camp was organized by Staff Welfare Club of ICAR-CIFA on 28 March, 2017. The staff members and their families voluntarily participated in the camp.

Programmes undertaken by Hindi Cell

- Hindi Divas '*Pakhwada*' was observed at the Institute during 14-28 September, 2016. Various competitions like debate, dictation and essay writing were organized among staff and research scholars of ICAR-CIFA and also among the wards of the staff members' of ICAR-CIFA. Prizes for the various competitions held during the period, were distributed by the Director, ICAR-CIFA.
- A seminar in Hindi on "Financial self-sufficiency: Role of the Scientist and Research Institution" was organised at Institute of Physics in collaboration with ICAR-CIFA on 27 February, 2017. Dr P.K.Meher, Principal Scientist and In-charge Official Language presented a talk on the role of CIFA technologies and financial benefits by using these technologies by fish farmers.

SUCCESS STORIES

Scientific Fish Farming with Improved Rohu (*Jayanti*) in Tirtol, Odisha: A Success Story of Mr. Saurav Kumar Biswal

Shri Saurav Kumar Biswal from Tulanga Village in Tirtol Circle of Jagatsinghpur District in Odisha is one of the progressive fish farmer who has created a niche for himself and is a source of inspiration for others of his clan. Today, he is a contented man being a proud owner of one Chinese circular hatchery, 10 nursery ponds and 6 well-maintained grow out fish ponds situated in an area of about 5 hectares. He earns around Rs. 15 lakh annually and employs many others.

The situation was different 8-9 years ago. After graduating, he has attended training on 'Entrepreneurship Development Program for Freshwater Aquaculture' organized by ICAR-CIFA with the help of DST, Govt. of India funding during 2006. After that training he ventured into scientific fish farming in 2007. Aided with bank loan he has excavated ponds and started growing carps, mainly rohu (85%), catla (10%) and mrigal (5%). During 2007-2011, he has collected spawn from different sources. The survival was ~30% and some mixed species seed was also observed along with IMC seeds. He was able to produce table size fish of 2.5 – 4.0 tonnes/ha/year.

In 2012 he had procured for the first time 2 lakh spawn of genetically improved rohu (*Jayanti*) from ICAR-CIFA through KVK, Jagatsinghpur for demonstration. In one demonstration he could notice that the seed was pure showing uniform growth and good colour pigmentation along with good survival (around 50%) from spawn to fingerling. Ever since he has been procuring seed from ICAR-CIFA and had replaced all his stock of normal (unselected) rohu with the improved variety. Now days he is producing 7.5 – 8.0 tonnes/ha compared to 4 tonnes/ha in 2012 with the better culture management practices. Jayanti rohu has shown genetic gain of 18% per generation for growth trait after nine generations of selective breeding. He also mentioned that due to good colour pigmentation of *Jayanti,* consumer preference is better compared to normal variety. He resorts to harvesting fish in the night and supply in live condition to the local market where he gets good price. He is convinced that because of culturing improved variety *Jayanti* he could improve his financial status and now sets an example in that area as a successful fish culturist.

He has travelled all over India to acquaint himself with the intricacies of scientific fish farming, to improve his knowledge and to increase productivity in order to generate more income. A successful fish farmer like Shri Biswal is indeed an inspiration for the people of Odisha state in general and Jagatsinghpur

in particular to be self-reliant. 'Multiplier unit status' would be provided to his hatchery to produce *Jayanti* rohu seed under the guidance of ICAR-CIFA and for disseminating the same to several fish farmers culturing carps in nearby areas.

Shri Saurav Kumar Biswal, Fish farmer, seen at his grow out farm facility

Early breeding of Indian major carps achieved in Tamil Nadu using broodstock feed CIFABROOD™

Shri S. Pugalendhi, aged 45 is the owner of Chola Fish Seed Farm, located in the Cauvery Delta Region of Vaduvoor in Thiruvaroor district of Tamil Nadu and is basically a carp seed producer. He is well established with annual production of 600-750 lakhs of spawn. This progressive farmer has established close linkage with the Fisheries College and Research Institute, Tuticorin as well as Tamil Nadu Fisheries University, (TNFU) Nagapatinam. Shri Pugalendhi's farm of about 10 acres has all required facilities and infrastructure for fish breeding and seed production.

He came to know about the broodstock feed CIFABROOD™ during the Farmer-Scientist interaction meeting conducted at Thanjavur on 'Carp Broodstock Management and Quality Seed Production' on 22 September, 2015 jointly organized by TNFU and ICAR-CIFA in collaboration with NABARD and NFDB, Hyderabad. He received 600 kg of CIFABROOD™ in December 2015 during unprecedented flood in Chennai and other parts of Tamil Nadu. Hence he started feedings trials of brood fish in February 2016.

Every year Shri Pugalendhi used to breed the fish starting from mid-June onwards and continue up to September except this year 2016 in which he wish to start early in April. The broods were stocked in 1st week of February 2016 and CIFABROOD™ was fed only in one pond. The remaining ponds were provided with his own preparation containing mixture of rice bran, soybean meal and groundnut oil cake along with some vitamin –mineral mixture available in the market and the cost of which may be Rs 50/-per kg. Fishes were fed at 2% of body weight. According to him, initially he started feeding CIFABROOD™ in a pond where mud silt was quite high and the pond water became turbid with ammonia gas formation. There was no sign of maturation even after one month of feeding. After seeing the deterioration of water quality he immediately shifted the same broods into another recently renovated pond and to his pleasant surprise observed that the same fishes became mature within next 20 days. He bred both rohu and catla in April-May 2016 with rohu bred first on 21st April and again on 25th April 2016 while catla was bred on 20th and 25th May 2016 using inducing agent (WoVA FH). Totally he could produce 75 lakhs of spawn from these early breeding. Again on 1st June, 2016 he has produced 59 lakhs of spawn by breeding catla. Successful breeding of IMC during April-May in Tamil Nadu is unprecedented. Shri Pugalendhi produced 200 lakhs of spawn/fry from CIFABROOD™ fed broods.

Collaborating scientists from ICAR-CIFA and TNFU have reported that while normal incubation time for spawning response was 9 h following the injection of inducing agent (WoVA FH), it reduced to 6 h in case of CIFABROOD™ fed broods. Minimum disturbance of broodfish, tray feeding and availability of good eco-hatchery added success to his venture. This progressive farmer has since expanded his business by including the farm ponds of his brother in law in nearby village where his April bred spawn has grown in to fingerling size already on 7th June 2016. Though this broodstock feed cost is relatively high (Rs. 81/-) now, Shri Pugalendhi is hardly bothered about that and commented that with the benefits of this broodstock feed profit is assured. Initially he got Rs. 2/- per fingerling, and the cost is likely to increase to Rs. 5/- per fingerling during November-December. His customers are happy and satisfied, and the seed from his farm is selling like hot cake. Tamil Nadu is carp seed-deficient state, and the recent success of Shri Pugalendhi would catalyze increased seed production in the state. Seed production is possible even during peak summer, if water is available; Tamil Nadu has the advantage of having two monsoon seasons. The main advantage of early breeding of

Indian major carps is in the early stocking of seeds for grow out culture with the onset of monsoon which will result in further increase in the period of culture, thereby, increasing fish production.

Harvesting of fish at the farmers pond

Freshwater Pearl Farming Motivates Woman Entrepreneurship

Pearl culture is one of the alluring entrepreneurship option and has multifaceted uses viz, as food, feed for lower animals, uses of shell in button, cosmetics, pharmaceutical, decorative, in lime industry etc. *Lamellidens marginalis* is one of the important candidate species for freshwater pearl production. Highlighting this background, ICAR-CIFA, Bhubaneswar conducted training on "Freshwater pearl farming for entrepreneurship development" to develop the human resource on freshwater pearl farming in the country. Dr. Nina Singh from Balasore, Odisha, India was a trainee of the National Training Programme on Freshwater Pearl Culture for Entrepreneurship Development in ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar. She had around sixteen years of rich expertise in conceptualizing, executing and managing projects in Government as an Orissa Administrative Service Officer and corporate sector. With vast research experience during her Ph.D work and due to passion to do something in a sparsely treated field, she took up freshwater pearl farming since 2014. She started pearl culture in buckets at the backyard and later stepped into tanks culture with the technical support provided by Pearl Culture Unit of ICAR-CIFA. Her culture unit is at Januganj, Remuna Golai Chowk in Industrial Area of Balasore, Odisha which is very near to the NH- 5. At present she receives lots of response from different parts of India for technical support and guidance for entrepreneurship development in the field of freshwater pearl farming. Also, farmers from various states are visiting her farm to see the low cost facilities and innovations. She could be an example for women entrepreneurs in coming future. She is uninterruptedly involved in shaping of designer pearl, nucleus preparation and rearing of mussels in confinement. 'The learning and constant support of ICAR-CIFA coupled with practice and experience in the field along with guidance of some experts in the field helped me to climb the ladder of pearl culture in Indian context" says Dr. Singh.

Designer freshwater pearl production by Tulshi Krishi Vigyan Kendra, Ganiwan, Uttar Pradesh: A Success Story of Mr. K. S. Shukla

Mr. Kamala Shankar Shukla, Scientist of Tulshi Krishi Vigyan Kendra, Ganiwan, Uttar Pradesh has achieved a great success in production of designer freshwater pearl in composite fish culture pond. During 2013-2014 he attended a training programme at ICAR-CIFA, Bhubaneswar on 'Freshwater pearl farming for entrepreneurship development'. He has been in constant touch with experts of pearl culture unit of the institute and interacted several times about improvements of freshwater pearl farming. He had put implanted freshwater mussel *Lamellidens marginalis* in enclosed net with freshwater carps in 0.4 ha pond. Following the ICAR-CIFA technology for pearl production and proper managements, he could get more than 2000 quality designer pearls along with good haul of fish.

A successful pearl grower like Mr. Shukla had completed Bachelor of Fisheries degree from College of Fisheries, Pantnagar and joined Tulshi Vigyan Kendra in Uttar Pradesh. The constant technical support of ICAR-CIFA coupled with field experience helped a lot to achieve the success in freshwater pearl farming in Uttar Pradesh", says Mr. Shukla.

Culture of climbing perch, *Anabas testudineus* in urban settings/concrete tanks near Bhubaneswar: A success story

The climbing perch, *Anabas testudineus* is one of the important indigenous air-breathing fish of India. This is a preferred fish and fetch high market price in many states like West Bengal, Tripura, Assam, Manipur, Bihar, Kerala, etc. The fish is rich in iron, copper, unsaturated fatty acids, many essential amino acids, etc. Due to its air breathing ability and tolerance to a wide range of adverse environmental conditions, the fish is being considered as a promising candidate species for climate resilient aquaculture. Apart from the regular trainings, many farmers and entrepreneurs visit ICAR-CIFA, Bhubaneswar for seeking guidance on fish farming. One such farmer, Mr. Tribhuban Jena, Bhubaneswar had visited this Institute during June, 2016 and shown interest towards climbing perch farming. After detailed discussion with the concerned scientist he was attracted for taking up of its culture in the concrete tanks in his farm. He has a farm of 2.5 acre at Naharkanta under Khordha district which is about 20 kms from ICAR- CIFA, Bhubaneswar with various plants like coconut, mango, guava, lemon, banana, cabbage, cauliflower, and many varieties of leafy vegetables. He had few concrete tanks with inlet and outlet facility and water source is bore well. He got 3250 nos of fingerlings (40-50 mm) from ICAR-CIFA, Bhubaneswar and stocked in his three concrete tanks

during June 2016. Initially fishes were fed floating feed at 3-4% and gradually reduced to 2% of their biomass. The water quality parameters were analyzed periodically. The excess as well as exchanged water from fish culture tank was utilized for horticultural crops and floriculture. We closely monitored the growth and health status of fish supplied through personal visits to develop the confidence in the entrepreneur. After 5 months of culture, the fingerlings have grown to an average size of 88 g/14.5 cm. At the onset of winter they have sold 25 kg of fish at Rs. 200-250/kg at farm. Still he has more than 80- 90 kg of fish in his farm. The success of Mr Jena in climbing perch farming in concrete tanks will open up the new avenues for even urban farmers to culture this fish for own consumption as well as for income generation.

WORKSHOP

Workshop on "Climate Change"

The Institute organized a sensitization workshop on "Climate change and its consequences on aquaculture" on 25 April, 2016. Under a centrally funded project "National Innovation in Climate Resilient Agriculture (NICRA)" the institute is addressing the concerns of climate change in freshwater aquaculture informed Dr. P. Jayasankar, Director, ICAR-CIFA. The Institute is investigating the impact of rising temperature, shortage of water, etc. in seed production and culture of fish; consequences of other climate related aberrations on fish production and productivity. He called for concerted effort of the stakeholders *e.g.,* Department of Fisheries, NFDB, NGOs, farmer's associations, etc. to make the aquaculture sector climate resilient.

Sri P. Krishna Mohan, Chief Executive, Chilika Development Authority addressed the farmers. Noted experts in the field of agro-meteorology, Dr. G. Kar, Principal Scientist, IIWM, Bhubaneswar; Prof (Dr.) B.S. Rath, College of Agriculture, OUAT and representatives from NFDB, State Dept. of Fisheries, NGOs, SHGs, school teachers from Laxminarayanpur and Pubasasan, farmers and farm women attended the workshop and shared their experiences.

Brainstorming Meet on "Application of Metagenomics and Microbiomes to Augment Fish Production and Productivity"

A brainstorming meet on "Application of metagenomics and microbiomes to augment fish production and productivity" was held on 21 June, 2016 at ICAR-CIFA, Bhubaneswar. While welcoming the guests Dr. P. Jayasankar, Director, ICAR-CIFA highlighted the relevance of metagenomics and microbiomes in facilitating faster growth, better immunity and disease resistance of fish, which all play vital role in higher production and productivity as well as in ensuring higher farm income.

Dr. C.G. Joshi, Prof. and Head, Dept. of Animal Biotechnology, AAU emphasized the need to know about how microbiomes are established, how they communicate each other and how they make survival of host. Dr. A.G. Ponniah, Ex-Director, ICAR-CIBA and Chairman, RAC, ICAR-CIFA suggested harnessing bacteria in terms of probiotic interventions to improve pond productivity leading to higher fish production. Others who made presentations in the technical session included Dr. S.K. Das, Scientist-E, ILS, Bhubaneswar; Dr. P. Aich, Associate Prof. NISER, Bhubaneswar and Dr. S.K. Chikara, EM, Eurofins, Bengaluru.

Salient recommendations of the meet were:

- Understand the role of nutrient-phytoplankton-feed chain in pond culture systems
- Collect base line information on most productive or less productive aquaculture ponds
- Study the technical and economic efficacy of probiotics in freshwater aquaculture systems
- Study nutrient dynamics in freshwater system, microcosm and mesocosm

Release of publication during the meeting

- Research on soil water interface *vis-a-vis* microbiome diversity and pond health
- Review the literature on metagenomics, microbiomes and their application in aquaculture
- Conduct interdivisional in-house study on a project mode

Workshop on "Popularization of *Jayanti* Rohu"

A Workshop on Popularization of *Jayanti* Rohu was organized with financial support of NFDB at the Institute on 11 July, 2016. The objective of the workshop was establishment of multiplier units and obtaining feedback from the farmers on the genetically improved strain, *Jayanti* rohu. The following multiplier units were established by signing of MoU between Director, ICAR-CIFA and respective entrepreneurs (Mr. S. K. Biswal, Jagatsinghpur, Odisha; Mr. S. Belchandan, Durg, Chhattisgarh; Mr. R. Amir, WB; Mr. Kumar J. Maharathha, Bhatapada, Banpur, Odisha; Mr. Debajit Barman, Nalbari, Assam). These entrepreneurs were also inducted as incubatee of ABI-CIFA to receive further technical support in future.

Launch Workshop on "Upgradation and Dissemination of Seed Production Technology of Murrel"

The Institute organized the Launch Workshop of the Project Upgradation and Dissemination of Seed Production Technology of Murrel (funded by NFDB) on 23 July, 2016. The project aims to develop captive brood-stock of striped murrel in a re-circulatory

system and to upscale and disseminate its seed production technology. While welcoming the guests Dr. P. Jayasankar, Director, ICAR-CIFA highlighted the commendable work done by the Institute on captive breeding and seed production of murrels and hoped that the project would play a vital role in dissemination of the available technology. Dr V. V. Sugunan, Sr. Consultant of NFDB inaugurated the launch workshop which was attended by farmers, entrepreneurs and researchers from Andhra Pradesh, Telangana, West Bengal, Jharkhand and Odisha.

Workshop on "Next Generation Sequencing & Other Innovative Technologies"

A collaborative awareness workshop on Next Generation Sequencing & Other Innovative Technologies was conducted at ICAR-CIFA during 26-27 August, 2016. There were about 62 participants from various disciplines in the workshop. Dr. P. Jayasankar, Director, ICAR-CIFA updated the importance of genomics in aquaculture as well as various other fields. He mentioned the importance of metagenomics study in aquaculture. By use of advanced Next Generation Sequencing (NGS) techniques as single-end amplicons and shotgun approaches, it would be more convenient to analyze metagenomics data. The guest speakers were Dr. Sriram Parameswaran, Chief Technology Officer & Dr. Sathish Kumar, Team Leader, Genotypic, Bangalore. Example data were run on Ubuntu for data quality check and data processing using FastQC software. The experts delivered additional talk on various data analysis tools: MG-RAST, QIIME, MEGAN, MOTHUR,

UPARSE and databases as SILVA.

Awareness workshop on "Successful demonstration of improved rohu *Jayanti* and CIFABROOD™"

ICAR-CIFA and TNFU jointly organized an awareness workshop on "Successful demonstration of improved rohu *Jayanti* and CIFABROOD™" at Thanjavur, Tamil Nadu on 4 August, 2016, as a follow up of the meeting on producing quality seed (held on 23 September 2015) and subsequent effective transfer of technology for improved rohu, *Jayanti* and CIFABROOD™ to two progressive framers in Thanjavur District. Prof. Karl Marx, Dean, Faculty of Basic Sciences, TNFU in his welcome speech briefed about the background of the programme. Dr P. Jayasankar, Director, ICAR-CIFA assured the farming community in the state to facilitate by opening Aqua Field School at Arvind Fish Farm and encouraged the farmers to learn scientific method of culturing fish. The dignitaries present on the occasion were Prof Ratnakumar, Vice-Chancellor (Acting), TNFU; Prof P. Natarajan, Anbo University, Ethiopia; Mr S. Subburaj, Joint Director, Dept. of Fisheries; Dr S. Senthil Kumar, Assistant Professor and Dr. A.G. Ponniah, Chairman, RAC, ICAR-CIFA. Mr S. Ravichandran and Mr Pugalendhi, beneficiaries of improved rohu and broodstock diet spoke about the advantages of using these technologies; and expressed that fingerlings of improved rohu were available as early as in June. Dr J. K. Sundaray, Dr K. D. Mahapatra and Dr S. Nandi explained particulars of these two technologies. Around 100 farmers, department officials and bankers attended the program.

National Seminar on "Aquaculture Diversification: The Way Forward for Blue Revolution (NaSAD-2016)"

National seminar on Aquaculture Diversification: The Way Forward for Blue Revolution was organized at the Institute during 1-3 December, 2016. Dr. P. Jayasankar, Director, ICAR-CIFA & Convener, NaSAD-2016 in his welcome address exhorted to think beyond Indian major carps, and commented that more species and systems are right steps for increasing fish production and productivity. Dr. S. N. Pasupalak, Vice Chancellor, Orissa University of Agriculture and Technology (OUAT), Bhubaneswar and Chief Guest of the inaugural function suggested that availability of quality seeds of diversified species would offer variable options to the farmer. Dr. K. K. Vijayan, Director, ICAR-Central Institute Brackishwater Aquaculture, Chennai requested all the participants to debate on strength and weakness of all the available technologies and prioritize them. Dr. A. K. Singh, Director, ICAR-Directorate of Cold Water Fisheries Research, Bhimtal, Nainital preferred to shun exotics for aquaculture. Dr. C. N.

Ravishankar, Director, ICAR-Central Institute of Fisheries Technology, Cochin, Kochi emphasized on various challenges before the aquaculture and post harvest sector. Dr. B. K. Das, Secretary, AoA, & Director, ICAR-Central Inland Fisheries Research Institute, Barrackpore endorsed the scope of enclosure culture in reservoirs and diversification of aquaculture. Dr. S. D. Tripathi, Former Director, ICAR-Central Institute on Fisheries Education, Mumbai elaborated the foundation of aquaculture research and development carried out in post-independence era in India. Over 180 participants deliberated upon 5 sub-themes *viz*., Breeding and Seed Production; New Frontiers in Aquaculture; Fish Nutrition and Physiology; Social Science Research in Aquaculture; Fish Health Management & Aquatic Environment Management.

Training-cum-Workshop on "Fish feed production and feeding management in aquaculture"

The Institute organized a National Training Programme on “Fish Feed Production and Feeding management in Aquaculture” during 7-9 December, 2016. The programme was conducted under Outreach Activity on 'Fish Feed' in collaboration with

Agri-Business Incubation (ABI) unit of ICAR-CIFA. Prof, Dr. K Samantray, Former Director, College of Fisheries, OUAT and Chief Guest emphasized on the role of both live and supplementary feed to enhance the aquaculture production. Other dignitaries on this occasion were Dr. A. K. Sahu, Former Head, Aquaculture Production and Environment Division, ICAR-CIFA and Scientist Emeritus, DBT, Mr. Sukumar Das, CEO, Krushi Jeevika Producer Company Ltd, Bhubaneswar, Prof (Dr.) R.K Swain, Head, Animal Nutrition, OUAT, Bhubaneswar. Over 30 participants comprising entrepreneurs, progressive aquaculturist and officials from 8 states across the country participated in the programme.

