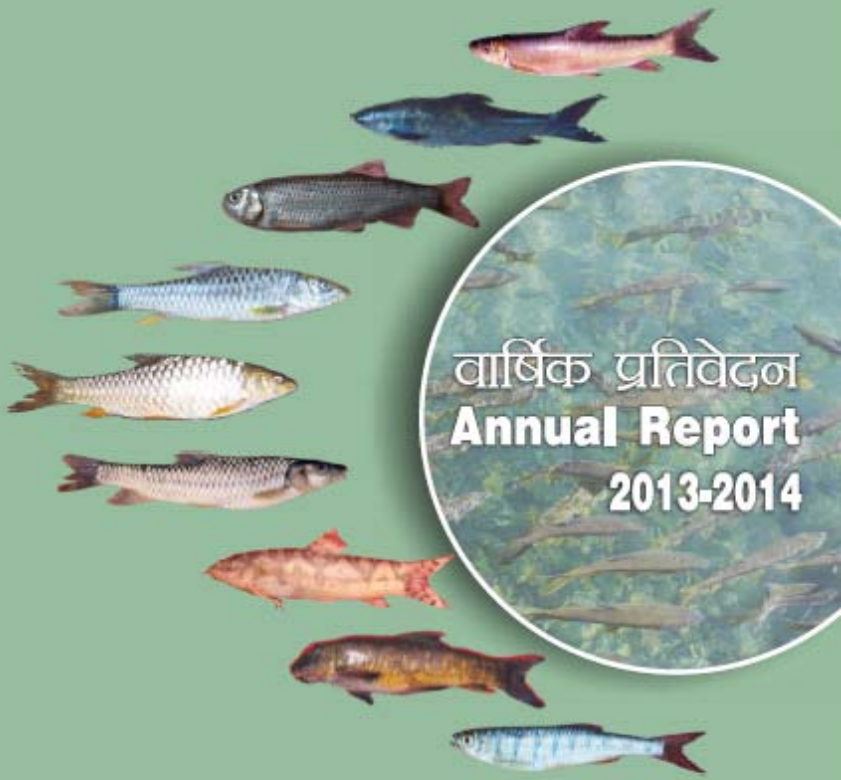
DCFR ANNUAL REPORT 2013-2014



# वार्षिक प्रतिवेदन
# Annual Report
# 2013-2014


शीतजल मात्स्यिकी अनुसंधान निदेशालय
(भारतीय कृषि अनुसंधान परिषद)
भीमताल 263136, नैनीताल, उत्तराखण्ड (भारत)

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

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Directorate of Coldwater Fisheries Research

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DCFR Annual Report 2013-2014

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# Preface

The cold water fisheries contribution is athough small in comparison to the Indian fisheries scenario, but has significant importance in the tender ecological regime of the Himalayan region. The unique geographical and climatic condition sustains entirely different fish faunal diversity. Fish faunal diversity as well as the ecosystem diversity of the region is the great treasure of our country. With a mission to enrich this sector, Directorate of Cold water Fisheries Research has taken continuous effort in research and extension. The dominant species such as mahseer and snow trout has a unique distribution and adaptation to the cold condition. During the year 2013-14, total mtDNA sequencing of closely related species of *Schizothorax* was worked out to study the evolutionary and phylogenetic significance. Attempt was made to develop a reference database using cDNA library of *Schizothorax richardsonii* and to identify a set of genes responsible for adaptation to changing environment. Under the species diversification endeavour, scientists worked hard for refining the breeding and rearing technique of *chocolate mahseer*, *Labeo dero, L. dyocheilus* including some ornamental fish species. Feed and seed being the important consideration for successful aquaculture, due emphasis was given for healthy seed production and cost effective feed production. Health management of important cultivated coldwater fishes was addressed covering several states and live specimens from grow out facilities were regularly screened for presence of any viral and bacterial pathogens. Using GIS tools, suitable aquaculture site and the resources of West Sikkim was mapped for future aquaculture development and planning.

Focused programme of extension was taken up under the NEH activity and the Tribal Sub Plan (TSP). For the first time, scientists ventured to work with the farmers in the high altitudes of Leh & Ladakh for initiating rainbow trout farming. A great success and spectacular development was achieved in expanding the rainbow trout culture as well as seed production in the state of Sikkim. On farmers' demand, need based training programmes was organized in Kullu district of Himachal Pradesh, Pithoragarh district of Uttarakhand and also in the North-eastern region.

Strides were also undertaken for resource management particularly to protect the declining population of golden mahseer in Kumaon lakes. Awareness program on "*mahseer bachao jagrukta*

*abhiyan* was campaigned. A conservation measures through seed ranching of golden mahseer (*Tor puititora*) was undertaken in Bhimtal and Naukuchiatal Lakes in collaboration with State Fisheries Department.

The state of Uttarakhand witnessed a devastating flood during the year, destroying infrastructures, and claiming human as well as animal lives. In this critical situation, scientists and staff of DCFR along with other ICAR research organization of Kumaun region and CIBA Chennai participated in the relief and rescue operation in Pithoragarh district. The rehabilitation programmes are even continued in the region.

The Directorate on Coldwater Fisheries Research fostered the research linkages with national & international organizations during the year for promoting R & D activities. I appreciate the contribution of all the scientists and staff members of the DCFR in successful execution of research, development and extension activities during the reporting period. I express my sincere thanks to all scientists and other staff in this endeavor. Thanks are also due to members of the editorial committee for their meticulous effort in compilation and bringing out the Annual Report on time.

I am deeply indebted to Honorable Secretary, DARE and Director General, ICAR, Dr. S. Ayappan for moral support and visionaries 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 continued support, encouragement and guidance for planning and execution of research, extension and other activities of this Institute.

Date: 10/06/2014

(A. K. Singh)

Director

# Contents

# 1 - कार्यकारी सारांश

भारत के पर्वतीय भागों के ग्रामीण क्षेत्रों में लोगों को खाद्य सुरक्षा उपलब्ध कराने एवं उनकी आय के स्त्रोत में वृद्धि करने के लिए शीतजल मात्स्यिकी में अपार सम्भावनाऐं हैं। जनसंख्या वृद्धि एवं शहरीकरण के कारण पर्वतीय जल संसाधनों में कमी आयी है। इसलिए देश के शीतजल क्षेत्रों में मात्स्यिकी संसाधनों कें सतत् प्रयोग एवं विकास का महत्व बढ़ गया है। इस दिशा में शीतजल मात्स्यिकी अनुसंधान निदेशालय ने वर्ष 2013–14 की अवधी में 11 संस्थानीय परियोजनाओं, 6 बाह्य–पोषित परियोजनाओं, दो अर्न्तसंस्थानीय आउटरीच गतिविधियों तथा एक राष्ट्रीय निगरानी कार्यक्रम के प्रयोजन तथा भारतीय कृषि अनुसंधान परिषद के अन्तर्गत विभिन्न मात्स्यिकी संस्थानों के सहयोग से अनुसंधान गतिविधियों को सफलतापूर्वक सम्पन्न किया गया।

जी.आई.एस. उपकरणों के प्रयोग द्वारा पश्चिमी सिक्किम में मिट्टी तथा जल की गुणवत्ता एवं अभिसंरचना के आधार पर मत्स्य पालन के लिए उपयुक्त स्थानों का मानचित्र तैयार किया गया है। अध्ययनों से पता चला कि 41 वर्ग किमी. का क्षेत्र जल की गुणवत्ता के मापदण्डों के अनुकूल पाया गया जबकि 31 वर्ग किमी. का क्षेत्र मिट्टी की गुणवत्ता हेतु उपयुक्त था। मत्स्यपालन हेतु 12.3 वर्ग किमी. क्षेत्रफल उपयुक्त पाया गया जिसमें 7.2 वर्ग किमी. क्षेत्रफल ट्राउट मत्स्य पालन हेतु, 1.1 वर्ग किमी. क्षेत्रफल कार्प पालन के लिए तथा 4.0 वर्ग किमी. का क्षेत्रफल मामूली रूप से उपयुक्त पाया गया।

भारत में विदेशी कार्प का प्रवेश कुछ सदियों पूर्व ही हो चुका था किन्तु इसके बुनियादी ऑकड़े उपलब्ध नही हैं। देश के शीतजल क्षेत्रों में स्थित राज्य सरकार के स्वामित्व वाले एवं व्यक्तिगत दोनों प्रकार के ट्राउट फार्मों से प्रजनन, उत्पादन स्तर एवं सम्वर्द्धन से सम्बन्धित कुल 14 ट्राउट हैचरियाँ, 40 ट्राउट पालन ईकाईयाँ तथा 268 ट्राउट ईकाईयाँ व्यक्तिगत क्षेत्र के अन्तर्गत हैं। वर्ष 2002–03 में ट्राउट उत्पादन 90 टन था जो कि वर्ष 2012–13 में 260 टन हो गया। ट्राउट मत्स्य पालन एवं ट्राउट बीज उत्पादन में हिमाचल प्रदेश एक अग्रणी राज्यों में से एक है। वर्ष 2009–10 में राज्य में ट्राउट उत्पादन 44.19 मिट्रिक टन था जो वर्ष 2011–12 में 130 टन पहुँच गया। उत्तराखण्ड राज्य मत्स्य विभाग ने हैचरियों एवं फार्मो के निर्माण हेतु प्रयास किए हैं। उत्तराखण्ड राज्य मत्स्य विभाग के अर्न्तगत 35 पक्के तालाब हैं। सिक्किम में भी ट्राउट की खेती आशाजनक है यहां 2012–13 में उत्पादन 80.0 मि. टन पहुंच गया। अरूणांचल प्रदेश में प्रजनकों का संचयन एवं बीज उत्पादन हेतु दो मुख्य हैचरियों–पश्चिमी कामेंग के शेरगाँव तथा नूरानांग में किया जा रहा है।

मत्स्य जैव विविधता एवं संसाधन मूल्यांकन के अर्न्तगत हिमाचल प्रदेश में सतलज नदी की प्रमुख मत्स्य जैव सम्पदा को एकत्रित करने के लिए एक सर्वेक्षण किया गया। प्रत्येक प्रयासों में पकड़ी गयी मछलियाँ 200 ग्राम से 1900 ग्राम प्रति घंटा थी जो कि बहुत कम है। कुल मिलाकर सतलज नदी में शाइजाथोरैक्स प्रजाति के मछलियों की बहुलता थी जिसमें अन्य प्रजातियाँ जैसे ग्लिप्टोथेरैक्स, गारा, पुंटियस तथा निमैकाइलस प्रजातियाँ भी विद्यमान थी। पश्चिमी बंगाल एवं अरूणांचल प्रदेश की पहाडियों में भी अन्वेषणात्मक सर्वेक्षण किया गया। अरूणाचल प्रदेष के तवांग जिले में समुद्र तल से 13000 फीट की ऊँचाई पर कई झीलें स्थित हैं, तवांग क्षेत्र में अत्यधिक ऊँचाई पर स्थित झीलों में अभी तक अन्वेषण कार्य नही हुआ है। इन जल स्त्रोतों की भू आकृति विज्ञान, जलवायु, जैविकीय, रासायनिक, जलीय पर्यावरण, सूक्ष्म जैव विविधता आदि पर वैज्ञानिक तरीके से अनवेषण कार्य किऐ जाने की आवश्यकता है। प. बंगाल के सुदूर उत्तरी जिला जलपाइगुड़ी में भी सर्वेक्षण कार्य किया गया।

पर्वतीय क्षेत्रों में मत्स्य उत्पादन अर्न्तस्थली जल स्त्रोतों जैसे झीलों, तालाबों व नदियों तक ही सीमित है। मत्स्य उत्पादन मुख्यतः तराई क्षेत्र में उन स्थानों पर ही केन्द्रित है जहाँ चाइनीज कार्प एवं भारतीय कार्प का पालन किया जाता है। क्षेत्र का सुदूर पर्वतीय क्षेत्र वास्तव में अछूता रहा है। दूर–दराज की पर्वतीय आबादी के सामाजिक–आर्थिक स्तर को सुधारने के लिए पिथौरागढ़ और ऊधम सिंह नगर जिले के सुदूरवर्ती ग्रामों में 33 मत्स्य पालकों के बीच मत्स्य पालन सम्बन्धी गतिविधियों का विस्तार किया गया है। सभी मत्स्य पालकों को एक वर्ष के लिए बुनियादी सुविधाऐं जैसे उनकी भूमि पर तालाब की सुविधा, मत्स्य बीज, मत्स्य आहार, जाल तथा उवर्रक आदि उपलब्ध करायी गयी हैं तथा सभी प्रबन्धन सम्बन्धी क्रिया कलाप निदेशालय द्वारा संचालित की जाती है।

