



ICAR-Directorate of Coldwater Fisheries Research
 (Indian Council of Agricultural Research)
 Bhimtal 263136, Nainital, Uttarakhand, India
 E-mail: director.dcfri@icar.gov.in,
dcfrin@gmail.com, dcfrin@rediffmail.com
 Website: www.dcfri.res.in

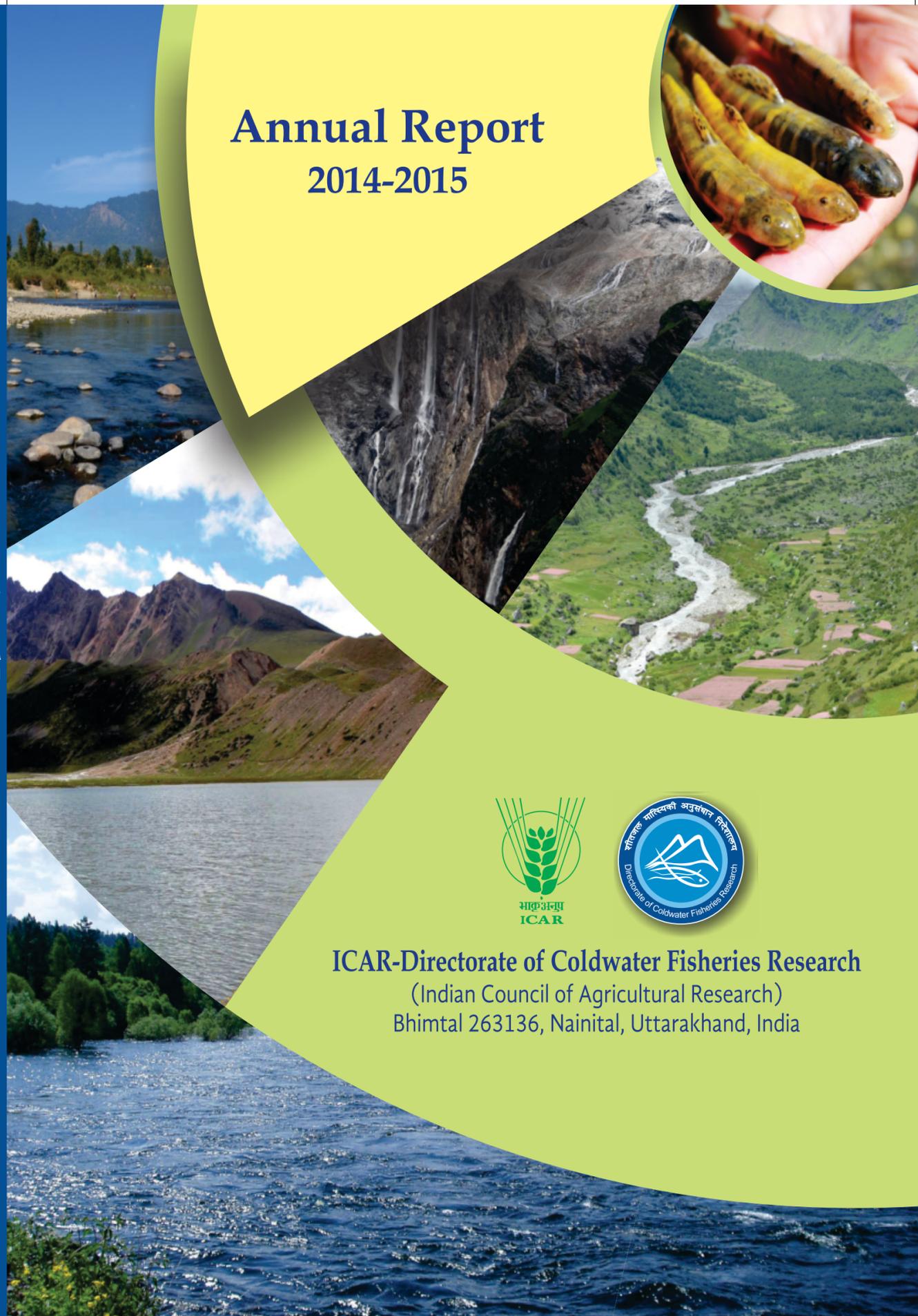


ICAR-DCFR

Annual Report

2014-2015

Annual Report 2014-2015



ICAR-Directorate of Coldwater Fisheries Research
 (Indian Council of Agricultural Research)
 Bhimtal 263136, Nainital, Uttarakhand, India

ANNUAL REPORT

2014-15



ICAR-Directorate of Coldwater Fisheries Research
(Indian Council of Agricultural Research)
Bhimtal- 263136, Nainital, Uttarakhand, India



Credits

ICAR-DCFR Annual Report 2014-2015

Editors

Dr. R.S. Patiyal
Dr. Biju Sam Kamalam
Dr. Ciji Alexander
Dr. Suresh Chandra

Photographs

Dr. R.S. Patiyal
Dr. Biju Sam Kamalam
Mr. Vijay Kumar Singh

Computer Assistance

Mr. Amit Kumar Saxena

Cover design

Mr. Dasari Bhoomaiah

Publisher

Dr. A.K. Singh
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.



(A. K. Singh)

Director

ICAR-Directorate of Coldwater Fisheries Research has been carrying out several innovative multidisciplinary researches to address the multifarious challenges that hinder sustainable enhancement of fish production in the Indian uplands. During the year 2014-15, significant achievements have been made in varied aspects of resource assessment, aquaculture expansion and diversification. Breeding and rearing technique of chocolate mahseer (*Neolissochilus hexagonolepis*) and minor carps (*Labeo dero* and *Labeo dyocheilus*) have been standardized for diversifying coldwater aquaculture using endemic species. Hill stream fishes with ornamental and culture potential such as *Barilius bendelisis* and *Chagunius chagunio* were captive bred successfully. Constraints in captive maturation of golden mahseer (*Tor putitora*) and chocolate mahseer are being systematically addressed. On farm experimental culture trials of *Osteobrama belangeri* along with Chinese carps have been undertaken. Brood bank facility for *Semiplotus semiplotus* has been started at Jasingffa Aqua Tourism Centre, Assam. Suitable sites for aquaculture and available resources of Sikkim were mapped using GIS tools for future aquaculture development and planning. To make hill aquaculture activities lucrative, attempts are being made to develop cost effective fish feed by incorporating cheaper protein sources such as fish silage and *Azolla*. Disease surveillance in coldwater fish farms are being periodically carried out as part of fish health management programme. Under NSPAAD project, a Microsoft Access based database on coldwater fish diseases has been developed. As a continuous endeavour, exploratory surveys are being carried out at several places including remote high altitude areas to gauge the coldwater resources and its resident fish fauna. For elucidating the molecular aspects of climate resilience, the transcriptome of *Schizothorax richardsonii* was sequenced and it is being used for characterization and mining of genes and molecular pathways associated with thermal tolerance. A microsatellite library has been constructed to identify microsatellite loci for *Schistura sikmaiensis*, to assess its genetic diversity.

During the year 2014-15, the Directorate also organized various training programmes, workshops, frontline demonstrations, extension activities and exhibitions in order to build and improve the capacity of fish farmers, tribal people, state fishery officials and university faculty on various aspects of coldwater fisheries and aquaculture. In particular, a national workshop on 'Mahseer in India: resources, captive breeding, propagation, policies and issues' was organized to address the major challenges in mahseer propagation and rehabilitation. The Directorate also continues in its endeavour to enhance the natural stock of mahseer through several awareness-cum-ranching programmes across the hilly regions of the country. Further, many demonstrations and training programs

were organised under NEH activity and Tribal Sub Plan (TSP). Conforming to the Ministry of Agriculture's initiative to provide technical advisory to farmers, the 'Mera Gaon Mera Gaurav' scheme has been recently initiated.

Moreover, the Directorate has strengthened linkages with different state fisheries departments, non-governmental organisations, research institutes, universities, National Fisheries Development Board and other national-international organizations during the year for promoting research and development activities. I appreciate the contribution of all the scientists and staff members of the Directorate for the successful execution of research, development and extension activities during the year. I also thank the members of the editorial committee for their meticulous effort in compiling and bringing out the Annual Report 2014-15 on time.

The Directorate has received immense support from ICAR to pursue its various activities. With respect to this, I am deeply indebted to Honourable Secretary, DARE and Director General, ICAR, Dr. S. Ayyappan for his visionary support and guidance. I am also grateful to the Deputy Director General (Fisheries), Dr. B. Meena Kumari and the Assistant Director General (Inland Fisheries), Dr. S. D. Singh for their continuous support, encouragement and guidance in the planning and execution of research, extension and other activities of this Directorate.

Contents

Preface	
1. Executive Summary	1 - 5
2. Introduction	6 - 10
3. Research Accomplishment	11 - 31
3.1. Resource Assessment	11
3.2. Aquaculture	13
3.3. Disease Surveillance & Health Management	20
3.4. Molecular Genetics & Breeding	21
3.5. Outreach Activities	23
3.6. Externally Funded Projects	25
4. Important Events and Meetings	32 - 35
5. Extension Activities and Other Services	36 - 44
6. Tribal Sub Plan (TSP) Activities	45 - 47
7. North East Hill (NEH) Activities	48 - 50
8. Consultancy	51 - 52
9. Training & Capacity Building	53 - 56
10. Awards/Honour/Recognition	57 - 58
11. Linkages	59
12. Publications	60 - 65
13. List of Projects	66 - 67
14. Participation in Conference/Symposia/ Workshop/Training/Meetings & others	68 - 76
15. Staff News	77
16. Library & Information Services	78 - 79
17. Distinguished Visitors	80 - 81
18. Important Committees	82 - 85
19. Personnel	86 - 87
Annexures	88 - 99



EXECUTIVE SUMMARY

Since its establishment, the ICAR-Directorate of Coldwater Fisheries Research has remained steadfast in spearheading research and extending developmental inputs to enhance hill aquaculture production and sustain coldwater fisheries in Indian uplands. The comprehensive initiatives of the Directorate also aim to safeguard and improve the livelihood of the less privileged inhabitants of access restricted geographic terrains, through technological interventions and knowledge transfer. Some of the noteworthy accomplishments of the Directorate includes meticulous exploration-documentation of fish biodiversity and aquatic ecology in remote hilly locations; geographic information system based assessment and mapping of coldwater resources; molecular characterization of coldwater fishes and their inherent variations; successful breeding, rearing and seed production of several endemic coldwater fishes such as mahseer, snow trout and minor carps; promotion of exotic trout and improved strain of Hungarian common carp; enhancement of natural fish stocks through ranching; development of aquaculture overtures like open water cages; customised feeds and feeding schedules for candidate species; disease surveillance and health management in farming systems; exhaustive nutrient profiling of coldwater food fishes; technological inputs for water management; environmental impact assessment services; human resource development through training programmes and workshops; and partnership mode outreach activities. The following summary outlines the research issues addressed and the various activities undertaken by the Directorate during the reporting period 2014-15.

Resource assessment and management

- Digitizing the availability of natural resources and site suitability for coldwater aquaculture development was carried out using geographical information system and primary remote sensing data. Separate thematic maps were prepared for eastern and southern districts of Sikkim using spatial analyst, based on different physicochemical parameters of water resources. Moreover, maps representing water availability and accessibility were also generated to assist policy makers. Importantly, an area of 784 (825) and 301 (501) hectares in south and east Sikkim, respectively, was delineated as most (moderately) suitable for aquaculture using criteria base analysis.
- Resource assessment surveys were conducted in different streams, lakes and river stretches in Uttarakhand. Parwati lake (4512 m above msl), Kuti Yangti river (3845 m above msl) and Kali river at Gungi (3223 m above msl) in Pithoragarh district were identified as potential sites for developing fisheries and aquaculture activities. About 200 live specimens of *Barilius sp.*, *Tor sp.* and *Nemacheilus sp.* were collected from river Kali to strengthen brood banking of endemic coldwater fishes.

Aquaculture oriented research and development

Breeding and seed production

- Artificial breeding of *Chagunius chagunio*, an indigenous cyprinid fish that commands good market price and high consumer preference

was carried out for the first time. The fish was observed to be a batch spawner with peak breeding season in May and September. It attains sexual maturity at the age of 3 years, when it measures 15-20 cm and weighs 100-125 g. The relative fecundity was found to be 25000-30000 eggs/kg body weight. The breeding protocol is being further refined and developed.

- The Indian hill trout, *Barilius bendelisis*, another indigenous cyprinid identified as a potential candidate for aquaculture diversification and ornamental trade was also successfully bred for the first time. Spawning was induced by intraperitoneal administration of ovotide to female (0.6 ml/kg) and male (0.3 ml/kg) mature brooders. The fertilization rate was estimated to be 55-60 %. The larvae hatched out in 130-140 hrs at 15-20°C.
- Comparative assessment of the maturity status of captive reared and matured wild golden mahseer (*Tor putitora*) was carried out to decipher the possible constraints in maturation under captive conditions. Ovarian histology showed compact yolk globules and denser granulosa and thecal cells in the oocyte of wild caught fish as compared to pond reared females. Likewise, a relatively lower level of serum estradiol was observed in captive reared females of golden mahseer. Further, oxidative stress was found to be more prevalent in captive reared mahseer.
- As a need based solution in rainbow trout breeding, a wooden stripping stand was designed to reduce the physical stress on the brood fish and simplify the stripping operation. The device has been practically introduced to the trout farmers in Sikkim.
- In terms of seed production, 3.3 lakh eyed ova and 15000 advanced fry of rainbow trout were produced in our field centre at Champawat and additionally 2 lakh eyed ova were produced in state trout farm, Uttaray, West Sikkim, through collaborative efforts. Concerning carps, 4.25 lakh fry of common carp (*Cyprinus carpio*), 4.5 lakh fry of minor carps (*Labeo dyocheilus*

and *Labeo dero*) and one lakh fry of ornamental fish (gold fish and koi carp) were produced at Champawat and Bhimtal, respectively, for supplying seed to adopted farmers. In our mahseer hatchery, 70,000 fry of golden mahseer were produced for propagation.

Molecular genetics and biotechnological contribution

- Using 15 polymorphic microsatellite loci, different stocks of farmed rainbow trout from Dachigam (Western Himalaya); Bairangana, Champawat and Patlikul (Central Himalaya); and Munnar (Nilgiri hills) were evaluated for allelic/genetic diversity. Moderate genetic differentiation was observed among stocks. Genetic clustering analysis demonstrated that stocks from Munnar and Dachigam formed separate clusters, whereas stocks from Bairangana, Champawat and Patlikul were grouped in another cluster indicating common origin.
- A microsatellite library was constructed for *Schistura sikmaiensis* and 9 highly polymorphic microsatellite loci were identified for population genetic studies.
- Using next generation sequencing (Illumina platform), the transcriptome of golden mahseer (*Tor putitora*) and snow trout (*Schizothorax richardsonii*) was sequenced. A total of 77907 mahseer transcripts and 80459 snow trout transcripts were assembled de novo for the respective full transcriptome. Functional annotation is in progress.
- The complete coding region of kisspeptin1 gene (508 bp) was generated from the brain of golden mahseer by conventional cloning and sequencing. The kiss1 cDNA was found to contain a 330 bp open reading frame encoding 109 amino acids and showed high degree of conservation only in the kisspeptin-10 region (Kp-10). Based on this, a synthetic peptide of 16 amino acid (molecular weight: 1977.22) corresponding to *T. putitora* Kp-10 region was synthesized using Fmoc chemistry, purified by semi-preparative RP-HPLC and confirmed

by MALDI-MS. This peptide will be used for evaluating the stimulatory effect of exogenous kisspeptin administration in gonadal development of fish.

Disease surveillance and health management

- Surveillance of coldwater fish diseases was periodically carried out in 27 fish farms across Himachal Pradesh, under the National Surveillance Programme on Aquatic Animal Diseases (NSPAAD). Tissue samples were collected from morbid fish and were investigated for the presence of infectious pancreatic necrosis virus and viral haemorrhagic septicaemia virus by RT-PCR using the positive controls that was developed in-house. So far, none of the samples tested were positive. Further when these samples were inoculated in CHSE-214 and BF2 cells, no cytopathic effect was observed, suggesting the absence of the said viruses in the farms surveyed. A Microsoft Access based database has been developed as an information tool.
- Ten isolates of *Chryseobacterium* were recovered from diseased gills of golden mahseer (collected from Bhimtal lake) showing clinical symptoms of bacterial gill disease. One isolate was identified as *Chryseobacterium scophthalmum*, a gram negative, short rod shaped bacteria that form yellow colonies in Shieh medium supplemented with Tobramycin. Out of 55 tested antibiotics, it was found to be resistant to 17. Detailed study of its prevalence, virulence and patho-physiology is presently being carried out.
- Rainbow trout farms in Himachal Pradesh and Uttarakhand were screened for potential bacterial pathogens. Bacterial profiles of tissue samples from diseased trout were identified by phylotyping. Four strains of *Lactococcus garvieae* were recovered from diseased rainbow trout showing typical symptoms of lactococcosis.

Alternative feed ingredients and feed formulations

- The efficacy of free-floating aquatic weed, *Azolla*, as a protein supplement was tested in the supplementary feed of herbivorous minor carp, *Labeo dyocheilus* fingerlings. A paste of fresh *Azolla* (30-40%) was added to the feed formulation having 28% protein level. The growth performance was found to be equivalent to traditional feed mixture (rice polish and mustard oil cake) and there was a 25% reduction in feed cost.
- A poultry/fish offal based farm made feed formulation having 35% protein content was developed for rainbow trout. The performance of this feed was not at par with commercially available fish meal based trout feeds, but it can serve as a cost-effective and simple alternative for small-scale trout growers placed at remote locations.

Extension activities and training programmes

Initiatives under tribal sub-plan

- Rainbow trout culture was promoted in Leh, Jammu and Kashmir, for improving the socio-economic status of the resident tribal population. Three existing raceways were repaired and five new raceways were constructed for four beneficiaries in Chushout Shamma village. Besides, feed and 10,000 rainbow trout fingerlings were distributed.
- After preliminary surveys concerning water availability, site suitability and social standing, raceways for rainbow trout culture and ponds for composite carp culture were constructed in Pithoragarh and Uddamsingh nagar districts of Uttarakhand.
- Front line demonstrations and farmer-scientist interaction meets were held frequently in the tribal villages of Uttarakhand, namely Belkheda, Bheti, Pippiliya, Sauvuara, Katahar,

Pangu, Himkhola, Chalmachilanso and Gothi. Water quality monitoring, health management, fish handling and feeding were demonstrated to the farmers. Carp and trout seeds and feed were distributed to the adopted tribal fish farmers.

Initiatives under NEH plan

- Awareness camps on the management of Jhora fishery and integrated fish farming was organized at Kalingpong (Darjeeling) and Nongmahir (Meghalaya).
- On collaborative mode, development of *Semiplotus semiplotus* broodstock and culture of *Osteobrama belangeri* in composite ponds are being carried out. A brood bank facility for *Semiplotus* was set up at Jasingfa aqua-tourism centre, Nagaon, Assam.
- An ova house was constructed at Shergaon Govt. trout farm, Arunachal Pradesh and it was made functional. During the year (2014-15), one lakh fingerlings of rainbow and brown trout was produced.
- Complete technical support was provided to the Directorate of Fisheries, Sikkim in broodstock development/maintenance, breeding and seed production of rainbow trout.

Seed ranching programme, farmer advisory and exhibitions

- In continuation of the painstaking endeavour towards stock enhancement of golden mahseer in its native habitats, 2000 hatchery raised and cage reared mahseer fingerlings were ranched in Kosi river (Ramnagar), Sadiyatal lake and Nainital lake, Uttarakhand. 10,000 fingerlings of golden mahseer and 2000 fingerlings of chocolate mahseer were also ranched at Nongmahir lake, Meghalaya, under an initiative to develop a mahseer eco-park. Moreover, awareness exhibition was organised to sensitize the local fish farmers concerning the need to save and protect mahseer.
- On a regular basis, technical support is being provided to fish farmers and state fisheries departments in the hill states, through

personal visits and communication mediums. Farm-specific advisory given to trout farmers include appropriate stocking density, water flow, grading of growing stock, maintenance of raceways and feed management. For carp farmers, specific technical guidance was provided with respect to design of polytank, selection of species and stocking density. To strengthen the farm advisories further, the Directorate has initiated the 'Mera Gaon Mera Gaurav' scheme, where individual or team of scientist will be in constant touch with farmers of the adopted village to facilitate the flow of technical information.

- The research and development activities of ICAR-DCFR in coldwater fish species were highlighted and exhibited at several conferences and kisan melas. Notable displays were put up in the 10th Indian Fisheries and Aquaculture Forum held at ICAR-NBFGR and 12th Agricultural Science Congress held at ICAR-NDRI.

Trainings and workshops

- National Fisheries Development Board sponsored six training programmes were organised for state fisheries department officials and fish farmers. The themes of these 5 day training programmes were hatchery management and seed production practices of golden mahseer; management practices of Jhora fisheries; culture and breeding of important coldwater fish species; coldwater fish farm management in mid hills; prevention and control of diseases in rainbow trout; and common fish health problems in mid-hill fish tank and their management. All the trainings integrated theoretical and practical aspects. Relevant study material was also drafted and provided.
- ICAR short course on 'Application of molecular tools in coldwater fisheries management' was organized during June 2014. The participants were given detailed lectures and practical sessions on various molecular techniques and their applications.

- Two day national workshop on 'Mahseer in India: resources, captive breeding, propagation, policies and issues' was organised at Guwahati on December 2014. Established scientific leaders and over 133 researchers took part in the deliberations and agreed towards a concerted national effort to propagate and conserve mahseer.

Besides the above mentioned research progress and wide ranging activities, the scientific fraternity of the Directorate was rewarded with some distinguished fellowships and awards.

- Dr. A. K. Singh (Director) was conferred the "Vigyan Ratn award" to honour scientific excellence by the Council of Science & Technology, Govt. of Uttar Pradesh.
- Dr. Amit Pande (Principal Scientist) achieved the distinction of being selected as "ICAR National Fellow" by the Indian Council of Agricultural Research, New Delhi, to recognize

his meritorious scientific contribution and to facilitate research activities under the project "Development of a method for detecting the presence of any virus signal in clinical samples of fish" for the next five years.

- Dr. M.S. Akhtar (Scientist) was conferred "Dr. M.S. Swaminathan award for the Best Indian Fisheries Scientist of the year 2013" by the Professional Fisheries Graduate Forum, Mumbai.
- Dr. Ciji Alexander (Scientist) received the prestigious "Jawaharlal Nehru award for PG outstanding doctoral thesis research in agricultural and allied sciences-2013" instituted by the Indian Council of Agricultural Research, New Delhi.

It is also worth noting that the scientific cadre strength of the Directorate got an impetus with the joining of five new Agricultural Research Service recruits.

INTRODUCTION

2.1 Brief History

To address the research and development needs of the coldwater fisheries sector, the Indian Council of Agricultural Research (ICAR) established the National Research Centre on Coldwater Fisheries (NRCCWF) on 24th September 1987, during the VII Five Year Plan. Notwithstanding the constraints in terms of manpower and infrastructure, the centre



ICAR-DCFR

made significant contributions in the appraisal of coldwater fishery resources and developed suitable technologies to propagate the aquaculture of important exotic and indigenous coldwater fish species in different hilly regions of the country.

Considering the expanding activities of NRCCWF and the growing prospects of coldwater fisheries in different Himalayan states, the research centre was upgraded to ICAR-Directorate of Coldwater Fisheries Research (DCFR) during the XI plan. Since then, the Directorate has made commendable efforts to harness available resources in a sustainable manner and develop location-situation-system specific aquaculture technologies for all the Himalayan states extending from Jammu & Kashmir to Arunachal Pradesh.

During the past 27 years of existence, the Directorate has evolved continuously to address new challenges in coldwater fisheries sector and is

striving towards sustainable enhancement of fish production. It has emerged as the nodal facility in the country to carry out research investigations focusing on endemic coldwater fish species and priced exotic trouts (rainbow and brown trout) and carps (Chinese and common carp).

2.2 Location

The headquarters of ICAR-DCFR is located at Bhimtal (29°19'52.647"N 79°33'18.083"E), Nainital district, Uttarakhand, at an altitude of 1470 m above msl. It is about 22 km away from the famous tourist hill station Nainital, the city of lakes. The nearest railway station is Kathgodam, which is 278 km from Delhi. The nearest major airport is Indira Gandhi International Airport, New Delhi. At present, a small airport is also in operation at Pantnagar. The experimental field centre of the Directorate is at Chirapani in Champawat district (29°17'55.537"N 80°6'8.915"E) of Uttarakhand, which is about 150 km from Bhimtal.



Main campus at Bhimtal

2.3 Management

A high powered Research Advisory Committee (RAC) guides the Directorate on thrust areas of research and on new initiatives. The RAC also evaluates and monitors the progress of research

activities carried out in the Directorate. The Institute Management Committee (IMC) constituted and mandated by Indian Council of Agricultural Research under the chairmanship of the Director, supervises the various management aspects of the Directorate. A number of other internal committees such as Institute Research Council (IRC), Official Language Committee and Institute Joint Staff Council (IJSC) are in place for decentralized management.

2.4 Mandate

- To conduct basic, strategic and applied research in coldwater fisheries and aquaculture
- To develop stock management models and culture technologies for major coldwater fish species
- To create awareness and provide training and consultancy

2.5 Infrastructure

Building and Farm

The Directorate is functioning from its building complex constructed at Industrial area, Bhimtal, Nainital. The main building has several facilities such as library, laboratories, AKMU cell, aquarium, wet lab, hatchery, flow-through ponds, guest house and auditorium. A mahseer seed production unit is also operational at Bhimtal. Further, the Directorate has an experimental fish farm facility at Chhirapani, Champawat, Uttarakhand. The field centre has trout hatchery, cemented raceways for nursery and brood stock rearing, staff quarters and few circular tanks for conducting trials on various culture aspects of indigenous and exotic fish species. Construction and installation of a high capacity water recirculation system is in progress.



Guest house



Farm complex at ICAR-DCFR, Bhimtal



Farm complex at ICAR-DCFR, Champawat



Aquarium

Laboratory Facilities

The Directorate has well equipped laboratories to support research on Molecular Genetics & Breeding, Fish Health Management (Diagnostic Virology and Diagnostic Bacteriology), Environmental Fish Biology & Nutrient Profiling, Fish Nutrition and Geoinformatics. Moreover, there is wet laboratory facility with flow through troughs for setting up physiological experiments and nutrition trials in coldwater fishes. One feed mill is also installed in the main campus of the Directorate to meet routine requirement of fish feeds in the experimental farm.



Laboratory facilities



Agriculture Knowledge Management Unit

2.6 Support Services

Prioritization Monitoring and Evaluation cell

A separate unit called the Prioritization Monitoring and Evaluation cell monitors the implementation and progress of research projects being carried out by the Directorate. This cell organizes the annual meeting of Institute Research Council (IRC) to evaluate the progress made in each research project and accordingly approves the work programme for the current year. The new proposals are also approved by the IRC after thorough evaluation of the objectives, practical utility, manpower and financial involvement. The PME cell is responsible for maintaining records of project reports through RPF/RPP system and for dealing with all technical matters within and outside of ICAR system. The cell takes care of publications, training programmes, deputation and participation of scientists in seminars, symposia, workshop and conferences.

Agriculture Knowledge Management Unit

The Agriculture Knowledge Management Unit of this Directorate provides the facilities for internet

access (BSNL), scanning and printing to the 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, computer and internet facilities are also available for other research scholars and students working under various project/programmes. Internet facilities at Experimental Field Centre, Champawat is provided through VSAT.

The website of this Directorate (<http://www.dcf.res.in>) is being regularly updated by AKMU 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 ongoing and forthcoming training programmes, seminar/symposia conducted, 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.in>). Electronic mail and messaging solutions (mail server) are also maintained at this Directorate for smooth information communication via webmail. Individual user login credentials are allotted for new scientists/officers for appropriate use of the mail server at this organization.

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 organizations 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. Recently, an inventory of e-journals containing 35,138 soft copies of important fisheries research



Library

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

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.

2.7 Staff strength (As on 31.03.2015)

Category	Sanctioned	Filled	Vacant
Director (RMP)	01	01	-
Scientific	30	21	09
Technical	14	13	01
Administrative	13	12	01
Supporting	15	11	04
Total	73	58	15

2.8 Financial Statement

(Rupees in lakh)

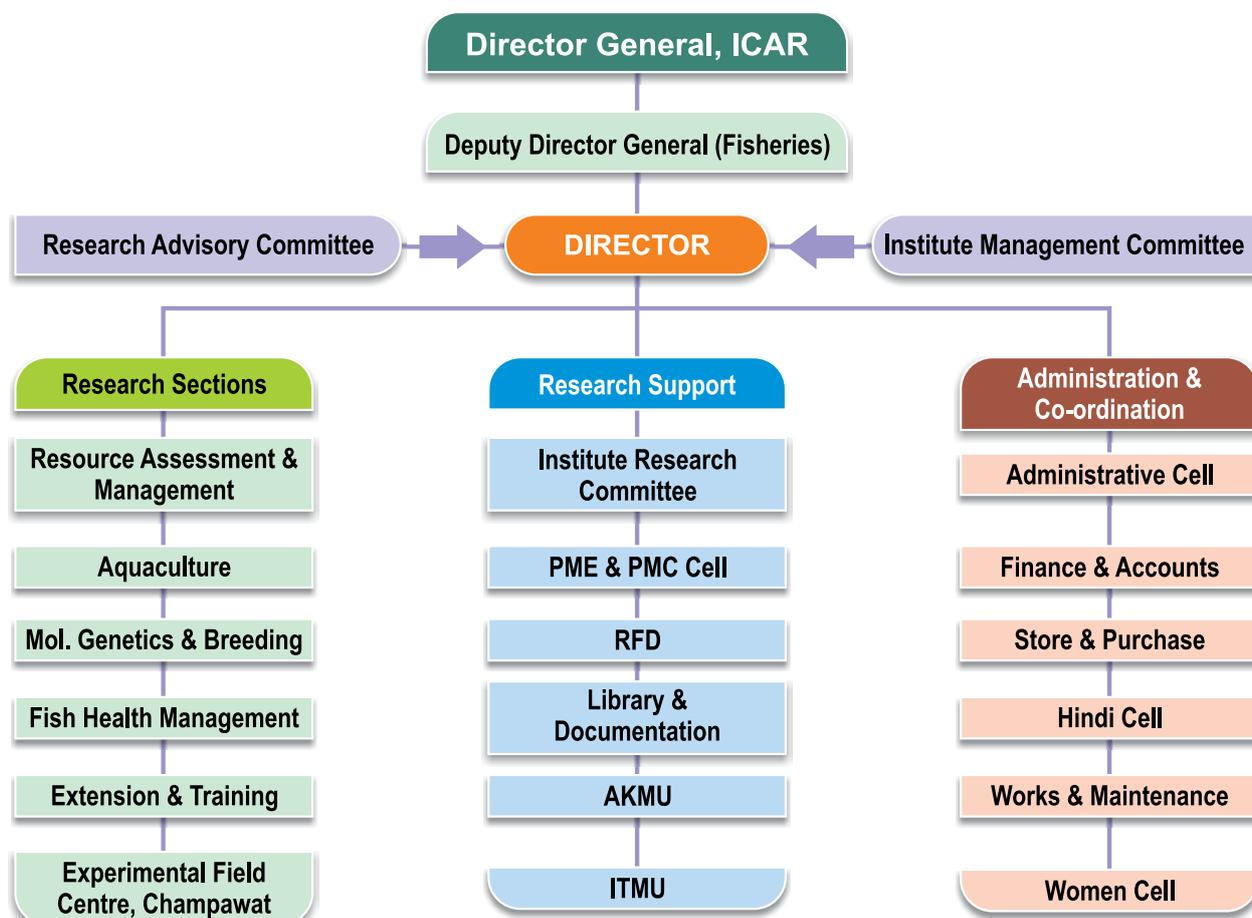
Major Head of Account	Approved R.E. 2014-15	Actual Expenditure during 2014-15
Non-Plan	507.00	474.63
Plan	340.00	339.36

Budget Statement for the year 2014-15

(Rupees in lakh)

Head of Account	Budget (R.E.)		Expenditure	
	Plan	Non-Plan	Plan	Non-plan
Pay & Allowances	0.00	465.00	0.00	433.04
Travelling allowances	20.00	1.00	20.00	1.00
Research & Operational expenses	90.00	6.00	90.00	6.00
Administrative expense	94.00	24.50	93.96	24.34
HRD	4.50	0	4.50	0
Equipment	35.00	2.00	34.83	1.99
Information Technology	10.00	0	9.93	0
Library books	30.00	3.00	29.77	2.96
Furniture & Fixture	10.00	2.00	9.88	1.81
Miscellaneous expenses	5.50	3.50	5.50	3.49
NEH component	25.00	0	25.00	0
TSP component	16.00	0	15.99	0
Total	340.00	507.00	339.36	474.63

2.9 Organizational Setup



RESEARCH ACCOMPLISHMENT

3.1 Resource assessment

The coldwater resources of our country are extremely diverse (streams, rivers, lakes and reservoirs) and harbour a distinct class of endemic and introduced fish species. The Directorate is strenuously exploring ways to sustainably manage and use these resources which are distributed across mountainous regions, through different projects.