Workshop on "Fish Feed Formulation, Preparation and Its Importance in North East India"

In collaboration with NFDB, Guwahati and the ICAR-CIFRI Regional Centre, Guwahati, the Institute organized a two-day workshop on “Fish Feed Formulation, Preparation and Its Importance in North East India” during 22-23 December, 2016 for the benefit of the entrepreneurs, progressive fish

farmers, non-government organizations and the fish feed cooperatives of the NE Regions. The participants were taught about basic knowledge on fish nutrition, commonly used feed resources, fish feed formulation using locally available feed ingredients, fish feed processing technology, feeding management in aquaculture, farm made feed, live feed used in aquaculture and the establishment of feed mill.

National Workshop on "Empowering Communities through Community Radio"

ICAR-CIFA has joined hands with Community Radio Association of Odisha and organized the National Workshop on “Empowering Communities through Community Radio” on 14 February, 2017 at ICAR-CIFA, Bhubaneswar, Odisha. The workshop was conducted in connection with the World Radio Day celebrated on 13 February, 2017. The workshop was attended by 130 participants comprising of 50 staff from the Community Radio Stations from the country, scientists, academicians, extension workers

from the state departments and many other relevant stakeholders. The workshop was inaugurated by Mr. Manoj Ahuja, IAS, Principal Secretary, Ministry of Agriculture and Farmers Empowerment, Government of Odisha and he urged the community radio to be responsible in disseminating relevant information for the farmers for adoption of improved practices. He also informed that the government will support for any development initiatives taken by the association. A special address was delivered by Dr. S. S. Mishra, Director (I/C), ICAR-CIFA and informed that though there are many information channels for the farmers, radio is still popular in the rural areas and urged to harness the potentials of community radio. During the workshop the release of the first episode *"Let us connect Odisha"* was launched by the chief guest. In the workshop there were presentations from experts on information seeking behavior of farmers, good practices in technology transfer, agricultural entrepreneurship and good practices of community radios.

National workshop on "Responsible use of Antibiotics & Chemicals: Impact on Animal Health and Aquaculture"

ICAR-CIFA organized one day National Workshop on Responsible Use of Antibiotics & Chemicals: Impact on Animal Health and Aquaculture on 10 March, 2017. Dr P. Ravichandran, Former Director, ICAR-CIBA & Member Secretary, Coastal Aquaculture Authority, Chennai; Dr. S.C. Mukherjee, Former Joint Director, ICAR-CIFE, Mumbai; Dr J. K. Sundaray, Director (Acting) , ICAR-CIFA; Dr B K. Das, Director, ICAR-CIFRI, Barrackpore; Dr Anusha Rohit, MD, Madras Medical Association, Chennai; Dr U. C. Mohapatra, RC-MPEDA, Bhubneswar; Dr. S. Mohapatra, DDF, Odisha; Dr R. C. Patra, Dean, OUAT, Odisha ; Dr P K Patil, ICAR-CIBA, Chennai participated as experts. Total 100 participants including scientists from ICAR-CIFA and research scholars participated. The program was organized under ICAR-All India Network Project on Fish Health.

Other Extension Activities

Farmers-Scientist Interaction Meet on Quality Seed Production and Technology Dissemination in Chhattisgarh

The Institute in collaboration with the Department of Fisheries, Govt. of Chhattisgarh organized Farmers-Scientists Interaction Meet on 'Quality Seed Production' on 7 June, 2016 at Durg, Chhattisgarh. The Interaction meet was conducted to sensitize the hatchery owners, seed traders, farmers, planners and other stakeholders on the importance of quality seed to sustain growth of aquaculture sector in Chhattisgarh. More than 47 stakeholders participated in the meeting. ICAR-CIFA has already conducted three such meetings in West Bengal, Tamil Nadu and Odisha aligned to the recommendations of the Research Advisory Council of the Institute.

The officials who participated in the meeting were Mr. N. K. Tripathi, Joint Director, DoF, Govt. of Chhattisgarh; Mr. Surendra Belchandan, Proprietor of Poonam Fisheries, Tirga, Durg; Mr N.S. Nag, DDF, Raipur; and Mrs Sudha Das, Assistant Director (Fy), Raipur. The interaction was very fruitful and the following expectations from farming communities were noted.

- Human Resources Development in Aquaculture (disease and feed) management
- Regulatory mechanism on monosex tilapia aquaculture
- Common Minimum Agenda for quality seed production and development of guideline for seed certification
- Availability of cryo-banking of fish sperm
- Development of fish brood bank for the state
- Demonstration of ICAR-CIFA technologies like Jayanti, CIFABROOD™, cryo-banking
- Protocols for use of locally available ingredients as feed in aquaculture
- Modernization in fish seed transportation system for long distance transport
- Control measures of frog tadpole menace

A meeting was held on 8 June, 2016 between the scientists from ICAR-CIFA and Shri Anoop Kumar Shrivastava I.F.S., Secretary, Agriculture, Fisheries and Animal Husbandry, Govt. of Chhattisgarh, Mr. V. K. Shukla, Director (Fy.), Govt. of Chhattisgarh, Prof. H.K. Vardia, Dean, College of Fisheries, Kawardha to discuss the issues related to aquaculture development in the State.

A programme on aquaculture technologies and its dissemination to the small farmers of Chhattisgarh

through Aqua-Field School (AFS) was organized by Agri-Business Incubation Centre of ICAR-CIFA at Aquaculture Field School, Tirga, Durg on 9 June, 2016. Mr. Pritpal Belchandan, Chairman, District Cooperative Bank, Mr. B.R. Rao, General Manger, Corporate Social Responsibility, Bhillai Steel Plant, Bhillai, Mr. Vindo Gupta, Chief Executive, District Cooperative Bank were among the guests present on the occasion. The AFS developed by ICAR-CIFA has been capacitated through training and teaching materials to reach out to these farmers.

Farmer-Scientist Interaction Meet in Ranchi, Jharkhand

A Farmer-Scientist Interaction meet was organised on 01 September, 2016 at Fish Training Centre, Shalimar, Ranchi, Jharkhand. Around 150 farmers and state government officials, entrepreneurs participated in this interaction meeting. The theme of this meet was to develop aquaculture activities in tribal dominated belt of Jharkhand state. The Director ICAR-CIFA, Dr. P. Jayasankar was the Chief Guest on the function. The Director and team of scientists, ICAR-CIFA interacted with the farmers and officials during the visit at the different aquaculture hubs in Jharkhand i.e. Cage culture at Chandil, Feed mill unit at Chandil, Bundu Talaab, Bundu and Salvani. Others dignitaries present on the occasion were Dr. Rajiv Kumar, Director of Fisheries and other state fisheries officials. The Director of Fisheries, Jharkhand requested to work in collaboration with ICAR-CIFA and to disseminate the advanced aquaculture technology in Jharkhand. The major highlights of the interaction was expansion of cage culture practices, best management practices for cage culture, diversification of the aquaculture species, emphasis on quality seed production, development of seed production technology of Pangas, post harvest & value addition, establishment of small scale industries, registration of the Co-operative societies through FPO.

Farmer FIRST programme (FFP)

The Institute initiated farmer FIRST programme (FFP), one of the flagship projects of ICAR, New Delhi on 28 November, 2016. The Farmer FIRST Program considers putting the farmer in driver's seat in matters of problem identification, prioritization, conduct of experiment and its management. "Strong partnership with farmer for developing location specific, demand driven farmer friendly technology option will be the guiding principle" according to Dr P. Jayasankar, Director, ICAR-CIFA. FFP has four components enhancing farmer-scientist interface; interface economically viable technology options; partnership and institution building and E-enabled knowledge sharing.

The Institute has selected five villages in Khordha District (3 villages in Jatani and one each is Balianta and Balipatna Block) and involved around 400 farm families. Modules on improved technologies on crop,

horticulture, livestock and fishery will be promoted. Skill training and technical backup will be provided to the beneficiaries. Small and marginal farmers, farm women would be given special attention. For gender mainstreaming SHG based intervention on backyard poultry and mushroom will be carried out.

The launching workshop was attended by Sri Rabi Narayan Mahapatra, District Agricultural Officer; Sri Pradosh Kumar Panda, Asstt. Director of Horticulture, Bhubaneswar; Block level officers of line departments; Scientists of KVK-Khordha; representative of farmers from selected villages.

Fish Health Camps and Farmers' meet

The Fish Health Management Division of this Institute regularly organizes Fish Health Camps and Farmers' meet to sensitize fish farmers on aspects like Host-Pathogen-Environment, BMP (Better Management Practices), Fish health card, National Disease Surveillance, disease causing organisms (bacteria, virus, protozoans) and common fish diseases and their prevention and control measures. The following camps were conducted during the period:

Table 44. Fish health camps

Sl No.	Date	Venue No. of	Participants
1.	28.04.2016	DFO Office, Khordha, Odisha	92
2.	04.05.2016	Bhagabanpur Village, Kendrapara, Odisha	91
3.	11.05.2016	Sarakana village, Balianta Block, Khordha, Odisha	15
4.	12.05.2016	DFO Office, Khordha, Odisha	27
5.	18.05.2016	Khandala Village, Balipatna block, Odisha	23
6.	28.05.2016	Astaranga Village, Puri dist. , Odisha	70
7.	30.06.2016	Mallavaram Village, West Godavari Dist, AP1	20
8.	31.07.2016	Astaranga Block , Puri District, Odisha	82
9.	22.10.2016	Derunia Village, Astaranga, Odisha	89
10.	07.12.2016	Gop, Puri Dist. , Odisha	63
11.	05.03.2017	Sarada Village, Konark, Puri dist. Odisha	103

Awareness Programmes

The following Awareness Programmes were organized by the Institute.

- At Konark, Odisha on 19 November, 2016: The programme sensitized the farmers about the role of water quality parameters for better fish production, responsible use of chemicals, antibiotics and drugs for fish culture. Total 84 pond water samples were examined on-spot and desired recommendations were suggested.
- World antibiotics awareness week was observed Under ICAR-All India Network Project on Fish Health. The programme was graced by Dr. P. Jayasankar (Director, ICAR-CIFA), Dr.(Mrs.) R. Jayasankar (SIC, ICAR-CMFRI, Puri), Dr. B. B. Sahoo (Deputy Director), Dr.(Mrs.) A. Parmeshwaran (MPEDA, Odisha), Dr. S. K. Sahoo (DDF, Puri) and the Heads of the Division of ICAR-CIFA. A workshop leaflet was released to make awareness about the handling of antibiotics with care and when to be used and how to be used without creating any havoc to animal health and human health. The programme was attended by 140 fish farmers including farm women from different part of the Puri district (Konark, Brahmagiri, Astaranga, Pipli area).

Technical help extended to establish the feed mill in Assam, West Bengal, Chhattisgarh and Bihar

Technical help was rendered to establish the fish feed mills in Assam, West Bengal, Chhatisgarh and Bihar. Starting from the construction of building for housing the feed mill, procurement of machineries used for feed mill, processing of the ingredients, production of feed, quality evaluation, packaging and storage methods were taught to the farmers/entrepreneurs.

Demonstration of rain tree pod based feed in farmer's pond

Rain tree (*Samanea saman*) pod (RTP) is a good source of protein (252 g kg^{-1}) and energy (20 KJg^{-1}). RTP contains ∑ SFA, ∑ MUFA, ∑ PUFA n-6, and ∑ PUFA n-3, at 30%; 25%; 41% and 3%, respectively. Complete protocol has been developed at ICAR-CIFA to incorporate this non-conventional ingredient in carp feed.

A demonstration programme was taken up at farmer's field to demonstrate the performance of RTP based feed against an iso-nitrogenous feed without RTP. Although the final harvest is yet to be done, the performance of both the feeds are at par with each other. This observation concludes that rain tree pod as a non-conventional ingredient can partially substitute the edible oil cake in carp feed.

Winter School on Current trends in Molecular Diagnosis for Better Health Management in Aquaculture

Twenty-one days ICAR- sponsored Winter School on Current trends in Molecular Diagnosis for Better Health Management in Aquaculture was conducted

at ICAR-CIFA, Bhubaneswar during 15 February to 7 March, 2017. One booklet on common diseases of freshwater fish and their management was released on this occasion for the benefits of fish farmers. Total 17 participants from various SAU's and ICAR Institutes participated.

Table 45. Radio talks/Television programmes

Name	Date	Programme
Dr. S. C. Rath	27.08.2016	Talk on AIR Cuttack "*Machha chasa pain kam dama re khadya prastuti*"
Dr. S. C. Rath	5.10.2016	Talk on AIR Cuttack "*Pokharira swacchta 'O'parichhanata*"
Dr. S. C. Rath	23.10.2016	Talk on AIR Puri "*Pokharira swacchta 'O'parichhanata*"
Dr P. Jayasankar Dr S. Saurabh Ms Sweta Pradhan	28.10.2016	Talk on DD Kisan National Channel entitled '*Moti ki Kheti*'
Dr. S. C. Rath	16.02.2017	Talk on AIR Puri "*Machh pokharire Khadya parichalana*"
Dr. S. Adhikari Dr. B. N. Paul	20.02.2017	Talk on Kolkata Doordarshan Programme in "Hello DD Basundhara" on the theme "*Jolashoyer Poribesh o Machh*"
Dr. S. Saurabh	23.03.2017	DD Kisan Programme (Hello Kisan)
Dr S. K. Swain	27.03.2017	Talk on AIR, Puri "Aquarium maintenance"

AGRI-BUSINESS INCUBATION (ABI)

Agri-Business Incubation (ABI) which has started operating at ICAR-CIFA from March 2016, has been organizing meetings to showcase eight technologies to the prospective buyers and entrepreneurs. The technologies were available on the website. Business Plan for 31 Aqua enterprises was prepared for various entrepreneurs.

- Partnering with the State Govt. to develop inner projects on freshwater aquaculture in seven dimensions; support to APICOL to develop the business plan for the seven technologies; price fixation of pearls of Tisya Agri Aqua venture; helped to create website and literature materials for the Tisya Agri Aqua venture pearl farming and Aqua Field School based on Pearl Farming. Market Assessment for the fish products was carried out by ABI, CIFA in Bhubaneswar and nearby markets. ABI also conducted the Aqua field School development at Durg by Poonam Fisheries.
- National training programme on Installation and operation of FRP hatchery was organized by ABI and more than 25 entrepreneurs participated in the workshop. Aisharya Aquaculture one of the incubatees of ABI, was being supported to produce fish feed with the guidance of CIFA.
- West Bengal Dairy & Poultry Devlopment Corp. Ltd. (WBDPDC) was given consultancy to set up a 5 tph Fish feed Plant wih a project cost of Rs 12 crores.
- Technology Park for visitors and entrepreneurs in freshwater aquaculture serves as a better learning space. ABI, CIFA serves as a catalyst in this aspect.
- Workshop on Popularizing *Jayanti* Rohu was conducted and five multiplier units were set up across India being supported by ABI-CIFA. Two numbers of training programs on Entrepreneurship Development in Aquaculture Value Chain of TAAL, Bhopal Madhya Pradesh with 40 participants was conducted for 8 days in total.
- ABI-CIFA along with KVK, CIFA organized a Public Private Partnership in Extension Reforms with MANAGE Hyderabad. It also conducted a flagship industry integrated training program on Fish Feed Production and Feeding Management in Aquaculture with participants from across the country.
- Conducted a sensitization workshop for State Bank of India Officials towards Aqua-entrepreneurship.
- Conducted a session for NABARD, Bhubaneswar and arranged field trip to ABI-Incubatee Farms.
- During the small span of 12 months ABI, CIFA could generate a revenue worth of 21.00 Lakhs.

Table 46. Technology commercialization by ABI-CIFA

Mode	Technology	Firms/Institutions	Service
Institutional consultancy mode	Aquaculture, FRP Hatchery, Carp Breeding, Fish Processing ,Fish Waste Management, Sinking Feed Pellet	• TAAL, Bhopal, MP	Consultancy, training, Business Plan Development
	Floating Feed Mill	• West Bengal Dairy & Poultry Development Corp. Ltd. (WBDPDC)	Consultancy, Business Plan Development, Training
	Feed Mill (1 and 0.5 tph) Carp Hatchery, Aquaculture, Integrated Farming, Poultry Farming, Pearl Farming, Dairy Farming	• APICOL	Business Plan Development, Consultancy
Incubation Mode	Aqua Field School	• Poonam Fisheries, Chhattisgarh • Tisya Agriaquaventure Odisha • Mr. Akshya K.umar Sahoo, Boisingha, Odisha • M/s M.M.Fish Seed Cultivation Pvt. Ltd., Chhattisgarh	Business Plan development, Material Support, Technical Support, funding Linkage
	Fish processing	• M/S Dependable Agri Services pvt. ltd. Odisha • Mr. Amaesh Chatterjee, West Bengal • M/s M.M.Fish Seed Cultivation Pvt. Ltd., Chhattisgarh	Business Plan development, Material Support, Technical Support, funding ,marketing Linkage
	Fish Hydrolysate	• Mr. Surendra Belchandan, Chhattisgarh, • M/s Tisya Agri Aqua Venture, Odisha • Mr. Sumanta Behera, Odisha	Business Plan development, Material Support, Technical Support, funding ,marketing Linkage

Mode	Technology	Firms/Institutions	Service
	Prawn Brooder	• Mr. Prakash Kumar Bhaul, Odisha	Material Support, Technical Support, funding marketing Linkage
	IMC Breeding	• Mr. Ramaraju Chentalpati, Andhra Pradesh. • Mr Kumar Nand Kishore, Bihar • M/s M.M.Fish Seed Cultivation Pvt. Ltd CGS	Business Plan Material Support, Technical Support, funding marketing Linkage
	Murrel Breeding	• Mr. K. Siva Nagendra Prasad, Andhra Pradesh • M/s M.M.Fish Seed Cultivation Pvt. Ltd. Chhattisgarh,	Material Support, Technical Support, funding marketing Linkage
	Fish Feed plant Consultancy	• M/s Glaucus Agrochem pvt. ltd. West Bengal • M/s M.M.Fish Seed Cultivation Pvt. Ltd. Chhattisgarh,	Business Plan Material Support, Technical Support, funding marketing Linkage
	Pabda, *Mystus gulio* cultivation	• Mr Sujit Gosh, WB • Anand Fish Cooperative, WB	Business Plan Material Support, Technical Support, funding marketing Linkage
	Aqua-tourism	• Ms Rani Das	Business Plan Material Support, Technical Support, funding marketing Linkage
Contract Service Mode	FRP Hatchery	• KVK, Sitapur • KVK, Ratlam • KVK, Kanker • KVK, Puri • KVK, Gajapati • KVK, Sundergarh • NBGFR • ICAR-DCFR • Mr. Sanjay Agarwal • M/s BADC, Bls • Fishery Research station, Palair • IBSD, Manipur • Kamdhenu University	Installation, Plan development, training

Mode	Technology	Firms/Institutions	Service
	Jayanti Multiplier Unit	• Mr. Surendra Belchandan • Mr. Kumar Jagat Maharatha • Mr. Sourav Biswal • Mr.Debjit Barman • Mr. Ritwik Amir	Business Plan, Material transfer, quality management
	Nano Technology based Aerator	• M/s Eesavyasa technologies Pvt. Ltd. (ETPL)	Product testing , Project report development
Transfer of IP (Published)	• Spot agglutination for diagnostic of Bacterial gill disease in fish • Dot Elisa Kits for diagnostic of Bacterial gill disease for columnaris disease in fish • Rohu Catla Hybrid Detection Kit • Argulus (*A. siamensis* & *A. japonicus*) Detection Kit • White Tail Disease Diagnostic Kit • Koi Herpes Virus (KHV) Diagnostic Kit • Spring Viraemia of Carp Diagnostic Kit • FRP Demand Fish Feeder	• Spot agglutination for diagnostic of Bacterial gill disease in fish (Agrawal Trading Co., Raipur, C.G.) • Dot Elisa Kits for diagnostic of Bacterial gill disease for columnaris disease in fish (Agrawal Trading Co., Raipur, C.G)	EoI has been published in Website. EoI has been received for two technologies
Transfer of IP (To be Published)	• Mechanical Pond Applicator • CIFA Bind ADD^{+} • CIFAFRY • Fish Hydrolysate • Shining Barb	Under process for EoI	

INTERNATIONAL COLLABORATION

- DST and Centre for Science and Technology of non-aligned and other developing countries (NAM S&T) selected Mr. Kasoji Nasser, Research officer –Aquaculture, Livestock and Fisheries Programme Leader, National Agricultural Research Organization (NARO) Abi Zonal Agricultural Research and Development Inst P.O BOX 219 Arua-Uganda RTF-DCS fellow of NAM S&T for award of fellowship in the field "Breeding management approaches of carp with reference to brood stock diet" for research in ICAR-CIFA. He completed 5 months training during 1 April- 31 August 2016. The Mentor Scientist from ICAR-CIFA was Dr S. Nandi, Principal Scientist.
- Dr. Leandro Andres Miranda, Professor and Independent Researcher, IIB-INTECH, University of San Martin, Argentina visited ICAR-CIFA, Bhubaneswar from 21st June to 18th July, 2016 for undertaking collaborative research work on "Cryopreservation of embryonic stem cells and primordial germ cells for translation and surrogate fish production" .
- Ms Jane Nagayi K. Y., Lecturer, Gulu University, Uganda was awarded the C. V. Raman International Fellowship for African researchers and completed her training (2 September-23 December, 2016) at ICAR-CIFA for research work in freshwater aquaculture. She worked under the guidance of Dr P. C. Das, Principal Scientist, APED, ICAR-CIFA.
- Norway's Ambassador to India H. E. Nils Ragnar Kamsvåg visited the Institute on 23 March, 2017. Dr J. K. Sundaray, Director (Acting), ICAR-CIFA welcomed the envoy and apprised him about the Institute's activities and achievements. Later, the Ambassador interacted with the scientists about the scope of future collaboration in aquaculture.

