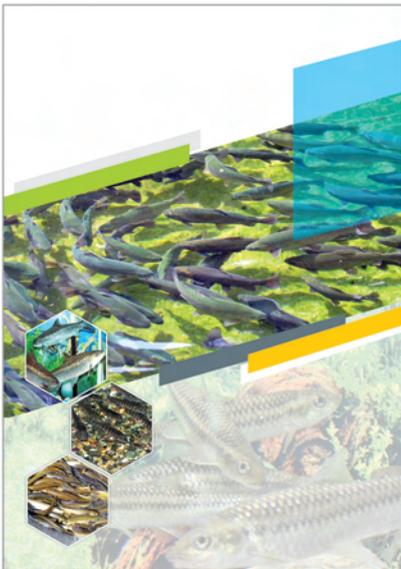


ANNUAL REPORT

2018-19



ICAR-Directorate of Coldwater Fisheries Research
Bhimtal-263 136, Nainital, Uttarakhand, India



Front Cover:

Theme: Coldwater candidate species



Back Cover:

Theme: Coldwater fish farming practices.

ANNUAL REPORT

2018-2019



ICAR-DIRECTORATE OF COLDWATER FISHERIES RESEARCH

Bhimtal - 263 136, Nainital
Uttarakhand, India



Citation:

ICAR-DCFR Annual Report 2018-2019, ICAR-Directorate of Coldwater Fisheries Research, Bhimtal - 263136, Nainital, Uttarakhand, India

Front cover:

Theme: Coldwater candidate species

Back cover:

Theme: Coldwater fish farming practices

Editors

Dr. Deepjyoti Baruah
Dr. M.S. Akhtar
Dr. (Mrs.) Khangembam Victoria Chanu
Mr. Kishor Kunal

Technical Assistance

Mr. Amit Saxena

Concept & Published by

Dr. Debajit Sarma
Director, ICAR-DCFR, Bhimtal

ICAR-DCFR Annual Report is not a priced publication. Recipients of complimentary copies are not permitted to sell photocopies of the report in part or in full. This report includes unprocessed or semi-processed data which would form the basis of scientific papers in due course. The material contained in the form of reports and photographs, therefore, may not be used without the permission of this institute, except for quoting it as scientific reference.

Layout design & Printed at

M/s Royal Offset Printers, A-89/1, Naraina Industrial Area, Phase-I, New Delhi 110028.
Mobile: +91 9811622258



ICAR-Directorate of Coldwater Fisheries Research (ICAR-DCFR), Bhimtal, Nainital is the premier research Institute in the country working towards the sustainable production, management and conservation of coldwater fisheries by constantly providing scientific and technological inputs through imparting quality research and services.

During 2018-19, ICAR-DCFR has made genuine efforts under its mandated responsibilities including research, training and capacity building, extension activities, fostering partnership and linkages as well as scientists-farmers-officers interactive programmes ensuring safeguard of coldwater fisheries and expansion of hill aquaculture for enhancing farmer's income and overall development of coldwater fisheries sector in the country.

Stepping our endeavours and commitments to excellence, Directorate has been working towards resource assessment and advancement in GIS based site suitability maps and developed digitized maps on aquatic resources, drainage network, land use & land cover and digital elevation models for three districts of Arunachal Pradesh. Technological advancements in hill aquaculture include captive maturation and breeding of golden and chocolate mahseer, *Schizothorax plagiostomus* and *Garra gotyla*; development of breeding and rearing protocols of indigenous coldwater ornamental fishes under controlled aquarium conditions; identification of histology based appetite markers for devising feeding regimen in golden mahseer larvae; protocol for in-house synthesis of neuropeptide (GnRH) hormone; development of a semi-commercial (32 m³ capacity) re-circulatory aquaculture system as a climate resilient technology to minimize the usage of land and water in rainbow trout culture; identification/designing of new cell penetrating peptides from fish viral proteins for delivery of gene into fish cells; development of cost effective growout trout feed containing RDDG, a by-product of distillery units; development of low cost and effective fish anaesthesia; screening of gender specific markers in golden mahseer and successful triploidy induction in rainbow trout. Under the national project on innovations in climate resilient agriculture (NICRA), attempts are being made to develop a climate resilient rainbow trout through thermal programming. The concerns and challenges of coldwater fish diseases are precisely being addressed by putting sincere efforts in disease surveillance of coldwater fish farms of different hill states; identification of pathogens and development of management measures including development of sensitive, specific and rapid LAMP based detection assay for fish pathogen *Lactococcus garvieae*, designing of PNA probes for detection and identification of *Saprolegnia* species and screening of various anti-fungal and anti-bacterial chemicals.

To promote mahseer based eco-tourism and recreational fisheries in north-east India, scientists-farmers-officers interactive meet on seed production and conservation of mahseer and fish farming in the cold region of Nagaland together with an angling competition was organized at village Suteplenden (Longkong), Mokokchung district, Nagaland and established a mahseer hatchery and brood bank facility too. The Directorate also organized various other trainings, field demonstrations, farmer advisories and exhibitions to disseminate scientific knowledge on various aspects of coldwater fisheries and aquaculture to farmers, fisheries officers and other stakeholders. Under tribal sub-plan activity,

rainbow trout farming is being promoted as a remunerative livelihood option and the Directorate is providing infrastructure and inputs to adopted tribal farmers, for example the Directorate established rainbow trout raceways in the difficult hilly terrain of Munsiyari, Uttarakhand. Under NEH activity, one trout hatchery and three trout raceways were established and made operational at Dzuleke, Kohima; One one unit of chocolate mahseer hatcheries were established in Meghalaya, Mizoram and Nagaland. Further, under NEH, developed captive breeding facilities of mahseer in Mizoram and established trout feed unit at Dirang, Arunachal Pradesh. The Directorate has also successfully implemented the newly instituted Govt. of India programme called Scheduled Caste Sub-Plan (SCSP). Under SCSP, activities such as training of scheduled caste fish farmers for enhancing their income were undertaken.

As per directive received from the Government of India and SMD, focus was also given on programmes such as *Swachh Bharat Abhiyan*, *Mera Gaon Mera Gaurav*, *Soil Health Card* and *Skill India Programme* and implemented the programmes in its true sense. The other important events of the year such as Republic Day, World Environment Day, International Yoga Day, National Fish Farmer's Day, Independence Day, DCFR Foundation Day, Hindi Pakhwada, Vigilance Awareness Week, World Antibiotic Awareness Week and World Soil Health Day were celebrated in spirit and zeal.

The Directorate also strengthened linkages with other ICAR research institutes, fisheries departments of hill states, agricultural universities, KVKs, non-governmental organisations and central agencies such as National Fisheries Development Board and Department of Biotechnology for promoting research, extension and capacity building. Stepping ahead towards Public-Private-Partnership research, the Directorate inked MoUs between S.P.Y. Agro Industries Ltd., Nandyal, Andhra Pradesh (high protein RDDG producer) and String Bio Pvt. Ltd., Bengaluru, Karnataka (methanotrophic bacterial meal producer) for evaluation of alternative protein sources for development of cost effective trout feed. ICAR-DCFR has also signed an MoU with Kannan Devan Hills Plantations Co. Pvt. Ltd, Munnar, Kerala and has been providing consultancy on rainbow trout culture which may open new avenues for trout farming in peninsular India.

The continuous support, guidance and encouragements received from Dr. T. Mohapatra Secretary, DARE & Director General, ICAR was commendable. The supports, motivation and guidance received from the Dr. J.K. Jena, Deputy Director General (Fisheries), and Dr. Pravin Putra, Assistant Director General (Marine Fisheries) are recorded with sincere thanks and gratitude.

I sincerely thank and appreciate the contributions of all the scientists and staff members of the Directorate for the commendable progress made during the year. I also thank the members of the editorial committee for their sincere efforts in compiling and bringing out the Annual Report 2018-2019 on time.



(Debajit Sarma)
Director

Contents

	<i>Preface</i>	iii
1.	Executive Summary	1
2.	Introduction	5
3.	Research Achievements	12
	3.1. Resource Assessment and Management	12
	3.2. Aquaculture Research and Development	16
	3.3. Molecular Genetics & Biotechnology	28
	3.4. Disease Surveillance & Health Management	31
	3.5. Outreach Activities	33
	3.6. Externally Funded Projects	35
4.	List of Research Projects	44
5.	Important Events and Meetings	47
6.	Extension Activities, Consultancy and Other Services	58
7.	Tribal Sub Plan (TSP) Activities	78
8.	North East Hill Activities	82
9.	Scheduled Caste Sub Plan (SCSP)	87
10.	Training and Capacity Building	89
11.	Linkages	99
12.	Awards/ Honours/Recognitions	101
13.	Publications	103
14.	Participation in Conference/ Symposia/Workshop/Meetings	109
15.	Library and Information Services	119
16.	Distinguished Visitors	121
17.	Important Committees	123
18.	Staff News	127
19.	Personnel	128

Executive Summary

1

ICAR-DCFR has been working continuously towards development of coldwater fisheries sector in all the Himalayan states of the country through resource assessment and promotion of hill aquaculture for enhancing farmer's income. The Directorate has put sincere efforts in explorations of important habitats, study of ecology and biology of endemic species for regular updating fish biodiversity and molecular characterization of commercially important coldwater fish species. To promote diversification in hill aquaculture, various protocols for breeding, rearing and seed production of several prioritized indigenous candidate species have been developed and standardized. The institute has also worked for enhancement of natural fish stocks through ranching particularly mahseer and promote eco-tourism and fish sanctuaries in various places. DCFR has provided technical support to hill states of the country for implementation of the innovative farming practices towards doubling the farmers income. DCFR has developed human resource through skill development training programmes, on-farm demonstrations, consultancies, farm advisory and establishment of hatcheries. Directorate has made research linkages by making MoUs with Universities, State fisheries departments and other institutions for collaborative research and academic dissertation work of the students in Master and Ph. D. level. The research accomplishments during the reporting period April, 2018- March, 2019 have been summarized as follows:

Resource Assessment and Management

- *S. richardsonii* was found to dominate at Shergaon region whereas *S. plagiostomus* dominated in the upper reaches of the Kameng drainage of Arunachal Pradesh
- Fish species other than *Schizothorax* found in river Tenga of Arunachal Pradesh were *Garra* sp., *Glypthothorax* sp, *Psilorhynchus* sp., and *Schistura* sp.
- 30 species of phytoplankton under 24 families, 19 orders and 6 classes were identified from Kameng drainage and river Kille. Among the species, *Navicula* (27%) dominated in river Dirang chu, *Meridion* (36%) in river Sangti, *Spirogyra* (50%) in river Tenga, *Stigeoclonium* (23%) in river Choskorong Kho and *Spirogyra* (24%) in river Kiile.
- Digitized maps on aquatic resources, drainage network, land use land cover, digital elevation model, slope and potential fisheries development suitability sites have been prepared for three districts of Arunachal Pradesh viz., Tawang, West Kameng and Lower Subansiri.
- Wetlands in the form of upland lakes accounting 342, 61 and 1 in numbers were found scattered at an altitude ranging between 3000-6000m MSL, 3000-4000m MSL and 500-1000m MSL in the districts of Tawang, West Kameng and Lower Subansiri respectively.
- Wasteland occupies 17.58%, 19.53% and 6.55% of the total area respectively in the three districts which includes the marshy, swampy and unutilized water-logged areas.
- An area of 23.64 km² (0-10 degree slope) and an area of 107.19 km² (10-20 degree slope) was found highly and moderately suitable for aquaculture and fisheries development programmes in the district of Tawang. Similarly, 98.76 km² (0-10 degree slope) and 279.77 km² (10-20 degree slope) in West Kameng district and 84.73 km² (0-10 degree) and 183.87 km² (10-20 degree) in Lower Subansiri district were found suitable..

Aquaculture Research and Development

- Based on histological appetite markers such as goblet cell, zymogen granules and supra-nuclear vesicles in hindgut it could be concluded that digestion apparatus in golden mahseer juveniles starts to reorganize and get ready for second meal after 6 hours of post feeding.
- Protocol for in-house synthesis of neuropeptide (GnRH) hormone has been standardized. The synthetic hormone will be evaluated for its efficacy in spawning of golden mahseer in captivity.
- In captive conditions, it was found that the gut microbial profile of snow trout, *Schizothorax richardsonii* is highly dynamic and influenced by external factors such as water temperature, diet and chemical exposure.
- The optimum temperature for *S. richardsonii* ranged from 16.34-18.28°C based on the polynomial regression analysis of weight gain percentage and expression response of myogenic regulatory transcripts, *Srmyf6* and *Srmyog*.
- The close correlation between reproductive hormone levels and gonadal maturation stages in female and male specimens with apparent natural synchronization clearly indicates that *S. richardsonii* breeds twice in a year, possibly during September to October and February to March in the coldwater riverine habitats of the Indian Himalayan region.
- *Schizothorax plagiostomus* has been successfully bred in captivity. It was observed that *S. plagiostomus* showed growth of 40±2g with 16% better growth over *S. richardsonii* in four months.
- *Garra gotyla* has been successfully bred in captivity. The mean growth recorded after one month is 1±0.5cm in length, 2.25±0.5cm in second month and 3.8±0.5cm after the completion of third month from the date of hatching.
- RDDG, a by-product obtained in the process of producing alcohol or neutral spirit in modern grain based distillery units was investigated

for its potential as fish meal replacement in rainbow trout feeds. Based on results of growth and feed utilisation, it was found that RDDG can partially replace fish meal in trout feeds without any nutrient supplementation.

- A semi-commercial (32 m³ capacity) RAS system consisting of larger culture tanks (7 m³ water volume) and smaller (0.5 m³) experimental tanks have been designed for evaluation and demonstration of recirculatory aquaculture system as a climate resilient technology, which minimizes the usage of land and water in rainbow trout culture.
- 80 % success in triploidy induction in rainbow trout was achieved with heat shock treatment resulting in 40-46% hatching rate and 57-68% survival upto swim up fry stage.

Molecular Genetics and Biotechnological

- Six new cell penetrating peptides (CPPs) have been identified/designed from fish viral proteins using online CPP prediction tools viz. **CPPpred** and **CellPDD** and synthesized. Among six peptides, two peptides have shown potential for delivery of gene into fish cells.
- A comprehensive transcriptomic dataset for *T. putitora* has been generated by sequencing the gonads and brain of both sexes using the Illumina HiSeq 2500 system. As indicated by BUSCO run, the assembly was nearly complete with 96.9% complete matches to vertebrate orthologs.
- Developed a safe, low cost and highly efficacious anaesthesia for fishes to be used during regular sampling, surgical procedure, injection and challenge study.
- Developed sensitive, specific and rapid LAMP based detection assay for fish pathogen *Lactococcus garvieae*.
- Multiplex PCR for the rapid detection of *E. coli* in food samples was standardised.
- Nucleotide sequences of CoxI (640 bp), Cyt b (962 bp) and ATPase6/8 (842 bp) genes were sequenced from 120 samples of Chocolate mahseer. Parameters of genetic

diversity calculated individually for genes and concatenated sequence displayed high genetic diversity and revealed 16 haplotypes for CoxI, 14 haplotypes for Cytb and 15 haplotypes for ATPase6/8 gene.

- In brown trout (*Salmo trutta fario*) the analysis of three genes, COI gene (700 bp), ATPase (937bp), Cytb (919bp) showed very likeliness/ or identity within individuals and among all the populations collected from Himachal Pradesh, Jammu & Kashmir, Sikkim, Uttarakhand, and Arunachal Pradesh.
- Procedure for the culture of fish cells from different organs of snow trout (*Schizothorax richardsonii*) have been standardized.
- Illumina HiSeq high-throughput sequencing was performed to generate partial genome sequences of Assamese king fish. A total of 216,809 assembled sequences were used to search for simple sequence repeat (SSR) loci, and 50,964 SSR loci were detected in 34,573 SSR containing sequences. The tetra-nucleotides were the most frequent repeat motif, followed by di-nucleotides, pentanucleotides, hexanucleotides, and tri-nucleotides.

Disease Surveillance and Health Management

- Five PNA probes have been designed for detection and identification of *Saprolegnia* species, keeping minimum purine bases, considering melting temperature (T_m), restricting to ≤ 16 nucleobases due to the intrinsically higher T_m of PNA.
- PHMB stabilized AgNPs synthesized in the laboratory was characterized by electron microscopy and FTIR spectroscopy. The particle size was found to be in the range of 13-23 nm.
- Field trial to study the effectiveness of boric acid on trout eggs was also conducted at Sikkim. Based on the result, it can be ascertained that different species of *Saprolegnia* infect different life stages of rainbow trout and different dose should be applied based on the life stages against sporulation, germination and mycelial growth of *oomycetes* species like *Saprolegnia*

diclina and *Saproegnia parasitica*.

- Antimicrobial resistance were analysed for *E. coli*, *Staphylococcus* sp. and *Aeromonas* sp. isolated from four districts (Champawat, Udham singh nagar, Bilaspur, Kullu-Mandi) of India covering 2 states (Uttarakhand and Himachal Pradesh. Most of *E.coli* was resistant to Cefotaxime and Ampicillin. *Staphylococcus* sp. was found to show high resistance to most antibiotics. Most of the *Aeromonas* were resistant to Ampicillin/sulbactam.
- Prudent dose of antibiotic, oxytetracycline (OTC) against *A. hydrophila* was determined in experimentally challenged rainbow trout (fry and fingerling stage). Prudent dose of OTC for frys was 60-80 mg/L of water and that for fingerling 4 gm OTC/100 pound fish/day.

Important Events, Extension Activities, Trainings and Other Developments

- Scientists-Farmers-Officers Interactive Meet on Seed production and conservation of Mahseer and fish farming in the cold region of Nagaland together with an Angling Competition was organized at village Suteplenden (Longkong), Mokochung district, Nagaland on 25 April 2018.
- World Environment Day was celebrated with the theme of "Beat Plastic Pollution" at ICAR-DCFR on 5 June 2018.
- Rajbhasha Parliament Committee from New Delhi visited Nainital to inspect the implementation and usage of Hindi language as official work in the Central government organizations during 12-14 June 2018.
- Live telecast of an interaction programme of the Hon'ble Prime Minister of India with farmers of the nation was arranged for all the staffs of the Directorate on 20 June 2018.
- International Yoga Day was celebrated at ICAR-DCFR with the participation of 62 staff members, students and farmers on 21 June 2018.
- A review meeting for North-West states for Blue Revolution programme of NFDB, Hyderabad

- and Department of Animal Husbandry, Diary and Fisheries was organized at ICAR-DCFR on 28 June 2018.
- A day-long Fish Farmers' Day was celebrated at ICAR-DCFR which was participated by more than one hundred participants from different Himalayan states including Leh Ladakh, Uttarakhand, Sikkim, Assam and Meghalaya on 10 July 2018.
 - Independence day of our nation was celebrated with flag hoisting ceremony attended by all the scientist and staffs of the Directorate on 15 August 2018.
 - Swachhta Hi Seva campaign under Swachh Bharat Abhiyan was carried out with great enthusiasm at ICAR-DCFR during 15 September to 2 October 2018.
 - 31st Annual Foundation Day of ICAR-DCFR was celebrated with great enthusiasm at the Directorate on 24 September 2018.
 - Vigilance Awareness Week was celebrated at ICAR-DCFR and the staff members, villagers, students of Saraswati Public School and workers of Bhimtal area were sensitized against the immorality and corruption by organizing different competitions during 29 October to 3 November 2018.
 - World Antibiotic Awareness Week was organized at ICAR-DCFR from 12 to 18-November 2018, during which an awareness programme on Antimicrobial Resistance was conducted to sensitize participants on the effects of indiscriminate use of antibiotics on fisheries and human health on 17 November 2018.
 - Institute Management Committee Meeting was held at ICAR-DCFR on 27 November 2018.
 - On World Soil Health Day, ICAR-DCFR conducted awareness cum demonstration programme at village Dehra, Amia and Amritpur, Bhimtal on 5 December 2018.
 - Swachhta Pakhwada was observed by all the staffs and members of ICAR-DCFR with a pledge during the period 16-31 December 2018.
 - Republic Day of our nation was celebrated with flag hoisting ceremony by all the scientists and staffs of the Directorate on 26 January 2019.
 - Live telecast the inaugural program of *Pradhan Mantri Kisan Samman Nidhi* was organised by ICAR-DCFR for 100 farmers, staff members of the Directorate and public representatives of Bhimtal and nearby villages on 24 February 2019.
 - Research Advisory Committee (RAC) of ICAR-DCFR was held at the Directorate, under the chairmanship of Dr. M. Sinha on 28-29 March 2019.
 - Six ToT (Training of Trainers) programme sponsored by NFDB were organized at ICAR-DCFR, Bhimtal which were attended by more than 70 participants from different states of the country.
 - Two skill development programme for 100 farmers in two batches were organized at ICAR-DCFR, Bhimtal.
 - Two training programme of 200 hrs for 40 aquaculture workers were organized at ICAR-DCFR, Bhimtal.
 - Four months orientation course for BFSc students of Chandrashekhar Azad University of Agriculture & Technology Kanpur was conducted.

Introduction

2

2.1 Brief History

ICAR-Directorate of Coldwater Fisheries Research is a premier research institute of Indian Council of Agricultural Research, Ministry of Agriculture & Farmers Welfare, Government of India. Initially it was created as National Research Centre on Coldwater Fisheries (NRCCWF) on 24 September 1987 during the VII Five Year Plan. Keeping in view of the greater potential of coldwater fisheries in different Himalayan states and the ever expanding activities of NRCCWF, the institute was upgraded to Directorate of Coldwater Fisheries Research (DCFR) during the XI plan. The institute has well-structured organization set up having scientific, administration & coordination, monitoring and evaluation, account and drawing and disbursing section.

Since its inception, the Directorate has been working towards resource assessment and promotion of hill aquaculture for enhancing farmer's income in particular and overall development of coldwater fisheries sector in all the Himalayan states of the country. In recent years, the Directorate has made many advancements including generation of GIS maps of site suitability, ichthyofaunal distribution covering Leh and Ladakh, Jammu &



Kashmir, Himachal Pradesh, Sikkim, Uttarakhand and Arunachal Pradesh. Advancements in hill aquaculture includes captive maturation and spawning of golden mahseer through photo-thermal manipulations, development of captive breeding and rearing protocols of various coldwater fish species under controlled conditions.

The Directorate is also ISO certified (ISO 9001:2015) nodal facility in the country to carry out research investigations and to develop technologies on commercially important coldwater fish species. The Directorate has been working untiringly to address issues and challenges of coldwater fisheries through various aspects such as development of efficient and cost-effective feeds, use of modern techniques and biotechnological tools, regular disease surveillance of coldwater fish farms, identification of pathogens and development of management measures. The institute has also put sincere efforts to enhance production and productivity in hill locked areas of the Himalayan states for employment generation and sustainable management of the aquatic resources.

2.2 Location

The headquarters of ICAR-DCFR is located at Bhimtal ($29^{\circ}19'52.647''\text{N}$ $79^{\circ}33'18.083''\text{E}$), at an altitude of 1470 m asl in the district of Nainital of Uttarakhand state. The closest railway station is Kathgodam, around 22 km from Bhimtal and about 280 km from Delhi. Pantnagar is the nearest airport which is about 55 km from Bhimtal. The experimental field centre of the Directorate is at Chirapani in Champawat district ($29^{\circ}17'55.537''\text{N}$ $80^{\circ}6'8.915''\text{E}$) of Uttarakhand, which is about 150 km from Bhimtal.

2.3 Vision

Coldwater fisheries and aquaculture to be an important economic activity in upland region for livelihood security and ecotourism

2.4 Mission

To become a Centre of excellence for assessing and managing coldwater fishery resources, development technologies and models of hill aquaculture and formulating strategies for holistic growth of the sector

2.5 Mandate

To conduct basic, strategic and applied research in coldwater fisheries and aquaculture

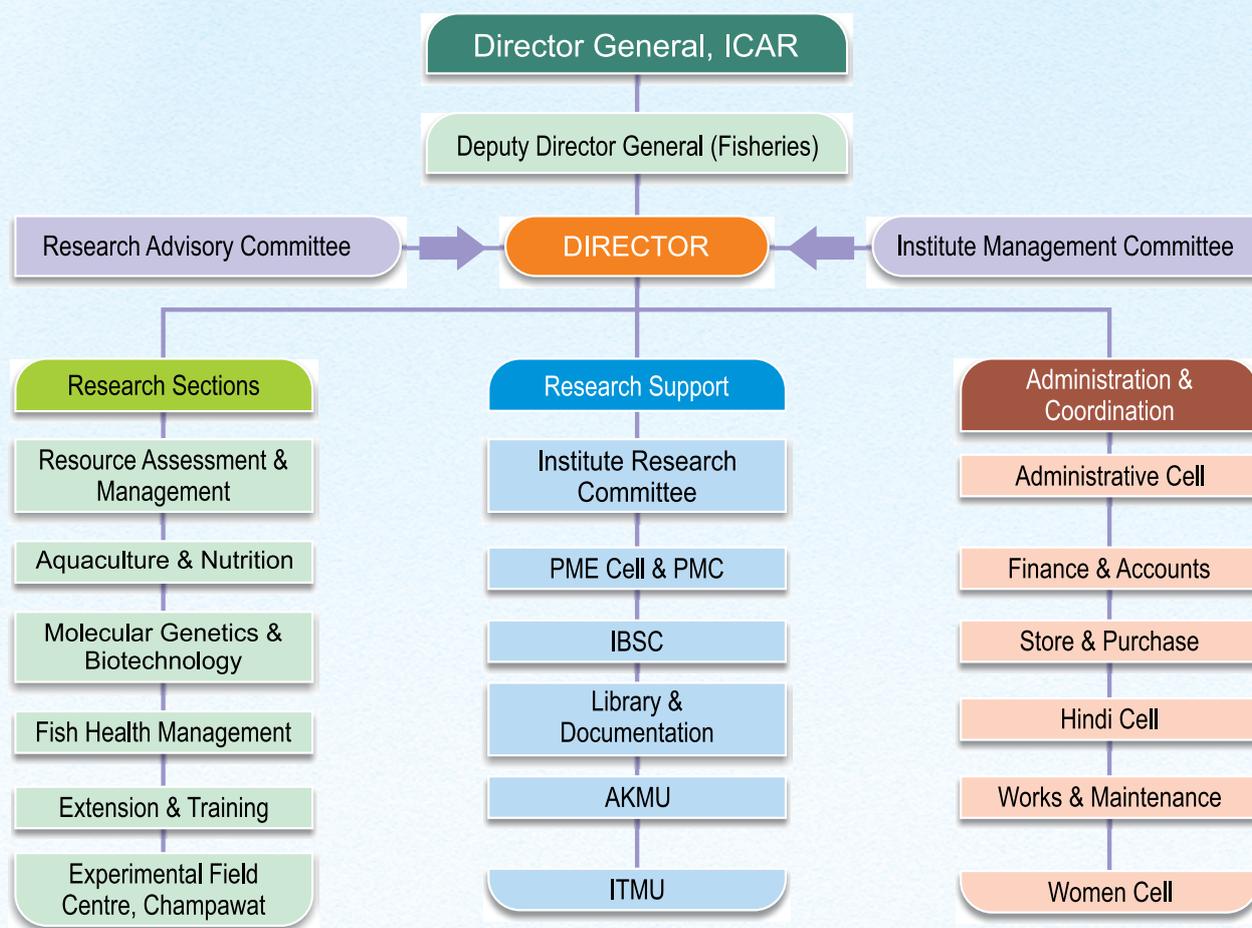
To act as repository of hill fisheries resources

Human resource development through training, education and extension

2.6 Organizational set-up

2.7 Management

As per the rules of Indian Council of Agricultural Research, Research Advisory Committee (RAC) guides the Directorate on research programmes based on national and global context of research in the thrust areas and in formulating research projects with end –to-end approach within mandate and resources of the institute. The RAC also guide in soft skills development for efficient writing of reports, highlighting outputs and impact, commercialization, and innovative approaches for handling IPR and biosafety issues. Similarly, the Institute Management Committee (IMC), under the chairmanship of the Director, supervises the various administrative and financial aspects of the Directorate. A number of other internal committees such as Institute Research Committee (IRC), Project Monitoring and Evaluation Committee and Institute Joint Staff Council (IJSC) are in place for smooth functioning and management of the institute.

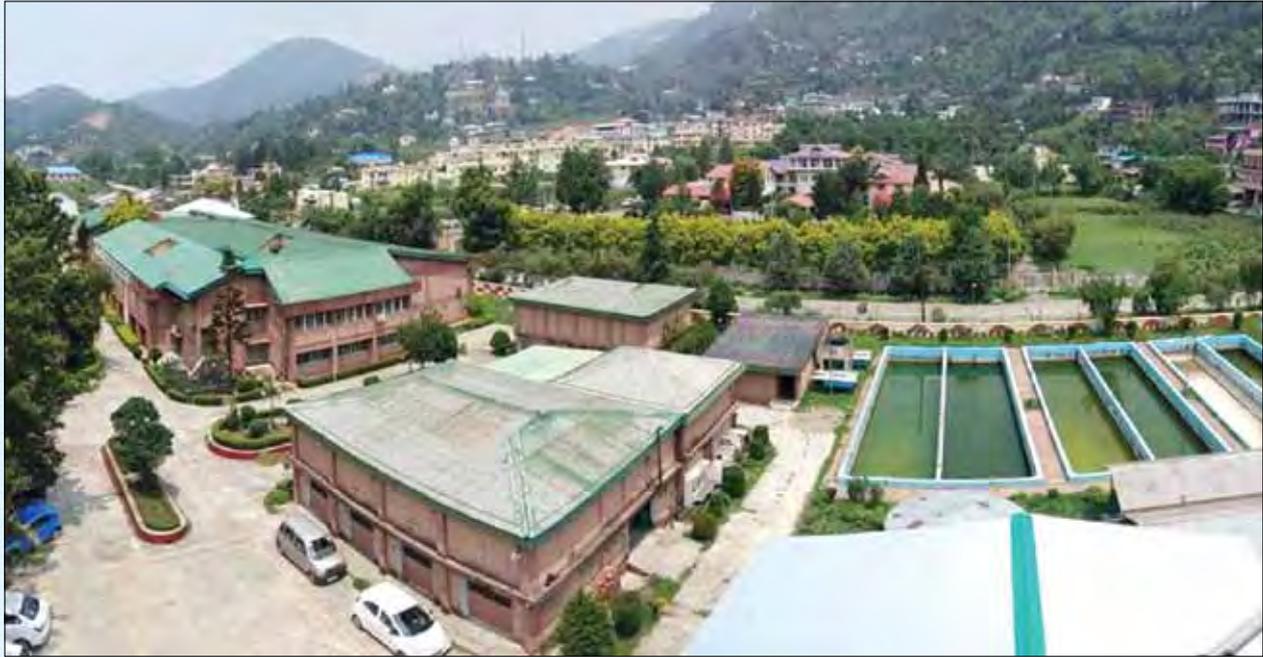


2.8 Infrastructure

Building

The main office complex of this Directorate is situated at Bhimtal. The facilities available at main complex are different laboratories; library, AKMU cell, wet labs, flow-through raceways, hatchery and well maintained aquarium open for public, guest house, committee rooms and auditorium.

A functional mahseer seed production unit is also available at a different site in Bhimtal. The Directorate has an experimental fish farm centre at Chhirapani, Champawat, Uttarakhand. The farm centre has trout hatchery, cemented nursery and grow-out raceways with water recirculation system, ponds, tanks for conducting experiments, laboratories, check dam, reservoir, meeting hall, guest house and staff quarters.



ICAR-DCFR premises at Bhimtal



Aquarium unit of ICAR-DCFR, Bhimtal



Mahseer hatchery unit of ICAR-DCFR, Bhimtal



Laboratory facilities of ICAR-DCFR, Bhimtal



Experimental fish farm centre of ICAR-DCFR at Champawat



Guest house of ICAR-DCFR, Bhimtal

Laboratory facilities

The Directorate has well equipped laboratories to support research on geo-informatics, environmental fish biology, nutrition, nutritional physiology, molecular genetics, molecular biochemistry, biotechnology, diagnostic virology, bacteriology and mycology. There is also wet laboratory facilities available in this institute which are well maintained and used for conducting research experiments in coldwater fishes. A small feed mill installed in the main campus of the Directorate is functional to meet the basic requirement of fish feed in the experimental farm.

2.9 Support Services

Prioritisation, Monitoring and Evaluation Cell

Prioritization Monitoring and Evaluation cell of the institute monitors the implementation and progress of research projects. The PME cell is responsible for maintaining the records of project reports through RPP system and for dealing with all the associated technical matters. The cell also keeps a record of publications, deputation and participation of scientists in seminars, symposia, workshop and conferences, training programmes attended as well as conducted. This cell also organizes the annual meeting of Institute Research Committee (IRC) and Research Advisory Committee (RAC) to evaluate the progress made in each research project and approve the work programme for the following year. New research proposals are also approved by the IRC after thorough evaluation of the objectives, technical programme, practical utility, manpower and financial involvement.

Agriculture Knowledge Management Unit

Agricultural Knowledge Management Unit (AKMU) of this Directorate provides the facilities for scanning and printing and internet access (BSNL) to all scientists and other staff members. It also serves as network administrator and monitors the LAN connectivity of around 50 computers at this Directorate. In AKMU cell, desktop computer and internet facilities are also available for research scholars and students working under various project/programmes. Internet facilities at the experimental field centre, Champawat is provided through BSNL. Electronic mail and messaging solutions (mail server) are also maintained

at this Directorate for secure communication via webmail.

The website of the Directorate (<http://www.dcfcr.res.in>) has been modified as per Guidelines for Indian Government Website (GIGW) and certified for Standardization Test Quality Certification (STQC). The website is also being regularly updated as per the ICAR guidelines, under the AGROWEB project. The site presents information about the Directorate's manpower, mandate, research projects, major achievements, technology generated and consultancy services. Further, the conduct of training programmes, seminars, symposia, recruitments and tender notices are being notified in the website. The Directorate's website is also linked to the website of Indian Council of Agricultural Research (<http://www.icar.org>).

Library and Documentation Unit

The library and documentation unit of the Directorate acts as a repository of literature and information. It provides services to scientists, staff members, research scholars, students and other individuals from neighboring institutes interested in scientific literature on coldwater fisheries and allied subjects. All scientific books have been catalogued with barcoding. The library also provides the facility to access free online publications and articles of many international and national journals through www.cera.jccc.in. The library maintains active reprography services by producing departmental publications and supplying required photocopies to the scientists and research scholars. An inventory of e-journals containing more than 35,000 soft copies of important fisheries research articles has been



Library facility of ICAR-DCFR, Bhimtal

developed. The documentation section is entrusted with the responsibility of publishing scientific bulletins, brochures, pamphlets, annual report and newsletters. The annual reports, special publications and technical bulletins published from time to time are being mailed to about 250 organizations, institutions, fishery agencies, etc. maintaining the exchange relationship with other research organizations.

Institute Technology Management Unit

The Institute Technology Management Unit has been constituted under the chairmanship of Director, for dealing with patents and other intellectual property rights developed at the Directorate. It is also responsible for safe transfer of technologies and for providing information about ICAR guidelines on IPR issues. Training and guidance are provided for concerned scientists with respect to IPR issues. The ITMU cell observes World Intellectual Property day on 26th April every year by organizing a special workshop to create awareness of intellectual property rights.

2.10 Staff Strength (as on 31.03.2019)

Category	Sanctioned	Filled	Vacant
Director (RMP)	1	-	1
Scientific	30	24	6
Technical	14	12	2
Administrative	13	11	2
Supporting	15	10	5
Total	73	57	16

2.11 Financial Statement for the Year 2018-19

S. No.	Head	R.E 2018-19	Actual Expenditure upto 31.03.19
	CAPITAL		
1	Works		
	Land	-	-
	Office Building	1.83	0.0
	Residential Building	-	-
2	Equipments	53.00	52.96
3	Information Technology	22.70	22.64
4	Library Books & Journals	1.05	0.43
5	Vehicle & Vessels	-	-
6	Furniture & Fixtures	22.84	22.83
I	Total Capital expenditure	101.42	98.86
II	Establishment Charges	699.68	695.59
III	Pension	71.68	71.58
	Travelling Allowance		
	Domestic TA/ Transfer TA	35.00	34.95
IV	Total TA	35.00	34.95
	Research & Operation Expenses		
	Research Expenses	115.58	115.52
	Operational Expenses	81.00	80.96

S. No.	Head	R.E 2018-19	Actual Expenditure upto 31.03.19
V	Total- Research & Operation Expenses	196.58	196.48
	Administrative Expenses		
	Infrastructure	105.21	103.03
	Communication	1.00	0.89
	Repair & Maintenance		
	Equipments, Vehicle & Others	4.80	4078
	Office Building	20.00	19.50
	Residential Building	-	-
	Minor Works	9.40	9.01
	Other (excluding TA) (instt.)	89.71	89.49
VI	Total Administrative Expenses	230.12	226.70
	Miscellaneous Expenses		
	HRD within India	3.00	2.66
	HRD (Abroad)	-	-
	Other Items (Fellowship)	-	-
	Publicity & Exhibition	1.50	1.00
	Guest House Maintenance	2.00	1.93
	Other Miscellaneous	7.03	7.02
VII	Total Misc. Expenses	13.53	12.61
	NEH (Capital)	8.00	8.00
	NEH (Revenue)	6.00	6.00
Total NEH		14.00	14.00
	TSP (Capital)	8.00	0.0
	TSP (Revenue)	17.00	16.85
Total TSP		25.00	16.85
	SCSP (Capital)	8.58	8.00
	SCSP (Revenue)	44.77	44.24
Total SCSP		53.35	52.24
Total Revenue (Grants in Aid Salaries + Grants in Aid General)		1314.36	1305.00
Total Revenue + Capital		1440.36	1419.86

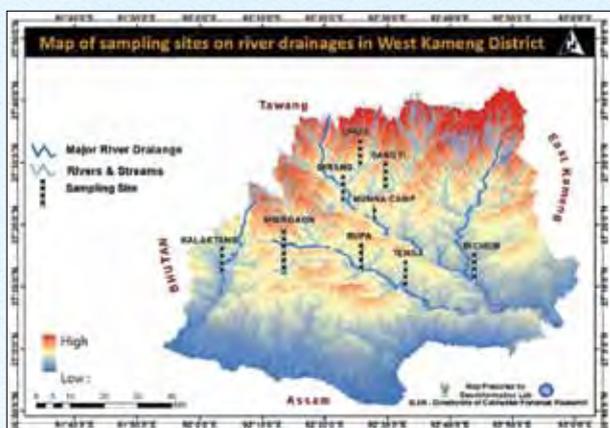
3

Research Achievements

3.1 Resource Assessment and Management

3.1.1 Assessment of population status, species diversity and habitat ecology of snow trout *Schizothorax* species in selected streams of Indian Himalayan region

Sampling area: Field sampling was carried out during 2018-19 at selected sampling stations of river Dirang *chu* (27.3537N, 92.2506E), river Sangti (27.3517N, 92.2681E), river Tenga (27.2186N, 92.43E) and river Choskorong Kho at Shergaon in West Kameng district of Arunachal Pradesh (1593±100m msl) and river Kiile at Ziro valley of Lower Subansiri district (1524±12m msl), Arunachal Pradesh to analyze the catch composition of snow trout, abiotic and biotic components of their habitats, food and feeding habits and the reproductive biology.

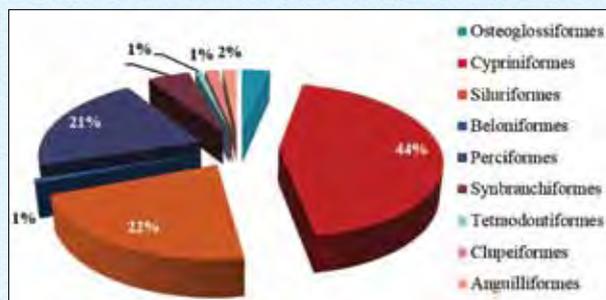


Location of sampling stations at Kameng drainage

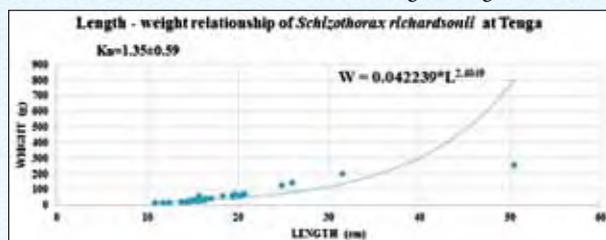


Sampling for assessment of abiotic and biotic variables at a sampling station in Kameng drainage

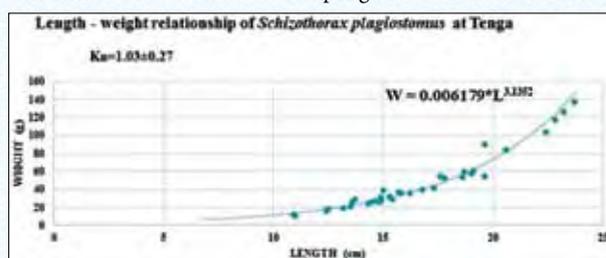
Snow trout composition: Two species of snow trout viz; *Schizothorax richardsonii* and *Schizothorax plagiostomus* have been found dominant in most of the selected sampling sites. *S. richardsonii* dominated at Shergaon region whereas *S. plagiostomus* dominated in the upper reaches of the Kameng drainage viz., river Dirang chu, river Sangti. In river Tenga, both the species were found in equal proportions. Other fish species recorded in these rivers were of *Garra* sp. *Glypthothorax* sp., *Psilorhynchus* sp., and loaches (*Schistura* sp.). The maximum sized catch of *S. richardsonii* and *S. plagiostomus* in these drainages were 45.0 cm in length and 654 gms in weight and 51.5 cm in length and 1200 gms in weight.



Distribution of fishes in Kameng drainage



Reflective length - weight relationship of *S. richardsonii* at one of the sampling stations

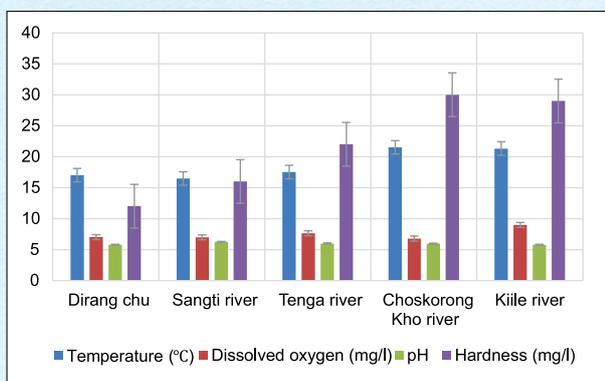


Reflective length - weight relationship of *S. plagiostomus* at one of the sampling stations

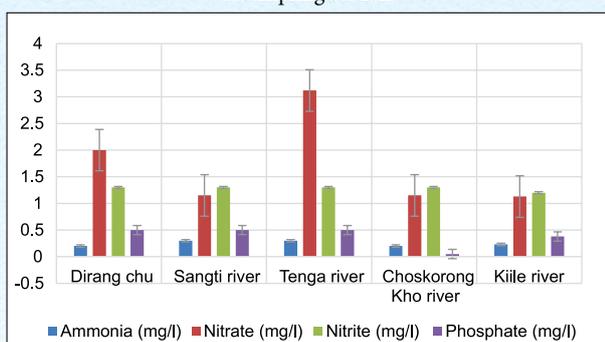
Fish samples were collected in each of the selected snow fed streams of the Kameng drainage to observe the gonadal status of the fishes. In all the three streams except the river Choskorong were found to be dominant with the male population.

	Dirang chu river	Sangti river	Tenga river	Choskorong Kho river
Samples analysed	108	68	71	92
Sex ratio (M:F)	3:1	All male	10:3	1:1

Habitat study: The abiotic variables of water in all the sampling sites of Kameng drainage and river Kille remained within the optimum level concluding good health of the water body and conducive for the abundance of the snow trout.



Graphical representation of water quality parameters at sampling stations



Graphical representation of water quality parameters at sampling stations

The biotic variable analysis of the water bodies included the plankton analysis and altogether 30 species of phytoplankton were identified under 24 families, 19 orders and 6 classes from the different sampling stations of Kameng drainage and river Kille. The species of *Navicula* (27%) dominated in river Dirang chu, *Meridion* (36%) in river Sangti, *Spirogyra* (50%) in river Tenga, *Stigeoclonium* (23%)



in river Choskorong Kho and *Spirogyra* (24%) in river Kille.

A few of the important fishing methods to catch snow trout in Arunachal Pradesh are the (i) Noose and line with a range of catch per unit effort (CPUE) of 1.8-2.2 kg/per hour/gear; (ii) Cast nets (0.5-5.2 kg/per hour/gear); (iii) Fishing trap (kholeya) with CPUE of 2.0-15.0 kg/day; (iv) Diversion of river water (neuta) to land the fishes on a perforated bamboo passage (0.5-4.2 kg/day).

3.1.2 GIS based digital data base on coldwater fishery resources of Arunachal Pradesh in North East Himalaya region

Three districts of Arunachal Pradesh viz., Tawang, West Kameng and Lower Subansiri were investigated and the aquatic resources, drainage network, land use land cover, digital elevation model, slope and potential fisheries development suitability sites were digitized and mapped using SOI toposheets, ground truthing and spatial data.

Digitised mapping of aquatic resources: Aquatic resources in the form of major river drainages, their connecting channels and streams, upland wetlands were digitized and mapped. The combined length of river network and wetland area is reflected in Table 1. Wetlands in the form of upland lakes accounting 342, 61 and 1 in numbers were found scattered at an altitude ranging between 3000-6000m MSL, 3000-4000m MSL and 500-1000m MSL in the districts of Tawang, West Kameng and Lower Subansiri respectively.