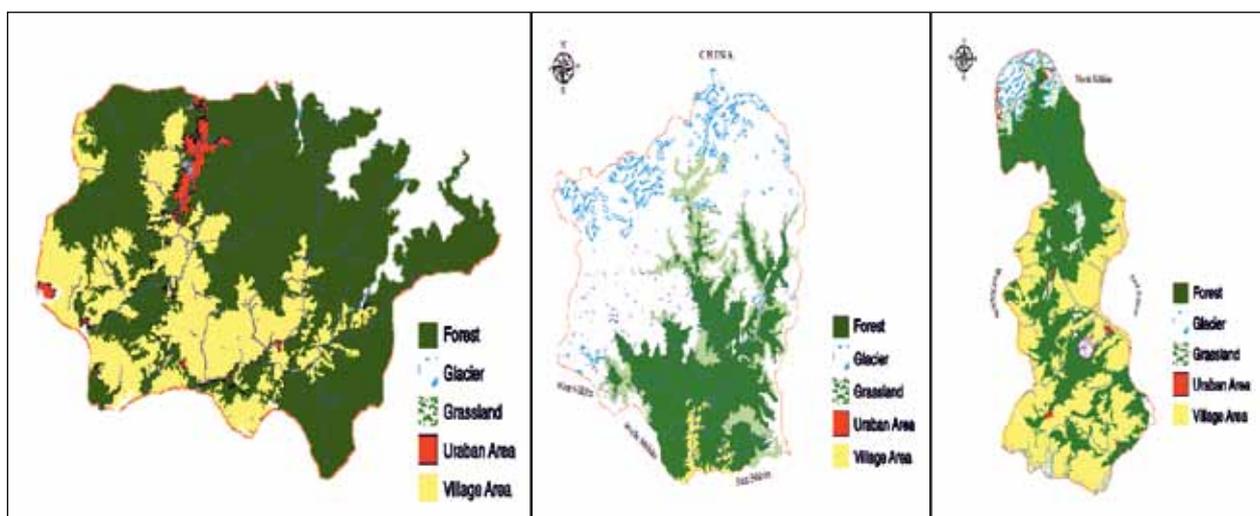
3.1.1 Selection of suitable sites for aquaculture using Geographical Information System

Geographical information system and remote sensing technologies are very effective tools to locate suitable sites for aquaculture. During 2014-2015, eastern, northern and southern districts of Sikkim were selected and suitability of sites for aquaculture was assessed using geoinformatic tools. The maps generated provide long-term outline to policy

makers and planners of aquaculture development. The following data were used in the study.

Data	Source
Village boundary map (1:50000)	Survey of India
Open access SRTM satellite data (28 m resolution)	USGS Earth Explorer (NASA)
Land use land cover	India Waris (ISRO)

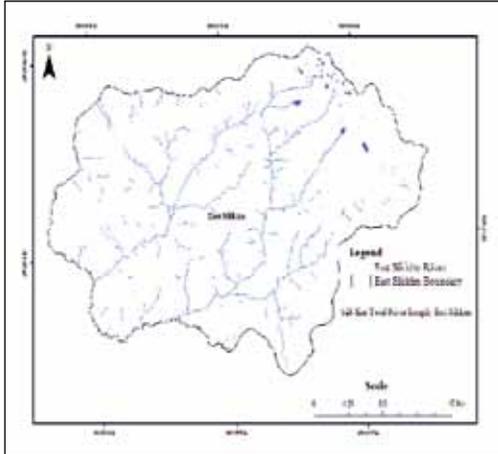
Separate thematic maps were prepared based on the different physico-chemical parameters of water and soil in east, north and south Sikkim, using spatial analyst. Map for water availability and accessibility was also prepared. Analytical Hierarchical Process (AHP) was used to find the significance of the criteria. Further, criteria base analysis was carried out for the different parameters and reflected in map that indicates the suitability of the site for aquaculture, as depicted below.



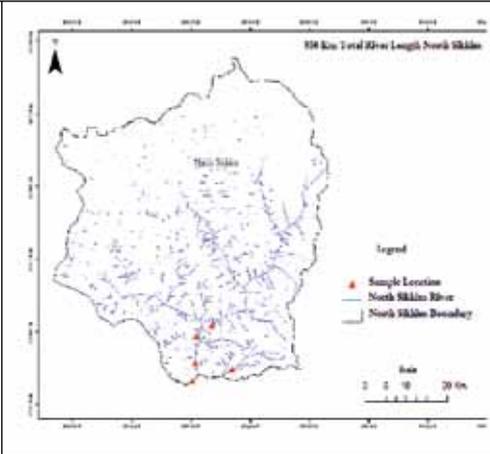
Land use/Land cover East Sikkim

Land use/Land cover North Sikkim

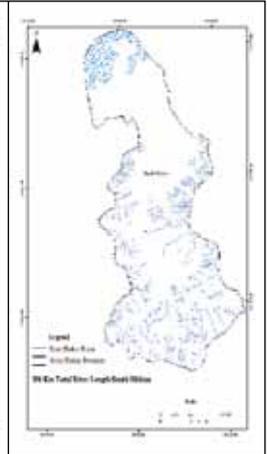
Land use/Land cover South Sikkim



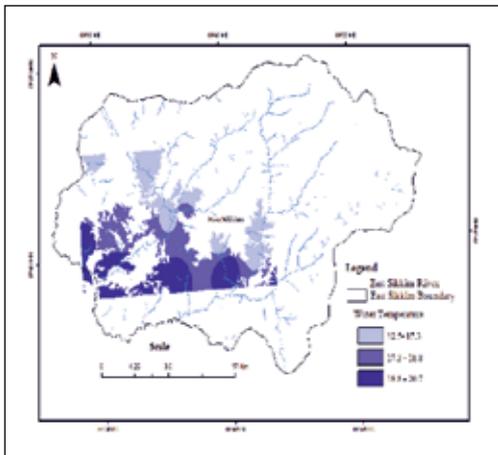
Drainage map East Sikkim



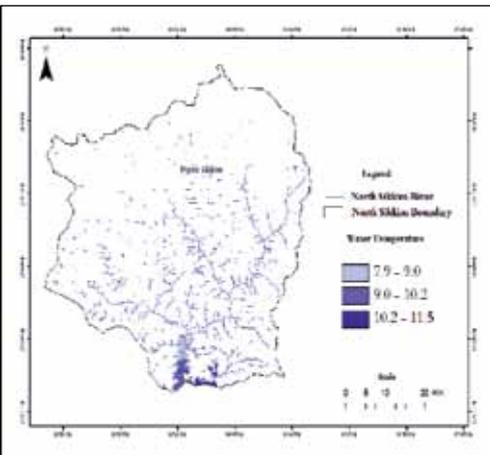
Drainage map North Sikkim



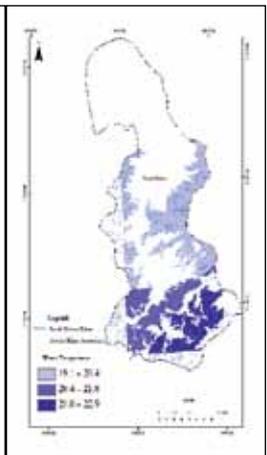
Drainage map South Sikkim



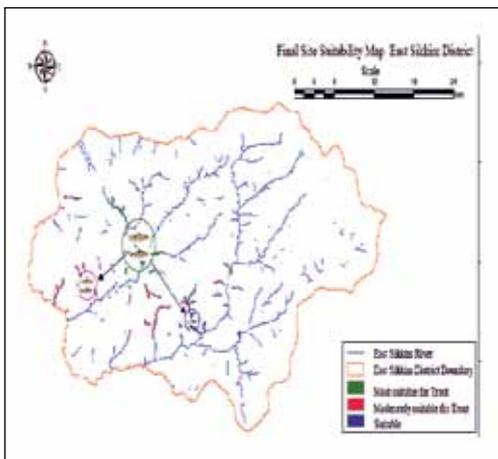
Thematic map of water temperature (East)



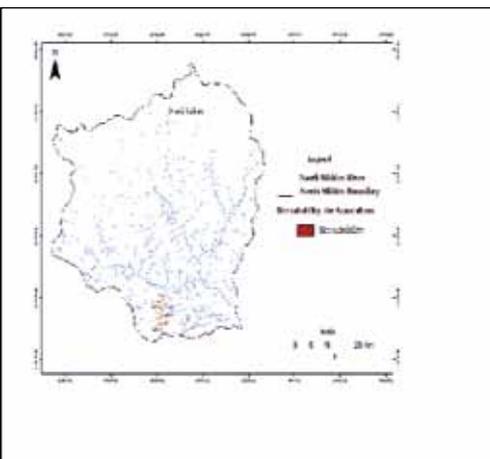
Thematic map of water temperature (North)



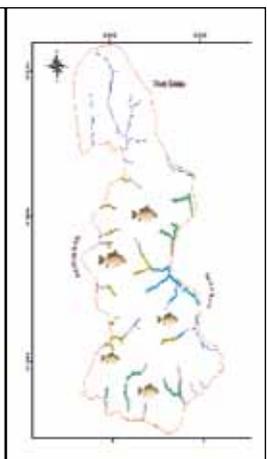
Thematic map of water temperature (South)



Aquaculture suitability map for East Sikkim



Aquaculture suitability map for North Sikkim



Aquaculture suitability map for South Sikkim

The final output of the study area in Sikkim is depicted hereunder

Dispersion of all classes	South Sikkim	East Sikkim	North Sikkim
Total area of district (Sq Km)	735	937	4072
Area under forest (Sq Km)	348.4	409.8	1128.6
Area under glaciers (Sq Km)	34	217.1	271.1
Area under urbanization (Sq Km)	2.7	17.2	
Area under grassland (Sq Km)	39.7	31.6	375.8
Area under wastelands (Sq Km)	1.1	37	2413.9
Area under village boundary/agriculture (Sq Km)	300.4	221.4	63.7
Most suitable area for Aquaculture (ha)	784	301	-
Moderately suitable area for Aquaculture (ha)	825	501	610

3.1.2 Exploration of high altitude resources

Some of the coldwater streams, rivers and lakes in Kumaon Himalaya are poorly explored as they are located in difficult terrains. An effort was made by researchers from ICAR-DCFR to assess the coldwater fisheries resources in remote locations of Pithoragarh district, Uttarakhand. Coldwater resources such as Parwati Lake (4512 m above msl, 30°21.15N, 80°39.37E), Kuti Yangti river (3845 m above msl, 30°18.59N, 80°45.43E) and Kali river at Gungi (3223 m above msl, 30°10.46N, 80°51.73E)



Kuti Yangti river at altitude of 3845 m above msl in Pithoragarh, Uttarakhand



Parwati lake at altitude of 4512 m above msl in Pithoragarh, Uttarakhand

were identified as potential targets for developing fisheries and aquaculture activities. Nevertheless, information on the abundance and diversity of fish species is not yet available and is currently being explored.

Further, to strengthen brood banking of indigenous coldwater ornamental fishes in DCFR, Bhimtal, an exploratory field trip was undertaken to collect fish germplasm from the stretch of river Kali located in the district of Pithoragarh, Uttarakhand. Sampling was conducted in 15 different locations with the help of local fishermen. About 200 live fish specimens of *Barilius sp.*, *Tor sp.* and *Nemacheilus sp.* were collected.



Fish germplasm exploration in Kali river

3.2 Aquaculture

In recent years, more emphasis is laid on expanding coldwater aquaculture through species diversification, progressive technical support and location specific culture practices. The Directorate aims to standardize and refine breeding, rearing and culture protocols of endemic and exotic coldwater fishes through different projects.

3.2.1 Performance of indigenous minor carps, *Labeo dero* and *Labeo dyocheilus* as candidate species for hill aquaculture

Brood stock of *Labeo dyocheilus* and *Labeo dero* were maintained at ICAR-DCFR Bhimtal in the thermal range of 5-22.5°C. Fishes were fed 3% of their body weight daily with conventional carp feed prepared by mixing rice bran and mustard oil cake in 1:1 ratio. For both *L. dyocheilus* and *L. dero* gonadal maturation was recorded under captive condition. It was observed that under similar ecological conditions, males normally mature 15 days earlier than the females. Therefore, we attempted early maturation in females with two preparatory doses of hormone (ovotide) during the month of June and achieved successful spawning on 3rd July 2014 at 21°C. Secondary sexual characters like roughness of the body and tubercles were observed and it was found that these secondary sexual characters appeared during the last week of April and disappeared gradually from the first week of September. Relative fecundity was recorded in the range of 1.5 to 2.37 lakh for *L. dyocheilus* and 1.43 to 2.25 lakh for *L. dero*.

Breeding occurred in eight batches during first week of July to end of August, 2014. Portable plastic carp hatchery was used for spawning and egg incubation and achieved 98% hatching and 82% spawn recovery at water temperature of 18-22°C. Water temperature below 16°C resulted in failure of spawning and pond water temperature below 5°C, continuously for more than 3 days resulted in mass mortality of the fingerlings. The water quality was characterized as low temperature (5-23.5°C), alkaline pH (8.2-8.8), high dissolved oxygen (6.5-7.2mg l⁻¹), medium alkalinity (82-146 mg l⁻¹) and low free CO₂ (0-1mg l⁻¹). Further, we evaluated growth in field condition under polyculture system with exotic carps. For this, yearlings of the size 28-40 gm were stocked in the polytanks at the rate of 3 fish per m³ with species composition of 20% silver carp, 30% grass carp, 20% common carp and 30% minor carps. At the end of 12 months of rearing, silver carp recorded weight in the range of 210 to 280g, grass carp 250 to 310g,

common carp 100 to 260g and minor carps 180 to 230g. Overall 30 to 32 kg fish was produced from 100 m² pond area.

The project has been completed and it was concluded that *L. dyocheilus* and *L. dero* are easily amenable to breed in captive condition and can be further reared up to stockable size. The growth of the fish is less in comparison to exotic carp, but table size fish can be produced after stocking of stunted fish. Since both the species are hardy, bottom browsing feeder and well suited for coldwater condition, they may be taken as candidate species for coldwater aquaculture.



Portable plastic carp hatchery



Fertilized eggs of *Labeo dyocheilus*

3.2.2 Performance of chocolate mahseer (*Neolissochilus hexagonolepis*) in pond condition of Kumaon region

Chocolate mahseer were collected, transported and acclimatized to pond condition at ICAR-DCFR, Bhimtal. Growth, survival, food and feeding habits were recorded for this important endemic

species of north-eastern region. Grow-out feed and management practices were developed for the culture of chocolate mahseer. Maturity cycle was analyzed and breeding was achieved in pond condition. Further, larval rearing protocols have been standardized. During 2014-15, six thousand fingerlings of chocolate mahseer were produced. Out of which 5000 nos. were stocked in Nongmahir Lake, Meghalaya for rehabilitation and propagation. 1000 fingerlings were given to 12 farmers of Kalimpong, West Bengal for stocking in 'Jhora fisheries pond', along with grass carp.

The project has been completed and it was concluded that chocolate mahseer accepts artificial feed and grows and thrives well in pond condition. There was no competition for food and space while culturing the fish with golden mahseer, *Tor putitora* and grass carp, *Ctenopharyngodon idella*.



Developmental stages of chocolate mahseer



Brood stock of chocolate mahseer

3.2.3 Breeding of *Chagunius chagunio*

Chagunius chagunio (commonly known as 'Chaguni' or 'Chippan') is an indigenous cyprinid fish, natively distributed along the Brahmaputra and Ganga river drainages in the Himalayan foot hills. In Kumaon region of Uttarakhand, it fetches

good market price of about Rs. 300/kg and has high consumer preference. For the first time, artificial breeding of this fish was carried out at DCFR, Bhimtal. As part of its reproductive biology, the fish was observed to be a batch spawner with peak breeding season in May and September. It attains sexual maturity at the age of 3 years, when it measures 15-20 cm and weighs 100-125 g. Male and female fish were stripped during the month of May 2014, and the fertilized eggs were incubated in flow-through trough and tray system. The relative fecundity was found to be 25000-30000 eggs/kg body weight. The breeding protocol is being further refined and developed.



Breeding of *Chagunius chagunio*

3.2.4 Photo-thermal manipulation for gonadal maturity of golden mahseer in captivity.

The lack of captive golden mahseer brooders is a major bottleneck for mass scale seed production and very little is known about the effect of environmental factors on the captive maturation of mahseer. Hence, the present project intends to elucidate the effect of photoperiod and temperature on gonadal maturity of golden mahseer in captivity. Adult golden mahseers (avg. weight, 423 ± 86 g) were collected from Kakrighat and Ramnagar stretch of river Kosi, Uttarakhand during the months of June, July and September, 2014 and stocked in floating cages at Bhimtal lake. The physico-chemical parameters of water like DO, temperature and pH at different collection sites were recorded. The stocked fishes were fed a basal diet containing 35 % crude protein till the start of the experiment.



Collection of golden mahseer adults from Ramnagar and Kakrighat, Uttarakhand

Photoperiod trial to manipulate gonadal maturity in captive golden mahseer

To elucidate the effect of photoperiod on gonadal maturity of golden mahseer in captivity, an experiment has been set up in the wet lab of ICAR-DCFR. Three photoperiodic treatments were applied (in duplicate) viz. 8 hour light and 16 hour dark (8L: 16D), 12 hours light and 12 hours dark (12L: 12D) and 16 hours dark and 8 hours light (8L: 16D). Adult golden mahseers which were wild collected and maintained in floating cages were randomly distributed into the FRP tanks of 2000L capacity under different photoperiodic treatments during last week of February, 2015. Fishes were acclimatized for one week and then experiment was initiated. The intensity of light was maintained at 1400±80 Lux using 35 watt CFL bulbs. The dark condition was maintained by covering the tanks with thick black plastic sheets. An internal circulation of water was being maintained in each tank using submersible pumps (800L/hour) to simulate a stream flow pattern. Fishes were being fed ad libitum with broodstock diet containing 35% crude protein, twice a day. The diet contains specific additional nutrient supplements such as tryptophan, soya lecithin, albumin and DHA. The experimental trial is in progress and is being monitored.

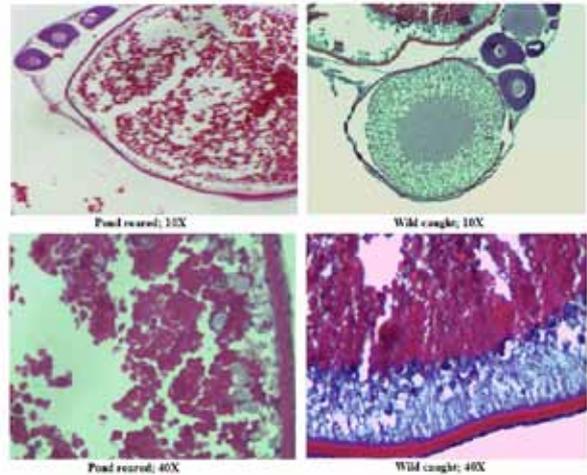


Experimental set up in ICAR-DCFR wet lab

Comparative assessment of maturity status in wild and captive reared golden mahseer

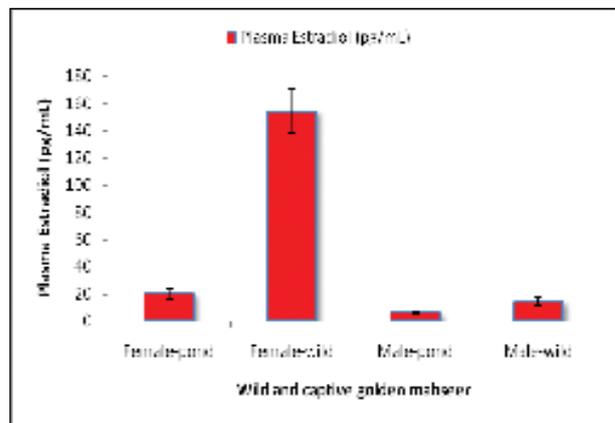
As maturation of golden mahseer in captivity is a general constraint, an attempt was made to assess its maturity by way of measuring different sex steroids and studying gonadal histology. Comparison was done with wild matured fish to decipher the possible bottlenecks in maturation under captive conditions. For this, 3 wild caught and 3 captive reared adult

female golden mahseers of similar size were used for plasma collection and histological analysis in the month of June, 2014, the peak spawning season. The collected plasma was used for estimation of sex steroids (progesterone and estradiol) and stress biomarkers (cortisol and antioxidative enzymes). For ovarian histology, gonad samples from wild and pond reared female mahseer were fixed in Bouin’s fixative and processed methodically.



Ovarian histology of wild and captive golden mahseer broods

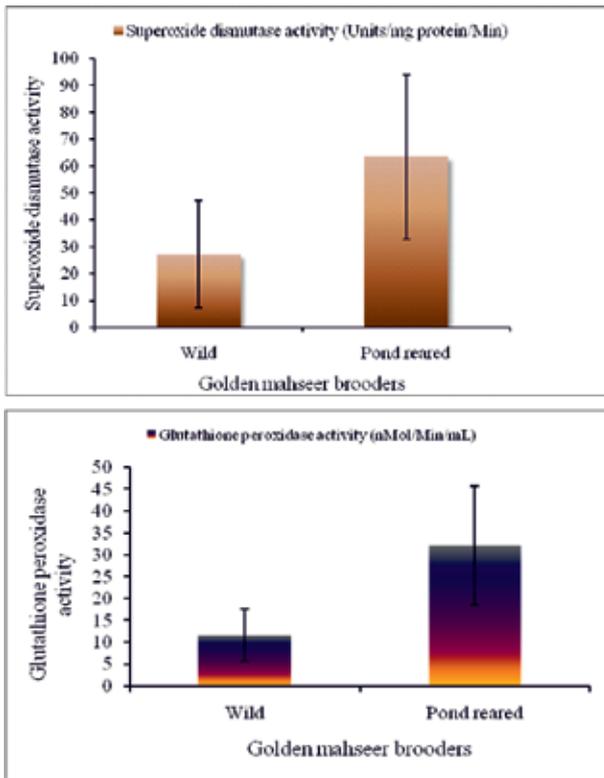
Ovarian histological observations showed denser granulosa and thecal cells as well as compact yolk globules in wild caught fish as compared to pond reared female golden mahseer. Estimation of plasma 17β-estradiol and progesterone revealed a significantly lower level of estradiol in captive reared females of golden mahseer than its wild caught counterparts, whereas plasma progesterone level in both wild and captive females were comparable and did not differ significantly.



Plasma estradiol levels of wild and captive golden mahseer

Comparative assessment of different stress biomarkers in wild and captive reared golden mahseer

Stress parameters such as cortisol, superoxide dismutase and glutathione peroxidase were also estimated in both wild and captive mahseer brooders. There was no significant difference in plasma cortisol levels between wild and pond reared brooders.

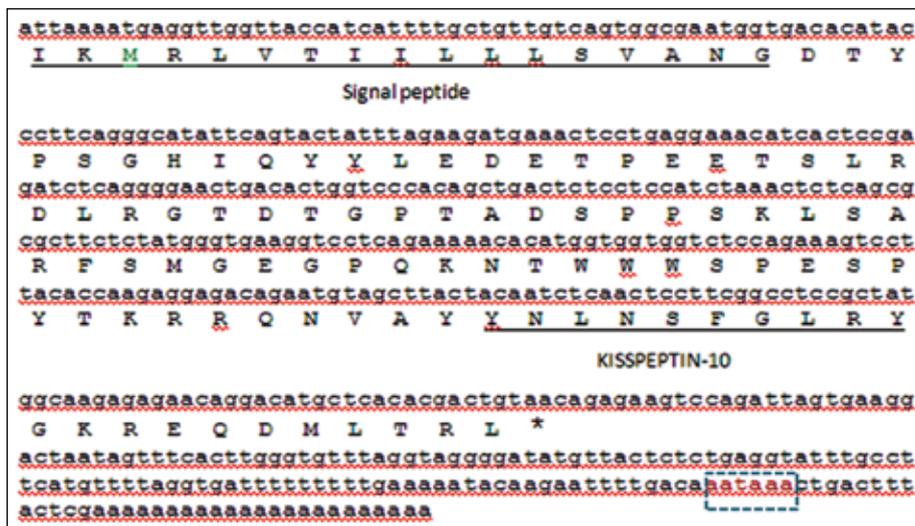


Plasma antioxidative enzyme activities in wild and captive golden mahseer

However, the activities of oxidative stress biomarker enzymes viz. glutathione peroxidase and superoxide dismutase in blood plasma were significantly higher in pond reared brooders compared to their wild counterparts, which indicated oxidative stress in captive reared mahseers.

3.2.5 Molecular characterization and gene expression profiles of kiss genes in golden mahseer during different gonadal development stages

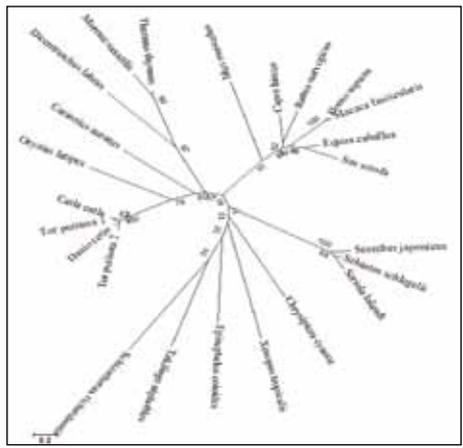
Live golden mahseer, *Tor putitora* were collected from Bhimtal and Sattal lakes of Uttarakhand. The fishes were sampled from February to November, 2014. In the collected fishes gonadal (testicular and ovarian) development stages were studied by macroscopic and microscopic methods. Additionally gonado-somatic, hepato-somatic and condition factors were also estimated. The organs such as brain, pituitary, gonad, liver, kidney, spleen, gall bladder and intestine were collected and stored for RNA isolation and cDNA synthesis. From brain complete coding region of kiss 1 cDNA (508 bp) was amplified and submitted to NCBI GenBank (GenBank Accession number: KP710729). The cDNA of kiss1 consisted of 330 bp open reading frame (ORF) encoding 109 amino acids. The deduced amino acid sequences of this gene when compared with those of other vertebrate species showed high degree of conservation only in the kisspeptin-10 region (Kp-10).



Nucleotide and deduced amino acid sequences of *T. putitora* Kiss1 cDNA. The putative signal peptide and kisspeptin-10 region are underlined. The stop codon taa is indicated by astricks (*). The polyadenylation signal (aataaa) is boxed. Genbank accession number is KP710729.

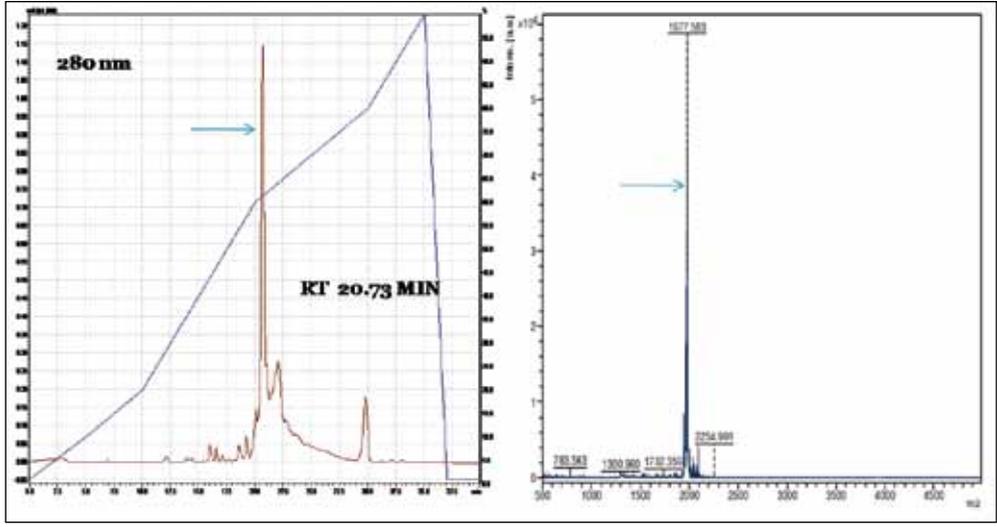


Alignment of deduced amino acid sequences of *T. putitora* kiss1 cDNA. (*) residues identical in all sequences in the alignment, (:) conserved substitution, (.) semi-conserved substitution.



The evolutionary history was inferred using the Neighbor-Joining method of MEGA6

A synthetic peptide of 16 amino acid (Molecular weight: 1977.22) corresponding to *T. putitora* Kp-10 region was synthesized using Fmoc chemistry on MBHA rink amide resin. The peptide was purified by semi-preparative RP-HPLC using C₁₈ column and the peptide mass was confirmed by MALDI-MS. This peptide will be used for evaluating the stimulatory effect of exogenously administered kiss1 in gonadal development of fish.



HPLC profile and mass chromatogram of synthetic peptide

3.2.6 Ornamental fish breeding at ICAR-DCFR, Bhimtal

Keeping in view the shrinking land size, water availability and slow growth of fish due to low temperature it was conceptualized that ornamental fish production should be promoted, especially among rural women. A breeding unit was therefore constructed at ICAR-DCFR, Bhimtal. Brood stock of koi carp and gold fish were raised and successfully bred in two years. Ornamental fish seed produced at the institute facility were distributed and released in farmer's ponds. Around 6000 fingerlings have been stocked over a two year period.

Gold fish

Breeding of Gold fish (*Carassius auratus*) was carried out during March/July 2014 in ponds lined with poly-sheet (temperature 21-26 °C) and FRP trough (15-19°C), by creating natural conditions. Egg release was observed after 42 hours and hatching took place after 120 hours. A total of 4000 fry were produced from two breeding trials. After four months of rearing, the average size recorded was around 65 mm and 4.2g.