NORTH-EASTERN DEVELOPMENT PROGRAMME

Under the North-Eastern Development programme the following activities were undertaken by ICAR-CIFA during the year 2016-2017.

Assam (including Bodo Territorial Council)

A demonstration programme of ICAR-CIFA on composite fish culture (CFC) in 8 ha water bodies comprising of 15 family ponds of selected beneficiaries Manusmari Village of Udalguri District resulted in fish production of 3.0 - 3.5 MT/ha/yr against the baseline production of 1.0 - 1.2 MT/ha/yr. Final harvesting of CFC demonstration and a training programme on "Freshwater aquaculture activities in NEH states" was organized during 6-8 February, 2017 in collaboration with Dept. of Fisheries, Govt. of Assam. The Principal Secretary and Director of Fisheries, Govt. of Assam interacted with the Scientists and appreciated the demonstration.

Final harvesting of CFC demonstration at Manusmari

A training programme on "Grow-out pond management of carps" for the fish farmers of BTC & TAC was organized during 27-29 June, 2016 at Guwahati, Assam. The topics discussed during the training programme were carp breeding using FRP hatchery, issues of quality seed production, composite fish culture principles and practices, grow-out pond management of carps, progress of composite carp culture in BTC, etc. Total 54 participants attended the programme.

Participants attended the training programme at Guwahati, Assam

The Institute in collaboration with Aquaculture and Biodiversity Centre, Department of Zoology, Gauhati University organised a training programme on 'Ornamental Fish Breeding & Culture' at Guwahati during 11-12 February, 2017. The objective of the programme was to promote breeding and seed production of indigenous and exotic species of ornamental fish among the progressive fish farmers of Assam. Prof Jatin Kalita, Dean, Faculty of Science, Gauhati University and Head, and Coordinator of the Aquaculture and Biodiversity Centre inaugurated the training programme in which more than 35

Training on ornamental fish breeding and culture at Guwahati

progressive fish farmers of Assam along with research scholars and faculty members of the Dept. of Zoology, Gauhati University participated.

Training on "Breeding and seed production of carps in FRP hatchery" was organized during 30 July to 01 August, 2016 in collaboration with Department of Zoology, Gauhati University, Guwahati, Assam and Department of Fisheries, Government of Assam at Aquaculture and Biodiversity Centre, Department of Zoology, Gauhati University. Dr. Mridul Hazarika, Honorable Vice Chancellor, Gauhati University attended the inaugural function as the Chief Guest and Mr. S. K. Das, ACS, Director of Fisheries, Govt. of Assam as a Guest of Honour. Total 70 progressive fish farmers of Assam along with Research Scholars and faculty from Gauhati University attended the programme.

Training on "FRP Magur hatchery and its installation" was organized during 9 - 10 November, 2016 at KVK, Nalbari. The main objective of the training programme was to make the participants aware about the magur hatchery operation and installation. Important issues like demand and supply of magur seed, issues in magur seed production and culture status of magur in and around Nalbari District, Assam were discussed in the programme. The training was attended by 40 participants.

Participants attended the training programme at KVK, Nalbari

Training on "Advanced freshwater fish culture techniques" with 100 nos. of trainees was conducted at Biswanath Chariali, Assam during 12-13 November, 2016. Shri. Parimal Suklabaidya, Hon'ble Minister of Fisheries (Assam); Mr. M.C. Jauhari, IAS, Pr. Secretary, Fishery Dept. of Assam and Mr. Padma Kanta Hazarika, MLA (local), Dr. Dilip Kumar, Consultant FAO – UN; Dr. B. K. Das, Director, ICAR–CIFRI were present in the inaugural programme.

Training on "Freshwater aquaculture activities in NEH states" organized during 6-8 February, 2017 at Manusmari, BTC in collaboration with Dept. of Fisheries, Govt. of Assam. Total 31 participants were present.

Fish farmers' meet was organized at Manumari, Udalguri District, BTC, Assam on 11 November 2016 by the Institute. Discussions were held on technical issues relating to composite fish culture, strategies to be followed to increase the fish growth in the region and to collect detailed information on the ongoing demonstration programme on "Composite Fish Culture" in 8 ha water bodies (15 beneficiaries). The meet was attended by 30 participants.

A Farmers' Fair was held at Biswanath Chariali and also ICAR–CIFA was represented in the inauguration of Blue Revolution Programme of Assam on 12 November, 2016, where thousands of people gathered and dignitaries like Dr. Dilip Kumar, FAO – UN; Dr. B. K. Das, Director, ICAR–CIFRI; Mr. A. Joshi,

Farmers' fare at Biswanath Chariali

IAS, Jt. Secretary, Ministry of Agriculture, Govt. of India; Mr. Parimal Suklabaidya, Hon'ble Minister of Fisheries (Assam); Mr. S.K. Das, ACS, Director, Fishery Dept. of Assam; Mr. M.C. Jauhari, IAS, Pr. Secretary, Fishery Dept. of Assam & Mr. Padma Kanta Hazarika, MLA (local) graced the occasion.

In collaboration with NFDB, Guwahati Centre and ICAR-CIFRI Regional Centre, Guwahati, a two day workshop on "Fish feed formulation, preparation and its importance in the North Eastern Region of India" was organized at Guwahati during 22-23 December 2016. The programme was inaugurated by Mr Parimal Suklabaidya, Hon'ble Minister of Fisheries, Excise & PWD, Government of Assam in presence of Mr. S.K.Das, Director of Fisheries, Government of Assam and Dr. Sanjay Sharma, In-Charge, NFDB Guwahati Centre. There were 32 participants, mostly the entrepreneurs and progressive fish farmers.

The Institute participated in the Kisan Mela organized by Bharatiya Kisan Sangh (BKS) at Raha, Nagaon District, Assam during 4-5 March, 2017. About 1000 farmers from 15 districts of Assam visited the ICAR-CIFA stall at the venue. Dr. Jitendra Mohan Chauhan, Co-ordinator of the programmes along with different state level dignitaries visited the stall and discussed about farmers development and issues with the visiting scientists of the institute. Dr. Kamaleshwar Kalita, Member of ICAR Governing Body Council; Director of KVKs, Barapani; and Dean, College of Fisheries Science, Raha visited the CIFA stall. They were duly informed about the CIFA activities in entire North Eastern States. Mr. Badrinarayan Chaudhary, Maha Mantri and Mr. D. Kulkarni, Organizing Secretary, Bharatiya Kisan Sangha praised ICAR-CIFA activities for farmer's welfare particularly in NEH states.

Arunachal Pradesh

A training programme on "Breeding and seed production of carps in FRP hatchery" was organized during 2-4 August, 2016 in collaboration with Dept. of Fisheries, Government of Arunachal Pradesh at Sonajuli, Arunachal Pradesh. It was attended by 22 progressive fish farmers & Departmental officials of Arunachal Pradesh. Mr. J. Taba, Director of Fisheries, Govt. of Arunachal Pradesh attended the inaugural function as the Chief Guest. The Assistant Director of Fisheries and the District Fisheries Officer, Papum Pare, Arunachal Pradesh were present and spoke on the occasion.

The final harvesting programme of demonstration of Pig-Fish-Agri-Horticulture crop culture in 0.25 ha water body along with training on "Freshwater aquaculture activities in NEH states" during 9-10 February, 2017 was conducted in collaboration with Dept. of Fisheries, Govt. of Arunachal Pradesh, where 23 people were present. During the period, one demonstration on "Installation of FRP Carp Hatchery" was also conducted where 15 participants were present. After completion of one year demonstration, it was found that fish production was 750 Kg from the 0.25 ha water body *i.e.,* 3.0 MT/ha/yr where 10,000 nos./ha fingerlings were stocked during November, 2015. In piggery, 6 piglet were grown to an average size of 80-100 kg which reproduced 23 more piglets. During the winter season along the pond dykes broccoli, red cabbage, Chinese cabbage and cherry tomato were also cultivated.

Pig cum fish culture at Sonajuli.

A hands-on demonstration program on installation and fitting of FRP carp hatchery, broodfish selection

and identification, hatchery operation was conducted at Sonajuli, Arunachal Pradesh on 4 August, 2016. About 50,000 nos. of *Labeo bata* seed was produced from the hatchery operation.

Installed one FRP-carp hatchery at Midpu village in the Akin Tara farm. Harvesting was done in Pig-Fish Integrated demonstration pond of Sonajuli at Nikom's farm and training programme was completed on 10 February, 2017.

Demonstration of FRP hatchery installation.

Tripura & TTAADC

The Institute in collaboration with DoF, Govt. of Tripura jointly organized the training program on "Broodstock Development for Quality Fish Seed Production" at Directorate of Fisheries, Tripura during 2–3 November 2016. A total of 30 participants including fish hatchery manager/farm in-charges/fish seed growers, and other officials from different districts attended the program. Mr. G.R. Das, Director of Fisheries; Tripura, Mr. Abani Debbarma, Joint Director of Fisheries and Mr. Nikhil Majumder, Dy. Director of Fisheries (C&D) also attended the training programme.

As per the proposal submitted by the Department of Fisheries, Government of Tripura, a total of 58 litres of fish medicine "CIFAX" and 8 MT broodstock diet CIFABROOD™ were supplied by ICAR-CIFA during the year 2016-17. CIFABROOD™ was distributed to six Government farms in two installments during May 2016 and February 2017. In the first case extended breeding period was reported by the officials. Feeding practices with CIFABROOD™ is going-on in two Government farms namely Sarma Fish Breeding Farm, Gandacherra and Dhanisagar Production Unit, Udaipur for early maturation and better reproductive performance of Indian major carps.

TRIBAL SUB-PLAN (TSP)

FRP hatchery installation and operation in tribal areas

Two FRP carp hatcheries were installed at Maa Majhigouri Adivasi Mahila PFDCS, Rayagada Block and Sri Loknath Nundruka, Muniguda Block of Rayagada District, Odisha in April 2016. One FRP hatchery was installed in NB Pokhria, Bisoi Block of Mayurbhanj District, Odisha. On 4 July 2016, by using the hatchery installed in Bisoi Block about 7.0 lakhs rohu spawn were produced in a single operation utilizing the breeders (6.0 kg males of 6 nos and 8.0 kg females of 5 nos).

During 25-27 July, 2016 the induced breeding of catla (*Catla catla)* was demonstrated successfully in the FRP hatchery installed at Kharialpara, Potaspur Block, East Midnapur District, West Bengal. During the demonstration, besides 40 tribal participants from Kharialpara, 30 tribal participants from Amarpur were also present from nearby Khar Village to learn about the seed production technology. On gaining experience from the demonstration on breeding operation by ICAR-CIFA team, the farmers of 'Amarpur Kharialpara Mathsyauthadan Samity' tried to induce breed rohu (*Labeo rohita)* and bata (*Labeo bata*) in FRP hatchery. In total 8, 10 and 2.5 lakh spawn were produced for rohu, catla and bata, respectively.

Scientist – Farmers' Interaction Meet at Aranga Village, Niladriprasad GP of Banpur

ICAR-CIFA in collaboration with Mera Gaon Mera Gaurav programme and SC/ST Project of Department of Biotechnology (GoI) organized a Scientist – Farmers' Interaction Meet on "Freshwater Aquaculture as Livelihood Option for Tribal Farmers" at Aranga Village, Niladriprasad GP of Banpur Block, Khordha District, Odisha on 24 May 2016. More than 300 fish farmers of Niladriprasad GP and line department officials participated in this programme.

The Institute adopted 20 (all) villages of this Grampanchayat (25 ponds of 21 acre water area) as

Area Saturation Model of fishery technology dissemination programme. Out of those 15 villages were implemented in Mera Gaon Mera Gaurav programme.

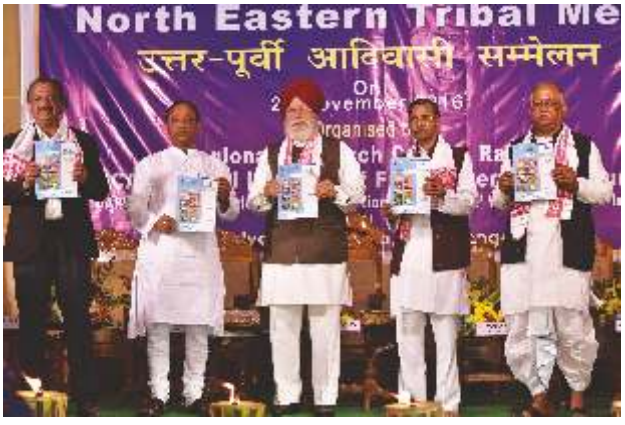
Awareness rogramme on 'Freshwater Aquaculture as Livelihood Option for Tribal Farmers of Pune, Maharashtra'

Awareness programme on 'Freshwater Aquaculture as Livelihood Option for Tribal Farmers of Junnar and Ambegaon Tahsils of Pune District, Maharashtra State' was conducted by ICAR-CIFA, Bhubaneswar in collaboration with Department of Fisheries, Govt. of Maharashtra, Pune and KVK, Narayangaon on 19 October, 2016 at KVK, Narayangaon. Around 192 tribal farmers from Junnar and Ambegaon Tahsils participated in the programme. On 18 October, 2016, ICAR-CIFA conducted a Focus Group Discussion at Amboli village to identify problems related to aquaculture and visited many small ponds and dam site to explore the possibilities of scientific fish culture at Junnar region. Three leaflets of ICAR-CIFA prominent technologies such as Portable FRP carp hatchery; Freshwater fish culture and Quality seed production in Marathi language were released on the occasion. The following major recommendations were drawn by all stakeholders:

1. Demonstration of scientific fish farming in the Junnar region.
2. Availability of local language extension leaflets on feeding, fish seed production, disease management, post harvest, value addition and farming must be available.
3. Training and exposure visit of the farmers to different successful state and fisheries institutes.
4. Availability of quality fish seed for the Junnar region.
5. Inclusion of genetically improved variety of carps for quality seed production.

North Eastern Tribal Meet and training programme held at Kalyani Field Station

ICAR-CIFA and Bharatiya Kisan Sangha jointly organized North Eastern Tribal Farmers' meet and 4-days training programme on “Pisciculture and Allied Farming Practices for Tribal Farmers of Northeast India” during 26-29 November, 2016 at Kalyani, West Bengal. The programmes were inaugurated by the Chief Guest, Shri Surendrajeet Singh Ahluwalia, Hon'ble Union Minister of State for Agriculture and Farmers' Welfare and Parliamentary Affairs. While gracing the occasion, Shri Ahluwalia Ji complimented the institute for undertaking various aquaculture development activities in Northeast Hill (NEH) states and other parts of the country, and highlighted the importance of fish as health food and the necessity of integrated farming systems and reclamation of water bodies to increase fish production. He also suggested for promoting crab farming and apiculture for the tribal people of Sunderbans. Shri Parimal Suklabaidya, Minister of Fisheries, PWD & Excise Department, Govt. of Assam appreciated the activities of ICAR-CIFA in Assam. He emphasized modifying technologies to suit specific requirements of the different agro-climatic regions of the NEH states. Shri Jayanta Naskar, MLA, Gosaba, Sunderban complimented the activities of ICAR-CIFA at Sunderban for the tribals and requested to standardize the technology of crab farming. Shri Dinesh Dattatraya Kulkarni, Organising Secretary, Bharatiya Kisan Sangha highlighted the works of the Sangha in different parts of the country and expressed his interest to continue such programme jointly with ICAR-CIFA in future. A total of 108 tribal farmers from NEH states and Sunderban, West Bengal, and 400 tribal school children of West Bengal attended the function.



Tribal Fish Farmers' Meet

- A Tribal Fish Farmers' Meet (*Jalabhumi Diwas*) was organized at Kalyani Field Station on 16th June 2016. Fish farmers from different parts of West Bengal including Sunderban, Naihati, Mursidabad and Hooghly participated the meet and shared their experience and benefits gained by adopting ICAR-CIFA technologies. Dr. Trilochan Mohapatra, Secretary, DARE, and DG, ICAR, New Delhi, Dr. J. K. Jena, DDG (Fy. Sci), Dr. V. R Suresh, Director (Acting), ICAR-CIFRI and scientists from other ICAR institutes in the region were present in the meet. Dr. T. Mohapatra emphasized on integrated farming system for the economic development of the resource-poor farmers. DG, ICAR released two pamphlets on "Nutrition Facts" and "Dissemination of Freshwater Aquaculture Technologies in Bali Island, Sunderban, West Bengal".

Table 47. Trainings conducted for tribal farmers

Title	Venue	Duration	No. of participants
Common carp breeding (organized by RRC, Bengaluru)	Pookode Lake Office, Dept. of Fisheries, Govt. Kerala	5-7 July, 2016	10
Breeding and seed rearing of Indian major carps (organized by RRR, Rahara)	Amarpur village, Potaspur, West Bengal	26-27 July, 2016	52
Pre-stocking management of carp culture (organized by RRC, Anand)	Kalak Village, Jambusar, Bharuch District, Gujarat	July,2016	35
Breeding and hatchery seed production of fish (organized by RRC, Anand)	Anand	4-6 August, 2016	28
Aquaculture in net enclosure systems (organized by RRC, Anand)	Anand	4-6 January, 2017	23
Supplementary feeding management in carp polyculture (organized by RRC, Anand)	Jambusar	9-11 January, 2017	22
Freshwater Aquaculture	ICAR-CIFA, Bhubaneswar	25-28 March, 2017	29

Krishi Vigyan Kendra (KVK)

Mandatory activities of KVK-Khordha

In 2016-17 KVK worked on the mandates of Technology Assessment, Refinement and Demonstration along with other works largely supporting the state and central government schemes. Significantly, KVK concentrated on convergence with ATMA, IFFCO, Community Radios, Sai Fertilizers, KRIBHCO and other relevant agencies working in the district with similar mandates. The flagship programme implemented by KVK during 2016-17 was on the cluster demonstration of oil seeds and pulses. The quantifiable achievements of KVK-Khordha in 2016-17 with the mandatory works are presented in Table 48.

Table 48. OFT, FLD and trainings

S.No	Activity	Number of activity	Beneficiaries
1.	On Farm trail (OFT)	17	149
2.	Front line demonstration (FLD)	20	717
3.	Mandatory training (Off campus and on Campus)	40	1060
4.	Mandatory training for rural youth	3	30
5.	Mandatory training for extension functionaries	2	35
6.	Sponsored trainings	10	303

The KVK assessed 17 technologies and demonstrated 20 frontier technologies during 2016-17 benefitting 866 farmers and other stakeholders. Significant technologies assessed and demonstrated are presented in the table.

Table 49. Significant technologies assessed and demonstrated to feed results to mainstream extension

Discipline	Technology assessed	Technology demonstrated
Crop production	• Scented rice Var. Ketakijuha/ Purnabhog/ Nuachinikamini • Soil Moisture Indicator • Herbicide Bispyribac Sodium in direct sown rice • Integrated Nutrient Management in Transplanted Rice (Kharif)	• Upland rice var. Swagidhan • Intercropping rice and arhar • Hybrid Sunflower
Horticulture	• Yam in poly bags • Arka Microbial Consortium(AMC) for increasing seedling vigor • Fertilizer management in Papaya var. Red Lady • Tomato variety Arka Rakshak during early summer • Panchagavya for quality marigold flower production	• Ginger var. Suprava in Semi shaded places • Banana special: Micro nutrient for banana • Foliar application of Panchagavya in Okra • Intercropping of Capsicum with maize
Animal Science	• Hand operated milking machine • Micronutrient licking blocks • Rearing of quail • Production of broiler goats	• Chelated Mineral Mixture licking blocks • Kaveri: Backyard poultry • Integration of native cross ducks in fish pond system • Coloured broiler
Home Science	• Pro super grain bag • Coconut dehusker • Oyster mushroom in sugarcane substrate • Low cost poly tunnel for nursery raising	• Honey bee cultivation • Baby corn var. G-5414 • Off season paddy straw mushroom cultivation • Mixed cauliflower pickles

KVK assessed aromatic rice variety for the district

Since several years farmers of Khordha District are cultivating different short grain aromatic rice. In 2016-17, KVK procured aromatic rice varieties developed by ICAR-National Research Institute, Cuttack and conducted the trial at the farmer's field. Under the project IARI-Post office linkage programme also KVK worked on assessing different aromatic rice varieties (Table 50). It was inferred that PUSA 1612 recorded the highest yield with 5.7 q/ha compared to other aromatic rice varieties.

Table 50. Performance of different aromatic rice varieties in farmer's field

S.No	Variety	Project	Seed source	Duration	Potential yield (t/h)	Yield in farmers field (t/ha)
1.	Ketekijoha	KVK	NRRI, Cuttack	145	3.50	3.05
2.	Nua Kalajeera	KVK	NRRI, Cuttack	145-150	3.00	3.50
3.	urna Bhog	KVK	NRRI, Cuttack	140-145	4.50-5.00	3.98
4.	Nua Chinikamini	KVK	NRRI, Cuttack	145-145	3.5	3.58
5.	PUSA 1612I	ARI-Post office linkage programme	IARI, New Delhi	120-125	5.70	5.70
6.	PUSA 44	IARI-Post office linkage programme	IARI, New Delhi	140-145	5.50	4.56

KVK introduced Yam production in poly bags

The practice of ground planting of yam in ill drained soils leads to rotting and is labour intensive. Yam can be cultivated in poly bags as they can be grown in desired enriched soil by the farmer, less labour intensive, easy to harvest, minimum or no damage while harvesting and also can be grown in roof tops. The technology is portable and can be lifted and kept at a suitable place if required. In 2016-17 KVK tested this technology. The yield of yam in gunny bags was found to be 223.5 qt/ha compared to that of planted in ill-drained soil in ground with an average yield of 204.9 qt/ha. However, the importance is about the less labour required and no damages while harvesting.

For further popularisation and to feed the results to mainstream extension an interaction meet was organised by KVK on 24th January, 2017. Officials from Horticulture Department and ATMA along with 30 progressive farmers participated.