कुछ प्रमुख शीतजल मत्स्य प्रजातियों एवं कुछ सजावटी मत्स्य प्रजातियों के ''प्रजनक–बैंक'' स्थापित करने के उददेश्य से कार्य आरम्भ किया गया है। इस कार्यक्रम के तहत उत्तराखण्ड़

के कुमायूँ क्षेत्र की विभिन्न नदियों जैसे – गोला, चाँफी, ऊपरी कोसी, निचली कोसी, काली, गोमती, प. रामगंगा व सरयू आदि में सर्वेक्षण कार्य किया तथा *टौर प्युटिटोरा, टौर चिलिनाइडिस, लेबियो डेरो, शाइजोथरैक्स रिचार्डसोनी, बेरिलियस बेंडेलिसिस, बेरिलियस वैग्रा, निमाकाइलस तथा गारा गोट्यला गोट्यला* आदि मत्स्य प्रजातियों को संग्रहित किया गया।

विदेशी गोल्ड एवं कोई कार्प सहित लगभग 400 सजीव मत्स्य प्रजातियों को डी.सी.एफ.आर. के मुख्य परिसर में अध्ययन हेतु प्रबधंन किया जा रहा है। प्रजनन कार्यक्रम के अन्तर्गत *लेबियो डेरो, चॉकलेट महाशीर* तथा सजावटी मत्स्य प्रजाति कोईकार्प व गोल्ड फिश पर सफलतापूर्वक प्रयास किऐ गऐ।

पॉलीथीन वाले तालाबों में चॉकलेट महाशीर और सुनहरी महाशीर की वृद्धि प्रदर्शन का मूल्यांकन किया गया और पाया गया कि सुनहरी माहशीर की तुलना में चॉकलेट माहशीर में जीरा से लेकर अंगुलिका स्तर तक 20 प्रतिशत की बेहतर वृद्धि देखी गयी। पिंजरो में पाली गयी सुनहरी माहशीर की वयस्क अगुंलिकाओं को निदेशालय द्वारा आयेजित ''सीड रैंचिंग प्रोग्राम'' के अन्तर्गत नौकुचियाताल झील छोड़ा गया। हंगेरियन कॉमन कार्प का भी विभिन्न तापीय मापदण्डों पर मूल्यांकन किया गया। राज्य मत्स्य विभागों के विलासपुर, हि.प्र. तथा पूर्वी सिक्किम के रांगपो मत्स्य फार्मो में अत्यधिक वृद्धि देखी गयी जबकि सेन्ट एण्टोनी कॉलेज, शिलांग, मेघालय के तालाबों में कम वृद्धि देखी गयी।

इस अवधि में विभिन्न कार्यक्रमों के अन्तर्गत मत्स्य स्वास्थ्य–प्रबन्धन पर भी कार्य किये गऐ। चम्पावत फार्म में परजीवी, फंफूद तथा गैर संक्रमणीय रोगों का मूल्यांकन किया गया तथा रेन्बो ट्राउट मछली के ऊपरी व निचले जबड़ो में लालिमायुक्त छाले, माउथ कैविटी, बाहर निकली हुयी आँखे, उदर के निचले हिस्सों में गहरे रंग के छाले आदि का अवलोकन किया गया। पूर्ण रूप से स्वस्थ्य 34 रेन्बो ट्राउट (आन्कोरिफस माइकस) के पेशियां, गिल, यकृत, आँत, आँख, स्प्लीन, गौलब्लैडर (पित्ताशय) तथा किडनी आदि जैसे नमूनों को एकत्र किया गया साथ ही जम्मू कश्मीर के कोकरानाग तथा दाचीगाँव के ट्राउट फार्मों से ट्राउट मछलियों के ऊतकों के नमूने भी लिए। दाँचीगाँव से एकत्र ट्राउट मछलियों के ऊतकीय नमूनों से 23 बैक्टीरियल आइसोलेट्स तथा कोकरानाग से 12 आइसोलेट्स प्राप्त किऐ गए।

जम्मू–कश्मीर एवं उत्तराखण्ड के विभिन्न भौगोलिक स्थलों से *शाइजोथोरैक्स, इसोसाइनस, प्लेजियोटोमस, लेविऐटस, प्रोगेस्टस एवं शाइजोथोरैक्स रिचार्डसोनी* के पंखों के ऊतकों के नमूने एकत्र किऐ गए। स्नोट्राउट के पूर्ण माइटोकौन्ड्रियल डी.एन.ए. को श्रेणीक्रम किया गया। इन सभी मछलियों के माइटोकौन्ड्रियल जीनोम का आकार लगभग 16 के.बी. था जिनमें 13 प्रोटीन कोडिंग जिन थे। सभी श्रेणीक्रमों को एन.सी. बी.आई. जीन बैंक में सम्मिलित किया गया।

इस वर्ष पश्चिमी बंगाल के दार्जिलिंग क्षेत्र, असम, हिमांचल जम्मू एवं कश्मीर के लेह–लद्दाख तथा उत्तराखण्ड राज्य में लक्षित जनजाती उपयोजन के अन्तर्गत कई कार्य किए गए। कार्प मत्स्य पालन तकनीकी तथा समन्वित मत्स्य पालन तकनीकी के प्रचार–प्रसार हेतु उत्तराखण्ड से 33 जनजाति कृषक तथा असम से 30 मत्स्य पालकों का चयन किया गया एवं उनको मत्स्य पालन से सम्बन्धित बीज, मत्स्य आहार तथा दूसरे जरूरी उपकरण उपलब्ध कराऐ गए। लेह क्षेत्र में ट्राउट पालन हेतु उचित स्थलों का चुनाव तथा कृषकों की पहचान के लिए एक सर्वेक्षण किया गया। घूछोट ग्राम में 5 किसानों के लिए पक्के तालाबों का निर्माण किया तथा दो तालाबों का पुर्ननिर्माण किया गया। इसी प्रकार हिमांचल प्रदेश तथा पश्चिमी बंगाल के विभिन्न स्थलों में मत्स्य पालन हेतु कृषकों की पहचान की गयी।

उत्तर–पूर्वी गतिविधियों के अन्तर्गत विभिन्न कार्यक्रम आयोजित किए गए। अरूणाचल प्रदेश में शेरगाँव मत्स्य फार्म में 2500 ब्राउन ट्राउट तथा 1000 रेन्बो ट्राउट के बीजों का उत्पादन किया गया तथा इन बीजों को सेला तथा त्सो झील में संचय किया गया। असम में समन्वित मत्स्य सह सुअर पालन कार्य आरम्भ किया तथा असम के खोरखोरी, पुथीमारी, फूलगुरी ग्रामों के 12 मत्स्य पालकों को तथा मेघालय के पश्चिमी व पूर्वी खासी पहाड़ियों में री–भोई के पिनोटसाला, लिटिभावरो, भयरांग, लेटखिरोंग, रियांग ग्रामों से 25 मत्स्य पालकों को समन्वित मत्स्य सह सुअर पालन अपनाने के लिए चयनित किया गया। सिक्किम राज्य में मत्स्य पालन को बढ़ावा देने के लिए डी.सी.एफ.आर. भीमताल व राज्य मत्स्य विभाग सिक्किम सरकार के बीच तकनीकी समन्वय से कार्य किया जा रहा है। यह समन्वय सिक्किम राज्य के ग्रामीणों की आजीविका सुरक्षा के लिए एक महत्वपूर्ण उद्यम है। डी.सी.एफ.आर. की मदद से विभिन्न ट्राउट फार्मों में ट्राउट के स्वस्थ्य प्रजनकों का संचय एवं प्रबधंन किया गया है। इस वर्ष सिक्किम राज्य में 3 लाख आइड ओवा उत्पादित किए गए।

अनुसंधान गतिविधियों के अतिरिक्त निदेशालय में विभिन्न कार्यक्रमों हिन्दी सप्ताह समारोह, कृषक दिवस, हिन्दी सेमिनार, बैठकें, आर.ए.सी., आई.आर.सी., संस्थान प्रबन्धन समिति, आई.जे.एस.सी. तथा मत्स्य पालकों एवं योजनाकारों, शैक्षणिक व छात्र–छात्राओं से सम्बन्धित विभिन्न प्रशिक्षण कार्यक्रम भी अयोजित किऐ गए। निदेशालय के वैज्ञानिकों ने कार्यशालाओं, संगोष्ठियों, बैठकों तथा अर्न्तसंस्थानीय खेल–कूद प्रतियोगिताओं आदि में भाग लिया तथा विभिन्न समारोह एवं राष्ट्रीय एकता एवं साम्प्रदायिक सद्भावना दिवस, पर्यावरण–दिवस आदि का सफल आयोजन किया। ❑

# 2 - Executive Summary

Coldwater fisheries have a great potential in generating rural income and providing food security to the rural in Indian uplands. On account of population upsurge and urbanization, upland aquatic resources once considered inexhaustible, are under threat. Hence, sustainable utilization and development of fisheries resources have assumed importance in coldwater region of the country. In this direction The Directorate of Coldwater Fisheries Research during the year 2013-14, has successfully carried research activities with eleven Institutional research projects, Six externally funded projects, two inter-institutional Outreach Activities and one National Surveillance Programme with different fisheries Institutes under ICAR.

- Site suitability map for aquaculture in west Sikkim has been prepared based on soil quality, water quality and infrastructure using GIS tools. The study revealed that 41 $km^2$ area was found suitable for water quality parameters while 31 $km^2$ area was suitable for soil quality. Considering, water & soil quality and infrastructure facilities, 12.3 $km^2$ area was found suitable for fish culture of which 7.2 $km^2$ area was most suitable for trout, 4.0 $km^2$ area was moderately suitable and 1.1 $km^2$ area was suitable for carp culture.
- Exotic trout were introduced in India more than a century back but there is lack of basic data. Study was aimed to collect basic information on the culture, breeding and production status of rainbow trout both in private and state government owned farms from the coldwater regions of the country. There are forty trout rearing units and 14 hatcheries with State Fisheries Departments 268 trout units under private sector. The trout production was increased from 90 tons during 2002-03 to 260 tons in 2012-13. Himachal Pradesh is one of the leading states in trout farming and trout seed production. The trout production from the state during 2009-10 was 44.19 MT which reached to 130 tons during 2011-12. Department of Fisheries, Uttarakhand initiated efforts to built hatcheries and farms. There are around 35 raceways under the State Fisheries Department and 8 raceways under the private sector. Sikkim is promising state for trout farming. The production of rainbow trout has reached 80.0 MT during 2012-13. In Arunachal Pradesh trout broodstock and seed production is being done in two main hatcheries at Shergaon of west Kameng and at Nuranang . Some constraints such as availability of trout seed, low cost feed and availability of market were identified during the survey.
- Under the exploration of fish faunal diversity and resources assessment, a survey was conducted to collect important fish fauna of river Sutlej in Himachal Pradesh. The catch per unit efforts (CPUE) indicated low catch ranging from 200 g to 1900 g hour for the middle and lower altitudes. Overall the predominant fish species in Sutlej River was comprising of *Schizothorax* spp. However; other species such as *Glyptothorax* spp., *Garra gotyla gotyla*, *Barilius* spp., *Puntius* spp., and *Noemacheilus* spp. were also recorded. Exploratory survey for resources

was also conducted in Arunachal Pradesh and hills of West Bengal. Tawang district in Arunachal Pradesh contributes maximum numbers of high altitude lakes at an elevation over 13,000 feet above the sea level. High-altitudes lakes in Gasila, Bongajong and Zimithang area of Tawang, Arunachal Pradesh are still unexplored. Scientific investigation on geomorphology, climatic, biological, chemical, limnology, microbial diversity and other life form of microorganism of these water bodies was initiated, The northernmost district of the Jalpaiguri Division, of West Bengal was also surveyed.