Ornamental gold fish produced at ICAR-DCFR, Bhimtal

Koi carp

Koi Carp (*Cyprinus carpio carpio*) was also successfully bred at ICAR-DCFR, Bhimtal. At low temperature ($16 \pm 2^\circ\text{C}$), spawning was observed 18 hrs after the injection. The fertilized eggs were adhesive and transparent with diameter ranging between 0.8 mm to 1.1 mm. The incubation period was 120 hours and 84 hours at 15-18°C (April) and 20-26°C (August), respectively. The hatchlings were transparent and measured 3.45-4.75 mm, with a large oval head, a well defined yolk sac and short tail. The yolk got fully absorbed within 2-3 days and

by this time mouth formation was completed and the larvae started exogenous feeding. A hatching success of about 80% was achieved and around 4000 fry were produced.



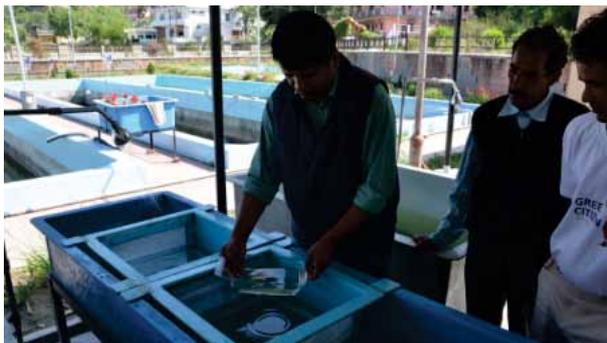
Broodstock of ornamental Koi carp at ICAR-DCFR, Bhimtal

Barilius bendelisis

The hill trout, *Barilius bendelisis* (Hamilton) is an indigenous cyprinid that is commonly distributed along the Brahmaputra and Ganga drainages in the Himalayan foot hills. It is also identified as a potential candidate for aquaculture and ornamental trade. As a pre-requisite, the fish was successfully bred for the first time at DCFR, Bhimtal through sustained efforts. Spawning was induced by intraperitoneal administration of ovatide to female (0.6 ml/kg) and male (0.3 ml/kg) mature brooders, at evening hours. 15 hrs post-injection, eggs were stripped from the female fish into a clean and dry enamel tray. About 1000 eggs were fertilized with freshly prepared milt suspension, and were placed in a flow-through trough and tray system maintained at 15-20°C. The fertilization rate was estimated to be 55-60 % and the larvae hatched out in 130-140 hrs. The fish has intermittent spawning period during March-April.



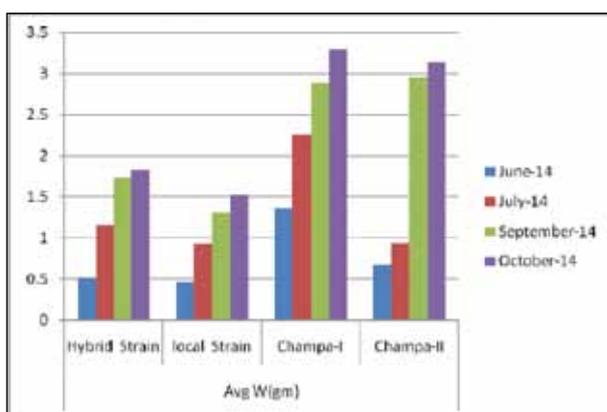
Barilius bendelisis mature brooders



Seed production of *Barilius bendelisis* at ICAR-DCFR, Bhimtal

3.2.7 Performance evaluation of improved strain of common carp, Champa-1 & Champa-2 at different thermal regimes

Breeding and rearing of Hungarian, local Bangkok strain and hybrid (between local and Hungarian strain) common carp was carried out at ICAR-DCFR field centre at Champawat. Physiochemical parameters of water, growth performance and health status of fish were regularly monitored and recorded. The results of the investigation showed that hybrid of local and Hungarian common carp showed 35% more growth as compared to local strain of common carp. It was also evident that temperature plays an important role in the growth of Hungarian strains. Further, genetic profiling of these stocks is under progress.



Growth performance of local, Hungarian and hybrid common carp

3.2.8 Developments of larval feed and grow out feed for snow trout, *Schizothorax richardsonii* (Gray)

A 60 day feeding trial was conducted to evaluate the optimum protein requirement of snow trout (*Schizothorax richardsonii*). The initial size and weight of fry was 52.87 ± 0.53 mm and

1.22 ± 0.14 g respectively. Four different diets with different level of crude protein (30, 35, 40 and 45 %) was formulated and fed to four groups of fishes in triplicates. Experimental rearing system comprised of troughs and trays. Each trough contained 4 trays with the dimensions of 40x40x17cm with 20 L water carrying capacity. Fish were collected from the local stream and transported to Champawat farm. After acclimation of fifteen days they were distributed randomly in each tray @ 15 fish/tray using completely randomized design. Fish were initially fed 8% of their body weight (twice daily) and later the feeding rate was adjusted according to their biomass gain over the period. Every fifteen days interval weight of the fish was recorded till the termination of the experiment. Results of the present investigation reveal highest weight gain (specific growth rate) and lowest feed conversion ratio in the group fed diet with 40% crude protein.

3.3 Disease surveillance and health management

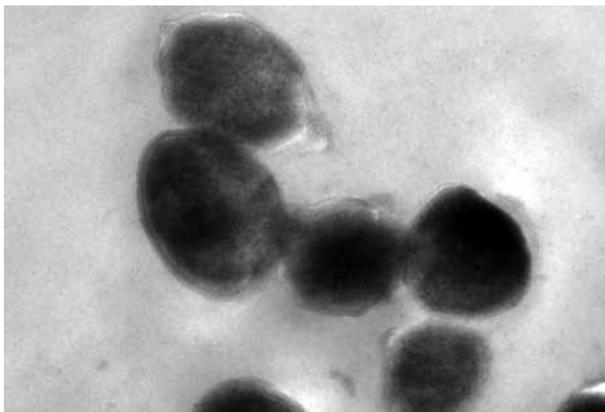
3.3.1 Potential bacterial pathogens in rainbow trout farms from northern India

Thirty-eight rainbow trout specimens were collected from Champawat, Uttarakhand and from Pahanala, Patlikuhul and Kullu, Himachal Pradesh. Tissue (muscle, gill, liver, gut, eye, spleen, gall bladder and kidney) and water samples were processed aseptically for preparation of bacterial pure culture. Pure cultures were subjected to molecular characterization and antibacterial susceptibility tests. Data on preliminary result of bacteria profile of trout farms at Pahanala, Patlikuhul and Kullu, Himachal Pradesh were generated. Phylotyping of kidney and eye sample of a diseased rainbow trout was completed for studying the profile of pathogenic bacteria in rainbow trout. Four strains of *Lactococcus garvieae* (GenBank accession no: KM 604701, KM 604702, KM 604703 and KM 604704) were recovered from diseased rainbow trout showing typical symptoms [unilateral exophthalmia, inflammation and swollen vent, petechial haemorrhages in viscera, focal haemorrhages and swelling in liver] of lactococcosis in Uttarakhand and Himachal Pradesh. Isolation of

Lactococcus garvieae must alert the trout farmers for prophylactic and therapeutic measures, as it is a zoonotic pathogen. Frequent recovery of *Citrobacter freundii* from trout farm draws the attention for its virulence study in details both in laboratory and field condition.



Unilateral exophthalmia



Lactococcus garvieae

3.3.2 *Chryseobacterium* - causative agent of bacterial gill disease isolated from *Tor putitora*

Golden mahseer (*Tor putitora*) was sampled periodically from Bhimtal lake for monitoring the health status of the natural population. Ten isolates of *Chryseobacterium* were recovered from diseased gills of 8 fish, showing clinical symptoms of bacterial gill disease (BGD). One isolate was identified as *Chryseobacterium scophthalmum*, TPBLGL 18 (NCBI accession no. KM822770). It was gram negative, short rod shaped, forming yellow colonies in Shieh medium supplemented with Tobramycin. The antibiotic sensitivity study showed that *Chryseobacterium scophthalmum* was



Golden mahseer showing symptoms of Bacterial Gill Disease

resistant to 17 antibiotics viz., Amphotericin-B Ap¹⁰⁰ & Ap¹²⁰, Bacitracin B⁸ & B¹⁰, Cloxacillin CX³⁰ & CX⁵, flucanazol Fu²⁵ & Fu¹⁰, Itraconazole It¹⁰, Ketoconazole Kt¹⁰, Metronidazole Mt⁵, Nystatin Ns¹⁰⁰, Oxacilin Ox⁵, Penicillin-G P², Polymixin-B Pb⁵⁰, Spectinomycin Se¹⁰⁰ and Tobramycin Tb¹⁰ out of the 55 tested antibiotics. Detailed study of its prevalence, virulence and patho-physiology is being carried out in our bacteriology laboratory.

3.4 Molecular Genetics and Biotechnology

3.4.1 Bioprospecting of genes and allele mining for thermal tolerance of *Schizothorax richardsonii*

Snow trout, *Schizothorax richardsonii*, is an endemic fish of Himalayan and sub-Himalayan region. It is an ideal species for investigating the effects of thermal stress as they thrive well in snow melt water, but are occasionally exposed to and are capable of enduring temperatures greater than 25°C. It is capable of greater tolerance to acute heat challenge, which may have bearing on the survival of the species in face of global climate change. As the transcriptome can help in interpreting the functional elements of the genome, in this study we have used deep RNA sequencing (RNA-Seq), a high throughput transcriptomic approach to provide an in-depth view of the transcriptome to characterize the genes and molecular pathways involved during heat shock response in snow trout.

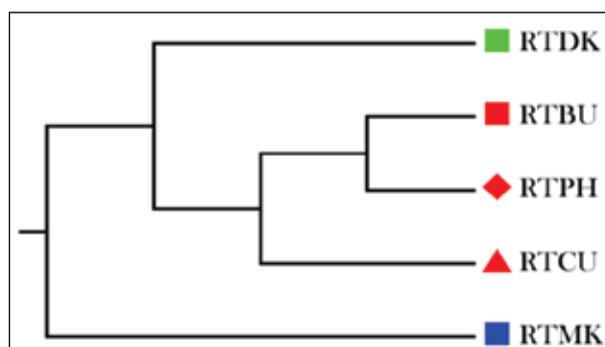
Live specimens of *S. richardsonii* were collected from Kosi river near Ratighat (29°27'48"N,

79°28'81"E, altitude: 1033 masl) located in Kumaun hills of Uttarakhand. The fishes were transported to the wet lab and acclimatized in aerated water at 10°C (ambient temperature) for one month before heat shock experiment. After the acclimation period, some fishes were transferred to two 1000 L FRP tanks. In one tank water temperature was maintained at 26°C (heat shock) by using the thermostat while in the other tank, fish was held at 10°C and that served as control. In each tank 20 fishes (average weight 50 gm) were held and water temperature was monitored constantly. The heat shock lasted for 3 hours. After the heat shock period the thermostats were turned off and water in the heat shocked tank was brought back to 10°C by re-establishing the flow of water (temp=10°C). Three fishes from each tank were sampled (liver tissue) at the cessation of heat shock immediately and subsequently after 3, 12 and 24 hours of the cessation of heat shock. Total RNA was isolated from the collected liver tissue samples and concentration, purity and integrity of RNA were measured. The RNA from control (CT) and heat shocked (HS) group, collected at different time intervals (0, 3, 12 and 24 hr) were pooled in equal concentration for library construction. Two (one each for control and heat shocked) RNA-Seq libraries were constructed from liver tissues. The library (2x101 paired end) sequencing was performed using Illumina HiSeq 2000 platform by commercial service provider (Scigenom laboratories, Kochi, India). The *de novo* transcriptome assembly was represented by 80,459 contiguous sequences (contigs) ranging from 200 to 16889 bp in length with an average length of 735 bp. The N75 and N50 for *de novo* assembly was 461 and 1274 respectively. The contigs were further assembled into Unigenes using sequence clustering software CAP3, generating a total of 78,862 unigenes (comprises of 1543 contigs and 77319 singletons). Further analysis for GO annotation and identification of differentially expressed genes are in progress.

3.4.2 Stock assessment of farm raised rainbow trout (*Oncorhynchus mykiss*)

Different stocks of rainbow trout from Dachigam (Western Himalaya); Bairangana, Champawat and

Patlikul (Central Himalaya); and Munnar (Nilgiri hills) were evaluated for allelic and genetic diversity using 15 polymorphic microsatellite loci. Substantial genetic differentiation was observed among stocks using FSTAT v.2.9, which indicated average F_{st} and R_{st} value of 0.118 and 0.519, respectively. The genetic clustering analysis carried out using ARLEQUIN v.3.5 and MEGA v.5.05 demonstrated that stocks from RTMK (Munnar, Kerala) and RTDK (Dachigam, Kashmir) formed individual clusters, whereas RTBU, RTCU (Bairangana and Champawat, Uttarakhand) and RTPH (Patlikul, Himachal Pradesh) stocks were grouped in another cluster indicating a common origin of the culture stocks. Moreover, the data revealed significant genetic variability among different stocks showing allelic and gene diversity ($N_a=4.2-9$ alleles/locus, mean 6.09; $H_o=0.042-0.934$, $H_e=0.612-0.824$) when calculated using GDA v.1.1. Pair wise genetic differentiation revealed mean $F_{st}=0.118$, indicating a moderate level of genetic differentiation. The average inbreeding coefficient (F_{is}) was 0.31. The mode shift test analyzed using BOTTLENECK v.1.2.02 did not show any distortion of allele frequency and showed a normal "L" shaped distribution.



Phenogram (UPGMA) constructed based on Nei's genetic distance among stocks

3.5 Outreach Activity

3.5.1 Fish genetic stock

Under the fish genetic stock programme the species targeted were chocolate mahseer, (*Neolissochilus hexagonolepis*) and brown trout (*Salmo trutta fario* L). *N. hexagonolepis* is a commercially important food as well as game fish, distributed in India, Bangladesh and Myanmar. The status of the species is near threatened in IUCN red list of threatened species [www.iucnredlist.org]. Brown trout (*Salmo trutta fario* L.) belonging to family salmonidae is native to Europe. It was introduced in India in the early 19th century for food and sports. Presently the species has established itself in different streams and also cultured at various farms of Himalayan regions in Kashmir, Himachal Pradesh, Uttarakhand and Arunachal Pradesh. Since there is very less information on genetic variability and stock structure, these two species were selected to assess the genetic variability among different geographically isolated populations and to develop species specific DNA markers as well. Initially, several surveys were performed for availability of both the species followed by samples collected from different locations in Uttarakhand, Himachal Pradesh, Assam, Arunachal Pradesh and Meghalaya.



Brown trout collection at Rupin River

Length weight of each sample was recorded and photographs of each specimen on graph paper were digitized for truss-morphometric analysis. Fin tissues of each sample were collected in 70%

ethanol for genomic DNA isolation. So far, 116 samples of chocolate mahseer and 58 samples of brown trout were collected. DNA was isolated from all the collected fin tissue samples by phenol: chloroform: isoamyl alcohol method, qualitatively and quantitatively estimated, and preserved. The PCR amplification of mitochondrial genes viz. cytochrome oxidase 1 (CO I), ATPase 6/8 and cytochrome b (Cyb) is in progress.

3.5.2 Fish feed

Development of larval feed for *Labeo dyocheilus*

Newly hatched larvae of *L. dyocheilus* were observed for feeding behaviour. Mouth opening was found on 4th day of hatching at 18-22°C water temperature and it starts to feed on 8th day. Rotifers and cladoceran are excellent source of live food for fry rearing. Initial sample of plankton was collected from the fish culture ponds of Bhimtal using plankton net. The freshwater rotifer *Brachionus calyciflorus* was identified and isolated under binocular microscope with fine glass dropper. The isolated rotifer were maintained in a glass beaker and fed with *Chlorella vulgaris* which were raised in outdoor tanks using fertilizers. Culture of rotifers was carried out in vessels by feeding them with chlorella (2x10⁶ cells/ml) and the initial inoculum size and growth performance was evaluated. In outdoor culture, cell density of chlorella was highest as 155x10⁵ cells/ml at 18-22°C after 8 days of inoculation. Size of the initial inoculum was standardized as 20-30 ind./ml. Water temperature of 28±10°C is suitable for rotifer culture with chlorella feeding. Similarly, culture of cladoceran at 16-28°C was standardized with inoculum size of 20-25 ind./ml. A field trial for one week was conducted to standardize the optimum density of plankton for better growth and survival of fry. Best growth and survival (64%) of larvae was achieved with green water and rotifer feeding at the rate of 10 ind./ml for 100 larvae/L stocking density. Fertilizers, cow dung slurry and paddy straw were used for plankton culture with aeration. Green water and rotifer feeding is effective for initial stage of *L. dyocheilus*. However, goat liver suspension at the rate of 50 g/day may be used for 1 lakh fry, whenever natural feeding is not available.

Dietary protein requirement of fry of *Labeo dyocheilus*

Field trial was conducted to assess the dietary protein requirement of *L. dyocheilus* at fry stage. 15DAH larvae were used for the experimentation and 4 formulated diets of different dietary protein level i.e. 20%, 25%, 30% and 35% namely T20, T25, T30 and T35 were tested in triplicates for 60 days (75DAH). Average initial length and average initial weight of fry were 9.2 ± 0.10 mm and 0.011 ± 0.01 g, respectively. At the end of the experiment, the final average length of the fry of treatment T20, T25, T30 and T35 were 40.4 ± 1.70 mm, 44.5 ± 2.10 mm, 53.6 ± 1.40 mm and 53 ± 1.20 mm while the final average weight were 0.552 ± 0.05 g, 0.564 ± 0.03 g, 0.674 ± 0.04 g and 0.682 ± 0.03 g, respectively. The length gain and percent length gain were found maximum in treatment T30 while weight gain (0.671 ± 0.01 g) and percent weight gain (476.08%) with 65% survival was recorded in treatment T35. It was concluded that 35% protein level is optimum for fry rearing.

Growth of *Labeo dyocheilus* fry with formulated larval diet

The increasing cost and scarcity of conventional feed ingredients has created the necessity to find cost-effective and abundant alternate sources of protein. In this context, a short term feeding trial (60 days) was conducted by incorporating *Azolla* (a free-floating weed) as the main protein source in the diet of newly hatched *Labeo dyocheilus* larvae. A test diet having 30% protein was formulated by using soyabean meal, rice polish and paste of fresh azolla. Test diet was compared with plankton feeding and supplementary feeding with rice polish and MOC. Better growth and survival was recorded with formulated diet and periphyton based natural feeding with net weight gain of 0.888 ± 0.02 g, percent weight gain of 8072.7 ± 0.92 , SGR of 8.017 and survival of 62% from 15DAH to 75DAH stage. This encouraging growth performance suggests that *Azolla* can be advocated as an alternative cheaper protein source.

Azolla based feeding to fry of minor carp

Optimum inclusion level of *Azolla* in the diet of fry and fingerlings of *L. dyocheilus* was assessed in a feeding trial of 60 days. Three wet test diets having similar protein level of 30% were formulated with different level of *Azolla* i.e. 20%, 30% and 40% and were tested in triplicates. Diet A30 having 30% azolla with soyabean meal and rice polish recorded better weight gain of 0.782 ± 0.03 g, percent weight gain of 6516.7 ± 0.06 g, SGR of 7.840 and survival of 64% from 15DAH to 75DAH stage. Excess inclusion of *Azolla* in the diet adversely affected the growth and survival. *Azolla pinnata* and *Azolla microphylla* was grown in coldwater condition, analysed for proximate composition and found that it contained 90 to 95% moisture, 22 to 24% crude protein, 6.0 to 6.2% crude fat and 13 to 18% crude fibre. *Azolla microphylla* is suitable to grow in coldwater condition (5-22°C) with production of 5 times biomass in 7 days.



Azolla microphylla

Farm made feed for rainbow trout

A farm made trout feed using poultry/fish offal was developed having protein level of 35% and tested in field. For this, fish/poultry offal was washed thoroughly in hot water, cooled at room temperature and 3% formic acid was added to digest the content so as to get silage (protein 22-24%). Liquid silage was mixed with roasted soyabean cake, wheat flour, vitamin and mineral mixture, asafoetida, turmeric powder and dry hen egg shell powder. In a feeding trial of 120 days, farm made trout feed (FCR-2.2) did not show superior

performance over commercial trout feed (FCR-1.5). However, it was found to be cost effective (Rs. 47/- kg) and can be easily formulated at the farm level. This farm made feed may be further refined to get cost effective acceptable grow out trout feed.

Comparative evaluation of farm made trout feed is given below:

Commercial feed	Farm made feed
Fishmeal & Fish oil is used	Poultry/ fish offal is used
Ingredients are expensive	Easily available local ingredients
FCR-1.5	FCR-2.2
Production cost-Rs.100/ kg	Production cost-Rs.47/ kg
Feeding cost- Rs.150/kg fish	Feeding cost- Rs. 104/ kg fish

3.5.3 Nutrient profiling and evaluation of fish as a dietary component

Under this programme, the nutritional quality of coldwater food fishes viz., rainbow trout, snow trout, chocolate mahseer, common carp, *Labeo dero*, *L. pangusia*, *L. dyocheilus*, *Sanguina sangunia*, *Barilius bendelisis* and *Garra gotyla* were studied. The amino acid score calculated based on World Health Organization protein standard indicated good quality proteins in the above species but with marginally lower values for common carp. When compared with the recommended amino acid levels, all the fish species were found to constitute a good source of essential amino acids. Limiting amino acids lysine, methionine and cysteine occurred at levels higher than or marginally lower than the recommendation. The analysis showed that the cold water species are rich in lysine and aspartic acid. Rainbow trout, snow trout and mahseer recorded good amount of n3 fatty acid (8.69-21.48%) and n-3/n-6 ratio ranged from 0.7-4.98. Chocolate mahseer recorded a good percentage of DHA. Maximum concentration of potassium was found in *Labeo dero* followed by *Labeo pangusia*. Selenium was abundant in *L. dero* followed by *L. dyocheilus*, *S. sangunia*, *B. bendelisis*, *G. gotyla* and chocolate mahseer. This knowledge base about the nutritional quality would enhance the value of fish as a source

of quality animal protein and amino acids and aid in their inclusion in dietary counselling and patient guidance for specific nutritional needs.

3.6 Externally Funded Project

3.6.1 Surveillance of coldwater fish diseases in Himachal Pradesh and Jammu & Kashmir under National Surveillance Programme on Aquatic Animal Diseases (NSPAAD)

Disease Surveillance

Disease surveillance was conducted in four districts of Himachal Pradesh namely Kullu, Mandi, Chamba and Kangra. Base line data was collected from 27 farms. Samples were collected from 21 rainbow trout and 4 carp farms. During sampling, eleven farms in Kullu, eight in Mandi, four in Chamba and four in Kangra were visited. Five morbid fish were randomly selected and twelve samples were obtained from each fish. The samples of each tissue were pooled and transported on ice for detailed laboratory analysis. From the said 27 farms, 1520 samples were collected during April 2014 to March 2015. These samples were analysed by RT-PCR and all the samples tested negative for infectious pancreatic necrosis virus and viral haemorrhagic septicaemia. Moreover, randomly selected 19 samples were used for inoculation of cultured fish cells. These samples did not produce any cytopathic effect, suggesting the absence of these two diseases.

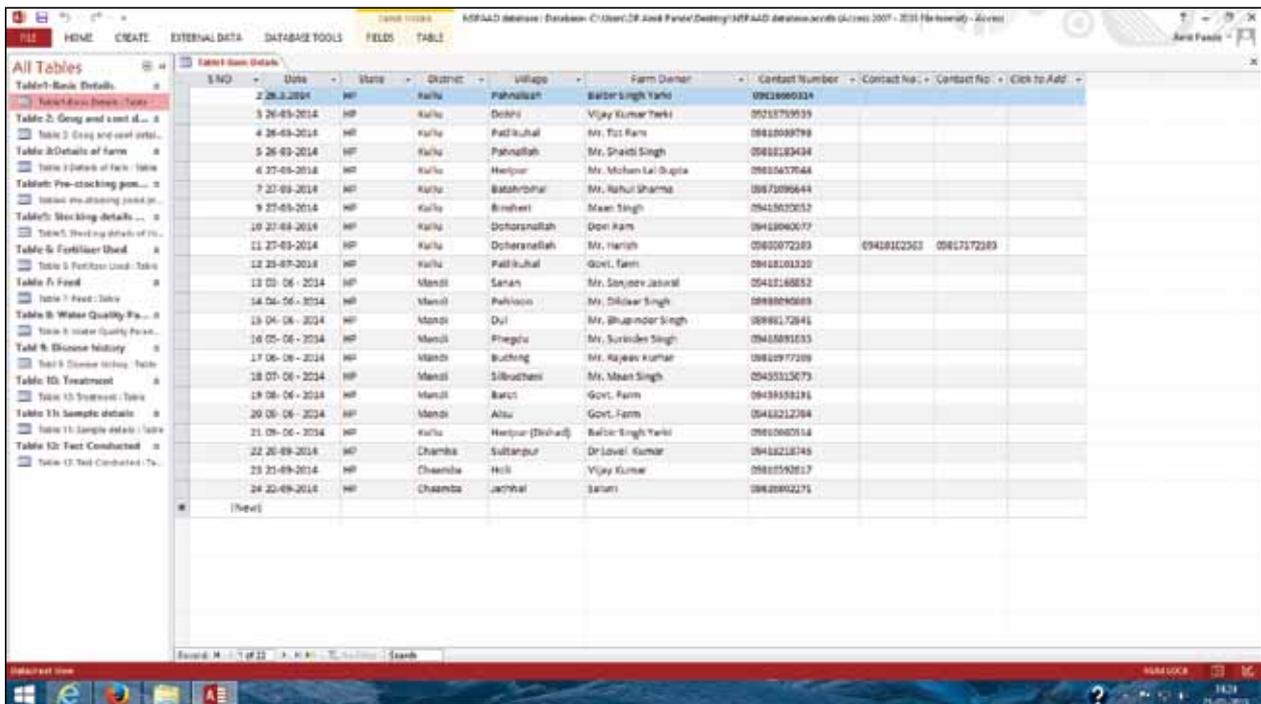
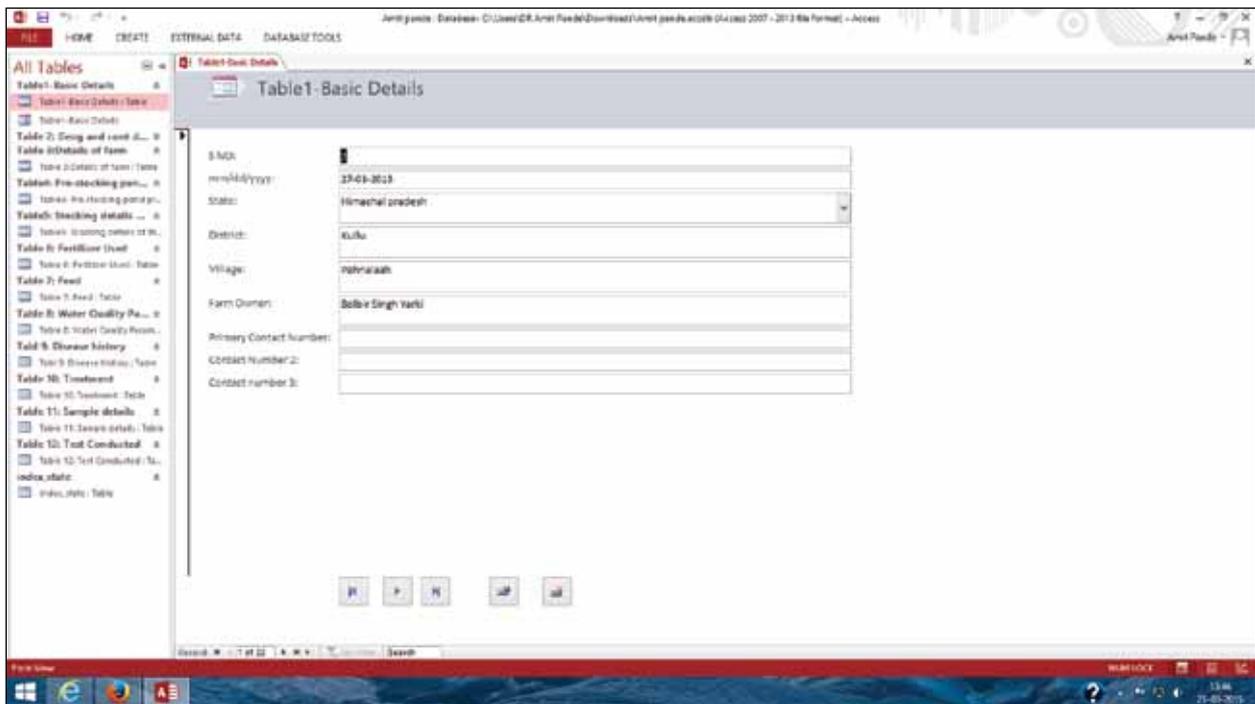


Sample collection from morbid fish

Development of a database for surveillance of diseases

Under disease surveillance programme (NSPAAD) an attempt has been made for developing a Microsoft Access based database. This database has been developed to provide a complete information on farms visited. It contains information on basic

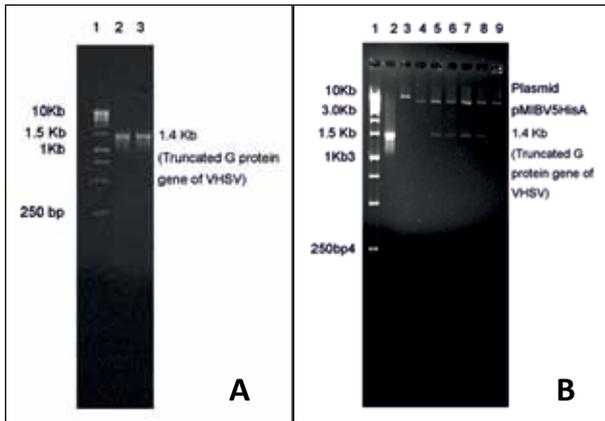
details, geographical and contour details, details of the farm, pre-stocking pond preparation, stocking details, fertilizer used, feed, water quality parameters, disease history, treatment, sample details and tests conducted. In future this database can be a valuable asset for the monitoring of disease surveillance programme.



Screen shot showing the database containing the detailed information of every farm visited.

Development of positive control for the diagnosis of VHSV

For disease preparedness there is an urgent need of a positive control which would enable development of indigenous serological tests in future. To address this issue, experiments are being conducted to obtain a positive control. Using recombinant DNA technology, proteins can be expressed that can be used for diagnosis. To begin with, we have synthesized a truncated glycoprotein gene of viral hemorrhagic septicaemia virus without its transmembrane anchor. This gene has been cloned into an expression vector pMIBV5HISA in order to express soluble VHSV-glycoprotein. To achieve this objective, different methods of transfection in insect cells are being standardized.



Cloning of 1.4Kb truncated PCR product in the expression vector pMIBV5HisA.

A: Amplification of truncated glycoprotein gene of viral hemorrhagic septicemia virus.

Lane 1: Marker, lanes 2&3 1.4Kb amplified product.