Technology Demonstration and Uptake of results

Ginger cultivation in semi shaded backyards with state department

Ginger cultivation in semi-shaded backyard places of farm families was successfully tested by KVK in 2014-15 particularly in rainfed blocks of the district. In 2016-17, KVK demonstrated the practice with larger farm families to adopt and also an interaction meet was held to feed the research results to main stream extension. A field day was observed on cultivation of Ginger in semi-shaded places at KVK on 21st January, 2017. Assistant Director Horticulture, Bhubaneswar and field staff of other blocks participated in the field day observation along with 17 progressive farmers from five blocks of the district.

Kaveri as new backyard poultry strain

KVK-Khordha demonstrated the performance of newly released Kaveri poultry in the backyard production system through an on farm trial. Kaveri birds have characteristic features like low early chick and layer mortality, excellent flock uniformity, early sexual maturity, withstanding predators, laying brown coloured eggs, etc. The participatory trial was organised at 30 farmer's fields administering participatory approach by providing 300 chicks to the farmers. The biggest gain of Kaveri poultry in the trial was the body weight, which was recorded to be 3200 g in male and 2800 g in female birds at the end of 12 months compared to 1750 g and 1250 g, respectively, with the local strains. Kaveri chicks exhibited superiority in their livability with a mortality rate of 15% during the critical period of the first 10 weeks of their life compared to the most popular backyard improved strain Vanaraja in which it was up to 24% in the backyard system.

Cluster demonstration of groundnut var. Devi

In 2016-17, KVK undertook cluster demonstration of oil seeds and pulses covering 180 ha benefitting 450 farmers. The details of the cluster demonstration of KVK in 2016-17 are given in Table 51.

Table 51. Crop wise cluster demonstration of KVK during 2016-17

S.No	Crop	Variety	Area (in ha)	Beneficiaries
1.	Groundnut	Devi	60	140
2.	Black gram	PU-35	30	75
3.	Green gram	TARM-1	30	75
4.	Sunflower	NFSH-17	50	130
5.	Sesame	Kanak	10	30
	Total		180	450

KVK demonstrates Hybrid Watermelon variety Augusta with support of ATMA-Khordha

Hybrid Watermelon variety Augusta was demonstrated by KVK in Tangi and Chilika Blocks of the district. The demonstration was carried out with the support of ATMA-Khordha and seeds were supplied for undertaking demonstration in 75 acres.

KVK introduces Liquid Bio-fertilizers

KVK conducted a farmer's meet involving 200 farmers to introduce Liquid Bio fertilizer of KRIBHCO on the eve of Akhyatritiya Celebrations. KVK facilitated KRIBCHO to popualrise liquid bio fertilizer use in Pumpkin cultivation. In addition to that KVK

scientists provided information to farmers on use of Panchagavya and other organic products.

Soil test based nutrient management

KVK collected 58 soil samples from Rajas village of Balipatna block and provided a training programme on Integrated Nutrient Management in paddy. In this initiative IFFCO, Bhubaneswar supported to analyse the samples with KVK and provided recommendations based on soil test for Kharif season paddy in 2016 for 58 farmers.

KVK expands Banana Special with extension efforts

Field Day on application of Micro Nutrient formulation "Banana Special" in banana crop was observed in the farmers field. Significantly, a KVK farmer Mr. Gatikrushna Nanda, Prataprudrapur of Balianta block coordinated the field day along with the experts of KVK. Preparation of Banana Special solution and spraying techniques were demonstrated. The field day was attended by 60 progressive farmers from 20 villages and officials of Horticulture Department from Balianta and Balipatna blocks.

Interface of KVK-Khordha and ATMA-Khordha

An interface meet of KVK and District Agriculture Extension System involving ATMA-Khordha and state department of agriculture was organized jointly by KVK on 4th January, 2017. The KVK-ATMA convergence work, popularization of scented rice and soil moisture indicator through validation and demonstration along with participatory discussion about emerging problems in the district for inclusion in KVK Annual Action Plan were some of the highlights of the interface meet. Apart from that KVK and ATMA agreed to work on 13 point agenda on scaling up technologies suitable for the district. The interface was attended by 45 extension functionaries including the KVK head and experts. The joint activities of KVK and ATMA carried out in 2016-17 are given in Table 52.

Table 52. Joint activities of KVK and ATMA in the district

S.No	Activity	No of activity	Activity details		Role of KVK	Role of ATMA	Funds released by ATMA (Rs.)
			Area (in ha)	Beneficiaries			
1.	Demonstration of Watermelon var. Augusta	1	30		Lead for the process and implementation of the demonstration	• Financial support • Joint implementation • Support for field day	3,00,000
2.	Cluster demonstration for Groundnut var. Devi	1	60	92	Lead for the process and implementation of the demonstration	• Supply of Pheromone traps and demonstration of the product • Support for field day	30,000
3.	Interface meet with KVK and District Agriculture Extension system	1	-	-	Lead for the design	• Agreed to work on a joint action plan for scaling up of technologies	Nil

TRAINING INITIATIVES

Skill Development "Friends of Coconut Tree"

In 2016-17, KVK-Khordha and Coconut Development Board, Bhubaneswar centre implemented five training programme entitled "Friends of Coconut tree". Under this programme five trainings were conducted and 173 rural youths (14 girls) were benefitted. The training mainly focussed on the employability for rural youth by skill training on coconut climbing machines and also focussing on the advances in coconut cultivation. All the trained rural youth were provided with a coconut climbing machine.

KVK trained beneficiaries of Tata Steel Rural Development Society

KVK trained 21 beneficiaries of Tata Steel Rural Development Society from Jajpur and Keonjhar district of Odisha on composite fish culture and Integrated Farming Systems (IFS). They were trained on the improved package of practices of composite fish culture and IFS with exposure visits to KVK farmers adopted with IFS. The training was sponsored by Tata Steel Rural Development Society, Kalinganagar, Odisha.

KVK works with MANAGE, Hyderabad on Public Private Partnership (PPP)

A training on Public Private Partnership in Extension Reforms was sponsored by MANAGE, Hyderabad to KVK-Khordha. Senior and middle level extension functionaries from the state departments, NGOs and private sector attended the programme. About 31 participants attended the four-day training. Dr. Kanaka Durga, Faculty from MANAGE, Hyderabad was the course Director along with Dr. P. N. Ananth, Senior Scientist and Head of KVK-Khordha.

KVK trains farmers of ILFS under Corporate Social Responsibility Funds

KVK organised two batches of Skill development training on Freshwater Aquaculture and Integrated Farming Systems for the farmers of Balasore district, Odisha. The 45 participants of the training were the beneficiaries of the development interventions of ILFS through its Corporate Social Responsibility. These farmers have been successful to increase their production from 0.6 t/ha to 1.5 t/ha since the intervention of ILFS. However, ILFS has selected 45 master farmers and requested KVK to train them to be master-cum-champions to train other farmers of the locality. The training had lectures, practical sessions and field visits to progressive farmers and state fisheries farm.

23rd Zonal Workshop of KVKs of ATARI, Zone VII at KVK

The 23rd Zonal Workshop of all KVKs under ATARI, Zone VII was jointly organised by KVK and ATARI, Zone VII, Jabalpur. The workshop was to review the activities and sensitise the KVKs on the latest updates with agriculture and allied sector technologies. Shri Dharmendra Pradhan, Minister, of State (Independent Charge), Petroleum and Natural Gas inaugurated 23rd Zonal Workshop of Krishi Vigyan Kendras under ATARI, Jabalpur. The workshop was inaugurated in the presence of Dr. A. K. Singh, Deputy Director General (Agricultural Extension), Dr S. Pasupalak, Vice Chancellor, Dr Anupam Mishra,

Director, ATARI Zone-VII, Dr P. Jayasankar, Director, ICAR-CIFA briefed on recent research initiatives of the Institute and many other guests. The innovative farmers of Odisha were felicitated. The workshop

was attended by more than 250 participants including 100 Senior Scientists and Heads of KVKs from Madhya Pradesh, Chhattisgarh and Odisha; 16 ICAR Institutes, 4 NGO Chairmen/Heads; 120 progressive farmers and corporate representatives.

Awareness on "Pradhan Mantri Fasal Bima Yojana"

A "Farmers' Fair-cum-Exhibition" was organised by KVK-Khordha for sensitizing farmers regarding "Pradhan Mantri Fasal Bima Yojana" on April 4, 2016. Prof (Dr.) Prasanna Kumar Patasani, Member of Parliament, Bhubaneswar Constituency in his inaugural speech spoke about the crop insurance to be crucial for the support of farmers, who face crop loss due to various reasons. Dr. S. K. Rout, Ex-Dean, Extension, OUAT in his key note address stressed the importance of crop insurance in the present context of climate change. In this occasion 10 farmers of KVK were recognized for adopting improved

technologies. A Farmer-Scientist Interaction was held on the prevailing agricultural schemes and its implementation aspects.

KVK in *Sansaad Adarsh Gram Yojana*

KVK organized a demonstration on Seed treatment in paddy at the Sansaad Adarsh Gram Yojana Village on 7th June, 2016. The practice was demonstrated to cover 200 acres of land under paddy during Kharif 2016-17. The demonstration was attended by more than 35 farmers "Bhagavat Dev Krushak Club". The demonstration was supported by the Department of Agriculture, Tangi, Khordha.

A fish harvest mela under 'Meera Gaon Mera Gaurav Scheme' was conducted at Orada Village of Sansaad Adarsh Gram Yojana of Tangi block of Khordha district on 30th December, 2016. A harvest mela was arranged at the village in which the community pond was stocked with Indian major carps. The fishes were harvested from the pond and distributed to the farmers of the village. In addition to that the new fresh fingerlings raised in another pond of the village were transferred to the pond that was harvested. About 12,000 fingerlings have been stocked in the community pond. About 50 farmers of the village participated in the mela. An interaction was also held with the farmers of the village on the management practices to be followed which was lead by experts of KVK and scientists of ICAR-CIFA.

KVK organised an Interaction Meet of KTS (Krishi Tantra Sevaks) Project Nirmiti of Syngenta

Project Nirmiti has been established by Syngenta under the Corporate Social Responsibility to establish sustainable and scalable business models to address smallholders' needs on paddy and vegetables. In this project enterprising smallholders become "Krishi Tantra Sevaks" (KTS) or Farm Technology Service Providers to support 3-4 neighboring villages with agricultural knowhow and inputs, and earn commission. KVK-Khordha hosted the Interaction Meet for KTS (Krishi Tantra Sevaks) from Khordha and Puri Districts to chalk out the business plans for farmers under the Rabi season. KVK-Khordha provided the technical expertise for the preparation of business plans.

KVK and Community Radios of Odisha

KVK-Khordha designed and supported the Community Radio Association of Odisha (CRAO) to organise a National Workshop on Empowering Community through Community Radio. The workshop was inaugurated by Mr. Manoj Ahuja, IAS, Principal Secretary, Ministry of Agriculture and Farmers Empowerment, Government of Odisha. The workshop first of its kind in Odisha intended to explore the enormous potential of community radio and to bring back more community voice to the fore. The workshop was attended by more than 150 participants from different states of the country.

KVK organises the concluding week long celebrations on Jai Kisan Jai Vigyan

KVK conducted the concluding meeting on the week long Jai Kisan Jai Vigyan Week celebrations on 29th December, 2016. The meeting was attended by 120

farmers from six blocks of Khordha district, and officials from the line departments. During the occasion, 12 progressive farmers were felicitated and 10 exhibitors from the government, non-government and private sector displayed their activities and demonstrated the new technologies. Dr. S. K. Rout, Ex-Dean, Directorate of Extension Education, OUAT was the chief guest and Dr. S. R. Das renowned Plant Breeder of OUAT addressed the gathering.

Farmers Interaction Meet during DDG (Fy.Sc) visit to KVK

A farmers interaction meet and exhibition was organised during the visit of Dr. J. K. Jena, DDG (Fisheries Science), ICAR to KVK-Khordha. Activities of KVK were displayed and 40 progressive farmers had interaction with DDG. Suggestions were provided to have at least 4-5 farmers of each village of Khordha district to keep the visibility and linkages.

Success story of KVK-Khordha

Institutions key to break discontinuance

This story is about a cluster demonstration on oil seed implemented in 2015-16 in Nagapur village of Balianta Block benefitting 41 farmers covering an area of 16.4 ha. In this village farmers were cultivating groundnut 10 years ago after the harvest of paddy in the month of December. KVK had worked in the village with several interventions and observed that farmers have discontinued groundnut cultivation due to increased cost of seeds, heavy infestation of pests and diseases and other factors.

KVK analysed reasons for crop failure in groundnut and implemented this cluster demonstration. A meeting was conducted and farmers were encouraged and motivated to adopt groundnut cultivation. The cluster selected a leader Mr. S. K. Rout, a rural youth and a progressive farmer to facilitate with KVK in identification of farmers, delivering the seeds and to organize training and field days. Distribution of seeds with an inception meeting was the key to farmers informing about the cluster demonstration and group marketing of the produce. To inform the package of practices a training programme was conducted to inform the details of the variety, seed treatment and inoculation with bio fertilizers, irrigation and mulching. As an initial step soil samples from their respective field after harvest of paddy was collected and analyzed. The seeds were procured from Orissa State Seed Corporation Ltd for distribution. To further motivate the farmers, IFFCO, Bhubaneswar and Sai Fertilizers, Kolkata were invited by KVK for demonstration of biofertilizer and granulated single super phosphate to increase production in the cluster. In the process an awareness meeting was also conducted on use of bio-fertilizer and its advantages.

All the farmers irrigated the crop twice and followed package of practices as informed and trained by KVK. Farmers realised an average yield of 19.6 qt/ha compared to 17.2 qt/ha of district average production in groundnut. During the field day farmers were in high spirits that KVK brought back groundnut cultivation to their village after 10 years. To further motivate KVK in early 2016 selected this cluster and invested to provide an exposure on latest technologies in a farmers fair.

Community success in using Hybrid Okra

It is true that poor of the poorest have stronger affinity towards community than individual satisfaction, and this story proves this. This success story is about a community that worked intensively to improve their okra production from Nalipada village of Arjunpur, Khordha block. KVK entered into this village in 2009-10 and could observe that 30 farmers adopted open pollinated varieties to cultivate okra in an area of 10 acres. The farmers cultivated okra after the harvest of paddy investing a seed cost to Rs. 150 to Rs. 500/kg and harvesting a low yield ranging from 18-20 qt/acre. The reasons for the low production were due to less fruiting and high incidence of pest and disease.

KVK decided to intervene with its mandatory works and conducted training, demonstration and provided advisory services. In 2009, KVK organised training on hybrid okra cultivation, distributed extension literature and brought ATMA-Khordha to support the intervention in convergence. In the next initiative, farmers were demonstrated with hybrid okra and all advisory services were provided and the farmers started reaping the benefits with huge profits. Though KVK left this village and adopted another nearby village advising these farmers continued. Surprisingly and curious to know the impact, KVK observed in 2015 that the area under okra has increased to 25 acres from 10 in 2009, all farmers adopted hybrid okra by replacing open pollinated varieties and the number of farmers involved has increased to 60 from 30 in 2009. In terms of production, there has been an high increment from 18 qt/acre in 2009 to 34-50 qt/acre with a change of 2.5 times by 2015. Significantly rural youth have started cultivating hybrid okra and to state a youth Mr. Manoj Pandia who invested Rs. 22,000 got a gross income of Rs. 80,000 from 0.4 acre. The prime lesson learnt was that participatory need based intervention yields better results for development institutions.

Table 53. Meetings attended by KVK staff

Event	Venue	Duration	Participant
Brainstorming session on the Role of ATARIs in the development of Fisheries	NFDB, Hyderabad	April, 2016	P. N. Ananth
State level Seminar on "Plant architecture and flower regulation in Mango" (organized by Central Horticultural Experiment Station)	ICAR-IIHR, Bhubaneswar	18 March, 2017	A. K. Dash
District Implementation Committee Meeting for approval of District Irrigation Plan (DIP) under PMKSY-2016-17	Collector Office, Khordha	21 June, 2016	A. K. Dash

EDUCATION AND INFORMATION SYSTEM

Library

Dr. Hiraral Chaudhuri Library 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 material. The library has more than 200 members viz., scientists, technical officers and research scholars. During the year, 2576 users visited the library which included staff and research scholars of the Institute and visitors from other organisations. The library is fully automated with Koha Library Management Software. It is one of the partner of the NAIP's e-Granth project. Under this project, the Institute library implemented the Koha software for the library.

The library is also a part of IDEAL platform. IDEAL is ready platform for Agricultural Libraries of Indian National Agricultural Research and Education System (NARES) which enables them to adopt Integrated Library management system for their day-to-day operations of their library functionality. It is a software platform 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 catalog (AgriCat). An integrated digital library delivered at the desk of the researchers, faculty and students of NARES can definitely boost the quality of research output and save time. Libraries can reduce cost incurred in procuring books & other library resources by sharing through this digital system. At present 38 libraries of the NARES as part of e-granth project supported by National Agricultural Innovation Project (NAIP) of the ICAR. The endeavor is to establish IDEAL which is easily extendable to more libraries covering whole NARES.

The users of the Library extensively used the Consortium of E-resources on Agricultures (CeRA). Wiley journal are added in Cera. The IndiaAgristat is available in CeRA from this year. In addition to above online access in CeRA, the library is providing Document Delivery Services to various institutions (including the SAUs) under the NARES.

The library mails Institute's publications to all ICAR Institutes, other Research organisations, state fisheries departments, fisheries colleges, KVKs, entrepreneurs and farmers to keep them abreast with latest developments in freshwater aquaculture. The library sends the important articles both to the internal users of the Institute as well as scientists and researchers from outside the institute.

The library also provides the photocopy facility, and during the year 2016-17 more than 20,792 copies have been photocopied. Most of the photocopies were provided to the Scientists and Technical Staff of the Institute, and they were done from the holdings of the library. The library also sends the news clippings about the fisheries and aquaculture sector, and about the events of the Institute to the internal users.

The library subscribed to Ithenticate and RemoteXs software for the year 2017-18. ASFA database also subscribed for the year 2017-18.. The library has been recognised as the FAO

Depository Library and has a good collection of FAO publications related to fisheries and allied agricultural sciences.

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 action monitored.
- Scrutiny of research project proposals for external funding, abstract presentation at Seminars, research papers submitted to Journals, applications for awards, fellowships, foreign deputations, etc.
- 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 2015-16 (in English)
- CIFA News Vol. 23 (Nos. 2, 3, 4); Vol. 24 (No. 1)
- Research Project Proposals – 2016-17
- Leaflets and Brochures

Communication of reports

- Material for DARE-ICAR Annual Report 2016-17
- 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
P. P. Chakrabarti B. C. Mohapatra	Life Time Achievement Award from Fisheries Department, Government of Assam	Guwahati, Assam	10 July, 2016
B.C. Mohapatra	Life Fellow from the Academy of Environmental Biology	New Delhi	25 November, 2016
S. Ferosekhan	ICAR-International Fellowship to pursue Ph.D	Aquaculture Research Group (GIA), University of Las Palmas de Gran Canaria, Spain	2016
P. K. Sahoo	Fellow of Indian Association of Veterinary Pathologists	Durg, Chhattisgarh	2016
P.K. Sahoo	Fellow of National Academy of Agricultural Sciences	NAAS, New Delhi	2016

Academic/Other Accomplishments

- Dr Ajit Keshav Chaudhari, Scientist of RRC of ICAR-CIFA, Anand was conferred with Ph.D (Aquaculture) on 13 May, 2016 from ICAR-Central Institute of Fisheries Education, Mumbai.
- Dr Mukesh Kumar Bairwa completed his PhD degree (Aquaculture) on 14 October, 2016 from ICAR-Central Institute of Fisheries Education, Mumbai
- Dr I. Sivaraman, Scientist completed his Ph.D Degree (Fisheries Extension) on 30 January 2017 from ICAR-Central Institute of Fisheries Education, Mumbai.
- Dr. P. K. Sahoo, National Fellow & Principal Scientist received 'Certificate of Appreciation' from The Editors of 'Gene' in recognition of the contributions made to the quality of the Journal on June 2016.
- Dr P.K. Sahoo, Pr. Scientist and National Fellow received 'Certificate of Outstanding Contribution in Reviewing' awarded in June 2016 in recognition of the contributions made to the quality of the Journal " Fish & Shellfish Immunology"
- Dr S. Saurabh, Scientist received a Certificate of Appreciation during a Workshop on "Pearl Culture" held at Kamdhenu University, Gandhinagar, Gujarat on 14 September, 2016.
- Dr Rajesh Kumar, Scientist received letter of appreciation by the Dean, College of Fisheries, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana, Punjab for highly informative expert lecture and consultancy on "Breeding and Culture of Murrel and Anabas".
- Dr K. N. Mohanta, Pr. Scientist and Head (I/C), FNPD received the "Reviewer Excellence Award 2016" from Indian Journal of Animal Research.
- This Institute received an award Rs. 5.00 lakhs from the Council towards Cashless transactions in financial dealings. An award Rs. 1.00 lakh was also given to the KVK, Khordha of ICAR-CIFA for cashless transactions.

CIFA Annual Day

The 30th Annual Day of CIFA was celebrated on 1 April, 2016 at its Headquarters. 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 account of the Institute's overall growth and highlighted some of its

notable technologies, products and future plans. He conferred life time achievement award upon 20 retired employees of the Institute including scientists, technical, administrative and supporting personnel, in recognition of the meritorious service rendered by them. The Chief Guest on the occasion was Padmashree (Prof) Priyambada Mohanty Hejmadi, Former Vice Chancellor, Sambalpur University, Odisha and the Guest of Honour was Dr (Ms) Jatinder Kishtwaria, Director, ICAR-CIWA, Bhubaneswar.

The 30th Annual Day of ICAR-CIFA was celebrated on 1 April, 2016 also at the institute Regional Research Centres.