- Fish Production in hill region is confined to inland waters such as lakes, reservoirs and rivers. Aquaculture production is concentrated mainly in Tarai region where Chinese carp and Indian major carp are being cultivated. The remote hilly areas of the region is virtually untouched but the region is promising for coldwater fisheries development. To improve the socio-economic status of the remote hill population, aquaculture intervention was extended to 27 farmers in the remote villages of Distt. Pithoragarh and Udhamsinghnagar. All the farmers were facilitated with pond infrastructure on their lands, critical inputs like feed, seed, nets and fertilizer etc.were provided for one year and all management activities was monitored by the Directorate. In Sikkim technical support was extended for seed production of rainbow trout using wild brood stock of Memencho lake and produced seed was reared in state trout farm, Momencho.
- A work was initiated with an objective of developing brood banking of some ornamental fish species and some other important coldwater fish species. Under the programme various river system of Kumoun, Uttarakhand *viz* Gola, Chafee, upper Kosi, lower Kosi, kali ,Gomati, western Ramganga and Saryu river were surveyed and collected *Tor putitora* ,*Tor chillinoides*, *Labeo dero*, *Schizotharax richardsoni*, *Barilius bendelensis*, *Barilius vagra*, *Nemachilus sp.*, *Gara gotyla gotyla* etc.
- So far 400 live fishes including exotic gold and koi carp are being maintained at DCFR main complex for further study and breeding trials.Under breeding programmes, successful attempts were made for *Labeo dero*, *Neolisochilus hexagonelepis* , and ornamental fishes gold fish (*Crassius auratus),* Koi (*Cyprinus carpio)* however, *Gara gotyla gotyla* didn, responded well.
- Growth performance of chocolate mahseer and golden mahseer was evaluated under poly-culture system showed that the chocolate mahseer had 20% better growth rate during fry to fingerling stage in comparison to golden mahseer. Cage reared advanced fingerlings of golden mahseer were harvested and stocked in Naukuchiatal lake on the occasion of an awareness programme on "Seed Ranching Programme" organized by DCFR.
- Performance of Hungarian Common carp was also evaluated at different thermal regime, the maximum growth was found in state fish farm Bilaspur, Himachal Pradesh, followed by Rangpo fish farm at east Sikkim while minimum growth was reported in the fish pond of St. Antony College of Shillong,Meghalaya in one year.
- The work on health management was continued through various programmes during the period under report. Parasitic, fungal and non-infectious disease evaluation was reported from Champawat farm and observed reddening and ulceration in lower and upper jaw, mouth cavity, exophthalmia, dark coloration and ulceration in lower abdominal part of rainbow trout specimens. To identify the bacterial pathogens, samples from muscle, gill, liver, gut, eye, spleen, gall bladder and kidney were obtained from 34 apparently healthy rainbow trout, *Oncorhynchus mykiss.* Rainbow trout tissue

samples were also collected from Dachigaon and Kokernag trout farms in Jammu & Kashmir. 23 bacterial isolates were recovered from tissues samples collected from trout farm, Dachigaon, whereas 12 isolates were recovered from tissue samples collected from trout farm, Kokernag.

- Fin tissue samples of *Schizothorax esocinus, S. plagiostomus, S. labiatus, S. progastus* and *Schizopyge niger* were collected from different geographical locations of Uttarakhand and Jammu & Kashmir. Total mitochondrial DNA of these collected snow trout specimens was sequenced.Using next generation RNA sequencing technologies, attempt was made to develop a reference database by developing cDNA library from liver of *Schizothorax richardsonii* to identify a set of genes for future application in adaptation to changing environment.
- The work on targeted Tribal Sub Plan (TSP), this year programme was continued in the states of Uttarakhand, Leh-Ladhakh of Jammu & Kashmir, Himanchal Pradesh, Assam and Darjeeling area of West Bengal. To disseminate the carp culture technologies and integrated farming system, 33 tribal farmers from Uttarakhand and 30 farmers from Assam were selected and facilitated with infrastructures related to aquaculture including provision of seed ,feed and other necessary inputs. Surveys were carried out in Leh area to find out the suitable site and farmers for trout farming. Five new raceways were constructed for five farmers in village Chuchot and two raceways were renovated. To identify the farmers and their site for initiation of trout and carp culture, survey was conducted in various places of Himanchal and West Bengal.
- Various activities were undertaken for NEH programme. In Arunachal Pradesh, 25000 brown trout seed and 10000 rainbow trout seed were produced at Shergaon Goveronment. Trout Farm Bomdila and stocked in Sella and PTso lakes. Integrated pig-cum fish culture was initiated in Assam and adopted 12 farmers of the village Phulguri, Puthimari & Khorkhori of Assam. 25 farmers were selected to adopt integrated fish cum pig farming in the village of Rtiang, Laitkyrhong, Myrang, Laitmawroh and Pynhurslla of Ri-bhoi, East Khasi hills and West Khasi hills dist. of MeghalayaFor the promotion of trout farming in Sikkim DCFR, Bhimtal got technically associated with State Fisheries Department Sikkim. To develop it as an important enterprise for livelihood security to the rural people of Sikkim State. With the help of DCFR, a healthy brood stock of trout is being maintained at different government trout farms. This year 3 lakh eyed ova was produced in Sikkim State.
- Other than research activities, the Directorate organized Hindi Saptah, Farmer's Day, Hindi Seminars, meetingsRAC, IRC, Institute Management committee, IJSC and and conducted various training programmes related to farmer, academicians, entrepreneurs and students. Scientists of DCFR also participated in Symposia, workshops, meetings, ICAR Inter zonal sports and celebrated various events like National days, Environment day and Spirit of Communal Harmony.

❑

# 3 - Introduction

## 3.1 Brief History

The Directorate of Coldwater Fisheries Research (DCFR) came into existence as National Research Centre on Coldwater

Fisheries as an independent Research Centre on 24th September 1987 during the VII Five Year Plan. This is the only national facility in the country to take up the research investigation on capture and culture aspects with a focus on exotic and indigenous coldwater fish species. Since its inception, the DCFR in spite of constraints in terms of manpower and infrastructure has made significant contribution for proper appraisal of codwater fishery resources and developed suitable technologies to propagate important coldwater fish species in hills.

Keeping in view the ever expanding activities of NRCCWF and the greater potential of coldwater fisheries in different Himalayan states, in a significant decision during the XI plan, it has been renamed as Directorate of Coldwater Fisheries Research (DCFR), to develop location, situation and system specific technologies by all the Himalayan states from Jammu & kashmir to Arunachal Pradesh on sustainable basis.

Directorate of Coldwater Fisheries Research has completed 26 years of establishment. During this period the Directorate has done sincere efforts to harness the available resource in a sustainable manner and equipped itself to face new challenges in coldwater fisheries research and development. The progress made in terms of infrastructure and research facilities are commendable. The DCFR is on its glorious path of virtually actualizing its vision by imparting quality research on sustainable coldwater fisheries production, management and conservation.

## 3.2 Location

The headquarters of DCFR is located at Bhimtal at an altitude of 1470 masl in the district of Nainital of Uttarakhand state. It is about 25 km away from the famous tourist place of Nainital. The nearest railway station is Kathgodam, which is about 280 km from Delhi. The nearest airport is Indira Gandhi International Airport, New Delhi. The experimental field station of the Directorate is at Chirapani in Champawat district of Uttarakhand State is about 150 km from Bhimtal.

This Directorate is now emerging as the nodal facility in the country where research investigations are under taken both on capture and culture aspects with a focus on exotic and indigenous coldwater species.

### 3.3 Management

A high powered Research Advisory Committee (RAC) guides this Directorate in the research in thrust areas and on new initiatives. The RAC also evaluates and monitors the progress of research activities of this Directorate. The Management Committee (IMC) constituted and mandated by Indian Council of Agricultural Research under the Chairmanship of the Director, supervises various management aspects of this Institute. A number of internal committees such as Institute Research Council (IRC), Official Language Committee and Institute Joint Staff Council (IJSC) are in place of decentralized management.

### 3.4 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

### 3.5 Organizational set-up

#### Infrastructure

##### *Building and Farm*

The Institute is functioning from its complex constructed at Bhimtal, Industrial area. The main building has several facilities such as library, laboratories, AKMU cell, aquarium, wet lab, hatchery ponds and Guest house and auditorium. A pilot scale mahseer seed production unit is also under operation at Bhimtal. The directorate has an experimental fish farm facility at Chhirapani in Champawat district of Uttarakhand State, which has trout hatchery, cemented raceways for nursery and brood stock rearing and few circular

iron tanks for conducting trials on various culture aspects of the indigenous and exotic fish species.

### 3.6 Support Services

##### *Project Implementation and Monitoring Cell*

A separate cell called the **Project Implementation and Monitoring Cell (PME)** monitors the implementation and progress of research project programmes being conducted by the Directorate. This cell biannually organizes the meeting of Institute Research Council (IRC) to evaluate the progress made in each research project and accordingly approves the work programmes for the current year. The new proposals are also approved by the IRC after thorough evaluation of the objectives, practical utility, manpower support and financial involvement. The cell is also responsible for maintaining records of project reports through RPF system.

The PME cell has given the responsibilities of dealing with all technical matters within and outside of ICAR system. The cell takes care of the publications, training programmes, deputation and participation of scientists in seminars, symposia, workshop, meetings etc. and organizing conferences.

### 3.7 Library and Documentation

The library provided services to the scientists and other staff members of the Institute apart from scholars, researchers, students and other persons from local organizations interested in scientific literature on coldwater fisheries and allied subjects. All scientific books have been catalogued with barcoding. The digitization works of the Institute's publications are also under process. The library also provided facilities

to access free online downloads of publications, articles of many international and national journals through www.cera.jccc.in. The library maintained active reprography services by producing departmental publications and supplying required photocopies to the scientists, research scholars as well as of other research organizations. The documentation section is entrusted with responsibility of publication of scientific bulletins, brochures, pamphlets, annual report and newsletters. The library maintained exchange relationship with various research organizations and institutes of national and international levels. The annual reports, special publications and technical bulletins published from time to time have been mailed to about 250 organizations, institutions, fishery agencies etc.

### 3.8 AKMU

The AKMU of this Directorate provides the facilities for Internet through BSNL, scanning, printing to the scientists and other staff members. It also acts as Network Administrator and monitors the LAN connectivity of around 50 computers at this Directorate. In AKMU Cell computer and Internet facilities also available for other research scholars and M.Sc./Ph.d. students working under various project/programmes. The AKMU Cell provides internet facilities at Experimental Field Centre, Champawat through VSAT.

The website of this institute is being updated from time to time as per instructions of the ICAR and under the AGROWEB project. The site contains the information about manpower, institute mandate, project programmes and achievements, tenders & job announcements etc. The DCFR's website has been uploaded with the new domain name http://www.dcfr.res.in. The major achievements of the Directorate, the technology generated, consultancy services were incorporated in the site. Further, the ongoing and forthcoming training programmes, seminar/ symposia conducted by the institute, recruitments, tender notice has been reflected in the website. The Directorate's website finds a place in the Indian Council of Agricultural Research (ICAR) website with the address: http://www.dcfr.res.in. The mail & messaging solutions, (mail server) maintained at this Directorate for smooth information

communication via email. Individual user ids and passwords for new scientists and officers were allotted from time to time for proper use of the mail server at this organization.

### 3.9 Laboratory Facilities

The Directorate has well equipped laboratories of Fish Nutrition, Environmental Fish Biology & Nutrient Profiling, Molecular Genetics, Fish Health Management (Diagnostic Virology Laboratory & Diagnostic Bacteriology Laboratory). A Geoinformatics Laboratory is under the process of setting up to conduct

research on remote sensing and GIS application in coldwater fisheries. In addition to these there is a wet laboratory facility equipped with flow through troughs for setting up physiological experiments and nutrition trials for coldwater fishes. One Feed mill also installed at the main campus of Institute to meet routine requirements of fish feeds.

### 3.10 ITMU

The Directorate has constituted Institute Technology Management Unit (ITMU). It is responsible for providing information about ICAR guidelines on IPR issues. Trainings to the concerned scientists have also been given regarding IPR issues. The ITMU Cell observes World Intellectual Property Day on 26th April. The ITMC has been constituted under the chairmanship of Director for dealing with patents and other intellectual property rights to recognize technologies developed at the Institute and their safe transfer.