Table 1: River network length and wetland area of the selected districts

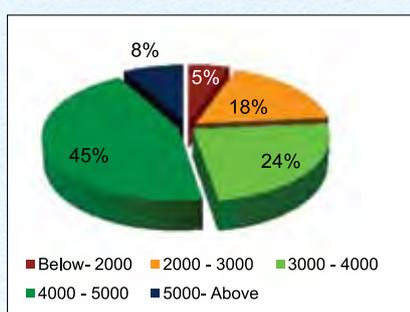
Resources	Districts		
	Tawang	West Kameng	Lower Subansiri
River network in length (km)	2006.61	3843.53	1310.97
Wetland area (ha)	1230.90	180.31	5.07

Development of Land Use Land Cover (LULC) maps: Eight categories of LULC were classified for the three districts and the area of coverage in each category is mentioned in Table 2. Forest covers 36.82%, 71.13% and 89.11% of the total area in the districts of Tawang, West Kameng and Lower Subansiri respectively. Snow area is occupied only in Tawang and West Kameng districts covering 41.13% and 2.31% of their total area. Wasteland occupies 17.58%, 19.53% and 6.55% of the total area respectively in the three districts which includes the marshy, swampy and unutilized water-logged areas. Shifting cultivation is a prominent feature in Arunachal Pradesh and is practised in 2.34%, 5.38% and 2.28% area in the three districts. Integrated rice fish culture in Lower Subansiri district covers 59.12% and is restricted within the total land area (41 sq. km) of the Ziro valley.

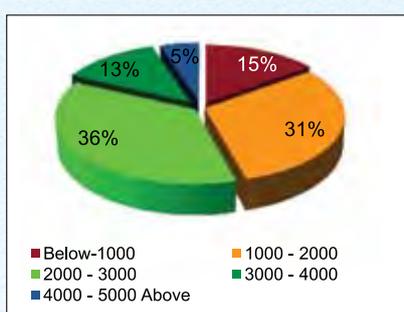
Table 2: Confusion matrix of the LULC classes

Sl. No.	LULC classes	Districts (Area in sq. km)		
		Tawang	West Kameng	Lower Subansiri
1.	Agricultural land	18.24	14.81	34.98
2.	Built up	15.88	18.12	8.39
3.	Forest	1154.14	3377.43	2369.10
4.	Grassland & Grazing land	2.00	3.42	0.99
5.	Wastelands	550.90	927.55	174.10
6.	Water bodies	30.78	41.79	10.41
7.	Shifting Cultivation	73.22	255.28	60.75
8.	Snow / Glacier area	1288.97	109.80	0.00

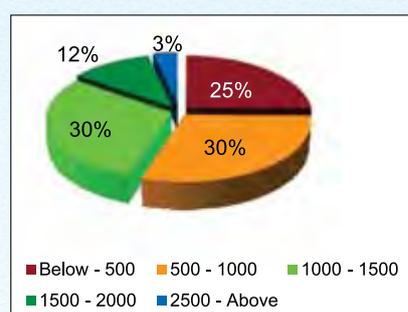
Digital Elevation Model (DEM) and Slope: The DEM examination infers that the elevation class ranging from below 1000m to 3000m encompassing 23%, 82% and above 85% of the total geographic area in the districts of Tawang, West Kameng and Lower Subansiri can provide suitable sites for undertaking aquaculture activities provided the other conditions are conducive. Furthermore, the slope class 0-20 degree in green colour comprising 40%, 52% and 58% of the total geographic area has better probability in considering potential sites for undertaking fisheries developmental activities as compared to slope class 20-30 degree and the slope class 30 degree and above of the region.



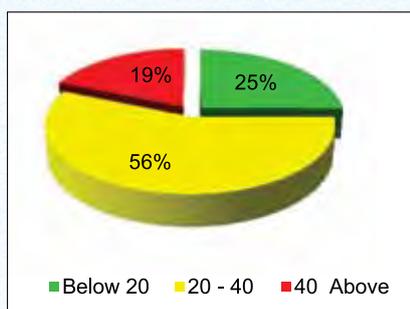
DEM of Tawang district



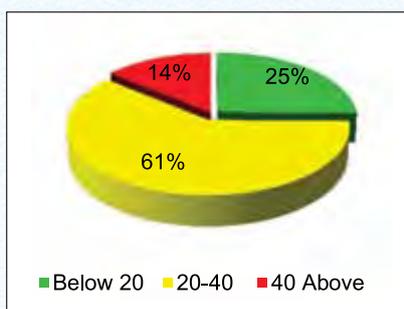
DEM of West Kameng district



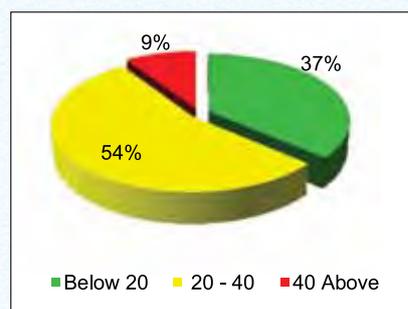
DEM of Lower Subansiri district



Slope of Tawang district



Slope of West Kameng district

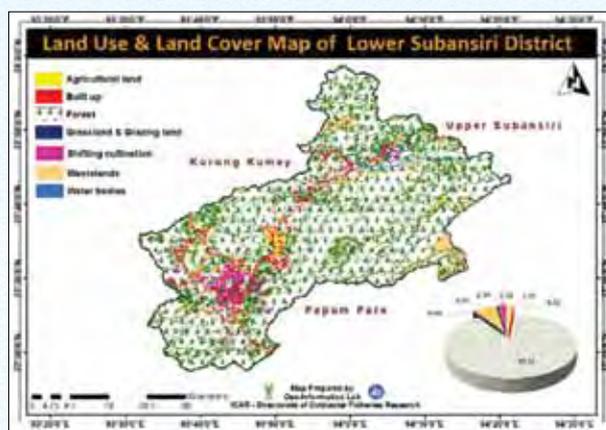
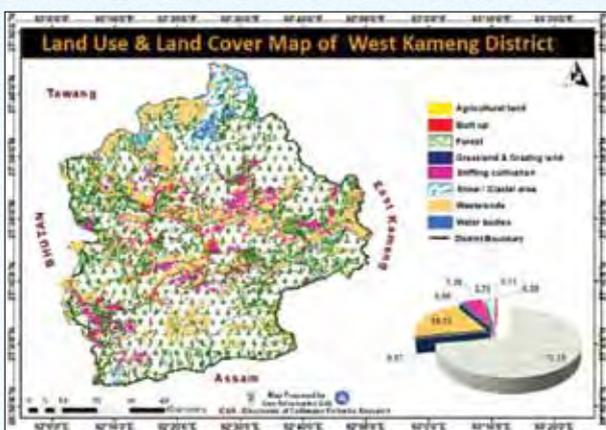
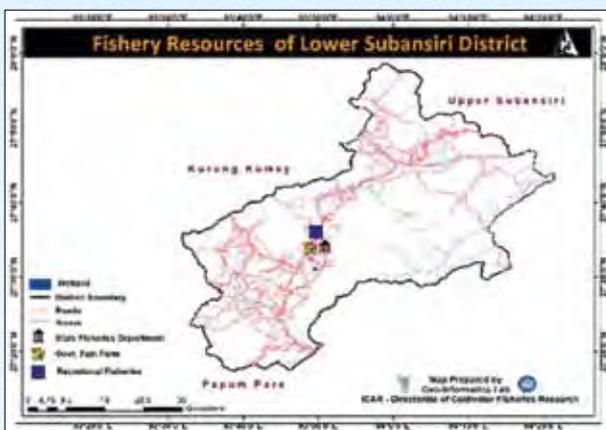
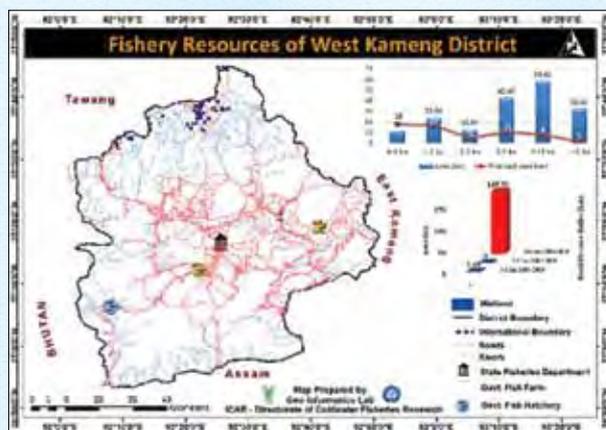
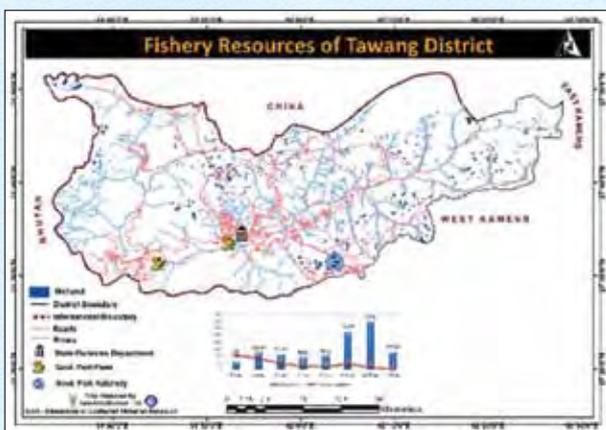


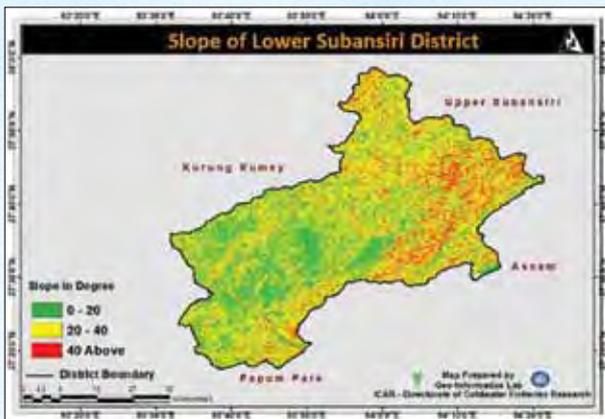
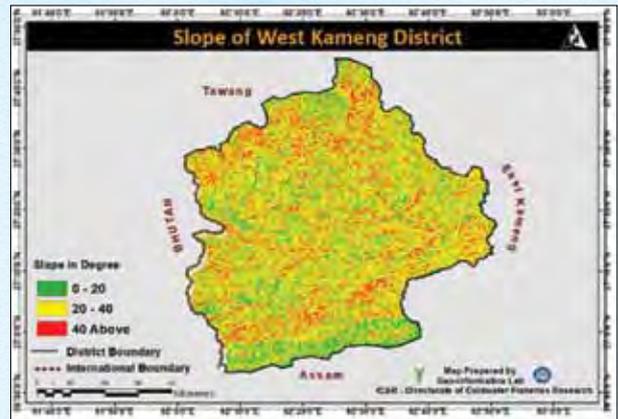
Slope of Lower Subansiri district

Mapping of potential fisheries suitability sites:

Since the districts of the state are at a higher elevation with hilly terrains and little human habitation, it is presumed that the water of the region is pollution free and of the optimum quality as desired for coldwater aquaculture operations. The other feature classes which were taken as input criteria to designate the probable potential areas for fish farming were the drainage network, road connectivity, slope of the region (0-20 degree), digital elevation model and land use land cover (agricultural land and wasteland). Based on these criteria, the selected

input feature classes were superimposed in the GIS environment and high potential areas conducive for fish farming were identified. An area of 23.64 km² (0-10 degree) and an area of 107.19 km² (10-20 degree) was found highly and moderately potential areas in the district of Tawang. Similarly, 98.76 km² (0-10 degree) and 279.77 km² (10-20 degree) area was suitable in West Kameng district and 84.73 km² (0-10 degree) and 183.87 km² (10-20 degree) area was suitable in Lower Subansiri district for aquaculture and fisheries development programmes.





3.2 Aquaculture Research and Development

3.2.1 Devising a feeding regimen based on return of appetite in golden mahseer (*Tor putitora*) larvae/juvenile

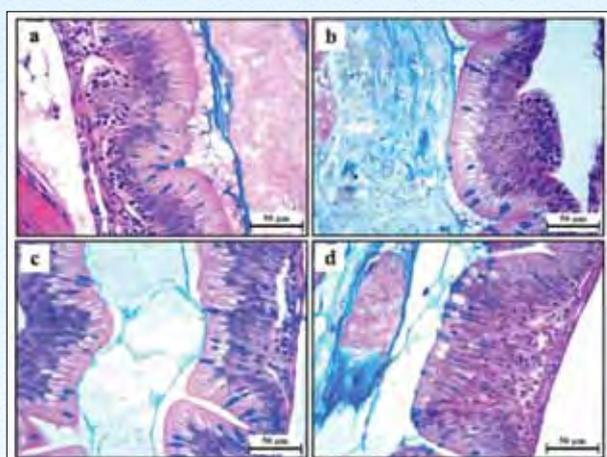
The observation of pilot study for screening and identification of appetite markers is accomplished. In observational scanning, the possible histological markers such as goblet cell dynamicity (in buccal cavity, esophagus, fore, mid and hindgut), food content, texture and color in fore, mid and hindgut, zymogen granule dynamicity in pancreas, and supra-nuclear vesicles in hindgut were checked.

Postprandial samples of 45 and 90 days post hatching (dph) golden mahseer juveniles were taken in triplicates, at 1, 6, 12, 18 and 24 hours of feeding, for identification of potential histological appetite markers such as goblet cell (GC) dynamics (esophagus, fore, mid and hindgut), luminal dynamics, pancreatic zymogen granules (PZGs), and hindgut supra-nuclear vesicles (SNVs). At 6 hours of feeding, numbers of GC in esophagus were found to be drastically lower compared to all other time, and the gradual building up of same was found after 12 hours. Foregut distention was found to be started at 1 hour, peaked at 6, and constriction continued until 24 hours. A gradual progression in density and

size of SNVs in hindgut were observed between 6 to 12 hours of feeding; in 18 to 24 hours, they were found to be gradually decreasing. The hindgut-GCs on the other hand, were seen to be frequent at 24 hours. Maximum reduction in PZGs was seen at 6 hours of feeding; and following that, the gradual increase was seen at 12, 18, and 24 hours. Long story short, in November (15-17 °C, on macerated goat liver diet), digestion in golden mahseer juvenile peaks at around 6 hours of post feeding, absorption of nutrients last from 6 to 12 hours. Based on interplay of these identified appetite markers, it can be concluded that digestion apparatus in golden mahseer juveniles starts to reorganize and get ready for second meal after 6 hours of post feeding.



Image showing the sizes of 45 and 90 dph juveniles used in the experiment

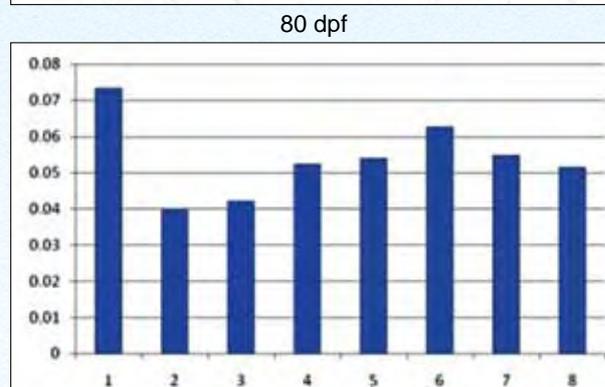
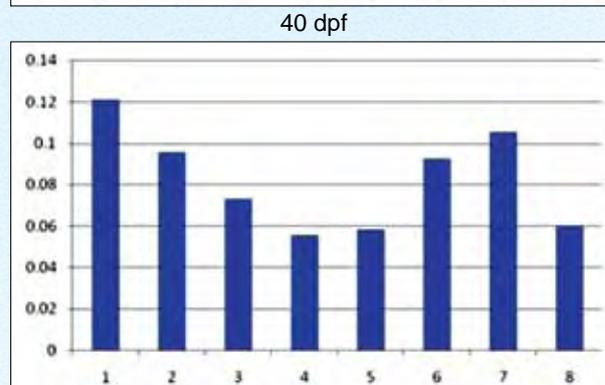
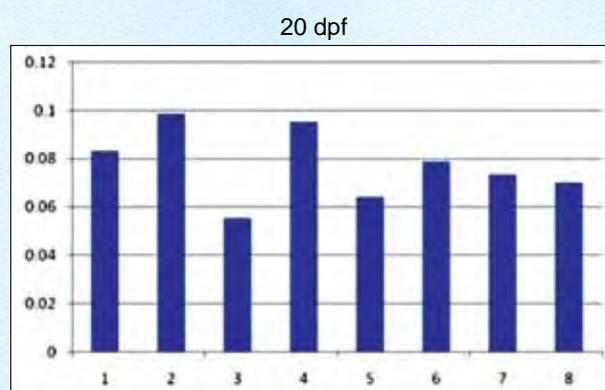


Photomicrographs of hindgut (supranuclear vesicle; SNV) of 90 days post hatched (dph) golden mahseer sampled at 1 (a), 6 (b), 12 (c) and 24 (d) hours of post feeding. There is sudden rise in SNV density from 6 (b) to 12 hours (c). SNV density at 18 hours (d) is significantly lower than 12 and the same at 24 hours (e) is moderately lower than 18 hour (d). The densities of SNV are quite similar at 24 and 1 hours. The density of SNV is seen positively correlated to luminal distension (or luminal content or chyme). Staining: hematoxylin, eosin and alcian blue.

Photomicrographs of hindgut (supranuclear vesicle; SNV) of 90 days post hatched (dph) golden mahseer sampled at 1 (a), 6 (b), 12 (c) and 24 (d) hours of post feeding. There is sudden rise in SNV

density from 6 (b) to 12 hours (c). SNV density at 18 hours (d) is significantly lower than 12 and the same at 24 hours (e) is moderately lower than 18 hour (d). The densities of SNV are quite similar at 24 and 1 hours. The density of SNV is seen positively correlated to luminal distension (or luminal content or chyme). Staining: hematoxylin, eosin and alcian blue.

An experiment to determine the feeding frequency based on enzymological and histological end points, was conducted (for first feeding, 40 and 80 dph juveniles) and samples for histological observations (five each in of eight time points; total of



Trypsin (rate/mg protein)
X-axis index
 1=1 hrs post feeding 5=8 hrs post feeding
 2=2 hrs post feeding 6=10 hrs post feeding
 3=4 hrs post feeding 7=12 hrs post feeding
 4=6 hrs post feeding 8=24 hrs post feeding

5x8x3=120), enzyme activity (of digestion related enzymes like trypsin, chymotrypsin, leucine amino peptidase, amylase and lipase) and gene expression analysis (of digestion related enzymes like trypsin, chymotrypsin, amylase and lipase). Until date the histological preparation of permanent slide is accomplished. Quantitative histological observation is under progress, enzyme activity analysis is over.

3.2.2 Scaling up the seed production of chocolate mahseer in captivity

Nearly 20 (twenty) chocolate mahseer females (weight 400-500g) were collected and transported from Simsang river, Williamnagar, Meghalaya to mahseer hatchery of ICAR-DCFR, Bhimtal in the month of July. The fishes were acclimatized for a period of one month and then reared along with the males collected from the pond culture unit of ICAR-DCFR. Broodstock rearing was carried out in two different temperatures with and without substrate

to evaluate the optimum rearing temperature for maturation induction and also to unravel the necessity of substrate for attainment of the final maturation in the female broodstock of chocolate mahseer. A recirculatory aquaculture system was constructed for



Collection of chocolate mahseer broodstock from Williamnagar, Meghalaya

providing continuous flow of water in the broodstock rearing tanks. An experiment was set up to evaluate the optimum rearing temperature for assessing the maturation induction and also to unravel the necessity of substrate for attainment of maturation. Two under-gravel based tanks were used as treatment for broodstock rearing in gravel based substrate. For without substrate treatment broodstock were reared in RAS tanks. These treatment groups were further exposed to two different acclimation temperatures

(20°C and 24°C). For broodstock maintenance, a diet was prepared containing approximately 40% protein, 11% lipid using fish meal and soya bean as protein source, fish oil and soya oil as lipid source. Blood sample was collected from 6 (six) males and females at the beginning of experimental trial.

3.2.3 Optimizing reproductive and spawning performance of golden mahseer for upscaling its seed production in captivity

Captive reared adult golden mahseer were caught from reservoir tank at Nishaula, Bhimtal and transported to the pond at DCFR's Mahseer Hatchery Complex. The collected mahseers were given 5.0 ppm KMnO₄ dip treatment before stocking into the pond.

Prepared broodstock/maturation diet for feeding the brooders. The brooders were fed twice a day @ 1-2% of the biomass. Fabricated six FRP tank installed bed biofilters using natural gravels and a series of parallel PVC pipes (~25 mm diameter) and power heads (3200 - 6000L/h capacity). The PVC plumbing design was laid on the bottom of the tanks and mixture of river gravels and sandstones (3.0 - 12 mm) were uniformly spread over it to a thickness of 13-15cm. The plumbing design was meant to enable the suctioning of water through gravels uniformly across from the tank bottom area which reduced dead zones while enhancing nitrifying bacterial growth throughout the gravel surfaces and trapping faecal matter and uneaten feed pellets. The depth of water column was maintained at 50-55 cm in circular tanks. The initial turnover rate of water in the tanks was 4 times/hour and later increased up to 6 times/ hour which resulted in more crystal clear water. After the biofilters were fabricated, they were kept for 10 days to get matured (building up of sufficient nitrifying bacteria) by adding a gravel inoculum and adding 3 ppm of total ammonia nitrogen in the form of NH₄Cl.

Fourty eight collected adult mahseer (@ 4 ♂s and 4 ♀s in each tank) were randomly distributed into three treatment (White, Blue and Green) biofilter tank groups to evaluate the best light spectra for maturation. The optimum photoperiod of 12h light & 12h dark and temperature of 25°C which were standardized in our previous experiments



Fabrication of biofilter and adult mahseers in the biofilter tank



Haul of mahseer



RAS unit for chocolate mahseer broodstock maintenance

were maintained throughout the experimental period. The water temperature was maintained using 1000W thermostatic water heaters. Fishes were fed *ad libitum* with broodstock diet twice daily. Water quality parameters such as temperature, DO, pH, nitrite, ammonia, free CO₂, hardness etc were monitored regularly.

After four months of rearing in the standardized optimum, we observed following spontaneous spawnings in the biofilter tanks:

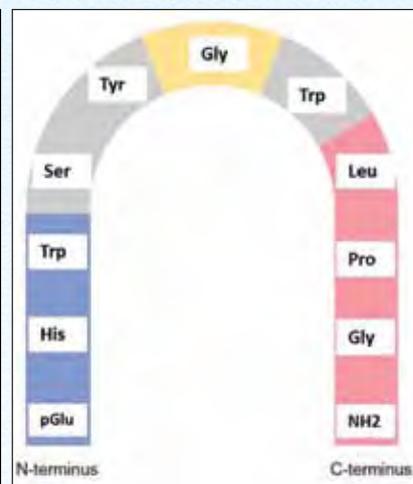
Date of spawning	Tank/Treatment	Eggs retrieval
07/01/2019	White light - round	100 eggs
13/03/2019	Green light - round	350 eggs
15/03/2019	Blue light - round	50 eggs
28/03/2019	Green light - round	275 eggs

On the other hand, protocols for in-house synthesis of neuropeptide (GnRH) hormone for

evaluating its efficacy in spawning of golden mahseer in captivity was standardized. The synthesized GnRH contains 10 amino acids. The cocktail mixture contained GnRH, dopamine inhibitor and a vehicle.



Synthesized GnRH cocktail



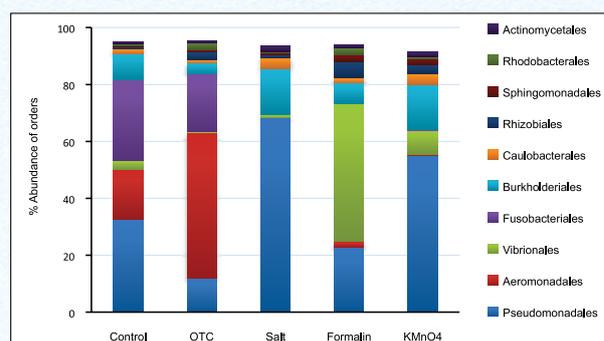
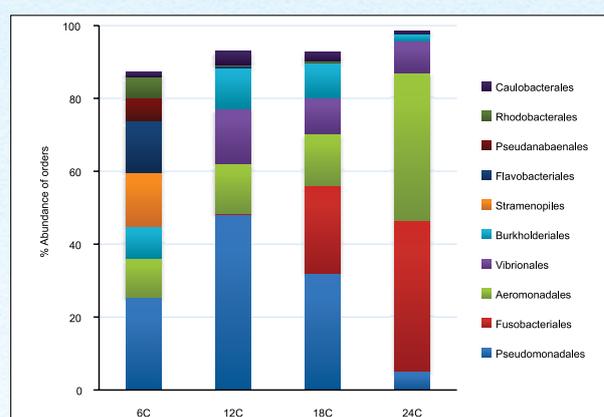
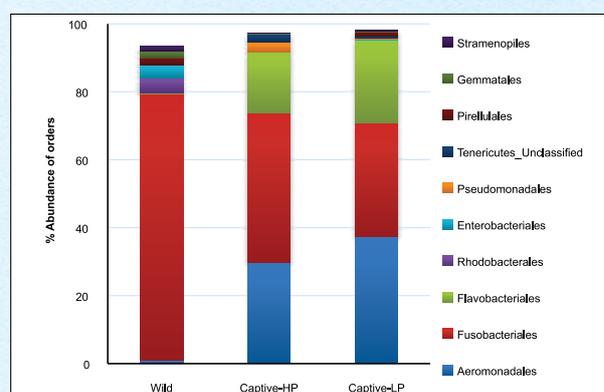
Structure of GnRH

3.2.4 Decoding the constraints in growth, maturation and captive management of snow trout (*Schizothorax richardsonii*, Gray, 1832)

3.2.4.1 Central and peripheral regulation of feed ingestion and nutrient uptake in snow trout, *Schizothorax richardsonii*

The digestive tract of fish is known to harbour a complex microbial ecosystem, which play key roles in the digestion of complex nutrients, intestinal nutrient acquisition, proliferation of enterocytes, production of secondary metabolites and defence against pathogens. However, changes in habitat and husbandry related factors are known to dynamically alter the gut microbiota of fish, with possible functional implications. In this milieu, we investigated the changes in the gut microbial composition of *Schizothorax richardsonii* due to wild-captivity transition, diet composition, rearing temperature and prophylactic treatments. In addition, other aspects such as the microbial contribution of natural feed source, intestinal zonation and the existence of resident-transient microflora were also examined using high-throughput sequencing of the V3-V4 region of bacterial 16S rRNA amplicon (Illumina MiSeq platform). The results (NCBI BioProject PRJNA380713) showed that *Cetobacterium somerae* belonging to the phylum Fusobacteria was the most abundant gut microbe in wild snow trout specimens. In fact, *C. somerae* was found to be present in the natural feed of snow trout and was the most abundant bacteria in the different intestinal segments as well as the gut content of wild snow trout. Under captive conditions, the overall bacterial diversity and the relative abundance of *Cetobacterium* was found to decrease, with concomitant increase in the abundance of *Flavobacterium* and *Aeromonads*. This pattern of change was more pronounced in fishes fed a low protein diet as compared to a high protein diet. Environmental temperature was found to have a marked influence on the gut microbial profile of snow trout. In particular, the presence/abundance of *Cetobacterium* was found to require higher ambient temperature (18-24°C). Whereas, in this study, *Enhydrobacter sp.* was found to be the predominant gut microbe at 6, 12 and 18°C. Conspicuously, an unclassified Stramenopiles

bacteria, *Flavobacterium succinicans*, *Aeromonas popoffii*, *Arthronema sp.* and *Rhodobacter sp.* were present only at the lower end of the temperature spectrum (6°C). Similarly, each prophylactic compound was found to differentially alter the gut microbiota of snow trout. *Enhydrobacter sp.* was found to be abundant in salt and KMnO₄ treated fishes, whereas an unclassified bacteria belonging to Aeromonadaceae and Pseudoalteromonadaceae was found to dominate the gut microbiota of snow trout after oxytetracycline and formalin, respectively. The abundance of *Cetobacterium sp.* was drastically reduced after salt, formalin and KMnO₄ bath treatment. Overall, through this series of investigations, we elucidated that the gut microbial composition of snow trout is highly

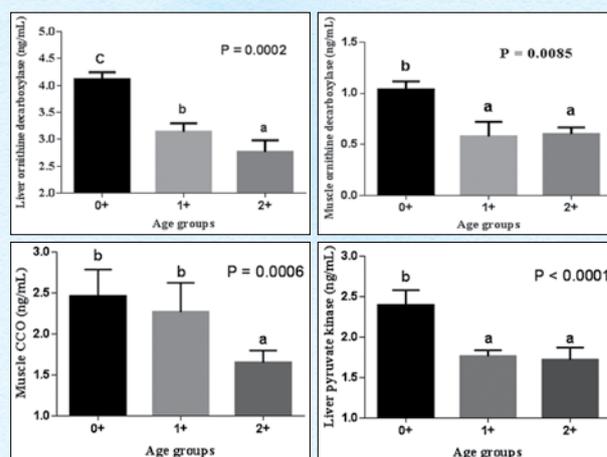


dynamic and is modified by external factors such as water temperature, diet and chemical exposure, in captive conditions.

3.2.4.2 Nutrient mediated metabolic regulation of growth and well-being in snow trout *Schizothorax richardsonii*

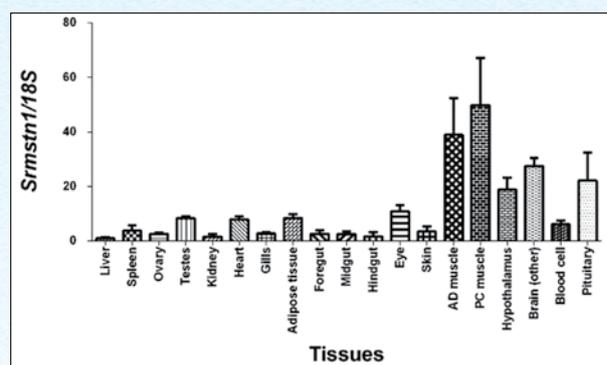
In order to assess the size/age dependent growth of snow trout, three size/age groups viz. 0+, 1+ and 2+ were collected from wild during April, 2018. Nearly 100 snow trout (*Schizothorax richardsonii*) were collected from the Chaffi, Nainital area of river Gola and Sipra (Bhowali range). Electro-fishing was employed for fish collection. The transportation stress and mortality was minimized using oxygen packing. They were acclimated and maintained in the wet laboratory. Tissue samples such as liver and muscle were collected and homogenised in PBS for analysis of growth and metabolism correlating enzymes like cytochrome C oxidase, ornithine decarboxylase, pyruvate kinase.

The enzyme ornithine decarboxylase (ODC) is a key regulatory enzyme for growth in higher vertebrates, playing an essential and rate-limiting role in the biosynthesis of polyamines. ODC activity and polyamine levels are elevated during periods of rapid growth and increased protein synthesis. The activity of ornithine decarboxylase in liver of snow trout was significantly ($p = 0.0002$) higher in 0+ group compared to 1+ and 2+ groups. Similarly, the ODC activity in muscle of 0+ group was also significantly ($p = 0.0085$) higher. Cytochrome c oxidase (CCO) activity, an aerobic enzyme reflecting metabolic capacity, is positively correlated with growth rate in fish. The enzyme has been estimated in snow trout of different age groups. The activity of CCO in liver was significantly ($p = 0.0006$) higher in 0+ group compared to 1+ and 2+ groups. Concurrently, the CCO activity in muscle of 0+ group was also significantly ($p = 0.003$) higher, but activity in 1+ and 2+ groups were similar. On the other hand, the pyruvate kinase activity in liver and muscle of 0+ groups of snow trout was significantly higher than the 1+ and 2+ groups.



3.2.4.3 Myogenic regulation and protein turnover of muscle growth in snow trout *Schizothorax richardsonii*

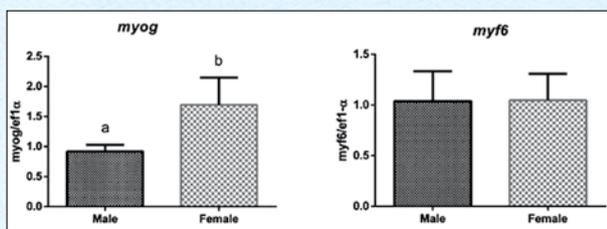
To understand the muscle growth mechanism in slow growing cyprinid *Schizothorax richardsonii* five myogenic regulatory transcripts (*myod*, *myog*, *myf5*, *myf6* and *mstn1*) were characterised. Their spatial expression pattern revealed that they are highly expressed in muscle tissue indicating muscle specific role of these MRFs. On the other hand, the expression pattern of myostatin 1 (*Srmstn1*) was ubiquitous with the highest expression in skeletal muscle followed by brain and other tissues, indicating the secondary role of myostatin in non-skeletal tissues.



Relative fold expression of *Srmstn1* in different tissues of *Schizothorax richardsonii*

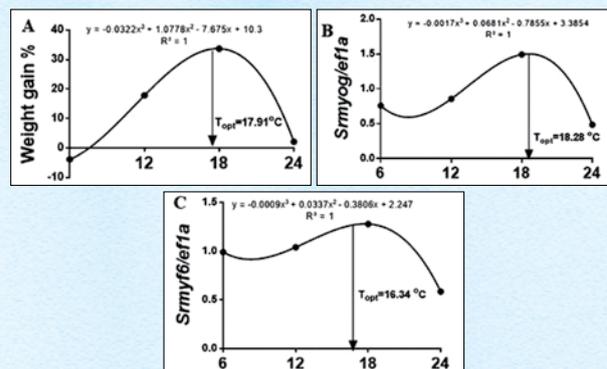
Based on the observed phenotypic differences, the expression patterns of these MRFs were studied with respect to intrinsic factors such as sex and age. The *Srmyog* was highly expressed in females as compared to males, whereas *Srmstn1* expression

was conversely lower in females, correlating with observed sex-dependent growth differences in snow trout. In terms of age/size classification, only *Srmyf6* expression was higher in older-bigger (2+ age) individuals than younger-smaller (0+age) fish, while other myogenic factors were not significantly different between the age/size groups. These results indicate possible linkage between the sex and age related growth differences and myogenic regulation. To understand the effect of starvation and re-feeding on MRFs expression and growth response, snow trout were either fed or starved for 3 weeks and subsequently re-fed for 3 weeks. The snow trout exhibited compensatory growth response to re-feeding after three weeks of starvation. Changes in plasma triglycerides, viscero-somatic index and hepatocytes volume clearly indicated the mobilization of visceral and hepatic fat to meet the maintenance energy requirement during starvation. Re-feeding normalised the plasma triglyceride level, VSI and hepatocytes volume. *Srmyf6* expression significantly increased in response to short term re-feeding and *Srmstn1* transcript abundance decreased upon long term re-feeding, indicating the changes in myosatellite activity in response to re-feeding.



Relative fold expression of *Srmyog* and *Srmyf6* mRNA in white muscles (fast muscle fibre) of different sex of *Schizothorax richardsonii*

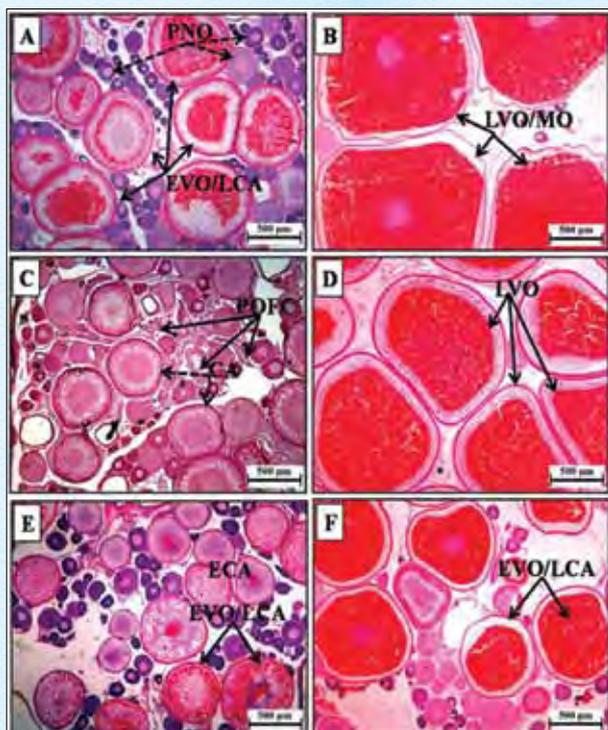
The thermal regulation of MRFs and *Srmstn1* were studied in snow trout reared at four different temperatures 6, 12, 18 and 24°C for 75 days. The weight gain and SGR of snow trout were the highest in 18°C and lowest in 6 and 24°C. Expression pattern of all the MRFs and *Srmstn1* were highest in 18°C or lower temperatures and lowest expression were detected in fishes reared at 24°C. Based on the polynomial regression analysis of weight gain percentage and expression response of *Srmyf6* and *Srmyog*, the optimum temperature for *S. richardsonii* ranged from 16.34-18.28°C.



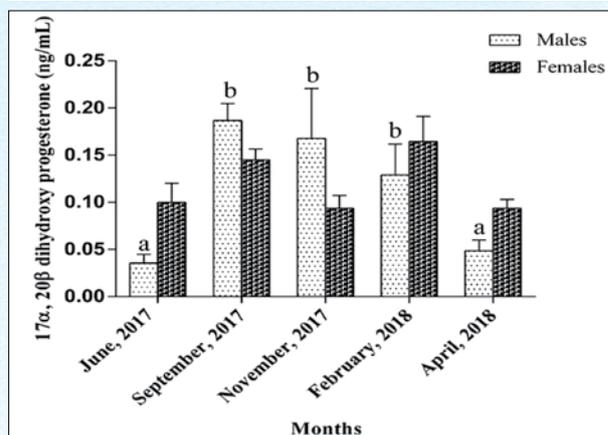
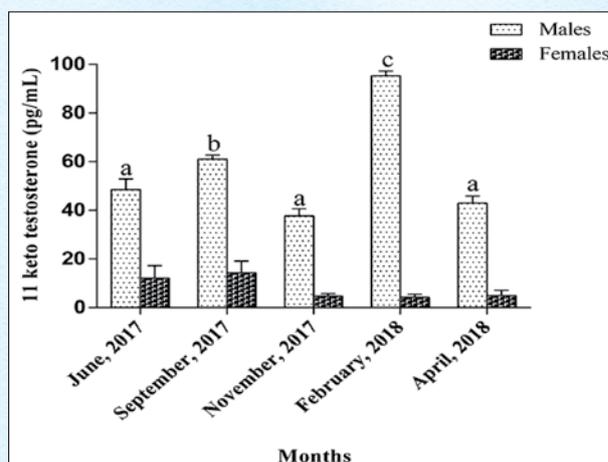
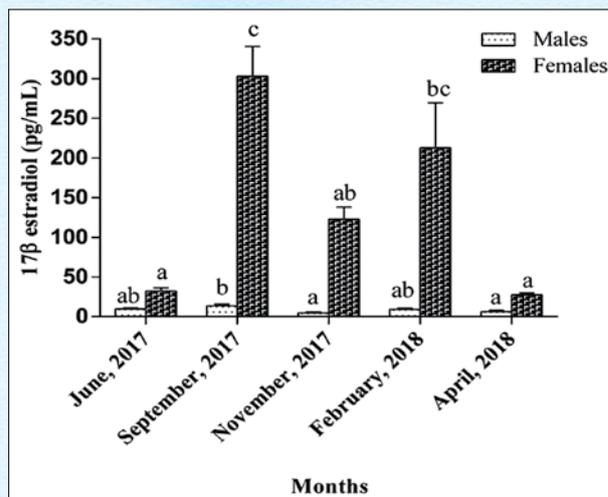
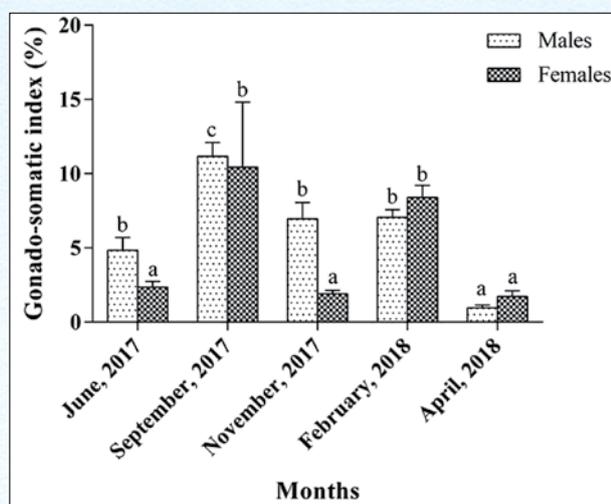
Polynomial regression between rearing temperature and different response variables. Polynomial regression between temperature and (A) weight gain %, (B) *Srmyog*, (C) *Srmyf6* relative fold expression.

3.2.4.4 Endocrine aspects of growth and maturity of snow trout, *Schizothorax richardsonii*

In the present study, periodic changes in reproductive hormone levels, gonadal histology and gonado-somatic index (GSI) of male and female snow trout *Schizothorax richardsonii* was examined to ascertain the annual cycle of gonadal development and reproductive status in their natural habitat (Kalsa rivulet of river Gola in Central Himalayas). In females, there were coherent changes in the plasma levels of 17 β estradiol and vitellogenin, along with GSI (relative size of ovary), oocyte maturation and vitellogenic progression, collectively indicating two distinct maturation or breeding peaks during the month of September and February. Coinciding with this, in males, plasma levels of 11-keto testosterone (11-KT) exhibited similar bimodal peaks, with highest GSI values in September. However, plasma 17 α , 20 β -dihydroxyprogesterone levels of males were found to be persistently high from September to February, in tandem with relatively bigger testicular lobules which were filled with spermatozoa. This observation suggests the potential presence of matured oozing males over a longer period, unlike in the case of females. Negligible levels of 17 β estradiol were also detected in males. Overall, the close correlation between reproductive hormone levels and gonadal maturation stages in female and male specimens with apparent natural synchronization clearly indicates that *S. richardsonii* breeds twice in a year, possibly during September to October and February to March in the coldwater riverine habitats of the Indian Himalayan region.



Photomicrographs of ovarian sections of female *S. richardsonii* collected periodically in June (A), September (B), November (C), February (D) and April (E&F). A: Initiation of primary growth stage with late cortical alveolar (LCA)/early vitellogenic oocytes (EVO) from the milieu of resting perinucleolar oocytes (PNOs). B: Advanced stages of oocytes mostly late vitellogenic (LVO) to maturing oocytes (MO; germinal vesicle starting to move off the center) along with some resting PNOs. C: Reinitiation of growth and development of oocytes after ovulation is evident from the presence of postovulatory follicle complex (POFC), along with some early cortical alveolar (ECA) oocytes within the matrix of resting PNO. D: Advanced stages of oocytes mostly (LVO) along with some resting PNOs. E: Reinitiation of growth and development of oocytes after ovulation is evident from the presence of ECA and LCA/EVO oocytes within the matrix of resting PNOs. F: More advanced stage of oogenesis as compared to E (from same season), evident from the presence of LCA/EVO oocytes within the matrix of resting PNOs and some ECA oocytes.



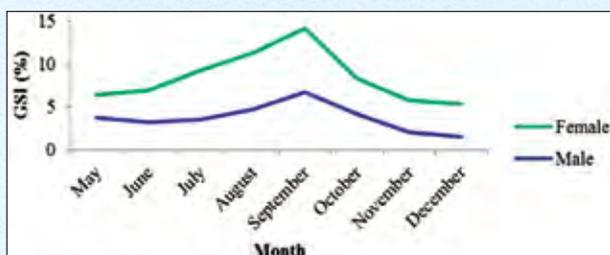
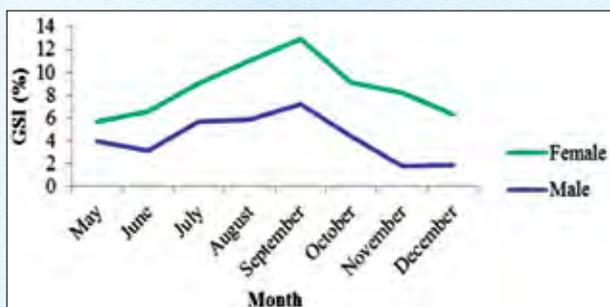
Periodic changes in gonado-somatic index (GSI) and reproductive hormone levels of male and female snow trout *Schizothorax richardsonii*

3.2.5 Growth potential and breeding performance of *S. progastus* and *S. plagiostomus*

Collection of fish: Fish were collected from the Alaknanda stream near Nand Prayag and Sirodi and Chafi stream. Female specimen of *Schizothorax progastus* and *Schizothorax plagiostomus* ranges as 120-365 mm in length and 24-640 g in weight,

while male specimen showed comparatively inferior size having 86-320 mm length and 18-370 g weight. Female specimen of *Schizothorax richardsonii* ranging from 80-325 mm in length and 18-340 g in weight, and male specimen showing comparatively inferior size having 60-280 mm length and 10-110 g weight were also collected.

Comparative study of gonadosomatic index (GSI): A comparative study of gonadosomatic index (GSI) of captive reared brooders of *S. progastus* and *S. plagiostomus* has been done during the period of May 2018 to December 2018. The GSI values of *S. progastus* ranges from 5.72% to 12.91% in females and 1.80% to 7.24% in males with the peak during the month of September. The GSI values of *S. plagiostomus* ranges from 6.33% to 14.10% in females and 2.52% to 8.74% in male stock.