The ICAR-CIFA Annual Awards (for the year 2015) were presented to the following:

Best Division	:	Fish Genetics and Biotechnology Division (FGBD)
Best Scientist	:	Sri Kiran D. Rasal, Scientist (FGBD)
Best Technical Staff	:	Sri Surendra Singh, SMS (Crop Production) (KVK) Sri Lingaraj Muduli, Tech. Assistant (T-3)
Best Extension Worker	:	Dr B.C. Mohapatra, Principal Scientist (APED)
Best Research Scholar	:	Amruta Mohapatra, SRF; (National Fellow Scheme of Dr P. K. Sahoo) (FHMD)
Awards for School Children Best Girl Child Award for the Highest Scorer in Class X in 2015	:	Shreyasi Samanta (D/o Dr M. Samanta, Pr. Scientist, (FHMD)

ICAR-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 from Ms Ramaprabhu, and Scientists and Parents of Dr B.R. Mohanty. An award was instituted with a donation of Rs. 1,00,000/- in December 2015 by Dr P. Jayasankar in the memory of his father Prof. M. Induchoodan. The award caries a scholarship to be given to meritorious students of Kausalyaganga Primary School and purchase sport and other gadgets for the school, apart from payment to the priest in the temple situated within the Institute premises.

The recipients of the above awards are as follows:

Girish Chandra Chaudhury Memorial Scholarship	
Name	Class
Ms Sandhya Priyadarshini	XI-XII

Smt. S. Susheelamma Scholarship	
Name	Class
Ms Priyadarshini Mohapatra	IX-X
Ms Archana Priyadarshini	VII-VIII
Mr Swaraj Ranjan Behera	VII-VIII

Dr T. Ramaprabhu Memorial Award	
Name	Designation
Dr (Ms) Sofia Priyadarsani Das	RA
Mr Subrat Kumar Swain	RA

Dr B.R. Mohanty Memorial Award	
Name	Designation
Ms Amruta Mohapatra	SRF
Mr Swagat Kumar Patra	SRF

Prof. M. Induchoodan Memorial Award	
Name	Class
Mr Pravash Kumar Behera	Class – VI
Kumari Srabani Behera	Class – IV

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) of the Institute was constituted for a period of three years w.e.f. 1.2.2016 to 31.1.2019. The second meeting of this committee was held during 20-21 February, 2017 under the Chairmanship of Dr A. G. Ponniah. The other Members were Dr Indrani Karunasagar, Dr K. P. Joy, Dr C. G. Joshi, Dr H. K. Vardia, Dr S. Raizada, ADG (I.Fy), ICAR; Dr J. K. Sundaray, Director (Acting), ICAR-CIFA and Dr K. D. Mahapatra, Member Secretary.

The major recommendations of the Committee (division-wise) are as follows:

Aquaculture Production and Envionrment

- Develop a project on reproductive physiology of murrels -with multidisciplinary team of scientists from CIFA and from other institutes - to address shortfalls in large-scale breeding and for further refinement of the technology. In view of the fund constraints, collaboration with other institutes would be without any financial commitment. Also to explore possibility of study visits of concerned scientists on murrels to Thailand/Vietnam where murrel breeding technology is advanced and farmers have adopted the technology.
- Information to be generated from exporters and other trade sources of native ornamental fishes to identify high value ornamental fish species and research to be restricted to these species. Work to be initiated on breeding, seed production and culture of *Channa barca.*
- CIFA should develop and implement a roadmap for reviving scampi farming in a cluster approach around existing hatcheries using the improved strain of freshwater prawn and other technical backstopping.

Fish Nutrition and Physiology

- More work need to be focused on feed development of high value fishes like murrel, magur, pabda and anabas. Focus should be on replacing live feed during late fry and feed for fingerling production.

Fish Health Management

- The assessment of economic loss due to different pathogens should be determined. The choice of using cutting edge science for intervention may be prioritized. In this context the work on vaccine development for Flavobacterium to be evaluated. The pathogens affecting to fishes as well as human should be documented to create awareness in the public.

Fish Genetics and Biotechnology

- More data to be generated on the impact of CIFABROOD in a scientific manner.
- The data on the variability of the selected traits of tilapia stocks to be evaluated to ensure that sufficient variability is still available and based on that evaluation, further actions may be taken to continue the selection programme.
- Quality seed awareness programme to be taken up in other geographical areas, specially Chhattisgarh and MP. A status and policy document to be prepared on Chhattisgarh on the pattern followed for Orissa.

Social Sciences

- Analyze the impact of before and after cluster development of magur culture in the Nalbari, Assam and to document the process so that this can be reproduced in other geographic areas

Metagenomics project

- Further refinement of the experimental methodology is required to ensure that the microbiome study would contribute to aquaculture applications. Hence, instead of field-based experiments, in which difference in growth due to probiotic could not be demonstrated, further evaluation of microbiome and metagenomics applications

may be done in laboratories where microbial interventions have an impact on growth.

RRC Rahara and Kalyani

- Risk due to human viruses from waste water aquaculture in West Bengal need to be undertaken and to complete the compilation on waste water aquaculture.

RRC Bengaluru

- Develop standard practices for hatchery operations using RAS and amelioration of local water quality problems . Work on RAS for hatchery could also be taken up in HQs

RRC Vijayawada

- Impact of vannamei culture in low-salinity environment to be submitted to AP government along with mitigation strategies.
- Assess economic damage of suckerfish on pond production in Andhra Pradesh and explore possibilities of alternative use of harvested sucker fish and development of better aquaculture practices for controlling the negative impact.

RRC Anand

- More emphasis on ornamental fish production in collaboration with the state government and scientists from headquarters.
- More emphasis on documenting vannamei culture in the southern Gujarat in the freshwater area and further improvement in its production

RRC Bathinda

- Conduct survey to document practice and technology gaps in Punjab
- Explore possibilities of fish culture in running water in canals

Institute Research Council

The Annual Institute Research Council meeting was held during 21-23 April, 2016 under the Chairmanship of Dr P. Jayasankar, Director, ICAR-CIFA. Fourteen institute-based projects were reviewed and new projects submitted for approval. The externally funded projects were also discussed.

The Mid-term IRC meeting was held on 16 November, 2016 under the Chairmanship of Dr P. Jayasankar, Director, ICAR-CIFA. The progress of all the Institute-based and externally funded projects were discussed.

Institute Management Committee

The 40th Institute Management Committee meeting was held on 22 February, 2017 under the Chairmanship of Dr J. K. Sundaray, Director (Acting), ICAR-CIFA. The other Members were Dr S. Raizada, ADG (I.Fy), ICAR; Dr S. Alavandi, Principal Scientist & HoD, ICAR-CIBA, Chennai; Dr Vindhya Mohindra, HoD, ICAR-NBFGR, Lucknow; Dr A. K. Barat, Principal Scientist, ICAR-DCWFR, Bhimtal; Sri N. V. R. N. Murty, F&AO and Sri K. C. Das, SAO, ICAR-CIFA as Member-Secretary. Agenda items included confirmation of proceedings of 39th Institute Management Committee; discussion on R&D highlights and a few research programs of the Institute; procurement of equipment during FY 2016-17 under Plan Budget; execution of works during FY 2016-17; execution of works (repair/renovation and maintenance under Head ICAR-CIFA-Non-Plan carried out during FY 2015-16 and to be carried out during FY 2016-17); execution of works at RRC of ICAR-CIFA, Rahara and Kalyani Field Station.

TRAINING AND CAPACITY BUILDING

Foreign Assignments

Sl. No.	Events/Training	Venue	Period	Participant(s)
1.	Expert C onsultant to Food and Agriculture Organisation (FAO), Khartoum, Sudan to provide Technical Consultancy Services in the field of 'Tilapia Broodstock and Seed Production (ITBS)	Khartoum, Sudan	15 August – 1 September, 2016	P. Routray
2.	Senior Programme Specialist (Fisheries)	SAARC Agriculture Centre, Dhaka, Bangladesh	Three years w.e.f. 5 May, 2016	S. S. Giri
3.	Bilateral research project India - Argentina inter -Governmental Programme of Cooperation in Science and Technology entitled "Cryopreservation of embryon ic stem cells and primordial germ cells for transplantation and surrogate fish production"	IIB-INTECH, University of San Martin, Argentina	25 February – 15 March, 2017	P. Routray

Training undergone by the staff members of the Institute

Scientific Category

Sl. No.	Event/Training	Venue	Period	Participants
1.	Interactive Co-learning Workshop-cum Training on Philosophy, M ethods and Ethics in Science	ICAR-CIFA	26-28 May, 2016	23 young scientists from Hqrs.
2.	Molecular Biology and Biotechnology for Fisheries Professionals (sponsored by DBT)	ICAR-CIFE, Mumbai	02 May-31 July, 2016	B. S. Ananda Kumar
3.	Hands-on Training on "NGS Techniques"	Genotypic technologies Pvt. Ltd. Bengaluru	11 June, 2016	Lakshman Sahoo
4.	Training on Carbon Sequestration and Green House Gas Measurement in IFS Models of AICRP on Integrated Farming System	ICAR-IIFSR, Modipuram, Meerut	2 August, 2016	S. Adhikari

Sl. No.	Event/Training	Venue	Period	Participants
5.	Bioinformatics in Next Generation Sequencing Data Analysi	ICAR-NBFGR, Lucknow	02- 11 August, 2016	Lakshman Sahoo
6.	Designing Breeding Plans and Genetic Analysis of Complex Traits	ICAR-CIFE, Mumbai	13-22 September, 2016	Avinash Rasal
7.	Biofloc Technology: Basic Concepts, Benefits and Application in Aquaculture	ICAR-CIBA, Chennai	15-17 September, 2016	Suhas Kamble
8.	One Week Public Training on Indian Patenting Procedure, Patent Search, Drafting and International Filing	Rajiv Gandhi National Institute of Intellectual Property Management, Nagpur	19-23 September, 2016	J. K. Sundaray
9.	Linear Mixed Models in Practice: An As-REML Oriented Approach	ICAR-CIFE, Mumbai	13-15 October, 2016	Bindu R. Pillai K. D. Mahapatra
10.	Training on Uploading of RTI Replies in the Respective RTI Website	ICAR-NAARM, Hyderabad	24-26 October, 2016	P. K. Meher
11.	Hindi as Official Language	Central Hindi Training Institute (Dept. of Official Language, Ministry of Home Affairs, Govt. of India), New Delhi	07-11 November, 2016	P.V. Rangacharyulu Ramesh Rathod
12.	Rapid Diagnostics for Fish Health Management	ICAR-CIFE, Mumbai	18 November-8 December, 2016	Anirban Paul
13.	Good Practices in Extension Research & Evaluation	ICAR-NAARM	29 November – 02 December, 2016	I. Sivaraman
14.	Preparation of Fisheries Projects	NFDB, Hyderabad	28 November - 2 December, 2016	Pushpa Choudhary Avinash Rasal
15.	Interaction Workshop on National Agriculture Innovation Fund	NASC Complex, New Delhi	23 December, 2016	N. K. Barik
16.	Hands on Advanced Instruments of Water Quality Monitoring and Testing	National Institute of Hydrology, Roorkee, India	16-20 January, 2017	Subhas Sarkar

Sl. No.	Event/Training	Venue	Period	Participants
17.	Application of Molecular Markers in Fish Breeding and NGS Data Analysis.	ICAR-CIFE, Mumbai	31 January - 9 February, 2017	Mukesh Kumar Bairwa Khuntia Murmu
18.	ICAR- Winter School on Current Trends in Molecular Diagnosis for Better Health Management in Aquaculture	ICAR-CIFA	15 February - 7 March, 2017	Pushpa Choudhary Mohan Badhe Uday Kumar Udit
19.	Genome Editing Technologies and their Applications in Biology, Medicine and Agriculture	KIIT, Bhubaneswar	18-25 February, 2017	Kiran D. Rasal
20.	Competency Enhancement Program for the Effective Implementation of Training Functions by HRD Nodal Officers of ICAR-Slot 4	ICAR-NAARM, Hyderabad	23-25 February, 2017	K.N.Mohanta
21.	DBT Sponsored Three Months Training Programme on 'Molecular Biology and Biotechnology for Fishery Professionals'	ICAR-CIFE, Mumbai	7 March - 6 June, 2017	Farhana Hoque
22.	ICAR Sponsored Short Course on 'Molecular Immunology of Fish and Shellfish'	ICAR-CIFE, Mumbai	15-24 March, 2017	Pushpa Choudhary
23.	Indian Patent Filing Procedure	ICAR-CIFA	24 March, 2017	Scientists from Hqrs.
24.	Training on Fish Farming	KVK, Dahod	24 March, 2017	Chaudhari Ajit Keshav

Technical Category

Sl. No.	Event/Training	Venue	Duration	Participants
1.	Training-cum-Workshop on Hindi as Official Language conducted by Dept. of Official Language	Central Hindi Training Institute, Government of India, MOH Affairs, New Delhi	04-05 April, 2016	U.L.Mohanty N. Panda Sukanti Behera
2.	Training Programme on "Public-Private Partnership in Extension Reforms, sponsored by MANAGE, Hyderabad	KVK, Khordha	13-16 September, 2016	N. Panda
3.	Training-cum-Workshop on Hindi as Official Language conducted by Dept. of Official Language	Central Hindi Training Institute, Government of India, MOH Affairs, New Delhi	07-11 November, 2016	D. Tarai Rabindra Das

Sl. No.	Event/Training	Venue	Duration	Participants
4.	Training-cum-Workshop on Hindi as Official Language conducted by Dept. of Official Language	Central Hindi Training Institute, Government of India, MOH Affairs, New Delhi	21-25 November, 2016	D.P.Rath S.K.Mohanty S.K.Nayak
5.	Hands-on Training on Advanced Instruments of Water Quality Monitoring and Testing	National Institute of Hydrology, Roorkee	16-20 January, 2017	Bibhudatta Mishra
6.	Technology Management and Business Planning for Entrepreneurship Development	Southern Regional Station (SRS) NDRI, Bangalore	13-18 March, 2017	Raghavendra, C.H.
7.	Indian Patent Filing Procedure	ICAR-CIFA, Bhubaneswar	24 March, 2017	Technical staffs from Hqrs.

Administrative Category

Sl. No.	Event/Training	Venue	Duration	Participants
1.	Hindi Training	Central Hindi Training Institute, Government of India, MOH Affairs, New Delhi	04-05 April, 2016	S. Soren
2.	Hindi Training	Central Hindi Training Institute, Government of India, MOH Affairs, New Delhi	09-13 May, 2016	I. Muduli
3.	Hindi Training	Central Hindi Training Institute, Government of India, MOH Affairs, New Delhi	05-09 September, 2016	Loknath Senapati Prakash Chandra Parida
4.	Hindi Training	Central Hindi Training Institute, Government of India, MOH Affairs, New Delhi	07-11 November, 2016	Tapas Kumar Mishra
5.	Hindi Training	Central Hindi Training Institute, Government of India, MOH Affairs, New Delhi	21-25 November, 2016	J.N. Jena
6.	NIC's e-Procurement Solution Through CRP Portal	ICAR-IASRI, New Delhi	22-23 February, 2017	Tapas Kumar Mishra
7.	NIC's e-Procurement Solution Through CRP Portal	ICAR-IASRI, New Delhi	22-23 February, 2017	J. N. Jena
8.	Indian Patent Filing Procedure	ICAR-CIFA, Bhubaneswar	24 March, 2017	Administrative staffs from Hqrs.
9.	Training on Pension and Retirement Benefits	ISTM, New Delhi	4-7 April, 2017	Tapas Kumar Mishra
10.	Enhancing efficiency and behavioral skills	NAARM, Hyderabad	28 July - 3 August, 2017	Manjula

Skilled Support Staff Category

Sl. No.	Event/Training	Venue	Duration	Participants
1.	Soft Skill & Personal Effectiveness	IMAGE, Siripur, Bhubaneswar	02-03 February, 2017	Dushmanta Sahoo , Kedar Jally Maharaga Majhi, Debahari Behera Damodar Ghadei, Gayadhar Behera Baikuntha Nayak, Pitambar Swain Prahallada Swain, Bhikari Charan Bhoi Murali Bhoi, Sudam Behera Nabaghana Ghadei, Kapilash Barik Sarat Barik, Manoj Jena Purna Bhoi
2.	Training-cum-Exposure Visit to Nayahati, Kalyanai and Rahara	RRC-CIFA, Kalyanai	20-25 March, 2017	Ullash Bhoi, Jagannath Ojha B. B. Pradhan, Gundicha Prusty Baja Muduli, Premananda Bisoi Aruna Muduli, Prasana Behera Mahendra Behera, Purna Bhoi Jagannath Ghadei, Tanaya Barik Budhia Behera, Sudam Behera
3.	Training on "Soft Skill & Personal Effectiveness"	SMILE, Laxmi Sagar, Bhubaneswar	27-29 March, 2017	Ramesh Ghadei, Rama Mallick Gopal Mahapatra, Jayakrushna Pallai B. K. Deo, Lokanath Swain Ch. M. Rao, Bhagban Swain Pravat K. Mohapatra, Jagannath Ghade Kalandi Ch. Biswal, Sarat Ch. Barik

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

Events	Venue	Duration	Participant(s)
Seminar on Aquaculture Legislation as a part of Indo-Norwegian Cooperation in the Field of Fisheries and Aquaculture (organized by Fisheries Development Commission, Govt. of India)	New Delhi	8 April, 2016	P. Jayasankar
Workshop on Promotion of Murrel Culture in Telangana State	Prakasham Krishi Vigyan Kendra, Karimnagar, Telangana	11 April, 2016	Rajesh Kumar
Preliminary Meeting with Representatives of State Govt. and other ICAR Research Institute for NFDB Outreach Projects	NFDB, Hyderabad	11-12 April, 2016	P. Jayasankar
Punjab Fish Festival-2016	GADVASU/Punjab Agricultural University, Ludhiana	24-25 April, 2016	Rajesh Kumar
Interface Meeting on Quality Control of Fish Seed	RRC of ICAR-CIFA, Kalyani, West Bengal	26-27 April, 2016	B.R. Pillai
Interface Meeting on Quality Control of Fish Seed with Department of Fisheries, Govt. of West Bengal, ICAR-CIFA and Hatchery Owners	Kalyani F.S.	27 April, 2016	P.P. Chakrabarti R. N. Mandal A. Das A. Hussan
3rd PAF Congress on Social Entrepreneurship in Aquaculture	ICAR-CIFE, Mumbai	27-29 April, 2016	Sunil Kumar Ail
Meeting on Second Green Revolution	ICAR Research Complex for Eastern Region, Patna	3 May, 2016	P. Jayasankar
Brainstorming Session on "Physio-nutritional Approaches Enhancing Production in Dairy Animals"	ERS, NDRI, Kalyani	9 May, 2016	B. N. Paul P. P. Chakrabarti
62nd Foundation Day & Stakeholder Meeting	Research Centre, ICAR-IISWC, Vasad	10 May, 2016	C. K. Misra Chaudhari Ajit Keshav

Events	Venue	Duration	Participant(s)
DBT Project Meeting	ICAR, New Delhi	17 May, 2016	P. Jayasankar
Workshop-cum-Training on "Intensive Pond Aquaculture Technology (IPAT)	Visakhapatnam (AP)	17-18 May, 2016	Ramesh Rathod
Meeting convened by the Secretary, DARE and DG, ICAR with the Senior Officers of the Agriculture Department of the Eastern States and Stakeholders in ICAR and SAUs regarding Preparation of Road map for the Development of Eastern States	ICAR, New Delhi	18 May, 2016	P. Jayasankar
Valedictory Program for the Diploma in Agricultural Extension Services for Input Dealers	IDEA, AAU, Anand	2 June, 2016	C. K. Misra
9th Meeting of Scientific Panel on Fish and Fisheries Products	FSSAI, New Delhi	6 June, 2016	P. Jayasankar
Assessment Committee Meeting of Five Scientists	IBSD, Imphal	07 June, 2016	P. K. Sahoo
Interactive Meeting of all Directors of Fisheries Institutes	ICAR, New Delhi	9 June, 2016	P. Jayasankar P. K. Sahoo
Interface Meeting between DAHD&F and ICAR	ICAR, New Delhi	10 June, 2016	P. Jayasankar
First Meeting on Cage Culture Guidelines	NAARM, Hyderabad	14 June, 2016	P. Jayasankar
Meeting with Secretary, DARE and DG, ICAR	RRC, Rahara and Field Station, Kalyani	16 June, 2016	P. Jayasankar
47th IMC Meeting of ICAR-CIBA.	ICAR-CIBA, Chennai	18 June, 2016	B.R. Pillai
Brainstorming Meet on 'Application of Metagenomics and Microbiomes to Augment Fish Production and Productivity'	ICAR-CIFA, Bhubaneswar	21 June, 2016	All scientists of CIFA Hqrs.
XXIII ICAR Regional Committee Meeting-II (RCM-II)	NAARM, Hyderabad	24-25 June, 2016	P. Jayasankar P. P. Chakrabarti B. S. Giri
Review meeting of Farmer First Project	New Delhi	28 June, 2016	H. K. De
Meeting for handing over and taking over of land, etc to open the RRC of ICAR-CIFA in the state of Punjab in Bathinda	Bathinda, Punjab	4-5 July, 2016	P. Jayasankar K. C. Das (SAO)