## Financial Statement

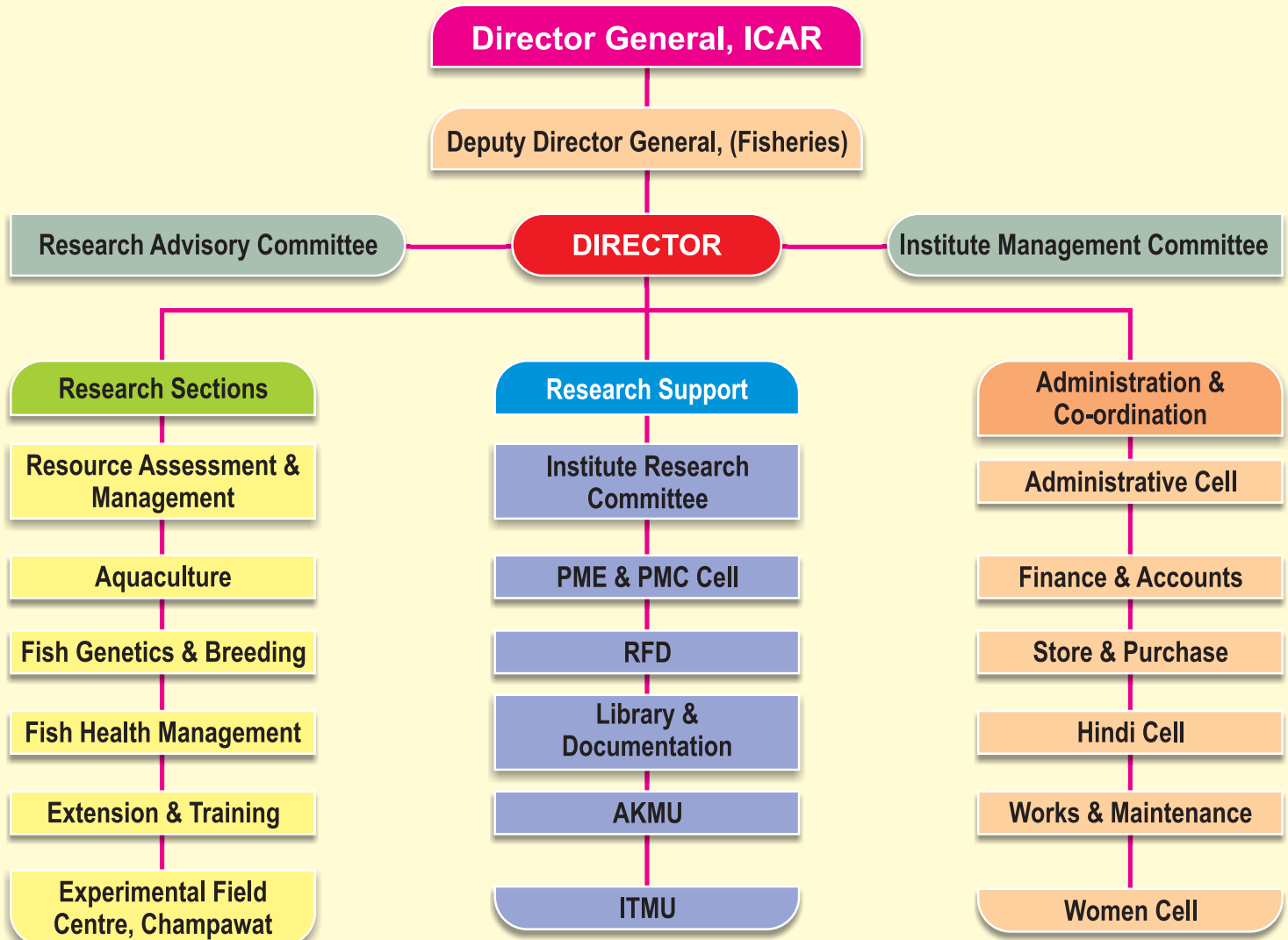
| Major Head of Account | Approved R.E. 2013-14 | Actual Expenditure during 2013-14 |
|---|---|---|
| Non -Plan | 438.56 | 429.69 |
| Plan | 360.00 | 359.85 |

### Budget Statement for the year 2013-14

| Head of Account | Budget (R.E.) | | Expenditure | |
|---|---|---|---|---|
| | Plan | Non-Plan | Plan | Non-plan |
| Pay & Allowances | - | 347.20 | - | 340.40 |
| Traveling Allowances | 20.00 | 2.00 | 20.00 | 2.00 |
| HRD | 5.00 | 0.00 | 5.00 | 0.00 |
| Other Charges Including Equipment | 255.50 | 73.59 | 255.49 | 71.53 |
| Information Technology | 9.50 | 0.00 | 9.40 | 0.00 |
| (a)Major Works | 0.00 | 0.00 | 0.00 | 0.00 |
| (b) Repair & Maintenance | 0.00 | 10.12 | 0.00 | 10.12 |
| Other items | 5.00 | 5.65 | 4.97 | 5.64 |
| NEH Component | 40.00 | 0.00 | 40.00 | 0.00 |
| TSP Component | 25.00 | 0.00 | 24.99 | 0.00 |
| **Total** | **360.00** | **438.56** | **359.85** | **429.69** |

## Staff Strength (As on 31.03.2014)

| Category | Sanctioned | Filled | Vacant |
|---|---|---|---|
| Director (RMP) | 01 | 01 | - |
| Scientific | 30 | 16 | 14 |
| Technical | 14 | 13 | 01 |
| Administrative | 13 | 12 | 01 |
| Supporting | 14 | 11 | 03 |
| **Total** | **72** | **53** | **19** |


Director General, ICAR
Deputy Director General, (Fisheries)
Research Advisory Committee
DIRECTOR
Institute Management Committee
Research Sections
Resource Assessment & Management
Aquaculture
Fish Genetics & Breeding
Fish Health Management
Extension & Training
Experimental Field Centre, Champawat
Research Support
Institute Research Committee
PME & PMC Cell
RFD
Library & Documentation
AKMU
ITMU
Administration & Co-ordination
Administrative Cell
Finance & Accounts
Store & Purchase
Hindi Cell
Works & Maintenance
Women Cell

# 4 - Research Accomplishment

## 4.1 Resource Assessment

The coldwater fishery resource of India spread throughout 2500 km from Jammu & Kashmir in the west to Arunachal Pradesh in the east and 200-400 km from north to south comprise a mountainous area of 5,33,604 km$^2$. The geographical area of this region is about 16.2% and about 4% of total population of the country. The coldwater resources are distributed mainly in the form upland streams, rivers, high and low altitude lakes and reservoirs located in different hill states. As the cold water resources are situated in difficult areas, it has not yet been exploited to its potential. Thus DCFR undertook exploration for the resource assessment of this sector both physical and faunal through different running projects.

### 4.1.1 Geographical Modelling

Geographical Information System and remote sensing technologies have been used to demonstrate suitable sites of aquaculture for planning and development. The technology can address generic questions like locations, conditions, trends, patterns and modelling. These generalized maps support in making authentic decision, based on ground realities and can be used for scientific management of water bodies. West Sikkim district was selected for the study and spatial data was generalized as per following details:

| Data | Source |
|---|---|
| Village boundary Map (1:50000) | Survey of India |
| Open Excess SRTM Satellite date (28 m resolution) | USGS Earth Explorer (NASA) |
| Land Use Land Cover | India Waris (ISRO) |

*Table: Details of procedure for Spatial map development*

The spatial data were imported in the system and then were geo-rectified and projected. The spatial data were joined with the non-spatial data. Different thematic maps were prepared. The study revealed that the West Sikkim has a total geographical area of 1157 km2 of which 683 km2 is under forest, 133 km2 snow cover & glaciers and 196 km2 waste land. A total of 165 km2 covers are cultivable land. Apparently, Therefore about 86 % of the total geographical area may not be utilized for aquaculture. The water availability map was prepared using SRTM data and a buffer of 200 meters was prepared to propose the trout farm development. Following steps and equations were used to prepare suitability maps:

- Prepared thematic maps of water quality parameters such as Water temperature, Dissolved oxygen, pH, Free CO2, Alkalinity, Hardness, Nitrate, Phosphate and transparency using interpolation technique based on available/generalized data.
- Prepared thematic maps of soil quality parameters such as sand, silt and clay using interpolation technique and available data.
- Prepared thematic maps of roads, streams (water sources) and proposed locations for hatchery development.
- Established Analytical Hierarchy Process (AHP) model for study area using soil & water quality parameters and infrastructure facilities.
- Query based analysis was carried out based on soil & water quality parameters and infrastructure facilities using following equations.

**I. Water quality**

$$Water_{suitability} = Grid_{Temp} \times 0.23 + Grid_{pH} \times 0.17 + Grid_{DO} \times 0.16 + Grid_{CO2} \times 0.10 + Grid_{Alkal} \times 0.10 + Grid_{Hardness} \times 0.09 + Grid_{Phosphate} \times 0.05 + Grid_{Nitrate} \times 0.05 + Grid_{Transp} \times 0.05$$ - **Equ. (1)**

**II. Soil quality**

$$Soil_{suitability} = Grid_{pH} \times 0.64 + Grid_{texture} \times 0.36$$ - **Equ.(2)**

**III. Infrastructure** $_{suitability} = Grid_{Road} X\ 0.45 + Grid_{hatchery\_distance} X\ 0.55$ - **Equ.(3)**

**IV. Final criteria**

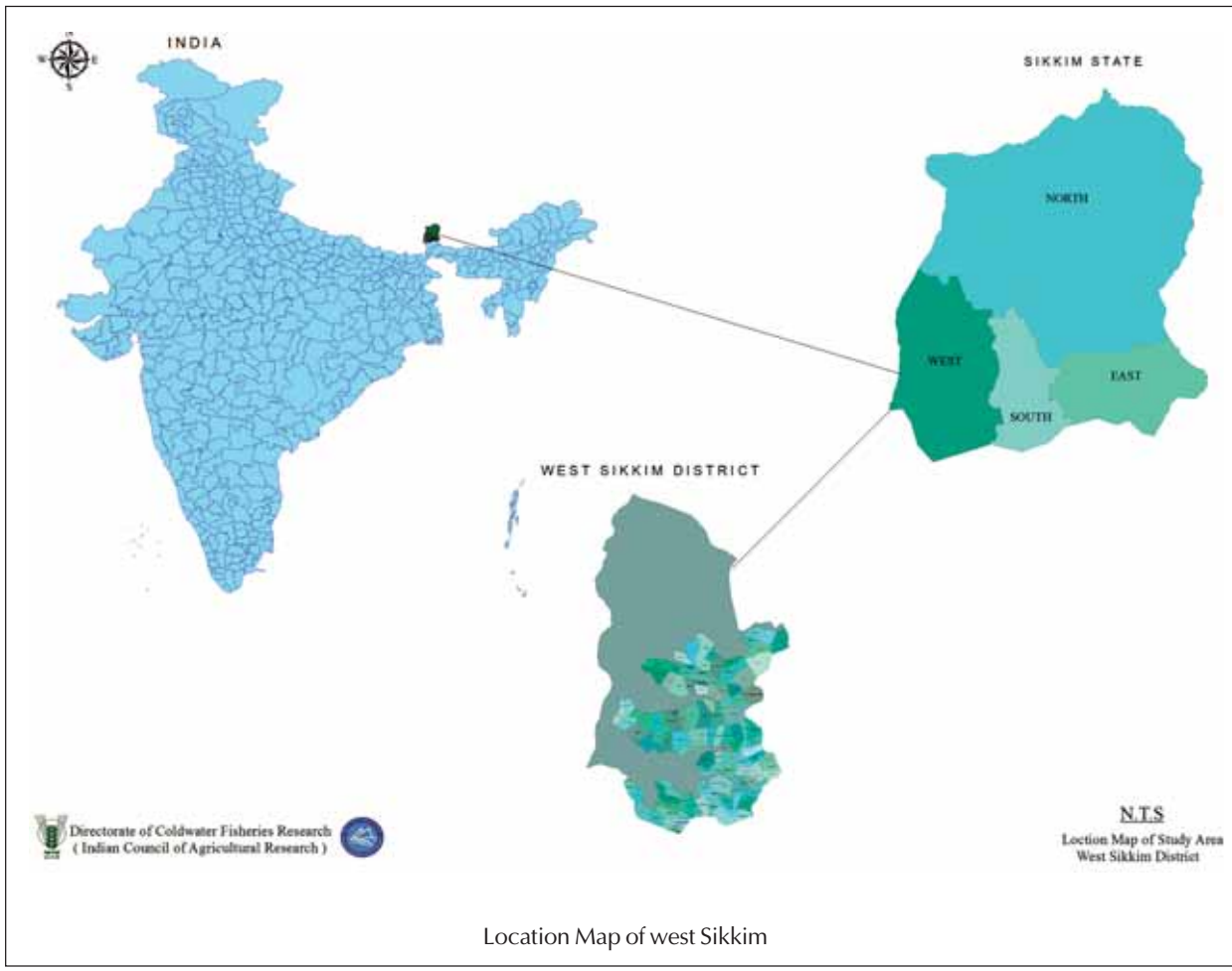
$$Site\ suitability\ grid = Grid_{water\ quality} \times 0.54 + Grid_{soil} \times 0.15 + Grid_{infrastructure} \times 0.31$$ - **Equ.(4)**

Following criteria were used for preparing the suitability map for aquaculture sites.