Gonadosomatic index (GSI) of captive reared brooders of (A) *S. progastus* and (B) *S. plagiostomus*

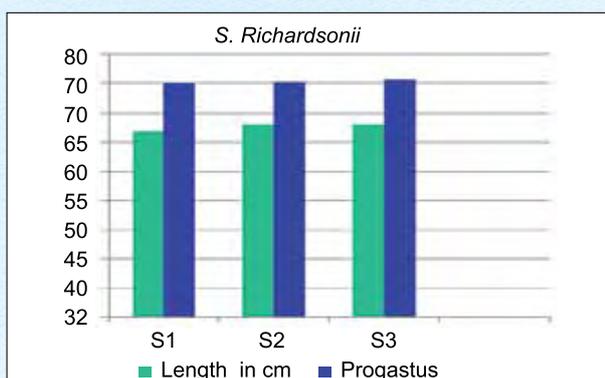
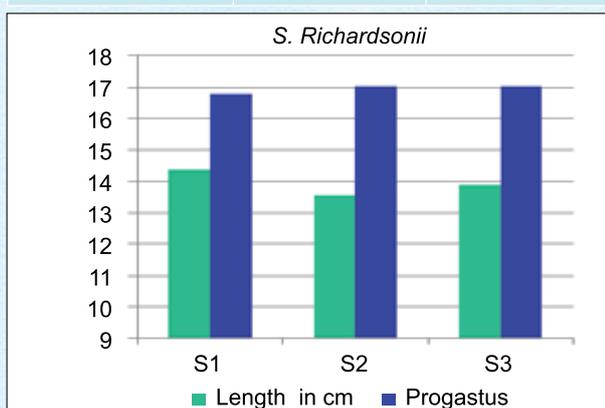
Breeding trial with *S. plagiostomus*: The fish was observed to spawn during the month of September at a water temperature range of 18.0°C-21.5°C. Three females were stripped during third week of September. The average number of egg laying in this group ranges as 14,000-18,000 per kg body weight of the fish. Hatching takes place within 11-18 days at water temperature of 18-21°C. The size of eggs is also quite large (3.7-4.0 mm). It was observed that the fully ripe eggs, which were orange in colour started degeneration within 2-5 days, if not extruded in time. The over-ripe eggs turned dull orange in colour. In general, eggs are spherical,

translucent, and swell within fifteen minutes in water after extrusion and fertilization. Survival rate of fry to fingerlings was found to be 24%.



Comparative growth in field conditions: Field experiment was conducted with stocking of yearlings of *S. richardsonii* and *S. plagiostomus* at the stocking density of 40 fish /m³ for 120 days. The rearing period was of four months (October – January). In four months *S. plagiostomus* showed growth of 40±2g with 16% better growth over *S. richardsonii*.

Parameters/Species	<i>S. plagiostomus</i>	<i>S. richardsonii</i>
Initial length	11.05±0.7 cm	7.9±0.4cm
Final length	16.9±0.3cm	13.9±0.4cm
Initial weight	35.4±0.6g	32.9±0.7g
Final weight	75.4±0.5g	67.4±0.9g
Weight gain in 120 days	40.0g	34.5g



Comparative growth performance of yearlings of *S. richardsonii* and *S. plagiostomus*

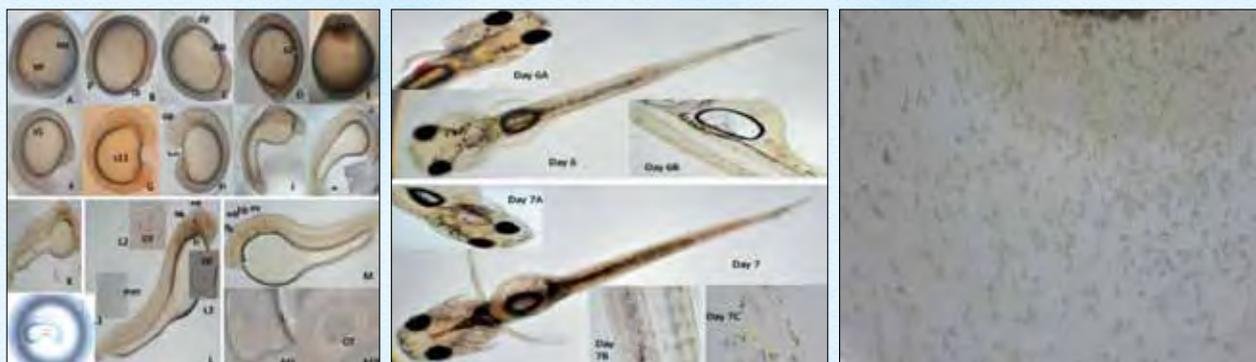
3.2.6 Embryonic development, breeding and seed production of Sucker head, *Garra gotyla*

Garra gotyla is a high valued food fish in Indian uplands as well as a popular ornamental fish species among aquarists. It is reported to be exported from India under the ornamental trade name of 'Stone fish or gotyla' with an export price of USD 2-25 per piece. Particularly, *Garra* is well known for its excellent algae cleaning abilities and therefore it can be proficiently used as a coldwater aquarium cleaner fish candidate in cold water aquarium, where the temperature is generally low (10-23°C). *G. gotyla* is commonly found in several Trans-Himalayan countries namely India, Pakistan, Bangladesh, upper Myanmar, Afghanistan, Bhutan and Nepal. The fish is characterized by elongated body, well developed

mouth with median proboscis and a transverse lobe at tip, sectorial disc on chin and two pair of barbells. Adults inhabit fast flowing streams with boulders and rocks along the Himalayan ranges. They are hardy; prefer cooler water, peaceful, bottom feeder and algae eating fish. As per IUCN Red list (2012), this fish has been categorized as least concern. However, it is apparently considered vulnerable in North-eastern and West Bengal in 2015. This was the first effort for studying their reproductive biology, captive breeding and ontogenic development. The fertilization rate is 70-75% and hatching rate is 85-90%. And mature fertilized ova are 0.8-1.0 mm in diameter. The complete embryonic development took 1420 min and the emerging sac fry was measured 3 mm in length and five day old larva was measured 6 mm in length. The mean growth recorded after one month is 1±0.5cm in length, 2.25±0.5cm in second month and 3.8±0.5cm after the completion of third month from the date of hatching.



Monitoring for maturity confirmation and breeding of *Garra gotyla*



Embryonic developmental stage of *Garra gotyla*

3.2.7 Development and validation of cost effective feed formulation for rainbow trout based on commercial scale industrial by-products

In India, at present, rainbow trout feeds are predominantly based on fish meal (FM) as the major source of protein. However, the availability, pricing and quality of FM is known to fluctuate greatly, necessitating their substitution with alternate protein sources, which are less expensive, nutritionally adequate and sustainably available. In this regard, we have selected high protein distiller's dried grains derived from rice (RDDG) and a bacterial meal derived from methane oxidising bacteria (String Pro) for investigations on FM replacement in rainbow trout feeds. In terms of nutritional composition, RDDG has 62-65% crude protein, 1.5-3% crude lipid, 9-12% starch, 2.5-6% fibre and 2.5-6% ash. Lysine and cysteine-methionine content was found to be low. String Pro meal had 72.5% crude protein, ~8% crude fat, 3.3% starch, 3.8% fibre and 7% ash. Lysine and cysteine-methionine content was lower than that

of fish meal, but all the other amino acids were in equal or excess levels. For further studies on these alternate protein sources, the Directorate has signed a memorandum of understanding with S.P.Y. Agro Industries Ltd., Nandyal, Andhra Pradesh (high protein RDDG producer) and String Bio Pvt. Ltd.,



Preparation of experimental feeds

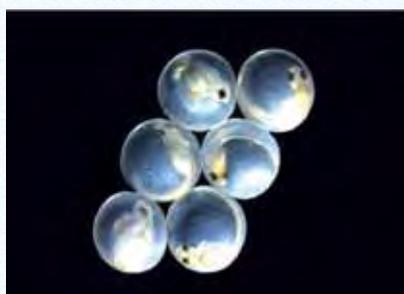
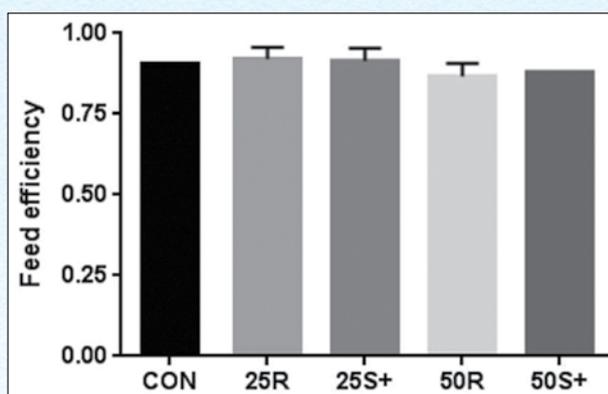
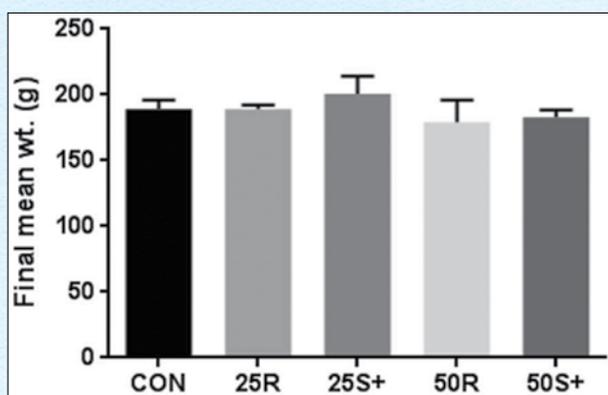
Bengaluru, Karnataka (methanotrophic bacterial meal producer).

In the first feeding trial under this project, we evaluated the potential of RDDG, a by-product obtained in the process of producing alcohol or neutral spirit in modern grain based distillery units, as a FM substitute in trout feeds. For that, we fed triplicate groups of juvenile rainbow trout (mean initial weight ~ 30 g) either of five experimental diets (Control, completely FM based; 25R, 25% FM replacement; 25S+, 25% FM replacement + limiting nutrients + phytase; 50R, 50% FM replacement; and 50S+, 50% FM replacement + limiting nutrients + phytase) for 12 weeks. The trial was conducted in an experimental RAS system, with water temperature maintained at $17 \pm 2^\circ\text{C}$. At the end, our results indicated that growth (weight gain, SGR and TGC) and feed utilisation (feed intake and FCR) indices



Feeding trial set up at ICAR-DCFR, Bhimtal

were not significantly different between the dietary groups. With respect to protein utilisation, protein efficiency ratio was highest in the 25R group and lowest in 50S+ group. However, whole body protein content, protein retention and nitrogen gain was not significantly different between the dietary groups. Supplementation of limiting nutrients (lysine, methionine and phosphorus) and phytase was apparently associated with excess nitrogen loss in the 25S+ and 50S+ diet fed groups. Also, lipid retention was found to be significantly lower in the 25S+ and 50S+ group. Whereas, whole body lipid content and daily lipid gain was found to be significantly higher in the control and 25R diet fed groups. As the RDDG inclusion level in the diet increased, phosphorus retention was found to increase, with concurrent reduction in phosphorus loss, suggesting a lower phosphorus load in the effluent water. Further



Garra annandalei brooder, developing embryo and larvae

analyses of amino acid profile in feed and whole body samples are in progress. Moreover, blood and tissue samples have been collected and stored for analysis of plasma metabolites and intestinal histology. Preliminarily, based on growth and feed utilisation, we conclude that it is possible to partially replace FM in trout feeds using RDDG, without any nutrient supplementation.

3.2.8 Network project on Ornamental fish breeding and culture (NPOFBC): ICAR- DCFR component: -Development of breeding protocol and larval rearing technique of the selected indigenous hill stream ornamental loaches, suckers and hill trouts

Seed production of *Garra annandalei* was successfully achieved in month of July, 2018. Around 50 *G. annandalei* larvae are being maintained in the larval rearing unit. Larvae are fed with both prepared feed and *Chlorella* algae. *Chlorella* culture is maintained in the indoor lighted condition with red LED light in BG 11 medium. Further to achieve a consistent seed production more *Garra* species were collected from Bramhaputra river of Assam Arunachal border and transported to ICAR-DCFR. Species level identification through morphological observation revealed two species of *Garra* i.e. *G. annandalei* and *Garra birostris*. *G. birostris* was identified by its prominent proboscis whereas such structure was absent in *G. annandalei*. Further, males of *G. birostris* show distinguished red horny tubercles on proboscis. The fish species are reared in under gravel aquarium units in larval rearing unit of ICAR-DCFR for broodstock development. *Garra annandalei* were found to be single spawner having fecundity of around 610-700 eggs per fish (weight 14-16g) with egg size of 1150-1186.91µm. Fertilization rate was observed as 60 % and hatching rate was 90%.

Schistura obliquofascia (3 -5 g) were collected from rivers Gaula (29°17'25" N - 79°37'43" E),



Garra birostris brooder



Indoor Chlorella algae culture for larval rearing of *Garra annandalei*



Chocolate Mahseer Fry

Kumaon region of Central Indian Himalayas, Uttarakhand during month of Dec-March, 2019. A subtotal of 50 *S. obliquofascia* are maintained in 2 under-gravel filter based aquarium tanks. Fishes are fed with the DCFR prepared feed for maintenance. A periodical monitoring is carried out to observe the morphological indicators of maturation.

3.3 Molecular Genetics and Biotechnology

3.3.1 Development of fish viral peptide based nano system for intracellular delivery of biomolecules

A total number of six new CPPs have been identified/ designed from fish viral proteins using online CPP prediction tools viz. **CPPpred and CellPDD**. These predicted CPPs have been synthesized in the laboratory using Fmoc chemistry and purified by reversed-phase HPLC.

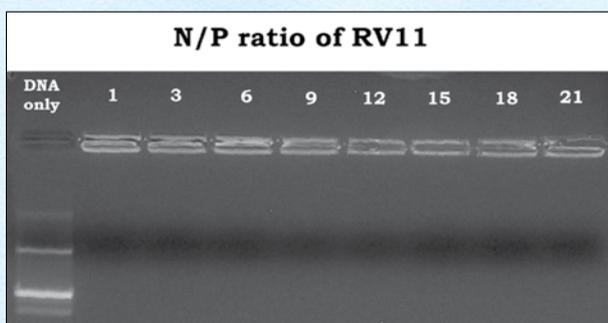
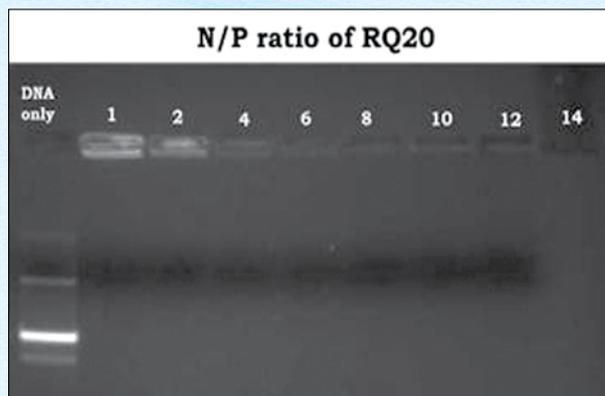
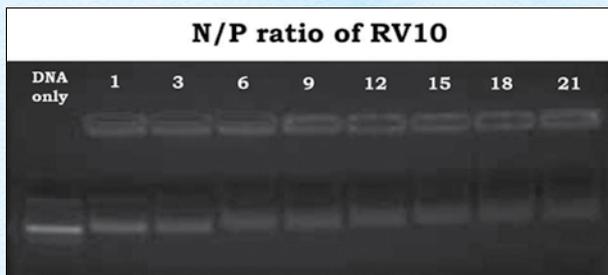
Table: Designing of cell penetrating peptides from fish viral proteins using online CPP prediction tools

CPP ID	Net Charge	Fish viral source
RV10	6	Red spotted grouper nervous necrosis virus
RV11	8	Epizootic hematopoietic necrosis virus
KR14Y	6	Spring viremia of carp virus
KR14W	6	Spring viremia of carp virus
WT17	8	Infectious hematopoietic necrosis virus
RQ20	6	Infectious pancreatic necrosis virus

To determine whether CPPs/nano systems were able to interact with plasmid DNA (pDNA) to form noncovalent complexes *in-vitro*, gel retardation assays were performed. Peptide-plasmid complexes were formed in sodium phosphate buffer. pHMGFP green fluorescent protein expressing plasmid was propagated. Briefly, plasmid DNA was mixed peptide nano system with standardized nitrogen (NH₃⁺)/phosphate (PO₄⁻) (N/P) ratio in phosphate buffer and allowed to form complexes at 37°C for 60 minutes. The complex mixtures were electrophoresed on a 0.8% agarose gel for 60 min. The results demonstrate that all CPPs/nano systems are able to interact with DNA to form stable complexes *in vitro*.

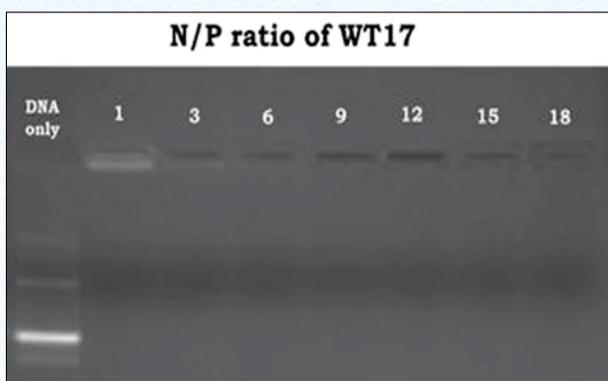
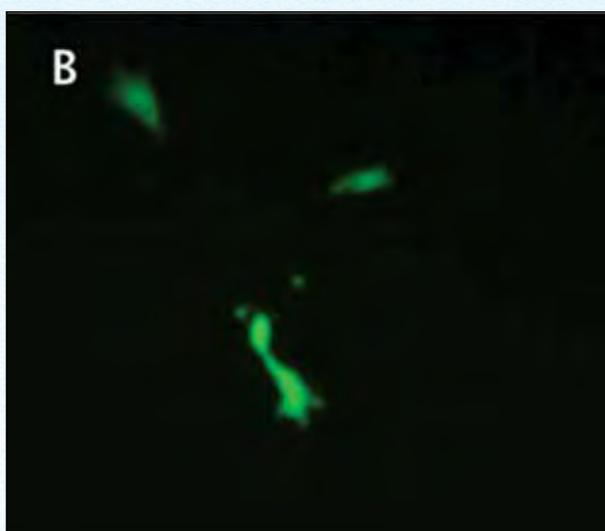
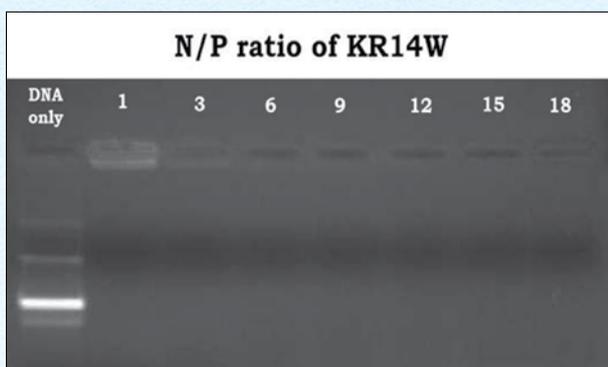
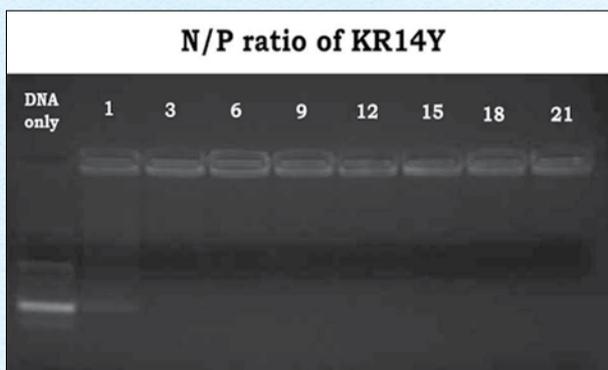


Large scale purification of plasmid DNA (pHMGFP)



Gel retardation assay to determine the interaction of the CPPs with plasmid DNA *in vitro*

Among six peptides, the peptides RV11 and RQ20 have shown potential in delivery of gene into fish cells. In future, these peptides will be modified to make it a suitable peptide based delivery vectors for various biological applications.



Delivery of green fluorescent protein (GFP) gene into EPC cells by RQ20 (A) and RV11 (B) peptides

3.3.2 Transcriptome based sex specific marker discovery in golden mahseer (*Tor putitora*)

Tor putitora is one of the commercially important preferred game fish, endemic to India and found in most Trans-Himalayan countries ranging from Afghanistan to Myanmar. In the last decade, skewed sex ratios have been reported in various populations of golden mahseer. In order to uncover potential sex-related mechanisms and unravel the molecular differences between male and female fishes, we generated a comprehensive transcriptomic dataset for *T. putitora* by sequencing the gonads and brain of both sexes using the Illumina HiSeq 2500 system. The transcriptome sequencing of twelve cDNA libraries generated 1,542,676,164 raw reads (paired-end, 100 bp). Pre-processing of raw reads resulted in 1,497,389,188 high-quality reads. The clean reads were used for the initial transcriptome assembly (Minimum transcript length 300bp), which consisted of 703,696 putative transcripts (N50: 1648 nucleotides, mean length: 1022 nucleotides). After transcript quality assessment and filtering process, our initial dataset was limited to 316,548 contigs (N50: 1129; mean length: 846 nucleotides). To evaluate the accuracy of the final assembled sequences (transcripts), all cleaned reads were aligned onto the transcripts using Bowtie2 software. A high percentage of cleaned reads (81.4%) were successfully back-mapped. In addition, BUSCO run indicated that the assembly was nearly complete with 96.9% complete matches of vertebrate orthologs. This highly reliable transcriptome assembly will be useful for future genomic and genetic studies of golden mahseer and related species. This data would also serve as an important reference for studies on sex differentiation and gonadal maturation mechanisms in golden mahseer.

3.3.3 Gender specific transcriptomic response to environmental stress in golden mahseer (*Tor putitora*)

The Himalayan or putitor mahseer *Tor putitora* (Hamilton) is considered as the most important and popular freshwater game fish of the Indian subcontinent. However, due to its overexploitation, its natural population has significantly declined leading to the status of 'endangered' species in the IUCN red list. In addition to this, differential

and skewed sex ratio has also been observed and reported in golden mahseer natural population from different rivers of the Himalayas. It was found that males are mostly predominant than females in natural environment. It is also interesting to note that the sex ratio has not only declined but also likely to have reversed in last four decades. Earlier report indicated comparatively higher females than males in natural water bodies. In recent studies, it was reported that breeding phenology of golden mahseer in natural water body appears to have undergone a transition over the last ten decades. The climatic factors play important role in life cycle events of the species as it provides necessary environmental cues for essential activities such as, reproduction and migration. It is also known that these environmental cues often drive gonadal maturation and either precedes or delays spawning by several days or weeks. Global climate change poses many threats to biodiversity and altering the physical, chemical, and biological characteristics of freshwater habitats, with concomitant effects on freshwater and diadromous fishes. Fishes being ectotherms, the associated impacts affecting temperature niche may be particularly challenging because they are metabolically sensitive to environmental temperature. Their likely response to the challenges associated with global climate change is in many ways dependent upon the effects of new environmental inputs on essential physiological processes. 'Plasticity' and 'evolutionary changes' are two primary mechanisms by which populations might alter phenotypes in response to environmental change. It is widely accepted that phenotypic plasticity is a characteristic of most living organisms and it can aid population persistence during periods of rapid environmental change. The present study was envisaged to examine the gender specific response to temperature stress in golden mahseer. The skewed sex ratio in mahseer may be a response to the environmental warming. Since, temperature plays an important role in sex determination and identified as an important factor in determining sex ratios in many other species of fishes, amphibians, and reptiles. Therefore it would be essential to understand the sex specific gene expression against environmental stress in mahseer which would further be helpful in understanding the genetic

factors contributing to the skewed sex ratio as well as the sex specific environmental resistance against environmental stress. The golden mahseer were collected from hatchery stock and acclimatized at 25°C for a period of three months in the wet lab facility of DCFR. During the acclimatization period fishes were fed on the artificial diets *ab libitum*. The water quality was maintained with adequate aeration to avoid any mortality. A total of 24 specimens (avg. wt. 17±0.5 g) were maintained in a separate tank (around 90 l capacity) for temperature treatment. Fishes were exposed to a particular temperature stress for a period of 8 weeks. After the completion of first experiment a total of 18 specimens were sacrificed and different tissue samples (Brain, gonads, kidney, liver, spleen, heart, muscle, intestine & gills) were collected and preserved in RNA later and stored in -80°C for further analysis. Histological identification of sexual maturation stages of gonads is in progress.

3.4 Disease Surveillance and Health Management

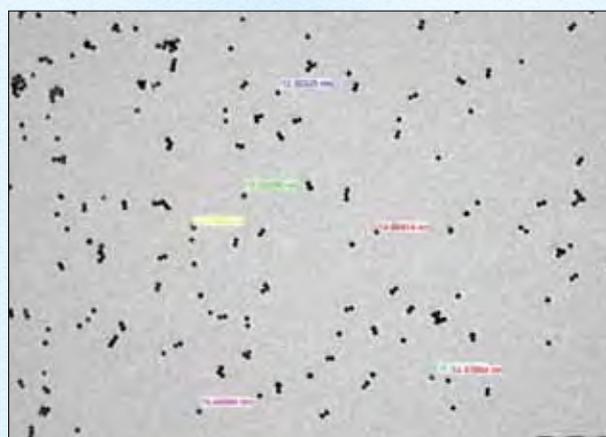
3.4.1 Development of rapid assays for detection & identification of *Saprolegnia* species

Designing of peptide nucleic acid (PNA) probes: ITS region of *Saprolegnia parasitica* was amplified and the purified PCR product was subjected to two-way sequencing. A contig of 736 bp was obtained from the sequences which is submitted to NCBI (Accession no. MK163535). The sequence was aligned with other sequences of *Saprolegnia* available at NCBI and was analyzed for key differences in the sequences. Based on the sequences, five probes have been designed keeping minimum purine bases, considering melting temperature (T_m), restricting to ≤16 nucleobases due to the intrinsically higher T_m of PNA.

Optimization of protocols for synthesis of PNA probes: Protocol for in house synthesis of PNA probes was optimized using a model PNA sequence. Coupling of the activated Fmoc protected PNA monomers (A,T,G,C, 3 equivalent in excess) was performed on pre-swollen resin in dry DMF for 1 h, after which the de-protection of the Fmoc group was performed using a 20% piperidine

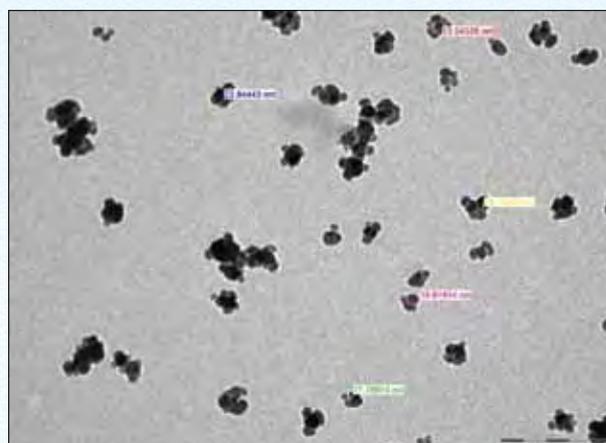
solution in DMF (v/v) for next monomer coupling. The synthesis steps were repeated until the desired length of PNA was complete. PNA was then cleaved from the resin, and then precipitated by dried and chilled diethyl ether. The precipitated PNA was dissolved in HPLC-grade water and purified by RP-HPLC.

TEM characterization of in house synthesized gold nanoparticles: AuNPs synthesized in the laboratory was characterized spectrometrically at 520 nm. The size of the AuNP was also determined by transmission electron microscopy. The particles size was found to be in the range of 12-15 nm but the aggregated AuNP showed a larger size.



3.4.2 Evaluation of antimicrobial activities of nano & polymer-based formulation against *Saprolegniasis*

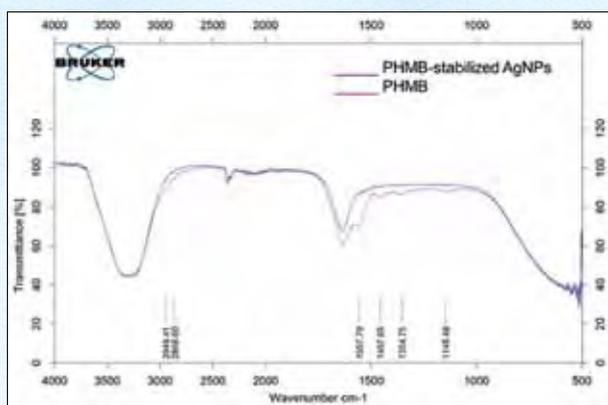
Characterization of laboratory synthesized PHMB stabilized silver nano particles (AgNPs): PHMB stabilized AgNPs synthesized in the laboratory was characterized by electron microscopy. The particle



Transmission electron micrograph of PHMB-stabilized silver nanoparticles

size was found to be in the range of 13-23 nm.

The coating of silver nanoparticles with PHMB was characterized using FTIR spectroscopy which is a valuable tool to characterize various functional groups in molecules. PHMB showed sharp spectral peaks between 1,300 and 1,700 cm^{-1} as shown in its FTIR spectrum. Its strong absorption peak around 1,540 cm^{-1} is disappeared in PHMB-modified Ag NPs indicating the interaction of imine groups of PHMB with the nanoparticles.

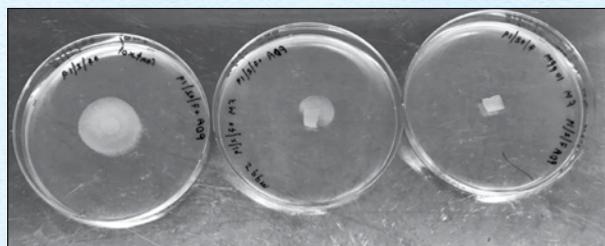


FTIR spectra of PHMB and PHMB-stabilized silver nanoparticles

3.4.3 Evaluation of available anti-fungal agents and herbs for their efficacy against oomycetes infection in farmed rainbow trout

To generate information of most promising treatment for different life stages of rainbow trout against saprolegniasis :Around four species of *Saprolegnia* were isolated from different life stages of rainbow trout, *Onchorhynchus mykiss* and molecularly characterised. 5000 eggs of rainbow trout were collected from Dachigaon, Jammu & Kashmir for the study. First, *in-vivo* experiment trial were conducted to test the safety of continuous exposure of live eggs to different concentration of boric acid, and also to test the efficacy of boric acid with regards to its ability to control the spread of *Saprolegnia diclina* infections between rainbow trout eggs/yolk sac. Second, experiment was designed to test the efficacy of boric acid & formalin to the safety of continuous exposure of rainbow trout fry to delineate at what concentration this chemical/drug/product protect rainbow trout fry from becoming infected by *Saprolegnia* spores during a natural outbreaks of Saprolegniasis. Challenge experiment models has been developed for above efficacy

study. Field trial were also conducted to study the effectiveness of boric acid on trout eggs at hatchery of Mr. Sandup Bhutia from Sribadam, Sikkim. He has been advised to use boric acid to control the outbreaks of saprolegniasis in eggs of rainbow trout. Around 75% eggs were survived after boric acid treatment. Based on the result, it could be ascertain that different species of *Saprolegnia* infect different life stages of rainbow trout and different dose should be applied based on the life stages against sporulation, germination and mycelial growth of oomycetes species like *Saprolegnia diclina* and *Saprolegnia parasitica*.



Determination of MIC of herbal bioactive compound

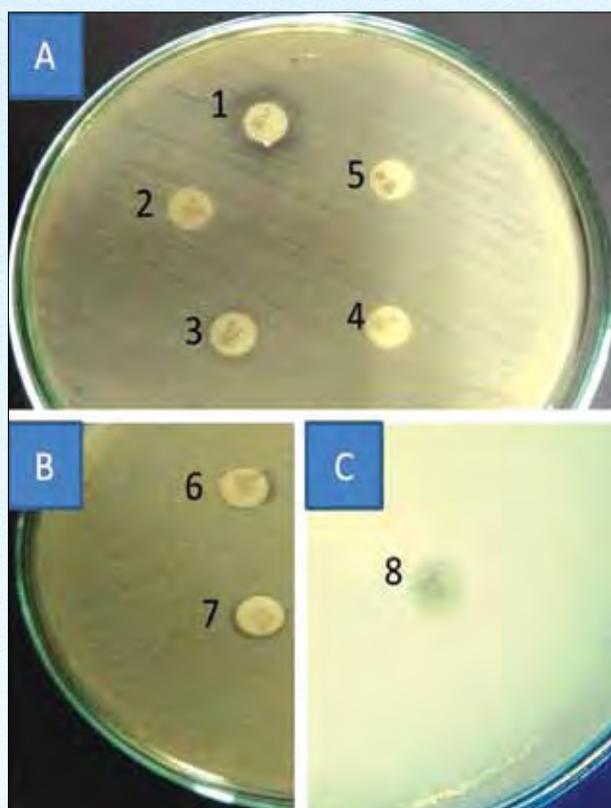


Challenge experiment of rainbow trout eggs with *Saprolegnia* species

3.4.4 Network programme on antimicrobial resistance (AMR) in fishes under INFAAR

Under this project, prevalence and antimicrobial resistance of *Escherichia coli*, *Staphylococcus* sp and *Aeromonas* sp isolated from four districts (Champawat, Udham singh nagar, Bilaspur, Kullu-

Mandi) of India covering 2 states (Uttarakhand and Himachal Pradesh) was determined. A total of 29 farms were sampled and 29 fish samples were analysed during the reporting period for isolation of *E. coli*, *Staphylococcus* sp and *Aeromonas* sp. During the course of study, a total of 68 bacterial isolates were analysed comprising of 26 isolates of *E. coli*, 19 isolates of *Staphylococcus* sp and 23 isolates of *Aeromonas* sp. Multiplex PCR was standardized in Diagnostic Bacteriology Laboratory for identification of *E. coli*. A total of 26 isolates of *E. coli* were analyzed for antimicrobial resistance for 17 antibiotics. Most of them were resistant to Cefotaxime and Ampicillin. A total of 19 isolates of *Staphylococcus* sp. were analyzed for antimicrobial resistance for 10 antibiotics. High resistance was observed for most antibiotics. A total of 23 isolates of *Aeromonas* were analyzed for antimicrobial resistance for 14 antibiotics. Most of them were resistant to Ampicillin/sulbactam.



Antimicrobial resistance of *Staphylococcus*, *Aeromonas* and *Escherichia coli* were examined by disc diffusion method. 1-Chloramphenicol, 2-Oxacillin, 3-Linezolid, 4-Erythromycin, 5-Penicillin G, 6-Cephalothin, 7-Ampicillin/Sulbactam, 8-Ampicillin. A-*Staphylococcus* sp. showing multi-drug resistance to Chloramphenicol, Oxacillin, Linezolid, Erythromycin and Penicillin G B- *Aeromonas* sp. showing resistance to Cephalothin and Ampicillin/Sulbactam, C- *Escherichia coli* showing resistance to Ampicillin

3.5 Outreach Activities

Fish Genetic stock

Genomics technologies have aided the species identification as well as their population characterization using species-specific markers. These markers further help in identification of populations preferably for fish breeding and conservation programs. Eventually marker-assisted stock selection facilitated in faster recovery of rapidly declining populations and, development of healthy stocks for hatchery propagation. *Neolissochilus hexagonolepis* known as 'Chocolate mahseer' is abundant in the Northeast region of India particularly in the Brahmaputra river basin and widely reported from Southeast Asia. It is also a popular food and sports fish and serves as a rich source of protein. Moreover, it has a potential to serve as a candidate species in the aquaculture system. However, the species is rapidly declining and ranked as nearly threatened in IUCN red list. Therefore, it is desirable to obtain the genetic background of this species for the implementation of any effective conservation and management programs. Thus, the genetic structure, population history and genetic diversity of geographically isolated populations of the Chocolate mahseer from Northeast India were studied using mitochondrial (ATPase 6/8; COI & Cytb) and microsatellite markers. Chocolate mahseer were collected from nine geographically isolated populations in the drainages of Assam, Arunachal Pradesh and Meghalaya in India. Nucleotide sequences of CoxI (640 bp), Cyt b (962 bp) and ATPase6/8 (842 bp) genes were sequenced from 120 samples of Chocolate mahseer. Parameters of genetic diversity calculated individually for genes and concatenated sequence displayed high genetic diversity and revealed 16 haplotypes for CoxI, 14 haplotypes for Cytb and 15 haplotypes for ATPase6/8 gene. Analysis of concatenated gene sequence revealed a total of 33 haplotypes with significant haplotype diversity (H_d) (0.8880 ± 0.019). Nucleotide diversity (mean π) (0.0280) of concatenated mitochondrial genes ranged from 0.0000 to 0.0104. The phylogeographic inference was performed using the median-joining network which depicted six major groups. The pairwise F_{ST} comparison of populations using concatenated

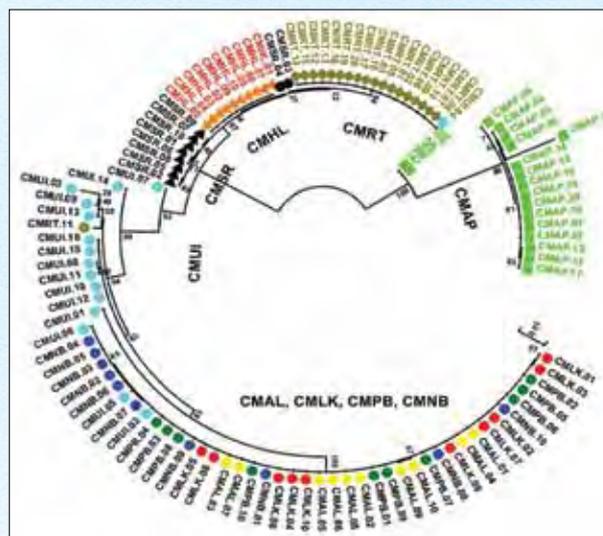
mitochondrial gene sequences showed significant genetic difference 0.9088 ($p < .05$) with range 0.0741–0.9959. The hierarchical AMOVA revealed 89.33% genetic variations among the populations and 10.67% within the populations where the majority of genetic variations were contributed by differences among populations.



Chocolate mahseer (*Neolissochilus hexagonolepis*)

Further, we developed novel polymorphic microsatellite markers by next-generation sequencing (NGS) using Illumina Miseq platform to assess genetic diversity estimation. Partial genome sequencing of chocolate mahseer produced a total of 8,269,226 reads containing 2,489,037,026 bases which were deposited to the Short Read Archive (SRA) of NCBI under the accession number PRJNA490417. Perl script MISA identified a total of 184,882 microsatellite loci, where 52,164 contigs comprised more than one SSR loci. In the identified contigs most frequently encountered repeat motifs were tetra-nucleotides (54.86%) followed by di-nucleotides (44.53%), and trinucleotides (0.61%). All contigs representing novel 25 SSR loci were submitted separately to the NCBI GenBank database (acc. MH746735-MH746760). A total of 25 polymorphic loci (mean PIC = 0.933) were identified and 21 loci were used to genotype 194 individuals from seven populations of chocolate mahseer from different geographical locations of Northeast India. We observed high genetic diversity across the loci with a mean number of alleles per locus = 23; mean observed (H_o) and expected heterozygosity (H_e) were 0.557 and

0.939 respectively, with no evidence of individual loci deviating significantly from Hardy–Weinberg equilibrium. Analyses indicate substantial pairwise Nei’s genetic distance and moderate to high levels of genetic differentiation among sample locations (mean $F_{ST} = 0.23$). Population structure analysis identified five major groups that can be considered as different conservation units while formulating any management measures. Furthermore, the migration analysis inferred that there is no active migration among the studied populations. Results suggested that *N. hexagonolepis* population in particular from Dikrong river, Sankosh river and Umiam river, having high genetic differentiation can serve as founder of a hatchery stock to maintain substantial genetic variations in the descendant populations. However, the populations from Amlayee and Wah Pamblang (Meghalaya) need immediate attention



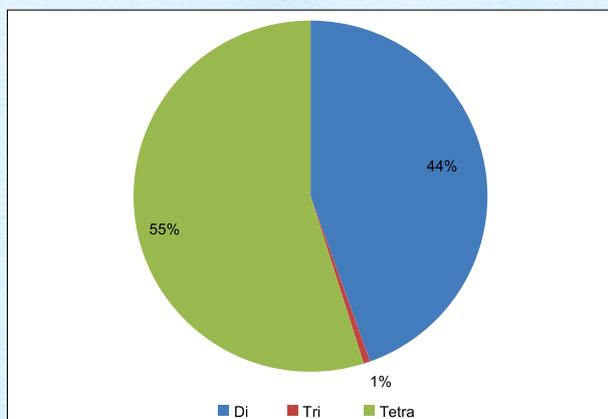
The evolutionary history of Chocolate Mahseer (*N. hexagonolepis*) inferred by using the Maximum Likelihood method based on the Hasegawa-Kishino-Yano model (log likelihood = -4737.6982). A discrete Gamma distribution was used to model evolutionary rate differences among sites (5 categories (+G, parameter = 0.1249)). Branch length of tree depicts the number of substitution per site. (CMAP: Dikrong river; CMHL: Haflong; CMSR: Sankosh river; CMRT: Rtiang; CMAL: Wah Amlarem; CMPB: Wah Pamblang; CMLK: Lakroh; CMUI: Umiam; CMNB: Nongbareh)

Table: Composition and variation in mitochondrial genes of Chocolate mahseer (*N. hexagonolepis*)

Sr. No.	Gene	Size (bp)	Primers	Vs	Vs %	PIS	Si
1.	CoxI	640	AGTATAAGCGTCTGGGTAGTC CCTGCAGGAGGAGGAGAYCC	48	7.5%	46	0
2.	Cytb	836	GCCTACGAAAAACACACCCC AAATTGGGTGATTGGGCGGA	79	9.2%	72	7
3.	ATPase 6/8	818	AAAGCRTYRGCTTTTAAGC GTTAGTGGTCAKGGGCTTGGRTC	42	10%	82	3

Vs- Variable site, PIS- Parsimony informative site, Si- Singleton sites

for their conservation due to low genetic diversity. The SSR markers developed in the present study will provide a valuable resource for future population genetic assessment and implementation of effective conservation strategies for wild chocolate mahseer.



Distribution of microsatellites repeats in *N. hexagonolepis*

The brown trout (*Salmo trutta fario*) is a salmonid species with important commercial and ecological value in India. However, there is a lack of knowledge regarding the genetic diversity of brown trout populations. Genetic characterization of brown trout population mainly from Himachal Pradesh, Jammu & Kashmir, Sikkim, Uttarakhand, and Arunachal Pradesh, was done using mitochondrial and microsatellite markers. Nucleotide sequences of COI gene (700 bp), ATPase (937bp), Cytb (919bp) were sequenced. All sequences were submitted to the NCBI GenBank. Sequence analysis of Cytb and ATPase6/8 revealed only 2 polymorphic sites, while COI gene showed only one polymorphic site. The overall Haplotype diversity in *Cytb*, *ATPase6/8* and *COI* gene was found to be 0.3897, 0.0661 and 0.2787 respectively. Neighbour-joining tree of Brown trout using *Cytb*, *ATPase6/8* and *COI* genes sequences showed that the sequences were clustered only in one group. The analysis of three genes showed very likeness/or identity within individuals and among all the populations. We observed very less variations in the nucleotide sequences. Though the populations were from geographically isolated drainage systems, the species have a common ancestor and a possible genetic bottleneck. Further we developed the novel microsatellite markers for brown trout using next-generation sequencing (NGS) for the assessment of genetic status of this species in India. Partial genome sequencing of brown trout produced a total of 14,093,654 reads containing which were deposited

to the Short Read Archive (SRA) of NCBI under the accession number PRJNA526610. A total of 12 microsatellite loci were developed to genotype 85 individuals of *brown trout* distributed over six localities. Mean polymorphic information content (PIC) was 0.71. The studied populations exhibited substantial pairwise Nei's genetic distances and low to moderate levels of genetic differentiation. The AMOVA analysis revealed a significant genetic variation within populations (68%) as compared to variation among populations (32%). The population genetic results reflect a weak genetic diversity and possible genetic bottleneck in brown trout populations.



Brown trout (*Salmo trutta fario*)

3.6 Externally Funded Projects

3.6.1 Development of a method for detecting the presence of any virus signal in clinical samples of fish (ICAR National Fellow Scheme)

Transient transfection of fish cells with the reporter plasmids pGLGFPRBTMxpro and pGLGFPSntIRF3pro was standardized earlier to demonstrate gene reporter assay. In order to obtain a lineage of stable cells, cells transfected with the said reporter plasmids were selected in selective medium containing 400µg/ml G418. Lineage of EPC-2 cells was selected up to 11 passage levels and cells expressed GFP upon treatment with poly I:C. However, in the subsequent passages, anomalous result was observed as the cells started expressing GFP without treatment with poly I:C. The reason of this inconsistent reaction was explored and trouble shooting was carried out. In order to trouble shoot the problem, fresh transfections were conducted in the presence of polymyxin B. The ability of polymyxin B to inhibit LPS induced TLR activation was observed by treating the cells without or with poly I:C. As evident from the figure, cells that were transfected with reporter plasmids in the absence of polymyxin B and poly I:C, expressed GFP. This indicates LPS

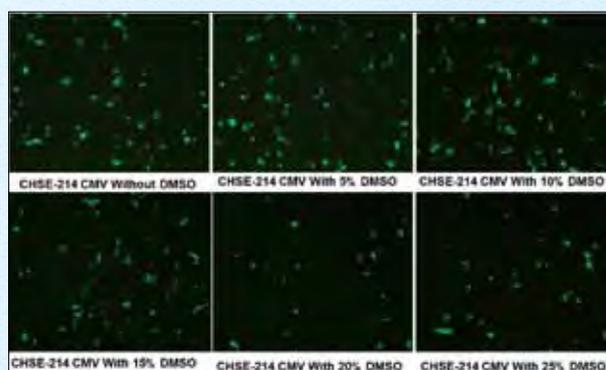
induced TLR activation suggesting the presence of LPS in the plasmid preparation. This assumption was further confirmed. Reporter plasmids treated with polymyxin B and transfected in fish cells had far lesser cells expressing GFP. However, when fish cells were transfected with reporter plasmids treated with polymyxin B followed by treatment with poly I:C, GFP was expressed, as visualised under fluorescent microscope. Further the toxicity of polymyxin on fish cells was determined using MTT assay. It was observed that upon increasing the concentration of polymyxin B there was an enhancement in cytotoxicity.