B: Restriction digestion of the recombinant plasmids pMIBV5 His A. lane 1: 1KbDNA ladder,

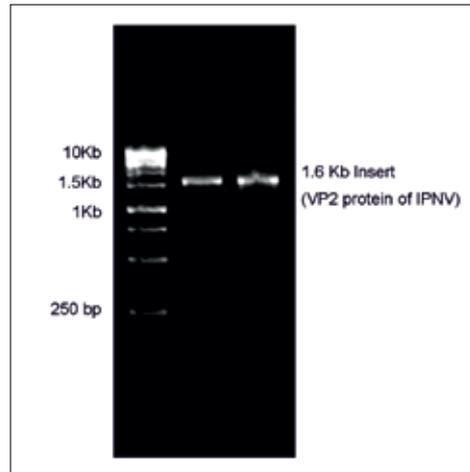
lane 2: 1.4 Kb truncated glycoprotein gene, lane 3 linearized pMIBV5 HisA, lanes 5-9

recombinant plasmids digested with HindIII and XhoI.

Development of positive control for the diagnosis of IPNV

VP2 protein of IPNV is an antigenic protein. Monoclonal antibodies directed to this protein have been effectively used to identify different serotypes. Therefore, if recombinant VP2 could be produced, it could be used as a positive control for sero-diagnostic tests like ELISA, dot-ELISA etc. With an intention to produce recombinant VP2 of IPNV, full length VP2 gene was synthesised and obtained as a

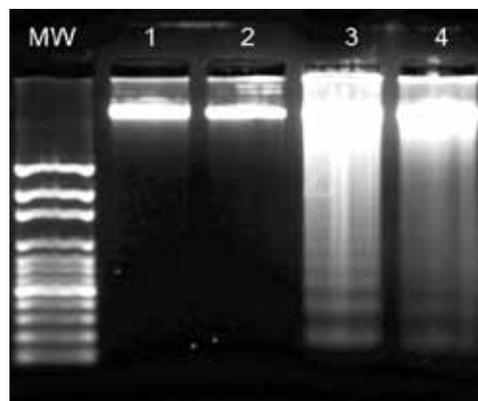
plasmid clone. VP2 gene was then amplified using Pfu DNA polymerase and a PCR product of 1.6kb was obtained and was used to prepare a plasmid construct containing the VP2 gene cloned in an expression vector pTriEx1.1 capable of expressing recombinant protein in both bacterial and insect cells. Further studies are on to test the expression of the said protein.



Amplification of VP2 gene for obtaining 1.6kb fragment that was cloned in the expression vector pTriEx1.1.

3.6.2 Evaluation of genetic toxicity and ecological damage caused by coal mines on fish fauna of Simsang River, Garo hills, Meghalaya and development of microbial bioremediation measures (DBT Twin programme with NE)

Fish diversity present in coal mine affected stretches of Simsang River, Meghalaya have been assessed. Genetic toxicity experiment by using 25% Acid Mine Drainage (AMD) was carried out



DNA laddering test: MW- DNA marker of molecular weight 100bp , 1and 2- Control fish DNA (intact band), 3 and 4 - 25% AMD treated fish DNA showing DNA laddering in kidney and liver respectively

and different blood parameters, histological study, Comet assay, Tunel and FADU assay were done to evaluate genetic toxicity of the AMD on fingerlings of golden Mahseer. AMD samples were processed for isolation and identification of bacteria flora for their ability to degrade coal mine wastage.



Coal mine affected stretches of Simsang river

Based on the results, the primary cause of degradation of water quality and the declining trend of biodiversity in the water bodies of the mining area is attributed mainly to the Acid Mine Drainage (AMD), which makes water highly acidic and rich in heavy metal concentration.

3.6.3 Development and characterization of microsatellite markers and assessment of genetic diversity of *Schistura sikmaiensis* from North-East India (DBT-TWIN-NE)

A microsatellite library was constructed initially to identify the microsatellite loci for *Schistura sikmaiensis*. About 2000 clones were screened in library and 36 loci were identified containing microsatellite regions (during 2014-15). Out of 36 sequences containing microsatellite repeat, 24 sequences were selected for primer designing. The primers were designed using Primer3Plus and synthesized from Eurofins Genomics India Pvt Ltd (India). Initially, all the 24 primers were screened through PCR amplification for optimal annealing temperature and other PCR standardizations using 5 DNA samples each from two populations. Out of 24 primer sets, 9 were found to be highly polymorphic and suitable for population genetic

studies in *S. sikmaiensis*. Other primer sets were either monomorphic or not amplified after repeated trials.

3.6.4 Transcriptome profiling of immune responsive genes in Golden mahseer (*Tor putitora*) (DBT)

The main purpose of this activity was to generate initially a reference database of whole transcriptome of this particular non model fish from different organ's ESTs. Golden mahseer (*Tor putitora*) were collected from the Kosi River, Ramnagar, Uttarakhand and were acclimatized in wet lab (DCFR) condition for 30 days. Water temperature was maintained to 18-20°C. Different fish tissues (Spleen, Liver, Gills, Kidney, Muscles and Brain) were collected in RNA stabilization reagent. Then the tissues were stored at -80°C until RNA extraction. Total RNA was isolated from the collected tissue samples and the concentration and purity were measured with a spectrophotometer and the integrity was visualized with electrophoresis in MOPS/formaldehyde agarose gels at 1.2% staining with ethidium bromide. The quality of total RNA was also verified on 2100 Bioanalyzer, with a minimum RNA integrity number (RIN) value of eight.

Illumina Library preparation and Sequencing

Six paired end RNA-Seq libraries were constructed using the TruSeq RNA sample preparation kit (Illumina). The library preparation and sequencing was performed by commercial service provider (Xcleris Genomics, Ahmedabad, India). The paired end RNA-Seq libraries so constructed were sequenced on MiSeq (Illumina) for generating 2 X 150 bp sequencing reads and were submitted to NCBI SRA (Accession No. SRS783069).

De novo Transcriptome Assembly

The *de novo* assembly and functional annotation was performed using the bioinformatics workflow. The raw reads generated from each sample were subjected to quality check using parameters like per-sequence analysis, per base analysis and over presentation analysis using CLC Genomics Workbench ver. 7.0 (CLC Bio, Denmark). Further,

the reads were separately trimmed for ambiguity, low quality and PCR duplicates. The clean reads were pooled and *de novo* assembled using the CLC Genomics Workbench. The contigs were further assembled into Unigenes using sequence clustering software CAP3. Further, the high quality data of six individual transcriptome were concatenated into single file named as full transcriptome and assembled using Trinity assembler with optimized parameters. A total 77907 transcripts were assembled for full transcriptome.

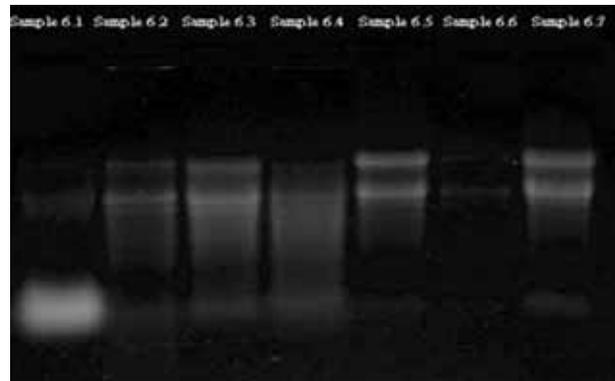
Functional Annotation

Unigenes comprised of contigs and singletons

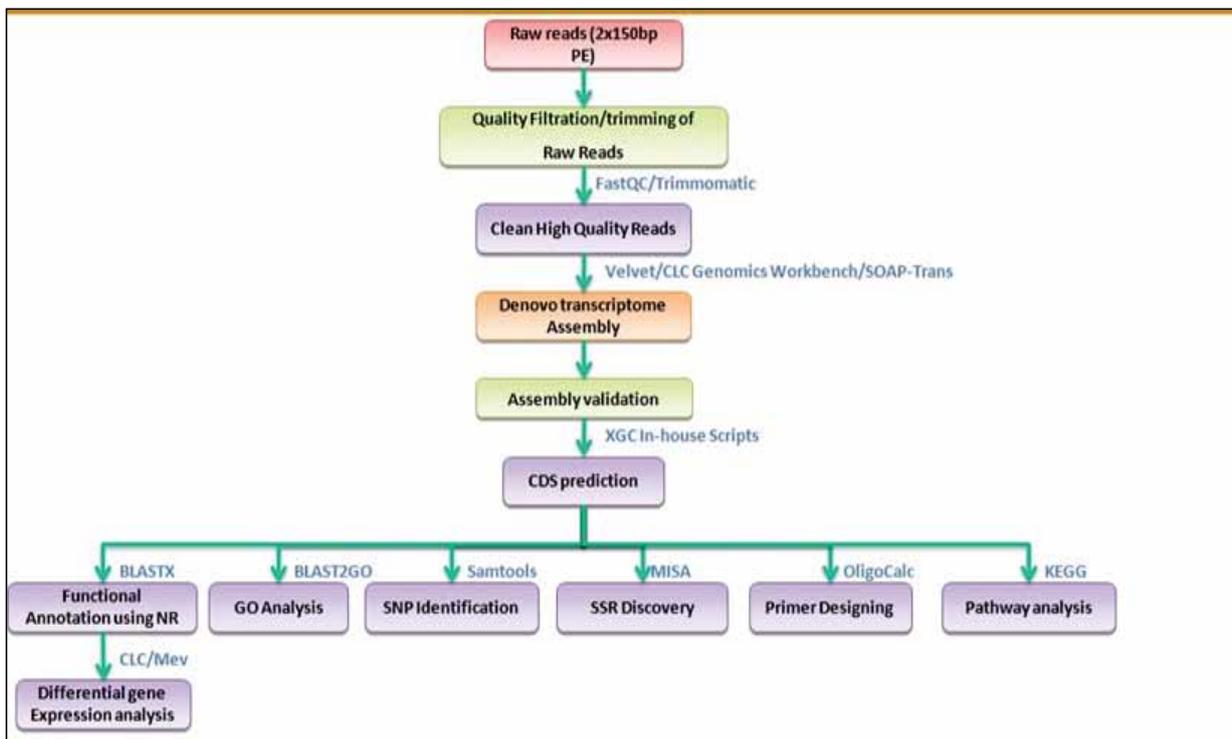
were annotated by performing BLASTX searches in the NCBI non-redundant (nr) protein databases. Homology search for 77907 transcripts was conducted using BLASTX in the NCBI nr database with a cutoff 'e value' of $< 10^{-5}$ for the best hit. Annotations of transcripts subjected to GO classification were acquired by BLASTX searching of the updated universal protein resource (UniProt) database by using Blast2Go program (www.blast2go.org). GO terms were assigned to all annotated unigenes by performing UniProt associations downloaded from the website of the Gene ontology consortium. These terms were further classified and mapped to three GO categories.



Acclimatization of *Tor putitora* collected from wild.



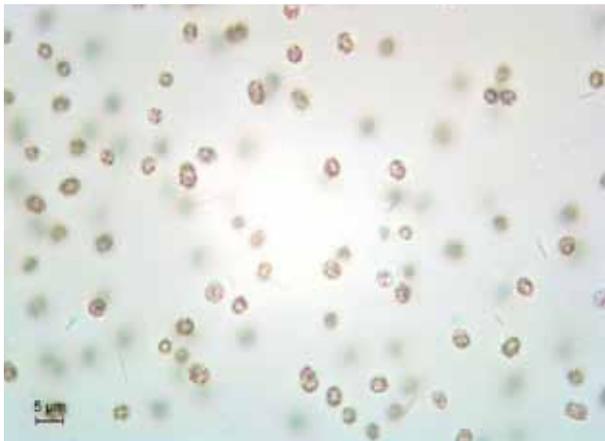
Denaturing agarose gel QC of total RNA (6.2-Spleen; 6.3-Liver; 6.4-Gill; 6.5- Kidney; 6.6-Muscle; 6.7-Brain).



Workflow for the analysis of transcriptome data

3.6.5 Development of bacterial bioremediation measures for the mitigation of micro-algal blooms in freshwater aquaculture ponds (DBT-5)

Microcystis aeruginosa is a harmful freshwater phytoplankton known to produce neurotoxins that cause mass death of fishes in aquaculture ponds. The bloom occurs mainly during summer months, when water temperature is relatively high. Algicidal bacteria have received attention over the past few years as a promising agent to control *M. aeruginosa* bloom. The objective of the present work is to collect *M. aeruginosa* from freshwater lakes (Bhimtal and Sattal) and aquaculture ponds, isolate and characterize associated bacteria. The identified bacteria will be subsequently screened for algicidal activity. Survey of lakes and aquaculture ponds for *Microcystis aeruginosa* bloom was initiated, sampling microalgal blooms and screening of bacteria for algicidal activity is in progress.



Microcystis aeruginosa colonies



Microalgal culture set up

3.6.6 Economic development of SC/ST community of mid hill region of Pithoragarh district through aquaculture intervention (DBT)

Aquaculture was an entirely a new concept in Dharchula block, so preliminary survey was conducted in different areas and sites suitable for aquaculture were located. Based on the resource availability, land suitability and interest of the farmers' so far 23 farmers were selected. Out of which, 4 belong to SC and 19 to ST community. To overcome the water seepage problem in hilly terrain and the economic constraints in cemented pond,



Map of targeted areas in Uttarakhand



Gold fish brooders used for seed production

polythene sheet lined ponds were promoted. A base line data was collected in target socio-economic status of selected farmers and their knowledge of fisheries using semi structured interview schedule was updated in second year, along with the addition of 11 other farmers.

Keeping in view production related limitations; ornamental fish culture was advocated in addition to carp farming. Brood stock of koi carp, gold fish and *Barilius sp.* were maintained in DCFR farm facility and induced breeding was carried out successfully. The 5000 fry produced were distributed to farmers and backyard farming was encouraged for livelihood security. Seeds of carps and ornamental fish species were stocked in the ponds.

Water quality and plankton composition were also observed in these ponds during the reporting period. A total of 29 species of phytoplankton belonging to Chlorophyceae (10 species),

Bacillariophyceae (7 species), Cyanophyceae (7 species) and Euglenophyceae (5 species); and 22 species of zooplankton belonging to Protozoa (5 species), Rotifera (5 species), Copepoda (5 species), Cladocera (4 species) and Ostracoda (3 species) were recorded from different ponds created under this program in upper and lower hill regions.

To assess the growth performance of fish stocked in the polylined ponds, a sampling was conducted in 10 ponds, in December 2014. It was observed that the first year's harvest of fish was around the rate of 3057 kg/ha. The maximum growth of fish recorded in the hill region (altitude 1900-2100 m above msl) was 800 g/year in grass carp followed by common carp 400g and silver carp 450g. For enhancing farmers skill, trainings, interactions and demonstrations on handling of fish, pond management and feeding was arranged for around 60 farmers of Pangu, Himkhola, Chalmachilanso, Galati, Baluwakot and Gothi villages.



Plankton collection from farmer's ponds



Harvested fish

Table. Seasonal variation in physicochemical parameters of water in the created ponds

Parameters (Mean values ± SE)	Upper Hill region			Lower Hill region		
	Winter	Summer	Monsoon	Winter	Summer	Monsoon
Water temperature (°C)	10.5±0.9	20.2±1.9	18.3±1.6	13.6±1.2	25.3±2.3	23.2±2.2
pH	8.3±0.2	8.9±0.3	6.9±0.2	7.5±0.2	7.9±0.2	6.4±0.1
Dissolved oxygen (mg/l)	7.8±0.1	6.1±0.1	7.3±0.2	7.1±0.1	6.6±0.3	7.2±0.2
Alkalinity (mg/l)	165 ±5.1	253±3.9	202±3.7	210 ±5.6	245±5.8	189±4.7
Hardness (mg/l)	155±5.2	192±6.3	182±5.4	188±7.3	238±8.6	159±4.9
TDS (mg/l)	220±8.2	288±7.4	237±6.9	239±7.9	276±6.6	225±8.2
Chlorides (mg/l)	172±5.4	232±6.2	145±4.6	159 ±5.4	220±7.3	180±7.7
Nitrates (mg/l)	3.0 ±0.05	3.9±0.09	2.0±0.06	2.9 ±0.08	4.0±0.09	2.2±0.07
Phosphates (mg/l)	2.7±0.1	3.2±0.1	2.1±0.1	2.7 ±0.1	3.5±0.2	2.0±0.05

4

IMPORTANT EVENTS AND MEETINGS

4.1 Institute Research Committee Meeting

The Institute Research Committee (IRC) meeting of the Directorate was held on 1st and 2nd April 2014 under the chairmanship of Dr. A. K. Singh, Director. All concerned scientists presented their research achievements and proposals, which was followed by thorough discussion. Initiatives taken by the Directorate for NEH and TSP activities was also appraised in the house.



IRC meeting

4.2 Quinquennial Review Team Meeting

The Quinquennial Review Team (QRT) meeting of the Directorate was held at Bhimtal during 24th to 26th April 2014 under the chairmanship of Dr. M. Sinha. Other respected members present during the meeting were Prof. M.M. Goswami, Prof. M.H. Balkhi, Dr. V.R. Chitranshi,



QRT meeting

Dr. Prem Kumar (Member Secretary) and Dr. P.C. Mahanta (as special invitee). The committee visited various infrastructures facilities of the Directorate including fish farm, mahseer hatchery and cage culture unit installed at Bhimtal lake. The committee reviewed the research achievements and future orientation of the Directorate and had discussions with the scientists and administrative staff on various research programs and administrative developments. The committee also received the comments and suggestions of the Institute Management Committee, before finalizing its recommendations.

4.3 Institute Management Committee meeting

Institute Management Committee (IMC) meeting was convened on 26th April 2014 under the chairmanship of the Director Dr. A.K. Singh. Other respected members present during the meeting were Dr. A.B. Pandey, Dr. P.K. Agarwal, Dr. P. Punia, Dr. Malvika Das, Shri A. Srivastava and Shri Y.S. Dhanik (Member Secretary). Issues related to Institute management and proposed procurement were discussed and approved. Members of the QRT also attended and discussed their recommendations.



IMC meeting

4.4 Research Advisory Committee meeting

The Research Advisory Committee (RAC) meeting was convened on 20th May 2014 at Bhimtal, it was chaired by Dr. J.R. Dhanze and the other esteemed members were Dr. S.D. Singh, Dr. H.S. Raina, Dr. S.N. Mohanty and Dr. B.S. Yarki. The committee critically examined the progress and achievements of ongoing and completed projects, after brief project presentation by the respective principal investigators and suggested necessary changes.



RAC meeting

4.5 Fish Farmer's Day

Fish farmer's day and scientist-farmer interaction meet were jointly held at Belkheda, Nanakmatta, Uttarakhand on 10th July 2014. Dr. A.K. Singh, Director, DCFR presided over the programme. It was attended by 71 women and 50 men tribal fish farmers. In his presidential address, Dr. Singh highlighted the importance of aquaculture for income generation and livelihood security of the marginal tribal farmers with small land holdings. On his visit to farmer's ponds, he expressed satisfaction in the growth of the stocked fish and gave valuable suggestions for up scaling of farming practices. Later in the evening, a lively farmer - scientist interaction meet was organised. The Director and scientists contributed in the deliberations and addressed the queries raised by the farmers. Further on the occasion, fish seeds were distributed to the farmers and released in the culture ponds constructed under the Tribal sub plan (TSP). Fish feed was also distributed to the adopted progressive fish farmers of Sauvuara, Belkheda and Pippiliya tribal villages.



Distribution of carp seed



Visit to farmer's pond

4.6 ICAR Foundation Day

To commemorate the ICAR Foundation Day on 16th July, DCFR organised a one day programme on 'Ornamental fish culture' at Khunari Village, Champawat, Uttarakhand. The event was attended by 45 farmers. The chief guest, Shri K.S. Nagniyal, I.P.S., superintendent of police, Champawat, appreciated the efforts of farmer Shri Naveen Chandra Joshi and DCFR scientists for developing the infrastructure for ornamental fish rearing in the remote district and expressed hope that this small beginning will create awareness among local people



Release of ornamental fish seed in farmer's pond

towards entrepreneurship opportunities in ornamental fish rearing and generate secondary income to poor families. 400 Koi and Gold fish seed produced by DCFR was distributed and released in the farmer's pond.

4.7 Independence Day

Enduring the heavy rain, the 68th Independence Day was celebrated on 15th August 2014 with a flag hoisting ceremony. Dr. A. K. Singh, Director, unfurled the national flag and urged the gathering to work in unison towards novel scientific breakthroughs in fish farming and conservation that will augment the socio-economic well-being of the upland population.



4.8 ICAR-DCFR Foundation Day

DCFR celebrated its 27th Foundation Day on 24th September 2014. In his opening remarks, Dr. A.K. Singh, Director, highlighted the historical progress of the Institute; its achievements and services to the upland fish farmers; the future challenges to surmount in fisheries resource management, hill aquaculture and conservation; and the coordinated action to be pursued and strengthened through linkages with state fisheries departments and educational institutes. The chief guest Dr. B.S. Bisht, ex-VC, GBPUA&T, Pantnagar along with Dr. P.C. Mahanta, former Director, DCFR and Dr. J.C. Bhatt, Director, VPKAS, Almora graced the function and emphasized the potential of aquaculture to enhance livelihood in hill areas. On the occasion, Dr. Ajay Rawat, a noted environmentalist delivered an exhilarating talk on "Himalayan Biodiversity". Besides all the scientists, technical staff and research students of this Directorate, local dignitaries, invitees and

farmers attended the function. The celebration was preceded by tree plantation within the campus, and ended with the distribution of carp seed to 11 farmers of Khatima region under TSP programme and handing over of 10,000 golden mahseer fingerlings to the Department of Fisheries, Darjeeling, West Bengal.



Lighting the lamp by Dr. Ajay Rawat



Tree planting by the Dignitaries

4.9 Hindi Saptah Samaroh

The Institute celebrated Hindi week in September 2014 during which the Hindi section conducted several intramural linguistic competitions to promote and recognise hindi knowledge among the scientific, technical and administrative staff of the institute.



Hindi Week competition

4.10 Swachh Bharat Abhiyan

ICAR-DCFR joined the national 'Clean India Mission' launched by the Government of India and carried out a cleanliness drive at Bhimtal on 2nd October 2014. Dr. A.K. Singh, Director led the way and all the staff of the Directorate actively participated in sanitizing the premises in and around the campus. The Director also urged the staff to take up the challenge initiated by the honourable Prime Minister on a routine basis.



Cleanliness drive

4.11 National workshop on Mahseer

ICAR-DCFR organized a two day national workshop on 'Mahseer in India: resources, captive breeding, propagation, policies and issues' at Guwahati on 22nd-23rd December, 2014. Over 133 scientists from all over the country participated in the workshop. In view of the persisting threats to wild population of different mahseer species (*Tor putitora*, *T. tor*, *T. khudree* and *Neolissocheilus hexagonalepis*), it was unanimously agreed to have a national concerted effort to artificially propagate selected species for conservation and aquaculture purposes. During the occasion, a manual 'Mahseer research and development: a journey by DCFR' was released. An exhibition was also organized, in which different fisheries institutes and NGOs participated. Established scientific leaders like Dr. A.K. Singh, Dr. K.K Vass, Dr. P.C Mahanta, Dr. A.P. Sharma, Dr. S.N. Ogale, Prof. W. Vishwanath, Dr. S.K. Das, Dr. P. Nautiyal, Prof. M.H. Balkhi and Prof. R.S. Chauhan took part and deliberated the various strategies to be adopted to save mahseer from extinction. The plenary session was chaired

by Mr. Hemanta Narzary, Commissioner and Secretary, Dept. of Fisheries, Govt. of Assam.



Dr. A.K. Singh delivering keynote address



Dignitaries visiting ICAR-DCFR stall in Exhibition

4.12. Republic Day

Dr. A.K. Singh, Director, hoisted the national flag on 26th January 2015 in presence of other staff members. In his republic day address, he highlighted the achievements of the Directorate during 2014 and encouraged all the scientists and staff members to work in coordination to achieve further milestones for the betterment of the sector.



EXTENSION ACTIVITIES AND OTHER SERVICES

Research outputs and technological developments of the Directorate have been transferred to farmers and other stakeholders through diverse extension activities such as trainings, field demonstrations, farmers' meets and exhibitions.

5.1 Technical support and Training to Farmers

- A farmers' meet was organized on 13th April 2014 at Katahar village, Champawat, Uttarakhand, to provide seed and feed to 35 fish farmers.
- Field Day organized on 24th November, 2014 for sampling of coldwater fish species and productivity analysis in river Kali and Sarju at Panchashwar in Champawat district.
- Another Field Day was organized by DCFR Field Centre Champawat on 9th December, 2014 at Sashatra Seema Bal (SSB), Camp Office of the Commandant, 5th Battalion, and Champawat. Sampling was done for growth and health monitoring of stocked fishes.
- The scientific team of ICAR-DCFR provided complete technical support to the Directorate of Fisheries, Sikkim in developing rainbow trout broodstock, breeding, seed production, feed formulation and health monitoring. Healthy trout broodstock was maintained at the state trout farm, Uttarey and during this breeding season, 3 lakh eyed ova and 1.5 lakh advanced fingerlings were produced. Further, individual brood fish were selected at Uttarey for stock improvement, with the production target of 5 lakh eyed ova in the next breeding season. Also, a wooden stripping stand was designed to reduce the physical stress on the brood fish as well as manpower and to simplify the entire stripping operation. The device was introduced and practically demonstrated to the trout farmers in Sikkim.



Wooden stand for rainbow trout stripping

- Supply of rainbow trout eyed ova to state fisheries department: On 3rd February 2015, about 20,000 rainbow trout eyed ova produced in Chirapani field centre of ICAR-DCFR, were supplied to the Department of Fisheries, Uttarakhand. The concerned Inspector of Fisheries, Mr. Kanak Shah and Dr. Ramesh Chalal, received the healthy consignment at Champawat.
- Conducted field visit to Kataharh village followed by interaction with fish farmers on 7th March, 2015. Another field visit and farm advisory service to SSB Champawat was given on construction of earthen pond for fish culture on 12th March, 2015.
- The scientific team of ICAR-DCFR provided complete technical support to Shergaon Govt. trout farm, Arunachal Pradesh in developing rainbow trout broodstock. Arunachal Pradesh has got immense scope for rainbow

trout farming particularly in the district of West Kameng and Tawang. The water and temperature is favourable for its culture and propagation. However, there has been a constraint of seed availability of rainbow trout in the state although few numbers of brown trout eyed ova was produced at Shergaon and Nuranang trout farm. Keeping this in view, ICAR-DCFR made an effort to transport a consignment of rainbow trout from Jammu & Kashmir during the year 2009 and reared them in the raceways at Shergaon Govt. trout farm. The eyed ova developed into brooders during 2014-15 in the farm condition under technical support of ICAR-DCFR. However, it was realized that seed production could be possible through the developed brooders at the farm. Therefore, ICAR-DCFR supported technically and financially to install an ova house having hatching facility in the said trout farm in order to solve the problem of not getting fry and fingerling of trout.



View of Shergaon trout farm, Arunachal Pradesh



Seed production of rainbow trout in the newly constructed ova house at Shergaon, Arunachal Pradesh

It is noteworthy to mention here that with all these efforts of DCFR with Department of Fisheries, Govt. of Arunachal Pradesh, 1 Lakh fry of trout has been produced during 2014-15 at Shergaon Govt. trout farm, Arunachal Pradesh for the first time. DCFR has taken further initiative to improve the seed production potential of trout providing balanced diet and other management techniques. At present 500 kg of brooders of both rainbow trout and brown trout has been maintained in the farm creating further avenues of trout fry and fingerlings for the farmers of the region.

5.2 Awareness Programmes

- Seed ranching programme of golden mahseer was organised at Kosi river, Ramnagar, Uttarakhand on 25th April, 2014 to increase the native mahseer population. On this occasion, 2000 (hatchery cum cage reared) advanced fingerlings of golden mahseer were released, in the presence of QRT committee Dr. M. Sinha, former Director, CIFRI; Dr. V.R. Chitranshi, former ADG (I. Fy.); Dr. P.C. Mahanta, former Director, DCFR; Prof. M.M. Goswami, dept. of



Ranching of golden mahseer in Nainital lake and Kosi river, Ramnagar

zoology, Gauhati university; Prof. M.H. Balkhi, Dean, college of fisheries, SKUAS&T-K and Forest range officer, Ramnagar. In July 2014, cage raised fingerlings of golden mahseer were released in Sadiyatal lake and Nainital lake.

- Under the DBT programme an Interaction programme was conducted in Pangu, Himkhola, Chalmachilanso and Gothi villages of Pithoragarh district, Uttarakhand for educating farmers about the testing of water quality parameters and fish feeding. Stocking was done in five ponds, stocks of *Cyprinus carpio* (Bangkok and Hungarian strain of common carp), *Hypophthalmichthys molitrix* (silver carp) *Ctenopharyngodon idella* (grass carp) stocked in one pond koi carp was also released. Additionally, a baseline data was generated by collecting information pertaining to the livelihood security of the selected farmers using interview schedule.



Fish sampling in farmer's pond at Pithoragarh

- Demonstration cum rainbow trout seed stocking programme in farmer's pond was organized on 8th June 2014 at Kataharh village, Simalta in Champawat District.

- An awareness camp on the management of Jhora fishery was organized on 27th July 2014 at Kalingpong, Darjeeling, West Bengal. Seed and feed was given to the adopted farmers. Similarly, another awareness camp on integrated fish farming was organized on 9th September 2014 at Nongmahir, Meghalaya.
- In continuation of the painstaking endeavour of ICAR-DCFR, Bimital towards stock enhancement of mahseer, 10,000 fingerlings of golden mahseer and 2000 fingerlings of chocolate mahseer was ranched at Nongmahir Lake, Meghalaya on 9th September 2014, in the presence of Additional chief secretary, Principal secretary (fisheries) and Director of fisheries, Government of Meghalaya; Director, ICAR research complex for NEH Region, Barapani; and Deputy commissioner, Ribhoj District, Meghalaya. This lake was identified as a suitable mahseer habitat and initiative was taken up to develop a Mahseer Eco- Park. On this occasion, an exhibition was arranged on site displaying educational extension material in Khari languages to create awareness among local people and to sensitize them to save and protect mahseer. About 200 fish farmers participated in the awareness-cum-mahseer ranching programme. The chief guest of the



Awareness campaign and seed ranching program

programme, Shri K.S. Kropha, Additional chief secretary, distributed certificate of appreciation to 20 DCFR adopted fish farmers.

5.3 Front line demonstrations

- A front line demonstration (FLD) programme on breeding of improved common carp strains was organized on 30th April 2014 for the fish farmers of Bheti village, Lohaghat (Chommola).
- Under ICAR-DCFR's tribal sub-plan programme, a front line demonstration (FLD) of composite fish culture was organized for the tribal farmers of Udham Singh nagar district of Uttarakhand. During the FLD, water quality monitoring, health management, netting, fish handling and feeding were demonstrated to the farmers. Overall under the TSP scheme, 10 fish ponds were constructed and fingerlings of catla, rohu, grass carp, silver carp and common carps were stocked. On 8th November 2014, harvesting was done after about one year culture duration, and average growth of all species was 1 kg/year. The production was quite satisfactory for the farmers. Further, 1300 fingerlings of silver carp, grass carp and common carp were stocked in 7 new ponds created under TSP.



Harvesting fish crop in farmer's pond

- Another front line demonstration of composite fish culture was carried out for the farmers of 4 villages Pangu, Himkhola, Chalmachilanso and Gothi villages in the Pithoragarh district of Uttarakhand, with the financial support of Department of Biotechnology. Different aspects of fish culture like water quality monitoring, health management, netting, fish handling, feeding and length-weight recording

was demonstrated to the farmers. Further, post harvest baseline information pertaining to income generation through fish culture was made. It was observed that fish (silver carp, grass carp and common carp) production was about 3000 kg/ ha/yr in these remote hilly areas, where fish culture has been introduced for the first time.