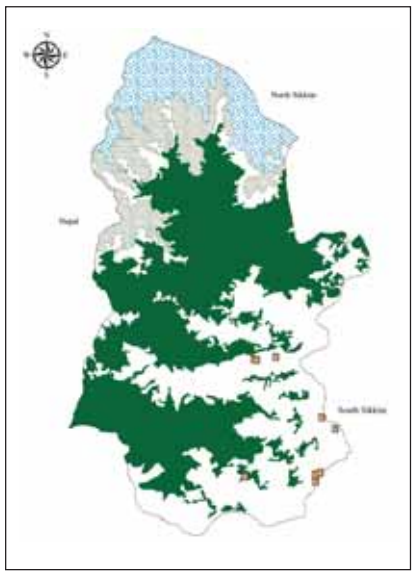
Criteria based analysis was carried out for the different parameters which intern into a map that indicates that a suitability of site for aquaculture. Different thematic maps were prepared for the study area using spatial analysis and some of the maps are depicted hereunder:

| Parameters | Suitability rating and score | | |
|---|---|---|---|
| | Most suitable for trout(3) | Moderately suitable for trout (2) | Suitable for carps (1) |
| **Water Quality** | | | |
| Temp ($^0$C) | 12-16 | 16-22 | > 22.00 |
| pH | 7.0 - 8.0 | 6.5-7.0 & 8-8.5 | 6.5-7.0 & 8-8.5 |
| DO (mg/l) | >8.0 | 6.5-8.0 | <6.5 |
| $CO_2$(mg/l) | 0-5 | 5-8.0 | >8.0 |
| Total Alkalinity(mg/l) | 30-60 | 20-30 and 60-100 | >100 |
| Hardness (mg/l) | 30-100 | 20-30 and 100-200 | >200 |
| Phosphate (mg/l) | 0.05 - 0.25 | 0.25 - 0.40 | >0.4 |
| Nitrate (mg/l) | <.05 | 0.5- 1.0 | >1.0 |
| Transparency (cm) | 80-120 | 60-80 | <60 |
| **Soil Quality** | | | |
| Soil pH | 6.5 to 8.5 | 6.5 to 8.5 | 6.5-8.5 |
| Soil texture (% clay) | - | - | >35 |
| **Infrastructure Facilities** | | | |
| Distance to water body (m) | <200 | 200-500 | >500 |
| Distance to road (m) | <500 | 500-1000 | >1000 |
| Distance to hatchery (m) | 10000 | 10000 | 10000 or >10000 |

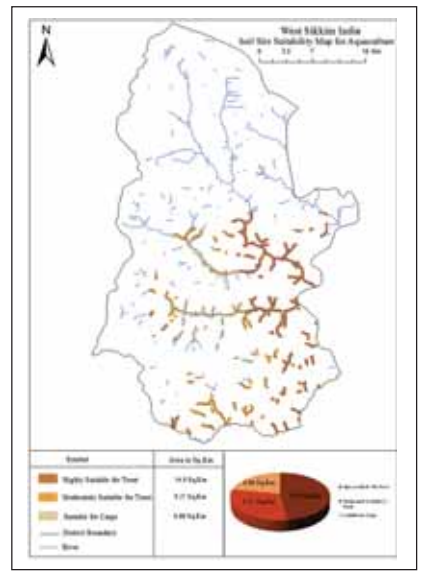
*Table: Suitability levels of water quality, soil quality and infrastructural facilities for aquaculture*



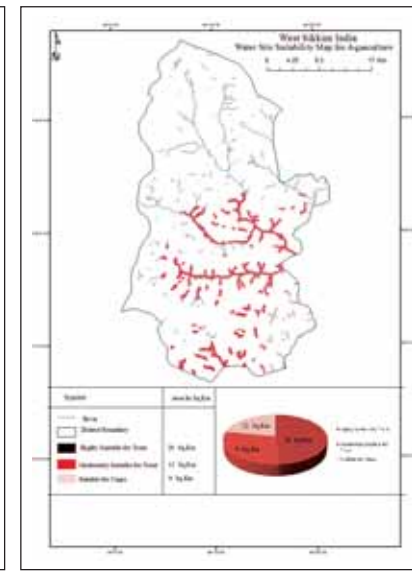

Location Map of west Sikkim



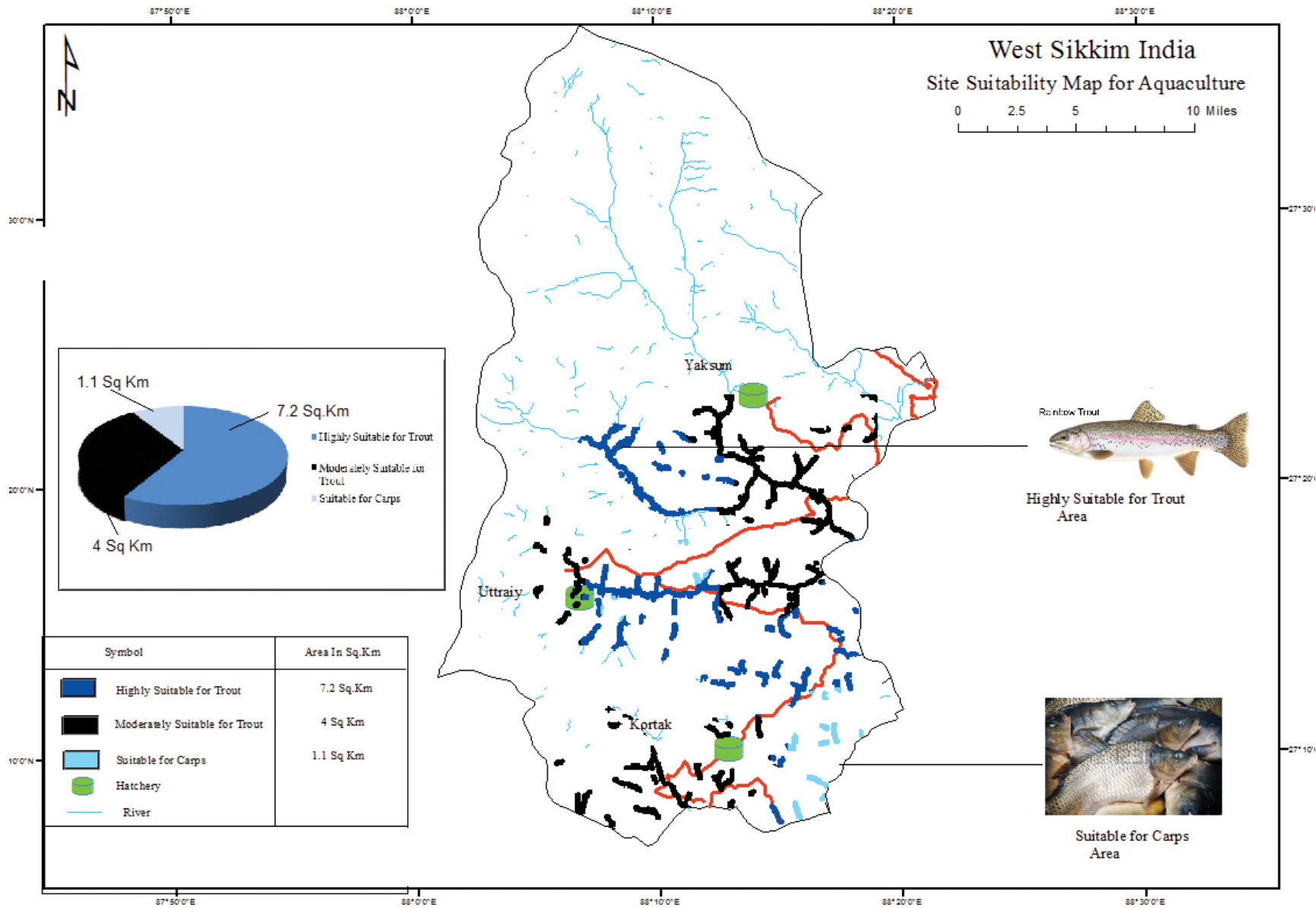
Sampling Locations



Soil suitability map



Water suitability map



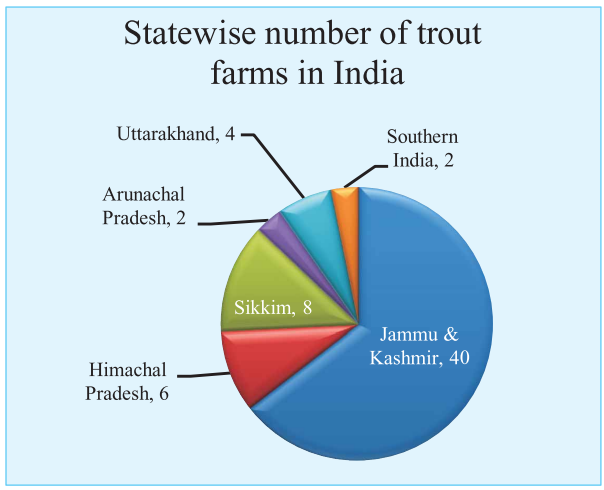

Aquaculture suitability map

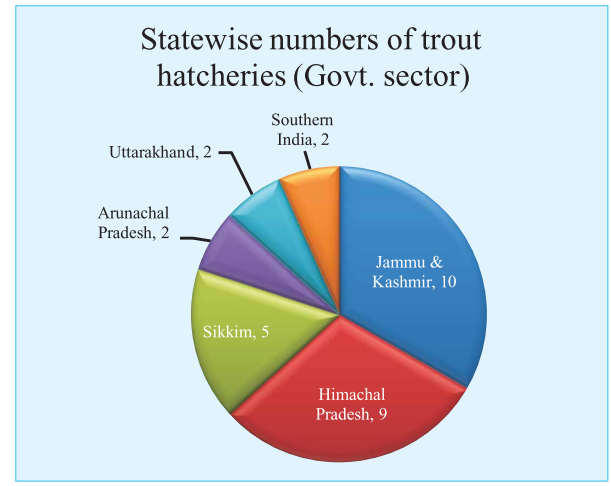
It was found that 41 km2 areas were found suitable for water quality parameters while 31 km2 areas was suitable for soil quality. Considering, water & soil quality and infrastructure facilities, 12.3 km$^2$ areas was found suitable for fish culture, of which 7.2 km$^2$ area under most suitable for trout, 4.0 km$^2$ area under moderately suitable and 1.1 km$^2$ area under suitable for carp culture.

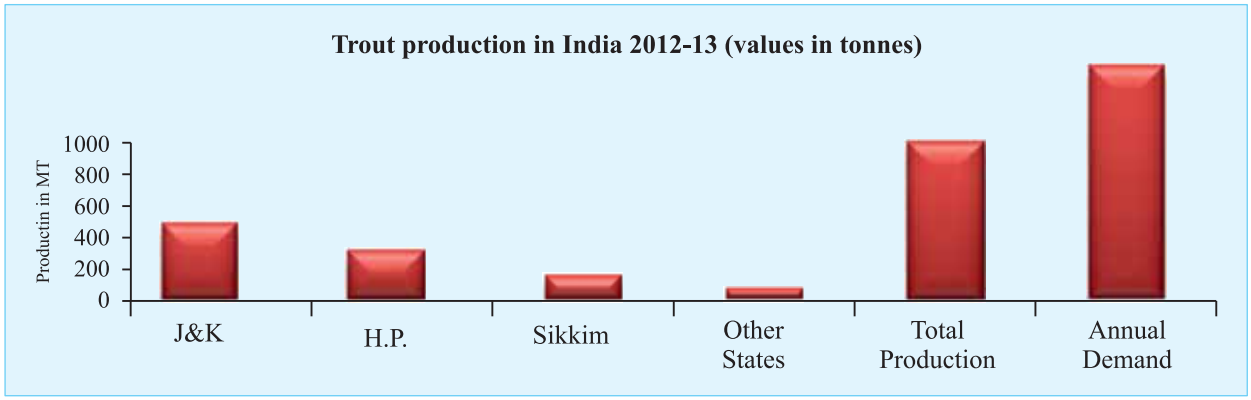
### 4.1.2 Development of Database on Rainbow trout

The transplantation of brown and rainbow trout was attempted independently in the Himalayan and in the non-Himalayan States. Therefore, the study aimed at collecting basic information on the culture, breeding and production status of rainbow trout both in private and state government owned farm from the coldwater regions of the country i.e. Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir, Sikkim, Tamil Nadu and Uttarakhand.