Events	Venue	Duration	Participant(s)
Interaction Meeting-cum Demonstration on Nanotechnology in Fish Feed	ICAR research Complex, Barapani, (Meghalaya) and College of Fisheries, Raha, Assam	4-7 July, 2016	K. C. Das
2nd Meeting of the Aquaculture Subcommittee, FAD 12:1 under FAD 12 of BIS	Manak Bhavan, New Delhi	14-16 July, 2016	K. N. Mohanta
Workshop on Culture of Lesser Known Species with Commercial Importance of N.E India (organized by NFDB, Hyderabad in association with Department of Fisheries, Govt. of Assam)	Guwahati, Assam	16 July, 2016	Rajesh Kumar
11th Meeting of Programme Advisory Committee (PAC) on Animal Sciences	Thevara, Kochi	20-22 July, 2016	P. Jayasankar
Viva-voce for the admission of Ph.D. candidates as the Chairman of the Exam Committee	ICAR-CIFE, Mumbai	25 July, 2016	P. Jayasankar
Review Meeting of the NASF, ICAR Funded Hilsha Project chaired by Shri Radha Mohan Singh, Union Minister of Agriculture and Farmers Welfare in presence DDG (Fy), ICAR	Krishi Bhawan, New Delhi	25 July, 2016	D. N. Chattopadhyay
Writeshop on BMP for Ornamental Fish Production	NFDB, Hyderabad	25-27 July, 2016	K. N. Mohanta
Awareness Workshop on Guidelines for Access to Biological Resources under the Biological Diversity Act, 2002 (Sponsored by DBT & National Biodiveristy Board, New Delhi)	Univeristy of Agricultural Sciences,GKVK, Bangalore	28 July, 2016	N. Sridhar M. R. Raghunath B. Gangadhar
Meeting with Principal Secretary (ARD), Govt of Maharashtra	Mantralay, Mumbai	29 July, 2016	C. K. Misra
NFDB Meeting to Prepare a Draft Document on Interim Guidelines for Sustainable Cage Culture in India	ICAR-CIFRI, Barrackpore	30 July, 2016	D. Panda
Awareness Meeting on Successful Demonstration of CIFA Technologies	Thanjavur	4 August, 2016	P. Jayasankar

Events	Venue	Duration	Participant(s)
Workshop on National Operating Standard (NOS) for Skill Development in Fisheries	NFDB, Hyderabad	4-5 August, 2016	K. N. Mohanta
Visit and Interaction with Successful Farmers	Thanjavur	5 August, 2016	P. Jayasankar
Workshop on Whole Genome Sequencing and Development of Allied Genomic Resources in two Commercially Important fish- *Labeo rohita* and *Clarias batrachus*	ICAR-NBFGR, Lucknow	10 August, 2016	Lakshman Sahoo
Fish farmers interaction Meet	Mursidabad, W.B.	19-20 August, 2016	P. Jayasankar
Expert Member in the Selection Committee Meeting for Promotions of Assistant Professors under CAS	Tirupati Sri Venkateshwara Veterinary University, Tirupati	22 August, 2016	B. R. Pillai
6th Advisory Committee Meeting	CIFRI, Barrackpore	30-31 August, 2016	D. N. Chattopadhyay R. N. Mandal A. Das
Interaction Meet on "ICAR-CIFA Technologies for Jharkhand Tribal Farmers"	Ranchi, Jharkhand	1 September, 2016	P. Jayasankar D. K. Verma
58th National Symposium 2016 of CLFMA, India	Kolkata	2-3 September, 2016	B. N. Paul
Minimizing Water Use in Agriculture	ICAR-IIWM, Bhubaneswar	3 September, 2016	S. Ferosekhan
23rd Zonal Workshop of KVKs under Zone-VII held at ICAR-CIFA, Bhubaneswar	ICAR-CIFA	3-5 September, 2016	Pankaj A. Patil
XXIV Meeting of ICAR-Regional Committee (VI) organized by ICAR-CAZRI, Jodhpur	ICAR-CAZRI, Jodhpur	13-14 September, 2016	C. K. Misra
Workshop on Freshwater Pearl Culture (organized by Kamdhenu University, Gandhinagar)	Kamdhenu University, Gandhinagar, Gujarat	14 September, 2016	Shailesh Saurabh Chaudhari Ajit Keshav
Workshop-cum-Training on Biofloc Technology: Concept, Benefits and Application in Aquaculture	CIBA, Chennai	15-17 September, 2016	Suhas P. Kamble
Conference on Coastal and Marine Biodiversity of India: Prospects, Threats and Conservation Strategies (CMBI-2016)	Dept. of Marine Biology, Vikrama Simhapuri Univeristy, Nellore	16-17 September, 2016	Ramesh Rathod

Events	Venue	Duration	Participant(s)
11th Scientific Advisory Committee (SAC) Meeting	KVK, Arnej, Dist. Ahmedabad	20 September, 2016	Chaudhari Ajit Keshav
Jharkhand Fish Festival	Ranchi	20-24 September, 2016	H. K. De
Zonal Agricultural Research and Extension Council Meeting (Rabi Season)	AAU, Anand	26 September, 2016	C. K. Misra Sunil Kumar Ail
National Seminar on "Possibilities of Selection of Alternate Breeds of Fishes for Fish Farming"	Dept. of Fisheries, Govt. of Bihar at BAMETI, Patna	27 September, 2016	D. Panda
State Level Farmers' Meet (organized by NABARD on Doubling of Farmers Income by 2022' and gave a talk on 'Importance of Aquaculture for Doubling Income of Farmers')	KIIT school of Rural Management, Bhubaneswar	28 September, 2016	B.R. Pillai
Write-shop on Package of Practices for Freshwater Fishes	NFDB, Hyderabad	28-29 September, 2016	Rajesh Kumar S. Ferosekhan Suhas P. Kamble
Financial and Technical Review Meeting of NICRA	ICAR-CRIDA, Hyderabad	30 September-02 October, 2016	S. Adhikari
International Workshop on 'Linear Mixed Models in Practice: An As-REML-Oriented Approach'	ICAR-CIFE, Mumbai	13-15 October, 2016	B. R. Pillai K. D. Mohapatra
International Conference on Food, Water, Energy Nexus in arena of Climate Change	AAU, Anand	14-16 October, 2016	C. K. Misra
ICAR-CIFA & SIFT, Department of Fisheries, Govt. of A.P, Farmers - State Officials-Scientists Interaction workshop on "Major Health Management Issues in Fish and Shellfish Farming" under National Surveillance Programme for Aquatic Animal Diseases	SIFT, Kakinada	26 October, 2016	P. K. Sahoo
10th Meeting of FADIZ	BIS, New Delhi	26 October, 2016	K. N. Mohanta
XXVth Meeting of the Regional Committee No.VIII	SBI, Coimbatore	8-9 November, 2016	N. Sridhar
Global Rajasthan Agritech Meet	Jaipur, Rajasthan	9-11 November, 2016	Mukesh P Bendarkar
1st International Agrobiodiversity Congress (IAC)	ICAR, New Delhi	05-10 November, 2016	S. Ferosekhan
International Workshop on National Action Plan on Antimicrobial Resistance for Developing Countries	CSE, New Delhi	10-11 November, 2016	P. Swain

Events	Venue	Duration	Participant(s)
Blue Revolution Mission Programme of Assam	Biswanath Chariali, Assam	12 November, 2016	B. C. Mohapatra
Prophylaxis in Aquaculture	CIBA Chennai	16 November, 2016	J. Mohanty
Workshop on Mainstreaming Climate Change and Adaptation in Agriculture and Allied Sectors	MANAGE, Hyderabad	16-17 November, 2016	Ramesh Rathod
Orientation Workshop of Farmer First Project	Raipur	17-19 November, 2016	H. K. De
Intensive Hindi Workshop (No. 444)	Central Hindi Training Institute, New Delhi	21 - 25 November, 2016	S. K. Mohanty
Preparation of the Fisheries Projects	NIPHM, Hyderabad	28 Nov.-2 Dec., 2016	Avinash Rasal
9th National Livestock Championship	Muktsar Sahib	2-3 December, 2016	N. K. Chandan
Half Yearly review meeting of AINPFH	CIBA, Chennai	5-7 December, 2016	Rakesh Das
5 Annual Review Workshop of NICRA	NASC, New Delhi	9-10 December, 2016	S. Adhikari
Expert Consultation on 'Prospects of Sustainable pacu, *Piaractus brachypomus* Culture in India'	NBFGR, Lucknow	10-11 December, 2016	P. P. Chakrabarti
Annual Workshop of AICRP on PET	Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan	15-16 December, 2016	B. C. Mohapatra
Fish and Prawn Culture Business (under WTO cell)	B.A. College of Agriculture, Anand	22 December, 2016	C. K. Misra
Expert Member, FAO-ICAR Joint collaborative Meeting of National Action Plan for Antimicrobial Resistance	NASC, New Delhi	27 December, 2016	P. Swain
District Krushi Mahostav 2017	Sambalpur	05 January, 2017	P. K. Sahoo
Scope of Freshwater Aquaculture in the state of Gujarat	Khambat	07 January, 2017	C. K. Misra
Sensitization Programme on National Surveillance for Tripura State	College of Fisheries, Agartala	09 January, 2017	P. K. Sahoo
Institute Management Committee Meeting of ICAR-ATARI	Kolkata	13 January, 2017	H. K. De

Events	Venue	Duration	Participant(s)
Workshop on M.Sc (Life Sciences) Syllabus	Regional Institute of Education, (NCERT) Bhubaneswar	9-13 January, 2017	S. C. Rath
Meeting in connection with visit of Secretary, DARE & DG, ICAR and DDG (Fy. Sc), ICAR	RRC, Bengaluru	15 January, 2017	J. K. Sundaray
Visit to RRC, Rahara and Field Station, Kalyani	RRC, Rahara and Field Station, Kalyani	16 January, 2017	J. K. Sundaray
Indian Horticulture Society, Salt Lake	Bidhan nagar, Kolkat a	18 January, 2017	P. P. Chakrabarti
Second Workshop of Nodal Officers of KRISHI: Knowledge Based Resources Information Systems Hub for Innovations in Agriculture (ICAR Research Data Repository for Knowledge Management) organised by ICAR-IASRI, New Delhi	NASC Complex, New Delhi	24-25 January, 2017	N. Panda
48th IMC Meeting of ICAR-CIBA	ICAR-CIBA, Chennai	28 January, 2017	B. R. Pillai
Convocation of Kamdhenu University	Gandhinagar, Gujarat	1 February, 2017	C. K. Misra
FICCI Workshop on Millennium Alliance	Hotel Excellency, Bhubaneswar	3 February, 2017	B. R. Pillai
EFC meeting	ICAR, New Delhi	6-7 February, 2017	J. K. Sundaray P. K. Sahoo
Zonal Agricultural Research and Extension Council Meeting (Kharif Season)	AAU, Anand	7 February, 2017	C. K. Misra Chaudhari Ajit Keshav
Seminar on Profit on Aquaculture - 2017	Vishnu educational Institutions, Bishnupur, Bhimavaram, AP	10-12 February, 2017	S. K. Sahoo Rajesh Kumar
International Conference on Profit on Aquaculture	Bhimavaram, Andhra Pradesh	11-14 February, 2017	Rajesh Kumar
ICAR Directors and VC Conference	ICAR, New Delhi	14-15 February, 2017	J. K. Sundaray
Roadmap of Aquaculture Development for Bihar	Fishery Secretariat, Patna	16 February, 2017	P. P. Chakrabarti
Symposium on Climate Change Impact and Adaptation: Current Scenario in Indian Fisheries & Aquaculture (CCIFA-2017)	Centre for Ocean Research, Satyabhama University, Chennai	16-17 February, 2017	S. Adhikari

Events	Venue	Duration	Participant(s)
International Symposium on Genome Editing Technologies and their Applications in Biology, Medicine and Agriculture	KIIT, Bhubaneswar	16-18 February, 2017	Kiran D. Rasal
Meeting at Department of Animal Husbandry Dairying and Fisheries	ICAR, New Delhi	17 February, 2017	J. K. Sundaray
Foundation Day of CIWA: Scientist's-Farm Women Interface	ICAR-CIWA, Bhubaneswar	17 February, 2017	P. C. Das
13th Meeting of Agricultural Research Council for the subcommittee of Animal Production and Fisheries Sub-committee	AAU, Anand, Gujarat	17-18 February, 2017	C. K. Misra Ajit Keshav Chaudhari
Meeting on Waste to Profit through Reduce Recycle and Reuse during National Productivity Week	ICAR-CIWA, Bhubaneswar	18 February, 2017	B. B. Sahoo
Genome Editing Technologies and their Applications in Biology, Medicine and Agriculture	KIIT Bhubaneswar	18-25 February, 2017	Kiran D. Rasal
XIII Agricultural Science Congress-2017	UAS, GKVK, Bengaluru	21-24 February, 2017	N. Sridhar Gangadhar Barlaya P. K. Sahoo
Rural Advisory Committee Meeting	DDK, Bhubaneswar	22 February, 2017	S. C. Rath P. N. Ananth
Annual Review Workshop of the NASF Project (BS-4003)	NASC Complex, Pusa, New Delhi	23 February, 2017	M. Samanta
3rd Annual Review Meeting of the NASF, ICAR for the Hilsa Project	NASC Complex, New Delhi	23 February, 2017	D. N. Chattopadhyay
Competency Enhancement Program for Effective Implementation of Training Functions by HRD Nodal Officers of ICAR	NAARM, Hyderabad	23-25 February, 2017	K. N. Mohanta
Meeting of the Board of Directors of APICOL	APICOL Office, Baramunda, Bhubaneswar	25 February, 2017	B. R. Pillai
Awareness Workshop on Importance of Quality Seed in Aquaculture and Performance of 'Jayanti' in Low Saline Water	Madanganga, Namkhana, West Bengal	27 February, 2017	J. K. Sundaray P.P. Chakrabarti S. Adhikari R. N. Mandal A. Hussan F. Hoque

Events	Venue	Duration	Participant(s)
Seminar on Financial Self-sufficiency: Role of the Scientist and Research Institution (in Hindi) (organized at Institute of Physics in collaboration with ICAR –CIFA)	Institute of Physics, Bhubaneswar	27 February, 2017	P.K.Meher Uday Kumar Udit V. Ganesh Kumar
Technical Guidance/Consultancy to College of Fisheries, GADVASU	College of Fisheries, GADVASU, Ludhiana, Punjab	27-28 February, 2017	Rajesh Kumar
Farmers Day	Research Centre, ICAR-IISWC, Vasad	28 February, 2017	C. K. Misra
Seminar on Environmental Sustainability & Industrial Growth	Gangadhar Meher University, Sambalpur	3-4 March, 2017	N. Panda
13th Convocation, 2nd Student Convention & ICAR-CIFE Industry Meet	ICAR-CIFE, Mumbai	3-5 March, 2017	Chaudhari Ajit Keshav
Industry meet	ICAR-CIFE, Mumbai	4 March, 2017	J. K. Sundaray
Symposium on Quantitative Proteomics"(NSWQP2017)	ILS, Bhubaneswar	6-10 March, 2017	Mohan Badhe J. Mohanty
FAO-ICAR Meeting on Establishment of a National Network of Veterinary Laboratories for AMR	Kolkata	7-8 March, 2017	P. Swa in
Priorities of Fisheries and Aquaculture	College of Fisheries, Rangeilunda, Odisha	11-12 March, 2017	J.K. Sundaray K. N. Mohanta K. D. Mahapatra S. K. Swain P. C. Das D. Panda B. Mishra Sweta Pradhan I. Sivaraman
Review Meeting for the Progress of Fisheries Development Project/ Proposals (DAHDF)	ICAR, New Delhi	15 March, 2017	J. K. Sundaray
Institute Management Committee Meeting	NIBSM, Raiput	15 March, 2017	K. N. Mohanta
Visit to Office of the Secretary, Fisheries Department, Govt of Rajasthan	Dept. of Fisheries, Govt of Rajasthan	15-18 March, 2017	C. K. Mishra S. Saurabh M. K. Bairwa G. M. Siddaiah
Meeting with Secretary, Department of Fisheries, Govt of Rajasthan	Jaipur, Rajasthan	16 March, 2017	C. K. Misra

Events	Venue	Duration	Participant(s)
Third Research Council Meeting	Fisheries College and Research Institute, Ponneri, Tamil Nadu	17 March, 2017	J. K. Sundaray
Annual Review Meeting of Farmer First Project	ICAR-NAARM, Hyderabad	17-18 March, 2017	I. Sivaraman
Regional Seminar and Farmers' Interaction on "Coastal Ecosystem of India: Recent Developments and Future Strategies"	ICAR-National Institute of Jute and Allied Fiber Technology, Kolkata	18 March, 2017	P. P. Chakrabarti
Visit to RRC, Rahara	RRC of ICAR-CIFA, Rahara	18 March, 2017	J. K. Sundaray
Seminar & Farmers Interaction	ICAR-CSSRI, Canning, West Bengal	18 March, 2017	P.P. Chakrabarti
DD Kisan Programme (Hello Kisan) a Live Programme on *Moti Ki Kheti*	DD Kisan, New Delhi	23 March, 2017	Shailesh Saurabh
21st Meeting of the 'National Committee on Introduction of Exotic Species in Indian Waters'	ICAR, New Delhi	24 March, 2017	B. R. Pillai
FAO-ICAR Meeting to Identify Research Priorities in Veterinary Sector for AMR	Kochi	27-28 March, 2017	S. S. Mishra P. Swain

EXHIBITIONS

The Institute participated in the following exhibitions during 2016-17.

S.No.	Exhibition	Venue	Period
1.	70th Foundation Day and Dhan Diwas of NRRI, Cuttack	NRRI, Cuttack, Odisha	23 April, 2016
2.	Congress on Social Entrepreneurship in Aquaculture	CIFE, Mumbai	27-29 April, 2016
3.	Akshaya Tritiya Celebration and Farmers Fair	NRRI, Cuttack, Odisha	9 May, 2016
4.	6th Krishi Fair-2015 (organised by Shree Shrikshetra Soochana, Puri)	Sardhabali, near Sri Gundicha Temple, Puri	4-8 June, 2016
5.	Farmers' Conclave on Sustainable Agriculture	Banapur, Nayagarh, Odisha	8 June, 2016
6.	Inter State Horti Fair "Sangam-2016"	Hajipur, Bihar	9-10 July, 2016
7.	20th National Agriculture Exhibition	Surer Math, Dum Dum, Kolkota-74	10-14 August, 2016
8.	Zonal Workshop of KVKs under Zone-VII (Odisha, CG, MP)	CIFA, Bhubaneswar	3-5 September, 2016
9.	Jharkhand Matsya Mahotsav-2016	Vidhan Sabha Maidan, Ranchi	22-23 September, 2016
10.	Global Rajasthan Agritech Meet (GRAM)	Jaipur, Rajasthan	9-11 November, 2016
11.	63rd All India Cooperative Week organized by FISFCOPFED with Govt. of Odisha & NFDB	Bhubaneswar	15 November, 2016
12.	Exhibition during the Seminar on "Aquaculture Diversification: The Way Forward for Blue Revolution (NaSAD-2016)"	CIFA, Bhubaneswar	1-3 December, 2016
13.	Jai Kisan Jai Vigyan Week (23-29 December 2016)	CIFA, Bhubaneswar	29 December, 2016
14.	Youth and Farmer Festival	Ramakrishna Ashram, Bhandaripokhari, Bhadrak	19-21 January, 2017
15.	Krishi Samridhi Rasthtriya Krishi Mela	Raipur, Chhattisgarh	27-31 January, 2017

S.No.	Exhibition	Venue	Period
16.	'Foundation Day' celebration by ICAR-CIWA	ICAR-CIWA, Jokalandi, Barmunda, Bhubaneswar	17 February, 2017
17.	Gramodaya Mela	Chitrakoot, Madhya Pradesh	24-27 February, 2017
18.	Exhibition during Second National Students Convention on Innovative Approaches for Academic Excellence in Higher Fisheries Education	ICAR-CIFE, Mumbai	3-5 March, 2017
19.	Bharatiya Kisan Sangh Establishment Day	Raha, Nagaon, Assam	4-5 March, 2017
20.	Exhibition dring National Seminar on "Priorities in Fisheries and Aquaculture"	College of Fisheries, Rangeilunda, Odisha	11-12 March, 2017
21.	Krishi Unnati Mela-2017	ICAR-IARI, New Delhi	15-17 March, 2017

BUDGET

A. Provision from the ICAR (2016-2017)

(Rs. in lakhs)

Sl.No.	Sub-head	Non-Plan						Plan	
		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)	Allocation	Exp.
1	2	3	4	5	6	7	8	9	10
1.	Capital Exp.								
a)	Land								
b)	Building							105.00	105.00
c)	Equipments	2.00		2.00	1.81		1.81	60.00	59.97
d)	Furniture/Fixture							10.00	10.00
e)	Info. Tech.							10.00	9.99
f)	Vehicle/Vessels								
g)	Library Books							10.00	10.00
2.	Revenue Exp.			1917.75	1891.29	15.00	1906.29		
a)	Estt. Charges	1902.75	15.00						
b)	Wages	68.15		68.15	67.54		67.54		
c)	OTA	0.40		0.40	0.26		0.26		
d)	Pension & Other Retirement benefits	155.58		155.58	155.37		155.37		
3.	Loans & Adva.	15.00		15.00	3.90		3.90		
4.	TA	10.00		10.00	9.94		9.94	30.00	30.00
5.	Other Charges								
a)	Res. Expenses	50.00		50.00	22.29		22.29		
b)	Operational Expenses	193.00		193.00	220.71		220.71	208.00	208.00
c)	Admn. Expenses	138.00		138.00	137.98		137.98	142.00	141.99
d)	Misc. Expenses	1.12		1.12	4.01		4.01		
6.	HRD							20.00	20.00
7.	NEH							80.00	80.00
8.	TSP							10.50	10.49
	TOTAL	2539.00	15.00	2554.00	2511.19	15.00	2530.09	685.50	685.44