Moreover, in order to enhance the transfection efficiency fish cells, transfections were carried out in the presence of different concentrations of DMSO as DMSO is known to enhance the transfection efficiency in animal cells. However, our findings suggest that there was not an appreciable change in the transfection efficiency. Therefore, transfections were carried out with Viafectin in the absence of DMSO.

Further, reporter vectors pGLGFP_{RBTMxpro} and pGLGFP_{SntIRF3pro} have been transfected in EPC-2 cells and the selection of transgenic cells is under progress. However, gene reporter activity with reporter plasmid having Mx promoter of snow trout could not be demonstrated. The reason for this anomaly is the absence of interferon-stimulated regulatory element (ISRE) in the promoter of snow trout that has been repeatedly observed by nucleotide sequencing during the course of this study. One or more ISREs have been reported to be present in Mx promoters of from several fish species and other animals. Moreover, ISRE is known to be important for the function of Mx promoter as disruption of

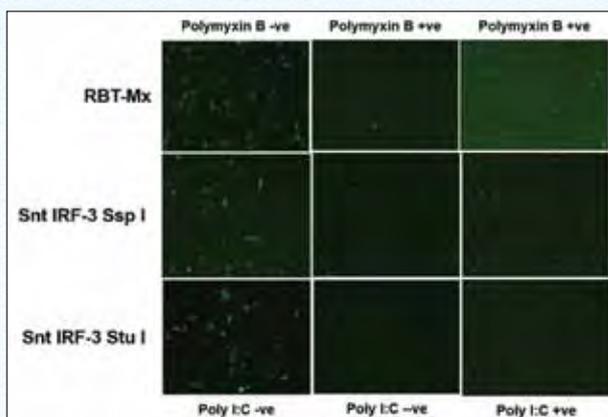
ISRE can either reduce or eliminate the activity of Mx promoter. Therefore, the Mx promoter of snow trout identified in the present study is not the best bet for developing such assay. Therefore, the stable cell lines are being targeted using Mx promoter of rainbow trout and IRF3 promoter of snow trout.

Demonstration of the presence of LPS in the plasmid preparations used for transient transfection of EPC-2 cells. Mx promoter of rainbow trout (RBTM_{xpro}) and snow trout IRF3 promoters (SntIRF-3_{SspI} and SntIRF-3_{StuI}) were deduced after chromosome walk. EPC2 cells were transfected with the said reporter plasmids and expression of GFP was observed in cells transfected in the absence or presence of polymyxin B.

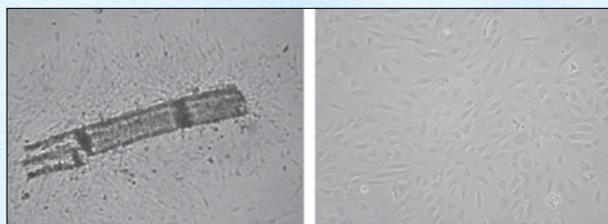


Effect of DMSO on transient transfection of EPC-2 cells. Cells were transfected with transfection mix containing 0, 5, 10, 15, 20 and 25% DMSO. The number of transfected cells is almost the same in 0, 5, 10 and 15% DMSO while in 20 and 25% DMSO the number of cells expressing GFP is reduced.

Development of cell lines from different organs of snow trout: The procedure for the culture of fish cells was standardized from different organs of snow trout (*Schizothorax richardsonii*). To begin with, explant cultures of snow trout caudal fin was attempted. Fish was anesthetized with 0.5% clove oil and a small portion about (1cm²) of caudal fin was cut. The excised fin was finely chopped and washed several times with sterile PBS, followed by three washings in PBS containing 1X penicillin and streptomycin. Excess PBS was removed and the explants were suspended in 0.2ml of PBS containing 40% fetal calf serum and seeded in 25cm² tissue culture flasks. Cells were seen radiating from the explants after 24 hours. Once the monolayer was nearly complete, the cells were trypsinized with



0.01% trypsin versene and seeded in fresh flask. These cells have been preserved at fifth and sixth passages and are being maintained at ninth passage level in the laboratory.



Snow trout caudal fin culture. Cells radiating from fin explant (Left) and monolayer of snow trout caudal fin cells (right)

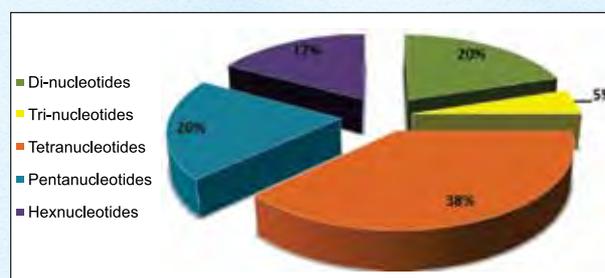
Similarly, culture of brain cells, liver cells, muscle cells, testis cells, spleen cells and swim bladder cells were also attempted. Cells from brain, swim bladder and liver could not be expanded as they were lost after the first passage. However, appreciable growth is being observed in cells from testis and muscles while the growth of spleen cells is quite slow. Further work is in progress to develop cell lines from other organs of rainbow trout.

3.6.2 Molecular and Genetic Characterization of selected important ornamental Fishes of North East India

Assamese kingfish is one of the important cyprinids endemic to the Trans-Himalayan states of southern Asia, with considerable subsistence fishery value. As such it plays a crucial role in local livelihood, food security and occupies a prominent place in ornamental fish trade. Its population is declining in its natural habitat due to overexploitation and related anthropogenic pressures. Understanding the extent of genetic differentiation among the populations provides insights into founding histories, source stocks and movement of individuals. Such findings have consequences for fisheries managers stocking natural ecosystems with captive-reared fish, biologists attempting to understand the interactions between wild and domestic fish, and fish farmers involved in stocking or restoration activities.

Nevertheless, no genetic and genomic information is available for this species, which has impeded systematic genetic studies. In this study, Illumina HiSeq high-throughput sequencing technology was performed to generate partial genome sequences of Assamese king fish. A total of 216,809 assembled sequences were used to search

for simple sequence repeat (SSR) loci, and 50,964 SSR loci were detected in 34,573 SSR containing sequences. The tetra-nucleotides were the most frequent repeat motif, followed by di-nucleotides, pentanucleotides, hexanucleotides, and tri-nucleotides. A total of 28,061 primer pairs were successfully designed in the flanking sequences of the SSRs, and 50 sets of primers were randomly selected for the initial validation in two populations of the fish. The validation of selected SSRs and genetic diversity analysis are in process.



Pie-chart of six SSR motifs identified in the Assamese kingfish genome sequence

3.6.3 NSPAAD-Surveillance of coldwater fish diseases in Himachal Pradesh and Uttarakhand (NFDB funded multi-institutional project)

Active diseases surveillance was undertaken from 35 trout and carp farms and baseline data of 38 raceways / tanks were collected covering districts in Uttarakhand i.e. Champawat and 2 districts i.e. Kullu & Mandi in Himachal Pradesh. Total 25 trout, 10 carp farm were surveyed in Himachal Pradesh and Uttarakhand and details of the hatchery with major constraints of each hatchery were collected. Total 155 un-pooled and 146 pooled samples of kidney, spleen, liver, skin, intestine, brain and gills were collected and screened for VHSV, IHNV, bacterial, fungal and parasitic infections. Passive disease surveillance in cages at Bhimtal and in snow trout hatchery at Champawat was carried out. The samples of each tissue were pooled as per the sampling procedure given and transported for detailed laboratory analysis. The bacterial and fungal samples were transported in transport media. The samples for virological studies were collected in RNA later and were used for extraction of RNA or stored at -20 °C for future use. RT-PCR was conducted using the gene specific primer of VHSV (Viral hemorrhagic septicemia virus) and IHNV (Infectious hematopoietic necrosis virus) along with

the positive controls provided by ICAR-NBFGR, Lucknow; PCR was conducted using ITS-1 and ITS-4 primers for fungal identification; 16sRNA for bacterial infections. All the collected samples from surveyed sites were found negative for VHSV & IHNV in RT-PCR. Oomycetes i.e. *Saprolegnia sp.* were identified based on morphological and molecular techniques from rainbow trout farms in Himachal Pradesh. *Aeromonas sp.*, *Rhinella sp.*, *Enterococcus faecium*, *Plesiomonas shigelloides*, *Aeromonas hydrophilla*, *Aeromonas veronii*, *Alcaligenes sp.*, *Proteus sp.*, *Carnobacterium sp.*, *Acinetobacter sp.* were the bacterial isolates characterized from the collected samples. Detailed water quality analysis of 35 fish farmers done. Two awareness programmes and three demonstration programs were organized on fish health management, good management practices involving about 155 farmers.

Passive surveillance on bacterial infection in cage culture, Bhimtal: A disease outbreak took place at DCFR cage culture in Bhimtal Lake in Nainital Lake of Uttarakhand during June & July 2018, where advance fry of grass carp, *Ctenopharyngodon idella* were severely infected and mass mortality up to 40 % was observed. The infected fishes showed tail and fin rot, erratic behaviour, no feed intake and gathering at one place of the cage with necrosis of tail region. Twenty moribund advance fry were collected, processed aseptically and bacterial isolates belonged to 5 different genus were identified by biochemical and PCR (16S rRNA) as *Aeromonas veronii* (12nos), *Aeromonas jandaei* (1nos), *Lactococcus garvieae* (4nos), *Klebsiella pneumonia* (2nos), *Enterobacter mori* (1nos), *Enterobacter asburiae* (1no) and *Pantoea sps* (1nos). Based on the virulence study, *Aeromonas veronii* was selected for challenge study.

3.6.4 All India Network Project on Fish Health-AINP-FH

Under the project All India Network Project on Fish Health, we determine the biosafety level of oxytetracycline (OTC) which is an FDA approved antibiotic used in aquaculture. Besides this, determine of efficacy of OTC against infection of *Aeromonas hydrophila* is also the objective of the project. Rainbow trout is one of the highly nutritious and economically important but very sensitive coldwater fish. *A. hydrophila* is one of the

most common and highly pathogenic bacteria that cause Mortile Aeromonad Septicemia in rainbow Trout. In our study, we determined prudent dose of antibiotic against *A. hydrophila* in experimentally challenged rainbow trout (fry and fingerling stage). In our study, we used six groups i.e. negative control, positive control and four treatment groups. For advanced frys, the treatment doses were 20, 40, 60 and 80 mg OTC/L of water for four consecutive days and for fingerling, the treatment doses were 2, 4, 6 and 8 gm OTC/100 pounds fish /day for ten consecutive days. Negative control was not challenged with bacteria and positive control was challenged with bacteria without any antibiotic treatment. Throughout the experimental period we observed behavioural changes, feeding behavior and water quality parameters. The infected fishes showed slow movement, dark coloration, abnormal swimming, swimming out of the group and grasping of air etc. During the experiment we gave feed according to 2% of their body weight. Feed consumption was good in negative control, positive control and 2 gm OTC treatment groups. 4gm OTC, 6gm OTC and 8gm OTC treatment groups show comparatively low feed consumption. As per our experimental findings, prudent dose of OTC for frys was 60-80 mg/L of water and that for fingerling 4 gm OTC/100 pound fish/day and above doses is effective against *A. hydrophila* in rainbow trout.



Visiting farmers' ponds at Pati block to collect basic information on fish culture practices and on-field validation of use of aquaculture inputs in hills

3.6.5 Development of climate resilient rainbow trout and innovative trout farming strategies to mitigate climatic stressors (NICRA)

Under the field work component, we are continuously monitoring the periodic changes in important water quality parameters in two clusters of private rainbow trout farms in Kullu and Mandi districts of Himachal Pradesh, having distinct micro-climatic conditions. With the help of H.P. State Fisheries Department, this activity was carried out in 12 rainbow trout farms, during the months of April and October 2018, and January 2019. Further, for obtaining more frequent data-points, a complete water quality kit was put together, distributed to the farmers and hands on training was provided for estimating the different water quality parameters.



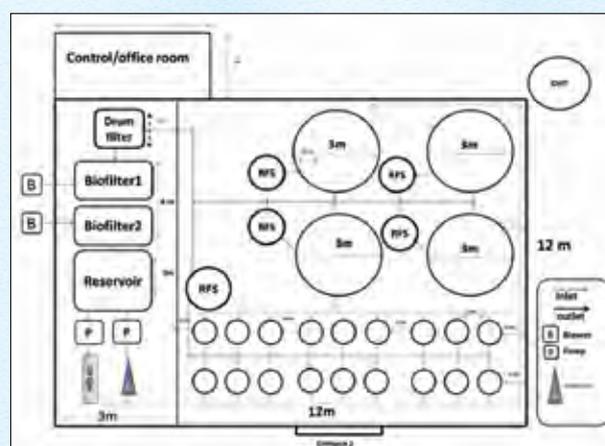
On site demonstration on water quality testing in trout farm



On site demonstration on water quality testing in trout farm

Concerning the evaluation and demonstration of recirculatory aquaculture system as a climate

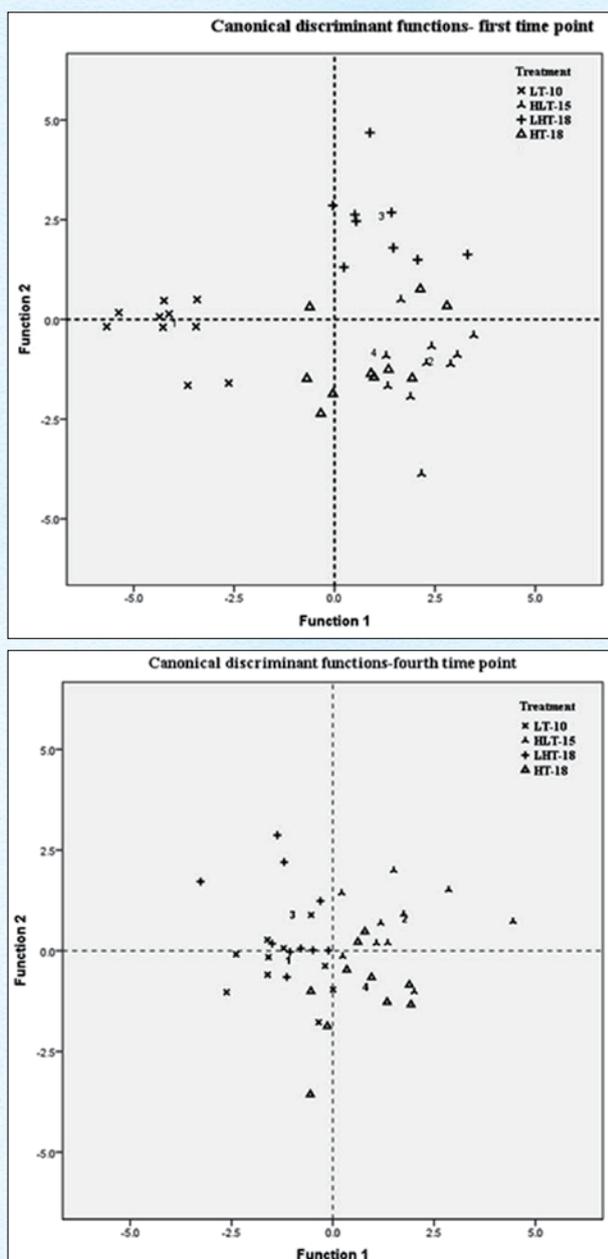
resilient technology, which minimizes the usage of land and water in rainbow trout culture, we have designed a semi-commercial (32 m³ capacity) RAS system consisting of larger culture tanks (7 m³ water volume) and smaller (0.5 m³) experimental tanks. All the culture tanks will have dual drain system with radial flow settler for removal of settleable solids and drum filter for removal of suspended solids. Further the complete system will feature a moving bed biofilter, reservoir tank, UV filtration



Schematic diagram of the recirculatory aquaculture system

unit for disinfection, oxygen cones and heating system. The fabrication and installation of this RAS system is in progress.

We had also conducted a study to examine the potential for thermally programming rainbow trout during early life. In that, eyed ova of rainbow trout from the same genetic lineage were first incubated at two different temperatures, low (LT, 10±1°C) and high (HT, 18±1°C). After hatching, half of the LT sac fry was transferred to 18°C (LHT) and half of HT sac fry was transferred to 15°C (HLT) and reared at the respective temperature until 45 dph. As expected, growth in terms of length and weight revealed temperature dependent variations throughout the study. At the same time, morphometric features (as examined by Truss analysis) were found to be substantially influenced by temperature in the initial phase, with decreasing significance later on (as shown in the biplot given below).



Canonical discriminant function of different morphometric variables of rainbow trout fry at two different ontogenic time points

3.6.6 Triploid rainbow trout (*Oncorhynchus mykiss*) production for aquaculture enhancement and ecological risk management

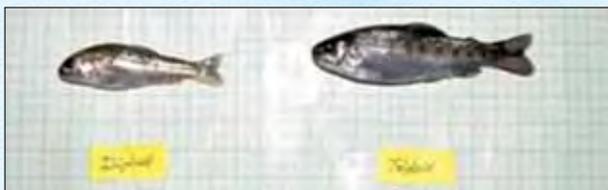
Experiment was conducted at three sites at different altitudes viz. village Skhras, District Anantnag, Kashmir, State trout farm, Uttarey and State trout farm, Rabum, Sikkim. The major variables to optimise the methodology were timing after fertilisation, intensity and duration of the thermal shock. For the confirmation of ploidy level in the treated and control group of rainbow trout fry, two methods were applied, direct method by karyotyping of fry (visualization and counting of

chromosomes) and indirect method by measuring nucleus and cell size of erythrocytes in blood smear of 6 months old individuals. The second part of the study was comparative assessment of growth and survival in triploid and diploid rainbow trout under field conditions.

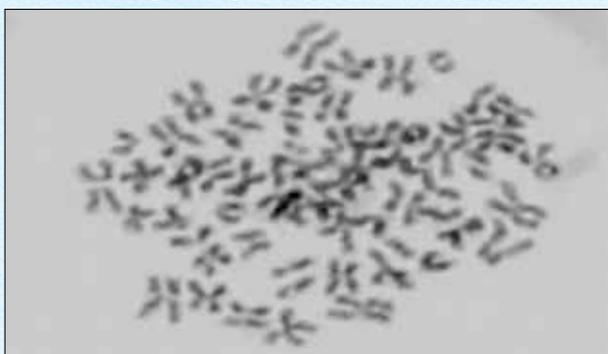
Heat shock treatment is an easy applicable and effective tool for triploidy induction in fertilized ova of rainbow trout (*Oncorhynchus mykiss*). Timing after fertilisation for heat treatment, temperature for thermal shock treatment to retain the second polar body and exposure time of treatment are the key factors for the success of triploidy induction. Low thermal regime, high dissolved oxygen level, very less ammonia level (<0.01 mg/l) and prolonged stable temperature favours the better triploidy induction rate (TR). Heat shock treatment at 28°C for 10 min can be applied to green eggs for better triploidy induction rate (TR). Low shock temperature (<28°C), less exposure time (<10 min) and low dissolved oxygen (<8 ppm) results in no retention of the second polar body. Higher shock temperature (>28°C), more exposure time (>10 min) results in damage of nucleus and ova become white/ opaque in colour and finally dead within 20 min. 80 % success of triploidy induction in rainbow trout was possible with 40-46% hatching rate and 57-68% survival upto swim up fry stage. 74% hatching rate and 72-80% survival upto swim up fry stage was observed in diploid stock at similar environmental conditions.

Karyotyping of fry after yolk absorption and erythrocytes measurements can be used for verification of triploidy induction. In treated group, three sets of chromosomes (86-90) were observed in chromosome plates. Though, chromosomes plates do not contain well spreads, but are countable to know the sets of chromosomes. Erythrocytes measurement (μm) reflects the 13% larger cell size and 12% larger nucleus in triploids over the diploids. In triploids, the average size of the erythrocytes is 16.31 μm with 6.86 μm nucleus size, while it is 14.45 μm and 6.14 μm in case of diploids.

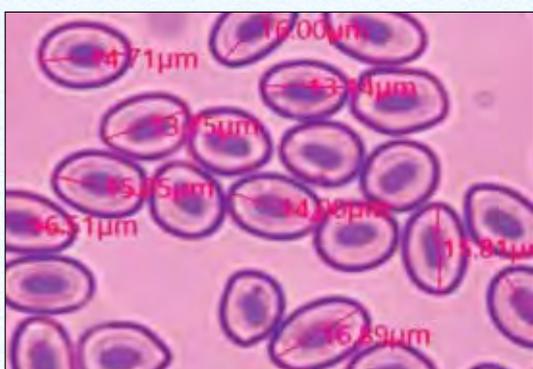
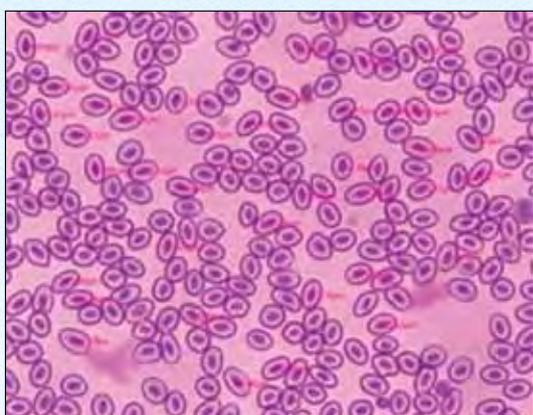
There is 9-19% better growth in triploids over the diploids in different rearing conditions at fingerlings stage in a field study of 90 days. The survival of triploids fingerlings was observed as 48-68%, while



Comparative growth of Triploids & Diploids



Chromosome plate of triploid rainbow trout



Erythrocyte of triploids

it was 62-72% in diploid stock. Accuracy of heat shock treatment and better rearing conditions are required for better TR and survival.

An Attempt has been made for triploidy induction in rainbow trout by pressure shock, using APV 2.7 machine. Three females of average size of 1.30kg and three males of average size of 1.42kg were stripped and fertilised eggs were exposed for Pressure of 9500PSI with TTU 375 minutes for 5minutes duration. Brooders were anaesthetised by using clove oil and ethanol mixture in 1:9 @ 1ml in 5l of water. Operation has resulted 98% triploidy induction with 80% hatching rate and 52% survival of swim up fry.



Triploid induction in rainbow trout at talwadi, district chamoli by pressure shock

3.6.7 Immunomodulation in golden mahseer (*Tor putitora*) broodstock under captive conditions

To carry out the experiment for elucidating immuno-modulatory effect of β -glucan in golden mahseer under captive conditions, captive reared adult golden mahseer were collected live from reservoir tank of Nishaula, Bhimtal and stocked in the pond at ICAR-DCFR's Mahseer Hatchery Complex and are being reared. Few fishes were sacrificed and tissue samples such as spleen, kidney

practice due to water scarcity. Study was conducted with or without integration of fish farming and horticulture which resulted for increasing production of horticulture and additional income by fish production. Polythene lined fish pond is the nucleus of climate resilient horticulture practice in this drought prone area.



Seed Stocking at Vill- Jyur-Kafun, Almora



Integrated Fish Farm at Vill- Jyur-Kafun, Almora



Netting and Sampling at Vill- Jyur-Kafun, Almora

3.6.9 ICAR-Extramural Project: Development of anti-infective synthetic peptide against *Lactococcus garviae* & other pathogenic bacteria isolated from rainbow trout, *Oncorhynchus mykiss*

Under this project antimicrobial activity of four synthetic peptides against 15 isolates of *Lactococcus garviae* and one isolate of *Aeromonas hydrophila* were evaluated using microdilution method. The results showed that out of four peptides, highest inhibition was observed with peptide-X (100%) against all the 15 isolates of *L. garviae*. None of the peptides showed inhibition against one isolate of *A. hydrophila*.

Table: Economics of field experimentation with and without integration

	With integration	Without integration
Crop duration	12 months	12 months
Area	Pond-100m ² Horticulture Plot-200m ²	Horticulture Plot-300m ²
Average yield	Fish-70kg Radish-400kg Radish seed-5kg Coriander-50kg	Radish-450kg Radish seed-4kg Coriander-45kg
Sale price (Rs. /kg)	Fish- Rs. 150 Radish-20 Radish seed-1200 Coriander-120	Radish-20 Radish seed-1200 Coriander-120
Gross return	Rs. 30500	Rs. 19200
Production cost	Rs. 12500/-	Rs. 9500/-
Net return	Rs. 18000/300m ²	Rs. 9700/300m ²
Crop rotation	2 crops of Radish-Coriander and fish in pond	2 crops of Radish-Coriander and fish in pond

4

List of Research Projects

4.1 Institutional Projects

Project Code	Project Title	Investigators	Year of Start	Year of Completion
A. Resource assessment and management				
CF-6	Ecosystem assessment and mapping of aquatic resources in Indian Himalayan regions	D. Sarma (Coordinator)		
	Sub-project 4: Assessment of population status, species diversity and habitat ecology of snow trout <i>Schizothorax</i> species in selected streams of Indian Himalayan region	D. Baruah D. Sarma P. Sharma K. Kunal P.A. Ganie	2016	2020
	Sub-project 5: GIS based digital data base on coldwater fishery resources of Arunachal Pradesh in North East Himalaya region	D. Baruah D. Sarma K. Kunal P.A. Ganie	2018	2021
B. Aquaculture research and development				
AQ-16	Captive management of mahseer in perspective to aquaculture and conservation	D. Sarma (Coordinator)		
	Sub-project 3: Devising a feeding regimen based on return of appetite in golden mahseer (<i>Tor putitora</i>) larvae/juvenile	P. Sharma D. Sarma M.S. Akhtar	2016	2019
	Sub-project 4: Scaling up the seed production of chocolate mahseer in captivity	P. Dash D. Sarma N.N. Pandey R.S. Tandel	2018	2021
	Sub-project 5: Optimizing reproductive and spawning performance of golden mahseer for upscaling its seed production in captivity	M.S. Akhtar D. Sarma D. Thakuria Ciji, A. Rajesh, M.	2018	2021
AQ-17	Decoding the constraints in growth, maturation and captive management of snow trout (<i>Schizothorax richardsonii</i> , Gray, 1832)	D. Sarma (Coordinator)		
	Sub-project 1: Central and peripheral regulation of feed ingestion and nutrient uptake in snow trout, <i>Schizothorax richardsonii</i>	B.S. Kamalam N.N. Pandey P.Sharma	2015	2019
	Sub-project 2: Nutrient mediated metabolic regulation of growth and well-being in snow trout <i>Schizothorax richardsonii</i>	M.S. Akhtar Ciji, A. A.K. Giri	2015	2019
	Sub-project 3: Myogenic regulation and protein turnover of muscle growth in snow trout <i>Schizothorax richardsonii</i>	Rajesh, M. D. Thakuria B.S. Kamalam	2015	2019

Project Code	Project Title	Investigators	Year of Start	Year of Completion
	Sub-project 4: Endocrine aspects of growth and maturity of snow trout, <i>Schizothorax richardsonii</i>	Ciji, A. Rajesh, M. P. Sharma P. Dash	2015	2019
AQ-19	Domestication, biology and breeding of selected species for species diversification in mid-hill aquaculture	N.N. Pandey (Coordinator)		
	Sub-project 4: Growth potential and breeding performance of <i>S. progastus</i> and <i>S. plagiostomus</i>	N.N. Pandey R.S. Patiyal R. Singh	2018	2021
	Sub-project 5: Embryonic development, breeding and seed production of Sucker head, <i>Garra gotyla</i>	R.S. Patiyal N.N. Pandey	2018	2021
AQ-21	Development and validation of novel feed formulations for rainbow trout (<i>Oncorhynchus mykiss</i>) based on commercial-scale industrial by-products	B.S. Kamalam Rajesh, M. N.N. Pandey Ciji, A. P. Sharma	2018	2021
NPOFBC	Network project on Ornamental fish breeding and culture (NPOFBC): ICAR- DCFR component: -Development of breeding protocol and larval rearing technique of the selected indigenous hill stream ornamental loaches, suckers and hill trouts	P. Dash D. Sarma A.K. Giri	2018	2023
C. Molecular genetics and biotechnology				
AQ-18a	Development of fish viral peptide based nano system for intracellular delivery of biomolecules	D. Thakuria N. Shahi K.V. Chanu R.A.H. Bhat	2015	2019
AQ-18b	Transcriptome based sex specific marker discovery in golden mahseer (<i>Tor putitora</i>)	Siva, C. S. Ali P. Sharma Rajesh, M.	2017	2020
AQ-18c	Gender specific transcriptomic response to environmental stress in golden mahseer (<i>Tor putitora</i>)	S. Ali Siva, C. P. Sharma	2018	2021
D. Disease surveillance and health management				
AQ-20	Development of diagnostic & therapeutic measures for rainbow trout pathogens	D. Sarma (Coordinator)		
	Sub-project 1: Development of rapid assays for detection & identification of <i>Saprolegnia</i> species	K.V. Chanu D. Thakuria R.S. Tandel	2017	2020
	Sub-project 2: Evaluation of antimicrobial activities of nano & polymer-based formulation against Saprolegniasis	D. Thakuria K.V. Chanu R.S. Tandel	2017	2020
	Sub-project 3: Evaluation of available anti-fungal agents and herbs for their efficacy against oomycetes infection in farmed rainbow trout	R.S. Tandel R.A.H. Bhat S.K. Mallik P. Dash	2017	2020
AMR	Network programme on antimicrobial resistance (AMR) in fishes under INFAAR	S.K. Mallik N. Shahi	2018	2021

4.2 Externally Funded Projects

Project Code	Project Title	Investigators	Year of Start	Year of Completion
NMP-1	Fish Genetic stock-Outreach activities	S. Ali R.S. Patiyal Siva, C	2014	2019
ICAR-National Fellow	Development of a method for detecting the presence of any virus signal in clinical samples of fish	Amit Pande	2014	2019
DBT-6	Molecular and Genetic Characterization of selected important ornamental Fishes of North East India	Siva, C.	2017	2020
NSPAAD	National surveillance programme for aquatic animal disease-Surveillance of coldwater fish diseases in Himachal Pradesh and Uttarakhand (NFDB funded multi-institutional project)	S. Chandra S.K. Mallik R.S. Tandel R.A.H. Bhat	2014	2019
AINP-Fish Health	All India Network Project on Fish Health-AINP-FH	S.K. Mallik N. Shahi R.S. Tandel	2015	2019
NICRA	Development of climate resilient rainbow trout and innovative trout farming strategies to mitigate climatic stressors	D. Sarma R.S. Patiyal D. Baruah B.S. Kamalam Rajesh, M. P. Sharma R.S. Tandel S.K. Mallik M.S. Akhtar N. Shahi Ciji, A., A.K. Giri Siva, C. R.S. Halder	2017	2020
DBT-7	Triploid rainbow trout (<i>Oncorhynchus mykiss</i>) production for aquaculture enhancement and ecological risk management	N.N. Pandey B.S. Kamalam R. Singh	2017	2020
DBT-8	Immunomodulation in golden mahseer (<i>Tor putitora</i>) broodstock under captive conditions	M.S. Akhtar Ciji, A. Rajesh, M.	2018	2021
NMSHE	National Mission for sustaining the Himalayan ecosystems (NMHSE-Taskforce 6 for Himalayan Agriculture)	N.N. Pandey/ D.Sarma S. Ali R.S. Patiyal Rajesh, M. B.S. Kamalam A.K.Giri	2015	2019
Extramural	Development of anti-infective synthetic peptide against <i>Lactococcus garviae</i> & other pathogenic bacteria isolated from rainbow trout, <i>Oncorhynchus mykiss</i>	S.K. Mallik N. Shahi	2018	2021

Important Events and Meetings

5

5.1 Scientists – Farmers - Officers Interactive Meet and Angling Competition at Nagaland

Scientists-Farmers-Officers Interactive Meet on Seed production and conservation of Mahseer and fish farming in the cold region of Nagaland together with an Angling Competition was organized at village Suteplenden (Longkong), Mokokchung district, Nagaland on 25 April 2018. The programme was jointly organized by ICAR-Directorate of Coldwater Fisheries Research, Bhimtal, Uttarakhand and Department of Fisheries & Aquatic Resources, Govt. of Nagaland under the NEH Activity. Dr. Sudhir Raizada, ADG (Inland Fy), ICAR, New Delhi chaired the interactive meet whereas Shri Tongpang Ozukum, Hon'ble Minister, PWD (R&B, Housing & Mechanical), Govt. of Nagaland graced the occasion as Chief Guest and inaugurated the angling competition. The other dignitaries present on the occasion are Shri T. Mhabemo Yanthan, Secretary, Department of Fisheries & Aquatic Resources, Govt. of Nagaland; Shri Kevisa Kense, Director, Department of Fisheries & Aquatic Resources, Govt. of Nagaland; Dr. A.K. Singh, Former Director, ICAR-DCFR, Bhimtal; Dr. Debajit Sarma, Director (Acting), ICAR-DCFR; Dr. R.S. Haldar, Nodal Officer NEH Activity, ICAR-DCFR, Bhimtal; Shri Neitho-o Kuotsu, Deputy Director Fisheries, Nagaland; Shri Nava Kumar Gogoi, Chief Managing Director and Shri Dilwar Hussain of Jasingfaa Aqua Tourism Centre, Nagaon, Assam; Dr. Pranay Pallav, Assistant Professor, Nagaland University; Shri Imti Sunep, District Fishery Officer, Mokokchung, Nagaland and Mr. Phukato Sumi, President, Anglers Association of Nagaland. About 50 anglers, 100 fish farmers, panchayat members and local people were also present during the programme. Certificates were distributed to the farmers for their participation. Prizes (1st, 2nd and 3rd) were also distributed to the angling competitors for the maximum catch on the day.



Interaction of ICAR scientists with the farmers of Mokokchung, Nagaland



The Chief Guest inspecting the catch during the angling fest

5.2 World Environment Day

ICAR-DCFR celebrated the World Environment Day with great enthusiasm on 5 June 2018 with the theme of Beat Plastic Pollution. The celebrations began with a plantation drive in and out of the institute campus. School children from Mount Alvern, Harbour Minor and Lake International displayed the models in an exhibition on the occasion. Invited guest Padamshree Shri Sekhar Pathak delivered a presentation on *Halat-i-Himalaya* while addressing the gathering on the day. Other invitees Dr. B.S. Bisht, Director, Birla Institute of Applied Sciences; Dr. H.C.S Bisht, HOD, Dept. of Zoology, Kumaon University; Shri P.N. Shivpuri, Academician and Social Activist and Shri Saurabh Rautela, President, Vyapar Mandal, Bhimtal graced the occasion. Dr. Victoria Chanu, Dr. Ciji Alexander and Mrs. Pragyan Dash coordinated the event.



Planting at ICAR-DCFR by the invited guest on the World Environment Day



Dr. Prasanna Kumar Patsani, Hon'ble Member of Parliament (Lok Sabha) inspecting the Hindi publications of the Directorate



Display of science models by school children at ICAR-DCFR

5.3 Rajbhasha Inspection Parliament Committee Meeting

Rajbhasha Parliament Committee from New Delhi visited Nainital during 12-14 June 2018 to inspect the implementation and usage of Hindi language as official work in the Central government organizations. A meeting was jointly organized by ICAR-DCFR, Bhimtal; BSNL, Haldwani; Field Outreach Bureau, Nainital; Doordarshan, Nainital and VPKAS, Almora during the inspection. Dr. Prasanna Kumar Patsani, Hon'ble Member of



Release of a technical bulletin in Hindi language by the Rajbhasha Parliamentary Committee

Parliament (Lok Sabha) chaired the session in the presence of Dr. S. Raizada, ADG (Inland Fisheries), New Delhi; Dr. D. Sarma, Director; Mr. Amit Joshi, I/c Hindi Cell and other scientists and staffs of ICAR-DCFR. The committee expressed their satisfaction on the implementation of the Hindi language in most of the official work of the Directorate. ICAR-DCFR publications such as Annual Report, technical bulletins, *Himjyoti* etc were displayed to the guest on the occasion.

5.4 National Live Telecast Programme

The Directorate arranged to watch the live telecast of an Interaction programme of the Hon'ble Prime Minister of India with farmers of the nation on 20 June 2018 in DD Kisan channel in the committee room. All the scientists, staffs, scholars and students were present on the day to watch the programme enthusiastically.



The Hon'ble Prime Minister of India addressing the farmers of the nation

5.5 International Yoga Day

ICAR-DCFR celebrated the International Yoga Day on 21 June 2018 with the participation of 62 staff members, students and farmers. At Bhimtal,

the yoga session were guided by yoga guru Dr. Hem Chandra Kapil who explained the importance and benefits of different aasans and pranayamas. The different aasans followed by the enthusiast participants of the institute were included the vajrasana, sasankasana, setu bandhasana, alanasana, uttanpadasana, bhujangasana, salabhasana, pavanamuktasana, shavasana and two pranayamas udgeeth and bhramari. Similarly, the International Yoga Day was organized at Champawat by the staffs and practiced yoga aasans and mudras. In both the places, it was felt by the staffs that the regular practice of yoga would be helpful in relieving of body pains and remedy for several stress & diseases.



Staff of ICAR-DCFR practising different aasans on the International Yoga Day

5.6 NFDB Review Meeting

ICAR-DCFR organized a review meeting for North-West states for Blue Revolution programme of NFDB, Hyderabad and Department of Animal Husbandry, Dairy and Fisheries on 28 June 2018 at its premises. The Director of Fisheries for the state of Jammu and Kashmir, Uttarakhand and Himachal Pradesh, representative from DADF, G.B. Pant University of Agriculture & Technology along with

all scientists of ICAR-DCFR participated in the meeting.



Review on the progress of Blue Revolution programme of NFDB, Hyderabad and DADF for North-West states



Field visit to wet labs of ICAR-DCFR

5.7 National Fish Farmers' Day

A day-long National Fish Farmers' Day was celebrated on 10 July 2018 at ICAR-DCFR which was participated by one hundred and above participants from different Himalayan states including Leh Ladakh, Uttarakhand, Sikkim, Assam and Meghalaya. Progressive farmers shared their valuable experiences and benefits of coldwater aquaculture in providing them the best means of living which is expected to increase their income. Dr. Debajit Sarma, Director addressed the farmers and scientists and emphasized the potential of coldwater fish farming in improving the livelihood of Himalayan farmers in a sustainable manner. Dr. M.S. Akhtar, Scientist spoke on contributions of Dr. Hiralal Chaudhary (the father of induced breeding in India) in fisheries sector of India. The programme was witnessed by the gracious presence of Dr. A.K. Singh, Former Director ICAR-DCFR; Dr. A.P. Sharma, Former Director ICAR-CIFRI; Dr. R.S Rawal, Director GBPNIHESD and

Dr. Prem Kumar, Principal Scientist ICAR New Delhi. During the programme, 15 progressive fish farmers were awarded for their best contribution in bringing the higher level of fish production in their respective states. Among the awardees, Shri Pitambardutt Gahtori, Shri Laxman Singh, Shri Girish Sanwal, Smti. Bhawana Devi, Shri Jubair Ahmad, Shri Gopal Pradhan, Shri Wanshaphrang Tiewsoh and Shri Padma Mili shared their experiences in coldwater fish farming. All the scientist and staffs of the Directorate attended the program. The program was coordinated by Dr. M.S. Akhtar and Mr. Kishor Kunal and ended with vote of thanks by Dr. N.N. Pandey of ICAR-DCFR.



Dr. D. Sarma, Director, ICAR-DCFR addressing the gathering



Farmers receiving Certificate of Appreciation

5.8 Independence Day Celebrations

The Independence day on 15 August 2018 of our nation was celebrated with flag hoisting ceremony attended by all the scientist and staff of the Directorate. Dr. Debajit Sarma, Director unfurled the national flag on the Independence day and saluted the patriots who gave us the freedom and the opportunity to celebrate the day. Scientists and staff of the Directorate also expressed their pride for being the part of such a glorious nation. Likewise, Independence day was celebrated at Experimental Fish Farm, Champawat with great fervour. The National Flag was unfurled by K. Kunal, Scientist

on 15 August 2018 in presence of all the scientists and staffs of the fish farm. All the staff in various capacities were sensitized on the importance of celebrating the Independence day.



Dr. D. Sarma, Director addressing the gathering on the auspicious day



K. Kunal, Scientist EFF addressing the gathering on the auspicious day

5.9 Hindi Saptah Samaroh

Hindi Saptah was organized at Bhimtal during 14-20 September 2018 by conducting various competitions such as essay writing, word knowledge, Hindi to English translation, Hindi skill, computer oriented Hindi typing among the staff of the



Enthusiasts participants of ICAR-DCFR during the Hindi Saptah

Directorate. Prizes were distributed to the winners on the Annual Foundation Day of ICAR-DCFR on 24 September 2018. The I/c Hindi Cell Shri Amit Joshi coordinated the programme.

5.10 Swacchta Hi Sewa

The *Swachhta Hi Sewa* campaign has been initiated under Swachh Bharat Abhiyan with great enthusiasm during from 15 September to 2 October 2018 by the ICAR-DCFR. All the



Briefing on the *Swachhta Hi Sewa* campaign to the staff of ICAR-DCFR



Cleanliness drive executed by the staff of ICAR-DCFR in the vicinity



Mass rally by the ICAR-DCFR staffs to aware the local residents of Bhimtal on *Swachhta*



Swachhta Hi Sewa campaign at EFF Champawat

staff members, research scholars, students and contractual staff performed various activities for the *Swachhta* of the office campus and nearby places at Bhimtal. The major works performed under the programme are cleaning of the office premises and adjoining areas including various public and tourist places. Shri Santosh Kumar, Nodal Officer for Swachh Bharat Mission coordinated the programme.

5.11 ICAR-DCFR Foundation Day

ICAR-DCFR celebrated the 31st Annual Foundation Day on 24 September 2018 at its premises with great enthusiasm. Dr. J. K. Jena, Deputy Director General, ICAR, New Delhi graced the occasion as Chief Guest and appreciated the contributions of ICAR-DCFR for significant coldwater fisheries and aquaculture research in the country. He also released the first issue of the *Journal of Coldwater Fisheries* alongwith seven other publications of the Directorate. Dr. D. Sarma, Director, ICAR-DCFR, briefed on activities and achievements of ICAR-DCFR during the past years emphasizing the potential of coldwater fish farming in improving the livelihood of Himalayan farmers in a sustainable manner. 150 delegates including 50 eminent scientists and former Directors of ICAR including Dr. S.D. Tripathi, Dr. M. Sinha, Dr. A.E. Eknath, Dr. W.S. Lakra and Dr. A.K. Singh from the country participated in the foundation day celebrations. Coldwater Fisheries Society of India (CFSI), c/o ICAR-DCFR awarded eminent scientists and researchers with CFSI Gold Medal, CFSI Fellowship, CFSI Life Time Achievement Award, CFSI Special Recognition Award, CFSI Photo Contest Award for their significant



Dignitaries lighting the auspicious lamp



Dignitaries addressing the gathering on the occasion



Release of ICAR-DCFR publications



CFSI award to Dr. J.K. Jena, DDG (Fisheries and A.H)

contributions to coldwater fisheries research and development.

5.12 Vigilance Awareness Week

ICAR-DCFR celebrated Vigilance Awareness Week during 29 October to 3 November 2018 and the staff members, villagers, students of Saraswati Public School and workers of Bhimtal area were sensitized against the immorality and corruption by organizing different competitions on debate, slogan writing, rangoli, quiz, running, mehendi, essay and poetry writing competitions on the theme *Prevention of Corruption*. Awareness among the ICAR-DCFR staff was initiated with Integrity Pledge against corruption. Vigilance awareness at village Nissola for the 33 villagers of nearby 8 villages was arranged. Participants were informed on the Government initiatives like digital India movement, use of social media, keeping transparency in public places for eradicating corruption from the society. The participants spoke on the subject *Eradicate Corruption- Make New India*, and shared their relevant experiences. Certificate of appreciation and prizes were distributed to the winners of

the competitions in various categories. Ms. Lata Sharma won first prize in slogan writing, while



Integrity pledge at the Directorate



Awareness drive at Nissola village for women farmers



Awareness programme at Saraswati Public School, Bhimtal



Rangoli competition at the Directorate



Integrity pledge at the EFF Champawat



Prize distribution at PG Degree College Champawat and Gram Sabha at village Mudiyani

Ms. Aishwarya Sharma stood first in debate competition. Shri Anupam, Shri Duchen along with Ms. Kavita and Ms. Vandana won first prize in Rangoli competition. In various sports categories Shri Deepak Dumka, Shri Gaurav Pandey and Ms. Kavita stood first. Along with that women farmer Ms. Surekha and Ms. Tulsi stood first in Mehendi competition. The programme was coordinated by Dr. S. Chandra, Ms. Kavya, Ms. Bhawna Gehlot and Ms. Nupur Joshi. Vigilance awareness week was also observed at EFF Champawat and coordinated by Dr. R. Singh, K. Kunal and P. A. Ganie.