The state of Jammu & Kashmir has three main provinces viz. Jammu, Kashmir and Leh & Ladakh. As per generalized information, there were 40 trout rearing units established in the state. Besides, we also recorded presence of 14 hatcheries (8 operational and 6 under construction) in the region. Trout production in J&K increased over the year and presently the state was assessed to contribute highest trout production in the country. The trout production was found to increase from 90 tons during 2002-03 to 260 tons in 2012-13. The Fisheries Department continuously worked for the development of trout farming and enhancing production. Initiatives were taken by State Fisheries Department for the introduction of trout farming at suitable locations in the state and private farmers were encouraged to take up trout farming. Around 268 trout units were found established under private sector during 2012-13 which was just 126 in the year 2010-11. There was a two fold increase in the growth in

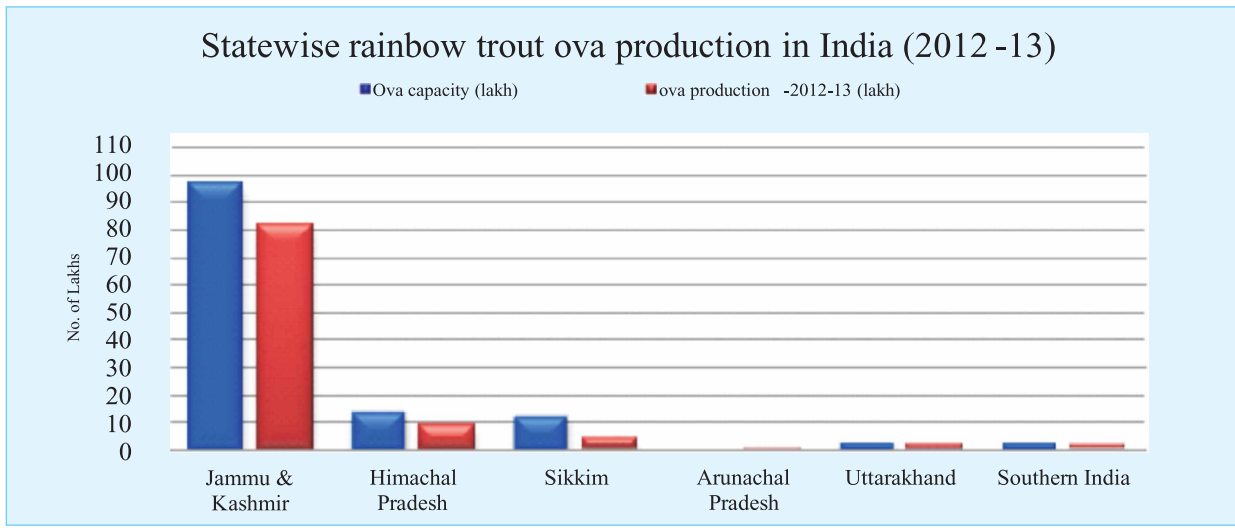


just two years which was an encouraging sign of development of trout in the state. Himachal Pradesh proceeded the leading states in trout farming and trout seed production. The upper zones of rivers in Himachal Pradesh was found to inhabit indigenous schizothoracids and exotic salmonids (both rainbow and brown trout). As per generated information 12 fish seed farms were found under the control of Himachal Pradesh Fisheries Department out of which 6 were trout farms and another 6 were carp farms. Area of the State declared as Trout Zones are Chamba Valley, Kinnaur Valley, Kullu Valley, Lahul Spiti Area, Pabbar Valley, Uhl Valley. The state fisheries department own five trout farms and seed production unit in the state. The largest trout seed production farm is located in Patlikuhal in Kullu district. Other trout farms are Barot (Mandi), Dhamwari (Shimla), Sangla (Kinnaur) and Holi (Chamba). Except Patlikuhal and Barot, other farms are smaller in size and mainly supply seeds to the farmers. The trout production from the state during 2009-10 was 44.19 MT and the department earned a revenue of Rs. 211.74 lakh from the sale of trout. The total trout production in the state reached up to 130 tons, while total seed production has reached up to 8.68 lakh (eyed eggs) during 2011-12. There were 44 active trout growers in the state during 2007 which increased to 75 by the end of 2011-12. The private trout growers are mainly located in the Kullu, Chamba, Shimla, Kinnaur and Mandi districts of the state. Average trout production from individual farm ranges from 2-5 tons per year. Sikkim is one of the North-Eastern states of India. Where trout culture was started in Men moi tso trout farm, which was established in 1954 by the State Forest Department. Rainbow trout (Oncorhynchus mykiss) ova were brought from Himachal Pradesh during 1986. Later on consignment of rainbow trout was brought from Himachal Pradesh in 2003 and from J&K. The state has 8 trout farms and 5 hatcheries under State Fisheries Department. The production of rainbow trout in the financial year 2010-11 was around 53.4 tonnes and trout seed production during was about 2.4 million which has increased to around 80.0 MT during 2012-13. There are about 199 trout farmers/growers in the state. Out of which 52 are in East district, 72 are in West district, 42 in North district and 33 are in the South district. The maximum numbers of farmers are located in the West district. Out of these three farmers are also engaged in trout seed production. Among the total trout farmers, around 17% farms are owned by women.

The generated information revealed that initial attempts for the introduction of trout in the Kumaun Hills were made in the year 1910. With the introduction of rainbow trout in Uttarakhand the Department of Fisheries initiated efforts to built hatcheries and farms. Kaldyani and Talwari hatcheries were renovated



and Bairnagana hatchery was established with seed production and rearing facilities. Presently only trout farm and hatchery is functional and is producing around 3 lakh eyed ova and 2 lakh advanced fry annually. The seed production during 2009-10 was reported as 1.85 lakhs by the Uttarakhand state fisheries development. There are around 35 raceways under the State Fisheries Department of Uttarakhand and around 8 raceways under the private sector. In Arunachal Pradesh trout broodstock and seed production is being done in two main hatcheries at Shergaon of west Kameng and atNuranang in Tawang. The trout hatchery at Nuranang produces about 15,000-20,000 of brown trout ova while Shergaon hatchery has 50,000 trout ova production capacity. Trout farming has not reached to private farmers yet in the state and now in collaboration with DCFR and Department of Fisheries the expansion of trout farming has been initiated and focus has been given to popularize trout farming in potential areas.

### 4.1.3 Ornamental Fish Resources

Resource assessment studies of few selected rivers of Uttarakhand were carried out for the investigation a coldwater fish diversity. For this purpose, river stretches of Kosi, Ramganga Ladiya, Lohawati and Gaggas were surveyed by S. K. Gupta. With the help of cast net operation, collected *Tor putitora, Schizotharax richardsoni, Barilius bendelensis. Barilius vagra* and *Garra gotyla gotyla* from the Ladiya river. Length and weight of the collected specimen were recorded. From the survey site of Lohawati, collected only *Schizotharax richardsonii*, and *Garra gotyla gotyla* whereas in Kosi river near Almora, we observed only *Barilius bendelensis*. At Chonani stretch of Ramganga, we collected different maturing stages of *Garra gotyla gotyla* and *Barilius bendeliensis* whereas near Masi stretch of Ramganga, we observed the presence of *Puntius ticto, Crossochielus latius latius* and *Barilius bendelensis*. In river Gaggas only *Barilius bendelensis species* was observed. Based on the resource assessment, it was found that, Ladiya river near Chalthi in Champawat harboured rich biodiversity of coldwater ornamental fishe. From the species catch composition of the coldwater ornamental fishes collected from the Ladiya river, *Garra gotyla gotyla* was dominant.

### 4.1.4 Fish Germplasm Exploration in Uttarakhand

Under the ornamental fish Brood banking initiatives Dr. R. S. Patiyal surveyed various river system of Kumoun, Uttarakhand to explore the collection of live ornamental fish germplasm. In ornamental Brood Bank so far 400 live fishes of *Tor putitora, Tor chillinoides, Barilius species, Nemachilus species, Garra species*, Koi and Gold fish is being reared. These species were collected from various rivers viz Gola, Chafee, upper Kosi, lower Kosi, kali, Gomati and Saryu river. As the main objective of brood bank is a breeding trial and explore the potential OFS, we have conducted two successful breeding trials. Regular monitoring, management and study in biology of Barilius species is being carried out.

Fish collection at Kosi river

Fish collection at Kali river

Sampling and collection from Ramganga

Mahaseer catch from Ramganga

Packing for live transportation

Fisherman with air packed Mahaseer

During 25-28th December with the help of local fisherman a team of DCFR Champawat center Dr S.Chandra conducted a survey in Kedar and Masi area in district Almora. During winter month, fishes were usually bound to inhibit deeper stretch of the river and with increase of water temperature during day time this started littile upward movement to shallower area for feeding on benthic flora floating algae, periphyton etc. Kedar movement to shallower area for feeding on benthic flora floating algae, periphyton etc. Kedar area of western Ramganga, total three fishe species were caught by Mahjal on first day and among these, two were mahseer (*Tor putitora*) and one *Labeo dero*. Size of mahaseer was 270-310 g. while *Labeo dero* was 190 g. Collected water samples were analyzed where we found pH 7.5-8.0, DO 7.2-9.0 ppm, hardness 75-80ppm, Nitrate 0.1ppm, Iron 0.2-0.3ppm, free CO2 2.0.3.6ppm,water depth of the river at shallower site was 1.5-3.0'.Larvae of some insects and copepods were observed beneath stones. The collected fishes were examined for health status and no parasites were found on the gills and skin. However, few specimens were found emaciated. The sediments of the sampled site were blackish with foul smell showing presence of higher organic matter in the area.

### 4.1.5. High altitude Lakes Survey in Arunachal Pradesh

Tawang district in Arunachal Pradesh contributes maximum numbers of high altitude lakes that are either unexploited or hardly been explored till today. The height of Tawang ranges from 3500 feet to 22,500 feet msl. During June, 2013, Dr Debajit Sarma and Mr Sumanta Kumar Mallik, from the Directorate along with officials of state fisheries department of Arunachal Pradesh visited high altitudinal lakes of Tawang for exploring the coldwater fisheries resources of these high mountain lakes. Initially the team visited the lakes located at Bumla Pass and

T- Gumpha area situated at an elevation over 13,000 feet above the sea level. During the exploration the team could locate following lakes which are listed in the table 1.

| Name of lakes | Location | GPS Location | Altitude (In feet) | Water area (In ha) |
|---|---|---|---|---|
| Pangang Tang Tso | 15 km from Tawang | N-27*30'17.8"E-091*51'25.5" | 12,867 | 5.0 |
| Shungatser | 42 km from Tawang | N-27*43'20.2"E-091*49'38.2" | 12,195 | 18.1 |
| Sela lake 1 | 95 km from Tawang | N-27*30'19.3"E-091*06'15.8" | 13,746 | 14.0 |
| Sela lake 2 | 95 km from Tawang | N-27*30'19.9"E-091*06'28.1" | 13,612 | 1.0 |
| Nagula-1 | 21 km from Tawang | N-27*39'15.7"E-091*51'47.9" | 13,487 | 4.0 |
| Nagula-2 | 42 km from Tawang | N-27*39'32.8"E-091*51'44.5" | 13,448 | 1.0 |
| Nagula-III | 42 km from Tawang | N-27*39'47.9"E-091*51'33.0" | 13,677 | 1.2 |
| Nagula-IV | 42 km from Tawang | N-27*40'05.7"E-091*51'22.6" | 13,792 | 2.5 |
| Nagula-V | 42 km from Tawang | N-27*40'05.7"E-091*51'22.6" | 13,792 | 4.6 |
| Barmusa klemta lake | 28 km from Tawang | N-27*40'46.7"E-091*52'17.2" | 13,946 | 4.5 |
| Klemta lake | 37 km from Tawang | N-27*41'08.4'E-091*52'24.0" | 14,153 | 1.5 |
| Khamakar lake | 40 km from Tawang | N-27*41'33.0"E-091*52'51.0" | 13,959 | 4.4 |
| Chochong lake | 52 km from Tawang | N-27*47'53.8"E-091*53'32.04" | 13,120 | 20.0 |
| Thapyumche lake | 30 km from Tawang | N-27*40'57.6'E-091*52'19.9" | 13,874 | 27.0 |
| **Name of lakes** | **Location** | **GPS Location** | **Altitude (In feet)** | **Water area (In ha)** |
| Lake-1 | Way to sangesor lake | N-27*41'45.3"E-091*50'23.4" | 13,621 | 2.4 |
| Lake-2 | Way to sangesor lake | N-27*41'49.3"E-091*50'34.4" | 13,634 | 3.35 |
| Lake-3 | Way to sangesor lake | N-27*41'33.7"E-091*51'07.7" | 14,064 | 15.30 |
| Lake-4 | Way to sangesor lake | N-27841'28.7"E-091*50'57.4" | 13,943 | 1.16 |
| Lake-5 | Way to sangesor lake | N-27*40'57.2"E-091*50'47.7 | 13,605 | 3.8 |