- Demonstration cum Field Visit and interaction with fish farmers of village Katarh organized on 7th March, 2015 following heavy rain in the area. Measures to save live stock were suggested.

5.4 Advisory for fish farmers

The scientific team at ICAR-DCFR is regularly involved in providing technical support to the fish farmers and state fisheries department units in the hill states, through personal visits and communication mediums. In particular, a delegated team of scientist visited the farm sites of 34 trout growers in Sree badam, Uttarey, Begha and upper Rimbi villages of west Sikkim. The growth and health of the farmed fish was assessed through field sampling. Farm-specific advisory concerning appropriate stocking density and water flow, grading of growing stock, farm made feed and maintenance protocols for individual raceway was offered. Similarly, the scientific team



Advisory to fish farmers

also visited trout farmers in Kullu valley, Himachal Pradesh and offered inputs concerning farm made feed formulations using poultry offal/fish offal and selection of broodstock. In Uttarakhand, the farmers were advised to do carp farming in polytanks with the integration of horticultural crops and this was successfully adopted by the farmers of Todera and Dudhauri villages in Almora district, Uttarakhand. Specific technical guidance was provided with respect to design of polytank, selection of species and stocking density. To strengthen these farm advisories further, ICAR-DCFR has initiated the “MERA GAON MERA GAURAV” scheme. Each scientist of this Directorate will be in constant touch with farmers of the adopted village to facilitate the flow of technical information.

5.5 Participation in Exhibitions

The research and development activities of ICAR-DCFR in coldwater fish species were highlighted and exhibited at several conferences and kisan melas organized in different parts of the country during the year 2014-15. Notable participations were:

- Exhibition during ‘Awareness campaign and seed ranching program’ at Nongmahir, Meghalaya on 9th September 2014 and displayed educational extension material in Khari languages to create awareness among local people and to sensitize them to save and protect mahseer.
- Exhibition in ‘Kisan Mela’ organized by VPKAS, Almora on 30th September at Hawalbagh, Almora.



Dr. A.K.Singh as guest of honour during kisan mela organised by VPKAS Almora

- Exhibition in 96th Agro industrial exhibition and Krishi kumbh at GBPUAT during 5 to 8th October, 2014.
- Exhibition in ‘National conference on challenges for sustainability of natural resources and Environment with emphasis on Aquatic ecosystem for livelihood security’ organised by College of Fisheries, GBPUA&T, Pantnagar and Academy of Environmental Biology during 5 to 8th October, 2014.
- Exhibition in Kisan Mela organized at KVK, Lohaghat on 15th October, 2014.
- Exhibition in connection with Kisan Mela organized by IVRI, Mukteswar at Nathuakhan on 28th October, 2014.



Hon’ble Shri N.S. Koshyari, MP Nainital in ICAR-DCFR stall during Kisan Mela, IVRI, Mukteswar

- Exhibition at ICAR-NBFGR, Lucknow in the 10th Indian Fisheries and Aquaculture Forum during 12-15th November, 2014.



Hon’ble DG, ICAR and President, NACA in ICAR-DCFR stall during 10th IFAF, Lucknow

- Exhibition in 'International Symposium on Biodiversity: Status utilisation and impact of Challenging conditions' organised by Babasahib Bhimrao Ambedkar University, Lucknow in collaboration with Indian Academy of Environmental Science, Haridwar during 30 to 31st October, 2014.
- Exhibition in connection with National workshop on 'Mahseer in India: Resources, Captive Breeding, Propagation, Policies & Issues' organised by DCFR at Guwahati during 19 to 20th December, 2014.
- Exhibition in ASC Indian Expo on the occasion of 12th Agricultural science congress organised by NAAS New Delhi at NDRI, Karnal during 3 to 6th February, 2015.



Dr. A.P. Sharma, Director, CIFRI & Dr. J.K. Jena, Director, NBFGR along with Dr. A.K. Singh at ICAR-DCFR stall, ICAR-NDRI, Karnal

- Exhibition in connection with 17th Indian Agricultural Scientist and farmers congress on Agri-innovation for enhancing production and Rural employment by Bioved Research Institute of Agriculture and Technology, Allahabad during 21 to 22nd February, 2015.
- Exhibition in Krishi vigyan mela organized at ICAR-IARI at New Delhi during 10 to 12th March, 2015.
- Exhibition in Krishi Kumbh organised by GBPUA&T, Pantnagar during 13 to 16th March, 2015.
- Exhibition in Regional Agriculture Fair organised by ICAR-IVRI, Bareilly during 17 to 20th March, 2015.

5.6 Interaction with Farmer and Students

- A batch of 15 students from Govt. Inter College, Ramgarh, Uttarakhand visited DCFR and interacted with Scientists on 9th May, 2014.
- A group of 10 students from MITRI, Bhimtal visited DCFR and interacted with Scientists on 19th May, 2014.
- A batch of 23 students from College of Fishery Science, Sri Venkateswara Veterinary University, Muthukur, Nallore, Andhra Pradesh visited DCFR and interacted with Scientists on 28th June, 2014.
- A group of 11 fish farmers from ATMA, Distt. Mandi, Himachal Praesh visited DCFR and interacted with Scientists on 28th August, 2014.
- A batch of 10 students from Kendriya Vidyalaya, Bhimtal visited DCFR and interacted with Scientists on 29th September, 2014.
- A group of 19 students from St. Andrew's College, Gorakhpur visited DCFR and interacted with Scientists on 7th October, 2014.
- A group of 59 students from College of Veterinary, AAU, Gohawati, Assam visited DCFR and interacted with Scientists on 18th October, 2014.



Student visitors at ICAR-DCFR, Bhimtal

- A group of 95 students from Wood bridge school, Sattal, Bhimtal visited DCFR and interacted with Scientists on 20th October, 2014.
- Two Students from Lagta levis pasture Institute Franch La Canoug La Conourgeec under trainee at College of Fisheries Pantnagar visited DCFR and interacted with Scientists on 30th October, 2014.
- A group of 24 Scientists/Assistant professors undergoing training in Kumaon University, Nainital (Refresher course, UGC-ASC) visited DCFR and interacted with Scientists on 5th November, 2014.
- A batch of 7 students from Faculty of Fishery Science, West Bengal University of Animal & Fishery Science, Kolkatta visited DCFR and interacted with Scientists on 23rd November, 2014.
- A group of 24 students from Department of Zoology, MG PG College, Gorakhpur visited DCFR and interacted with Scientists on 30th January, 2015.
- A group of 50 students from Department of Zoology, University of Calcutta, Kolkata visited DCFR and interacted with Scientists on 21st March, 2015.

5.7 Farm activities

Breeding and seed production of rainbow trout at Field Centre, Champawat

Total 144 female rainbow trout brooders in the size range of 750-1800 gm were stripped for seed production during 19.12.2014 to 30.01.2015 at ICAR-DCFR field centre, Champawat. To minimize handling and stripping stress, clove oil was used as anaesthetic at the rate of 40 mg/l. Average fecundity of brooders ranged between 1600-2000 no. of eggs/kg body wt. Total 2.8 lakh eggs were stripped and fertilization rate was recorded between 72-85%. Hatching duration was observed to be 40-50 days at temperature range of 4.5-9.1°C. A total of 1.68 lakh of eyed ova were produced. Presently 20,000 fry of rainbow trout is being reared at Champawat trout hatchery.



Stripping of rainbow trout



Fertilized rainbow trout eggs



Hatchlings of rainbow trout

Brood stock development and seed production of snow trout (*Schizothorax richardsonii*) at Field Centre, Champawat

Collection of snow trout (*Schizothorax richardsonii*) from river Ladhya, Sariyu, Ramganga and Gaudi was carried out periodically for undertaking feeding, breeding and rearing trials at Field Centre, Champawat under farm conditions. Maturing female (Avg. weight 60.84±18.79 g and Avg. length 200.40±22.69 mm with GSI of

16.60±4.44) and male Avg. weight 26.40 ±13.94 g and Avg. length 144.00 ±40.36 mm with GSI of 11.11±2.68) brooders were also collected from nearby fast flowing streams and rivers and reared in captive conditions. Stripping and fertilization was normal, but development and survival of eggs was low in hatchery conditions. Adult and fry rearing is in progress at Field Centre, Champawat.



Stripping of snow trout



Fertilized eggs of snow trout

Breeding and rearing of improved Hungarian common carp and Bangkok strain of common carp at Field Centre, Champawat

Breeding of improved Hungarian common carp and existing Bangkok strain was undertaken at Champawat farm during May, 2014. Selected male and female brooders were kept in breeding hapas and all the strains of common carp were bred without any hormonal manipulation. Comparative assessment of breeding performance, growth and survival were carried out. Hybridization of Hungarian and Bangkok strain of common carp resulted in higher growth compared to existing Bangkok strain at Champawat farm. Stunted seed of Hungarian Common carp are being reared at Champawat farm.



Sampling of Hungarian common carp

Introduction of brown trout at Champawat fish farm

Two thousand brown trout fry were taken from state fish farm Barot, Himachal Pradesh. They were brought to experimental fish farm and field centre at champawat for rearing.



Fry of brown trout

Water quality monitoring and fish health management at Field Centre, Champawat

Regular water quality monitoring was carried out in trout and carp raceways and in farmers' fish tanks. During 2014-2015, trout raceways and nurseries recorded minimum water temperature of 4°C in the month of December and maximum of 26°C in June while in carp rearing tanks it

ranged between 5.1 -28.8°C. Infection was noticed in trout sperm duct, lower alimentary canal and kidney which was controlled through medication and adoption of improved management practices. Regular cleaning and disinfection of trout hatchery, bigger trout raceways and carp tanks was undertaken periodically to maintain a healthy live stock in the farm. A recirculatory system is presently under construction at Champawat centre.

Resource generation at Field Centre, Champawat

The Field Centre at Champawat generated net revenue of Rs. 2,43,273 during 2014-15.

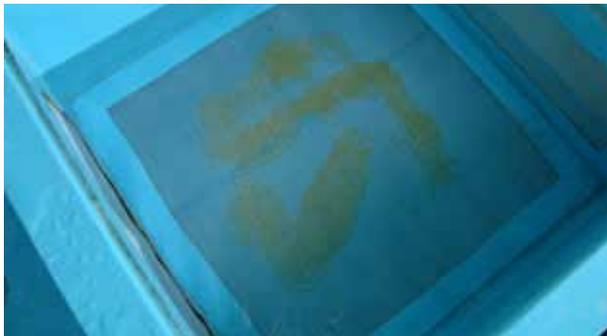
Seed production of golden mahseer at ICAR-DCFR, Bhimtal

The Directorate has produced 70,000 fingerling of golden mahseer in the mahseer hatchery complex this year. The hatchery management practices have been standardized achieving 90% fertilization and 80% hatching success. 20,000 seed was supplied to Fisheries Federation, Bhopal, Madhya Pradesh and earned a revenue of Rs. 1 Lakh. 10,000 hatchery produced seed were also transported to Nongmahir

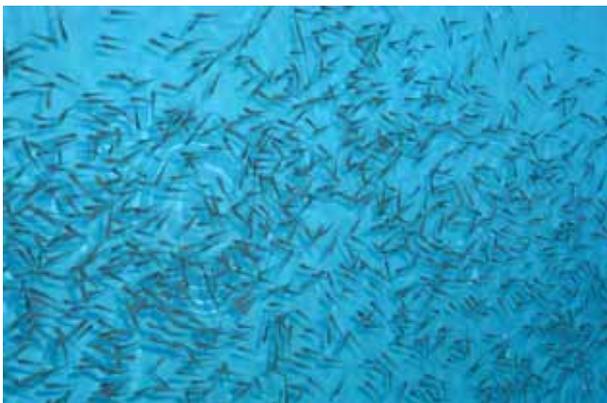
Lake, Meghalaya for stocking into the lake for rehabilitation and propagation. 10,000 fingerlings into the Nainital Lake and 1000 fingerlings in the Sariyat Lake were also released for restoration and development of eco-tourism park respectively.

Rearing of golden mahseer fry in floating cages in Bhimtal lake

The Directorate has consistently been involved in the rehabilitation and propagation of golden mahseer in different coldwater lakes and rivers by ranching golden mahseer in its fry stage. With an aim to produce healthy stocking material and to get higher survival, the golden mahseer fry were reared in floating cages installed in Bhimtal lake in *in-situ* conditions. Five thousand fry produced at DCFR Mahseer Hatchery were transferred to floating cages of size 2 x 2 x 2 m during October, 2013 and reared for 10 months. The growth and survival were monitored regularly. After attaining the desired size, the golden mahseer fingerlings were ranched in different coldwater lakes and river including Kosi river, Sariyat lake, Nainital lake and Nongmahir lake (Meghalaya) for its rehabilitation and stock enhancement.



Incubation of eggs



Mahseer seeds



Rearing of Mahseer fry in floating cages

TRIBAL SUB PLAN (TSP) ACTIVITIES

6.1 Initiative of Trout farming in High lands of Leh region

District Leh is a tribal dominant district where ICAR-Directorate of Coldwater Fisheries Research (DCFR), Bhimtal has proposed to play a vital role in improving socio-economic status of the tribal populations of this harsh agro-climatic region. ICAR-DCFR, Bhimtal initiated highland trout farming programme under Tribal Sub Plan during 2013-14. The programme was initiated after a detailed survey and suitable sites for trout farming were selected in Chushout Shamma village of Chushout block, which is about 20 kilometres from the Leh district head quarters having a perennial source of water. Initially five new raceways were



Trout raceways at Chushout Shamma village of Leh region



Dr. A.K. Sikka, DDG (NRM), ICAR and Dr. M.M. Roy, Director, CAZRI releasing rainbow trout seed in raceway

constructed and three raceways were renovated belonging to four beneficiaries of the village during 2013-14. Ten thousand number of trout fingerlings (average weight of 10 gram) were stocked and trout feed was also distributed to the beneficiaries. The seed was released in the DCFR developed raceways by Dr. A.K. Sikka, Deputy Director General (NRM), ICAR on 29.8.2014 in a ceremony of 'seed and feed distribution programme' organised by DCFR with High Mountain Arid Agriculture Research Institute, Leh (HMAARI, SKUAST-K) and RRS, CAZRI-Leh and State Fisheries Department (J&K). Five new trout raceways belonging to two women farmers have been created during 2014-15 and which are to be stocked soon.

6.2 Aquaculture initiatives in disadvantaged areas of Uttarakhand

Based on feasibility surveys that included environmental, social and resource considerations, few villages in the border district Pithoragarh, Uttarakhand, was found to be suitable for rainbow trout culture. Consequently, two trout raceways were constructed in Teentola, Dharchula Pithoragarh, under the TSP programme of ICAR-DCFR. Five more similar raceways are further under construction in Munsyari region.

Another survey was conducted on different ponds created in district Khatima on 08.11.2014 and around 1300 seeds of silver, grass and common carp were released in 7 new ponds belonging to ST beneficiary, which have been created under TSP programme. Training cum demonstration was conducted in Khatima and farmers were given demonstration about feeding and water quality management. the programme was coordinated

by R.S.Patiyal. At the farmers pond one year's production/ growth was demonstrated and observed. Average wt. was 1000g in a year, which indicates that the environmental conditions

prevailing in the area are better for the growth of carp fishes. Water parameters were noted and planktons were also collected for further study in laboratory.



Trout raceways created in Pithoragarh under TSP



Seed distribution to tribal farmers in village Pangu



Fish production in tribal farmer Shri Chanchal Singh's ponds



Seed banking under TSP



Munshyari - a new tribal area identified in Uttarakhand for expansion of trout culture under TSP

6.3 Initiatives on revival of Jhora Fishery in West Bengal

A field survey was conducted to restore the possibilities of strengthening “Jhora Fisheries” in three different villages of Kalimpong, GTA, Darjeeling dist. of West Bengal. 12 farmers were selected based on merit at the initial stage from Sindebong village. The farmers were provided one day training for motivation and revival of traditionally important of “Jhora Fishery” for the improvement of their livelihood on 25 July, 2014. During the program yearlings of chocolate mahseer were distributed to the farmers for stocking in the “Jhora ponds”.



Training program at Kalimpong GTA, Darjeeling, West Bengal



Distribution of chocolate mahseer (Katli) seed

is agriculture and collection of fire wood from hills and forest in the vicinity of their villages. In the month of January 2014, selected ponds were renovated and one pigsty (size: 20x10 feet) to each farmer have been constructed in traditional mode. As a part of fulfillment of components of the objectives, 7000 yearlings (40-55 g) of Rohu, Catla and Mrigala were distributed to the farmers and after eight months of rearing the fishes attain a weight of 530- 750 g. 10 Piglets (2 months old & size: 5.8 kg in Average) were also given to farmer.



Pond construction



Pig sty

6.4 Integrated farming in Assam

Community based Integrated Fish Farming was promoted for sustainable livelihood and socio-economic upliftment of few selected ST beneficiaries of Kamrup district of Assam.

In this connection, six tribal farmers of Kamrup district and their natural ponds have been selected. The Village Khokhori, Phulguri of Chaygaon, kamrup district of Assam belongs to the tribal community. The main profession of the community



Piglets distributed to farmers

7

NORTH EAST HILL (NEH) PROGRAMME

Under the NEH programme various activities were undertaken in different north eastern states including Assam, Arunachal Pradesh, Meghalaya and Sikkim and are described hereunder:

7.1 Development of broodstock for King fish, *Semiplotus semiplotus* (McClelland, 1839)

Semiplotus semiplotus is an endemic and highly preferred food fish species available in the lotic systems of Arunachal Pradesh and foothills zones of North-eastern states. However, the population of this species is declining at alarming rate in most of the river systems of Arunachal Pradesh because of anthropogenic activities, over exploitation from open water bodies and other developmental activities. Therefore it is high time to take up conservation measures to restore this rapidly declining wild population by induced breeding them in captivity and ranching in their natural habitat. For this, ICAR-DCFR in partnership with Rajiv Gandhi university, Itanagar, Arunachal Pradesh, initiated a project on 'Development of broodstock for king fish, *Semiplotus semiplotus*'. To begin with, a brood bank facility for *Semiplotus* was started at Jasingffa aqua tourism centre, Nagaon, Assam. Moreover, a total of 1050 fingerlings of *Semiplotus* were collected from Dikrong river and Sinki river of Papumpare district, Arunachal Pradesh during October 2014 to March 2015, sorted according to their size group and segregated in to different cisterns for future stocking in various farms or in running water deep cisterns of RGU. In all the farms and cisterns, water quality parameters were regularly monitored and supplementary feed is being given at the rate of 5% of the body

weight (formulated feed in addition to weekly application of lithophyton in cisterns and other natural algal fish food in farm ponds).



Collected fingerlings of *Semiplotus*



Stocking of *Semiplotus* in cisterns for brood stock development

7.2 Culture of *Osteobrama belangeri* and *Bangana devdevi* along with Chinese carps

Another collaborative project on "Culture of *Osteobrama belangeri* along with Chinese carps for production and livelihood upliftment in Thoubal district of Manipur" has been taken up by ICAR-DCFR and Krishi Vigyan Kendra, Thoubal, Manipur. Under this project, 10 fish

farmers were selected. Initial stocking in four different combinations of Grass carp, Silver carp, Pengba in the ratio of 25:25:50, 30:30:40, 35:35:30, 40:40:20 and one in combination of Pengba and Khabak (*Bangana devdevi*) in the ratio of 50:50 have been done in their ponds.



Stocking of Pengba and Khabak in ponds



Osteobrama belangeri and *Bangana devdevi*

7.3 Construction and establishment of ova house for seed production of trout

An ova house has been constructed at Shergaon Govt. trout farm, Arunachal Pradesh. The troughs and trays have been provided by ICAR-DCFR and are fixed according to the technical suggestions given by ICAR-DCFR. The newly constructed ova house has been

used for trout breeding during 2014-15. The Shergaon trout farm is maintaining about 500 kg brooders of rainbow and brown trout. During this year (2014-15) one lakh fingerlings of rainbow and brown trout was produced.



Functional ova house of trout at Shergaon trout farm, Arunachal Pradesh

7.4 Development of brood stock of golden mahseer at Jasingffa Aqua Tourism Centre, Nagaon and at ABACA, Nameri, Assam

Two hundred brooders of golden masheer were reared in the brood stock pond at Jasingffa Aqua Tourism Centre and at ABACA, Nameri, Assam for its seed production with a view to rehabilitate and propagate this endangered fish.



Mahseer brood bank at Jasingffa Aqua Tourism Centre, Assam



Mahseer brood bank at Eco-camp, ABACA, Assam

7.5 Promotion of Trout farming in Sikkim State

There is an inherent potential of trout farming in Sikkim State having good water quality and sufficient quantity of cool, clean and flowing water. ICAR-DCFR, Bhimtal is technically associated with State Fisheries Department for promotion of Trout farming. Trout farming is an important enterprise for livelihood security to the rural people of Sikkim State. A healthy brood stock has been maintained at different Government trout farms with the technical guidance of ICAR-DCFR. 500 kg brooder of Rainbow trout reared at Uttarey trout farm, fed with pelleted feed, maintained 300 LPM water flow in raceway

and achieved success in breeding with the production of 1.5 lakh advanced fingerlings and 3 lakh eyed ova of Rainbow trout. Wooden stripping stand designed by ICAR-DCFR was practically demonstrated to the farmers. Individual selection of the brood stock was carried at Uttarey for the stock improvement with the target of 5 lakh eyed ova production in the next breeding season.

A preparatory dose of Ovaprim @ 0.1 ml/kg was given to selected females during first week of September, which showed 15 days earlier maturity. Brooders of the age of 3-5 years showed earlier maturity (15 days) than the previous year. Dry stripping method was applied for the spawning at the water temperature of 9-14.6°C. Fecundity was recorded as 1350-1500 eggs/kg., fertilization rate 96%, survival upto eyed ova 76%, hatching rate 90% and cumulative survival of 72%. Milt of 3 males was mixed with eggs of 2 females to reduce inbreeding. Incubation period was 28-37 days at 9-14.6°C. The size of resultant yolk-laden alevin (early fry) ranged from 16-18 mm. Advance alevin started feeding after 12-14 days, when 3/4th absorption of the yolk sac had been completed and fed with specially prepared starter feed having 40% protein. Better growth and survival was recorded with sufficient water flow, adequate feeding and health care.

CONSULTANCY

Study on fish and fisheries of Yamuna and Tons & its tributaries in Uttarakhand under Institutional Consultancy

Under the Cumulative Environmental Impact Analysis of Yamuna and Tons & its tributaries in Uttarakhand as an Institutional Consultancy, work has been undertaken on the study of aquatic flora and fauna. Detailed sampling was conducted at 28 locations along the Yamuna, Tons and its tributaries. The field data on physico-chemical parameters of water and aquatic flora and fauna were collected in Yamuna starting from Janaki Chatti to Ponta Sahib and in Tons from Naitwar-Mori till confluence of Yamuna and Tons, and from tributaries of Yamuna and Tons rivers.

Salient findings

Planktons and Primary productivity

Important physico-chemical parameters were estimated during different seasons in the river Yamuna and its tributaries and were recorded in the range of 5.8 to 23.2°C during different seasons. In upper zone it varied from 5.8- 15.4°C, in the middle zone it varied from 8.5-20.2°C and in the lower zone it ranged from 18.0-22.0°C. The dissolved oxygen (DO) ranged from 8.0-10.8 mg/L. The overall primary productivity in the upper zone of River Yamuna and Tons is poor as compared to middle and lower zone of the river. Net Primary Productivity (NPP) in the upper zone was estimated and found as very low in the range of 23.6-42.6 mgC/m³/day; in the middle and lower zone ranged from 37.9-112.5 mgC/m³/day and 147.6-349.9 mgC/m³/day respectively. Nutrients provide the baseline for the productivity of these aquatic water bodies which supports the existence and

abundance of Ichthyofauna. Land use, change in physiographic features and soil/substratum type interact with lotic habitat to determine stream nutrient concentrations, which in turn affect the quality of aquatic assemblages. The phytoplankton inhabiting river Yamuna and Tons and its tributaries comprised of Bacillariophyceae (20 genera), Chlorophyceae (17 genera), Myxophyceae (Cyanophyceae, 7 genera) and Euglenophyceae (2 genera). The Bacillariophyceae dominated the phytoplankton fauna followed by Chlorophyceae and contributed around 73% and 21% of total biomass, respectively. Quantitative analysis showed that the density of phytoplankton was observed comparatively higher during pre-monsoon season with least occurrence in post-monsoon season. The contribution of green algae and blue green algae was comparatively less in almost all zones. A seasonal trend was observed with increased density of phytoplankton with increasing temperature and thus was found higher during pre-monsoon period. Seasonal variation in the diversity and density was well marked at different locations. Different hydrobiological features such as discharge and water residence time play an important role in planktonic development in the river. The zooplankton inhabiting in the sampling area of Yamuna basin comprised of 32 taxa of which Protozoan (9 genera), Rotifers (9 genera), Copepods (6 genera), Ostracoda (2 genera) was recorded. Among total zooplankton Rotifers (48%) dominated followed by Protozoans (28%) and Copepods (18%). The group rotifers dominated in the stream. The zooplankton density increased with decreasing altitude. The upper zones of Yamuna and Tons do not support rich zooplankton diversity and density

and their occurrence was occasional and also recorded in low number. The species diversity of planktons at different location during different seasons was estimated based on Simpson and Shannon indices. Simpson index was estimated in the range of 0.6-0.8 while Shannon index was estimated in the range of 1.0-2.4 which indicated poor to medium diversity of planktons.

Ichthyofaunal diversity

During the present survey from Yamuna and Tons and its tributaries a total of 35 fish species belonging to six orders namely Cypriniformes, Perciformes, Beloniformes, Mastacembeliformes, Siluriformes and Salmoniformes were recorded during the three seasons viz. pre-monsoon, monsoon and post-monsoon. Of these cypriniformes comprises the dominant group represented by 19 species belonging to 9 genera. *Schizothorax spp.*, *Barilius spp.* and *Tor spp.*, was the common species. Fish abundance was higher in the lower

reaches of Yamuna and Tons as compared to upper reaches. Important fish species recorded were *Schizothorax richardsonii*, *Nemacheilus spp.*, *Barilius spp.*, *Raimas bola*, *Tor spp.*, *Puntius sp.*, *Hypophthalmichthys molitrix*, *Labeo dero*, *L. dyochelius*, *L. rohita*, *Cirrhinus mrigala*, *Cyprinus carpio*, *Bagarius bagarius*, *Pangasius pangasius*, *Ompak bimaculatus*, *Mastacemblus armatus*, *Garra gotyla gotyla* and *Glyptothorax sp.* The exotic brown trout species (*Salmo trutta fario*) was observed in the river Rupin above Mori. The area has sizable population of brown trout which migrates into the stream for breeding. This species plays an important role in the development of aquatourism and sport fishery. Yamuna basin inhabits two major types of migratory species viz. snow trout (*Schizothorax spp.*) and mahseer (*Tor spp.*). Snow trout was found as dominant species in the middle zones of Yamuna and Tons. A total of 7 fish species are under various RET categories of IUCN red list.

TRAINING AND CAPACITY BUILDING

In the year 2014-15, the Directorate was actively involved in sharing knowledge and developing the skills of researchers, fisheries department officials, farmers and all interested stakeholders of coldwater fisheries sector through various short courses and trainings. The details of the trainings organized are provided below.

9.1 Short course on 'Application of molecular tools in coldwater fisheries management'

This ICAR short course was organized during 2nd - 11th June, 2014 at ICAR-DCFR, Bhimtal. 21 participants from 8 states of India attended the training programme. The participants were given an overview of the available molecular techniques and their applications in the study of genetic variability and diversity of species and populations. Detailed

lectures and practical sessions were offered on mtDNA based species barcoding, development of microsatellite markers, gene discovery and bioinformatics tools. Primer designing, gene search and multiple sequence alignments was demonstrated to the participants. Field visits to CITH, Mukteswar; IVRI, Mukteswar and PDFMD, Mukteswar, were organised. Guest lecture on different genome browsers/softwares and analysis of Next Generation Sequencing data were also delivered.

9.2 Training programme on 'Hatchery management and seed production practices of golden mahseer'

National Fisheries Development Board (NFDB) sponsored training programme on "Hatchery management and seed production practices of golden mahseer" was organized



Practical demonstration in lab & group photograph



Dr. A.K. Singh delivering inaugural address & release of conservation sticker

at ICAR-DCFR, Bhimtal during 23rd to 27th September, 2014. It was attended by a diverse group of 28 participants including officials from different state fisheries departments and assistant professors from all over the country. Dr. A.K. Singh, Director, DCFR, inaugurated the programme and briefed about the need to conserve and rehabilitate golden mahseer, the king of game fishes. The training integrated both theoretical and practical aspects of hatchery management, breeding and seed production of golden mahseer. A training manual and conservation sticker on 'Join us for rehabilitation and propagation of golden mahseer' was released on the occasion.

9.3 Training programme on 'Management practices of Jhora fisheries'

National Fisheries Development Board (NFDB) sponsored training programme on 'Management practices of Jhora fisheries' was organized at Kalimpong, Darjeeling district of West Bengal during 15th to 19th January 2015. The key objective of the training was to impart technical knowhow regarding organic management practices for chocolate mahseer (*Neolissochelus hexagonalepis*), common carp (*Cyprinus carpio*) and grass carp (*Ctenopharyngodon idella*) in Jhora fisheries pond. Smt. Nhamu Lamu Sherpa, Executive Director, Gorkhaland Territorial Administration graced the occasion as a Chief Guest of the inaugural session and motivated the participants to adopt fish farming as an alternative livelihood. It was attended by a diverse group of 33 participants including officials from different state fisheries departments, KVKs and farmers. Detailed lectures and field demonstration at Jhora fish pond were included in the training.



Field demonstration at Jhora fish pond

9.4 Training programme on 'Culture and breeding of important coldwater fish species'

NFDB sponsored training programme on 'Culture and breeding of important coldwater fish species' was organized at Rajiv Gandhi University, Arunachal Pradesh during 20th to 24th January 2015. The training program was focused on three pronged scientific fish farming techniques to augment fish production in the state. Additionally, the participants were given an overview of the propagation and rearing practices of different coldwater species viz., rainbow trout, mahseer, snow trout, Semiplotus and other minor carps. The Honourable Vice Chancellor of Rajiv Gandhi University, Prof. T. Mibang graced the occasion as chief guest and Mr. J. Taba, Director, Department of Fisheries, Arunachal Pradesh was Guest of Honour in the inaugural session. 24 participants from the state fisheries departments, KVKs, assistant professors, research scholars and progressive farmers attended the training.



Lighting of lamp by guest of honour

9.5 Farmers' training programme on 'Coldwater Fish Farm Management in Mid Hills'

NFDB sponsored training programme on 'Coldwater Fish Farm Management in Mid Hills' was organized at ICAR-DCFR Field Centre at Champawat during 27th to 31st January 2015. About 30 farmers of Uttarakhand attended the training programme. Dr. A.K. Singh, Director, DCFR inaugurated the programme and briefed about the need for culture expansion and seed production of coldwater fishes in mid hills. The training focused on both theoretical

and practical aspects of farm and hatchery management, breeding and seed production practices of rainbow trout and carps. On this occasion, a training manual book on 'Coldwater Fish Farm management in Mid Hills' was released.