5.13 World Antibiotic Awareness Week

In light to World Antibiotic Awareness Week during 12-18 November 2018, ICAR-DCFR organized an awareness programme on Antimicrobial Resistance on 17 November 2018 to sensitize participants on the effects of antibiotics on fisheries and human health. The programme was commenced with a welcome note from Dr. D. Sarma, Director, ICAR-DCFR on Injudicious use of antimicrobials in livestock including fishes and its direct implications on human health. Shri Sumanta

Kumar Mallik, Scientist associated with INFAAR programme mentioned on the Genesis of INFAAR and way forward and discussed on the solutions to combat AMR by rationalizing the use of available antimicrobial agents. Dr. Amit Pande, National Fellow and Dr. Suresh Chandra, Principal Scientist of ICAR-DCFR emphasized on adapting good animal husbandry practice to reduce AMR issues in veterinary and fisheries. An interactive session was carried out where participants expressed their earnest views and concerns on antimicrobial



Awareness campaign during the World Antibiotic Awareness Week at ICAR-DCFR

resistance in aquaculture ranging from misuse of antimicrobials, lack of knowledge and reluctance of individuals to practice safe aquaculture. Study materials of FAO and AMR slogans in terms of posters were displayed in the institute premises. The programme was participated by students from College of Fisheries Science, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur; scientists, research scholars, Young Professionals and students of ICAR-DCFR.

5.14 Institute Management Committee Meeting

The Institute Management Committee Meeting was organized on 27 November 2018 at the committee room of the Directorate which was chaired by Dr. D. Sarma, Director. The IMC members present during the meeting were Dr.



Discussion and decisions made by the IMC committee and their farm visit

B.P. Madhwal, Director, Department of Fisheries, Govt. of Uttarakhand; Dr. S.K. Das, Head, Fisheries Division, ICAR Research Complex for NEH region, Umiam; Dr. K.D. Joshi, Principal Scientist NBFGR,

Lucknow and Dr. M. Goswami, Principal Scientist, ICAR-CIFE, Mumbai.

5.15 World Soil Health Day

ICAR-DCFR conducted awareness cum demonstration programme on 5 December 2018 at village Dehra, Amia and Amritpur, Bhimtal on the occasion of World Soil Health Day. Seventeen fish farmers of Dehra village, twenty five students of Govt. Inter College of Amia and thirteen primary students and women farmer of village Amritpur at Govt. Primary School, Amritpur were enlightened on the importance of soil health for better agriculture productivity and fish production. Hands-on training on soil analysis was demonstrated using soil testing kits and the queries raised by the farmers were solved by Dr. N.N. Pandey of the Directorate. Shri Deepak Chauhan, Principal, GIC, Amia and Gram Pradhan Smti Kamla Devi and Smti Anita Kwira, Assistant Teachers of GPS, Amritpur were present on the occasion. Shri Bipin Vishwakarma; Shri Preetam Kala; Shri Dinesh Mohan and Shri Ajay if ICAR-DCFR organized the programme in these villages. Similarly, field demonstration on



Demonstration at GIC, Amia



Awareness at village Amritpur



Awareness, demonstration and group discussion at village Dudhpokhara, Champawat

soil health and water quality analysis from the fish ponds of village Dudhpokhara, Champawat district was conducted by Dr. Raghvendra Singh and Shri Kishor Kunal of Experiment Fish Farm, Champawat. A group discussion was also conducted by the EFF scientists with the farmers on the importance of maintaining soil and water health quality in rising hill aquaculture productivity.



Parliamentary Committee Meets for Hindi Awareness

5.16 Hindi Workshop

ICAR-DCFR organized a workshop for the scientists and staffs representing the non-Hindi speaking states of the country on 7 December 2018 in the Conference Hall. The staffs were trained in Hindi typing in computers, vocabulary usage and phonetics. The I/c Hindi Cell Shri Amit Joshi coordinated the programme.

5.17 Swachhta Pakhwada

Swachhta Pakhwada was observed during the period 16-31 December 2018 with a pledge by all the staffs and members if ICAR-DCFR on the initial day followed with a message on swachhta by the Director. Digitization of office records/e-office implementation was initiated. Old records,

files, obsolete furniture, junk material has been earmarked for disposing off. Cleanliness drive in office campus, nearby roadside, adjoining streets, residential colonies in Vikas Bhavan campus, block road, market place Vinayak areas etc was executed. Village people were briefed on waste disposal and to maintain sanitation as well as to adopt more and more organic farming practices. Trees were planted at the surroundings of the office premises. Shri Santosh Kumar, Nodal Officer for Swachh



Observing Swachhta Pakhwada in a remote village of Uttarakhand



Observing Swachhta Pakhwada at EFF Champawat

Bharat Mission coordinated the programme. At ICAR-DCFR Experimental Fish Farm, Champawat, the activities by the team of scientists and staffs during 23-29 December 2018 with a cleanliness awareness programme at Chaukunibora village and by organizing drawing competition on the theme swachhta for 38 pupils of Anand Bal Vidya Mandir school.

5.18 Republic Day Celebration

The Republic Day on 26 January 2019 of our nation was celebrated with flag hoisting ceremony attended by all the scientist and staff



Celebration of Republic Day at ICAR-DCFR, Bhimtal



Celebration of Republic Day at ICAR-DCFR, EFF Champawat

of the Directorate. Dr. Debajit Sarma, Director unfurled the national flag on the Republic Day and addressed the gathering to work in harmony. Shri K.C. Pandey, ADG Coast Guard was invited as the Chief Guest of the programme. Scientists and staff of the Directorate also expressed their views on the occasion. Likewise, the Republic Day was also celebrated at Experimental Fish Farm, Champawat with great fervour. The National Flag was unfurled by Mr. Kishor Kunal, Incharge on 26 January 2019 in presence of all the scientists and staffs of the fish Farm.

5.19 Mid-Term Institute Research Committee Meeting

ICAR-DCFR Scientists' Meet was held during 23 February 2019 as a Pre-Institute Research Committee (Pre-IRC) meeting under the Chairmanship of Dr. D. Sarma, Director. The Director welcomed all the scientists and briefed on the research gap in coldwater fisheries sector. Scientists of the institute presented the progress of the ongoing institutional research programmes. Discussion was also made on NEH, TSP, SCSP and farm activities at Experimental Fish Farm, Champawat. Project wise critical comments, suggestions and thorough discussions on each of the presentations were made during the meet.

5.20 Mann Ki Baat

ICAR-DCFR organized to webcast the inaugural program of *Pradhan Mantri Kisan Samman Nidhi* on 24 February 2019 in the Auditorium. 100 farmers, staff members of the Directorate and public representatives of Bhimtal and nearby villages participation the live telecast programme.



Live Telecast of Mann Ki Baat addressed by the Hon'ble Prime Minister of India to the farmers at ICAR-DCFR

5.21 Regional Advisory Committee Meeting

The Research Advisory Committee (RAC) of ICAR-DCFR was held on 28-29 March 2019 at the Directorate, Bhimtal under the chairmanship of Dr. M. Sinha, former Director, ICAR-CIFRI, Barrackpore. The meeting was attended by esteemed members Dr. S.C. Mukherjee, Dr. A.K. Sahoo and Dr. H.C.S. Bisht. Dr. D. Sarma, Director, ICAR-DCFR gave a brief account of the on-going research programmes, new initiatives and significant achievements during April 2018 to March 2019 and apprised the RAC on the recent development of infrastructure and facilities created at the Directorate. Dr. N.N. Pandey, Principal Scientist and Member

Secretary presented the action plan and progress on committed activities under approved SFCs. Based on the presentations made by the scientists, detailed review and discussion on the research outputs under different projects of ICAR-DCFR were made. RAC recommended to explore aquatic resources in high altitudinal regimes, action taken initiatives for commercialization of trout farming, development of breeding technology for different coldwater fish species and technical support to the state fisheries departments in doubling farmers' income. RAC appreciated the overall progress made by the institute and congratulated Director and scientists of ICAR-DCFR for their commendable work.



Apprising the RAC members on the developmental activities of the Directorate



Release of *Himjyoti* during the RAC meeting

6

Extension Activities, Consultancy and Other Services

6.1 Mera Gaon Mera Gaurav (MGMG)

The *Mera Gaon Mera Gaurav* is an ICAR initiative with a conceptual view to identify villages in the vicinity of ICAR institutions and Agricultural Universities by the team of scientists for providing advisories and consultations to farmers for increasing farm productivity and production. In pursuance to the above, ICAR-DCFR has divided 23 scientists in 6 teams for adoption of 24 villages so far. The gist of villages adopted, teams and activities undertaken under MGMG are summarised in Tables below;

6.1.1 Details of MGMG Team and status of benchmark survey of selected villages

Name of Nodal Officer	Designation of Nodal Officer			
Dr Suresh Chandra	Principal Scientist			

Team	Name of team coordinator	Name of scientists with discipline	Name villages adopted	No. of villages
Team 1	Dr. Debajit Sarma Principal Scientist & Director	Shri S.K. Mallik, Scientist Dr M.S. Akhtar, Scientist Dr Dimpal Thakuria, Scientist Dr Prakash Sharma, Scientist	Umshning, Pynhurslla, Laithrong, Myrang	4
Team 2	Dr. N.N. Pandey Principal Scientist	Dr Amit Pande, National Fellow Dr S. Ali, Scientist Shri Siva, C, Scientist	Todera, Dudhaulti, Jyurkafun, Manan	4
Team 3	Dr. S. Chandra Principal Scientist	Shri R.S.Tandel, Scientist Dr. (Mrs.) Kh. Victoria Chanu, Scientist Smti Pragyan Dash, Scientist	Alchaunna, Hari Nagar, Berijala, Baheri Gaon, (Vinayak) Boherakun	5
Team 4	Dr. R.S.Patiyal Principal Scientist	Dr. (Mrs.) Ciji Alexander, Scientist Dr. B.S. Kamalam, Scientist Shri Rajesh, M, Scientist	Salmatta, Sarmoli, Khunari	3
Team 5	Dr. D. Baruah Sr. Scientist	Dr. S. G. S.Zaidi, Sr. Scientist Dr. Neetu Shahi, Scientist	Chug, Hari, Changpa, Donglok	4
Team 6	Dr. R. Singh, Scientist	Shri Parvaiz .A. Ganie, Scientist Shri Kishore Kunal, Scientist	Dudhpokhara, Mudyani, Chekuni Bora, Moradi	4

6.1.2 Institute/SAU summary under MGMG

No. of Teams formed	No. of Scientists	No. of Villages adopted	No. of Blocks covered	No. of Districts covered	Bench Mark Survey conducted (No. of villages)
6	23	24	12	10	10

6.1.3 Summary of activities organized under MGMG by Institute/SAU

Sl No	Name of activity	Number	No. of farmers participated/ benefitted
1.	Visit to village by teams	41	488
2.	Interface meeting/ <i>Goshthies</i>	18	640
3.	Trainings conducted	10	419

Sl No	Name of activity	Number	No. of farmers participated/ benefitted
4.	Mobile based advisories	71	181
5.	Literature support provided	23	940
6.	Awareness created	75	992
7.	Linkages developed with other agencies	08	275

6.1.4 Summary of other activities organized under MGMG by Institute/SAU

S. No.	Name of activity	Quantity (qtl)/No.	Area (ha)	No. of farmers benefitted
1.	No. of demonstrations laid out	27	11.7	321
2.	Input support provided like seed, planting material, fertilizers, etc.			
i	Seeds (qtl)	30,000		25
ii	Planting material (No.)	-	-	-
iii	Fertilizers (qtl)	-	-	-
iv	Any other (specify) feed	700	11.7	20

6.1.5 List of villages adopted under MGMG by the Institute/SAU

State	Name of district	Name of block	Name of villages	No. of villages
Uttarakhand	Almora	Dwarhat, Hawal bagh	Todera, Dudhauli, Jyurkafun, Manan	4
	Pithoragarh	Munsyari	Sarmoli	1
	U. S. Nagar	Sitarganj	Salmatta	1
	Champawat	Champawat	Dudhpokhara, Mudyani, Chekuni Bora, Moradi, Khunari	5
	Nainital	Bhimal	Alchaunna, Hari Nagar, Berijala, Baheri Gaon, (Vinayak) Boherakun	5
Meghalaya	Ri-bhoi, East Khasi Hills, West Khasi Hills	Umshning, Pynhurslla, Laitkhrong, Myrang	Umshning, Pynhurslla, Laitkhrong, Myrang	4
Arunachal Pradesh	West Kameng Lower Subansiri	Dirang, Ziro	Chug, Hari, Changpa, Donglok	4

6.1.6 Details of demonstration conducted under MGMG by the Institute/SAU

Sl No	Title of demonstrations	No. of demonstration	Area covered under demonstration (ha)/ number of units, etc.)	No. of farmers benefitted
1.	Breeding and seed rearing of common carp	4	4.0	60
2.	Transportation and seed stocking of rainbow trout	2	0.2	15
3.	Health management in carp farms	6	0.8	80
4.	Fish tank preparation, seed stocking and management	1	0.5	53
5.	Feed formulations and feeding	2	0.2	60
6.	Cage farming	1	0.016	35
7.	Integrated fish farming and seed stocking techniques	4	2.0	45
8.	Soil water quality maintenance and integrated fish farming	3	1.2	40
9.	Breeding and seed production of mahseer	3	0.4	40

Sl No	Title of demonstrations	No. of demonstration	Area covered under demonstration (ha)/ number of units, etc.)	No. of farmers benefitted
10.	Improved techniques of fish farming	1	1.2	50

6.1.7 Details of Input support provided under MGMG by the Institute/SAU

Sl No	Type of Input Support Provided (Seed, planting material, technology, fertilizers, etc.)	Quantity (Kg/No.)	Area (ha)	No. of farmers benefitted
1.	Fish fry and fingerlings	30,000 nos.	8.0	45
2.	Fish feed	700 kg	3.7	35

6.1.8 Details of trainings conducted under MGMG by the Institute/SAU

Sl No.	Topic of training	Duration of training (No. of days)	No. of farmers participated in training
1.	Best management practices for culture and breeding of coldwater fishes	1 day	50
2.	Fish farming	1 day	10
3.	Awareness cum training programme on trout farming	1 day	200
4.	Awareness cum training programme on Chocolate mahseer farming	1 day	35
5.	Integrated fish farming	1 day	40
6.	Coldwater Fisheries and aquaculture practices in Indian Himalayan Region	1 day	10
7.	Fish farming	1 day	14
8.	Integrated fish farming	1 day	45
9.	Training on value addition	1 day	26

6.1.9 Details of literature support provided under MGMG by the Institute/SAU

Sl No.	Title of literature (Scientific cultivation of broccoli/ Improved varieties of wheat etc.)	Type of literature (Folder/pamphlet/leaflet/ package of practice, etc.)	No. of famers benefitted
1.	Good Management Practices (GMP) for trout and carp farming in mid hills, DCFR Pamphlet No 33.	Pamphlet	50
2.	Rainbow trout ke fry aum anguliyaoki safed daag ki bimari (In Hindi). DCFR Pamphlet No 34	Pamphlet	40
3.	Parvatiye chhetron kei pramukh palan yaog matsya prajatiyon kei prajanan avam beej utpadan takneekiya Bulltetin No,28	Bulletin	72
4.	Rainbow trout ki aakh aur muh kei Beemari,	Pamphlet	100
5.	Field observations on common health disorders of farmed rainbow trout (<i>Oncorhynchus mykiss</i>) Bulletin No.30	Bulletin	30
6.	Argulosis in coldwater fish, DCFR Pamphlet No- 31.	Pamphlet	75
7.	White spot disease in coldwater fish, DCFR Pamphlet No 32.	Pamphlet	80

6.1.10 Details of linkages created under MGMG by the Institute/SAU

Sl No.	Name of department/ organization/agency etc.	Type of linkage/purpose of creating linkage (for training/ for selection of villages/ for credit, etc.)
1.	Krishi Vigyan Kendra, Jeolikot, Nainital	Training/ for selection of villages
2.	Department of Fisheries, Nainital, Uttarakhand	Training/ for selection of villages
3.	ICAR- CITH, Mukteswar	Training/ for selection of villages

Sl No.	Name of department/ organization/agency etc.	Type of linkage/purpose of creating linkage (for training/ for selection of villages/ for credit, etc.)
4.	ICAR- VPKAS, Almora	Training/ for selection of villages
5.	KVK, West Kameng	Training/ for selection of villages
6.	KVK, Subansiri	Training/ for selection of villages
7.	HESCO, Dehradun	Technology Transfer

6.1.11 Details of awareness created under MGMG by the Institute/SAU

Sl No.	Subject matter of awareness (Swachhata/ Crop insurance/ climate change etc.)	No. of farmers benefitted
1.	On culture of rainbow trout at Sirmoli, Munsayari, Pithoragarh, Uttarakhand	200
2.	Soil water health, Champawat, Uttarakhand	20
3.	Health management in trout and carp farms, Champawat, Uttarakhand	15
4.	Fish farming in hills	100
5.	Health management	30
6.	Integrated fish farming	25
7.	Fish feed preparation	56
8.	Awareness for the participants towards cleanness in surrounding areas and in fish ponds/tanks was arranged.	35
9.	Fish tank management during winter months	40
10.	Integrated fish farming in mid hill tanks	14
11.	Awareness program on fish health management	100
12.	Awareness on fish farming in Tarai area	40
13.	Awareness on value addition	80

6.1.12 Details of problem diagnosed under MGMG by the Institute/SAU

Sl No.	Name of village	General problem	Agricultural problem
1.	Vinayak, Hari Nagar, Manan	Quality seed	Small size feed (fry) supply is common resulting to lower survival
2.	Alchanuna, Dudpokhera	Water quality & diseases	Bacterial and fungal infections in fish fry and fingerlings
3.	Chaukani Bora Kafalang, Shaktipur Bunga, Jyur Kafun,	Slow growth of stocked fishes	Lower water temp, algal blooms during summer, and impaired water quality in cement tanks/ polytanks

6.1.13 Details of any other activity organised under MGMG by the Institute/SAU

Sl No.	Name of activity	No. of farmers benefitted
1.	Hygiene & Cleanness in work place	170
2.	Hygiene & Cleanness in work place	60
3.	Kisan Samman Nidhi programe	100

Glimpses of Mera Gaon Mera Gaurav (MGMG)



MGMG programmes in Uttarakhand



Water quality analysis for trout farming at Menchukha valley



Diagnostic visit to integrated fish farming at Yachuli village



Soil analysis at rice fish plots of Ziro valley



Observation of fish growth and other biological parameters of fish harvested from rice-fish plots

6.2 Consultancy / Services / Outreach

6.2.1 Initiatives in rainbow trout farming at Munsyari

Demonstration was conducted on rainbow trout farming and farmer's meet with the participation of Shri Ravishankar, District Magistrate, Pithoragarh, Smti Tara Pangtey, Public Representative and 200 progressive farmers at Sarmoli, a remote tribal village in Munsyari area on 30 May 2018. Inauguration of rainbow trout hatchery was also carried out, which is a first initiative in the Munsyari area of Uttarakhand. Dr. R.S. Patiyal coordinated the programme of the Directorate.



Distribution of water test kits to the trout growers



Interaction with the trout growers of the region

6.2.2 Facilitating captive breeding of mahseer at Nagaland

ICAR-DCFR established a mahseer hatchery at Suteplenden village (Longkong), Mokokchung district of Nagaland in collaboration with the Department of Fisheries & Aquatic Resources, Govt. of Nagaland under the NEH activity. Successful breeding and seed production of the golden mahseer as well as chocolate mahseer was carried out in the month of September 2018 for the first time in the state in order to promote their aquaculture practices



Stripping of a female mahseer



Stripping of a male mahseer



Mixing of eggs and milt for fertilization



Fertilized eggs in flow through hatchery

and further rehabilitation in the natural systems of Nagaland. Mahseer being the state fish of Nagaland was successfully bred to produce substantial numbers of fry. Attempt is being made to rear 2000 young ones of the species under captivity in the hatchery complex for their further development as broodstock. Dr. R.S. Haldar, ACTO coordinated the programme.

6.2.3 Technical support in importing trout ova to Kashmir

A team of scientist including Shri Siva, C and Shri Raja Aadil of ICAR-DCFR provided technical support in transporting improved variety of rainbow trout eyed ova imported from Denmark to Beerwah trout hatchery, Budgam, Kashmir. The team visited the Budgam hatchery during 10-18 January 2019 and briefed the hatchery managers and operators of the Department of Fisheries, Govt. of Jammu & Kashmir on the healthy hatchery management and larval rearing practices.



Technical support in import of trout eggs from Denmark

6.2.4 Initiatives on rainbow trout farming at Ramgarh

ICAR-DCFR initiated in releasing rainbow trout seeds in raceways of the farmers of Ramgarh area in Nainital district, Uttarakhand in presence of Shri Ram Singh Kaida, Hon'ble Member of Legislative

Assembly and Chief Development Officer, Nainital. Dr. R.S. Patiyal, Principal Scientist coordinated the programme and visited on the occasion with Dr. D. Sarma, Director and Dr. N.N. Pandey on 24 February 2019.



Initiatives in rainbow trout farming at Ramgarg

6.2.5 Consultancy services on rainbow trout (*Oncorhynchus mykiss*) with KDHP Co. Pvt. Ltd at Munnar, Kerala

ICAR-DCFR has been providing consultancy on Rainbow trout culture for the officers and workers of Kannan Devan Hills Plantations Co. Pvt. Ltd. at Rajamallay Trout Hatchery, Munnar, Kerala; an age-old trout hatchery established by British more than 100 years ago. Shri A.K. Giri and Shri Siva C., scientists of the Directorate visited Munnar during 6-8 February 2019 and deliberated on Breeding and hatchery management of rainbow trout, feed and feeding practices for fry and grow out stages including the brood stocks and improved practices for wellbeing of ova house and rearing raceways in Hindi, English and Tamil language. Scientific intervention on feed and feeding practices especially the first feeding of trout fry with optimum frequency and feeding rate with ICAR-DCFR produced starter feed was demonstrated. Six numbers of females

(700-1000g weight and 43-52cm total length) and seven numbers of males (600-1100g weight and 41-53cm total length) were also dry stripped to produce 6000 numbers of eggs with an initial fertilization rate of 35-40%. The programme was coordinated by Shri Abhay Kumar Giri; Shri Siva C. and Dr. Rajesh M., Scientists of this Directorate under the guidance of Dr. Debajit Sarma, Director.



Demonstrations on trout breeding techniques at Rajamallay trout hatchery



Interaction with the hatchery managers and workers by the scientists of ICAR-DCFR

6.2.6 MOUs signed for collaborations with fish feed companies

Memorandum of Understanding between ICAR-DCFR and SPY Agro Pvt. Ltd. (RDDG) and String Bio Pvt. Ltd. (String Pro Meal) was signed on 8 February 2019 for collaborating in the research



MoU between ICAR-DCFR and S.P.Y. Agro Industries Limited



MoU between ICAR-DCFR and String Bio Pvt. Ltd

on Evaluation of single cell protein by product of methane conversion as an alternative protein source in rainbow trout grow-out feeds with an objective for subsequent ingredient evaluation experimentations and rainbow trout feeding trials. Dr. Rajesh, M and Dr. Biju S Kamalam, scientists of the Directorate is coordinating the programme.

6.2.7 Promotion of rainbow trout farming in Nagaland

ICAR-DCFR established three numbers of trout raceways and one trout hatchery at Dzuleke village, Kohima district in collaboration with the Department of Fisheries & Aquatic Resources, Government of Nagaland with an objective to popularize the rainbow trout farming in Nagaland under NEH activity. The first consignment of one lakh eyed ova of rainbow trout was brought from the Department of Fisheries, Govt. of Jammu & Kashmir and was stocked at the newly constructed trout hatchery at Dzuleke, Kohima on 14 February 2019 under the aegis of this Directorate. Dr. R.S. Haldar, ACTO coordinated the programme.



Transportation of rainbow trout eyed ova by air to Dzuleke, Kohima, Nagaland



Rearing of rainbow trout eyed ova at Dzuleke, Kohima

6.2.8 Promotion of ornamental fish farming in Assam

ICAR-DCFR initiated in culture and breeding of indigenous hill stream ornamental fishes in aquarium units established at Aquaculture & Biodiversity Centre, Department of Zoology, Gauhati University, Guwahati, Assam. The programme was initiated under the NEH activity and is jointly collaborated between ICAR-DCFR and Department of Zoology, Gauhati University, Assam. Dr. R.S. Halder, ACTO of the Directorate coordinated the programme.



Aquarium units established at Aquaculture & Biodiversity Centre, Gauhati University

6.2.9 Technical support for trout fisheries development at Menchukha valley

A team of scientist of ICAR-DCFR made a maiden visit to newly declared Shi Yomi district of Arunachal Pradesh along the Indo-China border to provide technical support to Department of Fisheries, Govt. of Arunachal Pradesh in conducting an extensive field survey during 13-14 February 2019 in the Menchukha region in selecting a suitable site for start-up of trout farming in concrete raceways and in establishing a seed production unit (ova house) in the Government and private sector each. The local villagers and residents of Menchukha region showed many of their farm sites

having potential for trout farming with good source of quality and quantity water to the scientists and officers. The water quality of the streams and river Yargyap chu and its adjoining snow-fed streams were analyzed, trout fish samples were examined and GIS points were taken to mark the possibility in selecting suitable sites for establishment of trout raceways and marking of trout protected zones for conservation. A road map on GIS platform and ground survey was prepared for policy framework and its implementation for trout fisheries development at GIS laboratory, coordinated by Dr. Deepjyoti Baruah, Sr. Scientist.



Analysing physicochemical parameters of snow fed river water for determining site suitability for trout farming at Menchukha valley

6.2.10 Advisory Services

- A team of scientists of ICAR-DCFR led by Shri A.K. Giri visited the state fish farm, Department of Fisheries, Govt. of Uttarakhand located at Uneri, Bhimtal on 26 October 2018 and 19 November 2018 for a case study and need assessment field survey. The objective of the survey was to develop a rainbow trout eyed ova hatching and rearing facility as a part of expansion programme of the Directorate for rainbow trout farming in hill states. Important

water quality parameters were estimated which are stated as dissolved oxygen: 8.35ppm; dissolved free carbon dioxide: 3.5ppm; water temperature: 16.1°C; pH-7.5; total alkalinity: 40ppm and total hardness: 55ppm.

- A team of scientists comprising of A.K. Giri, S.K. Mallik and Dr. S. Chandra of ICAR-DCFR conducted an exploratory survey with an aim of establishing coldwater fish germplasm repository at the Directorate. Live specimens of snow trout and *Barilius* sp. were collected from Gola river, Haldwani of Nainital district on 29 November 2018 with operation of cast net for stock development and research purposes.
- A team of scientists comprising of Dr. S. Chandra, Mr. S.K. Mallik and Mr. A.K. Giri from ICAR-DCFR surveyed various carp and pangas farms at Tarai region of U.S. Nagar district on 29 November 2018 to review the status of fish farming in that area. A total of 7 farms namely Bari fish farm, Mukesh Rana fish farm, Santipuri fish farm, Kiratpur fish farm, Ashok fish farm, State department fish farm and NFDB sponsored brood bank farm for pangas



Visit to Uneri, Bhimtal for case study



Exploratory survey for establishing coldwater fish germplasm repository

were covered during the case study and survey program. Random sampling was done in each of these farms to monitor the growth and health status of the stocked fishes. The fishes looked healthy in appearance and tissue samples were collected from skin, gill, liver, intestine, kidney and spleen of the fishes for further general microbial analysis under laboratory conditions.

6.3 Field Visits

- Biju Sam Kamalam, Abhay Kumar Giri, Siva C. and Rajesh M. has given farm advisory and conducted hands-on training cum demonstration on rainbow trout breeding to Kanan Devan Hills Plantation Company Private Limited, Munnar, Kerala.
- Rajesh M., Biju Sam Kamalam and R. S. Haldar conducted field adaptation trial and regular farm advisory was given to farmer Mr. Alok Naskar, a farmer- entrepreneur from Bhimtal, on culture and breeding of ornamental fishes.
- R. Singh, K. Kunal and P.A.Ganie provided technical support in estimating the Biochemical Oxygen Demand (BOD) at different sampling stations of River Gaudi, Champawat to the State fisheries department Uttarakhand during Sept-Oct. 2018
- Siva C and Raja Aadil Hussain Bhatt provided technical support to transport improved variety of rainbow trout eyed ova from Denmark to Beerwah trout hatchery, Budgam, Kashmir and visited the Budgam hatchery during 10-18 January 2019 and briefed the healthy hatchery management and larval rearing practices to the fisheries officials.

6.4 Coldwater Fish Breeding and Farm Production

6.3.1 Integrated fish-cum-horticulture using polytanks: A climate resilient practice in mid hill region

Polytank is a suitable structure to mitigate climate change with increasing temperature and draught like situation at Doonagiri, Almora (2220 msl, 79°29'604" E, 29°48'5"N) along the river Kosi, which favours the growth of the fish by keeping the pond water warmer. This pond water further serves

as a buffer stock for raising horticulture crops. A small farm pond in the form of polytank and practice of fish farming coupled with horticulture is a climate resilient approach in the mid altitudes of Indian Himalayan Region. Stunt yearlings of the exotic carps viz., Silver carp (*Hypophthalmichthys molitrix*), Grass carp (*Ctenopharyngodon idella*) and Common carp (*Cyprinus carpio*) and minor carp (*Labeo dyocheilus* and *Bangana dero*) of size 30-40 gm was stocked @2.5-3.0 nos/m³ with species ratio 20:40:20:20 in 10 polytanks and they were fed with rice polish and mustard oil cake coupled with fresh *azolla* @ 3% of their body weight on daily basis. Production of 60-70 kg fish/100m² was achieved with this technique in mid hill conditions in a span of 12 months. The overflow of the water was used for irrigating horticultural crops in an area of 200m². An average yield of 400kg radish, 5kg radish seed and



Incubation of golden mahseer eggs



Hatchery produced advanced fry of golden mahseer

50kg coriander was achieved. Two crops of radish-coriander and fish in pond can be attained in a year in this manner. Therefore, poly-lined rainwater harvesting tanks are suitable for this climate resilient practice in mid hills where scarcity and low water temperature are bottleneck in crop production.

6.3.2 Breeding and seed production of golden mahseer

Breeding and seed production of golden mahseer, *Tor putitora* was successfully carried out at mahseer hatchery complex of ICAR-DCFR, Bhimtal during May to September, 2018. About 38,000 nos. of eggs were stripped out from the matured female brooder collected from Bhimtal lake, which were then fertilized with milt by the stripping of mature males. The fertilization and hatching rates were 85% and 90% respectively. The incubation period was 72-96 hrs at water temperature 21.6 - 23.4°C. The water flow was maintained @ 1-2 l/min and @ 3-4 l/min during incubation and rearing of fry respectively. Total 30000 numbers of golden mahseer fry were produced, out of which 10000 numbers of fry were sold to Directorate of Fisheries, Govt. of Sikkim and 1000 numbers were sold to College of Fisheries, GBPUAT, Pantnagar for ranching purpose and generated a revenue of Rs. 1.1 lakh. 2000 numbers of advanced fry were transported to ABACA for the development of mahseer based recreational fisheries. The remaining fries were kept for the research purpose of the Directorate. The entire activities were coordinated by Dr. M. S. Akhtar, Mr. A. K. Giri and Dr. Rajesh M, scientists of ICAR-DCFR.



Golden mahseer brooder

6.3.3 Himani Aquarium

The Himani aquarium unit of ICAR-DCFR is maintaining 30 beautiful and fascinating indigenous cold water ornamental fishes including *Tor putitora*, *Neolissochilus hexagonolepis*, *Naziritor chelinoides*,



Ornamental fishes maintained at Himani aquarium



Schizothorax richardsonii, *Barilius bendelensis*, *Barilius vagra*, *Labeo dyocheilus*, *Channa striata*, *Garra annandalei*, *Annandale garra*,

Garra birostris, *Schistura obliquofascia*, *Schistura beavani*, *Botia kubotai* and *Botia dario*. Several variants of exotic fishes viz., *Andinoacara pulcher*,

Cyprinus carpio, *Angasianodon hypophthalmus*, *Astronotus ocellatus*, *Barbonymus altus*, *Scarus psittacus* and *Carassius auratus* are also maintained. This unit is open for the public to enjoy the aesthetic beauty of this aquarium from Monday to Saturday (closed on Sunday and public holidays) from 10:00 A.M. to 05:00 P.M. with an entry fee of ₹ 10.00.

6.3.4 Seed production of mahseer in Himani Aquarium

Breeding and seed production of chocolate mahseer (600-800g), golden mahseer (500-1000g) and dark mahseer (200-300g) was achieved in Himani aquarium unit periodically in the year 2018-19. Broodstock were triggered to spawn volitionally through maintenance of optimal environmental condition in glass aquarium (57"×36"×34") having water temperature of $21\pm 1^{\circ}\text{C}$ with adequate under gravel bio-filter system. 40-50% of fertilized eggs were recovered in natural spawning whereas 85% success was achieved in stripping process of the fishes. Egg hatching was observed in 96 hours at 23°C and 144 hours at 20°C of post-fertilization with 40% of hatching success and further 90% of survival rate of the hatchlings. 7000 numbers of chocolate mahseer fry (*Neolissochilus hexagonolepis*) were produced and reared in ornamental larval rearing unit of the Directorate. Similarly, 1500 numbers of golden mahseer fry (*Tor putitora*) were produced and reared in the larval rearing unit by replenishing the old stock with raceway reared broodstock. 500 numbers of dark mahseer fry (*Naziritor chelinoides*) were also produced and maintained in ornamental larval rearing unit of ICAR-DCFR.



Seed production of chocolate mahseer in aquarium conditions of ICAR-DCFR

breeding method without hormone administration. Egg were collected using plastic twines extracted from unused plastic sacks. About 150-200g of twines were per kg of female for collection of eggs. Sex ratio was kept 1.0-1.5:1.0 (Male:Female) by weight. Fertilized eggs were adhesive, pale yellowish in colour and have diameter ranging from 1.4-2.5 mm. Recorded fecundity was about 0.5-1.0 lakh eggs/kg body weight. Hatching takes place after 84-112 hrs post fertilization and yolk absorption takes place within 72-90 hrs at 18-22 o C The survival percentage of egg to spawn and spawn to fry was found 45-50% and 30-35%, respectively. Two hundred eleven numbers of female brooders of size range 261 g to 383g were deployed for breeding and about 4.91 lakhs fry (15dph) were produced. The whole breeding program was jointly coordinated by Mr. A.K. Giri, Dr. Raghvendra Singh, Mr. Kishor Kunal, Mr. P.A.Ganie and Mr. Raja A.H. Bhat.



Pre-stocking preparation of nursery tanks

6.3.5 Improved common carp breeding

Common carp (*Cyprinus carpio*) is a very important candidate fish in mid Himalayan region and widely practiced in polyculture cement tanks/ponds owing to hill geomorphological features and lower thermal regime. In order to obtain higher fish productivity in uplands, two improved Hungarian strains of common carp 'Ropsha scaly' and 'Felsosomogy mirror carp' were introduced at Champawat experimental farm in the year 2007. These species were found more suitable for hill farming due to their fast growth and wide temperature tolerance (5-32°C). The species spawn twice during a year, i.e. March-May and July-August. Breeding and seed production of improved common carp was carried out at fish farm, ICAR-DCFR, Champawat following old conventional hapa



Battery of breeding Hapa



Common Carp fry

6.3.6: Breeding and seed production of Snow trout

Snow trout, *Schizothorax richardsonii* is an important indigenous coldwater species locally known as Asela. Breeding and seed production of snow trout was carried out at experimental fish farm, Champawat by dry stripping method. No pre-treatment of any inducing hormone was given to fish prior to stripping. Breeding operation was carried out on 05 October 2018 keeping sex ratio as 1: 0.75 (Female: Male). For breeding, 12 numbers of female (wt. range: 92- 109 g) and 08 males (wt. range: 76-92g) were selected. Stripping of fishes resulted in production of about 18000 fertilised eggs. The size of unfertilized eggs was ranging from 2.1-2.3 mm with bright orange colour while fertilized egg were having a diameter of 2.2-2.5 mm Light yellow- orange colour. Fertilized eggs were semi- adhesive and demmersal. Recorded fertilization rate, incubation period hatching rate, yolk sac absorption time and survival rate was 92-96%, 147-173 hrs, 71 %, 9-11 days and 79 % respectively. Around 12,500 numbers of fry were produced during the breeding cycle. Effort has also been made in refurbish of the existing experimental



Brooders of snow trout



Mixing of gametes



Selection of brooders



Stripping of brooders

stock of snow trout at the Experimental Fish Farm, Champawat for better spawning results for which snow trout (*Schizothorax richardsonii*) of adult and fry stages were collected from Gaudi, Ladhiya and Chhirapani streams. The entire activity was coordinated by Mr. Kishor Kunal, Dr. Raghvendra Singh and Mr. Parvaiz Ahmad Ganie with the help of technical personnel of the farm.

6.3.7: Rainbow trout seed production and rearing

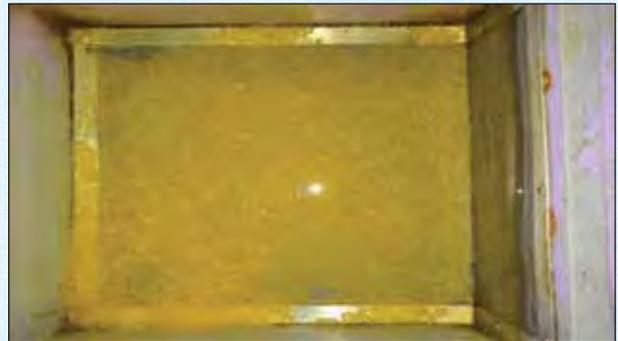
Breeding, seed production and culture of rainbow trout has been an important activity at the farm. In the reporting year, more than 150 adult rainbow trouts with weight more than 1200g were reared in raceway systems. Additionally, In order to improve the existing rainbow trout stock in the farm, around 25000 rainbow trout eyed ova were procured from state fisheries department, Jammu and Kashmir and incubated at the farm . Farm, Champawat. The farmers were also benefited from the imported eyed ova. The farm raised rainbow trout brooders were deployed for the breeding and seed production during December 2018 to

February 2019. For breeding purpose, total 34 numbers of female (wt. range: 1180- 1489 g) and 41 males (wt. range: 1120-1141g) were selected. Around 51000-53500 fertilised eggs of size ranging from 4.1-4.7 mm with yellow- orange colour were produced. Recorded fertilization rate, incubation period, hatching rate, yolk sac absorption time

and survival rate was 91-94%, 56-65 days, 62 %, 17-22 days and 67% , respectively. Around 22,500 numbers of swim-up fry were produced during the breeding cycle. The activities of seed production and rearing of rainbow trout were coordinated by Dr. Raghvendra Singh, Mr. Parvaiz Ahmad Ganie, and Mr. Kishor Kunal.



Selection of brooders



Incubation of fertilized eggs



Stripping of brooders



Mixing of gametes

ICAR-DCFR is undertaking collaborative work in PPP mode with ICICI FOUNDATION for upliftment of rural livelihood security of hill fish farmers in five villages of Nainital and Almora districts of Uttarakhand



6.3.8: Breeding and seed production of ornamental fishes

Breeding of popular ornamental fish species viz. koi carp and gold fish was also carried out at the farm during the month of July- August. For the purpose, 5 females with 10 males each of koi and gold fish were deployed in breeding hapa separately. The weight of koi carp ranged from 37-67g and that of gold fish from 27- 41g. About 2000 nos. of fry were produced from koi carp while gold fish produced about 1100 nos. of fry. Although, the survival was not that much promising. The activities of seed production and rearing were coordinated by, Dr. Raghvendra Singh, Mr. Parvaiz Ahmad Ganie and Mr. Kishor Kunal with the help of technical staff of the farm.

6.3.9 Fish seed sale and distribution

Rainbow trout seed (5-7 cm) numbering 1000 nos. were supplied from EFF, Champawat to trout

growers of Munsiri under TSP program of the directorate. Also, more than 11000 nos. of common carp fingerlings raised at the farm were sold/ distributed to different fish farmers, government and private agencies generating a revenue to the tune of Rs 16760.00 (Rupees sixteen thousand seven hundred sixty only). Besides this the seed of ornamental fishes reared at farm were also distributed to fish growers of the region in different farmer oriented programmes.

6.4 Participation in Exhibitions

The research and development activities of the Directorate were exhibited and disseminated to scientists, farmers, students, faculty members of different universities and other stakeholders at several seminar, symposia, workshop, conference and Kisan Mela etc, being organized across the country. The details of the participations are mentioned in the table below;

Name of the programme	Organizer	Duration	Place/venue
International Symposium on Aquaculture and Fisheries Education (ISAFE 3)	ICAR- Central Institute of Fisheries Education, Mumbai in collaboration with Indian Fisheries Association	May 16-18, 2018	ICAR- CIFE, Mumbai
22 nd National Agriculture Exhibition on the Theme on the Theme of "NEW INDIA : FUTURE LEADER OF THE GLOBE"	Central Calcutta Science & Culture Organization for Youth, Kolkata	August 3-6, 2018	Milan Samity Maidan, Kolkata - 700049
104 th Pantnagar Kisan Mela & Agro-Industrial Exhibition	Govind Ballav Pant University of Agriculture & Technology (GBPUAT), Pantnagar, Uttarakhand	October 05-08, 2018	GBPUAT, Pantnagar (U.K.)
1 st Kumaon Pashudhan Kauthik - Livestock Technology Expo and Fair	Department of Animal Husbandry in collaboration with Uttarakhand Livestock Development Board, Sheep and wool Development Board, Department of Fisheries, Dairy Development Board and PHD Chamber of Commerce, Uttarakhand	December 01-03, 2018	GBPUAT, Pantnagar (U.K.)
31 st All India Congress of Zoology (31 st AICZ) & National Seminar on Climate-Smart Aquaculture and Fisheries (CSAF)	North East Society for Fisheries and Aquaculture (India) in collaboration with Zoological Society of India (ZSI), Bodh Gaya	January 15-16, 2019	College of Fisheries, CAU (I), Lembucherra, Tripura
World Conference on Brackishwater Aquaculture (BRAQCON-2019)	ICAR-CIBA in collaboration with Society of Coastal Aquaculture and Fisheries (SCAFi)	January 23-25, 2019	ICAR-CIBA, Chennai
XIV Agricultural Science Congress	National Academy of Agricultural Sciences, New Delhi in collaboration with ICAR-IARI, New Delhi	February 20- 23, 2019	NASC Complex, New Delhi
105 th Pantnagar Kisan Mela & Agro-Industrial Exhibition	Govind Ballav Pant University of Agriculture & Technology, Pantnagar, Uttarakhand	March 7-10, 2019	GBPUAT, Pantnagar (U.K.)
Kisam Mela, ICAR-DCFR Experimental Fish Farm, Champawat	ICAR-DCFR, Bhimtal	March 11-12, 2019	DCFR Experimental Fish Farm, Champawat



Exhibition during 22nd National Agriculture Exhibition at Kolkata



ICAR-DCFR exhibition during the 31st All India Congress of Zoology & National Seminar on Climate – Smart Aquaculture and Fisheries at Tripura



Exhibition at World Conference on BRAQCON-2019 at Chennai



Exhibition during XIV Agricultural Science Congress, Delhi

6.5 Visitors

6.5.1 Farmer visits

- A group of fish farmers from District Tawang, Arunahal Pradesh, along with officers of Directorate of Fisheries, Itanagar visited at EFF, Champawat on 29th September 2018. An overview on Rainbow Trout culture and farming and Breeding and seed production of Snow trout was given to them. Mr. Parvaiz Ahmad Ganie, Mr. Kishor Kunal and Mr. Ravinder Kumar conducted and coordinated the visit.



Visit of farmers from Tawang district of Arunachal Pradesh during Sept., 2018

- A group of six fish farmers along with two Fisheries Officers from Tawang district of Arunachal Pradesh visited ICAR-DCFR Bhimtal and Experimental Fish Farm Champawat during 27 September to 2 October 2018 for their exposure visit on recent advances in coldwater aquaculture. The farmers were interacted by the scientists and deliberated on their issues, constraints and remedies in undertaking coldwater fish farming in their respective areas.
- A group of fifteen farmers from Almora district of Uttarakhand along with Scientists from G.B. Pant National Institute of Himalayan Environment & Sustainable Development, Kosi-Katarmal, Almora visited ICAR-DCFR on 21 February 2019 and interacted with scientists.
- Seven numbers of perspective trout farmers and entrepreneurs from Menchukha region of newly declared district Shi-Yomi of Arunachal Pradesh alongwith Mr.KenbomChisi, District Fishery Development Officer and Mr. Sange Dere Diri, Fishery Demonstrator of Department of Fisheries, Govt. of Arunachal Pradesh visited



Visit of fish farmers from Tawang district of Arunachal Pradesh during September 2018



Visit of fish farmers from Shi Yomi district of Arunachal Pradesh during December 2018

ICAR-DCFR and Experimental Fish Farm Champawat during 06-10 December 2018, with an objective to gain knowledge and to develop skill in trout raising and seed production.

6.5.2 Students visits

International Students

- A group of eighteen French students (DEFIAA Consortium, French Ministry for Food, Agriculture and Forestry) along with three faculty members from G.B. Pant University of Agriculture Science & Technology, Pantnagar, Uttarakhand visited ICAR-DCFR during 10 August 2018 and interacted with scientists.
- A group of thirteen students of B.Sc. (Fisheries), batch of 7th Semester along with two faculty members from Department of Aquatic Resources, Agriculture and Forestry University, Rampur, Chitwan, Nepal visited ICAR-DCFR on 5 November 2018 and interacted with scientists.

Indian Students

- A group of twenty seven students of M.Sc. Zoology (Aquaculture & Fisheries) 4th Semester with two faculty members from Department of

Zoology, University of Burdwan, Gopalgadh, Burdwan, West Bengal visited ICAR-DCFR on 10 April 2018 and interacted with scientists.