*Table 1: High altitude lakes of Arunanchal Pradesh their names, GPS location, altitude and water spread area.*

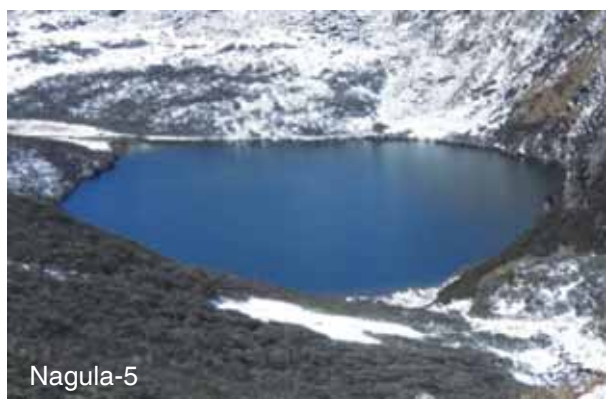
| Sl. No. | Parameter | Ptso lake | Tshungatser lake | Sela lake |
|---|---|---|---|---|
| 1. | pH | 5.2-5.8 | 5.5-6.0 | 5-5.6 |
| 2. | Conductivity | 42-45µs/cm | 20-28µs/cm | 36-45 µs/cm |
| 3. | TDS | 21-30 ppm | 10-16 ppm | 18-22 ppm |
| 4. | Free $CO_2$ | 4.6-4.8 mg/l | 4-4.2 mg/l | 5-5.4mg/l |
| 5. | Total Alkalinity (mg/l) | 20-28 mg/l | 8-14 mg/l | 25-30mg/l |
| 6. | Total Hardness (mg/l) | 20-24 mg/l | 2-5 mg/l | 22-24 mg/l |
| 7. | Cal. Hardness (mg/l) | 4.4-4.6 mg/l | 0.84-1.2mg/l | 4.8-5.2 mg/l |
| 8. | Mg. Hardness (mg/l) | 3.76-3.8 mg/l | 0.28-0.40 mg/l | 3.8-4.2 mg/l |
| 9. | Nitrate (mg/l) | 0.6-0.8-mg/l | 1-1.2 mg/l | 0.9-1.2 mg/l |
| 10. | Ammonium (mg/l) | 0.02-0.03 mg/l | 0.03-0.04 mg/l | 0.01-0.02 mg/l |
| 11. | Phosphate (mg/l) | 0.1-0.22 mg/l | 0.15-0.26 mg/l | 0.13-0.21 mg/l |
| 12. | Chloride (mg/l) | 6-8 mg/l | 7 -8mg/l | 5-6 mg/l |
| 13. | Sulphate (mg/l) | 2-3 mg/l | 3 -5mg/l | 2 -3mg/l |
| 14. | Potassium (mg/l) | 1 -1.5mg/l | 1-1.5 mg/l | 1-1.5 mg/l |
| 15. | Iron (mg/l) | 0.1-0.15 mg/l | 0.1-0.12 mg/l | 0.1-0.13 mg/l |

*Table 2: The physico-chemical status of water collected from lakes of Arunanchal Pradesh*











The view of some selected high altitudinal lakes of Tawang

High-altitudes lakes in Gasila, Bongajong and Zimithang area of Tawang, Arunachal Pradesh which are still unexplored, DCFR has initiated studying the signature of habitat & life in high-altitude lakes of Tawang, Arunachal Pradesh for exhaustive scientific investigation on geomorphology, climatic, biological, chemical, limnology, microbial diversity and other life form of microorganism of these water bodies.

Exploration of high altitudinal lakes of Arunnchal Pradesh at 16000 Ft. (Indo China border)

### 4.1.6 Resources in Himachal Pradesh

A survey was conducted to collect important fish fauna of river Sutlej in Himachal Pradesh. In the Himalayan streams distribution of fish species depended upon the flow rate, type of substratum, water temperature, availability of the food and the hydrographical features. The fish distribution also varies along the increasing altitude. Due to low biological productivity the prevalance of small-sized fish is common. The catch per unit efforts (CPUE) also indicated low catch ranging from 200 g to 1900 g per hour for the middle (about 1600 m MSL) and lower altitudes (600 m MSL). Overall the predominant fish species in Sutlej river comprised of *Schizothorax* spp. however, other species such as Glyptothorax spp., *Garra gotyla gotyla, Barilius* spp., *Puntius* spp., and *Noemacheilus* spp. were also recorded. Specimens of *Schizothorax richardsonii* and *S. progastus* were collected for genetic data analysis. The tributaries also harboured considerable fish fauna which was mainly used for shelter and breeding purposes. Snow trout was a short distance migratory species and moved between the tributaries for breeding and shelter.

### 4.1.7 Resources in West Bengal hills

Exploratory research was taken up in Darjeeling, the northernmost district of the Jalpaiguri Division, of West Bengal. The total area of Darjeeling district is 3149 Square Kms. Darjeeling town is located in the Lesser Himalaya at an altitude 2116 m asl (av. 2,050 m) with a latitude of 27°13' N to 26°27' and longitude of 88°53' to 87°59' E. Annual mean Temp. Was found 14.9°C (Max.) and 8.9°C (Min). The average annual rainfall was 3092 mm in average 126 rainy days. Darjeeling Districts has 04 Sub-divisions, 12 Blocks and 134 Gram Panchayats.

Teesta is the longest glacier fed river of Darjeeling district.The river takes its rise as 'Chumbu chu' (the upper most (Teesta) in the North-East edges of North Sikkim from Pouhunri (Pouhungri) glacier (29 59' N and 88 48' E) at an altitude about 6200 m asl. Lachung chhu and Lachen chhu are the two tributaries of Teesta. Teesta forms the boundary of the Darjeeling district from the point where it is joined by the Rangpo chhu at its junction with the river Rangeet. Teesta River is also fed by rivulets which arise in the Thangu, Yumthang and Donkia-La ranges besides other rivulets that join Teesta. Therefore, there are ample opportunities of fish culture in Darjeeling which could harness these aquatic resources in order to provide livelihood and food security.

A team lead by Dr. R. S. Haldar from DCFR visited and conducted surveys to explore the possibilities for development of coldwater aquaculture in the Darjeeling hills. The DCFR Team visited different areas of Darjeeling Hills with the officials of Gorkha Territorial Administration (GTA) and Department of Fisheries, Government of West Bengal. Farmer's meet was conducted in Upper Sindebong village (Kalimpong Block) and Sirikhola (Darjeeling Pulbazar Block) to facilitate a face to face interaction with the scientists. During this meeting, the farmers were made conversant about the objectives of TSP and how Tribals could be benefitted by promoting Jhora Fisheries in Sindebong village (Kalimpong Block) and trout

Jhora fishery pond in Sindebong village

Jhora fishery pond in Pabak village

Farming in Sirikhola (Darjeeling Pulbazar Block) to enable better livelihood opportunities.

Riyang Fish farm was also visited besides traditional Jhora fishery ponds in Upper Sindebong village (1205 m asl) and Pabak village (857 m asl) near Kalimpong along with State

Fisheries Officials. The team also surveyed village Bungkulung (700masl) and Oketi (Tarsing) near Mirik where there is a great scope for carp culture as well as ornamental fish.

Possibility of trout farming was explored in the villages of Gorkhey (2300masl), Rammam Village (2370 masl), Samanden village, Daragaon village (2180 masl), Sirikhola Village (1900 masl) and village Timbure (2150 m asl) and Phedikhola (1483 m asl).

## 4.2 Aquaculture

Cold water aquaculture is comparatively a new sector in the fresh water aquaculture production system. While freshwater aquaculture estimates to contribute over 95 percent of the total aquaculture production cold water aquaculture which mainly restricted to only trouts contribute only 1.5%. There is a great scope of horizontal expansion of hill aquaculture through species diversification, location specific cultural practice development, strong extension and other supporting facility. Species diversification, cultural diversification and refinement of location specific cultural practice are some of the aspect addressed through different projects

### 4.2.1 Aquaculture Exploration in Disadvantageous Areas

The uplands of the Uttarakhand are a kaleidoscope of diverse topography, climate, race, language and culture, live together and share common problems. Agriculture development has its own limits such as non-availability of the flat land, water scarcity and infrastructure facilities for intensive farming. Water conservation and management is an important area of work in the uplands for sustainable agriculture and aquaculture. In this context, the water harvesting / conservation have become the primary concern. In other hand the most of the populations cherish non-vegetarian food, generally, goat meat, chicken are preferable in the region, but in this regards they are not self sufficient.

Aquaculture intervention for tribal's in high Himalaya Border land of Dist.- Pithoragarh

To meet out their nutritional and food safeguards through water harvesting/ conservation integrated with aquaculture may be one of the multi beneficial approaches. Thus coldwater aquaculture may play an important role in improving the socio-economic status of the people dwelling in the mountainous zones of the country where the majority is now facing problems to meet their livelihood in these border areas which force them to migrate to plain areas to earn their both end meet.

Fish Production in Kumaon region is confined to inland waters like lakes, reservoirs and rivers. Aquaculture production is concentrated to Terai region where Chinese carps and Indian Major Carps are cultivated. The remote hilly area of the region is virtually untouched but the region is promising for coldwater fisheries development. To improve the socio-economic status of the rural population we made efforts to introduce freshwater aquaculture as an economic activity in the mid hills of Pithoragarh district of Uttakhand state adopting farmers through on-farm demonstration and training.

Transportation of Fish seed in difficult tribal area

Health Monitoring in Pond

Sampling in fish ponds

Seed stocking in ponds

Ornamental seed production

Fishing gears used by tribal's

Ornamental fish culture in pond

Twenty seven farmers from economically weaker and socially backward sections (SC/ST) were selected for aquaculture intervention. In the beginning suitable sites were selected and created water harvesting infrastructure for the aquaculture. Under the programme it is envisages to have a productivity of 3.5 to 4.5 ton/ha from the polyculture through scientific management and simultaneously seed production and culture of ornamental fish was also focused.

In Dharchula block aquaculture is entirely a new concept, so preliminary survey was conducted in different areas to locate the suitable sites. In order to empower the members of the Scheduled Caste, Scheduled Tribes, the under privileged and the rural population, various training and demonstration programmes were conducted in Pangu, Himkhola, Chalmachilanso, Galati, Baluwakot and Gothi villages for educating the villagers about aquaculture, its advantages and to motivate them for the enterprise. Before initiation, the exposer programme was conducted in one of the progressive farmers side to visualize the successful aquaculture prospect.

As per the suitability of sites and farmer's interest, 28 farmers were selected in village Gothi, Pangu, Himkhola, Baiku and Chalmachilanso and polythene lined ponds were constructed in their land and stocked with carps including, Cyrpinus carpio (normal common carp and Hungarian carp), Hypophthalmichthys molitrix (Silver carp) Ctenopharyngodon idella (Grass carp). Additionally, a baseline data was generated by collecting information pertaining to the livelihood security of the selected farmers using interview schedule. To provide seeds for ornamental fishes, brood stocks of Gold and Koi carp were raised at Directorate of Coldwater Fisheries Research (DCFR) and around 700 Gold fish and 2000 Koi carp fingerlings were successfully produced.

All the farmers were facilitated with pond infrastructure on their lands, critical inputs like feed, seed, nets and fertilizer etc. for one year and all management activities was monitored by Directorate. Such diversified farming practice in long run is expected to create a multiplier effect in the region through revenue generation, nutritional supplement and ultimately livelihood security of the region.

### 4.2.2 Trout culture Expansion in Sikkim

Exploratory survey was conducted for the higher altitudinal lakes in the East Sikkim for

Private trout grower at Sikkim

the enhancement of Brown trout population. Technical support was provided for the seed production of the brown tout by using wild broodstock from Momencho lake and seed was reared at state trout farm, Momencho. A new tout farm for raising stockable seed of the trout was established at Baba Mandir with the technical support from DCFR. These seed would be used for augmentation of the natural population in the higher altitudinal lakes. A floating cage unit was established in Momencho lake for raising brood stock with the technical support from DCFR. Water from natural stream was trapped at Kyongnosola to raise broodstock of trout and establishment of the trout hatchery.