Release of training manual

9.6 Training programme on 'Prevention and Control of Diseases in Rainbow Trout'

NFDB sponsored training programme on "Prevention and Control of Diseases in Rainbow Trout" was organised at ICAR-DCFR during 10-14 March, 2015 at Bhimtal. Twenty participants basically state fisheries department officials, KVK subject matter specialist, and fisheries university faculty and research scholars from Uttarakhand, Jammu & Kashmir, Tamil Nadu, Arunachal Pradesh and Manipur participated. At the core of the training, theoretical and practical aspects of commonly occurring diseases in farmed rainbow trout, associated risk factors, causative agents, diagnostic symptoms and preventive/control measures were taught and discussed in detail. In addition, all the participants visited ICAR-DCFR field Centre at Champawat to get a practical perspective of health management in rainbow trout rearing systems. The course material was compiled into a comprehensive manual and released during the inaugural ceremony by Dr A. K. Singh, Director, ICAR-DCFR. In his keynote address, Dr. Singh emphasized the importance of intensifying rainbow trout farming in India and the corresponding need to effectively address the challenges related to trout health management. The valedictory feedback of the participants

gave ample evidence for successful knowledge dissemination through the training and paved way for synchronized approaches.



Guest lecture & field exposure

9.7 Farmers' training programme on 'Common Fish Health Problems in Mid Hill Fish Tank and Their Management'

ICAR-DCFR Field Centre, Champawat organized NFDB sponsored five days training programme on "Common Fish Health Problems in Mid Hill Fish Tank and Their Management" during 18-22 March, 2015 for the farmers of Champawat district. Total 30 farmers of Champawat and Lohaghat area belonging to 14 villages participated in the program. The training emphasized on the significance of maintaining healthy fish stock for better fish



A section of farmer participants

production. The training program focused on both practical and theoretical aspects of identification of commonly occurring fish diseases, demonstration on collection, packing and transportation of water and fish samples for laboratory analysis, pond management, cleaning and maintaining hygienic conditions during seed production of coldwater fishes, pre and post health care of trout and carp brooders, control and treatment of fish diseases. A training manual on 'common fish health problems in mid-hill fish tanks and their control' was released on this occasion. A field visit to progressive fish farmer ponds in village Bheti (Lohaghat) was also organised to demonstrate healthy fish management practices.

9.8 Farmers training on fish diseases

Under the NSPAAD scheme, a training program on fish diseases was conducted for fish farmers at Dudhauri, Almora, Uttarakhand, on 30th March 2015.



Participants of NSPAAD training

AWARDS/HONOUR/ RECOGNITION

- Dr. A. K. Singh (Director) was conferred the “Vigyan Ratn award” to honour scientific excellence by the Council of Science & Technology, Government of Uttar Pradesh, India.



Mrs. A.K. Singh receiving Vigyan Ratn Award on his behalf from Minister of Science of Technology, Uttar Pradesh

- Dr. A. K. Singh (Director) has received “Fellowship Award-2014” of Zoological Society, Kolkata, India.
- Dr. A. K. Singh (Director) was conferred the “Bioved-Agri-Innovation Award-2015” of Bioved Research Institute of Agriculture & Technology, Allahabad for his outstanding contribution in the field of enhancement of livelihood security through sustainable farming system and related farm enterprises in North-West Himalayas.
- Dr. A. K. Singh (Director) received “Appreciation Award” of Zoological Society of India on the occasion of 25th All India Congress of Zoology organized on 17.11.2014 at Gurukul Kangri University, Haridwar, India.

- Dr. Amit Pande (Principal Scientist) achieved the distinction of being selected as “ICAR National Fellow” by the Indian Council of Agricultural Research, New Delhi, to recognize his meritorious scientific contribution and to facilitate research activities under the project “Development of a method for detecting the presence of any virus signal in clinical samples of fish” in the next five years.



Dr. Amit Pande

- Dr. M.S. Akhtar (Scientist) was conferred “Dr. M.S. Swaminathan award for the Best Indian Fisheries Scientist of the year 2013” by the Professional Fisheries Graduate Forum, during the 10th Indian Fisheries and Aquaculture Forum held at ICAR-NBFGR.



Dr. M.S. Akhtar receiving the best scientist award

- Dr. Ciji Alexander (Scientist) received the prestigious “Jawaharlal Nehru award for PG outstanding doctoral thesis research in agricultural and allied sciences-2013” instituted by the Indian Council of Agricultural Research, New Delhi.



Dr. Ciji, A. receiving the Jawaharlal Nehru award from Hon'ble Minister of Agriculture Shri Radha Mohan Singh

- Dr. D. Thakuria (Scientist, Biochemistry-Animal Science) was awarded Ph.D. degree under the supervision of Dr. Satish Kumar,

Head of Division, Division of Veterinary Biotechnology from ICAR-Indian Veterinary Research Institute, Izatnagar, for his research work on “Evaluation of oncolytic potential of synthetic peptide analogs of SAC domain in *Par-4* protein”.

- Dr. R. S. Halder, Assistant Chief Technical Officer has been conferred Fellow of the Academy of Environmental Biology, India by the Academy of Environmental Biology, Lucknow, India.



Dr. R.S. Halder conferred Fellow of AEB, India



LINKAGES

I CAR-DCFR promoted collaboration with the following national organizations and agencies during the period under report.

ICAR Institutes

- ICAR Research Complex, NEH, Sikkim
- ICAR-NBFGR, Lucknow
- ICAR-CIFRI, Barrackpur
- ICAR-CIFA, Bhubaneswar
- ICAR-CIBA, Chennai
- ICAR-CIFT, Kochi
- ICAR-CIFE, Mumbai
- ICAR-PDFMD, Mukteswar
- ICAR-IVRI, Mukteswar
- ICAR-VPKAS, Almora, Uttarakhand
- ICAR-IISWC, Dehradun

State Ministries/Department

- Department of Fisheries, Arunachal Pradesh
- Department of Fisheries, Sikkim
- Department of Fisheries, Jammu & Kashmir
- Department of Fisheries, Himachal Pradesh
- Department of Fisheries, Uttarakhand
- Department of Fisheries, Meghalaya

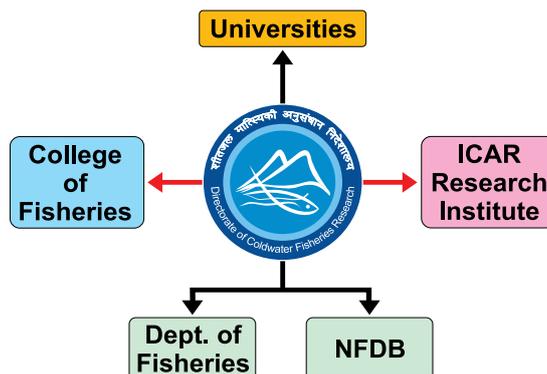
- Department of Fisheries, Madhya Pradesh
- Department of Fisheries, Tamilnadu

Universities & College

- GB Pant University of Agricultural Science & Technology, Pantnagar
- Rajiv Gandhi University, Arunachal Pradesh
- GB Pant Institute of Himalayan Environment and Development, Uttarakhand
- College of Fisheries, SKUAS&T, Jammu & Kashmir
- Tamilnadu Fisheries University
- Kerala University of Fisheries & Oceanography
- CSKHP Agricultural University, Himachal Pradesh
- Kumaun University, Nainital, Uttarakhand
- HNB Garhwal University, Uttarakhand
- Guwahati University, Assam
- Bhimrao Ambedkar Central University

Central Ministries/Departments

- National Fisheries Development Board
- Department of Biotechnology
- Uttarakhand Council for Biotechnology
- Department of Science & Technology



12.1 Research Papers

- Akhtar, M.S., Pal, A.K, Sahu, N.P, Ciji, A. and Mahanta, P.C., 2014. Higher acclimation temperature modulates the composition of muscle fatty acid of *Tor putitora* juveniles. *Weather and Climate Extremes*, 4: 19-21.
- Ali, S., Barat, A., Pandey, H., Sivaraman, G.K., Sahoo, P.K. and Sati, J., 2014. Mitochondrial DNA variation and population genetic structure of snow trout from Kumaun and Garhwal Himalayan Regions of India. *Journal of Ecophysiology and Occupational Health*, 14(1&2): 23-31.
- Barat, A., Goel, C., Sahoo, P.K. and Rao, A.R., 2014. Development of expressed sequence tags (ESTs) from the brain tissue of snow trout *Schizothorax richardsonii* (Gray, 1832) (Family Cyprinidae) and its preliminary annotation. *Indian Journal of Fisheries*, 61(2): 118-128.
- Barat, A., Sahoo, P.K., Kumar R., Mir, J.I., Ali, S., Patiyal, R.S. and Singh, A.K., 2015. Molecular characterization of rainbow trout *Oncorhynchus mykiss* (Walbaum, 1792) stock in India. *Journal of Genetics*, 94: e13–e18. <http://www.ias.ac.in/jgenet/OnlineResources/94/e13.pdf>.
- Baruah, K., Huy, T.T., Norouzitallab, P., Niu, Y., Gupta, S.K., Schryver, P.D. and Bossier, P., 2015. Probing the protective mechanism of poly- β -hydroxybutyrate against vibriosis by using gnotobiotic *Artemia franciscana* and *Vibrio campbellii* as host-pathogen model. *Scientific reports*, 5: 9427, DOI: 0.1038/srep09427.
- Bhagawati, K., Chadha, N.K., Sarma, D., Sawant, P.B. and Akhtar, M.S., 2014. Physiological responses of golden mahseer (*Tor putitora*) fry to dietary zinc and assessment of its optimum requirement. *Proceedings of the National Academy of Sciences, India - Section B: Biological Sciences*, DOI 10.1007/s40011-014-0383-y.
- Chandra, S. and Joshi, K.D., 2015. Study on growth and survival of carps in salt affected ponds under different treatments. *Journal of Inland Fisheries Society*, 47 (1).
- Ciji, A., Sahu, N.P., Pal, A.K., Akhtar, M.S., Tincy, V., Mishal, P. and Das, P., 2014. Effect of dietary vitamin E and nitrite exposure on growth and metabolic variables of *Labeo rohita* juveniles. *National Academy Science Letters*, 37 (2): 123-129.
- Fernandes, J., Pal. A.K., Kumar, P., Chandrachoodan, P.P. and Akhtar, M.S., 2015. Combined effect of heat shock and chlorine fails to elicit acquired thermal tolerance in *Labeo rohita* spawns. *Proceedings of the National Academy of Sciences, India - Section B: Biological Sciences*, DOI 10.1007/s40011-014-0478-5.
- Giri, A.K., Sahu N.P., Saharan, N. and Dash, G., 2014. Effect of dietary supplementation of chromium on growth performance and biochemical parameters of *Labeo rohita* (Hamilton) fingerlings. *Indian Journal of Fisheries*, 61(2): 73-81.
- Goel, C., Barat, A., Pande, V. and Sahoo, P.K., 2014. Molecular cloning and characterization of Mannose Binding Lectin homologue from snow trout (*Schizothorax richardsonii*). *Protein Journal*, DOI 10.1007/s10930-014-9591-9.
- Gupta, S.K., Pal, A.K., Sahu, N.P., Jha, A.K. and Prusty A.K., 2015. Effects of dietary microbial levan on growth

- performance, RNA/DNA ratio and some physio-biochemical responses of *Labeo rohita* (Hamilton) juveniles. *Aquaculture Nutrition*, DOI: 10.1111/anu.12216.
- Jin, J., Panserat, S., Kamalam, B.S., Aguirre, P., Véron, V. and Médale, F., 2014. Comparison of glucose and lipid metabolic gene expressions between fat and lean lines of rainbow trout after a glucose load. *PloS ONE* 9(8): e105548.
 - Jin, J., Panserat, S., Kamalam, B.S., Aguirre, P., Véron, V. and Médale, F., 2014. Insulin regulates lipid and glucose metabolism similarly in two lines of rainbow trout selected for muscle fat content. *General and Comparative Endocrinology*, 204: 49-59.
 - Kumar, P., Pandey, N.N., Okendro Singh, N., Chandra, N., Mishra, D.C., Agrawal, P.K., Barat, A. and Bhatt, J.C., 2014. Length weight relationship and growth pattern of Common carp (*Cyprinus carpio* Var. *Communis*) in different pond environment. *Journal of Ecophysiology and Occupational Health*, 1&2: 48-54.
 - Kumar, R., Sahoo, P.K., Vishwanath, W. and Barat, A., 2014. Karyotype of a new loach *Schistura obliquofascia* and a mahseer *Puntius chelynoides* from Kumaon Hills of Himalaya. *Cytologia* 79(2): 1-4.
 - Mir, F.A., Mir, J.I., Patiyal, R.S. and Kumar P., 2014. Length-weight relationships of four snow trout species from the Kashmir Valley in India. *Journal of Applied Ichthyology*, DOI 10.1111/jai.12482.
 - Mir, J.I. and Patiyal, R.S., 2015. Analysis of length-weight relationship of sympatric hill stream teleosts *Barilius bendelisis* (Hamilton, 1807) and *Barilius vagra* (Hamilton, 1822) from Garhwal Himalaya, India. *Journal of Applied Ichthyology*, DOI 10.1111/jai.12688.
 - Mir, J.I., Patiyal, R.S. and Sahoo P.K., 2015. Length-weight relationships of 10 fish species from a tributary of Ganga river basin in Uttarakhand, India. *Journal of Applied Ichthyology*, DOI 10.1111/jai.12686.
 - Mir, J.I., Saxena, N., Patiyal, R.S. and Sahoo P.K., 2015. Phenotypic differentiation in *Barilius bendelisis* (Hamilton, 1807) from four rivers of the Central Indian Himalaya. *Revista de Biologia Tropical*, 63 (1): 165-173.
 - Mohanty, B.P., Mahanty, A., Ganguly, S., Sankar, T.V., Chakraborty, K., Rangasamy, A., Paul, B., Sarma, D., Mathew, S., Asha, K.K., Behera, B., Aftabuddin, M., Debnath, D., Vijayagopal, P., Sridhar, N., Akhtar, M.S., Shahi, N., Mitra, T., Banerjee, S., Paria, P., Das, D., Das, P., Vijayan, K.K., Laxmanan, P.T. and Sharma. A.P., 2014. Amino acid compositions of 27 food fishes and their importance in clinical nutrition. *Journal of Amino Acids*, Article ID 269797, 7 pages. <http://dx.doi.org/10.1155/2014/269797>.
 - Monika, G., Pandey, N.N., Tiwari, V.K., Singh, R., Kumar, P., Haldar, R.S., Ali, S. and Pande, A., 2014. Effect of different temperature on incubation period, hatching rate, survival and growth of *Labeo dyocheilus* larvae. *Journal of Ecophysiology and Occupational Health*, 1&2: 59-62.
 - Monika, G., Pandey, N.N., Tiwari, V.K., Singh, R., Prakash, C. and Chaturvedi, C.S., 2014. Study of Gonadosomatic Index and fecundity of pond raised *Labeo dyocheilus* in cold water conditions. *International Journal of Advanced Research*, 1(7): 137-140.
 - Pandey, N.N., Haldar, R.S., Monika, G. and Singh, R., 2014. Study of gonado-somatic index and absolute fecundity of *Labeo dero* (Hamilton, 1822). *Journal of sustainable Research*, 3(1): 47-50.
 - Pankaj, V., Singh, A.K., Tripathi, M. and Srivastava, S.C., 2015. Comparative morphometry, growth and feeding ecology of feral *Oreochromis niloticus* (L.) invaded into the Ganga river system, India. *Research on Environmental and Life Sciences*, 8(1): 63-68.

- Panserat, S., Kamalam, B.S., Fournier, J., Plagnes-Juan, E., Woodward, K. and Devlin, R.H., 2014. Glucose metabolic gene expression in growth hormone transgenic coho salmon. *Comparative Biochemistry and Physiology Part A*, 170: 38-45.
- Ratul, K., Sarma, P.S., Dutta, A., Das, P. and Sarma, D., 2014. Induced breeding and larval rearing of *Anabas testudineus* (Bloch) under the agroclimatic conditions of Assam, India. *The Allahabad Farmer*, LXX(1): 261-269.
- Sarma, D., Kohli, V., Sarika, S.K., Jyoti, P., Mallik, S.K., Shahi, N., Das, P., Srivastava, S.K., Joshi, V. and Akhtar, M.S., 2014. Histological alterations in gill, liver and kidney of rainbow trout following fungal infection. *Journal of Ecophysiology and Occupational Health*, 14: 127-132.
- Sarma, D., Akhtar, M.S., Das, P., Das, P., Gariya, G., Shahi, N. and Ciji, A., 2014. Proximate and mineral composition of some selected coldwater fishes of upland Himalaya. *Nutrition and Food Science*, 44: 554-561.
- Sarma, D., Akhtar, M.S., Das, P., Ganesh, G., Ciji, A. and Mahanta, P.C., 2014. Morphometric changes during larval development of chocolate mahseer, *Neolissochilus hexagonolepis* (McClelland, 1839). *Indian Journal of Fisheries*, 62: 135-138.
- Shahi, N., Mallik S.K. and Sarma, D. 2014. Leukocyte response and phagocytic activity in common carp, *Cyprinus carpio* experimentally infected with virulent *Aeromonas allosaccharophila*. *Journal of Ecophysiology and Occupational Health*. 14(2) 66-70.
- Shahi, N., Mallik, S.K., Sarma, D., Sahoo, M. and Das, P., 2014. Corneal hypertrophy in farmed chocolate mahseer, *Neolissochilus Hexagonolepis* from Uttarakhand, India, *Journal of Ecophysiology and occupational health*, 14: 79-82.
- Shahi, N., Pandey, J., Mallik, S.K., Sarma, D. and Das, P., 2014. Gonadal development stages of wild male golden mahseer, *Tor putitora* from Nainital region of Uttarakhand, India. *Journal of Eco-physiology and Occupational Health*, 14: 133-138.
- Sharma, N.K., Mir, J.I., Pandey, N.N. and Singh, R., 2014. Morphometric and meristic characteristics of Birdi Loach, *Botia birdi* (Chaudhuri, 1909) from a tributary of Indus Basin, Jammu and Kashmir, India. *World Journal of Fish and Marine Sciences*, 6(3): 262-266.
- Sharma, N.K., Mir, J.I., Pandey, N.N., Akhtar, M.S. and Singh, R., 2014. Meristic and morphometric characteristics of *Crossocheilus diplochilus* (Heckel, 1838) from the Poonch Valley of Jammu and Kashmir, India. *World Journal of Zoology*, 9(3):184-189.
- Sharma, N.K., Mir, J.I., Pandey, N.N., Singh, R. and Akhtar, M.S., 2015. Length-weight relationships of six fish species from an Indus basin tributary in the Poonch region of Jammu and Kashmir, India. *Journal of Applied Ichthyology*, 31 (3): 585-586.
- Singh A.K. and Srivastava, P.P., 2015. A CYP19 based sex determination and monosex production in aquaculture species *Oreochromis niloticus* L. and a Cyprinid *Cyprinus carpio* L. *Fisheries and Aquaculture Journal* 6:1. <http://dx.doi.org/10.4172/2150-3508.1000112>.
- Singh A.K., Ansari, A., Srivastava, S.C. and Shrivastava, V.K., 2015. An appraisal of introduced African catfish *Clarias gariepinus* (Burchell 1822) in India: invasion and risks. *Annual Research & Review in Biology* 6(1): 41-58.
- Singh A.K., Ansari, A., Srivastava, S.C., Verma, P. and Pathak, A.K., 2014. Impacts of invasive fishes on fishery dynamics of the Yamuna river, India. *Agricultural Sciences*, 5: 813-821.
- Singh A.K., Srivastava, P.P., Singh, R. and Ansari, A., 2014. Effect of dietary administration of letrozole and tamoxifen on gonadal development, sex differentiation

and biochemical changes in common carp (*Cyprinus carpio* L.). *Reproduction, Fertility and Development*. DOI: 10.1071/RD13234.

- Singh, A.K., 2014. Emerging alien species in Indian aquaculture: prospects and threats. *Journal of Aquatic Biology & Fisheries*, 2(1): 32-41
- Singh, A.K., Srivastava, S.C., Verma, P., Ansari, A. and Verma, A., 2014. Hazard assessment of metals in invasive fish species of the Yamuna River, India in relation to bioaccumulation factor and exposure concentration for human health implications. *Environmental Monitoring and Assessment*. DOI: 10.1007/s10661-014-3660-6.
- Sivaraman, G.K., Barat, A. and Ali, S., 2014. Study of population genetic polymorphism and gene flow rate in Indian snow trout, *Schizothorax richardsonii* fish of Himalaya, India. *Journal of Environmental Biology* 35(6): 1115-1121.
- Tyagi, A., Ali, S., Goel, C. and Barat, A., 2014. Glycerol accumulation and modulation in selected enzyme activities in response to cold acclimation of two species of cyprinid fishes *Schizothorax richardsonii* (Gray) and *Barilius bendelisis* (Hamilton). *Indian Journal of Fisheries*, 61(2): 52-57.

12.2 Technical/Popular articles

- Chandra, S., Mallik, S.K. and Shahi, N., 2014. Matsya farm mein jaiv surakshya. *Matsyhyia Lok*, ICAR-NBFGR, Lucknow, 4: 7-11.
- Phulia, V., Jamwal, A., Saxena, N. and Tandel, R.S., 2015. Off-flavor in aquaculture products - causes and management strategies. *Aqua International*, pp: 44-48.
- Shahi, N., Mallik, S.K. and Sarma, D., 2014. Golden mahseer, *Tor putitora* - a possible candidate species for hill aquaculture. *Aquaculture Asia*, XIX(2): 22-28.
- Sikender, K., Gupta, S.K., Brijesh, K. and Chandra, S., 2014. Dietary intervention to improve aquaculture product quality. *Aqua International*, July issue, pp: 45-47.

12.3 Book Chapters/Manuals Edited/Bulletins

- Akhtar, M.S., Sarma, D., Mallik, S.K. and Ciji, A., 2015. *Training manual on Hatchery management and seed production practices of golden mahseer*. ICAR-Directorate of Coldwater Fisheries Research, Bhimtal, pp: 1-43.
- Chandra, S., Radheysyam, Saha, G.S., De, H.K., Lekha, S., Adhikari, S., Barik, N.K. and Eknath, A.E., 2014. Fish disease surveillance in village community ponds in Khurda and Puri districts of Odisha. In: Dwivedi, B.K. and Mishra, S.D. (Eds.), *Proceedings 16th Indian Agricultural Scientists & Farmers' Congress on Nanobiotechnological Approaches for Sustainable Agriculture & Rural Development*. Published by Bioved Research Society, pp -139-146.
- Chandra, S., Srivastava, S.K., Tandel, R.S., Giri, A.K. and Gupta, S.K., 2015. *Training manual on Common fish health problems in mid hill fish tanks and their management*. ICAR-Directorate of Coldwater Fisheries Research, Champawat, pp: 1-106.
- Dalvi, R.S. and Gupta S.K., 2015. Biomarkers for environmental contamination in fish: biotransformation and oxidative stress. In: Gupta, S.K., Bharti P.K. (Eds.), *Fish habitat and Aquaculture*. Discovery Publishing House Private Limited, New Delhi. pp: 1-25.
- Mallik, S.K., Chandra, S., Pandey, A., Shahi, N., Sarma, D. and Akhtar, M.S., 2014. Diseases in coldwater aquaculture and their control measures. In: *Scientific Fish Culture Technologies for Tirap District, Arunachal Pradesh*. Published by KVK, Tirap, Department of Agriculture, Govt. of Arunachal Pradesh.
- Mallik, S.K., Kamalam, B.S., Shahi, N. and Haldar, R.S., 2015. *Training manual on Prevention and control of diseases in rainbow trout*. ICAR-Directorate of Coldwater Fisheries Research, Champawat, pp: 1-156.
- Pande, A., 2014. Viral diseases in coldwater aquaculture. In: Kumar, A., Singh, V.K., Yadav, S.K. (Eds.), *Pre-proceedings of International*

Workshop on Aquatic Animal Health and Diseases, p: 19-22.

- Pande, A., Chandra, S., Mallik, S.K., Pandey, N.N., Tandel, R.S. and Haldar, R.S., 2014. Hindi extension bulletin on 'Seetjaliya Machliyon mei Rog, Nidan avam Upchar'. Published by ICAR-Directorate of Coldwater Fisheries Research, Bhimtal. Bulletin No 22, p: 1-23.
- Sarma, D. and Akhtar, M.S., 2014. Coldwater fish farming in Arunachal Pradesh. In: *Scientific Fish Culture Technologies for Tirap District, Arunachal Pradesh*. Published by KVK, Tirap, Department of Agriculture, Govt. of Arunachal Pradesh.
- Sarma, D., Akhtar, M.S. and Singh, A.K., 2014. *A manual on Mahseer research and development: A journey by DCFR*. ICAR-DCFR research monograph publication, pp: 1-16.
- Sarma, D., Gupta, S.K., Tandel, R.S. and Thakuria, D., 2015. *Training manual on Management practices of Jhora fisheries*. ICAR-Directorate of Coldwater Fisheries Research, Bhimtal, pp: 1-44.
- Sarma, D., Akhtar, M.S., Mahanta, P.C. and Singh, A.K., 2014. Climate change: A threat to upland fish diversity of NE Himalaya. In: *Compendium of National Workshop on "Integrated Environment management of aquatic resources of NE region"*. Published by COF, AAU, Raha, Assam. pp. 32-41.
- Sarma, D., Gupta, S.K., Tandel, R.S. and Thakuria, D., 2015. *Training manual on Culture and breeding of important coldwater fish species*. ICAR-Directorate of Coldwater Fisheries Research, Bhimtal, pp: 1-81.
- Singh, A.K., Kumar, P. and Ali, S., 2014. Ichthyofaunal diversity of the Ganges river system in Central Himalayas, India: conservation status and priorities. In: Sinha, R.K. and Ahmed, B. (Eds.) *Rivers for Life - Proceedings of the International Symposium on River Biodiversity: Ganges-Brahmaputra-Meghna River System, Ecosystems for Life*, A Bangladesh-India Initiative, IUCN, International Union for

Conservation of Nature, pp. 208-214. ISBN: 978-93-5196-807-8.

- Singh, A.K., Pandey, N.N. and Ali, S., 2014. Fishery based eco-tourism: scope and potential. In: Kumar, P. (Ed.), *Island Biodiversity*. Uttar Pradesh Biodiversity Board, Lucknow. 155-157.
- Singh, A.K. and Sarma, D., 2014. Nutritive quality of rainbow trout (*Onchorhynchus mykiss*) for human health. In: Mohindra, V., Sood, N., Pradhan, P.K., Tyagi, L.K., Kumar, R., Jena, J.K. (Eds.), *Souvenir 10th Indian Fisheries and Aquaculture Forum*. Published by Asian Fisheries Society, Indian Branch, Mangalore and ICAR-National Bureau of Fish Genetic Resources, Lucknow, pp: 57-67.
- Singh, A.K., 2014. Alien fish species in Aquaculture and Fisheries: Biodiversity issues and management. In: Dr R.S. Chauhan (Ed.), *Souvenir 34th Annual Session of the Academy of Environmental Biology, India & National conference on Challenges for Sustainability of Natural Resources and Environment with emphasis on Aquatic Ecosystem for Livelihoods Security*, College of Fisheries, GBPUA&T, Pantnagar. 45-53.
- Srivastava, S.K. and Chandra, S., 2015. *Training manual on Coldwater Fish Farm Management in Mid Hills*. ICAR-Directorate of Coldwater Fisheries Research, Champawat, pp: 1-111.

12.4 Book Edited

- Gupta, S.K. and Bharti, P.K., 2015. *Fish habitat and Aquaculture*. Discovery Publishing House Pvt. Ltd., Dariyaganj, New Delhi, India, pp: 1-224 (ISBN-93-5056-744-X).

12.5 Abstracts

- Akhtar, M.S., Sarma, D., Pandey, N.N., Mallik, S.K., Haldar, R.S., Kumar, S. and Singh, A.K., 2014. Optimization of stocking density for *in situ* rearing of golden mahseer (*Tor putitora*) fry in floating cages. 10th Indian Fisheries and Aquaculture Forum, 12-15 November, Lucknow. pp: 165, Abstract No. ABP-73.

- Anand Kumar, B.S., Thakuria, D. and Pande, A., 2014. Developments to combat viral diseases in coldwater aquaculture. Abstract in “VIROCON-2014” the XXIII National Conference on “Recent Trends in Virology Research in the Omics Era” held at the Tamil Nadu Agricultural University, Coimbatore from 18-20 December, 2014.
- Belwal, K. and Pande, A., 2014. Molecular characterization of a dsRNA binding receptor in snow trout *Schizothorax richardsonii*. 10th Indian Fisheries and Aquaculture Forum, 12-15 November, Lucknow. pp: 388, Abstract No. AAH-64.
- Ciji, A., Sahu, N.P., Pal, A.K. and Akhtar, M.S., 2014. Effects of sub-lethal concentration of nitrite exposure on *Labeo rohita* juveniles: Detoxification through dietary vitamin E and L-tryptophan. 10th Indian Fisheries and Aquaculture Forum, 12-15 November, Lucknow. pp: 282, Abstract No. FNB-22.
- Kamalam, B.S., Medale, F. and Panserat, S., 2014. Utilization of dietary carbohydrates in rainbow trout: Diet x Genotype interaction approach. 10th Indian Fisheries and Aquaculture Forum, 12-15 November, Lucknow. pp: 275, Abstract No. FNB-15.
- Mohanty, S., Tandel, R.S., Rana, N., Mishra, S.S. and Das, B.K., 2014. Morphological and molecular characterization of a new *Myxobolus* sp. infecting the gills of *Catla catla* in Odisha (India). 10th Indian Fisheries and Aquaculture Forum, 12-15 November, Lucknow. pp: 394, Abstract No. AAH-70.
- Rajesh, M., Kamalam, B.S., Bhat, K., Vijay, B., Sridhar, N., Pal, D.T. and Gowda, N.K.S., 2014. Non-supplementation of dietary minerals affects whole body mineralization, lipid content and morphometry in fringed lipped carp *Labeo fimbriatus* fingerlings. 10th Indian Fisheries and Aquaculture Forum, 12-15 November, Lucknow. pp: 310, Abstract No. FNB-50.
- Srivastava, S.K., Chandra, S., Gupta, S.K. and Singh, A.K., 2014. Effect of different feeds on the growth performance of Hungarian common carp. 10th Indian Fisheries and Aquaculture Forum, 12-15 November, Lucknow. pp: 267, Abstract No. FNB-07.
- Mallik, S.K., Pancholi, D., Shahi, N., Pandey, J., Chandra, S., Kumar, B.S.A., Giri, A.K. and Tandel, R.S., 2014. Potency of lipopolysaccharide (LPS) derived from *Pseudomonas fulva* on biochemical, hematological and non specific immune response in rainbow trout, *Oncorhynchus mykiss* (Walbaum, 1972). 10th Indian Fisheries and Aquaculture Forum, 12-15 November, Lucknow. pp: 355, Abstract No. AAH-31.