- A group of twenty students of M.Sc. Zoology (Fish & Fisheries) with two faculty members from Department of Zoology, Maharishi University, Lucknow, Uttar Pradesh visited ICAR-DCFR on 23 April 2018 and interacted with scientists.
- A group of fourteen students of M.Sc. Life Science along with two faculty and one staff members from Babasaheb Bhimrao Ambedkar Central University, Lucknow, Uttar Pradesh visited ICAR-DCFR during 1-7 May 2018 and interacted with scientists.
- A group of sixty six students of Class XII with three faculty members from Aryaman Vikram Birla Institute of Learning, Haldwani, Nainital, Uttarakhand visited ICAR-DCFR on 16 May 2018 and interacted with scientists.
- A group of twenty two B.F.Sc. 3rd Year students along with one faculty and two staff members from College of Fishery Sciences, Sri Venkateswara Veterinary University, Muthukur, Nellore district, Andhra Pradesh visited ICAR-DCFR during 20-22 July 2018 and interacted with scientists.
- A group of thirty five 3rd Year B.Sc. Agriculture students along with four faculty members from Birsa Agriculture University, Ranchi, Jharkhand visited ICAR-DCFR during 21-22 August 2018 and interacted with scientists.
- A group of twenty two participants in the rank of Assistant Professor of Veterinary Sciences participating in 21 days Winter School at ICAR-Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh along with scientists from ICAR-IVRI Izatnagar visited ICAR-DCFR on 3 October 2018 and interacted with scientists.
- A group of fifty four students of 1st and 2nd Semester along with two faculty members from Government Girls' Polytechnic, Almora, Uttarakhand visited ICAR-DCFR on 12 October 2018 and interacted with scientists.
- A group of thirty students of Class XII along with two faculty members from St. Joseph College, Nainital, Uttarakhand visited ICAR-DCFR on 16 October 2018 and interacted with

- scientists.
- A group of twenty seven students of M.Sc. Zoology 3rd semester with three faculty members from Department of Zoology, Sri Agrasen Kanya P.G. College, Varanasi, Uttar Pradesh visited ICAR-DCFR on 26 October 2018 and interacted with scientists.
 - A group of twenty post graduate students along with two faculty members from Department of Geography, D.S.B. Campus, Kumaun University, Nainital, Uttarakhand visited ICAR-DCFR on 30 October 2018 and interacted with scientists.
 - A group of six girl students of B.Sc. 4th year from College of Horticulture, Central Agriculture University, Imphal, Manipur visited ICAR-DCFR on 14 November 2018 and interacted with scientists.
 - A group of thirty three students of B.F.Sc. 4th semester along with two faculty members from College of Fisheries, Karnataka Veterinary, Animal and Fisheries Science University, Kankandy, Mangaluru, Karnataka visited ICAR-DCFR on November 15, 2018 and interacted with scientists.
 - A group of twenty nine students of B.F.Sc 3rd Year along with two faculty members from College of Fisheries, Babasaheb Sawant Konkan Krishi Vidyapith, Shirgaon, Ratnagiri, Maharashtra visited ICAR-DCFR on 29 November 2018 and interacted with scientists.
 - A group of twenty eight B.V.Sc & A.H. Final Year students along with four faculty members from College of Veterinary Science & A.H., Junagadh Agricultural University, Junagadh, Gujarat visited ICAR-DCFR on 14 January 2019 and interacted with scientists.
 - A group of eighty two students of Class IX and Class XI along with two faculty members from Govt. Inter College, Chanfi, Nainital, Uttarakhand visited ICAR-DCFR on 5 February 2019 and interacted with scientists.
 - A group of fifteen Post Graduate girls students of M.Sc. Zoology with two faculty members from R.S.M. College, M.J.P Ruhelkhand University, Dhampur, Bijnour, Uttar Pradesh visited ICAR-DCFR on 5 February 2019 and interacted with scientists.
 - A group of twenty one B.V.Sc & A.H. 4th Year students along with two faculty members from College of Veterinary Science, Maharashtra Animal and Fishery Science University, Nagpur, Maharashtra visited ICAR-DCFR on 6 February 2019 and interacted with scientists.
 - A group of seven PGDIF&AM Trainees from ICAR-Central Institute of Fisheries Education, Salt lake, Kolkata Centre visited ICAR-DCFR during 09-13 February 2019 and interacted with scientists.
 - A group of sixty students of Class IX along with four faculty members from Govt. Inter College, Satbunga, Ramgarh of Nainital district, Uttarakhand visited ICAR-DCFR on 16 February 2019 and interacted with scientists.
 - A group of twenty six students of M.Sc. Zoology 4th semester with three faculty members from Tamtalipta Mahavidyalaya, Tamluk, Purba Medinipur, West Bengal visited ICAR-DCFR on 26 February 2019 and interacted with scientists.
 - A group of forty students of Class VI-VIII along with three faculty members from Mallikarjun School, Bohrakun, Bhimtal, Nainital, Uttarakhand visited ICAR-DCFR on 27 February 2019 and interacted with scientists.
 - A group of twenty three students of B.Sc. Botany (Hons.) with two faculty members from Department of Botany, Sri Guru Tegh Bahadur Khalsa College, University of Delhi, Delhi visited ICAR-DCFR on 15 March 2019 and interacted with scientists.
 - A group of thirty seven students of Class IX along with three faculty members from Welham Boy's School, 5-Circular Road, Dehradun, Uttarakhand visited ICAR-DCFR on 15 March 2019 and interacted with scientists.
 - A group of twelve students of M.Sc. Zoology 4th semester with three faculty members from Department of Zoology, BSNV P.G College, Lucknow, Uttar Pradesh visited ICAR-DCFR on 27 March 2019 and interacted with scientists.
 - An Exposure cum demonstration visit for the students of *Rajkiya uchhattar madhyamik vidhyalaya*, Sirmoli. Iohagat for the was arranged on 13th April, 2018. They were explained about the farm and hatchery activities, coldwater fish

species and their culture practices. Mr A.K. Giri, Dr Raghvendra singh, Mr. Kishor Kunal, Mr Parvaiz ahmad Ganie, Mr Raja Aadil; Hussain Bhat conducted and coordinated the visit.

- An Exposure visit for the students of Class 12th along with their faculty members from Jawahar Navodaya Vidyalaya, Champawat at Experimental Fish Farm, Champawat was arranged on 16th August, 2018. They were explained about the fish farming practices in mid Himalayan region and career building in agriculture and fisheries. Mr. Kishor Kunal, Mr. Ravinder Kumar, Mr. T. Sharma and Mr. Hansa Datt conducted and coordinated the visit.

- An exposure visit for the group of 78 students of class IX and XI, GIC, Pulhindola, Lohaghat was arranged on 15th February, 2019 at EFF, Champawat. Dr. Raghvendra Singh, Mr. Kishor Kunal, Mr. Ravinder Kumar and Hansa Datt conducted and coordinated the visit.
- An exposure visit for the group of 40 students of class IX and XI GIC, Jankidhar, Lohaghat was arranged 16th February, 2019 at EFF, Champawat. Dr. Raghvendra Singh, Mr. Kishor Kunal, Mr. Ravinder Kumar and Hansa Datt conducted and coordinated the visit.



Visit of French students from DEFIAA Consortium, French Ministry for Food, Agriculture and Forestry



Visit of Assistant Professors of Veterinary Sciences to RAS unit



Visit of B.F.Sc. students from College of Fisheries, Mangaluru to the laboratories



Visit of students from Government Girls' Polytechnic, Almora to aquarium unit



Visit of Jankidhar students to ICAR-DCFR, EFF, Champawat



Visit of Govt. Inter College, Pilhindola students to ICAR-DCFR, EFF, Champawat

7.1 Establishment of Rainbow Trout Farming at Munsiyari, Uttarakhand

ICAR-DCFR established establish rainbow trout farming for the first time in the remote tribal village Sarmoli in Munsiyari, Pithoragarh, Uttarakhand under TSP programme with an objective to improve livelihood pattern of the underprivileged tribal farmers. Raceways for rainbow trout and a ova house with 16000 egg hatching capacity was inaugurated on 30 May 2018 by Shri C. Ravishankar, IAS, District Magistrate, Pithoragarh in presence of the Dr. D. Sarma, Director; Smti Tara Pangtey, Shri Sriram Dharamsaktu and other distinguished persons including the social workers of the region. More than 200 farmers including women self-help group from Munsiyari and Dharchula were demonstrated on the culture practices of rainbow in the programme and acquired practical hands on training on trout farming. Exhibition on the theme *fish farming in hill region* along with inauguration of *ornamental fish aqua garden model* was also undertaken during the program. Farm inputs in the form of 300 numbers of ornamental fishes, 5000 numbers of fry of rainbow trout, 100 kg feed of rainbow trout, silpauline sheets for poly-lining of tanks along with water analysis kit and nets were also distributed to the selected farmers. The entire activities were coordinated by Dr. R.S. Patiyal, Principal Scientist and Nodal Officer TSP.



Establishment of rainbow trout farming at Munsiyari

7.2 Aquaculture Intervention at Mizoram

An extensive survey was carried out at the fish farmers' ponds of Darlak village, Mamit district, Mizoram with an objective to raise the income level and secure livelihood of the tribal fish farmers through aquaculture intervention. In this pursuance, a team of experts of the Directorate Dr. R.S. Halder, ACTO and Shri A.K. Giri, Scientist conducted an orientation cum awareness camp and



Field visit to tribal villages of Mizoram

capacity building programme during 6-7 September 2018. A total of 25 numbers of fish farmers along with the officials from KVK Mamit and Department of Fisheries, Govt. of Mizoram participated in the programme.

7.3 Awareness Cum Interactive Meet at Dharchula

An awareness programme with interaction meet was organised at Dharchula, Pithoragarh, Uttarakhand on 9 December 2018 with an objective to create awareness among tribal farmers on the prospectus of aquaculture for livelihood security. Altogether 35 farmers from nearby villages participated in the awareness cum interaction meet. An exhibition stall was also installed at *Rang Mahostav*, Dharchula for sensitizing the tribal peoples regarding farming of coldwater fishes including ornamental fishes in high hill uplands. The stall was visited by about 300 persons including the distinguished personality, Shri N.S. Npalchyaal, Chairman of ST/SC commission and *Adhyaksh*, *Rang Kalyan Sanstha*.



Participants during the awareness cum exhibition programme

7.4 Exposure Cum Demonstration Visit on Rainbow Trout Farming

ICAR-DCFR conducted an exposure cum demonstration visit on rainbow trout farming for the tribal farmers of Uttarakhand under TSP activity during 13-19 February 2019 with an objective to promote and expand trout culture in Uttarakhand. A total of 17 tribal farmers including 4 women participated in the program and were later travelled to visit various rainbow trout hatchery and grow out units of Himachal Pradesh viz., Sairopa trout hatchery at Tirthan valley, State trout hatchery, Banjar and State Govt. Fisheries Trout Farm, Patlikuhl including the private trout culture farms located at Pahnala and Manali.



Visit of tribal farmers to trout raceways of Himachal Pradesh

7.5 Hand-on Skill Development in Preparation of Value-Added Fish Products

Three days training on Preparation of fish pickle and other value-added products of fish has been conducted under TSP during 18-20 March 2019 at ICAR-DCFR, Bhimtal. Total of 60 numbers of tribal participant farmers dominated by female participants from Dharchula, Munsiyari, Khatima and Haldwani

were participated in the training program. Practical demonstration on the preparation of fish pickle including other value-added products of fish like fish cutlet and fish ball were conducted by Dr. H. Mandakini Devi, Scientist and Dr. Sathish Kumar K., Scientist of ICAR-Central Institute of Fisheries Technology, Kochi, Kerala. Leaflets on preparation of fish pickle, fish ball and fish cutlet including participation certificate and inputs like fish pickle, fish ball and fish cutlet were distributed to all the participants. The entire training program was coordinated by Dr. R.S. Patiyal, Principal Scientist and Mr. A.K. Giri, Scientist of the Directorate.



Hands on training on preparation of value added fish products

7.6 Capacity Building for Fish Farmers of Tarai Region

Two days training workshop on Scientific management of fish culture in Tarai region was organized at Khatima, Udhamnagar, Uttarkhand during 9-10 March 2019 under TSP to provide technical information regarding fish farming in Tarai region and its impact for sustainability of livelihood. More than 120 numbers of tribal farmers including some progressive fish farmers, public representatives, scientists and other technical staffs of ICAR-DCFR participated in the program

to make the event a grand success. The chief guest, Shri Pushkar Singh Dhama, Member of Legislative Assembly Khatima, Uttrakhand inaugurated the exhibition on fish culture in Tarai region and appreciated the efforts made by ICAR-DCFR. The guest of honour Dr. Prem Singh Rana, Member of Legislative Assembly, Nanakmatta, Uttrakhand and the special guest Smti Poonam Rana, Member, Zila Panchayat given their respective views for doubling of farmers income through scientific intervention, demonstration, training, exposure with supply of necessary inputs. A training manual on *Tarai Kshetro Mein Matshyapalan* edited by Dr. R.S. Patiyal *et. al.* was released by honourable chief guest. Farm inputs viz., 1200 kg feed, 8000 numbers of good quality of ornamental and carp fingerlings including drag nets, hand nets, plankton nets and hapas were distributed to the participated farmers. Three numbers of progressive farmers Shri Devendra Rana, Sitarganj for ornamental fish culture, Shri Laxman Singh, Khatima and Shri Omprakash Singh Rana, Sitarganj for carp culture were also honoured with Appreciation award for their significant contribution in respective fields. One day field visit cum demonstration on various aspects like feeding, netting, plankton assessment, fish handling, feed preparation, pond manuring and



Interaction and distribution of farm inputs to fish farmers of Tarai region

management was also organized in a progressive farmer's farm at Sitarganj village.

7.7 Other Salient Activities

- Conducted five days training on rainbow trout culture during 20-24 October 2018 at Sirdang village, Dharchula of Pithoragarh district with participation of 7 numbers of tribal farmers.
- Conducted one day training on composite fish culture on 31 October 2018 at Khatima, U.S. Nagar with participation of 8 numbers of tribal farmers.
- 2500 numbers of rainbow trout fingerlings were stocked in the farmers raceways at Sisod village of Leh, Jammu & Kashmir.
- Three exhibitions were installed and displayed at Dharchula, Munsyari and Khatima with participation of 600 tribal farmers.
- Six trainings were conducted at Dharchula, Munsyari, Khatima, Mamit, Ri Bhoi and Bhimtal with participation of 295 tribal farmers.
- One workshop conducted at Khatima, U.S. Nagar with participation of 110 numbers of tribal farmers.
- Three demonstrations were conducted i.e. rainbow trout culture at high hill upland regions along with culture of carp and ornamental fish species at mid hill and foot hill regions.
- Distribution of inputs such as 70000 numbers rainbow trout eyed ova, 2500 numbers rainbow trout fingerlings and 400 kg rainbow trout feed to the tribal farmers of Pithoragarh and Leh along with distribution of 5000 numbers exotic carp fingerlings, 1225 kg carp feed, 3000 numbers ornamental fish seeds including drag nets, hand nets, plankton nets and hapas to the tribal farmers of Pithoragarh and U.S. Nagar.

Research and Developmental activities have been carried out in the states of Northeast namely Arunachal Pradesh, Manipur, Meghalaya, Mizoram and Nagaland under the NEH programme and the details of which are enlisted hereunder;

8.1 Promotion of Rainbow Trout Farming

Three numbers of trout raceways and one trout hatchery have been constructed at Dzuleke village (N-25°36.982', E-93°57.123' and 5502 ft msl), Kohima, Nagaland under the technical & financial support of ICAR-DCFR for promotion and expansion of rainbow trout farming in the state for the very first time. The raceways and the hatchery were established by this Directorate in collaboration with the Department of Fisheries & Aquatic Resources, Government of Nagaland. As an initiation, the first consignment of one lakh eyed ova of rainbow trout was brought from the Department



Establishment of rainbow trout raceways at Dzuleke, Nagaland



Establishment of rainbow trout hatchery complex at Dzuleke, Nagaland

of Fisheries, Govt. of Jammu & Kashmir on 14 February 2019 and stocked at trout hatchery of Dzuleke. The programme has been supervised by Dr. R.S. Haldar, Nodal officer, NEH and under the active guidance of Dr. D. Sarma, Director of ICAR-DCFR.

8.2 Establishment of Mahseer Hatchery and Brood Bank at Mokokchung

ICAR-DCFR established one unit of mahseer hatchery at Suteplenden village (Longkong), Mokokchung district of Nagaland by providing necessary technical and financial support to the Department of Fisheries & Aquatic Resources, Govt. of Nagaland. The mahseer hatchery is of the first kind established in the state with an objective to popularize artificial propagation and conservation of golden mahseer and chocolate mahseer. The mahseer hatchery was inaugurated on 25 April 2018 by Shri Tongpang Ozukum, Hon'ble Minister, PWD (R&B, Housing & Mchanical), Govt. of Nagaland in presence of Shri T. Mhabemo Yanthan, Secretary, Department of Fisheries & Aquatic Resources, Govt. of Nagaland; Dr. Sudhir Raizada, Assistant Director General (Inland Fy), ICAR, New Delhi; Mr. Kevisa Kense, Director, Department of Fisheries & Aquatic Resources, Govt. of Nagaland; Dr. A.K. Singh, Former Director, ICAR-DCFR; Dr. Debajit Sarma, Director, ICAR-DCFR; Dr. R. S. Haldar, Nodal Officer NEH, ICAR-DCFR; Mr. Neithoo Kuotsu, Deputy Director Fisheries, Govt. of Nagaland; Mr. Nava Gogoi, Chief Managing Director, Jasingfaa Aqua Tourism Centre and Mr. Dilwar Hussain of Jasingfaa Aqua Tourism Centre, Nagaon, Assam; Dr. Pranay Pallav, Assistant Professor, Nagaland University; Mr. Imti Sunep, District Fishery Officer, Mokokchung, Govt. of Nagaland and Mr. Phukato Sumi, President, Anglers Association of Nagaland. Altogether, 50 anglers and 100 fish farmers with local people participated the programme. The Hon'ble

Minister with the dignitaries further released mahseer fingerlings in the broodstock ponds under the mahseer seed ranching programme.



Visit of Shri Tongpang Ozukum, Hon'ble Minister, PWD (R&B, Housing & Mechanical), Govt. of Nagaland to the hatchery complex



Establishment of mahseer hatchery at Mokokchung, Nagaland



Release of mahseer seeds in the broodstock ponds by the dignitaries



Establishment of mahseer brood bank at Mokokchung, Nagaland

8.3 Development of Captive Breeding Facilities of Mahseer in Mizoram

ICAR-DCFR established one mahseer hatchery unit at Tamdil, Mizoram with necessary technical and financial support from this Directorate in collaboration with the Department of Fisheries, Govt. of Mizoram to popularize artificial propagation, culture and conservation of chocolate mahseer.



Establishment of mahseer hatchery at Tamdil, Mizoram

8.4 Establishment of Trout Feed Unit at Dirang

ICAR-DCFR installed one extruder machine and feed drier at farm premises of ICAR- NRC on Yak, Nyukmadung, Dirang, Arunachal Pradesh to fulfill the supply of trout feed demand to the different Government trout farm as well as private trout growers of the area. In this regard, a two days training cum orientation workshop on Feed formulation, preparation and demonstration for promoting trout fisheries in Eastern Himalayan Region was organized by ICAR-DCFR in collaboration with ICAR-National Research Centre on Yak, Dirang, Arunachal Pradesh and Department of Fisheries, Govt. of Arunachal Pradesh during 29-30 December 2018 at Dirang. Shri Adong Pertin, ADC, West Kameng graced the program as the

Chief Guest besides Dr. Debajit Sarma, Director, ICAR-DCFR, Bhimtal; Dr. P. Chakravarty, Director, ICAR-NRC on Yak; Shri Tenzing Jambey, CO Dirang; Dr. N.D. Singh, Head, KVK, Dirang; Dr. H. Kalita, JD, ICAR-NEH, Basar; Shri Tagi Yanggom, DDF participated the occasion as esteemed guest. Practical demonstration was imparted to the fisheries officials of Tawang, West Kameng and Dibang valley districts of Arunachal Pradesh and Sikkim on the subject of trout feed preparation by Shri Anupam Pandey, YP-II and operation of extruder and feed drier machines by the experts from ICAR-DCFR. 200 fish farmers from State participated in the programme and they were later



Practical demonstration on trout feed preparation to the State fisheries officials

distributed with prepared starter and grow out trout feed. A bilingual technical leaflet on *Rainbow trout nutrition and feeding* was also released on the occasion. The programme was coordinated by Dr. D. Baruah, Sr. Scientist; Dr. R. S. Halder, ACTO from ICAR-DCFR and Dr. D. Medhi, Sr. Scientist of ICAR-NRC on Yak.



Participation of farmers during the event

8.5 Exposure Visit for Fish Farmers of Ziro valley, Arunachal Pradesh

In pursuance to the establishment of a FRP fish hatchery at Hari village of Ziro valley, Lower Subansiri district, Arunachal Pradesh during March 2018 by ICAR-DCFR, the fish farmers and hatchery operators were brought for exposure to Pabhoi fish farm at Biswanath Chariali, Assam during the month of 20-24 May 2018 with an objective to develop hands-on skills in broodstock management, hatchery management, fish seed production, fish seed packaging and transportation. Detailed information was gathered on the good management practices of a scientific fish farm and hatchery operation criteria from Shri Biren Bhagawati and his elder son Shri Bhargav Bhagawati by the farmers of the Ziro valley. The programme was coordinated by Dr. D. Baruah, Sr. Scientist of the Directorate.



Distribution of ICAR-DCFR formulated starter and grow out trout feed among the farmers



Distribution of ICAR-DCFR formulated starter and grow out trout feed among the farmers





Hands-on skill development by exposure of Ziro based fish farmers at Assam

8.6 Strengthening in Fish Seed Raising and Nursery Management

ICAR-DCFR supplemented the local communities of the Ziro valley of Lower Subansiri district, Ziro valley, Arunachal Pradesh with technical and financial support in strengthening the embankments and renovation of brood ponds and fish nurseries at the premises of installed FRP fish hatchery at Hari village during March 2018. In addition to the development of the fish nurseries and brood ponds, ICAR-DCFR provided 5000 numbers of improved seeds of Amur common carp for stocking in rice-fish plots of the valley for enhanced fish production per unit area. The fish seeds were procured from Shri Bikul Goswami,

Madhulkalaya Fish Farm, Lakhimpur district, Assam. The programme was coordinated by Dr. D. Baruah of this Directorate.



Renovated fish nurseries at Ziro valley



Transport of Amur common carps from Lakhimpur to Ziro valley



8.7 Establishment of Aquarium Units at Gauhati University, Assam

A diverse species of ornamental fishes locally available in the Northeast are well known in international aquarium hobby circles like *Micropphis deocata*, *Channa barca*, *Dario dario*, *Olyra sp.*, *Schistura sp.* etc. These indigenous ornamental fishes can play a major role in gaining an accessory source of income for most people in the region to serve as employment and together bringing benefit to the country as a whole through the aquarium trade. Consequently, many such indigenous

ornamental fishes of Northeast India have become threatened and endangered due to multiple factors including pollution, over exploitation, habitat destruction, diseases infestation and introduction of exotic varieties. Therefore, effort has been made to develop package of practice along with development of captive breeding and larval rearing protocols



Aquarium units created at Aquaculture & Biodiversity Centre, Gauhati University, Guwahati

of certain hills stream fishes like *Dangio dangila*, *Barilius vagra*, *Devario aequipinnatus* and *Schistura* sp. in aquariums at Aquaculture & Biodiversity Centre, Department of Zoology, Gauhati University, Guwahati, Assam under the technical and financial assistance under NEH activity of this Directorate.

8.8 Fish diversity studies in Northeast Region

ICAR-DCFR has been exploring and studying important coldwater fish diversity in the selected Himalayan drainages in Northeast region of India. In this pursuance, the Directorate has collaborated with Department of Zoology, Nagaland University (A Central University), Lumami, Nagaland under NEH programme to study on resource assessment of mahseer (*Tor* sp.) in Dikhu river of Mokokchung district, Nagaland and adjacent areas.



Endemic Species of North-east India

Scheduled Caste Sub Plan (SCSP)

9

The Scheduled Caste Sub Plan (SCSP) component was started for the first time at ICAR-DCFR since February 2018. The programme undertaken by the Directorate within the stipulated time frame is mentioned below;

9.1 HRD Programme at Guwahati, Assam

Three days HRD programme on Integrated Fish Farming for Doubling Fish Farmers Income of Scheduled Caste Community of Northeast Region was jointly organized by ICAR-DCFR and Gauhati University, Guwahati, Assam during 27 February-1 March 2019, which was witnessed by more than 200 farmers belonging to Scheduled Caste population of the state Assam. The programme was chaired by Prof. Mridul Hazarika, Hon'ble Vice-Chancellor, Gauhati University, Assam and in presence of the Dr. D. Sarma, Director, Mr. R.S. Tandel and Mrs. P. Dash, Scientists of ICAR-DCFR; Dr. K.K. Tamuli, Dean, College of Fisheries, AAU, Raha, State Fisheries officers of Assam, KVK scientists and faculty members of Gauhati University and College of Fisheries, Raha. In order to encourage the fish farmers, critical input in the form of quality fish seeds, fish feeds and medicines were distributed free of cost to the farmers for adopting better management practices in their culture tanks and ponds. Certificate of Appreciation was awarded to 10 progressive fish farmers for encouragement. A technical pamphlet on *Fish based eco-tourism as an avenue for supporting livelihood to scheduled caste population in northeast India* was also released on the occasion. The farmers were taken to different units of Aquaculture & Biodiversity Centre, Gauhati University, Guwahati by Dr. Dandadhar Sarma, Professor, Gauhati University for gaining knowledge in fish farming practices. The programme was followed by field visits to fish farms of selected fish farmers for guiding them towards scientific fish farming. Dr. D. Baruah, Nodal Officer SCSP coordinated the programme.



Distribution of fish seeds to SC fish farmers of Assam



Release of technical pamphlet during the inaugural session

9.2 Farmers-Scientist Interactive Workshop cum Kisan Mela at EFF Champawat

Two days farmers-scientist interactive workshop cum Kisan mela was organized at ICAR-DCFR Experimental Fish Farm, Champawat (Uttarakhand) during 11-12 March 2019 which was participated by more than 250 farmers belonging to Scheduled Caste community from the villages Modiyani, Banlekh, Pati, Lafra, Mulakot, Kharhi, Gadyura, Chilthia, Patan, Nursingdanda, Dakna and Amakdiya. Special attention was given to develop skills on fabrication and maintenance of aquarium for generating revenue and preparation of fish pickles for self-employment. The farmers

were also taken to different units of the fish farm including the rainbow trout raceways, rainbow trout and snow trout seed production units, carp production units and ornamental fish units to learn the package of practice. Exhibitions was also arranged for the exposure of the farmers. Start-up farm inputs in the form of fish seeds, feeds, fishing nets, fish disinfectants, water quality test kits and accessories were distributed to all the SC farmers. Certificate of Appreciation was awarded

to 10 progressive fish farmers for encouragement. The programme was chaired by Dr. K.K. Vass, former Director, ICAR-CIFRI and ICAR-DCFR in presence of Dr. Raj Narayan, CITE, Mr. Vijay Verma, Chairman Municipality, Mr. Brijmohan Singh, Dy. Commandant, ITBPF, Champawat, Nitin Sharma, SSB, Champawat. Dr. D. Baruah, Nodal Officer SCSP; Shri K. Kunal, I/c EFF Champawat and Shri P.A. Ganie coordinated the programme with the initiatives of Dr. D. Sarma, Director.



Distribution of fish nets and fish seeds to SC fish farmers of Champawat district



Demonstration on preparation of fish pickles and fabrication of glass aquariums

Training and Capacity Building

10

10.1 Exposure Cum Demonstration Visit

A team of scientists from ICAR-DCFR EFF, Champawat led by Shri A.K. Giri organized an exposure cum demonstration programme for the model school students of Champawat district. A total of 250 numbers of students from 14 different model schools of *Rajkiya Ucchattar Madhyamik Vidyalaya* and *Rajkiya Ucchattar Prathmik Vidyalaya* along with their teachers visited EFF, Champawat on 23 May 2018 under the program *Rastriya Abiskar Aviyan of Sarba Sikshya Aviyan*. Shri A. K. Giri deliberated on Identification of different farm fishes and their significance in culture at mid-altitudinal regions.



Visit of school children at EFF Champawat

10.2 Awareness Program on Efficient Use of Mobile Phones

An awareness program was organized on Efficient use of mobile phones for minimizing human health hazards on 18 June 2018 at Experimental Fish Farm, Champawat. Mr. Pradeep Singh from Bharat Jyoti Education and Charitable Trust spoke on the effect of anti-radiation devices for the health benefits humans as a resource person. The program was organized by Shri A.K. Giri, Scientist and were participated by all the staffs of the EFF, Champawat.

10.3 Training Programme on Better Management Practices for Culture and Breeding of Coldwater Fishes

ICAR-DCFR conducted skill and capacity development program for the fish farmers of upland states on Better Management Practices for Culture and Breeding of Coldwater Fishes during 10-12 July 2018 under the aegis of National Fisheries Development Board, Hyderabad. Fifty farmers including twenty farm women of five Himalayan states from Uttarakhand, Sikkim, Meghalaya, Assam and Jammu & Kashmir participated in the training. The training programme started on the Fish farmers Day on 10 July 2018 and the farmers were welcomed with a speech by Dr D. Sarma, Director, whereas Dr. S. Chandra, Principal Scientist & Program Coordinator briefed the farmers on the purpose of conducting the skill development program. Deliberations were made by the scientists of ICAR-DCFR on Coldwater aqua farming: Opportunities and challenges, Coldwater fish farming for income and livelihood generation in Himalayan states, quality seed stocking and management on the principle *Learning by doing*, rainbow trout farming practices in mid hills, culture, breeding and seed production of golden mahseer, ornamental fish farm management, common fish disease, better health management practice for trout and carp

farms, fish feed formulations and feed preparation. Field visit to mahseer hatchery and seed raising cages established in Bhimtal Lake was conducted to make the farmers aware on hatchery management practices and breeding techniques. Participants expressed their views and were pleased to have an insight on profitable fish farming methods. Former Director Dr. A.K. Singh addressed the farmers on the final day of the programme. Dr. Suresh Chandra, Dr. D. Baruah and Mr. A.K. Giri coordinated the programme.



Participants of the NFDB sponsored training programme

10.4 Field Work Experience Programme (FWEP)

ICAR-DCFR conducted Field Work Experience Programme (FWEP) from 26 July to 24 November 2018 for sixteen B.F.Sc students (4th semester) College of Fisheries Science and Research, Chandra Shekhar Azad University of Agriculture and Technology, Etawah Campus, Uttar Pradesh. The students were taught and exposed to recent advances in coldwater fisheries of the country which includes the techniques of coldwater resource assessment and management, application of GIS, coldwater aquaculture, fish nutrition and feed management, molecular fish genetics and biotechnology and fish

health management. The course was coordinated by Dr. Suresh Chandra, Principal Scientist and co-coordinated by Dr. N.N. Pandey, Dr R.S. Patiyal, Dr. Amit Pande, Dr. D. Baruah, Dr. Rajesh, Dr. Dimpal Thakuria and Dr. R. Singh.



Students of FWEP at ICAR-DCFR



Certificate of participation in FWEP

10.5 ToT Programme on Prevention and Control of Important Coldwater Fish Diseases and their Management

ICAR-DCFR organised five days Training of Trainers (ToT) programme on Prevention and control of important coldwater fish diseases and their management under the aegis of NFDB, Hyderabad during 6-10 August 2018 at Bhimtal with a view to orient extension and line departmental personnel on identifying common fish farm diseases and their control measures. Twenty one departmental trainees from six districts of Uttarakhand viz., Almora, Bageshwar, Champawat, U.S. Nagar, Nainital and Tehri Garhwal and Srinagar of Jammu & Kashmir, Kangra and Mandi districts of Himachal Pradesh and Imphal West of Manipur. Welcoming the participants, Dr. Suresh Chandra, Principal Scientist & Programme Coordinator briefed on the goals and objectives

of the training followed with an inaugural speech from the Director Dr. D. Sarma. Deliberations were made by the ICAR-DCFR scientists on the major parasitic diseases of coldwater fishes, epidemiology, management measures in hatchery, nursery and grow out raceways, fish immune systems, important viral diseases, Oomycetes diseases of coldwater fishes, isolation and characterization of bacterial isolates, diseases sample transportation and water quality analysis. Practical sessions included sampling of fish pond for disease investigation, collection of symptomological features, preservation of tissue samples, haematology, virological techniques, microscopic examination were demonstrated. Trainees from Jammu and Kashmir and Himachal Pradesh actively interacted on various health problems faced in rainbow trout hatcheries and farms. Field visit to Nainital, Sattal lakes and mahseer hatchery was organised. The participants shared their views and comments on the training program and expressed their satisfaction at the end of the programme. The program was coordinated by Dr. S. Chandra, Dr. A. Pande, Shri S.K. Mallik, Shri R.S. Tandel and R.A.H. Bhatt.

10.6 NFDB Sponsored Training of Trainers (ToT) Programme on Mahseer

National Fisheries Development Board (NFDB) sponsored Training of Trainers programme on Hands-on-Training in Breeding and Seed Production of *Tor putitora* (golden mahseer) & *Neolissochilus hexagonolepis* (chocolate mahseer) was organized at ICAR-DCFR during 27-31 August 2019 and was participated by 18 fisheries officials of State Fisheries Departments and Assistant Professors from universities representing eight states of the country. Welcoming the participants, Dr. D. Sarma, Director briefed on the need to conserve and undertake rehabilitation programmes of golden mahseer through captive breeding for mass scale seed production. Both theoretical and practical aspects of hatchery management, breeding and seed production practices of golden mahseer and chocolate mahseer were taken. The participants were presented with ICAR-DCFR published book entitled on Mahseer in India: Resources, Breeding, Propagation, Conservation, and Policies and Issues as a reading material. Dr. M.S. Akhtar, Dr. Ciji



Participants of ToT on fish disease



Certificate distribution during ToT on mahseer breeding



Deliberation on fish health management



Participants during the programme on mahseer breeding and hatching

Alexander, Mr. A.K. Giri, Dr. Rajesh, M and Dr. R.S. Haldar, ACTO coordinated the program.

10.7 Mass Awareness Programme at Joginder Nagar, Himachal Pradesh

ICAR-DCFR conducted one day mass awareness cum training programme on Fish health management for the fish farmers at Joginder Nagar, Himachal Pradesh on 19 September 2018 under the National Surveillance Programme for Aquatic Animal Diseases (NASPAAD) with an objective to aware fish farmers on the common health problems of farmed trout and carp and their management. The programme was attended by State Fisheries Department officials and 30 trout growers from Mandi district of Himachal Pradesh. Lectures, demonstrations and interaction with farmers were conducted during the programme. Feedback and suggestions were also taken from the fish farmers in order to improve the effectiveness of such programmes in future. Shri Khem Singh Thakur and Shri A.K.Verma, Assistant Director Fisheries, Govt. of Himachal Pradesh, Mandi and other officials from the Department of Fisheries, Himachal Pradesh supported the programme. The



Mass awareness programme under NASPAAD project

awareness was coordinated by Shri A.H. Bhatt, Scientist, Dr. Suresh Chandra, Principal Scientist and PI (NASPAAD project) along with the SRFs of ICAR-DCFR, Bhimtal.

10.8 Awareness Cum Training Programme on Fish Farming at Jyur Kafun, Almora

A one day awareness cum training programme was conducted at Jyur Kafun, Almora on 28 September 2018 under the pilot study of NMSHE project. Hands-on training was provided to 10 farmers on fish stocking and rearing, water quality management, fish feed preparation and feeding by using locally available ingredients to achieve better growth and maximize the profit from unit area of rearing. Shri Santosh Kumar Arya, Sr. Technical Officer, Shri Dinesh Mohan, JRF-NMSHE and Shri Bipin Kumar Vishwakarma, Research Associate of ICAR-DCFR attended the farmer's queries while organizing the programme.



Integrated Fish Farm at village Jyur-Kafun

10.9 Training of Trainers (ToT) Programme on Breeding and Seed Production of Important Coldwater Ornamental Fishes

NFDB sponsored five days training programme was organized at ICAR-DCFR on Breeding and seed production of important coldwater ornamental

fishes during 23-27 October 2018, which was participated by 15 participants from Himachal, Assam, Rajasthan, Maharashtra, Madhya Pradesh. Welcoming the participants, Dr. D. Sarma, Director briefed the participants on the training objectives. The training was focused on the theoretical as well as practical aspects and a one-day field visit to the nearby hill stream resources and local fish farmer's farm at Khutani village was conducted. Mrs. Pragyan Dash and Dr. S.G.S Zaidi, Training Coordinators; and Dr. N.N. Pandey and Mr. A. K. Giri Co-coordinators deliberated and demonstrated on the designing of aquarium tanks, under gravel filter, aqua scaping, aquarium management, ornamental feed formulation and preparation, ornamental fish health management, re-circulatory aquaculture system, breeding and seed production of indigenous fishes (loach, suckers and hill trouts), gold fish and koi carp seed production techniques. Practical exposure on the research aspects of the Directorate was also conducted by accompanying the participants to each laboratory and mahseer hatchery. A training manual on *Breeding and seed production of important coldwater ornamental fishes* was also released in this occasion.



ToT programme at Bhimtal on ornamental coldwater fishes



Demonstration on low cost fish feed preparation for ornamental fish culture

10.10 Training for Fisheries Extension Officers of Jammu & Kashmir

ICAR-DCFR organized three days training programme on Fish diseases and their management in collaboration with Department of Fisheries, Jammu & Kashmir and State Agricultural Management & Extension Training Institute (SAMETI), Jammu during 30 October to 1 November 2018 at SKUAST-J campus. The three days programme also included Scientists-Farmers-Officers interactive meet held at State Fish Farm, Ghou Manhasan, Jammu which was attended by 70 participants including 35 fisheries officers, scientists of ICAR-DCFR, faculty members of SKUAST-J and trout farmers of J&K. Dr. Debajit Sarma, Director, DCFR highlighted the issues and innovative approaches towards improvement of coldwater fisheries and aquaculture in the country with special emphasis to J&K. Mr. Shanti Sarup Sharma and Mr. Irshad Ahmad Shah, Joint Directors of Department of Fisheries, Govt. of J&K expressed their willingness to join hands for the development of the coldwater fisheries sector of the region. Dr. K.S. Risam, Director, SAMETI deliberated the importance of fisheries in enhancing the economy of farmers and conveyed the commitment of the organization for overall development of farmers of the state. Dr. Suresh Chandra, Mr. S.K. Mallik and Mr. Raja Aadil Hussain Bhat of ICAR-DCFR coordinated the theoretical and practical sessions by imparting the trainees on the advancement in diagnostics tools, fish diseases, dose calculation of various drugs and chemicals, health management and development of medicated feed. Similar training programme on fish nutrition was also requested by the participants in their feedback. The programme was concluded with vote of thanks by Dr. Rama Kant, Deputy Director, SAMETI-Jammu.





Participants and organizers of ToT programme at Jammu

10.11 Training Programme Cum Exposure Visit of Farmers from Menchukha Valley

Perspective trout farmers and entrepreneurs from Menchukha valley of newly declared district Shi-Yomi situated along the Indo-China border of Arunachal Pradesh visited ICAR-DCFR and EFF Champawat alongwith Mr. Kenbom Chisi, District Fishery Development Officer and Mr. Sange Dere Diri, Fishery Demonstrator of Department of Fisheries, Govt. of Arunachal Pradesh during 6-10 December 2018. The farmers were trained on the topic *Coldwater Fisheries and Aquaculture Practices in Indian Himalayan Region* which includes coldwater fish diversity for food and recreation techniques, their seed production techniques, criteria for designing and developing raceways for trout culture through implication of GIS and ground truthing, development of trout ova house, fish feed preparation, fish health management. The farmers expressed their satisfaction on receive of the participation certificates and welcomed the team of scientists of ICAR-DCFR to visit Menchukha region to render further technical guidance in site selection,



Perspective trout growers from Menchukha valley at ICAR-DCFR EFF Champawat

seed raising and trout culture. The programme was coordinated by Dr. Deepjyoti Baruah of the Directorate.

10.12 Skill Development Training on Aquaculture Worker Job Role under ASCI

Two skill development training programmes of 200 hours each for a batch of 20 farmers of Nainital district in Aquaculture Worker Job Role was successfully conducted at ICAR-DCFR during 12 December 2018 to 17 January 2019 and 14 February to 15 March 2019 respectively. The fish farmers learnt scientific techniques of fish farming as per the National Occupational Standard for aquaculture worker. 20 lectures, 25 practical sessions and 6 exposures visits were arranged in each batch. Dr. N.N. Pandey, Dr R.S. Patiyal and Dr. D. Baurah and Dr. R. Singh took part in lecture sessions. Practical on the principal of learning by doing and deliberations on site selection, pre-stocking, post stocking pond management, safety, health and hygiene measures were organized. Exposure visits to progressive fish farmers ponds in Hari Nagar, Vinayak and Alchauna, nearby by Bhimtal lakes and carp and mahseer hatcheries was also undertaken to acquaint farmers on aquaculture practices. Online assessment of the trainees was accomplished on 31 January 2019 and 22 March 2019 where all the forty trainees completed the exams successfully. Certificates of ASCI were distributed by the Director Dr. D. Sarma. Dr Suresh Chandra, Principal Scientist cum certified trainer ASCI on Aquaculture Worker Job role successfully conducted both the programmes.



Different activities undertaken in the ASCI programme

10.13 Field Demonstration on Application of Safe Medicines and Therapeutics in Carp Tanks

ICAR-DCFR organised one day field demonstration programme at Hari Nagar village for

18 fish farmers of Bhimtal area on 14 January 2019. Water quality analysis, application of suitable doses of lime and fish therapeutics such as potassium permanganate ($KMnO_4$) was demonstrated to farmers on the principal of *learning by doing*. The programme was coordinated by Dr Suresh Chandra, Principal Scientist of the Directorate.



10.14 Awareness Programme for Entrepreneurs at Menchukha of Shi Yomi District

An awareness programme was jointly organized at Menchukha of newly declared Shi Yomi district of Arunachal Pradesh by ICAR-Directorate of Coldwater Fisheries Research, Bhimtal, Nainital, Uttarakhand Department of Fisheries, Government of Arunachal Pradesh. The programme of the first kind ever was conducted on 12 February 2019 on the topic Coldwater fish culture in Menchukha region which was witnessed by more than 110 participants from different villages of Menchukha region, officers and staffs representing various line departments, fisheries officers and scientists from ICAR-DCFR. The programme was chaired by Mr. Ngilyang Pussang, Deputy Director of Fisheries, Govt. of



Demonstration on fish health management and therapeutic application at Hari Nagar

Arunachal Pradesh who briefed the participants on the objectives of the programme. The other officers from Department of Fisheries, Govt. of A.P. present on the day were Mr. Tagi Yonggam, DDF; Mr. A. Rahman, ADF and Mr. Kenbom Chisi, DFDO, West Siang district, Aalo. Stress was given on the protection of the existing brown trout fishes (*Salmo trutta fario*) at river Yargyap chu by declaring a *Trout Protected Area* in a certain stretch of the river, which will provide a healthy home to the fishes to propagate and breed freely. Deliberations were made on the fundamentals rainbow trout farming, site selection

criteria for raceways, trout based eco-tourism, seed production technology and hatchery management, aquaculture site suitability by application of GIS. The participants expressed their great satisfaction on the programme and received a certificate of participation. The awareness programme was followed with an extensive field survey during 13-14 February 2019 in the Menchukha region for selecting a suitable site for start of trout farming with the assistance of the Fisheries Officials and local residents.



Discussions on perspective plans and projects for promotion of trout farming at Menchukha



Deliberations on trout farming and site suitability criteria by ICAR-DCFR team



A group photograph with the participants & ICAR-DCFR team, state fisheries officers and local entrepreneurs

10.15 Awareness Cum Training Programme on Fish Health Management in Coldwater Fishes

Mass awareness cum training programme was organised in the auditorium hall of the Directorate on the eve of Kisan Summan Nidhi on 24 February 2019 and which was participated by 110 farmers of the Bhimtal region. A series of deliberations were presented on the subject of fish health and good management practices for maintaining healthy fish stocks in ponds and raceways. The participants were exposed to the functioning of different hatchery models, raceways and ornamental culture practices of the Directorate. The programme was coordinated by Dr. S. Chandra, Principal Scientist alongwith Ms. Kavya, K.K., SRF under NASPAAD project.



Participants in the mass awareness programme

10.16 Training on Motivation, Stress Mitigation and Farm Management for ICAR Supporting Staff

ICAR-DCFR conducted a three-days training programme from 6-8 March 2019 on the theme Motivation, Stress Mitigation and Farm Management at Bhimtal which was participated

by thirteen Skilled Supporting Staff (SSS) of ICAR institutes viz., ICAR-IVRI, Mukhteswar; ICAR-CITH, Mukhteswar; ICAR-IISWC, Dehradun; ICAR-NBPGR, Bhowali and ICAR-DCFR, Bhimtal. The participants were trained on stress related to management of financial matters by Prof. Kavidayal, Head and Dean, Department Of Management Studies, Bhimtal; execution of bravery and power of positive thinking to remain stress free in adverse situations by retired Brigadier of Indian Army Shri Hari Mohan Pant from Bhimtal; interactive talk to keep positive, content and optimistic in day to day life by Shri P. N. Shivpuri followed with a session of motivation poem by Shri Krishna Kala. The training was coordinated by Dr. D. Sarma, Director cum Nodal Officer HRD and Dr. Neetu Shahi, Scientist and Co-Nodal Officer HRD.