DISTINGUISHED VISITORS

Kausalyaganga, Bhubaneswar

- Dr Trilochan Mohapatra, Secretary, DARE and DG, ICAR, New Delhi visited the Institute on 24 April, 2016. Other dignitaries who accompanied him were Dr A.K. Singh, DDG (Ag. Extn.); Dr Anupam Mishra, Director, ATARI; Dr A.K. Nayak, Director (Acting), NRRI; Dr J. Khishtwaria, Director, CIWA; Dr H S Singh, Head, CHES (IIHR) and Dr Archana Mukherjee, Head, RRC, CTCRI, Bhubaneswar. He interacted with the Director and Scientists of the Institute in a meeting organized on the occasion. He emphasized on transfer of promising aquaculture technologies through Krishi Vigyan Kendra, Khordha and to produce scientific communications of international standards. He suggested initiation of more work on classical breeding of few commercially viable aquaculture species and to work more on improved variety rohu. A collaborative project between ICAR-NRRI and ICAR-CIFA for integrated farming system with a particular reference to paddy-cum-fish culture could also be explored.
- Shri Debi Prasad Mishra, Hon'ble Minister, Industries, School and Mass Education, Govt. of Odisha inaugurated the 3rd National Training Programme on "Portable FRP Carp Hatchery Installation and Operation" on 15 July, 2016 at the Institute.
- Shri Dharmendra Pradhan, Hon'ble Minister for Petroleum and Natural Gas, Govt. of India, New Delhi was the Chief Guest during the 23rd Zonal Workshop of KVKs of Zone-VII organized during 3-5 September, 2016 at the Institute.
- Dr Prasanna Kumar Patasani, Hon'ble MP, Bhubaneswar was the Chief Guest at the valedictory function held to conclude the *Swachh Bharat Pakawada* on 31 October, 2016.
- Smt. J. Mercykutty Amma, Hon'ble Minister for Fisheries, Harbour Engineering and Cashew Industry, Govt. of Kerala visited the Institute on 30 November, 2016. She visited the farm facilities and held an interactive meeting with the Director and Heads of Divisions and other scientists.
- Dr (Mrs.) Jatinder Kishtwaria, Director, ICAR-Central Institute for Women in Agriculture, Bhubaneswar visited the institute on 23 December, 2016.
- Dr S. K. Rout, Ex-Dean, Extension Education, OUAT and Dr. S. R. Das, Honorary Professor of OUAT visited the Institute on 29 December, 2016 on the occasion of Jai Kisan Jai Vigyan valedictory function.
- Dr J. K. Jena, DDG (Fy), ICAR visited the Institute on 27 January, 2017 and held an interactive meeting with staff. He also visited the farm facilities and laboratories, and inaugurated the Central Instrumentation Facility at the Institute.
- Dr K. Samantaray, Former Principal, College of Fisheries, Rangeilunda and Prof. Dr Swati Mishra, Dept. of Biotechnology, MITS on International Day of Women and Girls in Science (13 February, 2017)
- Dr B. B. Mallick, Former Vice Chancellor, WBUAFS, Kolkata and Dr S. C. Mukherjee, Former Joint Director, ICAR-CIFE, Mumbai for Winter School on Current trends in molecular diagnostics for better health management in aquaculture (15 February, 2017)
- Dr A. G. Ponniah, Chairman, RAC; Dr I. Karunasagar, Dr K. P. Joy, Dr C. G. Joshi, Dr H. K. Vardia, Dr S. Raizada, ADG (I.Fy), ICAR, Members, RAC for the RAC meeting (20-21 February, 2017)
- Dr S. Alavandi, HoD, ICAR-CIBA, Chennai; Dr Vindhya Mohindra, HoD, ICAR-NBFGR, Lucknow; Dr A. K. Barat, Principal Scientist,

ICAR-DCWR, Bhimtal; Sri S. K. Das, F&AO, ICAR-NRRI, Cuttack for 40th IMC meeting (22 February, 2017)

- Sri Devendra Chaudhary, IAS, Secretary, Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture & Farmers Welfare, GoI visited ICAR-CIFA, Bhubaneswar. He visited the farm facilities and held an interactive meeting with the Director, Heads of Divisions, other senior Officers of the Institute and few Progressive Farmers along with Officials of Department Fisheries, Govt. of Odisha (28 February, 2017).

Regional Research Centre of CIFA, Anand

- Dr. Trilochan Mohapatra, Secretary, DARE and Director General, ICAR, New Delhi visited RRC of ICAR-CIFA, Anand, Gujarat on 3 September, 2016. He was accompanied by Dr. T. Janakiram, ADG (Horticultural Science), ICAR; Dr. Jitendra Kumar (Director, ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand) and Dr. Radhakrishnan, T (Director,

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

- Dr T. Mohapatra, Secretary, DARE and DG, ICAR and Dr J.K. Jena, DDG (Fy), ICAR visited the Regional Research Centre of CIFA-Rahara and Kalyani on 16 June, 2016. A Tribal Fish Farmers Mela and an exhibition was organized on the occasion and a publication entitled "Dissemination of Freshwater Aquaculture Technologies in Bali-Island, Sunderbans, West Bengal: A Success Story" was released.
- The members of Advisory Committee along with Scientists from CIFRI, CIBA, CIFE and Viswabharati University visited Kalyani Field Station of CIFA on 31 August, 2016 and artificial feeding to hilsa fingerling was demonstrated in two grow-out ponds.
- Shri Surendrajeet Singh Ahluwalia, Hon'ble Union Minister of State for Agriculture and Farmers' Welfare and Parliamentary Affairs, Govt. of India; Shri Parimal Suklabaidya, Minister of Fisheries, PWD & Excise, Govt. of Assam; Shri Jayanta Naskar, MLA, Gosaba, Sunderban and Shri Dinesh Dattatraya Kulkarni, Organising Secretary, Bharatiya Kisan Sangha visited Kalyani Field Station of ICAR-CIFA on 26 November, 2016.

Regional Research Centre of CIFA, Bangalore

- Dr. T. Mohapatra, Secretary DARE and Director General, ICAR along with Dr. J. K. Jena, DDG (Fy), ICAR and Dr. B. K. Das, Director, ICAR-CIFRI visited the Regional Research Centers of ICAR-CIFA, Bangalore (15 January, 2017). The dignitaries interacted with the Scientists and appreciated the work being done and offered critical inputs and insights. Dr J. K. Sundaray, Director (Acting), ICAR-CIFA was also present on the occasion.

PUBLICATIONS

Research papers

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Chakrapani, V., S.K. Patra, S.D. Mohapatra, K.D. Rasal, U. Deshpande, S. Nayak, J.K. Sundaray, P. Jayasankar and H.K. Barman, 2016. Comparative transcriptomic profiling of larvae and post-larvae of *Macrobrachium rosenbergii* in response to metamorphosis and salinity exposure. *Genes Genom.,* 38: 1061–1076.

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Sri A. S. Mahapatra
Dr N. K. Barik

Scientist
Dr Lakshman Sahoo
Dr Shailesh Saurabh
Dr Rajesh Kumar
Dr C. Devaraj
Dr Ramesh Rathod
Dr Subhas Sarkar
Dr Khuntia Murmu
Dr B. S. Anand Kumar
Dr D. Panda
Sri Ferose Khan
Sri Nitish Ku. Chandan
Sri Kiran Dashrath Rasal
Sri Anantharaja K.
Dr Ch. Ajit Keshav
Sri Arabinda Das
Sri Uday Ku. Udit
Sri Rakesh Das
Dr I. Sivaraman
Dr Mukesh Ku. Bairwa
Dr Suhas Prakash Kamble
(*transferred w.e.f. 31.3.2017*)
Sri Badhe Mohan Ramesh
Dr Mrs Puspha Choudhary
Dr Siddaiah G. M.
Mrs Rakhi Kumari
Mrs Priyanka C. Nandanpawar
Sri Avinash R. Rasal
Sri Sunil Ku. S. Ail
Sri Ajmal Hussan
Shi Anirban Paul
Mrs. Sweta Pradhan
Ms Farhana Haque
Sri Jackson Debbarma
Sri Arunjyoti Baruah

Chief Technical Officer
Ms B. L. Dhir

Asst. Chief Technical Officer
Sri A. K. Dash
Sri Surendra Singh
Dr B. K. Banja
Sri Satyendu Sarkar
Dr N. Panda
Dr B. K. Pandey
Ms Sukanti Behera

Senior Technical Officer
Dr D. K. Verma
Dr U. L. Mohanty
Sri P. R. Sahu
Sri S. K. Mohanty
Sri P. B. Bhakat
Dr Bibhudatta Mishra

Technical Officer
Sri S. Mahali
Sri Sovan Sahoo
Sri D. P. Rath
Sri Santosh K. Nayak
Sri Suratha K. Naik
Sri B. Tata Rao

Senior Technical Assistant
Sri Rabindra Das
Sri J. K. Ghosh
Sri Dukhia Majhi
Sri C.H. Raghavandra
Sri Aruna Kumar Behera
Sri Lingaraj Muduli

Compounder
Sri Aurobinda Patra, T-4

Technical Assistant
Sri Debendra Tarai
Sri Bhagabat Ch. Das
(Mike Operator)
Sri Affcer Mohamad
(Powertiller Operator)

Driver
Sri Alekh Nayak, Tech. Assistant
Sri Trinath Behura, Tech. Assistant
Sri K. C. Das, Tech. Assistant
Sri S. C. Panda, Senior Technician
Sri Dinabandhu Pradhan,
Senior Technician
Sri Sibo Prasad Behera,
Senior Technician

Sr. Administrative Officer
Sri K. C. Das

Administrative Officer
Sri V. Ganesh Kumar

Finance and Accounts Officer
Sri N. V. R. N. Murty

Security Officer
Sri Debabrata Sahoo

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

Private Secretary
Sri M. D. Das

Assistant Administrative Officer
Sri Indramani Muduli
Sri P. K. Sethy
Ms Golap Bhanja
Sri S. Nandi

Assistant
Sri Birabar Amanta
Sri A. K. Prusty
Sri Jitendranath Jena
Sri T. K. Mishra
Sri Manoj Ku. Mohapatra
Sri Loknath Senapati

Upper Division Clerk
Sri Swamiji Sen
Sri Sukanta Sarkar
Sri R. K. Behera
Sri S. K. Rath
Sri Niranjan Behera
Sri Sukhendu Biswas

Lower Division Clerk
Sri Arijit Panda
Sri Prakash Ch. Parida
Sri Jogendra Dalai

Personal Assistant
Ms A. Manjula
Ms Singa Soren
Ms Smita Acharya

Skilled Support Staff
Sri K. C. Jally
Sri Teegala Muthyullayya
Sri Debahari Behera
Sri G. C. Mallick
Sri Sudam Behera
Sri Rajan Swain
Sri Pitambar Swain
Sri Ramesh Ch Ghadei
Sri Pasupati Das
Sri Resham Bahadur (I)
Sri Biswanath Haldar
Sri Kapilash Barik
Sri Rahaman Shariff
Sri Purna Bhoi
Sri Muralidhar Bhoi
Sri A. K. Rout
Sri Gayadhar Behera
Sri Prahallad Swain
Sri Jagannath Ojha
Sri Siddaraju
Sri Ulash Bhoi
Sri Rabindra Kumar Nath
Sri R. C. Mallick
Sri Asit Kumar Pal
Sri Gundicha Prusty
Sri Bhagaban Swain
Sri Jagannath Ghadei
Sri Lokanath Swain
Sri Damodar Ghadei
Sri Dilip Das
Sri Ratan Das
Sri Ajit Kumar Ray
Sri Dilip Ch. Chanda
Sri Saroj Kumar Parida
Sri Sarat Ch. Barik
Ms Manju Singh
Sri Gopal Ch. Mohapatra
Sri Gouriguru Sibananda Bhuyan
Sri Baikuntha Nayak
Sri Manoj Kumar Jena
Sri Ch. M. Rao
Sri Budhia Behera
Sri Bauri Bandhu Pradhan
Sri Aruna Kumar Muduli
Sri Tanay Balav Barik
Md. Mohibullah
Sri Prasanna Ku. Behera
Sri P. Rajasekhar
Ms Sonali Adhikari
Sri Samir Das
Sri Nabaghana Ghadei
Ms Kalyani Mondal
Ms Kiron Oraon
Sri Sanatan Pradhan
Sri B. K. Deo
Sri Sarat Ch. Barik (E)
Sri Bhikari Charan Bhoi
Sri Mahendra Behera
Sri Dusmanta Ku Sahu
Sri J. K. Palai
Sri Kalandi Charan Biswal
Sri Baja Muduli
Sri P. K. Mohapatra
Sri Rabindra Nath Biswal
Sri Tapan Kumar Routray
Sri Basanta Kumar Mallick
Smt. Bilasi Nayak
Sri Goutam Mallick
Sri Babuli Samal
Sri Krushna Chandra Sethy

Staff transferred from RRC of CIBA, Puri
Sri P. C. Mohanty, T-3 (Driver)
Sri Maharaga Majhi, SSS
Sri Premananda Bisoi, SSS
Sri Nabin Jena
Sri Dwarika Nath Nayak
Sri Kalandi Behera
Sri Purna Ch. Behera
Sri Birabara Mallick
Sri Laxmidhar Behera
Sri Debedra Bhoi
Sri Abhiram Behera

CL with TS
Sri Pramoda Khatua
Sri Maheshwar Bhoi
Sri Judhistira Das
Sri Anadi Charan Bhoi
Sri Sridhar Bhoi
Sri Girish Ch. Upadhyay

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	
		r) Development of genomics resources in Indian major carp, *Catla*	Lakshman Sahoo	1.4.2013-31.3.2017
		s) Single nucleotide polymorphism discovery in *Labeo rohita* and *Macrobrachium rosenbergii*	P. Das	1.4.2014-31.3.2017
		t) Effect of "CIFABROOD" on the breeding performance and seed quality of Jayanti rohu (*Labeo rohita*)	S. Nandi	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-80	Sustainable freshwater aquaculture		
		h) Refinement of freshwater pearl culture technology for sustainable production of pearls in confined conditions.	Shailesh Saurabh	1.4.2013-31.3.2017
		i) Breeding and culture of tilapia for popularization and brood banking.	P. Routray	1.4.2013-31.3.2017
3.	I-84	Aquaculture development through participatory approach	G. S. Saha	
		e) Scaling up of AFS as a model of farmer to farmer extension	G. S. Saha	1.4.2016-31.3.2019
4.	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	1.4.2013-31.3.2017
		b) Value added products from medium and small indigenous fish species.	M. R. Raghunath	1.4.2013-31.3.2017
		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	1.4.2013-31.3.2017

Sl. No.	Institute Project Code	Project title	Principal Investigator	Duration
5.	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/ S. S. Mishra	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
6.	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
7.	I-90	Development of low cost feeds for *Macrobrachium rosenbergii* culture	P.V. Rangacharyulu	1.4.2014-31.3.2017
8.	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
		f) Evaluation of the performance of white leg shrimp, *Litopeneus vannamei* (Boone, 1931) in freshwater culture systems and refinement of culture practices	B. R. Pillai	1.4.2016-31.3.2019
		g) Comparative studies on primary productivity and plankton communities with reference to fish production and productivity in different fish farming systems in Krishna- Godavari delta, Andhra Pradesh	B. S. Giri	1.4.2016-31.3.2019
		h) Captive breeding of Narayan barb, *Pethia narayani* (Hora, 1937) of Western Ghats and its promotion in ornamental fish village	Mukesh Ku Bairwa	1.4.2016-31.3.2019

Sl. No.	Institute Project Code	Project title	Principal Investigator	Duration
9.	I-92	Carbon sequestration and carbon footprint in some aquaculture system	S. Adhikari	1.4.2015-31.3.2018
10.	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
11.	I-94	Evaluation of optimum stocking density for nursery raising of *Labeo rohita* spawn under hapa system (multi location trial) in village of middle Gujarat.	C. K. Misra	1.4.2015-31.3.2018
12.	I-95	Nutritional intervention and development of feeding strategy for freshwater aquaculture	K.N. Mohanta	
		a) Study on nutrient requirement and feed development for Pengba, *Osteobrama belangeri*	K.N. Mohanta	1.4.2016-31.3.2019
		b) Evaluation of mahua oil cake as a non-conventional ingredient and its use in carp feed	S.C. Rath	1.4.2016-31.3.2019
		c) Evaluation of some fish feed processing technology by use of some locally fish feed ingredients for enhancing the aquaculture production	K.C. Das	1.4.2016-31.3.2019
		d) Ontogeny of digestive system of selected catfish species and its implication on larval feed development	Rakhi Kumari	1.4.2016-31.3.2019
		e) Amelioration of heat stress in *Labeo rohita* through dietary intervention	C. Devaraj	1.4.2016-31.3.2019

Externally funded projects

Sl. No.	Project code	Title	Funding Agency	Pr. Investigator	Duration
1.	E-03	Application of plastics in aquaculture	ICAR-AICRP on "Plasticulture Engineering & Technologies	B. C. Mohapatra	Continuous (from May, 1988)
2.	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, 2021
3.	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, 2019
4.	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
5.	E-80	Stock improvement and quality seed production of important freshwater carps, catfish and prawn: prerequisite for 'National Center for Fish Broodstock Upgradation'	NFDB	K. D. Mahapatra	February, 2013 – February 2018
6.	E-83	Diversity and synthesis of immunoglobulin in the Indian major carps	NASF-ICAR	M. Samanta (multi-institute project)	April, 2013-Sept., 2017
7.	E-85	Whole genome sequencing and development of allied genomics resources in two commercially important fish – *Labeo rohita* and *Clarias batrachus*	DBT	P. Das	10 Sept, 2013-10 Sept, 2017

Sl. No.	Project code	Title	Funding Agency	Pr. Investigator	Duration
8.	E-86	National surveillance programme on aquatic animal diseases	NFDB-NBFGR	P. K . Sahoo	April, 2013- March, 2018
9.	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
10.	E-90	Molecular and computational approach to delineate metabolic path ways for better carbohydrate utilization in Labeo species	Network project on Agricultural Bioinformatics (CABin)	J. K. Sundaray	10 November, 2014 – 31 March, 2017
11.	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
12.	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
13.	E-93	Intellectual property and technology management (IP&TM) (renamed as "National Agriculture Innovation Foundation (NAIF)"	ICAR- NAIF	P. Swain	April, 2015 – March, 2017
14.	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
15.	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

Sl. No.	Project code	Title	Funding Agency	Pr. Investigator	Duration
16.	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
17.	E-97	Novel approaches towards vaccine development against argulosis in carps	ICAR (CRP on vaccines and diagnostics)	J. Mohanty	August, 2015 – March, 2017
18.	E-98	Development of vaccine against *Flavobacterium columnare*	ICAR (CRP on vaccines and diagnostics)	M. Samanta	August, 2015 – 31 March, 2017
19.	E-99	All India network project on fish health	AINP on fish health	S. S. Mishra	July, 2015 – March, 2017
20.	E-100	Production of plant sourced mannan oligosaccharides for improving the productivity of freshwater aquaculture	DBT	N. Sridhar	December 2015 – November, 2018
21.	E-101	Productivity and production enhancement of freshwater ponds through BMP and aquaculture for livelyhood development of the Aila affected SC/ST communities of Islands of Sundarbans, West Bengal	DBT	P.P. Chakrabarti	March, 2016 – March, 2019
22.	E-102	Carp seed production and integrated fish farming technology for livelihood development of Phailin affected tribal farmers of Ganjam district, Odisha (Under TSP)	DST, Govt. of India	B. C. Mohapatra	July, 2016 – July, 2019
23.	E-103	Cryopreservation of embryonic stem cells and primordial germ cells for transplantation and surrogate fish production	DST (International Division)	P. Routray	9 May, 2016- 8 May, 2019
24.	E-104	Upgradation and dissemination of stripped murrel seed production technology	NFDB	Rajesh Kumar	June, 2016– May, 2016
25.	E-105	Promoting improved agriculture and allied sector technologies in Khordha district through Farmer First Approach	FFP of the KVK Scheme of ICAR	H. K. De	October, 2016- September, 2018

Sl. No.	Project code	Title	Funding Agency	Pr. Investigator	Duration
26.	E-106	Development of a RNA interference-based silencing approach targeting lectin(s) gene transcripts in freshwater prawn, *Macrobrachium rosenbergii* and its implications as a biotherapeutant	DBT	J. Mohanty	September, 2016-September, 2019
27.	E-107	Upliftment of tribal community through scientific adoption of aquaculture technologies for the improvement of their livelihood and socioeconomic status in selected districts of Andhra Pradesh and Telangana states.	DBT	Ramesh Rathod	April, 2016 - March, 2019
28.	E-108	Risk and benefit assailment of an illegally introduced fish species *Piaractus brachypomus*, pacu in India	NFDB	P. P. Chakrabarti (Co-PI) B. S. Giri (Co-PI)	March, 2017-October, 2017

Outreach Project

Sl. No.	Title	Funding Agency	Pr. Investigator	Duration
1.	Outreach Activities on Fish Feed	ICAR	K. N. Mohanta	April 2008 – March 2017
2.	Outreach Activity on Nutrient Profiling and evaluation of fish as a dietary component	ICAR	B. N. Paul	April 2013 – March 2017
3.	Outreach activity on Fish genetic stock	ICAR Network mode	P. Das	2014 - 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 striatus*	Dept. of Science and Technology, Govt. of India	Ms. Shibani Dutta Mohapatra (H.K. Barman: Mentor Scientist)	April, 2014-March, 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.	Factors affecting germ cell proliferation and maturation in fish	DST-INSPIRE	P. Routray	2014-2019
4.	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	2014 - 2018
5.	Ecology, spawning and culture possibilities of small indigenous fish species, *Amblypharyngodon molla*	DST-INSPIRE	P. Routray	2015-2020