LIST OF PROJECTS

13.1 Institutional Projects

Project Code	Project title	Project Leader & Associate	Year of Start	Year of completion
AQ3	Performance of chocolate mahseer (<i>Neolissochilus hexagonolepis</i>) in freshwater aquaculture system in Kumaun Himalaya	D. Sarma M.S. Akhtar	2008	2015
AQ9	Performance of indigenous minor carps <i>Labeo dero</i> and <i>L. dyocheilus</i> as candidate species for hill aquaculture	N.N. Pandey R.S. Haldar Prem Kumar R.S. Patiyal S. Ali	2011	2015
AQ13	Potential bacterial pathogens in rainbow trout farms from northern India and maintenance of bacterial agents	N. Shahi S.K. Mallik S. Chandra	2011	2016
AQ14	Performance evaluation of improved strain of Common carp champa-1 & champa-2 at different thermal regimes	S.K. Srivastava S. Chandra R.S. Patiyal S.K. Gupta D. Sarma	2011	2015
AQ-15	Bioprospecting of genes and allele mining for thermal stress tolerance of <i>Schizothorax richardsonii</i>	A. Barat P.K. Sahoo S. Ali	2014	2017
AQ-16	Photo-thermal manipulation and profiling of Kiss genes during gonadal maturity of golden mahseer for captive breeding	Project coordinator: A. K. Singh	2014	2017
	A. Photo-thermal manipulation for gonadal maturity of golden mahseer in captivity.	M.S. Akhtar A. Ciji M. Rajesh N. Shahi D. Sarma		
	B. Molecular characterization and gene expression profiles of kiss genes in golden mahseer during different gonadal development stages	N. Shahi D. Sarma D. Thakuria M.S. Akhtar		
CF4	Study on selection of suitable sites for aquaculture in selected Coldwater area using GIS tools	Prem Kumar R.S. Haldar A.K. Saxena	2011	2015

13.2 Inter-Institutional Outreach Activities (Fisheries Division-ICAR)

Project Code	Project title	Project Leader & Associate	Year of Start	Year of completion
NMP1	Fish genetic Stock	A. Barat S. Ali P.K. Sahoo R.S. Patiyal	2014	2017
NMP2	Fish feed	N.N. Pandey S.K. Srivastava S.K. Gupta M.S. Akhtar B.S. Kamalam	2014	2017
NMP3	Nutrient profiling and evaluation of fish as a dietary component	D. Sarma N.N. Pandey M.S. Akhtar A. Ciji M. Rajesh	2014	2017

13.3 National Surveillance Project

Project Code	Project title	Project Leader & Associate	Year of Start	Year of completion
NSPAAD	National surveillance programme for aquatic animal diseases	A. Pande S. Chandra	2014	2017

13.4 Externally Funded Projects

Project Code	Project title	Project Leader & Associate	Year of Start	Year of completion
DBT-Twin project-1	Evaluation of a genetic toxicity and ecological damage caused by coalmines on fish fauna of Simsang river, Garohills, Meghalaya and development of microbial bioremediation measures.	D. Sarma N. Shahi S.K. Mallik	2012	2015
DBT-Twin project-2	Development and characterization of microsatellite marker and assessment of genetic diversity of <i>Schistura sikmaiensis</i> from NE India	A. Barat P.K. Sahoo	2012	2015
DBT-3	Economic development of SC and ST community of midhill region of Pithoragarh district through aquaculture interventions.	R.S. Patiyal P.K. Sahoo	2012	2015
DBT-4	Transcriptome profiling of immune responsive genes in Golden mahseer (<i>Tor putitora</i>)	A. Barat P.K. Sahoo	2013	2016
DBT-5	Development of bacterial bioremediation measures for the mitigation of microalgal blooms in freshwater aquaculture ponds	N. Shahi S.K. Mallik	2014	2017
ICAR-NF	Development of a method for detecting the presence of any virus signal in clinical samples of fish	A. Pande	2014	2019

PARTICIPATION IN CONFERENCE/ SYMPOSIA/WORKSHOP/TRAINING/ MEETINGS AND OTHERS

14.1 Participation in Training

- A. Barat attended the training programme on 'Next generation sequence data analysis' organized by Fish genetics and breeding division of ICAR-CIFA, Bhubaneswar, Odisha during 20th-24th January, 2015.
- A. Ciji undergone three month professional attachment training (mandatory requirement for new ARS recruit) at ICAR-IVRI, Barielly, in Animal nutrition lab under the guidance of Dr. D.N. Kamra from 12th May to 11th August, 2014 and feedback report has been submitted for evaluation.
- A.K. Giri undergone three month professional attachment training (mandatory requirement for new ARS recruit) at ICAR-CIFA, Bhubaneswar, in Aquaculture division under the guidance of Dr. S.K. Sahoo from 8th May to 7th August, 2014 and feedback report has been submitted for evaluation.
- B.S. Kamalam undergone three month professional attachment training (mandatory requirement for new ARS recruit) at ICAR-NIANP, Bangalore, in Gut Microbiology lab under the guidance of Dr. A. Thulasi from 8th May to 7th August, 2014 and feedback report has been submitted for evaluation.
- B.S. Kamalam, A. Ciji, M. Rajesh, R.S. Tandel and A.K. Giri undergone one month institute orientation training (mandatory requirement for new ARS recruits) at ICAR-DCFR, Bhimtal and ICAR-DCFR field centre, Champawat from

8th April to 5th May, 2014 and feedback report has been submitted.

- D. Sarma and R.S. Patiyl participated in the International training workshop on 'Coldwater or cool water fish aquaculture' held at Heilongjiang River Fisheries Research Institute of the Chinese Academy of Fishery Sciences from 9th-28th October 2014.



Dr. D. Sarma and Dr. R.S. Patiyl with the other participants

- M. Rajesh attended ten days ICAR- sponsored short course on 'Recent advances in molecular markers and population genomics' during 10-19th March, 2015 at ICAR-NBFGR, Lucknow.
- M. Rajesh undergone three month professional attachment training (mandatory requirement for new ARS recruit) at ICAR-NIANP, Bangalore, in Micro-nutrient lab under the guidance of Dr. N.K.S. Gowda from 8th May to 7th August, 2014 and feedback report is submitted for evaluation.
- M.S. Akhtar participated in the ICAR sponsored short course on "Application of Molecular Tools

in Coldwater Fisheries Management” during 02 – 11 June, 2014 at ICAR-DCFR, Bhimtal.

- N. Shahi attended national training on ‘Stem cell technology in farm animals’ organized during 9-29th December, 2014 at Animal Biotechnology Centre, ICAR-NDRI, Karnal.
- R.S. Tandel undergone three month professional attachment training (mandatory requirement for new ARS recruit) at ICAR-CIFA, Bhubaneswar, in Aquatic animal health laboratory under the guidance of Dr. B.K. Das, Dr. S.S. Mishra and Dr. P. Swain from 8th May to 7th August, 2014 and feedback report has been submitted for evaluation.
- S.K. Srivastava attended training on ‘Management development programme on consultancy project management’ at National academy of Agricultural Research and management, Hyderabad from 22-27th August, 2014.
- A.K. Singh attended meeting of the Standing Committee (as member) at the Department of Applied Animal Science at Babasaheb Bhimrao Ambedkar University, Lucknow on 26th December 2014 and on 9th January 2015.
- A.K. Singh participated as an expert in the selection committee for Professor/Associate Professor/Assistant Professor at Kerala University of Fisheries & Ocean Studies (KUFOS), Kerala during 22-24th January, 2015.
- A.K. Singh participated in ‘Vision-2050 Meeting of ICAR’ chaired by Secretary DARE & DG, ICAR at Krishi Bhawan on 19.11.2014 and presented the ICAR-DCFR Vision 2050, prepared the final draft Vision-2050 and submitted to the SMD by the end of December 2014.
- A.K. Singh participated in XXIII meeting of ICAR RCM I at Dehradun during 17-18th June, 2014.

14.2 Participation in Meeting

- A. Barat participated in ‘International consultation meeting on Fish Genomics’ organized by Fish genetics and breeding division of ICAR-CIFA, Bhubaneswar, Odisha during 23rd January, 2015.
- A.K. Singh attended 49th meeting of Academic Council of CIFE Mumbai as special invitee on 26th July, 2014.
- A.K. Singh attended Board of Management Meeting of UUIH, Bharsar as a member.
- A.K. Singh attended meeting convened by Secretary DARE in connection with presentation of DG FAO at NASC Complex, New Delhi on 8th September, 2014.
- A.K. Singh attended meeting convened by the Principal Secretary, Department of Fisheries, Secretariat, Dehradun on 18.12.2014.
- A.K. Singh attended meeting of the Committee on Exotics under the chairmanship of the Joint Secretary (Fisheries), Govt. of India on 23rd May, 2014 and on 28th October, 2014.
- D. Sarma and N. Shahi attended the project presentation meeting of NFBSEARA at New Delhi on 8th January, 2015. The title of the project presented on this meeting was ‘Maturity induction and Broodstock management for restoration of golden mahseer’.
- N.N. Pandey participated and represented ICAR-DCFR in stake holder meeting for cumulative Environmental Impact Assessment studies of Sutlej basin, organized by ICFRE at Dehradun on 27th February 2012.
- N.N. Pandey participated in International Angling meet organised by Trout conservation and angling association, Kullu, HP during 10-11th April 2014.
- R.S. Patiyal attended a meeting on Collaborative approach of TSP programmes with Director, VPKAS Almora and Director, Mandi Parisad Uttarakhand Govt. on 13th August 2014 organized by VPKAS, Almora.
- R.S. Patiyal attended a meeting of ICAR Institutions called by Shri Rao Inderjit Singh, Honourable Minister of State for Planning and

Defence, Govt. of India at IVRI mukteswar on 5th November 2014.

- R.S. Patiyal attended a meeting on “Revival of Mahseer” with Shri Ranveer Singh (IAS), Secretary, State Fisheries Department, Uttarakhand Govt. at Dehradun on 18th December 2014.
- R.S. Patiyal attended the Productivity Assessment Task meeting of Tehri Reservoir as committee member on 18 to 20th November 2014.
- S.K. Srivastava attended as a member, the scientific advisory committee meeting of Krishi Vigyan Kendra, Lohaghat, Champawat organized in December 2014.

14.3 Participation in Conference/ Workshop/Symposium

- A.K. Singh attended the 10th Indian Fisheries & Aquaculture Forum at ICAR-NBFGR, Lucknow, as an invited keynote speaker, during 12-15th November 2014.
- A.K. Singh attended initiation meeting cum workshop on phase II of outreach activity in Fish Genetic Stock at ICAR-NBFGR, Lucknow on 8th January 2015.
- A.K. Singh attended National Symposium at CIFE, Mumbai in commemoration of silver jubilee year celebration of NAAS during 21-22nd October 2014.
- A.K. Singh attended one day brainstorming session on ‘Reservoir fisheries development of India: Management and policy options’ at NASC Complex, New Delhi on 19th September 2014 under the chairmanship of President, NAAS and DG, ICAR.
- A.K. Singh participated in ICAR Foundation Day/Award Ceremony 2014 and VCs-Directors’ Conference at NASC Complex, New Delhi during 29-30th July 2014.
- A.K. Singh participated in IUCN sponsored ‘International Symposium on River Biodiversity’ jointly organized by Patna University and University of Chittagong (Bangladesh) and delivered an invited talk during 4-6th April 2014.
- A.K. Singh participated in the Foundation Lecture of NAAS and attended NAIP workshop on ‘Impact of capacity building programmes’ during 5-7th June 2014.
- A.K. Singh participated in the interactive Conference of Directors of ICAR Institutes and VCs of SAUs on 28th April 2014.
- A.K. Singh Participated in the workshop on NMSHE task force on Himalayan Agriculture at ICAR, New Delhi.
- A.K. Singh was the chief guest at the valedictory function of the 34th Annual Session of the Academy of Environmental Biology, India and National seminar on Challenges for the sustainability of natural resources and environment on 12th October 2014 at GBPUAT, Pantnagar.



Dr. A.K. Singh, Chief Guest at 34th AEB meeting

- B.S. Kamalam and M. Rajesh attended International Workshop on “Fish genomics” during 19-21st January 2015 at CIFE, Mumbai.
- D. Sarma attended the national workshop on ‘Research project development’ organized by NASF during 7-10th January 2015 at NASC, New Delhi.
- M.S. Akhtar and B.S. Kamalam participated as panelist in the NAAS silver jubilee symposium on “Indian Fisheries and Aquaculture: 25 Years of Achievements and Way Forward” during 21-22nd October 2014 at CIFE, Mumbai.
- M.S. Akhtar, A. Ciji and M. Rajesh attended Science Academics Lecture/Workshop on

- “Climate Change” during 26-27th December 2014 at G B Pant University of Agricultural Science & Technology, Pantnagar.
- N.N. Pandey and S.K. Srivastava participated in 12th Agricultural Science Congress organized by NAAS New Delhi at NDRI, Karnal 3-6th February 2015.
 - N.N. Pandey participated in the national conference on “Challenges for sustainability of natural resources and Environment with emphasis on Aquatic ecosystem for livelihood security” organised by College of Fisheries, GBPUA&T, Pantnagar and Academy of Environmental Biology during 10-11th October 2014.
 - N.N. Pandey, S.K. Srivastava, S. Chandra, N. Shahi, M.S. Akhtar, S.K. Gupta, A. Ciji, M. Rajesh, B.S. Kamalam, R.S. Tandel, and A.K. Giri attended and participated in oral and poster presentations in 10th Indian Fisheries and Aquaculture Forum during 12-15th November, 2014 at ICAR-NBFGR, Lucknow.
 - R.S. Patiyal participated in Indo-US symposium on “Recent trends in Nanobiotechnology” on March 2015 organized by Uttarakhand Council for Biotechnology, Biotech Bhawan, Haldi, U.S. Nagar, Uttarakhand.
 - S. Chandra and R.S. Tandel attended International workshop on ‘Aquatic Animal Disease Surveillance’ and also attended Annual meeting of the NSPAAD project on 15th November 2014 at ICAR-NBFGR, Lucknow.
 - S.K. Srivastava attended 17th Agriculture Scientists and farmers Congress on agri-Innovation for enhancing production and rural employment, at BIOVED Allahabad during 21-22nd February 2015.
- #### 14.4 Lectures/Talks delivered
- A. Barat delivered a lecture on ‘Development of microsatellite markers’ in ICAR sponsored training program on “Application of Molecular Tools in Coldwater Fisheries Management” during 2-11 June 2014.
 - A. Barat delivered a lecture on ‘Genomics in Coldwater fishes’ in the workshop on Recent advances in practical syllabus for UG courses in Zoology held during 9-16 March, 2015 at Department of Zoology, Guwahati University, Guwahati. He also interacted with faculty and students and gave practical demonstration on molecular genetics technique.
 - A. Barat delivered a lecture on ‘Isolation of Microsatellite loci using DynaBeads enrichment method’ at St Antony College, Shillong during 9-11 March, 2015.
 - A. Ciji delivered a lecture on ‘Larval nutrition and feed formulation’ to the officers of state fisheries department, under the NFDB training programme on ‘Hatchery management and seed production practices of golden mahseer’ organized during 23-27th September 2014 at ICAR-DCFR, Bhimtal.
 - A. Pande delivered a lecture on ‘Viral Diseases in coldwater aquaculture’ to the officers of state fisheries department, under the NFDB training programme on ‘Prevention and control of diseases in rainbow trout’ organized during 10-14 March 2015 at ICAR-DCFR, Bhimtal.
 - A.K. Giri delivered a lecture on ‘Prevention & control of diseases in coldwater fishes’ in NFDB sponsored training on ‘Prevention & control of diseases in rainbow trout’ organized during 10-14th March 2015.
 - A.K. Giri delivered lectures on ‘Rainbow trout farming’ and ‘Prevention & control of coldwater fish diseases’ in NFDB sponsored training on ‘Common fish health problems in mid hill fish tanks and their management’ organized during 18-22nd March, 2015 at ICAR-DCFR Field Centre, Champawat.
 - A.K. Giri delivered lectures on “Larval rearing & initial feeding” and “Preventive measures for disease control” in NFDB sponsored training on ‘Technical know-how for the culture and breeding of rainbow trout’ organized during 28th November to 2nd December 2014 at State trout farm, Uttarey, West Sikkim.

- A.K. Singh delivered a lead lecture on 'Research and development perspectives in coldwater fisheries in India' and chaired a technical session in the 10th Indian Fisheries and Aquaculture Forum held during 12-15th November 2014 at ICAR-NBFGR, Lucknow.
- A.K. Singh delivered an invited lecture at Gurukul Kangri University organized by Academy of Environmental Sciences.
- A.K. Singh delivered an invited lecture on 'Alien fish species in Aquaculture and Fisheries: Biodiversity issues and management' in National seminar on 'Challenges for sustainability of Natural Resources and Environment' under 34th Annual Session of The Academy of Environmental biology, India during 10-12th October, 2014 at GBPUAT, College of Fisheries, Pantnagar.
- A.K. Singh delivered an invited lecture on 'Coldwater fishery resources, fish diversity and its sustainable management' in International symposium on 'Biodiversity: Status, utilisation and impact of challenging climate conditions' organised by Babasaheb Bhimrao Ambedkar University, Lucknow during 30-31st October 2014.
- A.K. Singh delivered an invited lecture on 'Coldwater fisheries research and development perspectives' in National Symposium at CIFE, Mumbai in commemoration of silver jubilee year celebration of NAAS during 21-22nd October 2014.
- B.S. Kamalam delivered a lecture on 'Brood-stock nutrition of golden mahseer' to the participating officers of state fisheries department and KVKs, under the NFDB sponsored training programme on 'Hatchery management and seed production practices of golden mahseer' organised by ICAR-DCFR during 23-27th September 2014 at Bhimtal.
- B.S. Kamalam delivered a lecture on 'Nutritional diseases in rainbow trout: Diagnosis and prevention' to the participating officers of state fisheries department and KVKs, under the NFDB sponsored training programme on 'Prevention and control of diseases in rainbow trout' organised by ICAR-DCFR during 10-14th March 2015 at Bhimtal.
- M. Rajesh delivered a lecture on 'Developmental biology of golden mahseer' to the participating officers of state fisheries department and KVKs, under the NFDB sponsored training programme on 'Hatchery management and seed production practices of golden mahseer' organised by ICAR-DCFR during 23-27th September 2014 at Bhimtal.
- M.S. Akhtar delivered a lecture on 'Coldwater fish diversity and conservation of mahseer' to the officers of state fisheries department, under the NFDB training programme on 'Hatchery management and seed production practices of golden mahseer' organized during 23-27th September 2014 at ICAR-DCFR, Bhimtal.
- N.N. Pandey delivered lectures on 'Coldwater fisheries and aquaculture' and 'Fungal diseases' in training programmes on 'Application of molecular tools in coldwater Fisheries management', 'Coldwater fish farm management', 'Prevention and control of diseases in Rainbow trout', 'Common fish health problems in mid hill fish tanks and their management' and 'Matsya Rog Pravandhan evam Nidan' during 2014-2015.
- P.K. Sahoo delivered a lecture on 'Aquaculture prospective in hills' in NFDB sponsored training program on "Coldwater fish farm management in mid hills" organized during 27-31 January 2015 at ICAR-DCFR Field Centre, Champawat.
- P.K. Sahoo delivered a lecture on 'Fish Genomics and ICAR-DCFR' in ICAR sponsored training program on "Application of Molecular Tools in Coldwater Fisheries Management" organized during 2-11 June 2014 at ICAR-DCFR, Bhimtal.
- P.K. Sahoo delivered a lecture on 'Fish genomics at ICAR-DCFR' at St Antony College, Shillong, Meghalaya during 9-11 March, 2015.

- P.K. Sahoo delivered a lecture on 'Rural aquaculture' in the workshop on Recent advances in practical syllabus for UG courses in Zoology held during 9-16 March 2015 at Department of Zoology, Guwahati University, Guwahati.
- R.S. Tandel delivered a lecture on 'Fungal infections in coldwater fishes' in NFDB sponsored training on 'Prevention & control of diseases in rainbow trout' organized during 10-14th March 2015.
- R.S. Tandel delivered lectures on 'Fungal diseases and their control measures', 'Field level identification of trout diseases' and 'Prevention and control of diseases in rainbow trout hatchery' in the NFDB sponsored training program on 'Common fish health problem in mid hill fish tanks and their management' organized at Champawwt during 18-22 March 2015.
- R.S. Patiyal delivered a lecture on 'Ornamental fish culture in mid hill region' to the state fisheries department officers, Uttarakhand on 19 January 2015 at Betalghaton.
- R.S. Patiyal delivered a lecture on 'Prospects of carp and ornamental fish culture in hill region' to the state fisheries department officers, Uttarakhand on 24 February 2015 at Sattal.
- R.S. Patiyal delivered a lecture on 'Hill aquaculture' to the state fisheries department officers, Uttarakhand on 27 March 2015 at Naukuchiyatal.
- R.S. Patiyal delivered a lecture on 'Composite carp culture in mid hill region' to the state fisheries department officers, Uttarakhand on 28 March 2015 at Ramgarh.
- R.S. Patiyal delivered a lecture on "Status of Coldwater Fisheries In India" in the International training workshop on 'Coldwater or cool water fish aquaculture' held at Heilongjiang River Fisheries Research Institute of the Chinese Academy of Fishery Sciences during 9-28 October 2014, China.
- R.S. Patiyal delivered a lecture on "Ornamental fish culture in hill region" in NFDB sponsored training programme on 'Coldwater Fish Farm Management in Mid Hills' organized at ICAR-DCFR Field Centre, Champawat during 27-31 January 2015.
- R.S. Patiyal delivered a lecture on 'Culture and conservation of mahseer in India' during NFDB sponsored training programme on "Hatchery management and seed production practices of golden mahseer" organized at ICAR-DCFR, Bhimtal during 23-27 September 2014.
- R.S. Patiyal delivered a lecture on 'Common fish disease in ornamental fishes' during the NFDB sponsored training programme on "Common Fish Health Problems in Mid Hill Fish Tank and Their Management" organized at ICAR-DCFR Field Centre, Champawat during 18-22 March 2015.
- S. Chandra delivered a lecture on 'Breeding and seed rearing of rainbow trout' in NFDB sponsored training programme on 'Coldwater fish farm management in mid hills' organized during 27-31 January 2015.
- S. Chandra delivered a lecture on 'Parasitic diseases in farmed rainbow trout' in NFDB sponsored training on 'Prevention & control of diseases in rainbow trout' organized during 10-14 March, 2015.
- S. Chandra delivered lectures on 'Common coldwater fish diseases', 'Management and control of fish health problems' and 'Importance of biosecurity measures in fish farm' in the NFDB sponsored training program on 'Common fish health problem in mid hill fish tanks and their management' organized at Field Centre, Champawat during 18-22 March 2015.
- S.K. Gupta delivered a lecture on 'Feed formulation and feeding management of coldwater fishes' in the NFDB sponsored training program on 'Common fish health problem in mid hill fish tanks and their

management' organized at Champawat during 18-22 March 2015.

14.5 Workshop/Training/Meeting organized

- A. Barat, S. Ali and P.K. Sahoo co-ordinated ICAR sponsored short course on 'Application of Molecular Tools in Coldwater Fisheries Management' during 2-11 June 2014 at ICAR-DCFR, Bhimtal.
- A. Pande, N.N. Pandey and D. Thakuria conducted a training program on fish diseases for fish farmers under the NSPAAD scheme, on 30th March 2015, at Dudhauli, Almora, Uttarakhand.
- D. Sarma and M.S. Akhtar co-ordinated three awareness and seed ranching programme of golden mahseer at Kosi river, Ramnagar; Sariyatal lake and Nainital lake during April and July 2014.
- D. Sarma, M.S. Akhtar, M. Rajesh and A.K. Giri co-ordinated ICAR-DCFR organized mahseer seed ranching cum awareness programme on 9th September 2014 at Nongmahir lake, Kyrdem, Meghalaya.
- D. Sarma, S. Chandra, M.S. Akhtar, M. Rajesh and A.K. Giri organized a two days national workshop on "Mahseer in India: Resources, captive breeding, propagation, policies and issues" during 22-23 December, 2014 at College of Veterinary Science, Khanapara, Assam, Guwhati organized by ICAR-DCFR, Bhimtal.
- M.S. Akhtar, D. Sarma, S.K. Mallik and A. Ciji co-ordinated the NFDB sponsored training programme on 'Hatchery management and seed production practices of golden mahseer' for state fisheries department officials/assistant professors during 23-27th September 2014 at ICAR-DCFR, Bhimtal.
- N.N. Pandey and A.K. Giri coordinated NFDB sponsored training programme on "Technical know-how for the culture and breeding of rainbow trout" for trout growers of West Sikkim during 28 November to 2 December 2014.
- R.S. Patiyal conducted training cum demonstration for farmers on feeding and water quality management at Khatima on 8th November 2014.
- R.S. Patiyal coordinated and organized training programme on ornamental fish culture for 30 farmers at village Khunari, Champawat, Uttarakhand on 16th July 2014 as part of ICAR foundation day celebration.
- R.S. Patiyal coordinated awareness/interaction programme in Pangu, Himkhola and Gothi villages, Pithoragarh district, Uttarakhand during June 2014 for educating farmers about the testing of water quality parameters and fish feeding.
- R.S. Patiyal coordinated mahseer ranching programme with State fisheries department, Uttarakhand and released 10,000 mahseer seeds in Saattal on 25th September 2014.
- R.S. Patiyal organized training-cum-demonstration in six villages Pangu, Himkhola, Chalmachilanso, Galati, Baluwakot and Gothi villages, Uttarakhand for around 60 farmers during 2014.
- S. Chandra, S.K. Srivastava, R.S. Patiyal, S.K. Mallik, S.K. Gupta, R.K. Tandel and A.K. Giri coordinated the NFDB sponsored training programme on 'Common fish health problems in mid-hill fish tanks and their management', organized during 18-22 March 2015.
- S.K. Mallik, S. Chandra, B.S. Kamalam, N. Shahi, S.K. Srivastava and R.S. Haldar coordinated the NFDB sponsored training programme on 'Prevention and control of diseases in rainbow trout' organized during 10-14 March 2015.
- S.K. Srivastava and S. Chandra coordinated 'Fish farmer's day' organized on 10th July 2014 at Village Belkheda, U.S. Nagar, Uttarakhand.
- S.K. Srivastava and S. Chandra organized 'Farmers Field Day' at Katahar village, Champawat on 29th April 2014 and 30th January 2015 to impart the technical know-how on fish culture and farm management.

- S.K. Srivastava organized an awareness programme among tribal farmers of Munsyari about fish culture in mid hills on 6th July 2014.
- S.K. Srivastava, S. Chandra, R.S. Patiyal and S.K. Mallik coordinated the NFDB sponsored training programme on 'Coldwater fish farm management in mid hills' organized during 27-31st January 2015.
- S.K. Srivastava, S. Chandra, R.S. Tandel and A.K. Giri organized a 'Field day' at Chammla Khetikhan for carp culture and farm management on 26th February 2015.
- S.K. Srivastava, S. Chandra, S.K. Gupta, A.K. Giri and R.S. Tandel organized Hindi Pakhwada at ICAR-DCFR Field centre, Champawat.

14.6 Students Guided

- Monika Gupta from Central Institute of Fisheries Education (ICAR), Mumbai completed her PhD research work on the topic "Study on induced breeding and seed production of indigenous carp *Labeo dyocheilus* in captivity under coldwater conditions" under the co-supervision of Dr. N.N. Pandey.
- Neeraj Kumar Sharma from H.N.B. University, Srinagar is pursuing PhD under the co-supervision of Dr. N.N. Pandey on the topic 'Study on season dependent physio-metabolic indices and thermal tolerance of *Barilius bendelisis* (Hamilton)'.
- Neha Saxena from CIFE Mumbai is pursuing PhD under the co-supervision of Dr. R.S. Patiyal on the topic 'Gonadal development and captive breeding of hill stream fish *Barilius bendelisis* (Hamilton, 1807)'.
- Raghvendra Singh from CIFE Mumbai is pursuing PhD under the co-supervision of Dr. N.N. Pandey on the topic 'Study on induced breeding and seed production of indigenous carp, *Chagunius chagunio* (Hamilton-Buchanan, 1822)'.

14.7 Exhibition organized

- D. Sarma, M.S. Akhtar, M. Rajesh and A.K. Giri organized exhibition during 'Awareness campaign and seed ranching programme' at Nongmahir, Meghalaya on 9 September 2014.
- M.S. Akhtar organized two days book exhibition at ICAR-DCFR, Bhimtal during 19-20 August, 2014 and took dynamic initiative to create e-inventory of several journals.
- N.N. Pandey, R.S. Patiyal and Santhosh Kumar participated in exhibition in 'Kisan Mela' organized by VPKAS, Almora on 30th September at Hawalbagh, Almora.
- N.N. Pandey and Santhosh Kumar participated in exhibition in connection with 'National conference on challenges for sustainability of natural resources and Environment with emphasis on Aquatic ecosystem for livelihood security' organised by College of Fisheries, GBPUA&T, Pantnagar and Academy of Environmental Biology during 10 to 11th October, 2014.
- N.N. Pandey, S.K. Srivastava, S. Chandra, M. Rajesh, A.K. Giri, Santhosh Kumar and Gopal displayed ICAR-DCFR exhibition in 10th Indian Fisheries & Aquaculture Forum organized by ICAR-National Bureau of Fish Genetic Resource at Lucknow, India during 12-15 November, 2014.
- N.N. Pandey, Santhosh Kumar and Gopal participated in exhibition in 96th Agro industrial exhibition and Krishi kumbh at GBPUAT during 5 to 8th October, 2014.
- N.N. Pandey, Santhosh Kumar and Gopal participated in exhibition in connection with Kisan Mela organized by IVRI, Mukteswar at Nathuakhan on 28th October, 2014.
- N.N. Pandey, R.S. Patiyal, Santhosh Kumar and Vijay Kumar participated in exhibition in Krishi vigyan mela organized at ICAR-IARI at New Delhi during 10 to 12th March, 2015.

- N.N. Pandey, R.S. Patiyal, Santhosh Kumar and Vijay Kumar participated in exhibition in Krishi Kumbh organised by GBPUA&T, Pantnagar during 13 to 16th March, 2015.
- N.N. Pandey, Santhosh Kumar and Vijay Kumar participated in exhibition in Regional Agriculture Fair organised by ICAR-IVRI, Bareilly during 17 to 20th March, 2015.
- S. Chandra, R.S. Patiyal, M.S. Akhtar, M. Rajesh, A.K. Giri and Vijay Kumar organized ICAR-DCFR exhibition at Guwahati during national workshop on 'Mahseer in India: Resources, captive breeding, propagation, policies and issues', during 22-23rd December, 2014.
- S.K. Srivastava and S. Chandra participated in exhibition in connection with Kisan Mela organized at KVK, Lohaghat on 15th October, 2014.
- S.K. Srivastava participated in exhibition in 17th Agriculture scientists and farmers congress on agri-innovation for enhancing production and rural employment at BIOVED Allahabad during 21-22nd February, 2015.
- S.K. Srivastava, N.N. Pandey and Santhosh Kumar displayed ICAR-DCFR exhibition in connection with XII Agricultural Science Congress organized by NDRI Karnal during 3-6th February 2015.
- Vijay Kumar and Sushil Kumar participated in exhibition in 'International Symposium on Biodiversity: Status utilisation and impact of Challenging conditions' organised by Babasahib Bhimrao Ambedkar University, Lucknow in collaboration with Indian Academy of Environmental Science, Haridwar during 30 to 31 October 2014.

STAFF NEWS

15.1 Joining

The following newly recruited Agricultural Research Service scientists joined the Directorate on April 2014.

Mr. Abhay Kumar Giri (Aquaculture)

Dr. Ciji A (Fish Nutrition)

Dr. Biju Sam Kamalam J (Fish Nutrition)

Mr. Rajesh M (Fish Nutrition)

Mr. Ritesh Kumar Tandel (Fish Health)

15.2 Promotions

Dr. N.N. Pandey was promoted to the post of Principal Scientist (Aquaculture) under CAS of ICAR, w.e.f. 27.08.2013.