Participants during the programme

10.17 Demonstration on Fish Health Examinations in Pond Conditions

ICAR-DCFR organized demonstration on fish health examinations for better growth and production on 12 March 2019 at village Vinayak, Bhimtal. Altogether, 20 aquaculture workers of Alchaunna Hari Nagar and Bhimtal took part in the programme who were demonstrated on identifying a diseased fish in pond conditions by observing the fish behaviour, colouration of body, skin, gills, fins, eye etc. The participants were educated to maintain healthy stock in their tanks and raceways for better profitability. Techniques on examination of internal

organs were shown by following scientific collection methods under laboratory conditions. Dr. Suresh Chandra, Principal Scientist coordinated the activity.



Demonstration at fish health management at village Vinayak, Bhimtal

10.18 NFDB Sponsored Training of Trainers (ToT) Programme

NFDB sponsored Training of Trainers (ToT) programme on Breeding, seed production and health management of Rainbow Trout (*Onchorynchus mykiss*) was conducted from 4th to 8th March 2019 at ICAR-DCFR, Bhimtal. The training programme was attended by 15 participants including state fisheries department officials, entrepreneurs, farmers and NGO personnel. The programme was inaugurated by Dr D Sarma, director, ICAR-DCFR, Bhimtal. The programme included lectures, demonstrations and field visits covering different aspects of Rainbow trout breeding, culture and health management. The programme was coordinated by Dr Raghvendra Singh and co coordinated by Dr N N Pandey, Mr Kishor Kunal and Mr Parvaiz Ahmad Ganie.

10.19. Students Guided

- Shri Anupam Pandey is pursuing his PhD from Kumaon University under the supervision of Dr. D. Sarma, Dr. B. S. Kamalam and Dr. M. S. Akhtar on the topic 'Molecular and phenotypic investigation of thermal adaptation in a coldwater fish, rainbow trout (*Oncorhynchus mykiss*).'
- Dr. Rajesh M. completed his PhD from ICAR-Central Institute of Fisheries Education, Mumbai on the topic 'Nutritional regulation of muscle growth related genes in *Schizothorax richardsonii* (Gray, 1832)' under the supervision of Dr. A.K. Singh, Dr. N.N. Pandey and Dr. M.S. Akhtar.
- Shri Rathod Vishalbhai Jodhabhai from G.B. Pant University of Agriculture and Technology, Pantnagar submitted his M.F.Sc. dissertation on the topic 'Effect of thermal regime on growth and immune-biochemical responses of golden mahseer (*Tor putitora*) under the supervision of Dr. D. Sarma and Dr. M. S. Akhtar.
- Harmanpreet Singh from ICAR-CIFE, Mumbai is pursuing his M. F. Sc. (Aquaculture) on the topic, "Comparative growth performance of Rainbow trout *Onchorhynchus mykiss* Walbaum, 1972 in recirculatory aquaculture system and flow through system" under the supervision of Dr NN Pandey and Dr Raghvendra Singh.
- Shri Tarang Shah from G.B. Pant University of Agriculture and Technology, Pantnagar is pursuing PhD on the topic "Effect of *Thymus linearis* plant extract on growth and non-specific immune responses of Golden mahseer (*Tor putitora*) against *Saprolegnia parasitica* under super vision of Dr. Debajit Sarma.
- Ms. Annu Sharma from Kumaon University is pursuing PhD on the topic "Changes in fatty acid profile with seasonal changes in environmental factors, natural food and thyroid endocrine system of golden mahseer (*Tor putitora*) in lacustrine ecosystem "under super vision of Dr. Debajit Sarma.

10.20. NFDB Sponsored ToT Programme on Feed Management Practices in Coldwater Aquaculture

A NFDB sponsored Training of Trainers programme (ToT) on "Feed Management Practices in Coldwater Aquaculture" was organized during 25-29th September, 2019 at ICAR-DCFR, Bhimtal. Training program was attended by six participants including State Fisheries Personnel and entrepreneurs. The training involved both theoretical and practical teaching on various aspects of feed management practices and nutrition of coldwater fishes which includes nutritional requirements of coldwater fishes, selection of feed ingredients and anti-nutritional factors, digestive physiology of fishes, theory and practical's of feed formulation and preparation, larval nutrition, neutraceuticals and medicated feed, quality feed and feeding ration, feed budgeting and overall feeding management. Apart from above, a lecture on trout farming and farm made feed preparation and practical demonstration on small scale re-circulatory aquaculture system for trout culture were also covered. A field visit was also arranged to a farm of progressive fish farmer Mr. Malkhan Singh at Danpur, Rudrapur, US Nagar, Uttarakhand for demonstration of feeding management in farming conditions. The training programme was coordinated by Dr. Prakash Sharma, Dr. N. N. Pandey, Dr. Rajesh M and Dr. Ciji Aklexander.



Glimpses of class session and felicitation

ICAR-Directorate of Coldwater Fisheries Research, Bhimtal has developed functional linkages with different National-level Organizations, Agricultural Universities, State Department of Fisheries, Financial Agencies, Registered Societies for promotion of R&D in collaborative programmes.

11.1 ICAR Institutes

- ICAR-National Bureau of Fish Genetic Resources, Lucknow
- ICAR-Central Institute of Fisheries Technology, Kochi
- ICAR-Central Institute of Fisheries Education, Mumbai
- ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar
- ICAR-Central Institute of Brackishwater Aquaculture, Chennai
- ICAR-Central Inland Fisheries Research Institute, Barrackpore
- ICAR-Central Inland Fisheries Research Institute, Regional Centre, Guwahati
- ICAR Research Complex for NEH Region, Barapani
- ICAR-Indian Institute of Soil and Water Conservation, Dehradun
- ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora
- ICAR-Indian Veterinary Research Institute, Izatnagar
- ICAR-Directorate of Foot and Mouth Disease, Mukteswar
- ICAR-Indian Agricultural Statistics Research Institute, New Delhi

- ICAR-Indian Agricultural Research Institute, New Delhi
- ICAR-National Institute of Animal Nutrition and Physiology, Bengaluru
- ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur

11.2 Central Agencies/Departments

- National Fisheries Development Board
- Department of Biotechnology
- Department of Science & Technology
- Science and Engineering Research Board
- Indian Space Research Organization
- North Eastern Space Applications Centre, Shillong, Meghalaya
- Uttarakhand State Council for Science and Technology, Dehradun
- Survey of India, Dehradun, Uttarakhand
- State Agricultural Management & Extension Training Institute (SAMETI), Jammu
- Ministry of Environment, Forest & Climate Change
- Indian Council of Forest Research and Education
- Tehri Hydro Development Cooperation Ltd.
- Sashastra Seema Bal (SSB), Ministry of Home Affairs, Govt. of India, Champawat

11.3 State Agencies/Departments

- Department of Fisheries, Sikkim
- Department of Fisheries, Uttarakhand
- Department of Fisheries, Himachal Pradesh

- Department of Fisheries, Jammu & Kashmir
- Department of Fisheries, Arunachal Pradesh
- Department of Fisheries, Meghalaya
- Department of Fisheries, Mizoram
- Department of Fisheries, Nagaland
- Department of Fisheries, Tamil Nadu
- Uttarakhand Council for Biotechnology

11.4 Universities & Colleges

- GB Pant University of Agricultural Science & Technology, Pantnagar
- GB Pant Institute of Himalayan Environment and Development, Almora
- College of Fisheries, SKUAS&T, Jammu & Kashmir
- College of Fisheries, Assam Agricultural University, Raha
- College of Fisheries, Central Agricultural University, Lembucherra
- Tamil Nadu Fisheries University
- Kerala University of Fisheries & Oceanography
- CSKHP Agricultural University, Himachal Pradesh
- Kumaun University, Nainital
- HNB Garhwal University, Srinagar
- Guwahati University, Assam
- Nagaland University, Kohima
- Rajiv Gandhi University, Arunachal Pradesh

- Bhimrao Ambedkar Central University, Lucknow
- West Bengal University of Animal and Fisheries Science
- Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur, Uttar Pradesh
- Assam Don Bosco University, Guwahati

11.5 Krishi Vigyan Kendras (KVK)

- KVK Lohaghat
- KVK Almora
- KVK West Kameng
- KVK Tawang
- KVK Lower Subansiri
- KVK Upper Subansiri
- KVK Lower Dibang valley

11.6 Registered Societies

- Devan Hills Plantations Company (P) Ltd, Munnar, Kerala
- Gaumco Multipurpose Cooperative Society (P) Ltd, Ziro, Arunachal Pradesh
- ABACA, Nameri, Tezpur, Assam
- Jasingfaa Aqua Tourism Centre at Nagaon, Assam
- ICICI Pvt. Limited, Mumbai
- SPY Agro Pvt. Ltd. Nadyal, Kurnool, Andhra Pradesh
- String Bio Pvt. Ltd.

Awards/Honours /Recognitions

12

- Dr. Debajit Sarma, Director (Act.) was awarded Scientist of the Year-2018 during 2nd World Clean Environment Summit held on 16-18 July, 2018 at Kolkata.
- Dr. Debajit Sarma was conferred Dalela Oration Award-2018 during 38th Annual Session of The Academy of Environmental Biology held at Dr. Ram Manohar Lohiya Avadh University, Faizabad, U.P. on 3rd October, 2018.



Dr. Debajit Sarma receiving the Dalela Oration Award-2018

- Dr. Debajit Sarma received Eminent Scientist Award-2018 from Central Calcutta Science & Culture Organization for Youth during 3-6 August, 2018 at Milan Samity Maidan, Nimta, Belgharia, Kolkata.
- Dr. Debajit Sarma was bestowed IBRF Excellence Award 2018 on 5th October, 2018 at Science City Auditorium.
- Dr. Debajit Sarma was acted 'International Chair' at World Brackishwater Aquaculture Conference (BRAQCON) during 22-25 January, 2019 in Chennai.
- Dr. Debajit Sarma was conferred D. Sc. (Hon.) in the specialized area of Biological Science from Commonwealth Vocational University, Kingdom of Tonga.



Dr. Debajit Sarma being conferred D. Sc. (Hon.)

- Dr. Debajit Sarma received CFSI Honour- 2018 from Coldwater Fisheries Society of India, Bhimtal.



Dr. Debajit Sarma receiving CFSI Honour- 2018

- Dr. Debajit Sarma was awarded Dr. V. R. P. Sinha Medal-2019 by the Zoological Society of India.



Dr. Debajit Sarma receiving CFSI Honour- 2018

- Dr. Deepjyoti Baruah, Senior Scientist received the People's Choice Title for CFSI Photo Contest on the title "Hill Aquaculture & Fisheries" with a citation and cash prize of Rs. 500.00 on the occasion of DCFR's 31st Annual Foundation Day 2018 on 24/09/2018.
- Dr. Deepjyoti Baruah, Senior Scientist received Letter of Acknowledgement from Furmhub Services (OPC) Pvt. Ltd. for contributing in compilation of Anniversary Issue (April-May 2018) of Fishing Chimes.
- Dr. R. S. Haldar, Assistant Chief Technical Officer was conferred the Eminent Scientist on the occasion of 22nd National Agriculture Exhibition on the Theme of "New India : Future Leader Of The Globe" organized by Central Calcutta Science & Culture Organization for Youth, Kolkata during August 3-6, 2018 at Milan Samity Maidan, Nimta, Kolkata – 700049.
- Dr. R. S. Haldar was awarded the Congress of Zoology Medal by the Zoological Society of India (ZSI), Bodh Gaya during the 31st All India Congress of Zoology (31st AICZ) & National Seminar on "Climate – Smart Aquaculture and Fisheries (CSAF)" organized by North East Society for Fisheries and Aquaculture and Zoological Society of India (ZSI), Gaya, Bihar at College of Fisheries, CAU, Lembucherra, Tripura on 15th January, 2019.



Dr. R. S. Haldar receiving the Congress of Zoology Medal

- Dr. Biju Sam Kamalam, Scientist, received the Indo-Australian Career Boosting Gold Fellowship of Department of Biotechnology, Government of India to implement an

international project on 'Evaluation of biosynthetic resolvins and protectins as nutraceuticals for smolting Atlantic salmon' at the Nutrition and Seafood laboratory in Deakin University, Australia from October 2018 to June 2019.

- Dr. Neetu Shahi, Scientist received "Gold medal" from Coldwater Fisheries Society of India (CFSI) for research contributions in hill aquaculture of India during the year 2018.
- Dr. Neetu Shahi, Scientist received "Second prize in photo contest" from Coldwater Fisheries Society of India (CFSI) during the year 2018.
- Dr. Neetu Shahi, Scientist received "Certificate of Appreciation" from Food and Agriculture Organization of the United Nations, Office of the representative of India, for writing slogan on the occasion of World Antibiotic Awareness Week, 2018.
- Dr. Neetu Shahi, Scientist received First Prize in the "Slogan Writing Competition" as a part of "Vigilance Awareness Programme" held during 29th October-3rd November 2018 at ICAR-Directorate of Coldwater Fisheries Research, Bhimtal, Uttarakhand.
- Ms. Manisha Gupta, SRF was awarded "Asian Fisheries Society-Kanazawa Research Fellowship" during the 12th Asian Fisheries and Aquaculture Forum (12AFAF) held at Iloilo, Philippines on 10th April, 2019.



Ms. Manisha Gupta receiving the Asian Fisheries Society-Kanazawa Research Fellowship Award

13.1 Research Papers

- Akhtar, M.S., Rajesh, M., Ciji, A., Sharma, P., Kamalam, B.S., Patiyal, R.S., Singh, A.K. and Sarma, D., 2018. Photo-thermal manipulations induce captive maturation and spawning in endangered golden mahseer (*Tor putitora*): A silver-lining in the strangled conservation efforts of decades. *Aquaculture*, 497, 336-347.
- Ali, S., Pandey N.N., Kumar, P., Posti, R. and Singh, A.K., 2018. Response of fish communities to abiotic factors in River Western Ramganga, Kumaun Lesser Himalaya, India. *Current Science*, 114 (10): 2181-2188. doi: 10.18520/cs/v114/i10/2175-2181
- Barat, A., Sahoo, P.K., Kumar, R., Goel, C., Siva, C., Ali, S., 2019. Data on solute carrier transporter genes of a threatened Himalayan fish species- *Schizothorax richardsonii*, Data in Brief, <https://doi.org/10.1016/j.dib.2019.103712>.
- Baruah, D. and Singh, N.D. 2018. Rice-fish cultivation of apatanis: A high altitude farming system in Arunachal Pradesh, *Journal of Krishi Vigyan*, 7(1): 187-191.
- Baruah, D., Bhuyan, A., Dutta, A., Baiju, M., Nobi, P.S. and Pravin, P. 2018. Clap net operation in Brahmaputra valley for capturing *Tenualosa ilisha* (Hamilton, 1822), *Fishery Technology*, 55: 238-243
- Baruah, D., Kunal, K., Sarma, D., Ahmad, P., Sharma, P., Singh, A.K. and Singh, N.D. 2018. Aquatic biodiversity in upland streams of Kameng drainage in Arunachal Pradesh, *Journal of Krishi Vigyan*, 7(1): 10-15.
- Baruah, D., Pravin, P. and Dutta, A. 2018. Floats and sinkers in enhancing efficacy of fishing gears operated in Assam water bodies, *International Journal of Bioresource Science*. 5(1): 45-50.
- Bhat, I.A., Ahmad, I., Mir, I.N., Bhat, R.A.H., Gireesh-Babu, P., Goswami, M., Sundaray, J.K. and Sharma, R., 2018. Chitosan-eurycomanonenano formulation acts on steroidogenesis pathway genes to increase the reproduction rate in fish. *The Journal of steroid biochemistry and molecular biology*. 185: 237-247.
- Chaturvedi, P., Bhat, R.A.H. and Pande, A., 2018. Antimicrobial peptides of fish: innocuous alternatives to antibiotics. *Reviews in Aquaculture*. <https://doi.org/10.1111/raq.12306>.
- Dash, P., Tandel, R.S., Bhat, R.A.H., Mallik, S., Pandey, N.N., Singh, A.K. and Sarma, D., 2018. The addition of probiotic bacteria to microbial floc: Water quality, growth, non-specific immune response and disease resistance of *Cyprinus carpio* in mid-Himalayan altitude. *Aquaculture*, 495, pp.961-969.
- Ganie, P. A., Yousuf, D. J., Bhat, R.A.H., Bhat, I. A., Kunal, Kishor., Pandey, P.K., Sarma, D. 2018. Investigation of acute toxicity and behavioral response of Indian major carp, *Cirrhinus mrigala* (Hamilton, 1822) in response to Cypermethrin. *Journal of Entomology and Zoology Studies*. 6(6): 194-199.
- Ganie, P.A., Baruah, D., Kunal, K., Posti, R., Garima., Sarma, D. Phytoplankton diversity and abundance in upland streams of Kameng drainage, Arunachal Pradesh. *Journal of Entomology and Zoology studies*. 2018; 6(6):1166-1173.
- Jaffer, Y.D., Purushothaman, C.S., Kumar, H.S., Irfan, A.B., Gireesh-Babu, P., Ganie, P.A., Bhat, R.A.H. and Vennila, A., 2019. A combined approach of 16S rRNA and a functional marker gene, *soxB* to reveal the diversity of sulphur-oxidising bacteria in thermal springs. *Archives*

- of microbiology. <https://doi.org/10.1007/s00203-019-01666-4>.
- Jaffer, Y.D., Vinothkumar,R., Irfan, A. B., Ishfaq, N. M., Parvaiz A. G., Raja A. H. B., and Vennila, A. 2019. Isolation and characterization of thermophilic bacteria from Maharashtra hot springs: *Bacillus sp. and Staphylococcus sp.* Journal of Entomology and Zoology Studies. 7(1): 691-695.
 - Jha, G. N., Sarma, D., Akhtar, M. S., Charak, A. S., Paul, N. and Kour, R. 2018. Effect of spirulina (*Spirulina platensis*) fortified diets on growth performance of two important cold water fishes viz. *Barilius bendelisis* and *Schizothorax richardsonii*. Journal of Coldwater Fisheries, 1(1):85-88.
 - Kamalam, B.S., Mahija, J., Baral, P., Pandey, A., Akhtar, M.S., Ciji, A. and Rajesh, M., 2019. Temperature and oxygen related ecophysiological traits of snow trout (*Schizothorax richardsonii*) are sensitive to seasonal changes in a Himalayan stream environment. Journal of Thermal Biology, 83: 22-29.
 - Pandey, N. N, Kumar, P., Ali, S., Vishwakarma, B. K. and Kumar, S. 2018. Role of small tributaries in ichthyofaunal diversity of rivers in Uttarakhand. Journal of Coldwater Fisheries, 1(1):89-96.
 - Pandey, N. N, Rani, A., Vishwakarma, B.K., Singh, R. and Sarma, D. 2018. Study Of Gonado-Somatic Index And Absolute Fecundity of *Bangana dero* (Hamilton, 1822) Under Coldwater Conditions. (2018). International journal of advance research, 6(6):235-238
 - Pandey, N. N., Gupta, M., Singh, R., Vishwakarma, B. K. and Kumar, S. 2018. Optimum stocking density and rearing system for larvae of *Labeo dyocheilus* in coldwater conditions. Journal of Coldwater Fisheries, 1(1) 60-64.
 - Pandey, N. N., Kumar, P., Ali, S., Vishwakarma, B. K. and Kumar, S. 2018. Role of small tributaries in ichthyofaunal diversity of rivers in Uttarakhand. Journal of Coldwater Fisheries, .1(1)89-96.
 - Rajesh, M., Kamalam, B.S., Ciji, A., Akhtar, M.S., Pandey, N.N, Gupta, S., Sarma, D., Sahu, N.P. and Singh, A.K., 2019. Molecular characterisation and transcriptional regulation of muscle growth regulatory factors myogenin and myogenic factor 6 in the Trans-Himalayan cyprinid fish *Schizothorax richardsonii*. Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology, 231: 188-200.
 - Rajesh, M., Kamalam, B.S., Ciji, A., Akhtar, M.S., Sarma, D., Sahu, N.P. and Singh, A.K., 2018. Molecular cloning and in silico analysis of elongation factor 1A in *Schizothorax richardsonii*. Journal of Entomology and Zoology Studies, 6(4): 1444-1453.
 - Sarma, D., Akhtar, M. S., Sharma, P. and Singh, A. K. 2018. Resources, breeding, eco-tourism, conservation, policies and issues of Indian mahseer: A review. Journal of Coldwater Fisheries, 1(1):4-21.
 - Sarma, D., Singh, A.K. and Baruah, D. 2018. Checklist of endemic ichthyofauna of North-east India, Indian J. Fish., 65(3): 1-15.
 - Sharma, L., Ali, S., Barat, A., Kumar, R., Pande, V., Laskar, M.A., Sahoo, P.K. and Sumer, S., 2018. Molecular identification and genetic diversity analysis of chocolate mahseer (*Neolissochilus hexagonolepis*) populations of Northeast India using mitochondrial DNA markers. Mitochondrial DNA Part A, <https://doi.org/10.1080/24701394.2018.1526929>.
 - Tandel , R.S., Sharma, A., Dash, P., Bhat, R.A. H., Deo, A. 2019. Dietary vitamin C supplementation on growth and haemato - biochemical parameters of *Labeo rohita* (Ham.) fingerlings. Journal of Entomology and Zoology Studies. 7(1): 72-79.

13.2 Technical/Popular Articles

- Baruah, D. 2018. Interview with Mr Neelam Dutta of Assam. Fishing Chimes, 38 (1&2): 42-45.
- Baruah, D. 2018. Interview with Mr Soibam Surchandra Singh of Manipur. Fishing Chimes, 38 (1&2): 78-80.
- Baruah, D. 2018. Scope of recreational fisheries in Northeast India. Fishing Chimes, 38 (1&2): 93-100.

- Baruah, D. and Baruah A. 2018. Harvesting *Eurayle ferox* (makhana) from wetland (beel) fisheries of Assam, *Aquaculture Asia*, 22(3): 7-12.
- Baruah, D., Dutta, A., Bhuyan, A. and Pravin, P. 2018. Fishing gear and practices in flood waters of Assam. *Aquaculture Asia*, 22(4): 6-19.
- Baruah, D., Posti, R., Kunal, K., Ganie, P.A., Sarma, D. and Rinyo, G. 2019. Sustainable agro-aquaculture farming - LEISA INDIA, 21(1).
- Mahija, J., Raveender, B. and Kamalam, B.S., 2018. Freshwater macrophytes: multiple uses of a nuisance resource. *Fishing Chimes*, 38(3): 36-40.

13.3 Books/Book Chapters

- Baruah, D., Bhattacharyya, T., Dubey, M., Sharma, P., Das, P. and Sarma, D. 2019. Bharat me paristhitki-paryatan eyom manoranjantmak matsyiki. In: Shahi, N. And Joshi, A. K. (Eds). Himjyoti. Pp. 94-100.
- Baruah, D. and Baruah, A. (2019) Livelihood improvement of hill tribes through adaptive aquacultural approaches. In: Livelihood and sustainable development in Northeast India (edited by Ram Krishna Mandal, A. Ibotombi Singh and Paritosh Chandra Dutta), Concept Publishing Company Pvt. Ltd., New Delhi. pp 3-8.
- Ciji, A., Akhtar, M.S., 2018. Role of women in fisheries: Present status and issues. In: Surya R., Pratibha S. (Eds.), *Women in Agriculture (The Invisible Partners in Development)*, Jaya Publishing House, New Delhi, ISBN: 978-93-87 590-98-4
- Gupta, M., Singh, R., Das, S.C.S., Thakur, V.R., Singh, U., Shrivastava, R.S. and Das, B.K.(2019). *Mahseer Sanrakshan*. In: Das, B.K., Maurya, p., sahuo, S.K., and Kumari, S. (Eds.), *Samajik uthaan mein antarsthaliya matsyiki ki mehatta*. (In Hindi). ICAR-CIFRI, Barrackpore. Pp: 36-44.
- Kumar, A and Pande, A. 2019. Jaliye krishi mein CRISPR CAS ki upyogita. In: Shahi, N. And Joshi, A. K. (Eds). Himjyoti. Pp. 73-75.
- Nazim, S and Pande, A. 2019. Jalwayu privartan avom matsya udyog par uske parbhav. In: Shahi, N. And Joshi, A. K. (Eds). Himjyoti. Pp. 28-30.
- Rajesh, M., Ciji, A., Kamalam, B. S., Sharma, P. and Akhtar, M. S. 2019. Rainbow trout ka poshan avom aahaar. In: Shahi, N. And Joshi, A. K. (Eds). Himjyoti. Pp. 68-69.
- Sarma, D., Akhtar, M. S. and Ciji A. 2019. Sunhari mahseer (*Tor putitora*): Prajanana, beez utpadan avom hatchery prabandhan. In: Shahi, N. And Joshi, A. K. (Eds). Himjyoti. Pp. 31-41.
- Sarma, D., Das, P., Sharma, P., Akhtar, M. S. and Ciji A. 2019. Machhali ka paushanik mahatva. In: Shahi, N. And Joshi, A. K. (Eds). Himjyoti. Pp. 61-67.
- Singh, R., Gupta, M. and Pandey, N.N.(2019). *Rainbow trout machali ka prajanan evam beej utpadan*. In: Das, B.K., Maurya, P., Sahoo, S.K., and Kumari, S. (Eds.), *Samajik uthaan mein antarsthaliya matsyiki ki mehatta*. (In Hindi). ICAR-CIFRI, Barrackpore. Pp: 227-231.
- Tandel, R. S. and Bhat, R. A. H. 2018. Oomycetes infections of coldwater fishes & their control. In Training manual of NFDB sponsored training program on prevention & control of important coldwater fish diseases & their management during 6-10 august, 2018.

13.4 Bulletins/Leaflets/Booklets/Souvenirs/ Reports

- Baruah, D. and Patiyal, R.S. 2018. Tirthan valley – An adventure-centric getaway for sports fisheries, CFSI Newsletter, Vol. 2, No. 1. A periodical of Coldwater Fisheries Society of India.
- Baruah, D., Akhtar, M.S., Chanu, V.C. and Kunal, K. 2018. ICAR-DCFR Newsletter January – June 2018, ICAR-Directorate of Coldwater Fisheries Research, Bhimtal-263136, Nainital, Uttarakhand.
- Baruah, D., Akhtar, M.S., Chanu, V.C., Alexander, C. and Kunal, K. 2018. ICAR-DCFR Annual Report 2017-18.
- Baruah, D., Sarma, Debajit., Sarma Dadadhar and Tandel, R. S. 2019. Fish based eco-tourism as an avenue for supporting livelihood to scheduled caste population in northeast India, pg 1-6 (Leaflet).

- Chandra, S., Mallik, S. K., Tandel, R. S., Bhat, R. A. H., Sarma, D (2018). Field observation on common health disorders of farmed rainbow trout. Bulletin No. 30.Pp:1-28.
- Rajesh, M., Ciji, A., Biju, S.K., Sharma, P., Akhtar, M.S., Pandey, N.N., 2019. Rainbow trout nutrition and feeding, ICAR-DCFR, Bhimtal, Pp. 4. (Leaflet).
- Sarma, D., Akhtar, M.S., Ciji, A., Sharma, P., 2018. Nutrient composition of Himalayan fishes and their prospects in human nutrition. Bulletin No. 29, ICAR-DCFR, Bhimtal, Pp. 40.
- Sarma, D., Pandey, N.N., Chandra, S., Patiyal, R.S., Zaidi, S.G.S., Baruah, D., Akhtar, M.S., Rajesh, M., Giri, A.K. and Singh, R. (2018) Parvattia shetro ki pramukh palan yogya matsya prajatiyo ki prajanan aom beez utpadan techniqiya. ICAR-DCFR, Bhimtal, Bulletin No. 28
- Zaidi, S.G.S., Singh A.K. and Sarma, D. (2018). Breeding, seed production and rearing of coldwater ornamental fishes in aquarium. Bulletin No. 27, ICAR-DCFR, Bhimtal.
- Kaushik, S., Kamalam, B.S. and Jena, J.K., 2018. The Indian aquaculture prospective vision at 2040. WAS Aqua 2018, 25-29 August, Montpellier, France.
- Kunal, K., Baruah, D., Ganie, P.A., Das, P., and Sarma, D. Study on Ichthyofaunal diversity of River Shei, Arunachal Pradesh with special reference to *lipums*., 3rd International Symposium on Aquaculture and Fisheries education (ISAFE3); Theme: Fisheries education for sustainable economy 16th to 18th May, 2018 at ICAR-CIFE, Mumbai. PP. 266.
- Mallik, S. K., Shahi, N., Pant, K., Kala, K., Giri, A. K., Chandra, S. and Sarma, D. 2019. Zoonotic *Fusarium oxysporum* infection in captive reared fingerlings of golden mahseer, *Tor putitora* (Hamilton, 1822) from India. World Brackishwater Aquaculture Conference, ICAR-CIBA/SCAFi, 23-25 Jan 2019, Chennai, India. pp 188.
- Mir, M. I., Siddiqui, U., Patiyal, R. S. and Pandey, N. N. 2019. Comparative study of metabolic genes in association with seasonal fluctuation of temperature in rainbow trout (*Onchorynchus mykiss*) under captive conditions. XIV Agricultural Science Congress held in NASC, PUSA Complex, New Delhi from 20-23rd February 2019. Pp.361.

13.5 Abstracts

- Ali S., Sharma L., Siva, C., Sharma, A., Barat, A., Sahoo P.K., 2019. Mitochondrial gene sequences analysis suggest conservation priority for threatened chocolate mahseer (*Neolissochilus hexagonolepis*) in northeast India. Abstract No. 247; XIV Agricultural Science Congress, 20-23 February, 2019, NASC, Pusa, New Delhi, India, p. 344.
- Chandra, S., Mallik, S. K., Shahi, N., Patiyal, R. S. and Sarma, D. 2019. Epidemiology of emerging eye and mouth infections in farmed rainbow trout, *Oncorhynchus mykiss* (Walbaum, 1792). World Brackishwater Aquaculture Conference, ICAR-CIBA/SCAFi, 23-25 Jan 2019, Chennai, India. pp 189.
- Ganie, P.A., Baruah, D., Kunal, K., Das, P. and Sarma, D. Phytoplankton diversity and abundance in three tributaries of Kamneg drainage, Arunachal Pradesh. 3rd International Symposium on Aquaculture and Fisheries education (ISAFE3); Theme: Fisheries education for sustainable economy 16th to 18th May, 2018 at ICAR-CIFE, Mumbai. PP. 265
- Pandey, N. N., Kumar, P., Ali, S., Patiyal, R. S., Vishwakarma, B. K., Mohan, D., and Siddiqui, U. 2019. Integrated fish-cum-horticulture using polytanks: A climate resilient practice in mid Himalayan region. Abstract Book-9th ISCA HW Chapter Conference. GB Pant University of Agri & Tech, Panatnagar.
- Pandey, N. N., Kumar, P., Ali, S., Vishwakarma and Sarma, D. 2018. Contribution of tributaries and small streams for ichthyofaunal diversity in changing climate scenario. Abstract Book-Summit on Climate Resilient Mountain Agriculture. Watershed Management Directorate, Uttarakhand. Pp:75.
- Pandey, N. N., Kumar, P., Patiyal, R. S., Ali, S., Rajesh, M., Vishwakarma, B. K., Shah, R. H. And Sarma, D. 2018. Fish farming in hills to mitigate impact of climate change. Abstract Book- Summit on Climate Resilient Mountain Agriculture. Watershed Management

- Directorate, Uttarakhand. Pp:63
- Pandey, N.N. Singh, R., Kamlam, B. S., Vishwakarma, B. K. and Kala, P. 2019. Triploidy induction in rainbow trout by heat shock: A breakthrough in India. Abstract book- XIV Agricultural Science Congress innovations for agricultural transformation, Agricultural Science Congress, 20-23 February, 2019, NASC, Pusa, New Delhi, India p-345.
 - Patiyal, R. S., Mir, M. I, Pandey, N. N., Sarma, D. and Bhatt, P. 2019. A comprehensive study on developmental biology of *Garra gotyla* (Gray;1830,Teleostei; Cyprinidae). XIV Agricultural Science Congress held in NASC, PUSA Complex, New Delhi from 20-23rd February 2019. Pp.799.
 - Rajesh, M., Kamalam, B.S., Patiyal, R.S. and Sarma, D., 2018. Rainbow trout farming in re-circulatory aquaculture systems: An entrepreneurial prospect towards blue revolution in Indian uplands. 3rd International Symposium on Aquaculture and Fisheries Education, 16-18 May, ICAR-CIFE, Mumbai, India.
 - Tandel, R. S., Dash, P., Bhat, R.A.H., Kavya, K.K. and Sarma, D. 2019. Unravelling the pathogenic oomycetes from *Schizothorax richardsonii*, in Book of abstract World Brackishwater aquaculture conference 2019 held at Chennai during 23-25 January, 2019.
 - Kamalam, B.S., Rajesh, M., Akhtar, M.S., Ciji, A. and Singh, A.K., 2018. *Schizothorax richardsonii* gut microbiota at 24 degree Celsius (BioSample No. SAMN09949177; SRA: SRR7800872; BioProject: PRJNA380713).
 - Kamalam, B.S., Rajesh, M., Akhtar, M.S., Ciji, A. and Singh, A.K., 2018. *Schizothorax richardsonii* gut microbiota in proximal intestine (BioSample No. SAMN09949178; SRA: SRR7800896; BioProject: PRJNA380713).
 - Kamalam, B.S., Rajesh, M., Akhtar, M.S., Ciji, A. and Singh, A.K., 2018. *Schizothorax richardsonii* gut microbiota in distal intestine (BioSample No. SAMN09949179; SRA: SRR7800897; BioProject: PRJNA380713).
 - Kamalam, B.S., Rajesh, M., Akhtar, M.S., Ciji, A. and Singh, A.K., 2018. *Schizothorax richardsonii* gut microbiota in gut content/digesta (BioSample No. SAMN09949181; SRA: SRR7800903; BioProject: PRJNA380713).
 - Kamalam, B.S., Rajesh, M., Akhtar, M.S., Ciji, A. and Singh, A.K., 2018. Microbiota in *Schizothorax richardsonii* natural feed (BioSample No. SAMN09947834; SRA: SRR7800904; BioProject: PRJNA380713).
 - Kamalam, B.S., Rajesh, M., Akhtar, M.S., Ciji, A. and Singh, A.K., 2018. *Schizothorax richardsonii* gut microbiota (control) in RAS (BioSample No. SAMN09949270; SRA: SRR7800756; BioProject: PRJNA380713).
 - Kamalam, B.S., Rajesh, M., Akhtar, M.S., Ciji, A. and Singh, A.K., 2018. *Schizothorax richardsonii* gut microbiota after oxytetracycline bath treatment (BioSample No. SAMN09949271; SRA: SRR7800822; BioProject: PRJNA380713).
 - Kamalam, B.S., Rajesh, M., Akhtar, M.S., Ciji, A. and Singh, A.K., 2018. *Schizothorax richardsonii* gut microbiota after potassium permanganate bath treatment (BioSample No. SAMN09949273; SRA: SRR7800883; BioProject: PRJNA380713).
 - Kamalam, B.S., Rajesh, M., Akhtar, M.S., Ciji, A. and Singh, A.K., 2018. *Schizothorax richardsonii* gut microbiota after formalin bath treatment (BioSample No. SAMN09949272; SRA: SRR7800759; BioProject: PRJNA380713).

13.6 NCBI Submissions

- Kamalam, B.S., Rajesh, M., Akhtar, M.S., Ciji, A. and Singh, A.K., 2018. *Schizothorax richardsonii* gut microbiota at 6 degree Celsius (BioSample No. SAMN09947453; SRA: SRR7800810; BioProject: PRJNA380713).
- Kamalam, B.S., Rajesh, M., Akhtar, M.S., Ciji, A. and Singh, A.K., 2018. *Schizothorax richardsonii* gut microbiota at 12 degree Celsius (BioSample No. SAMN09947833; SRA: SRR7800880; BioProject: PRJNA380713).
- Kamalam, B.S., Rajesh, M., Akhtar, M.S., Ciji, A. and Singh, A.K., 2018. *Schizothorax richardsonii* gut microbiota at 18 degree Celsius (BioSample No. SAMN09949109; SRA: SRR7800812; BioProject: PRJNA380713).

- Kamalam, B.S., Rajesh, M., Akhtar, M.S., Ciji, A. and Singh, A.K., 2018. *Schizothorax richardsonii* gut microbiota after salt bath treatment (BioSample No. SAMN09949277; SRA: SRR7800884; BioProject: PRJNA380713).
- Kamalam, B.S., Rajesh, M., Patiyal, R.S. and Sarma, D., 2018. Microbiome associated with gravel bed biofilter in RAS (BioSample No. SAMN09947513; SRA: SRR7800906; BioProject: PRJNA489342).
- Whole genome sequence of algicidal bacterium *Fictibacillus phosphorivorans* DBL 17U12: DDBJ/ENA/GenBank under the accession - SAYN00000000 (Submitted by Shahi, N).
- Whole genome sequence of bacterial zoonotic fish pathogen *Lactococcus garvieae* RTCLI04: DDBJ/ENA/GenBank under the accession RSFD00000000 (Submitted by Shahi, N).

13.7 Copyrights ©

- Granted Copyright of literary work entitled “Mahseer in India: Resources, Breeding, Propagation, Conservation, Policies & Issues” Authored by D. Sarma, A. K Singh, M.S Akhtar

Participation in Conference/ Symposia/ /Workshop/ Meetings/Trainings

14

14.1 Participation in Conference/Symposia/Workshop/Trainings

- Meetings /seminars/conferences/workshops attended by Dr. Debajit Sarma, Director during 01.04.2018 to 31.03.2019:

Date	Place	Purpose
12.04.2018 to 13.04.2018	Dehradun	<ul style="list-style-type: none"> Meeting with Hon'ble Chief Minister, Uttarakhand to discuss issues for construction of residential quarters for DCFR staff at Bhimtal. Meeting with Secretary/Director of Fisheries, Govt. of Uttarakhand in connection with conservation of golden mahseer.
21.04.2018 to 26.04.2018	Guwahati	<ul style="list-style-type: none"> Participated in 'Fish Migration Day' at ABACA, Nameri, Guwahati. Organized Farmers-Officers-Scientists interaction meet & inauguration of mahseer hatchery installed by ICAR-DCFR at Mokokcheng/Nagaland.
02.05.2018	Hyderabad	<ul style="list-style-type: none"> Participated in the meeting of "Skill Development Workshop" at NFDB Hyderabad on May 02, 2018.
16.05.2018 to 18.05.2018	Mumbai	<ul style="list-style-type: none"> Participated in the 3rd International Symposium on Fisheries Education for a Sustainable Blue Economy at ICAR-CIFE Mumbai from May 16-18, 2018.
18.05.2018 to 19.05.2018	Arunachal Pradesh	<ul style="list-style-type: none"> Participated in agriculture conclave organized by NABARD on May 18-19, 2018 at Arunachal Pradesh.
30.05.2018	Munsiyari, Uttarakhand	<ul style="list-style-type: none"> Attended the DCFR organized training programme, awareness and field demonstration at Munsiyari on May 30, 2018
12.06.2018 to 13.06.2018	Nainital	<ul style="list-style-type: none"> Attended parliamentary committee inspection on Hindi Rajbhasha meeting at Nainital during June 11-14, 2018 and represented DCFR as coordinating institute.
16.07.2018	Delhi	<ul style="list-style-type: none"> Participated in the ICAR Foundation Day & Director's Conference on July 16, 2018 at NASC complex, New Delhi.
27.07.2018	Mumbai	<ul style="list-style-type: none"> Attended synopsis/presentation for the PhD students at ICAR-CIFE, Mumbai on July 27, 2018.
28.07.2018	Kochi	<ul style="list-style-type: none"> Participated in the launch workshop for Network Project on "Ornamental Fish Breeding and Culture" at ICAR-CMFRI, Kochi on July 28, 2018.
07.08.2018	Delhi	<ul style="list-style-type: none"> Participated in the NICRA Review Meeting at NASC Complex, New Delhi on August 7, 2018
15.09.2018	Mumbai	<ul style="list-style-type: none"> Attended Academic Council Meeting of ICAR-CIFE, Mumbai on September 15, 2018.
27.09.2018	Mukteshwar	<ul style="list-style-type: none"> Attended the meeting organized by NABARD at ICAR-IVRI, Mukteshwar on September 27, 2018.
03.10.2018 to 04.10.2018	Faizabad	<ul style="list-style-type: none"> Attended meeting on Dalela Oration at Dr. R.M.L. University, Faizabad on October 3-4, 2018.
05.10.2018	Kolkata	<ul style="list-style-type: none"> Attended IBRF Excellence Award in Life Science at Science City Auditorium, Kolkata on October 5, 2018.
06.10.2018 to 08.10.2018	Nagaon, Assam	<ul style="list-style-type: none"> Participated in Fish Festival & Skill Development programme at Jasingfaa, Nagaon, Assam during October 6-8, 2018

Date	Place	Purpose
30.10.2018 to 31.10.2018	Chatha, Jammu	♦ Organized collaborative training programme on Fish diseases & their management at State Management and Extension Training Institute (SAMETI-J), at Chatha, Jammu.
01.11.2018	Srinagar	♦ Participated in the Scientists-Farmers-Officers Interactive meet at Srinagar.
20.11.2018	Delhi	♦ Project presentation at Paryavaran Bhavan and institute work at SMD/ICAR Hqrs, New Delhi.
02.12.2018	Pantnagar	♦ Delivered the lecture on “Pashudhan Kauthik” at GBPUA&T, Pantnagar.
11.12.2018	Delhi	♦ Participated in the 23 rd meeting of the Committee on Introduction of Exotic Aquatic Species into Indian Waters at Krishi Bhawan, New Delhi under the Chairmanship of Joint Secretary (Fisheries) on 11.12.2018.
19.12.2018	Delhi	♦ Participated in a Consultation on Invasive Alien Fish Species organized by ICAR-NBFGR, Lucknow & WWF –India at Delhi on December 19, 2018.
29.12.2018 to 30.12.2018	Dirang, Arunachal Pradesh	♦ Organized training-cum-orientation workshop on trout feed formulation, preparation and management organized by ICAR-DCFR Bhimtal at ICAR-NRC on Yak, Dirang during December 29-30, 2018 to disseminate the package of practice of trout feed formulation & preparation to Department of Fisheries, Government of Arunachal Pradesh & Sikkim.
07.01.2019 09.01.2019 13.01.2019	Delhi Assam Guwahati Univeristy, Guwahati	♦ Meeting with Norwayan Delegates at Delhi. ♦ Meeting with Department of Fisheries, Assam ♦ Delivering a lecture at Guwahati University, Guwahati
15.01.2019	Agartala, Tripura	♦ Participated in National Symposium on Client Smart Aquaculture & Fisheries (CSAF), Agartala, Tripura on January 15-16, 2019
23.01.2019 to 25.01.2019	Chennai	♦ Participated in Brackishwater Aquaculture (BRAQCON 2019) organized by ICAR-CIBA Chennai from January 23-25, 2019.
31.01.2019 to 02.02.2019	New Delhi	♦ Attended ICAR Directors’ & Directors’ of Fisheries Institutes conference at NASC Complex, New Delhi from January 31- February 2, 2019.
20.02.2019	New Delhi	♦ Participated in XIV th Agricultural Science Congress at New Delhi.
26.02.2019 to 27.02.2019	Guwahati, Assam	♦ Participated in the National Workshop under Scheduled Caste Sub Plan (SCSP) organized by ICAR-DCFR Bhimtal in collaboration with Department of Zoology, Gauhati University, Guwahati at Deptt. of Zoology, Gauhati University, Guwahati.
02.03.2019	Pantnagar, Uttarakhand	♦ Meeting with Vice Chancellor, GBPUA&T Pantnagar to discuss on SCSP programme at College of Fisheries, GBPUA&T Pantnagar.
09.03.2019 to 10.03.2019	Khatima, Uttarakhand	♦ Organized & participated in the two days Farmers-Scientists Interactive Workshop cum Orientation programme for the tribal farmers inhabiting in tarai area of Uttarakhand during March 9-10, 2019 at Khatima, Uttarakhand.
11.03.2019 to 12.03.2019	Champawat, Uttarakhand	♦ Organized & participated in the two days Farmers-Scientists Interactive Workshop cum Kisan Mela under Scheduled Caste Sub Plan (SCSP) component during March 11-12, 2019 at ICAR-DCFR Experimental Fish Farm & Field Centre, Champawat, Uttarakhand

- B.S. Kamalam attended the '6th NICRA annual review workshop' held at NASC, New Delhi during 7-8 August 2018 and presented the progress made under the ICAR-DCFR project component 'Development of climate resilient rainbow trout and innovative trout farming strategies to mitigate climatic stressors'
- B.S. Kamalam completed the Deakin University SEBE's 'Lab safety training module' at Queenscliff, Australia on 22 October 2018.
- B.S. Kamalam completed the Deakin University's Animal Ethics training course on 'Regulatory issues in the care and use of animals for research and teaching' at Queenscliff, Australia on 20 March 2019.
- B.S. Kamalam completed the two-part training on 'Biosafety induction (PC1 & PC2) and use of biological safety cabinets' organized at Deakin University, Geelong Waurm Ponds campus, Australia on 12 December 2018.
- Ciji A., A. K. Giri, Rajesh M and R. S. Haldar organized NFDB sponsored TOT training programme as Co-coordinators on "Hands-on-Training in Breeding and Seed Production of *Tor putitora* (golden Mahseer) & *Neolissochilus hexagonolepis* (Chocolate Mahseer)" at ICAR-DCFR during 27-31 August, 2019.
- D. Baruah co-coordinated 18 days FWEP programme for 15 BFSc students from College of Fisheries Science & Research, Chnadra Shekhar Azad University of Agriculture & Technology, Kanpur during 26 July 2018 to 12 August 2018.
- D. Baruah co-coordinated 3-days training programme on skill development for farmers under NFDB during 10-12 July 2018.
- D. Baruah coordinated 5-days skill development programme on "Start up fish farming, fish seed production and hatchery management for hill farmers of Ziro valley, Arunachal Pradesh" at Pabhoi Fish Farm, Biswanath, Assam during 20-24 May 2018.
- D. Baruah coordinated 5-days training programme cum exposure visit for the farmers of Menchukha, Shi-Yomi district of Arunachal Pradesh at ICAR-DCFR & EFF, Champawat on the topic "Coldwater Fisheries and Aquaculture Practices in Indian Himalayan Region" during 6-10 November 2018.
- D. Baruah coordinated as transit committee of Parliamentary Committee visit on Rajbhasha on 12th June, 2018.
- D. Baruah made field visit to Ziro, Itanagar and West Kameng district of Arunachal Pradesh to conduct NEH activity, MGMG, exploration programme and to carry out institute research project.
- D. Baruah organized 2-days training cum orientation cum workshop on "Feed preparation, formulation and demonstration for promoting trout fisheries in Eastern Himalayan Region" during 29-30 December 2018 at ICAR-NRC on Yak, Dirang, A.P.
- D. Baruah organized 2-days Farmers-Scientist Interactive Workshop cum Kisan Mela as oversees at Experimental Fish Farm, Champawat under Scheduled Caste Sub Plan during 11-12 March 2019.
- D. Baruah participated in "All India 4th Open Catch and Release Angling Championship and Anglers Interactive Workshop" at Great Himalayan National Park, Sairopa, Tehsil Banjar, Kullu district, Himachal Pradesh. Organized by Trout Conservation & Angling Association, Kullu; Himachal Angling during 20-22 April 2018.
- D. Baruah participated in State Conclave on "Perspective Planning for Resurgent Agriculture and Allied Sector in Arunachal Pradesh" at State Legislative Assembly, Itanagar, Arunachal Pradesh, organized by NABARD and Govt. of Arunachal Pradesh during 18-19 May 2018.
- Debajit Sarma and Neetu Shahi organized three-day training programme for the skilled supporting staff (SSS) of ICAR institutes on the theme "Motivation, Stress Mitigation and Farm Management" during 6-8 March, 2019 at ICAR-DCFR, Bhimtal.
- Kishor Kunal, participated in the 3rd International Symposium on Aquaculture and Fisheries education (ISAFE3); Theme: fisheries education for sustainable economy from 16 - 18 May, 2018 at ICAR-CIFE, Mumbai.