SUMMARY IN HINDI

11. मुख्य अनुसंधान उपलब्धियाँ

- मिस्टस गुलिओ का सफलतापूर्वक प्रजनन एवं पालन और विशाल स्नैकहेड चन्ना मारुलियस के परिपक्वता और कैप्टीव प्रजनन को प्राप्त किया गया।
- इनडोर स्थिति में महानदी रीता लार्वा की उच्च वृद्धि दर एवं उत्तरजीविता के लिए २-३ लार्वा/लिटर के संचय दर की सिफारिश की गई है।
- चयनात्मक प्रजनन कार्यक्रम के तहत उच्च वृद्धि के लिए मीठाजल झींगा एम. रोजनवर्गाई की आठवीं पीढ़ी का उत्पादन किया गया।
- अध्ययन से पता चलता है कि मीठाजल में एल. वनामेई संवर्धन नमक/खनिजों के डाले बिना एक व्यवहार्य विकल्प नही है।
- बालासोर, ओडिशा के कृषक तालाब में एवं कृषि विज्ञान केंद्र, चित्रकूट, उत्तर प्रदेश में मीठाजल सीपी से डिजाइनर मोती का सफलतापूर्वक उत्पादन किया जा रहा है।
- लैमिलीडेन्स मार्जिनेलिस का लक्षण वर्णन को स्थापित किया गया है।
- कुछ जलकृषि प्रणालियों के मृदा कार्बन भंडारण एवं कार्बन पद् चिह्न विश्लेषण किया गया।
- अनुसूचित जाति एवं जनजाती समुदायों के लिए आजीविका विकास कार्यक्रम के तहत ओडिशा के खोर्धा जिला के चार प्रखंडो में कार्प प्रजनन, बीज संवर्धन एवं ग्रो आउट संवर्धन का प्रदर्शन किया गया है।
- तिलापिया संवर्धन के लिए उपयुक्त तापमान सीमा का पता लगाया गया तथा भारत के कुछ राज्यों में मीठाजल कृषि में जलवायु परिवर्तन प्रभाव की अनुकूलण एवं सामाधान की रणनीतियों की जांच की जा रही है।
- ९० प्रतिशत एवं ८० प्रतिशत का जल बदलाव स्तरों को कंक्रीट बीज संवर्धन प्रणाली में कार्प बीज उत्पादन की नर्सरी एवं अंगुलिकाए अवस्था के लिए आदर्श पाया गया।
- मांगुर हैचलिंग उत्पादन मे लागातार २८ घंटे वायुकरण के साथ २८ घंटे जल प्रवाह में महत्वपूर्ण उच्च हैचिंग प्रतिशत (८६%) प्राप्त किया गया।
- एनाबास टेस्टुडिनीयस के नर्सरी संवर्धन हेतु, १०/लिटर की स्पॉन संचयन घनत्व को इष्टतम पाया गया।
- भाप्रकार्प की जर्म कोशिकाओं का सफलतापूर्वक अलग किया गया और क्रायोप्रोक्टेंट के रुप में डीएमएसओ अन्य क्रायोप्रक्टेंट की तुलना में के ५-७.५इ घनत्व पर रोहू ७० प्रतिशत से ज्यादा जीवित जर्म कोशिकाओं को दिया है।
- कार्प के अनिषेचित परिपक्व अंडों को कार्प डिम्बग्रंथि द्रव्य (ओएएफ) और कृत्रिम कार्प डिम्बग्रंथि द्रव्य (ऐसीओएफ) में काफी हद तक जीवित्ता (निषेचन और हैचिंग) से समझौता किए बिना १८० मिनट के लिए इन विट्रो में भंडारण किया जा सकता है।
- जलकृषि प्रजातियों में एसएनपी मार्कर की खोज के लिए हेटेरोजायगस एसएनपीएस की पहचान एक उपयुक्त विधि नही हो सकती है।
- कुल मिलाकर, एम. रोजनवर्गी में १८५८५१ एसएसआरएस के साथ साथ रोहू एवं एम. रोजनवर्गी में क्रमशः ०.२ एवं ०.२६ मिलियन एसएनपी की पहचान की गई।
- रोहू में लिंकेज मैप के समृद्ध करने के संबंध में, ७७० एसएसआर लोसाई में से २१४ सुचनात्मक पाए गए। इसी प्रकार मांगुर में, २०३ सूचनात्मक लोसाई को फ्लोरोसेंस लेबल किए गए और मांगुर मेजर मैपिंग फैमिली में ११५ लोसाई के लिए जीनोटाइपिंग पूरा किया गया ।
- १५ व्यावसायिक रुप से महत्वपूर्ण मीठाजल की प्रजातियों का पूर्ण माइट्रोकोन्ड्रीयल जिनोम सिक्वेंस के दृश्यों की व्याख्या की गई ।
- पीएलजेडएफ जीन प्रोमोटर (प्रोमाईलोसाइटिक ल्यूकेमिया जिंक फिंगर), सी. बेट्राकस के एक स्टेम सेल आत्म नवीकरण मार्कर जीन का लक्षण वर्णन किया गया।

- एम रोजनवर्गी के सीरम नमूनों में हेइमाग्लुटीनेसन गतिविधि के प्रतिस्पर्धा निषेध को विभिन्न शक्कर और ग्लाइकोप्रोटीन के साथ मूल्याकंन किया गया और केवल एन एसिटाइलन्युरामिनिक एसिड एवं फेटुइन क्रमशः ५० एमएम एवं ०.३१ मिग्रा/एमएल की न्यूनतम निरोधात्मक घनत्व पर एचए गतिविधि को बाधित करने के लिए पाए गए ।
- वर्ष के दौरान उत्पादित १०४.७५ लाख जयंति स्पॉन में से ४७.७५ लाख स्पॉन को ओडिशा के ६ विभिन्न जिलों में प्रसारित किया गया और भारत के विभिन्न आठ राज्यो में ४६.० लाख स्पॉन को दिया गया।
- सीफाब्रूड आहार ने जंयति रोहू के प्ररुपी और जननांगो की परिपक्वता को बढ़ाया और बेहतर प्रजनन एवं लार्वा के विकास में मदद पहुचाँइ।
- ऑस्टियोब्रामा बेलेगेरी फिंगरलिंग के इष्टतम प्रोटीन एवं लिपिड की आवश्यकताए क्रमशः ३५% एवं ८% पाया गया ।
- रोहू के लिए एक आहार सीफा फ्राई को विकसित किया गया।
- एन्टरोबैक्टर क्लोअकई की एक प्रजाति सीएफ-एस२७, ने प्रयोगशाला स्थिति में बिना जल बदलाव में झींगा संवर्धन के पुरे ३० दिनों के दौरान घुलित नाइट्रोजन की अनभिज्ञनीय मात्रा को बनाए रखा ।
- लाइसोजाइम जी जीन एवं इसके पुनः संयोजक प्रोटीन को रोहू में कार्यात्मक रुप से लक्षण वर्ण किया गया ।
- रोहू के आहार में जिंक ऑक्साईड और सेलेनियम नैनोपर्टिकल स्वभाव में इम्युनोमोडुलेटरी पाया गया ।
- रोहू की बी-कोशिका संक्रियण कारक (बीएएफएफ) जीन को क्लोन कर लक्षण वर्णन किया जो इम्युनोग्लोब्युलिन एम (आईजीएम) संश्लेषण में अपनी महत्वपूर्ण भूमिका को दर्शाया है ।
- उभरते बैक्टीरियल मत्स्य रोगजनकों जैसे प्रोटीयस मिराबिलिस, क्लेबसिएलाा न्युमोनिएई, एवं एसिनेतोबेक्टर बैमान्नी को दर्ज किया और प्रकोप के मामलों को सुचित किया गया। दो मिक्सोस्पोरिडिएन परजीवी यानी जस्चोक्केला औरेतीस और थेलोनवेलस कादरी को भी मछली से पहचान की गई थी। इसके अलावा गोल्डफिश एवं कोई कार्प से दो नए उभरते वायरस जैसे क्रमशः सीवाईएचभी-२ एवं कार्प एडेमा वायरस को राष्ट्रीय निगरानी कार्यक्रम के तहत दर्ज किया गया।
- राष्ट्रीय कृषि इनोवेशन फाउंडेशन के तहत तीन पेटेंट को प्राप्त किया और दो को दायर किया गया।
- भारत में मरैल एवं कैटफिश मछली पालन के प्रभाव का मूल्यांकन किया गया ।
- कृषक से कृषक तक प्रसार के मॉडल के रुप में एएफएस के रुप में जांच की गई ।
- प्लास्टीक आधारित जलकृषि गैजेट अर्थात एक्रेलिक रेस्पीरोमीटर, मोबाइल फिश वेंडिंग ट्रॉली, पोषक तत्व फिल्म तकनीक (एनएफटी) एक्वापोनिक्स प्रणाली, फ्लोटिंग नर्सरी इत्यादि को विकसित किया गया एवं इसका जलकृषि प्रणाली में क्षमता की जांच की जा रही है।
- मीठे जल की तालाब में सफलतापूर्वा हिलसा लार्वा का संबर्धन एवं इसके पालन के लिए प्रयास किया गया ।
- पाकू पर जोखिम विश्लेषण के अध्ययन से पता चला कि भारतीय संवर्धन प्रणाली में इसके शामिल करने के संबंध में कम जोखिम का पता चलता है।
- इस अवधि के दौरान जलकृषि के विभिन्न पहलुओं पर ४३ प्रशिक्षण कार्यक्रमों, २७ फिल्ड दिवस एवं ९० समूहों का कृषक भ्रमण को संस्थान में आयोजित किया गया।
- २०१६-१७ में केवीके ने जिला में शामिल १८० हेक्टेयर क्षेत्र में बड़े पैमाने पर ऑयल सिड एवं दालों की सामूहिक प्रदर्शन किया है जिससे ४५० किसानों को लाभ मिला है।
- अनुकूली परीक्षण के परिणामस्वरूप पूर्णबोध और पुसा १६१२ को क्रमशः ४.२६ टन/हेक्टेयर और ५.७० टन/हेक्टेयर उत्पादन के साथ सबसे सुगंधित चावल की किस्मों के रुप मे पहचान की गई है ।
- नारियल विकास बोर्ड के समर्थन से केवीके ने १७३ ग्रामीण युवाओं को नारियल के पेड़ प्रशिक्षण कार्यक्रम के दोस्ते के तहत प्रशिक्षित किया जो रोजगारक्षमता (नारियल चढ़ाई मशीन) एवं नारियल की खेती में उन्नतियों पर केंद्रीत था।

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 were formed adopting 75 villages in the target area. Besides, the scientists working in the Regional Research Centres have selected another 25 villages for implementing the scheme. With the expertise of CIFA in freshwater aquaculture the villages were selected based on added criteria of possessing freshwater bodies.

All the 20 groups of scientists (at HQ and RRCs) visited their villages regularly and updated the villagers about new farming practices, varieties and Government schemes. Forging convergence with line departments/KVK/Banks/SHGs/NGOs etc. is being emphasized for implementation of the scheme.

Need based interventions are also being made by the team of Scientists in their selected villages. Under this scheme, a Scientist-Farmer interaction meet was organised at Derunia village, Astaranga Block, Puri District, Odisha on 23 October, 2016 and a fish harvest mela was conducted at Orada Village in Tangi Block of Khordha district on 30 December, 2016.

SWACHH BHARAT ABHIYAN

Under the *Swachh Bharat* Mission, *Swachhata Pakhwada* was organized at the Institute from 16-31 October, 2016. Many events regarding awareness of the benefits of cleanliness were conducted in the nearby villages and schools. The ICAR-CIFA organized Aquaculture Field Day on 19th October 2016 at its Aquaculture Field School (AFS) during celebration of "*Swachhata Pakhwada"* at Sarakana village of Khordha district, Odisha. A total of 48 participants including 35 fish farmers from neighboring villages took part in the programme. Several intra-

Institutional competitions like quiz, debate were organized at nearby school as well as in ICAR-CIFA, Bhubaneswar. A leaflet on key measures to be adopted by fish farmers for clean, safe and profitable fish culture was distributed among the farmers. A farmer-scientist interaction was held wherein farmer's queries about carp seed production, carp culture and fish health management were addressed by the Scientists in Odia language. The socio-economic impact of AFS was assessed from the farmers.

SUPERANNUATIONS AND APPOINTMENTS

SUPERANNUATION

- Sri M. Narasimhulu, SSS *w.e.f.* 30.4.2016
- Sri Rabindra Tarai, T-5 (Driver) *w.e.f.* 31.5.2016
- Sri H. K. Behera, SSS *w.e.f.* 30.6.2016
- Sri Golekha Behera, SSS w.e.f. 31.07.2016
- Sri Sridhar Kahali, SSS w.e.f. 31.07.2016
- Sri Satrughan Bhoi, SSS w.e.f. 31.07.2016
- Sri R. K. Sahoo, SSS w.e.f. 30.11.2016
- Sri Sital Chandra Haldar, SSS w.e.f. 31.01.2017
- Sri Kailash Chandra Jena, SSS w.e.f. 31.01.2017
- Sri Trailokya Pradhan, SSS w.e.f. 31.01.2017
- Dr. J.N. Saha, Pr. Scientist w.e.f. 28.02.2017
- Mr. Joydeb Paria, SSS w.e.f. 28.02.2017
- Sri Krushna Chandra Das, Sr. Administrative Officer w.e.f. 31.03.2017

APPOINTMENTS

- Shri Mukesh Kumar P. Bhendarkar, Scientist (Fisheries Resource Management) *w.e.f.* 06.04.2016.
- Ms Sweta Pradhan, Scientist (Aquaculture) *w.e.f.* 11.04.2016.
- Shri Patil Pankaj Amrut , Scientist (Aquaculture) *w.e.f.* 11.04.2016.
- Shri Anirban Paul, Scientist (Fish Health) *w.e.f.* 11.04.2016.
- Ms Farhana Hoque, Scientist (Fish Health) *w.e.f.* 11.04.2016.
- Dr Debabrata Panda, Scientist (Fisheries Resource Management) joined this Institute *w.e.f.* 1.6.2016 on transfer from ICAR-CIFRI, Barrackpore.
- Shri V. Ganesh Kumar joined as Administrative Officer at ICAR-CIFA on 20 October, 2016 on promotion from ICAR-CIWA, Bhubaneswar.
- Dr J. K. Sundaray, HoD, Fish Genetics and Biotechnology Division has been given the additional charge of Director (Acting), ICAR-CIFA w.e.f. 12 January, 2017.
- Shri Arunjyoti Baruah, Scientist joined the Institute on 22 March, 2017 on transfer from ICAR-CIARI, Portblair.
- Shri Jackson Debbarma, Scientist joined the Institute on 22 March, 2017 on transfer from ICAR-CIARI, Portblair.

PROMOTION

- Dr J. N. Saha, Sr. Scientist promoted to Principal Scientist *w.e.f.* 8.8.2014
- Dr M. Samanta, Sr. Scientist promoted to Principal Scientist *w.e.f.* 1.12.2014
- Smt. Golap Bhanja from Assistant to Assistant Administrative Officer w.e.f. 22.02.2017
- Shri Sunakar Nandi from Assistant to Assistant Administrative Officer w.e.f. 22.02.2017

TRANSFER

- Sri P. L. Lalrinsanga, Scientist (Aquaculture) was transferred from ICAR-CIFA to ICAR Research Complex for NEHR, Nagaland Centre, Nagaland *w.e.f.* 16.5.2016
- Dr B. K. Das, Principal Scientist was selected as Director, ICAR-CIFRI, Barrackpore and was relieved w.e.f. 29/07/16 from ICAR-CIFA.
- Dr P. Jayasankar, Director was relieved of his duties on completion of his tenure on 11 January, 2017 and transferred as Principal Scientist to ICAR-CMFRI, Kochi.

- Sri S. K. Rath, UDC joined ICAR-CIFA Hqrs. on 8 February, 2017 on transfer from RRC of ICAR-CIFA, Anand, Gujarat
- Sri S. C. Panda, T-2 (Driver) joined ICAR-CIFA Hqrs. on 6 March, 2017 on transfer from RRC of ICAR-CIFA, Rahara, W.B.
- Mrs Jesna P. K., Scientist was relieved from her duties on 23 March, 2017 from RRC of ICAR-CIFA, Bangalore to RRC of ICAR-CIFRI, Bangalore
- Mr Pankaj Amrut Patil, Scientist was relieved from his duties on 30 March, 2017 from ICAR-CIFA to ICAR-CIBA, Chennai
- Mr Suhas P. Kamble, Scientist was relieved from his duties on 31 March, 2017 from ICAR-CIFA to RRC of ICAR-CIFRI, Vadodra.
- Dr S. Adhikari, Principal Scientist was transferred to RRC of ICAR-CIFA, Rahara, West Bengal w.e.f. 23 July, 2016.

CIFA IN NEWS

Scientist-farmers interaction meet

Banpur: A scientist-farmers interaction meet was organised by IACR and CIFA under the tribal Sub-Plan programme 'Mera Gaon Mera Gaurav' and SC/ST Project of Department of Biotechnology on adoption of scientific aquaculture practices to improve the livelihood of tribal farmers. It was held at Aranga village in Niladriprasad panchayat under Banpur block in Khurda District on [illegible]. More than 300 fish farmers of Niladri-Prasad panchayat [illegible] villages. Among others [illegible] officials attended. Floating fish feed were [illegible] ICAR-CIFA, BC

'ସିଫା'ର ମତ୍ସ୍ୟଚାଷ ପ୍ରଶିକ୍ଷଣ ଶିବିର

କୃଷିଜାତ ଆବର୍ଜ୍ଜନାରୁ ଇନ୍ଧନ ପ୍ରସ୍ତୁତି ଗବେଷଣା ପାଇଁ ସହାୟତା

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ପ୍ରାନ୍ତୀୟ କର୍ମଶାଳା

ସିଫାରେ ଜାତୀୟ ଆଲୋଡନାଚକ୍ର
ଜଳକୃଷିର ବିବିଧତା : ନୀଳ ବିପ୍ଳବ ଦିଗରେ ଅଗ୍ରଗାମୀ

नीली क्रांति की ओर बढ़ते कदम पर संगोष्ठी

पेट्रोल पम्पରେ କୃଷି ସୂଚନା ରହିବ
ସିଫାରେ କୃଷି ବିଜ୍ଞାନ କେନ୍ଦ୍ରର କର୍ମଶାଳା

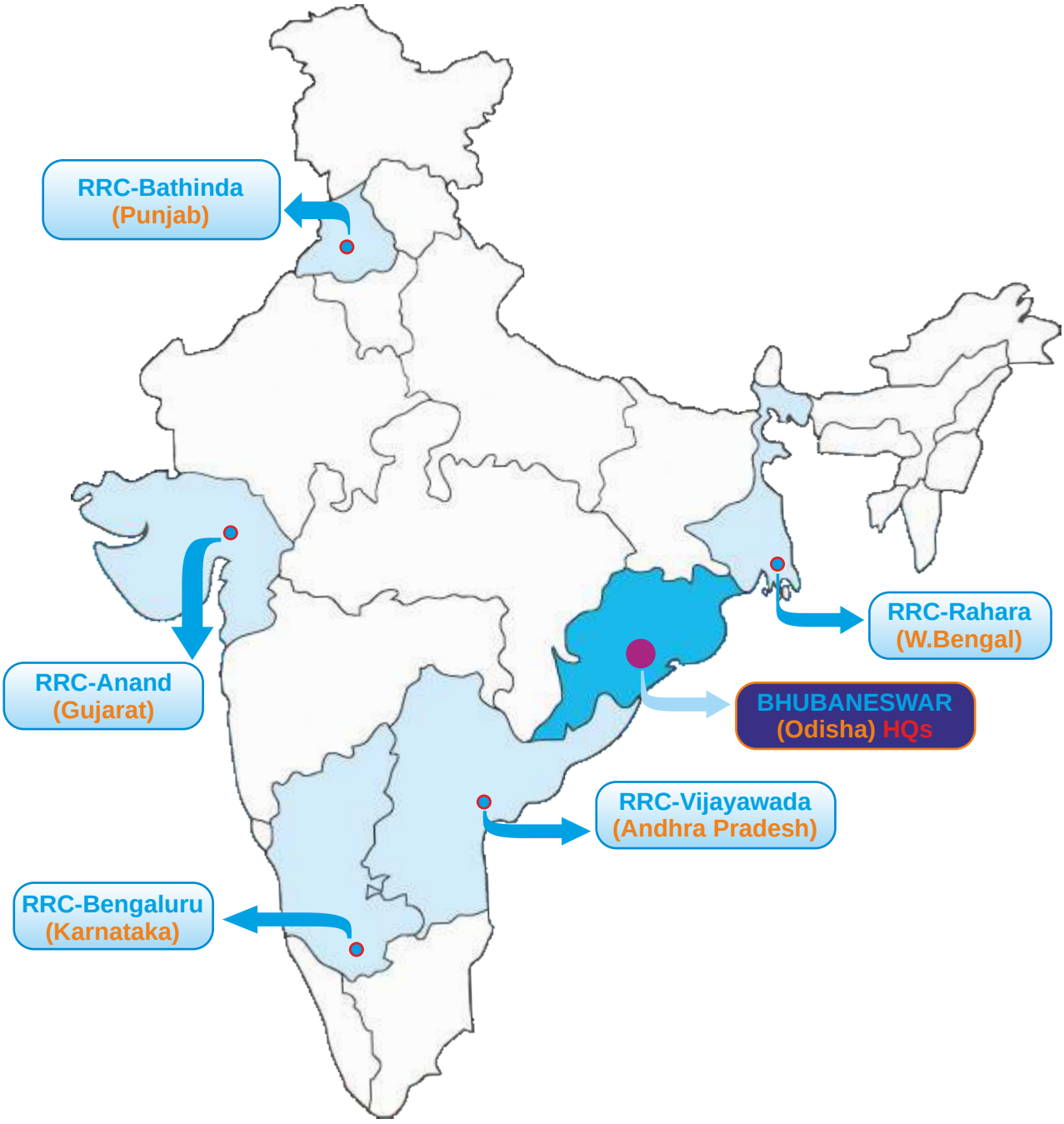
सिफारे प्रशिक्षण कार्यक्रम

मछली की आपूर्ति व मांग की खाई को पाटने के लिए विमर्श

कुल मछली उत्पादन का एक हिस्सा ही निर्यात

Pradhan inaugurates KVK workshop at CIFA

RESEARCH LOCATIONS



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