15.3 Farewell

- Dr. B.S. Ananda Kumar, Scientist was transferred to ICAR-Central Institute of Freshwater Aquaculture, Regional Research Centre, Bengaluru, by the Council. He was relieved from the Directorate with good wishes on 31st December, 2014.



- Shri. Hayat Singh, LDC retired on 30th January 2015, after several years of active service. ICAR-DCFR family wishes him a happy and healthy post-retirement life.



LIBRARY & INFORMATION SERVICES

The ICAR-DCFR library and Documentation Unit acts as a repository of literature and information and provides services to its scientists and other staff members as well as research scholars, students and other individuals from neighboring organizations interested in scientific literature on coldwater fisheries and allied subjects.

During the year 2014-15, the Directorate subscribed 11 online international journals, 7 Indian print journals and procured 151 scientific books of both Indian and foreign authored. The current holding of the library includes 3342 books, 1693 volumes of foreign journals, 536 volumes of Indian journals and 8000 other publications. The

library facilitated the scientists and other staffs to access free online download of publications and articles of many international and national journals through CeRA (www.cera.jece.in). The library is putting its sincere efforts in collection, processing and disseminating scientific/technical information to the potential users.

An exhibition of books was arranged during 19th and 20th August 2014 to facilitate the scientists, technical staffs and student users of the library with recent knowledge and advancements in fisheries and allied subjects, and to enrich the library of DCFR with new texts. Five book distributors/publishers participated in the exhibition.



Exhibition of scientific books at ICAR-DCFR

An inventory of e-journals has been developed. The inventory contains 35,138 soft copies of important fisheries research articles available under CeRA as well as from the journals subscribed by DCFR during the year 2014. The details of the journals in the inventory are summarized in the table given below.

The other activities carried out during the year include proper entries, accessioning, indexing, cataloguing and bar coding of books and other

publications of the library. The documentation section of the library is entrusted with responsibility of publications of scientific bulletins, brochures, pamphlets, annual reports and newsletters. During this period, one annual report (2013-14) and two newsletters of DCFR has been published. The annual reports, special publications and technical bulletins published from time to time have been mailed to more than 250 organizations, institutions and fishery agencies.

S. N.	Journal name	Articles downloaded from (Year)	Total volumes	Total no. of articles downloaded
A. Journals subscribed by DCFR				
1.	Aquaculture Nutrition	1996 to 2014	102	1131
2.	Aquaculture Research	1997 to 2014	212	3301
3.	Fisheries Management & Ecology	1997 to 2014	104	910
4.	Journal of Applied Ichthyology	1996 to 2014	107	2460
5.	Journal of Aquatic Animal Health	1997 to 2014	72	696
6.	Journal of fish Biology	1997 to 2014	266	5630
7.	Journal of Fish Diseases	1997 to 2014	187	1648
8.	Journal of Molecular Evolution	1997 to 2014	186	1823
9.	Mitochondrial DNA	1997 to 2014	99	1113
10.	Molecular Ecology	1997 to 2014	321	5861
11.	Molecular Ecology Resources	2001 to 2014	73	3329
12.	Reviews in Aquaculture	2009 to 2014	23	132
B. Journals available in CeRA				
13.	Animal feed Science & Technology	2001 to 2014	175	1672
14.	Aquaculture Economics & Management	1997 to 2014	72	462
15.	Aquaculture International	1997 to 2014	99	812
16.	Aquatic Ecosystem Health & Management	1998 to 2014	64	611
17.	Fisheries Research	2008 to 2014	76	1115
18.	General & Comparative Endocrinology	2001 to 2014	175	1685
19.	Journal of Thermal Biology	2002 to 2014	89	747
Total no. of articles available in the e-inventory				35,138

DISTINGUISHED VISITORS

- Shri Rao Inderjit Singh, Minister of State for Planning and Defence, Govt. of India
- Shri Bhagat Singh Koshyari, Member of Parliament, Former Chief Minister, Uttarakhand
- Dr. B.S. Bisht, Ex-Vice Chancellor, GBPUAT, Pantnagar
- Dr. M. Sinha, Advisor (Fisheries), Govt. of Tripura (Agartala)
- Dr. S.K. Bandyopadhyay, ASRB member, New Delhi
- Dr. A.S. Ninawe, Advisor, Department of Biotechnology
- Dr. P.K. Mishra, Director, CSWCRTI, Dehradun
- Dr. J.C. Bhatt, Director, VPKAS, Almora
- Dr. S. Solomon, Director, IISR, Lucknow
- Dr. R.K. Singh, Director, IVRI, Izatnagar
- Dr. J.R. Dhanze, Ex-Dean, College of Fisheries, Lembucherra, Agartala, Tripura
- Dr. P.C. Mahanta, Former Director, DCFR, Bhimtal
- Dr. S.D. Singh, ADG (I.Fy.), ICAR, New Delhi
- Dr. V.R. Chitranshi, Former Pr. Scientist & ADG (I.Fy.), SMD, ICAR
- Prof. M.H. Balkhi, Dean, College of Fisheries, SKUAS&T, Kashmir(J&K)
- Dr. Ajay Singh Rawat, Environment Activist, Nainital
- Prof. M.M. Goswami, Department of Zoology, Gauhati University, Guwahati
- Prof. Rina Chakraborti, Aqua Research Laboratory, Department of Zoology, University of Delhi
- Dr. H.S. Raina, Ex-Principal Scientist, Shiv Ram Enclave, Jammu
- Dr. S.N. Mohanty, Ex-HOD (CIFA), Bhubaneswar
- Dr. B.S. Yarki
- Dr. C.B. Joshi, Former Principal Scientist, DCFR, Bhimtal
- Dr. B.C. Tyagi, Former Principal Scientist, DCFR, Bhimtal
- Dr. K.D. Joshi, HOD, CIFRI Center, Allahabad



Visit of Hon'ble Shri Rao Inderjit Singh, Minister of State for Planning and Defence, Govt. of India



Dr. S.K. Bandyopadhyay, Member, ASRB visiting ICAR-DCFR facilities



RAC committee members visiting ICAR-DCFR experimental farm unit at Bhimtal



Dr. A.S. Ninawe, Advisor DBT interacting with ICAR-DCFR scientists & students



Dr. R.K. Singh, Director, IVRI planting tree at ICAR-DCFR, Bhimtal campus



Hon'ble Shri Rao Inderjit Singh, Minister of State for Planning and Defence visiting ICAR-DCFR Mahseer Hatchery

IMPORTANT COMMITTEES

18.1 Members of the Research Advisory Committee

Dr. J.R. Dhanze, Ex-Dean, College of Fisheries, Lembucherra, Agartala – 799 210, Tripura.	Chairman
Dr. H.S. Raina, Ex-Principal Scientist, Shiv Ram Enclave, Post Office – Sidhra – Sidhra, Jammu - 180 019, Jammu & Kashmir.	Member
Shri B.A. Bhatt, Chief Project Officer, Trout Fish Farming Centre, Kokernag, Distt. Anantnag – 192 101, Kashmir, Jammu & Kashmir.	Member
Dr. Sunit K. Singh, Associate Professor (Mol. Immunology), Molecular Biology Unit, Institute of Medical Sciences, Banaras Hindu University, Varanasi – 221 005, Uttar Pradesh.	Member
Dr. S.N. Mohanty, Ex-Principal Scientist (ICAR-CIFA), A4/21, Indira Gandhi Coop. Housing Society, Post - Shishupal Garh, Bhubaneswar – 751 002, Odisha.	Member
Shri Balbir Singh Yarki, Mohalla: Jarad Ghutti Colony, P.O. Shamshi, Tehsil & District Kullu – 175 126, Himachal Pradesh.	Member
Dr. S.D. Singh, ADG (I.Fy.), ICAR, New Delhi.	Member
Dr. Amit Pande, ICAR National Fellow, ICAR- DCFR, Bhimtal.	Member Secretary

18.2 Members of the Quinquennial Review Team

Dr. Maniranjana Sinha, Ex-Director, ICAR-CIFRI, Raghubir Sadan, District Judge's Compound, Civil Lines, Gorakhpur – 273 001, Uttar Pradesh.	Chairman
Dr. M.H. Balkhi, Dean, Faculty of Fisheries, S.K. University of Agri. Sciences & Technology of Kashmir, Rangil (Nagabal), Ganderbal, Post Box No. 1079, G.P.O., Srinagar – 190 001, Jammu & Kashmir.	Member
Dr. B.D. Sharma, Former Director, Department of Fisheries, Govt. of Himachal Pradesh, Village & P.O. Dangar, Tehsil – Ghumarwin, Bilaspur – 174 023, Himachal Pradesh.	Member
Dr. M.M. Goswami, Professor, Department of Zoology, Guwahati University, P.O. Jalukbari – 781 014, Guwahati, Assam.	Member

Dr. V.R. Chitranshi, Ex-Pr. Scientist & ADG (I.Fy.), SMD, ICAR, New Delhi.	Member
Dr. Prem Kumar, Senior Scientist, ICAR-DCFR, Bhimtal	Member Secretary

18.3 Members of the Institute Management Committee

Dr. A.K. Singh, Director, ICAR-DCFR, Bhimtal.	Chairman
Dr. S.D. Singh, Asst. Director General (I. Fy.), ICAR, KAB II, New Delhi.	Member
Dr. A.B. Pandey, Principal Scientist & Head, ICAR-IVRI Station, Mukteshwar, Uttarakhand.	Member
Shri Farooq Nawchoo, Joint Director, Department of Fisheries, Govt. of Jammu & Kashmir.	Member
Dr. P.K. Agarwal, Principal Scientist & Head, ICAR-VPKAS, Almora, Uttarakhand.	Member
Dr. Piyush Punia, Principal Scientist, ICAR-NBFGR, Lucknow.	Member
Shri S.R. Chanyal, Joint Director, Dept. of Fisheries, Govt. of Uttarakhand, Dehradun.	Member
Dr. Pradeep Katiha, Principal Scientist, ICAR-CIFRI, Barrackpore.	Member
Dr. Malavika Das, Professor, College of Fishery Science, GBPUAT, Pantnagar.	Member
Dr. S.R. Chaniyal, Director, State Fisheries Dept., Govt. of Uttarakhand, Dehradun.	Member
Shri Ashish Srivastava, Finance & Accounts Officer, ICAR-IVRI, Izatnagar.	Member
Shri Y.S. Dhanik, Administrative Officer, ICAR-DCFR, Bhimtal.	Member Secretary

18.4 Members of Institute Technology Management Committee

Dr. A.K. Singh, Director, ICAR-DCFR, Bhimtal.	Chairman
Dr. A. Barat, Principal Scientist, ICAR-DCFR, Bhimtal.	Member
Dr. (Mrs.) P.K. Sahoo, Principal Scientist, ICAR-DCFR, Bhimtal.	Member
Dr. Laxmi Kant, Principal Scientist, ICAR-VPKAS, Almora.	Member
Dr. S. Ali, Scientist, ICAR-DCFR, Bhimtal.	Member
Dr. M.S. Akhtar, Scientist, ICAR-DCFR, Bhimtal.	Member
Dr. Prem Kumar, Senior Scientist, ICAR-DCFR, Bhimtal.	Member Secretary

18.5 Members of Project Monitoring & Evaluation Cell

Dr. (Mrs.) P.K. Sahoo, Principal Scientist, ICAR-DCFR, Bhimtal.	Officer In-charge
Dr. S. Ali, Scientist, ICAR-DCFR, Bhimtal.	Member
Dr. (Mrs.) Ciji A., Scientist, ICAR-DCFR, Bhimtal.	Member
Sh. Amit Kumar Saxena, Sr. Technical Assistant, ICAR-DCFR, Bhimtal.	Technical support
Sh. Vijay Kumar Singh, Sr. Technical Assistant, ICAR-DCFR, Bhimtal.	Technical support
Mrs. Susheela Tewari, PS to Director, ICAR-DCFR, Bhimtal.	Secretarial assistance

18.6 Members of Project Monitoring & Evaluation Committee

Dr. A.K. Singh, Director, ICAR-DCFR, Bhimtal.	Chairman
Dr. A. Barat, Principal Scientist & In-charge, Molecular Genetics & Breeding, ICAR-DCFR, Bhimtal.	Member
Dr. D. Sarma, Principal Scientist & In-charge, Aquaculture, ICAR-DCFR, Bhimtal.	Member
Dr. Amit Pande, Principal Scientist & In-charge, Fish Health, ICAR-DCFR, Bhimtal.	Member
Dr. N.N. Pandey, Principal Scientist & In-charge, Resource Assessment & Extension, ICAR-DCFR, Bhimtal.	Member
Dr. S.K. Srivastava, Senior Scientist & In-charge, ICAR-DCFR Experimental Field Centre, Champawat.	Member
Dr. Prem Kumar, Senior Scientist & In-charge, AKMU, ITMU & GIS, ICAR-DCFR, Bhimtal.	Member
Dr. (Mrs.) P.K. Sahoo, Principal Scientist & In-charge, PME cell, ICAR-DCFR, Bhimtal.	Member Secretary

18.7 Institute Joint Staff Council

Official Side	
Dr. A.K. Singh, Director, ICAR-DCFR, Bhimtal.	Chairman
Dr. A. Barat, Principal Scientist	Member
Dr. Suresh Chandra, Senior Scientist	Member
Shri Y.S. Dhanik, Administrative Officer	Member
Shri B.C. Pandey, AF & AO	Member
Smt. Khilawati Rawat, AAO	Member Secretary

Staff Side	
Shri J.C. Bhandari	Member
Shri P.C. Tewari	CJSC Member
Shri R.K. Arya	Member
Shri T.M. Sharma	Member Secretary
Shri Manoj Kumar	Member
Shri Mangla Prasad	Member

18.8 Members of Result Framework Documentation

Dr. (Mrs.) P.K. Sahoo, Principal Scientist, ICAR-DCFR, Bhimtal.	Nodal Officer
Dr. S. Ali, Scientist, ICAR-DCFR, Bhimtal.	Co-Nodal Officer

18.9 HYPM, PERMISNET, PIMS, MIS & FMS

Dr. Prem Kumar, Senior Scientist, ICAR-DCFR, Bhimtal.	Nodal Officer
---	---------------

PERSONNEL

Staff list as on 31.03.2015

19.1 Research Management		
Dr. A. K. Singh, Director		
19.2 Scientific		
1.	Dr. P.K. Sahoo, Principal Scientist	Fish & Fishery Science
2.	Dr. Ashoktaru Barat, Principal Scientist	Fish Genetics & Breeding
3.	Dr. Debajit Sarma, Principal Scientist	Fish & Fishery Science
4.	Dr. Amit Pande, ICAR National Fellow	Biotechnology (Animal science)
5.	Dr. Nityanand Pandey, Principal Scientist	Aquaculture
6.	Dr. Prem Kumar, Senior Scientist	Fish & Fishery Science
7.	Dr. S.K. Srivastava, Senior Scientist	Fish & Fishery Science
8.	Dr. Suresh Chandra, Senior Scientist	Fish Pathology
9.	Dr. R.S. Patiyal, Senior Scientist	Fish Genetics & Breeding
10.	Sh. Sumanta Kumar Mallik, Scientist	Aquaculture
11.	Dr. Shahnawaz Ali, Scientist	Aquaculture
12.	Dr. Neetu Shahi, Scientist	Biotechnology (Animal Science)
13.	Dr. Md. Shahbaz Akhtar, Scientist	Fish & Fishery Science
14.	Dr. Dimpal Thakuria, Scientist	Biochemistry (Animal science)
15.	Dr. Sanjay Kumar Gupta, Scientist	Fish & Fishery Science
16.	Dr. Biju Sam Kamalam J, Scientist	Fish Nutrition
17.	Dr. Ciji Alexander, Scientist	Fish Nutrition
18.	Sh. Rajesh M, Scientist	Fish Nutrition
19.	Sh. Tandel Riteshkumar Shantilal, Scientist	Fish Health
20.	Sh. Abhay Kumar Giri, Scientist	Aquaculture
19.3 Technical		
1.	Dr. R.S. Haldar	Asst. Chief Technical Officer
2.	Sh. A.K. Joshi	Sr. Technical Officer
3.	Sh. Baldev Singh	Technical Officer
4.	Sh. Santosh Kumar	Technical Officer
5.	Sh. Ravinder Kumar	Sr. Technical Assistant
6.	Sh. Vijoy Kumar Singh	Sr. Technical Assistant
7.	Sh. Amit Kumar Saxena	Sr. Technical Assistant

8.	Sh. Hansa Dutt	Technical Assistant
9.	Sh. Gopal	Technical Assistant
10.	Sh. T.M. Sharma	Technical Assistant
11.	Sh. R.K. Arya	Technical Assistant
12.	Sh. Manoj Kumar Yadav, Driver	Sr. Technician
13.	Sh. Partha Das	Technician

19.4 Administrative

1.	Sh. Y.S. Dhanik	Admn. Officer
2.	Sh. Harish Ram	Asstt. Admn. Officer
3..	Sh. B.C. Pandey	Asstt. Fin. & Acc. Officer
4.	Smt. Khilawati Rawat	Asstt. Admn. Officer
5.	Smt. Susheela Tewari	Private Secretary
6.	Sh. P.C. Tewari	Assistant
7.	Sh. Arun Khulbe	Assistant
8.	Sh. Ankesh Kumar Sinha	Assistant
9.	Sh. J.C. Bhandari	Assistant
10.	Sh. Pratap Singh	UDC
11.	Smt. Munni Bhakt	UDC
12.	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. Pooran Chandra	-do-
5.	Sh. Manoj Kumar	-do-
6.	Sh. Kuldeep Kumar	-do-
7.	Sh. Bhola Dutt Mouni	-do-
8.	Sh. Dharam Singh	-do-
9.	Smt. Basanti Devi	-do-
10.	Sh. Mangla Prasad	-do-
11.	Sh. Sushil Kumar	-do-

ANNEXURE 1



Results Framework Document (RFD)

ICAR-Directorate of Coldwater Fisheries Research

(2014-2015)

Address:

Anusandhan Bhavan, Industrial Area
Bhimtal -263136 (Uttarakhand)

Website:

<http://www.dcf.res.in>

Section 1: Vision, Mission, Objectives and Functions

Vision

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

Mission

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

Objectives

1. Development of protocols for sustainable management of natural aquatic resources
2. Development of technologies for productivity and production enhancement from coldwater aquaculture

3. Transfer of technologies, training and farmer adoption

Functions

To counteract the effect of unregulated developmental activities in the fragile ecosystem of Himalayan region; judicious and scientific management of aquatic ecosystem by bridging the gap between actual fish yield and production potential can lead to the sustainable coldwater fishery resources, which in turn would accelerate the economy of the region. To achieve the goal it is necessary to harness fish for food, sports and livelihood security of hill communities through assessment, generation, refinement and adoption of appropriate technologies and manpower development in the sector.

Section 2: Inter se priorities among Key Objectives, Success Indicators and Targets

Sl. No.	Objective (S)	Weight	Actions	Success Indicators	Unit	Weight	Target/Criteria Value				
							Excellent 100 %	Very Good 90%	Good 80%	Fair 70%	Poor 60%
1.	Development of protocols for sustainable management of natural aquatic resources	34	Resource assessment and exploration	Number of explorations and surveys carried out	Number	10	8	6	4	2	0
				Development of molecular markers of important coldwater fishes	Number	9	65	55	45	35	25
				GIS based resources map developed	Date	7	20/02/2015	22/02/2015	24/02/2015	26/02/2015	28/02/2015
				Seed ranching programme taken up	Number	8	4	3	2	1	0
2.	Development of technologies for productivity and production enhancement from coldwater aquaculture	34	Enhancement of production	Broodstock for cold water fish species developed	Number of broodstock	7	300	250	200	150	100
				Seed production for cold water fish species	Number (in lakhs)	7	12	10	8	6	4
				Culture practices for hill aquaculture developed	Number	4	3	2	1	0	0
				Feed /feeding practices developed	Number	3	3	2	1	0	0
				Nutrient profiling of coldwater species	Number	3	5	4	3	2	1
				Disease surveillance undertaken	Number	5	4	3	2	1	0
			Fish health management	Identification & characterization of fish pathogens in coldwater fish species	Number of pathogen	5	7	6	5	4	3

Sl. No.	Objective (S)	Weight	Actions	Success Indicators	Unit	Weight	Target/Criteria Value				
							Excellent	Very Good	Good	Fair	Poor
							100 %	90%	80%	70%	60%
3.	Transfer of technologies, training and farmer adoption	12	Training, Extension and farmer adoption in coldwater sector	Training for skill up gradation programmes conducted	Number of trainees	6	190	175	160	145	130
				Farmers adopted	Number	3	25	20	15	10	5
				Exhibitions/farmers meet organized/participated	Number	3	5	4	3	2	1
	Publication/ Documentation	5	Publication of the research articles in the journals having the NAAS rating of 6.0 and above	Research article published	Number	3	5	4	3	2	1
				Timely publication of the Institute Annual Report(2013-2014)	Date	2	30/06/2014	02/07/2014	04/07/2014	07/07/2014	09/07/2014
				Utilization of released plan fund	%	2	98	96	94	92	90
	Efficient Functioning of the RFD System	3	Timely submission of Draft RFD 2014-2015 for approval	On-time submission	Date	2	May 15, 2014	May 16, 2014	May 19, 2014	May 20, 2014	May 21, 2014
				Timely submission of Results for 2013-2014	Date	1	May 1, 2014	May 2, 2014	May 5, 2014	May 6, 2014	May 7, 2014

Sl. No.	Objective (S)	Weight	Actions	Success Indicators	Unit	Weight	Target/Criteria Value				
							Excellent	Very Good	Good	Fair	Poor
							100 %	90%	80%	70%	60%
	Enhanced Transparency / Improved Service Delivery of Ministry/ Department	3	Rating from Independent Audit of Implementation of Citizen's / Client's Charter (CCC)	Degree of implementation of commitments in CCC	%	2	100	95	90	85	80
			Independent Audit of implementation of Grievance Redress Management (GRM) system	Degree of success in implementing GRM	%	1	100	95	90	85	80
	Administrative Reforms	7	Update organizational strategy to align with revised priorities	Date	Date	2	01.11.2014	02.11.2014	03.11.2014	04.11.2014	05.11.2014
			Implementation of agreed milestones of approved Mitigating Strategies for Reduction of potential risks of corruption (MSC)	% of implementation	%	1	100	90	80	70	60
			Implementation of agreed milestones for implementation of ISO 9001	% of implementation	%	2	100	95	90	85	80
			Implementation of agreed milestones of approved Innovation Action Plans (IAPs)	% of implementation	%	2	100	90	80	70	60

Section 3: Trend Values of the Success Indicators

Sl. No.	Objectives	Actions	Success Indicators	Unit	Actual value for FY 2012-13	Actual value for FY 2013-14	Target value for FY 2014-15	Projected value for FY 2015-16	Projected value for FY 2016-17	
1	Development of protocols for sustainable management of natural aquatic resources	Resource assessment and exploration	Number of explorations and surveys carried out	Number	6	6	6	7	8	
			Development of molecular markers of important coldwater fishes	Number	24	55	55	70	75	
			GIS based resources map developed	Date	-	-	22.02.2015	25.03.2016	25.03.2017	
2	Development of technologies for productivity and production enhancement from coldwater aquaculture	Management of depleting fishery resources	Seed ranching programme taken up	Number	2	3	3	4	4	
			Enhancement of production	Brood stock for cold water fish species developed	Number of broodstock	2*	3*	250	300	350
				Seed production for cold water fish species	Number (in lakhs)	6	10	10	12	12
	Culture diversification in coldwater	Fish health management	Culture practices for hill aquaculture developed	Number	1	1	2	2	2	
			Feed /feeding practices developed	Number	1	2	2	2	2	
			Nutrient profiling of coldwater species	Number	2	4	4	5	5	
	Disease surveillance programme	Disease surveillance programme	Number	2	3	3	3	4	4	
		Identification & characterization of fish pathogens in coldwater fish species	Number of pathogen	2	6	6	7	8	8	

Sl. No.	Objectives	Actions	Success Indicators	Unit	Actual value for FY 2012-13	Actual value for FY 2013-14	Target value for FY 2014-15	Projected value for FY 2015-16	Projected value for FY 2016-17
3	Transfer of technologies, training and farmer adoption	Training, extension and farmer adoption in coldwater sector	Training for skill up gradation programmes conducted	Number of trainees	104	173	175	150	200
			Farmers adopted	Number	20	20	20	25	30
	Publication/ Documentation	Publication of the research articles in the journals having the NAAS rating of 6.0 and above	Exhibitions/farmers meet organized/ participated	Number	4	4	4	5	6
			Research article published	Number	4	4	4	5	6
		Timely publication of the Institute Annual Report(2013-2014)	Annual Report published	Date	-	-	July 2 2014	-	-
	Fiscal resource management	Utilization of released plan fund	Plan fund utilized	%	98.27	99.96	96.00	97.00	98.00
	Efficient Functioning of the RFD System	Timely submission of Draft RFD 2014-2015 for approval	On-time submission	Date	-	-	May 16 2014	-	-
		Timely submission of Results for 2013-2014	On-time submission	Date	-	-	May 2 2014	-	-
	Enhanced Transparency / Improved Service Delivery of Ministry/ Department	Rating from Independent Audit of Implementation of Citizens / Client's Charter (CCC)	Degree of implementation of commitments in CCC	%	-	-	95	-	-
		Independent Audit of implementation of Grievance Redress Management (GRM) system	Degree of success in implementing GRM	%	-	-	95	-	-

Sl. No.	Objectives	Actions	Success Indicators	Unit	Actual value for FY 2012-13	Actual value for FY 2013-14	Target value for FY 2014-15	Projected value for FY 2015-16	Projected value for FY 2016-17
	Administrative Reforms	Update organizational strategy to align with revised priorities	Date	Date	-	-	02.11.2014	-	-
		Implementation of agreed milestones of approved Mitigating Strategies for Reduction of potential risks of corruption (MSC)	% of implementation	%	-	-	90	-	-
		Implementation of agreed milestones for implementation of ISO 9001	% of implementation	%	-	-	95	-	-
		Implementation of agreed milestones of approved Innovation Action Plans (IAPs)	% of implementation	%	-	-	90	-	-

* In previous year number of species was indicated

Section 4(a): Acronyms

Sl.No.	Acronym	Description
1.	GIS	Geographical Information System
2.	SAUs	State Agricultural Universities
3.	KVKs	Krishi Vigyan Kendras
4.	NGOs	Non-Governmental Organizations

Section 4(b): Description and definition of success indicators and proposed measurement methodology

Sl.No.	Success Indicator	Description	Definition	Measurement	General Comments
	Number of explorations and surveys carried out	Explorations are the prerequisite of assessment and management of the coldwater water bodies	It is a process of assessing the temporal status of natural water bodies	Quantification of resources and fish faunal diversity	Explorations of the water bodies is routine work of the institute
	Development of molecular markers of important coldwater fishes	Molecular markers may help in stock improvement programme	It is a molecular tool for characterization of species	Number of markers developed for different coldwater fish species	Genetic resource database for coldwater fish species
	GIS based resources map developed	Characterization of different water bodies in coldwater region	GIS is powerful tool to assess the fishery resources	Number of database developed	The map can be used for suitable site selection for aquaculture in coldwater region
	Seed ranching programme taken up	Due to inherent reasons the indigenous fish stocks are depleting in natural water bodies that can be counter acted with seed ranching programme	It is the process of rejuvenating the natural stocks	Number of ranching programme taken up	Farm raised fish seeds are ranching in nature for maintaining fish stock
	Broodstock for cold water fish species developed	Brood stock development is the primary key for artificial propagation in order to enhance the production in culture system	Raising the brood stock for quality seed production	Number of brood stock developed for breeding	The institute has taken programme on location specific brood stock development
	Seed production for cold water fish species	Mass scale seed production is required to enhance the fish production	Production of fish seed through induced breeding	Seed production	Required for sustainable aquaculture
	Culture practices for hill aquaculture developed	Suitable culture practices under different conditions are required	Culture practices as per the local condition	Culture practice suggested and advocated	Required for the local condition
	Feed /feeding practices developed	Species specific feed and feeding practices required.	Feed and feeding practices for selected coldwater species.	Feed and feeding practices developed and advocated.	Availability of feed and feeding practices is one of the major constraints in coldwater aquaculture

Sl.No.	Success Indicator	Description	Definition	Measurement	General Comments
	Nutrient profiling of coldwater species	Estimation of nutrients available in coldwater species	Proximate composition of fish and availability of different types of nutrients available in coldwater fishes	Number of coldwater species assessed for nutrient profiling	Fish is an integral part of human diet and it can fulfill the protein and other nutrient requirements
	Disease surveillance undertaken	Disease surveillance is a process of monitoring and reporting important fish diseases for the health of aquaculture production	Disease surveillance is listing, profiling and monitoring of health of aquaculture species and environment	Number of farms surveyed country wide	Need based programme for fish farmers
	Identification & characterization of fish pathogens in coldwater fish species	Preventive measure for aquaculture production	It is protective mechanism to identify fish pathogens	Number of pathogens identified	Required to develop fish health management programme
	Training for skill up gradation programmes conducted	Human resource development	Skill development of different stake holders	Number of trainees	Popularization of developed technology
	Farmers adopted	Adoption of farmers for transferring technical know-how for aquaculture practices	Adoption is a process which is required to support and develop farmers for increasing aquaculture production	Number of farmers adopted	The institute has initiated farmers oriented programme for popularization of aquaculture in hills
	Exhibitions/farmers meet organized/participated	Display of important technology and interaction with farmers	It is a method of extension for dissemination of technology and technical know-how	Numbers of exhibitions organized/participated	The institute participate in different exhibitions/farmers meet on regular basis

Section 5: Specific performance requirement from other departments that is critical for delivering agreed results

Location Type	State	Organization Type	Organization Name	Relevant Success Indicator	What is your requirement from this organization	Justification for this requirement	Please quantify your requirement from this organization	What happens if your requirement is not met
NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

Section-6 Outcome/impact of Department/Ministry

Sl. No.	Outcome/Impact	Jointly responsible for influencing this outcome/impact with the following organization/ department(s)/ministry(ies)	Success indicator	Unit	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
1.	Aquatic resources assessed and explored	Ministry of Agriculture, SAUs, Ministry of Environment & Forest, State Fisheries Department, KVKs, NGOs	Aquatic resources explored	Number	6	6	6	7	8
2.	Productivity and production of coldwater aquaculture increased	Ministry of Agriculture, SAUs, Ministry of Environment & Forest, State Fisheries Department, KVKs, NGOs	Seed production for coldwater fishes	Number (in lakhs)	6	10	10	12	12
3.	Trained man power available	State Department of Fisheries, KVKs and Private sector, Hydro-electric projects	Training and skill up gradation Farmers adopted	Number of trainees Number of farmers	104 20	173 20	150 20	150 25	200 30

ANNEXURE 2

ICAR-DCFR Field Centre Champawat

An experimental fish farm is located at Chhirapani in Champawat, Uttarakhand. This centre is carrying out various research programmes, human resource development and extension activities. Research activity includes breeding, seed production, culture and management of coldwater fishes such as rainbow trout, grass carp and common carp.

Address:

Scientist- in-charge

ICAR-DCFR Field Centre, Chhirapani,
Distt. Champawat, Uttarakhand, India

Pin- 262 523

Phone: 05965 - 230052

E-mail: srivastavask100@gmail.com