- Kishor Kunal presented a poster on “Study on Ichthyofaunal diversity of River Shei, Arunachal Pradesh with special reference to *lipums*” in the 3rd International Symposium on Aquaculture and Fisheries education (ISAFE3); Theme: fisheries education for sustainable economy from 16th to 18th May, 2018 at ICAR-CIFE, Mumbai.
- M. S. Akhtar and Kishor Kunal organized National Fish Farmers Day on 10th July, 2018.
- M. S. Akhtar organized NFDB sponsored TOT training programme as coordinator on “Hands -on-Training in Breeding and Seed Production of *Tor putitora* (golden Mahseer) & *Neolissochilus hexagonolepis* (Chocolate Mahseer)” at ICAR-DCFR during 27-31 August, 2019.
- M. S. Akhtar, Scientist coordinated Field Work Experience Course on “Coldwater Resource Assessment and Management” for the 15 BFSc students of College of Fishery Sciences, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, U.P. during 26th July, 2018 to 12th August, 2018.
- Mohammad Iqbal Mir participated in showcase of technologies developed by ICAR-DCFR, Bhimtal in Agri-Startup Conclave held in New Delhi during 16th to 17th October 2018.
- Neetu Shahi attended and presented a paper on ‘Comparative genomics of zoonotic fish pathogen *Lactococcus garvieae* RTCLI04, isolated from farmed rainbow trout, *Oncorhynchus mykiss* (Walbaum) in India’ at World Brackishwater Aquaculture Conference organized by ICAR-CIBA/SCAFi, Chennai during 23-25 Jan 2019.
- Neetu Shahi attended the training programme on “Management Development Programme for HRD Nodal Officers of ICAR for effective implementation of Training functions” from 14-16th March 2019 at Hyderabad, India
- N N Pandey organized NFDB sponsored TOT training programme as Co-coordinator on “Breeding, seed production and health management of Rainbow Trout (*Oncorhynchus mykiss*)” during 4-8 March, 2019 at ICAR-DCFR, Bhimtal.
- N N Pandey, Prakash Sharma, Ciji A and Rajesh M coordinated NFDB sponsored Training of Trainers (ToT) Programme on ‘Feed management practices in coldwater aquaculture’ during 25 to 29 September, 2018, Organized by ICAR-DCFR at Bhimtal.
- Parvaiz Ahmad Ganie, participated in the 3rd International Symposium on Aquaculture and Fisheries education (ISAFE3); Theme: fisheries education for sustainable economy from 16 -18 May, 2018 at ICAR-CIFE, Mumbai.
- Parvaiz Ahmad Ganie Co-coordinated 18 days FWEP programme for 15 BFSc students from College of Fisheries Science & Research, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur during 26 July 2018 to 12 August 2018.
- Parvaiz Ahmad Ganie and Kishor Kunal organized NFDB sponsored TOT training programme as Co-coordinator on “Breeding, seed production and health management of Rainbow Trout (*Oncorhynchus mykiss*)” during 4-8 March, 2019 at ICAR-DCFR, Bhimtal.
- Parvaiz Ahmad Ganie presented a poster on “Phytoplankton diversity and abundance in three tributaries of Kamneg drainage, Arunachal Pradesh” in the 3rd International Symposium on Aquaculture and Fisheries education (ISAFE3); Theme: fisheries education for sustainable economy from 16th to 18th May, 2018 at ICAR-CIFE, Mumbai.
- Raghvendra Singh, Kishor Kunal, Parvaiz Ahmad Ganie Co-coordinated 21 days FWEP programme for 15 BFSc students from College of Fisheries Science & Research, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur during 26 Oct 2018 to 15 Nov. 2018.
- Raghvendra Singh organized NFDB sponsored TOT training programme as Coordinator on “Breeding, seed production and health management of Rainbow Trout (*Oncorhynchus mykiss*)” during 4-8 March, 2019 at ICAR-DCFR, Bhimtal.
- Raghvendra Singh organized NFDB sponsored TOT training programme as Co-coordinator on “Grow out technologies of Indigenous

- Coldwater minor carps” during 4-8 March, 2019 at ICAR-DCFR, Bhimtal.
- Raja Aadil Hussain Bhat coordinated one day mass awareness cum training programme on “Fish Health Management” for the fish farmers at Joginder Nagar, Himachal Pradesh on 19th September, 2018 under the National Surveillance programme for Aquatic Animal Diseases (NASPAAD).
 - Rajesh M attended 3rd International Symposium on Aquaculture and Fisheries Education (ISAFE3) during 16-18 May, 2018 at ICAR-CIFE, Mumbai
 - Rajesh M attended a seminar on “Development and challenges in Coldwater Fisheries” organized by Himachal Pradesh State Fisheries Department on 31st January, 2019 at Bilaspur, Himachal Pradesh.
 - R S Tandel delivered lecture on ‘Fish Health Management in integrated fish farming’ in 3-days Human Resource Development Programme on Integrated Fish Farming for Doubling Fish Farmers Income of Scheduled Caste Community of Northeast Region at Gauhati University, Guwahati, Assam during 27th February to 1st March 2019.
 - R. S. Halder participated in Kisan Mela during 11-12 March, 2019 at ICAR-DCFR Field Centre Champawat by organising preparation of Fish pickle and distributing Fish seed to the farmers located in Champawat district of Uttarakhand.
 - R. S. Halder participated in the 31st All India Congress of Zoology (31st AICZ) & National Seminar on Climate-Smart Aquaculture and Fisheries (CSAF) organized by North East Society for Fisheries and Aquaculture (India) in collaboration with Zoological Society of India (ZSI), Bodh Gaya during January 15-16, 2019 at College of Fisheries, CAU (I), Lembuchera, Tripura.
 - R. S. Halder participated in the International Symposium on “Aquaculture and Fisheries Education (ISAFE 3)” organized by ICAR-Central Institute of Fisheries Education, Mumbai in collaboration with Indian Fisheries Association during May 16-18, 2018 at ICAR-CIFE, Mumbai.
 - R. S. Tandel participated in two days training programme on ICAR Research Data Management (KRISHI Portal) and presented detailed work progress of ICAR DCFR along with hands on Training on Institutional Publication Repository, Data Inventory Repository, Technology Repository, Video/Audio Gallery/ICAR Mobile Apps and ICAR Geo-Portal and Spatial Meta Data, held at ICAR-IASRI, New Delhi for the Officer Incharge, Data Management during 15-16 February 2019.
 - S. Ali organized 31st Foundation Day of the ICAR-DCFR on 24th September 2018.
 - S. Ali organized NFDB sponsored TOT training programme as Co-coordinator on “Grow out technologies of Indigenous Coldwater minor carps” during 4-8 March, 2019 at ICAR-DCFR, Bhimtal
 - S. Ali participated in the XIV Agricultural Science Congress during 20-23 February, 2019 at NASC complex, New Delhi.
 - Suresh Chandra, S. K. Mallik and Raja Aadil Hussain Bhat coordinated three days training programme with Department of Fisheries, Jammu & Kashmir and State Agricultural Management & Extension Training Institute (SAMETI), Jammu on “Fish diseases and their management” during 30th October to 1st November, 2018 at SKUAST-J.

14.2 Participation in Meetings

- Mohammad Iqbal Mir participated in “Industry Interface Meeting” organized by Zonal Technology Management Center (Fisheries) & Agri-Business Incubation Center of ICAR held at Central Institute of Fisheries Technology-Cochin on 27th March 2019.
- Raja Aadil Hussain Bhat attended twenty fifth meeting of the ICAR Regional committee No. 1 at SKUAST-K during 11-12 June, 2018.
- Raja Aadil Hussain Bhat participated in centre of advanced faculty training (CAFT) in “One health with special reference to fisheries and aquaculture” from 17th to 27th Feb., 2019 at ICAR-CIFE, Mumbai.
- S. Ali participated in 22nd EAC meeting of River Valley and Hydroelectric projects of

MoEF&CC, GoI, New Delhi on 27th February, 2019 with respect to CEIA study of hydroelectric projects in Yamuna, Tons and its tributaries in Uttarakhand.

- S. Ali participated in the 21st EAC meeting of MoEF&CC, GoI, New Delhi on 28th January 2019 with respect to Cumulative Impact Assessment of hydroelectric projects in Sutlej River Basin in Himachal Pradesh.

14.3 Lectures/Talks Delivered

- A. K. Giri delivered a lecture on “Breeding and larval rearing of Rainbow trout” to the students of Rajkiya Uchchatar Madhyamik Vidyalaya, Sirmoli, Lohaghat, Champawat on 13th April, 2018.
- A. K. Giri delivered a lecture on “High valued ornamental fish farming: A cost effective business, especially for household women of hilly expanse” to the students of Rajkiya Uchchatar Madhyamik Vidyalaya and Rajkiya Uchchatar Prathmik Vidyalaya, Champawat on 23rd May, 2018.
- A. K. Giri delivered a lecture on “Improved common carp varieties: A beneficial candidate species for up scaling farmers’ livelihood and income in mid-hill thermal regimes with low input cost” to the students of Rajkiya Uchchatar Madhyamik Vidyalaya and Rajkiya Uchchatar Prathmik Vidyalaya, Champawat on 23rd May, 2018.
- A. K. Giri delivered a lecture on “Rainbow trout farming: A profitable venture for hill aquaculture” to the students of Rajkiya Uchchatar Madhyamik Vidyalaya and Rajkiya Uchchatar Prathmik Vidyalaya, Champawat on 23rd May, 2018.
- A. K. Giri delivered a lecture on “Scenario and prospects and of indigenous snow trout species and major initiatives taken for its conservation and hill biodiversity as well” to the students of Rajkiya Uchchatar Madhyamik Vidyalaya and Rajkiya Uchchatar Prathmik Vidyalaya, Champawat on 23rd May, 2018.
- B.S. Kamalam delivered a lecture and practical demonstration on ‘Mahseer broodstock nutrition and feed preparation’ in the NFDB sponsored Training of Trainers programme

‘Hands-on training in breeding and seed production of *Tor putitora* (golden mahseer) and *Neolissochilus hexagonolepis* (chocolate mahseer)’ organized at ICAR-DCFR, Bhimtal during 27-31 August 2018.

- Ciji Alexander delivered a lecture as a resource person on ‘Larval nutrition and feed formulation’ in the NFDB sponsored ToT training programme on ‘Hands on training in breeding and seed production of *Tor putitora* (golden mahseer) and *Neolissocheilus hexagonolepis* (chocolate mahseer)’ at ICAR-DCFR, Bhimtal during 27-31st August, 2018.
- Ciji Alexander delivered four lectures (i) Protein and lipid nutrition (ii) Carbohydrate, vitamins and minerals in fish nutrition (iii) Larval nutrition and (iv) Nutritional requirement of major coldwater fishes to the BFSc students of Etawah campus, College of Fisheries Science and Research, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during 10-25th September, 2018 at ICAR-DCFR, Bhimtal.
- Ciji Alexander delivered three lectures (i) Principles and basics of fish nutrition (ii) Nutritional requirement of fish and (iii) Anti-nutritional factors in fish feed ingredients in the NFDB sponsored ToT training programme on ‘Feed management practices in coldwater aquaculture’ at ICAR-DCFR, Bhimtal during 25-29th September, 2018.
- D. Baruah delivered a lecture on “Fish breeding and hatchery management” during training programme for Skilled Supporting Staff on Motivation, stress mitigation and farm management (06-08/03/2019).
- D. Baruah delivered a lecture on “Trout farming for livelihood support” during training programme for 5-days Training of Trainers (TOT) on Breeding, seed production and health management of rainbow trout (04-08/03/2019).
- D. Baruah delivered lecture on “Promotion of trout farming and fish based eco-tourism in upland regions of IHR” during an awareness programme jointly organized by Department of Fisheries, Government of Arunachal Pradesh in collaboration with ICAR-Directorate

- of Coldwater Fisheries Research, Bhimtal, Nainital, Uttarakhand at Menchukha of newly declared Shi Yomi district of Arunachal Pradesh during 12-13th February 2019 on the topic “Coldwater fish culture in Menchukha region”.
- K. Kunal delivered a lecture on “Current status of marine fisheries in India” to the students of college of Fisheries, Etawah, CSAUA&T on 26th October, 2018.
 - K. Kunal delivered a lecture on “Breeding and larval rearing of Snow trout” to the students of Rajkiya Uchchar Madhyamik Vidyalaya, Sirmoli, Lohaghat, Champawat on 13th April, 2018.
 - K. Kunal delivered a lecture on “Breeding and Seed production of Snow trout” to fish farmers of District Tawang, Arunachal Pradesh on 29th Sep, 2018.
 - K. Kunal delivered a lecture on “Career in agriculture and Fisheries” to class 12th students of Jawahar Navodaya Vidyalaya, Champawat on 16th Aug, 2018.
 - K. Kunal delivered a lecture on “Career in agriculture and fisheries” to students of Govt. Inter College, Jankidhar, Lohaghat on 16th Feb, 2019.
 - K. Kunal delivered a lecture on “Fish farming practices in Champawat district” to students of Govt. Inter College, Pulhindola, Lohaghat on 15th Feb, 2019.
 - K. Kunal delivered a lecture on “Fish Farming Practices in Mid Himalaya Region” to class 12th students of Jawahar Navodaya Vidyalaya, Champawat on 16th Aug, 2018.
 - K. Kunal delivered a lecture on “Coldwater fishery resources of India” to the students of college of Fisheries, Etawah, CSAUA&T on 26th October, 2018.
 - K. Kunal delivered a lecture on “Conservation strategies for conserving Coldwater fish biodiversity on India” to the students of college of Fisheries, Etawah, CSAUA&T on 27th October, 2018.
 - K. Kunal delivered a lecture on “Current scenario of snow trout fishery in Indian upland waterbodies” to the students of college of Fisheries, Etawah, CSAUA&T on 30th October, 2018.
 - K. Kunal delivered a lecture on “Estimation and management of abiotic water quality parameters in fish ponds” to the students of college of Fisheries, Etawah, CSAUA&T on 1st November, 2018.
 - K. Kunal delivered a lecture on “Impact of global warming and climate change on coldwater fish biodiversity” to the students of college of Fisheries, Etawah, CSAUA&T on 29th October, 2018.
 - K. Kunal delivered a lecture on “Research priorities in the conservation of Coldwater fisheries” to the students of college of Fisheries, Etawah, CSAUA&T on 31st October, 2018.
 - K. Kunal delivered a lecture on “Reservoir Fisheries and its Sustainability” to the students of college of Fisheries, Etawah, CSAUA&T on 27th October, 2018.
 - K. Kunal delivered a lecture on “Threats to Coldwater fish Biodiversity” to the students of college of Fisheries, Etawah, CSAUA&T on 27th October, 2018.
 - K. Kunal delivered a lecture on “Snow trout culture and seed production” during the five days training of the fish farmers of Menchuka region, West Siang district, Arunachal Pradesh 6th to 10th Dec, 2018.
 - M. S. Akhtar delivered a presentation on contributions of Dr. Hiralal Chaudhary (the father of induced breeding in India) to fisheries sector of India on the occasion of national fish farmer’s day (10th July, 2018) organized at ICAR-DCFR, Bhimtal.
 - M. S. Akhtar delivered five lectures on (i) Mahseer resources of India and their economic importance (ii) Mahseer farming and raising (practical) (iii) Biology of commercially important fish groups with special reference to mahseer and trout (iv) Layout, design and management of mahseer hatchery (practical) and (v) Hands on skills in hatchery operation and management (practical) during 27 July to 3 August, 2018 to 15 B.F.Sc. students of College of Fishery Sciences, Chandra Shekhar Azad University of Agriculture & Technology,

- Kanpur, U.P. for their FWEP programme under the course title” Coldwater Resource Assessment & Management’
- M. S. Akhtar delivered three lectures on (i) Mahseer hatchery management and seed production (ii) Photo-thermal manipulations for maturation and spawning of golden mahseer in captivity and (iii) Mahseer breeding and seed production techniques (practical) in NFDB sponsored Training of Trainers (ToT) Programme on ‘Hands -on-training in breeding and seed production of *Tor putitora* (golden Mahseer) and *Neolissochilus hexagonolepis* (chocolate mahseer)’ during 27 to 31 August, 2018 Organized by ICAR-DCFR at Bhimtal.
 - M. S. Akhtar delivered two lectures on (i) Nutraceuticals and medicated feed in aquaculture with special reference to coldwater feed management and (ii) Larval nutrition of candidate species of coldwater aquaculture in NFDB sponsored Training of Trainers (ToT) Programme on ‘Feed management practices in coldwater aquaculture’ during 25 to 29 September, 2018, Organized by ICAR-DCFR at Bhimtal.
 - Mohammad Iqbal Mir participated and presented research paper entitled “Comparative study of metabolic genes in association with seasonal fluctuation of temperature in rainbow trout (*Onchorynchus mykiss*) under captive conditions” in XIV Agricultural Science Congress held in NASC, PUSA Complex, New Delhi from 20-23rd February, 2019. He also participated in the exhibition and showcased DCFR’s technologies/products.
 - P.A. Ganie delivered a lecture on “An overview of Rainbow Trout culture and farming” to fish farmers of District Tawang, Arunachal Pradesh on 29th Sep.2018.
 - P. A. Ganie delivered a lecture on “Grow out farming of Rainbow trout” to the students of Rajkiya Uchhtar Madhyamik Vidyalaya, Sirmoli, Lohaghat, Champawat on 13th April 2018.
 - P. A. Ganie delivered a lecture on “Site suitability, layout, design and construction of carp culture and seed production unit” during the five days training of the fish farmers of Menchuka region, West Siang district, Arunachal Pradesh 6th to 10th Dec, 2018.
 - P.A. Ganie delivered a lecture on “Abiotic components of Coldwater aquatic resources” to the students of college of Fisheries, Etawah, CSAUA&T on 28th July, 2018.
 - P.A. Ganie delivered a lecture on “Application of GIS for upland fisheries development” to the students of college of Fisheries, Etawah, CSAUA&T on 30th July, 2018.
 - P.A. Ganie delivered a lecture on “Biotic components of Coldwater aquatic resources” to the students of college of Fisheries, Etawah, CSAUA&T on 30th July, 2018.
 - P.A. Ganie delivered a lecture on “Brahmaputra river system and its piscine diversity” to the students of college of Fisheries, Etawah, CSAUA&T on 9th November, 2018.
 - P.A. Ganie delivered a lecture on “Cage and Pen culture” to the students of college of Fisheries, Etawah, CSAUA&T on 13th November, 2018.
 - P.A. Ganie delivered a lecture on “Classification of Lakes and wetlands” to the students of college of Fisheries, Etawah, CSAUA&T on 12th November, 2018.
 - P.A. Ganie delivered a lecture on “Current scenario of Mahseer fishery in Indian upland water bodies” to the students of college of Fisheries, Etawah, CSAUA&T on 7th November, 2018.
 - P.A. Ganie delivered a lecture on “Current status and production trends of Coldwater fishes in India” to the students of college of Fisheries, Etawah, CSAUA&T on 7th November, 2018.
 - P.A. Ganie delivered a lecture on “Estimation and management of biotic water quality parameters in fish ponds” to the students of college of Fisheries, Etawah, CSAUA&T on 13th November, 2018.
 - P.A. Ganie delivered a lecture on “Ganga river system and its piscine diversity” to the students of college of Fisheries, Etawah, CSAUA&T on 9th November, 2018.
 - P.A. Ganie delivered a lecture on “Indus river system and its piscine diversity” to the students of college of Fisheries, Etawah, CSAUA&T on 9th November, 2018.

- P.A. Ganie delivered a lecture on “Lake fisheries and its management” to the students of college of Fisheries, Etawah, CSAUA&T on 12th November, 2018.
- P.A. Ganie delivered a lecture on “Selection of suitable sites for aquaculture in mid hills” to the students of college of Fisheries, Etawah, CSAUA&T on 12th November, 2018.
- P.A. Ganie delivered a lecture on “Status of Game and Sports fisheries in India” to the students of college of Fisheries, Etawah, CSAUA&T on 14th November, 2018.
- P.A. Ganie delivered a lecture on “Estimation and management of soil quality parameters in mid hill fish farming practices” to the students of college of Fisheries, Etawah, CSAUA&T on 14th November, 2018.
- Pragyans Dash delivered 2 lectures on (i) Water and feed management in pond culture system in Human resource development programme under Scheduled Caste Sub Plan on (ii) Integrated fish farming for doubling fish farmers income for Scheduled caste community of Northeastern region during 27-29th Feb, 2019 at Guwahati, Assam.
- Pragyans Dash delivered 5 lectures on (i) Coldwater ornamental fish breeding and culture, (ii) Water quality management in aquarium, (iii) Estimation of important water parameters in aquarium, (iv) Feed formulation and preparation for ornamental fishes, (v) Recirculatory aquaculture systems and its components in NFDB sponsored training of trainers programme on “Breeding and seed production of important coldwater ornamental fishes” during 23rd to 27th October, 2018 at ICAR-DCFR, Bhimtal.
- R. S Patiyal participated and presented research paper entitled “A comprehensive study on developmental biology of *Garra gotyla* (Gray, 1830)” in XIV Agricultural Science Congress held in NASC, PUSA Complex, New Delhi from 20-23rd February, 2019.
- R. S Patiyal presented a lecture in one day awareness programme on “Intellectual Property Rights for Research Scholars” at DCFR, Bhimtal on 28th December 2018.
- R. Singh delivered a lecture on “Career in agriculture and fisheries” to students of Govt. Inter College, Pulhindola, Lohaghat on 15th Feb, 2019.
- R. Singh delivered a lecture on “Fish farming practices in Champawat district” to students of Govt. Inter College, Jankidhar, Lohaghat on 16th Feb, 2019.
- R. Singh delivered a lecture on “Grow out farming of Common carp in mid-hill regions” to the students of Rajkiya Uchchar Madhyamik Vidyalaya, Sirmoli, Lohaghat, Champawat on 13th April, 2018.
- R. Singh delivered a lecture on “Site suitability, layout, design and construction of culture systems for rearing and breeding of Rainbow trout” during the five days training of the fish farmers of Menchuka region, West Siang district, Arunachal Pradesh 6th to 10th Dec, 2018.
- R. Singh delivered a lecture on “Breeding and seed production of Rainbow trout” to the students of college of Fisheries, Etawah, CSAUA&T on 2nd November, 2018.
- R. Singh delivered a lecture on “Breeding and seed production of Snow trout” to the students of college of Fisheries, Etawah, CSAUA&T on 3rd November, 2018.
- R. Singh delivered a lecture on “Breeding and seed production of Common carp” to the students of college of Fisheries, Etawah, CSAUA&T on 5th November, 2018.
- R. Singh delivered a lecture on “Breeding and seed production of Grass carp” to the students of college of Fisheries, Etawah, CSAUA&T on 5th November, 2018.
- R. Singh delivered a lecture on “Culture and farming of minor carps in Indian mid hill regions” to the students of college of Fisheries, Etawah, CSAUA&T on 6th November, 2018.
- R. Singh delivered a lecture on “Current scenario of Rainbow and Brown trout fishery in Indian upland water bodies” to the students of college of Fisheries, Etawah, CSAUA&T on 2nd November, 2018.
- R. Singh delivered a lecture on “Current status of Rainbow trout farming in India” to the students

- of college of Fisheries, Etawah, CSAUA&T on 5th November, 2018.
- R. Singh delivered a lecture on “Disease diagnosis and health management in Coldwater aquaculture” to the students of college of Fisheries, Etawah, CSAUA&T on 3rd November, 2018.
 - R. Singh delivered a lecture on “Integrated fish farming practices” to the students of college of Fisheries, Etawah, CSAUA&T on 7th November, 2018.
 - R. Singh delivered a lecture on “Ornamental fish breeding and culture” to the students of college of Fisheries, Etawah, CSAUA&T on 6th November, 2018
 - R. Singh delivered a lecture on “Aquarium fabrication” to the students of college of Fisheries, Etawah, CSAUA&T on 6th November, 2018.
 - R. Singh delivered a lecture on “Polyculture of carps in mid hill regions” to the students of college of Fisheries, Etawah, CSAUA&T on 2nd November, 2018.
 - R. Singh delivered a lecture on “Candidate species of Coldwater aquaculture” in NFDB sponsored ToT Programme on “Growout technologies of Indigenous coldwater minor carps” held during 4-8 march, 2019.
 - R. Singh delivered a lecture on “An Overview of Rainbow trout farming in India” in NFDB sponsored ToT Programme on “Breeding, Seed production and health management of Rainbow trout” held during 4-8 march, 2019 at ICAR-DCFR, Bhimtal.
 - R. Singh delivered a lecture on “Breeding and Seed production of Rainbow trout” in NFDB sponsored ToT Programme on “Breeding, Seed production and health management of Rainbow trout” held during 4-8 march, 2019 at ICAR-DCFR, Bhimtal.
 - R. Singh delivered a lecture on “*Machali palan hetu talaab prabandhan*” in ASCI sponsored skill development training on “Aquaculture worker job role” held during 14 Feb-15 March, 2019 at ICAR-DCFR, Bhimtal.
 - Raja Aadil H. B. delivered a lecture on “Importance of water quality parameters in fish farming” to the students of Rajkiya Uchchatar Madhyamik Vidyalaya, Sirmoli, Lohaghat, Champawat on 13th April, 2018.

Library and Information Services

15

15.1 Library Procurement and Holdings

The ICAR-DCFR library and documentation unit acts as a repository of literature and provides latest information in the field of fisheries and allied aspects.

During the year 2018-19, the Directorate subscribed 3 Indian journals and finalized the process of procurement of 165 scientific and 45 Hindi books of both Indian and foreign authors through book exhibition by empanelled book suppliers/vendors held on 29th January, 2019. The current holdings of the library includes 6762 books 1693 volumes of foreign journals, 543 volumes of Indian journals and more than 9000 other publications. The library provides services to the scientists and other staff members of the institute apart from scholars, researchers, student and other persons from local organizations interested in scientific literature on coldwater fisheries and allied subjects. The total expenditure incurred by the library during the financial year 2018-19 was Rs. 5, 83,287=00 lakhs. The total revenue generated through selling of in-house publication was Rs.9, 850.



Scientists selecting books during the exhibition

15.2 Library Automation

Various activities of library have been computerized using TLS software. The records of books, journals, bulletins etc.were enters in the database. The bar coding of books and periodicals are actively being done.The digitalization work of the institute's in -house publications has been completed.

15.3 Information Services

The library also provides platform to access free online downloads of publications and articles of many international and national journals through www.cera.jece.in. The library is further continuing its efforts in collection, processing and disseminating scientific/technical information to the potential users. The library has provided many scanned reprints of offline/back volume research articles to various distant users /researchers of NARS through DDR (document delivery request), an online document deliver service of J-gate plus under CeRA of ICAR.

15.4 Reprography Services

The library maintained active reprography services by producing departmental publications and supporting required photocopies in grayscale as well as in colours to the scientists, research scholars as well as research organizations.

15.5 Exchanges Services

The library maintained exchange relationship with various research organizations and institute of national and international repute. The annual reports, newsletters, special publications and technical bulletins published from time to time have been mailed to more than 250 organizations, institutions, Fisheries Directors Dean and fishery agencies.

15.6 Documentation Section

The documentation section of the library is entrusted with responsibility of publications of scientific bulletins, brochures, pamphlets, annual reports, newsletters, monographs etc. During the

year, this section published two annual reports of 2018-19 (Hindi and English), five bulletins, two leaflets, one hindi magazine (Himjyoti) and one newsletter of the Directorate.



ICAR-DCFR's in-house publications during the year 2018-19.

Distinguished Visitors

16

- Smt. Rekha Arya, Hon'ble Minister of Women Welfare & Child Development, Animal Husbandry, Sheep & Goat Husbandry, Fodder & Meadows Development in Fisheries, Govt. of Uttarakhand visited ICAR-DCFR's Experimental Fish Farm & Field Centre, Champawat on 3rd May, 2018. On this occasion, she visited different research facilities such as rainbow trout hatchery and raceways, Snow trout hatchery and rearing units, Ornamental fish unit and Carp grow out unit. She praised the efforts of DCFR in promoting fish farming in Uttarakhand state.
- Dr. R. Meenakshi Sundaram (IAS), Secretary, Dairy Development, Animal Husbandry & Fisheries, Govt. of Uttarakhand visited DCFR on 8th May, 2018. An interactive session was also convened along with the scientists regarding development of Fisheries in Uttarakhand State.



Smt. Rekha Arya, Hon'ble Minister visiting farm facilities of DCFR, Champawat



Dr. R. Meenakshi Sundaram (IAS) visiting the farm facilities of ICAR-DCFR

- Smt. Krishna Raj, Hon'ble Minister of State, Ministry of Agriculture and Farmers Welfare, Govt. of India visited ICAR-DCFR on 13th May, 2018. She first visited various facilities available at the Directorate including laboratory facilities, ornamental fish unit and fish farm ponds. An interactive session was also convened along with the scientists, technical and administrative



Smt. Krishna Raj, Hon'ble Minister of State, Ministry of Agriculture and Farmers Welfare interacting with scientists and staffs of ICAR-DCFR

staffs and took appraisal of the progress made by the Directorate. She stressed upon the technological interventions for doubling the farmer's income.



Hon'ble minister visiting the farm facilities

- Directors, Dept. of Fisheries, Govt. of J&K and Himachal Pradesh visited the Directorate on 28.06.2018 on the occasion of NFDB's Regional Review Meeting on Fisheries for the Hilly Zone.



Directors, Dept. of Fisheries, Govt. of J&K and Himachal Pradesh observing the indigenous RAS unit of ICAR-DCFR

- Dr. J.K. Jena, Deputy Director General (Fisheries Sciences & Animal Science, ICAR), New Delhi, Dr. S.D. Tripathi, Former Director, ICAR-CIFE and CIFA, Dr. M. Sinha, Former Director, ICAR-CIFRI, Barrackpore, Dr. W. S. Lakra, Former Director, ICAR-CIFE, Mumbai, Dr. A. K. Singh, Former Director, ICAR-DCFR, Bhimtal and Dr. Ambekar E. Eknath, Former Director, ICAR-CIFA and World Fish Centre visited the Directorate on 24th September, 2018 on the occasion of DCFR's 31st foundation day.



Distinguished guests on the dias during 31st Foundation Day, 2018

Important Committees

17

17.1. Members of Research Advisory Committee

Dr. M. Sinha, Former Director, ICAR-CIFRI & Former Advisor, Department of Fisheries, Tripura Raghbir Sadan, District Judge's Compound, Civil Lines, Gorakhpur-273001, Uttar Pradesh.	Chairman
Shri I. P. Chhetri, Former Director (Fisheries), Dept. of Animal Husbandry, Livestock & Fisheries Services, Government of Sikkim, Krishi Bhawan, Tadong, Sikkim.	Member
Dr. S.C. Mukherjee, Former Joint Director, ICAR-CIFE, 187 A, Sahid Nagar, Bhubaneswar-751007, Odisha.	Member
Dr. A.K. Sahu, Former Principal Scientist, ICAR-CIFA, 16, Bhimpur Duplex Colony, Bhubaneswar-751020, Odisha.	Member
Dr. H.C.S. Bisht, Professor, Department of Zoology, Kumaon University, DSB campus, Nainital-263001, Uttarakhand.	Member
Dr. Pravin Putra, Asst. Director General (Marine Fisheries), ICAR, Krishi Anusandhan Bhawan-II, New Delhi-110012.	Member
Dr. Debajit Sarma, Director, ICAR-DCFR, Bhimtal.	Member
Dr. N.N. Pandey, Principal Scientist, ICAR-DCFR, Bhimtal.	Member Secretary

17.2. Members of Institute Management Committee

Dr. Debajit Sarma, Director, ICAR-DCFR	Chairman
The Assistant Director General (Inland Fisheries), ICAR, Krishi Anusandhan Bhawan -II, Pusa, New Delhi-110012.	Member
Dr. B.P. Madhwal, Director, Directorate of Fisheries, Badasi Grand Dhanyari, Raipur Road, Dehradun (UK)	Member
Dr. R.K. Sangwan, Director of Fisheries, Government of Haryana, Panchkula Haryana	Member
Dr. I.J. Singh, Dean, CFSc., GBPU&T, Pantnagar US Nagar (UK)	Member
Dr. K.D. Joshi, Pr. Scientist, ICAR-BBFGR, Dilkusha, Lucknow-226002 (UP)	Member
Dr. S.K. Das, Head ICAR Research Complex, Barapani, Meghalaya -793103	Member
Dr. B.P. Mohanty, Head of Department CIFRI, Barrackpore-700120	Member

Dr. Mukunda Goswami, Principal Scientist, ICAR-CIFE, Mumbai, Punch Marg, off Yari Road, Versova, Andheri (West) 400061.	Member
Shri Kunal Kalia, F&AO, ICAR Hqrs, Krishi Bhawan, New Delhi-110001	Member
Mr. Pushkar Joshi, Bharoment, Jeolikote, Post-Jeolikote-27 Distt-Nainital	Member
Mr. Vivek Sah, P/o Naini Cottage, Cantt. Tallital Nainital	Member
Shri.R.S. Negi, Administrative Officer, ICAR-DCFR	Member Secretary

17.3. Members of Prioritization Monitoring & Evaluation Cell

Dr. N.N. Pandey, Principal Scientist	In-charge
Dr. Shahnawaz Ali, Scientist	Member
Dr. Kh. Victoria Chanu, Scientist	Member
Sh. Amit Kumar Saxena, Sr. Technical Assistant	Technical support
Smt. Susheela Tewari, Private Secretary to Director	Secretarial assistance

17.4. Members of Prioritization Monitoring & Evaluation Committee

Dr. Debajit Sarma, Director	Chairman
Dr. Prem Kumar, Principal Scientist & In-charge, Agricultural Knowledge Management Unit	Member (upto 15.06.2018)
Dr. S. Chandra, Principal Scientist & In-charge, Field Centre, Champawat	Member
Dr. R.S. Patiyal, Principal Scientist & In-charge Institute Technology Management Unit	Member
Dr. N.N. Pandey, Principal Scientist & In-charge, PME cell	Member Secretary

17.5. Members of Institute Technology Management Committee

Dr. Debajit Sarma, Director	Chairman
Dr. Laxmi Kant, Principal Scientist, ICAR-VPKAS, Almora	External Member
Dr. Prem Kumar, Principal Scientist	Member (upto 15.06.2018)
Dr. Shahnawaz Ali, Scientist	Member
Dr. M.S. Akhtar, Scientist	Member

Mr. Kishor Kunal, Scientist	Member
Dr. R.S. Patiyal, Principal Scientist	Member Secretary

17.8. Library Advisory Committee

Dr. D. Sarma, Director	Chairman
Dr. N.N. Pandey, Principal Scientist	Member
Dr. Shahnawaz Ali, Scientist	Member
Sh. R.S. Negi, Administrative Officer	Member
Sh. Baldev Singh, Senior Technical Officer	Member
Sh. B.C. Pandey, Asst. Fin. & Acc. Officer	Member (upto 25.5.2018)
Sh. Sayed Mohsin Ali, Asst. Fin. & Acc. Officer	Member (from 14.2.2019)
Dr. M.S. Akhtar, Scientist & I/c Library	Member Secretary

17.9. Institute Joint Staff Council

Official Side	
Dr. Debajit Sarma, Director	Chairman
Dr. R.S. Patiyal, Principal Scientist	Member
Dr. Deepjyoti Baruah, Sr. Scientist	Member
Dr. R. S. Haldar, ACTO	Member
Sh. B.C. Pandey, Asst. Fin. & Acc. Officer	Member (upto 25.5.2018)
Sh. Sayed Mohsin Ali, Asst. Fin. & Acc. Officer	Member (from 14.2.2019)
Sh. R.S. Negi, Admin. Officer	Member Secretary
Staff side	
Sh. Ankesh Sinha, Assistant Admin. Officer	Member
Sh. Hansa Singh Bhandari, LDC	Member
Sh. T. M. Sharma, Sr. Technical Assistant	Member
Sh. Gopal, Sr. Technical Assistant	Member
Sh. Manoj Kumar, Skilled supporting staff	Member
Sh. Ravinder Kumar, Skilled supporting staff	Member

17.10. Institute Biosafety Committee

Dr. Debajit Sarma, Director, ICAR-DCFR, Bhimtal.	Chairman
Dr. A. K. Tiwari, Principal Scientist & Head, Division of Standardization, ICAR-IVRI, Izatnagar.	DBT Nominee
Dr. A. B. Pandey, Principal Scientist & Head, Division of Virology, ICAR-IVRI, Mukteshwar.	Outside Expert
Dr. A. K. Sharma, Principal Scientist, ICAR-IVRI, Mukteshwar.	Outside Expert
Col. (Dr.) C. S. Rawat, MBBS, DPH, FRIPHH	Biosafety Officer
Dr. Neetu Shahi, Scientist, ICAR-DCFR, Bhimtal.	Member
Dr. Dimpal Thakuria, Scientist, ICAR-DCFR, Bhimtal.	Member
Dr. Amit Pande, ICAR National Fellow, ICAR-DCFR, Bhimtal.	Member Secretary

18.1. Promotions

- Sh. Amit Joshi promoted to the post of Assistant Chief Technical Officer under DPC, with effect from 13-November, 2017.
- Sh. Ankesh Sinha was promoted to the post of Assistant Administrative Officer under Limited Departmental Examination, with effect from 10-October, 2018.
- Sh. Hansa Dutt Sanwal was promoted to the post of Sr. Technical Assistant under DPC, with effect from 22-September, 2015.
- Sh. T. M. Sharma was promoted to the post of Sr. Technical Assistant under DPC, with effect from 20-September, 2015.
- Sh. R. K. Arya was promoted to the post of Sr. Technical Assistant under DPC, with effect from 25-September, 2015.
- Sh. Amit Kumar Saxena was promoted to the post of Technical Officer under DPC, with effect from 28-July, 2016.
- Sh. Manoj Kumar Yadav was promoted to the post of Technical Assistant under DPC, with effect from 26-July, 2016.
- Sh. Partha Das was promoted to the post of Technical Assistant under DPC, with effect from 18-July, 2018.

18.2. Transfers

- Dr. Prem Kumar, Principal Scientist was transferred to Indian Council of Agricultural Research, New Delhi by the Council. He was relieved from the Directorate on 15-June, 2018.



Bidding farewell to Dr. Prem Kumar

- Sh. B. C. Pandey, Asst. Fin. & Acc. Officer was transferred to ICAR-VPKAS, Almora to the post of Fin. & Acc. Officer. He was relieved from the Directorate on 15-June, 2018.
- Sh. Sushil Kumar, Skilled Supporting Staff was transferred to ICAR-National Bureau of Fish Genetic Resources, Lucknow. He was relieved from the Directorate on 10-October, 2018.

18.3. Retirement

- Dr. S.Z.S. Zaidi, Senior Scientist retired from ICAR services on superannuation on 31-October, 2018. DCFR family wishes him a very happy and healthy post-retirement life.

18.4. New Joining

- Sh. Sayed Mohsin Ali joined this Directorate on 14-February, 2019 in the post of Assistant Finance & Account Officer.

Staff list as on 31.03.2019

19.1 Research Management		
Dr. Debajit Sarma		Director
19.2. Scientific Staff		
1.	Dr. Amit Pande	ICAR National Fellow (Biotechnology-Animal science)
2.	Dr. Nityanand Pandey	Principal Scientist (Aquaculture)
3.	Dr. Suresh Chandra	Principal Scientist (Fish Pathology)
4.	Dr. R.S. Patiyal	Principal Scientist (Fish Genetics & Breeding)
5.	Dr. Deepjyoti Baruah	Senior Scientist (Fish & Fishery Science)
6.	Dr. Shahnawaz Ali	Scientist (Aquaculture)
7.	Sh. Sumanta Kumar Mallik	Scientist (Aquaculture)
8.	Dr. Neetu Shahi	Scientist (Biotechnology-Animal Science)
9.	Dr. Md. ShahbazAkhtar	Scientist (Fish & Fishery Science)
10.	Dr. Dimpal Thakuria	Scientist (Biochemistry-Animal science)
11.	Dr. Kh. Victoria Chanu	Scientist (Biochemistry-Animal science)
12.	Dr. Ciji Alexander	Scientist (Fish Nutrition)
13.	Dr. Biju Sam Kamalam J.	Scientist (Fish Nutrition)
14.	Dr. Rajesh M	Scientist (Fish Nutrition)
15.	Sh. Tandel Ritesh kumar Shantilal	Scientist (Fish Health)
16.	Sh. Abhay Kumar Giri	Scientist (Aquaculture)
17.	Smt. Pragyan Dash	Scientist (Aquaculture)
18.	Dr. Prakash Sharma	Scientist (Fish Nutrition)
19.	Sh. Siva, C.	Scientist (Fish Genetics & Breeding)
20.	Dr. Raghvendra Singh	Scientist (Aquaculture)
21.	Sh.Kishor Kunal	Scientist (Fisheries Resource Management)
22.	Sh.Parvaiz Ahmad Ganie	Scientist (Fisheries Resource Management)
23.	Sh. Raja Aadil Hussain Bhat	Scientist (Fish Health)

19.3 Technical Staff

1.	Dr. R.S. Haldar	Assistant Chief Technical Officer
2.	Sh. Amit Kumar Joshi	Assistant Chief Technical Officer
3.	Sh. Baldev Singh	Sr. Technical Officer
4.	Sh. Santosh Kumar	Technical Officer
5.	Sh. Ravinder Kumar	Technical Officer
6.	Sh. Amit Kumar Saxena	Technical Officer
7.	Sh. Gopal C. Arya	Sr. Technical Assistant
8.	Sh. HansaDutt	Sr. Technical Assistant
9.	Sh. T.M. Sharma	Sr. Technical Assistant
10.	Sh. R.K. Arya	Sr. Technical Assistant
11.	Sh. Partha Das	Technical Assistant
12.	Sh. Manoj Kumar Yadav	Driver (Technical Assistant)

19.4. Administrative Staff

1.	Sh. Ravindra Singh Negi	Administrative Officer
2.	Sh. Sayed Mohsin Ali	Asstt. Fin. & Acc. Officer
3.	Smt. Khilawati Rawat	Asstt. Admn. Officer
4.	Sh. Ankesh Kumar Sinha	Asstt. Admn. Officer
5.	Smt. Susheela Tewari	Private Secretary
6.	Sh. P.C. Tewari	Assistant
7.	Sh. J.C. Bhandari	Assistant
8.	Sh. Arun Khulbe	Assistant
9.	Sh. Pratap Singh Bisht	UDC
10.	Smt. Munni Bhakt	UDC
11.	Sh. Hansa Singh Bhandari	LDC

19.5. Skilled Supporting Staff

1.	Sh. Ravinder Kumar	Skilled Supporting Staff
2.	Sh. Om Raj	-do-
3.	Sh. Sunder Lal	-do-
4.	Sh. Dharam Singh	-do-
5.	Sh. Pooran Chandra	-do-
6.	Sh. Manoj Kumar	-do-
7.	Sh. Kuldeep Kumar	-do-
8.	Sh. Bholu Dutt Mouni	-do-
9.	Smt. Basanti Devi	-do-
10.	Sh. Mangla Prasad	-do-



ICAR-Directorate of Coldwater Fisheries Research
Bhimtal-263 136, Nainital, Uttarakhand, India
E-mail: director.dcfri@icar.gov.in, dcfrin@gmail.com
Website: www.dcfri.res.in