Memencho lake cage installation

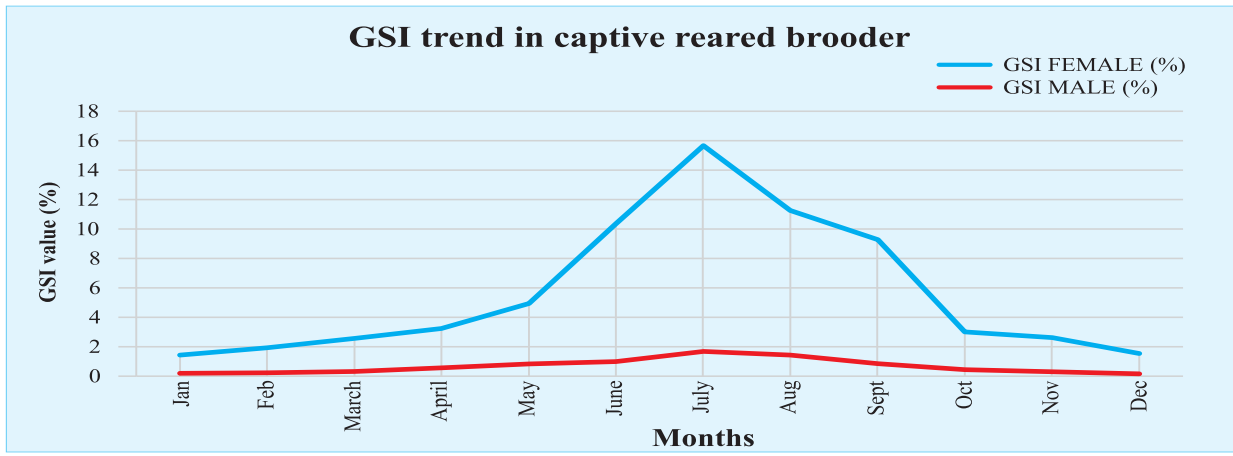
Farmer's sites were visited and private trout growers were imparted farm advisory service in north, east and west Sikkim. Further to assess the feasibility for construction of new trout raceways in this area was undertaken.

### 4.2.3 Induced Spawning of *Labeo dero* in Ccaptivity

In the previous study it was recorded that captive reared brooders of *Labeo dero* and *Labeo dyocheilus* (age 3+ years) was bred during 3rd week of July to end of August at 18-22.8oC. Onset of maturity was two weeks earlier in the natural condition (in streams). Gonado-Somatic index (GSI) increased gradually from April to July and decreased in the August in females. GSI ranged from 3.245 ± 0.153 to 15.656 ± 1.212 (after preparatory hormone dose) in captive reared females and 4.136 ± 0.254 to 15.546 ± 1.104 in wild females.

The females were characterized by soft, enlarged and distended belly while males were identified by developed prominent nuptial tubercles on the snout coupled with the roughness of the pectoral fin. The roughness of the body and tubercles appeared since the last week of April month and disappeared on first week of September.

For breeding, female fish were injected intramuscularly with Ovaprim @ 0.2 ml/kg body wt. (1st preparatory dose) on 1st June. No treatment of Ovaprim was given to male specimens. Same females were again injected with Ovaprim @ 0.2ml/kg body wt. (2nd preparatory dose) on 15th June, 2013. On 1st July, 2013, induced breeding was carried out by injecting with Ovaprim @ 0.7ml/kg body weight to females @ 0.2ml/kg body weight to males. After



administering the hormone, both male and female fishes were kept overnight together in FRP tanks having provision of continuously flowing water for spawning. After 22 hours of administering the hormone, fish spawned successfully at 18-22.8oC water temperature. The hatching period was recorded as 20-38 h. Relative fecundity was 1,23,400-1,43,600. Fertilized eggs were incubated in trough and tray having flow through system and mini incubation pool to standardized the best system for incubation by estimating the incubation period, hatching rate and survival of hatchlings.

A mini incubation pool designed and fabricated with locally available low cost material having a circular plastic tub (diameter 58 cm and height 26 cm), plastic dust bin (dia. 17 cm and height 25 cm) and other accessories. Total water volume contained in outer chamber of mini incubation pool was 40 liters. When a circular motion of water started, about 25000 fertilized eggs were gently transferred to it. A constant water flow was maintained to ensure an adequate oxygen supply. After hatching, spawn were sieved through a mosquito net to separate the egg shells and stocked at a stocking density of 50 nos./ liter in FRP tanks having a flow rate of 1-2 liter/ min. Hatching started earlier in the mini incubation pool than in trough and tray. Temperature range of 18-22oC was found suitable for the incubation of eggs giving hatching and survival rate of 94 - 96 and 74 - 76 respectively.

Mini egg incubation pool

Early spawning resulted with better survival (76%) of fingerlings during winter (5-12oC), while smaller sized fry of later spawning showed up to 68% mortality in nursery during winter.

Larval rearing trial of *Labeo dyocheilus* and *Labeo dero* in small polytanks was conducted for four months in two different system i.e. FRP tanks and poly tanks. The average length gain was found to be 36.4 ± 2.2 mm in polytanks which is significantly ($P < 0.05$) higher than fry of FRP tank. Similarly, the average gain in weights of the larvae, 0.493 ± 0.041 g was found in polytanks which is significantly ($P < 0.05$) higher. The average percent length gain was 846.51±6.2 and percent weight gain was 7042±26.50 respectively observed in the larvae reared in poly tanks.

For Growth performance of *Labeo dyocheilus* fish of the size 20-24 gm were stocked in the polytanks at Dharonch and Dudholi in polyculture system with grass carp and silver carp during April 2013. The stocking density was 3 fish per m3 water volume with species composition of 30, 40 and 30% for silver carp, grass carp and L. dyocheilus. The tested species, L. dyocheilus showed average weight of 230-240 g in 11 months, while the silver carp and grass carp recorded an average weight of 314-380 g and 320-650 g, respectively.

### 4.2.4 Breeding trials of *Garra gotyla gotyla*

The specimens of *Garra gotyla gotyla* was collected from Chonani stretch of Ramganga. Due to hardy nature and omnivorous feeding habit, we took-up the *Garra gotyla gotyla* for breeding trail at DCFR field centre, Champawat. To raise the broodstock of ornamental fish, *Garra gotyla gotyla*, two new polytank was constructed at Champawat field centre which were provided with small pebbles, cobbles and boulders at the bottom to provide them natural shelter. The dimension of the pond constructed was 5x4x0.8 m3. After acclimation in cement tank of 30 m2 dimension, fish were transferred to the polytank with natural algae pre-grown as food material. The physico-chemical parameters

viz: Temperature 19.0-22.0 0C, pH 6.9- 7.3, Dissolved oxygen 6-7.5 ppm, Hardness 25-50 ppm, Nitrate 10-20 ppm and dissolved iron-0.1-0.2 ppm were recorded. Sexual dimorphism was observed in both male and female. Males of Garra gotyla gotyla identified by the fact that they are slender than the females which appeared with soft and swollen belly. Also, the base of pectoral fin was rough in male while it was smooth in females. Some specimens of Garra gotyla gotyla were dissected to observe their maturity status. Gonado-somatic index and gastrosomatic index of the fish were analyzed using the primary data. In captive condition, maturity in case of female was not observed. Therefore, rearing of the both male and female in captive condition is under progress at Champawat field centre.

Male and Female specimen of *Garra gotyla gotyla*


Immature ovary with intact eggs in *Garra gotyla gotyla*


Male with oozing milt

### 4.2.5 Performance of chocolate mahseer in Captivity

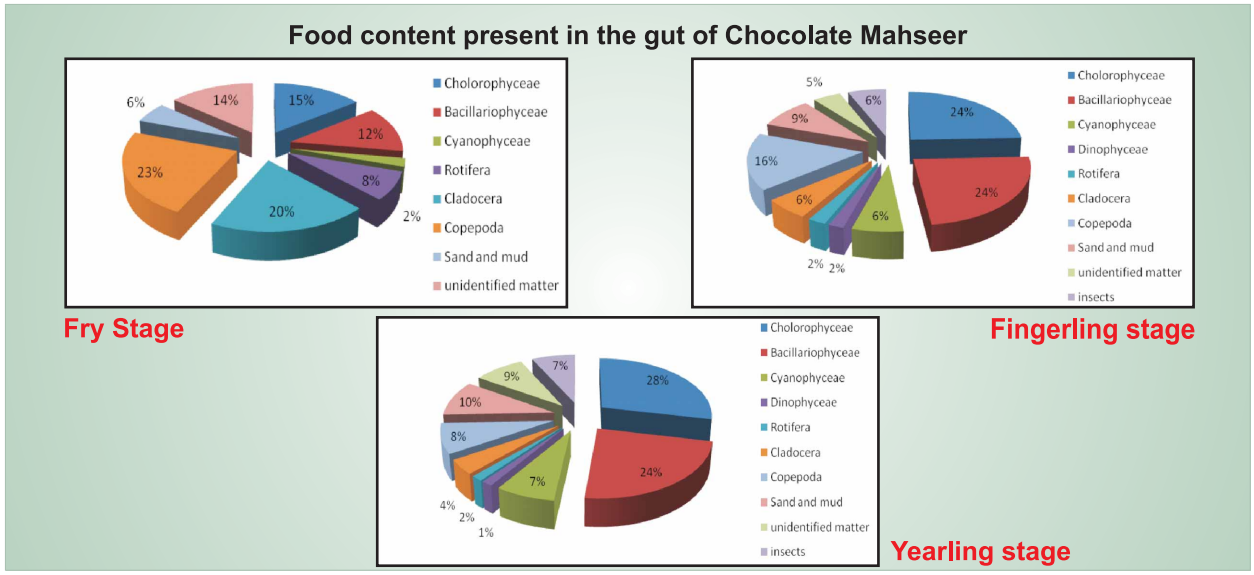
Collection, transportation and acclimatization of chocolate mahseer in pond condition were carried out at Bhimtal. The artificial feed fortified with Spirulina served as an effective feed for the growth of chocolate mahseer. 5% Spirulina fortified feed showed higher survival and growth performance. This 5% Spirulina fortified feed was also found to be cost effective when correlated with FCR. Thereby, the feed fortified with Spirulina may be considered as an effective feed for chocolate mahseer during its nursery rearing period in its new culture environment.

Growth performance of chocolate mahseer and golden mahseer under poly-culture system shows that they were highly correlated (r2 = 0.80). The growth performance results (length gain, weight gain and SGR) show that chocolate mahseer has got 20% better growth rate during fry to fingerling stage in comparison to golden mahseer.

Analysis of length weight relationship of monoculture and polyculture showed that the non-linear model was comparatively better to its corresponding linearized model. Length-weight relationship, condition factor and relative condition factor of chocolate mahseer showed that this fish was found in good condition in terms of general well being to its new culture environment.

Fry of chocolate mahseer were carni-omnivore, while the advanced fingerling and yearling were herbi-omnivore. Presence of sand and mud in the gut shows that it is column to bottom dweller.

Diameter of egg ranged from 700 to 900 $\mu$m. Head diameter of sperm ranged from 1.3 to 1.6$\mu$m and length of the tail was 2.8$\mu$ to 3.1$\mu$. Two batches of ova of different size groups were present in the matured ovary indicating shorter breeding period compare to golden mahseer. Male fish attained the first gonadal maturity during 3rd year of its life. Female fish attained the same after five years of hatching. The fecundity of chocolate mahseer is 6000-8000 eggs/kg body weight. Breeding period was from April-May & August- September, fertilization and hatching rate was 95 and 80%, respectively. The incubation period of fertilized eggs was 38-40 hrs.




### 4.2.6 Cage rearing of Golden Mahseer

To optimize the in situ rearing density of golden mahseer upto advanced fingerling for stock enhancement, an initial experimental trial was conducted. Fry of golden mahseer were stocked in four stocking densities viz. 60 nos / m3, 70 nos /m3, 80 nos /m3 and 90 nos /m3. The experiment continued for ten months and at the end of this initial trial, it has been revealed that the rearing of golden mahseer fry upto the stocking density of 90 nos/m3 did not affect significantly ($p > 0.05$) the growth and survival. Therefore, the second experimental trial for in situ seed rearing of golden mahseer in floating cages at Bhimtal Lake has been carried out with aim to harness the maximum carrying potential at higher stocking densities. The fry of average weight 0.191g were stocked in four stocking densities viz. 100, 150, 200 and 250nos/m3. The fishes were fed with formulated diets containing 35% protein ad libitum once daily. The growth, survival and water quality parameters like temperature, alkalinity, free CO2, pH, TDS, phosphate, nitrate, ammonia, sulphate, dissolved oxygen, nitrite, pH, alkalinity etc, critical for the growth and survival of fish, were monitored periodically. The weight was 9.12, 8.95, 8.27 and 7.87 g in the stocking densities of 100, 150, 200 and 250 Nos/m3 groups respectively. The % survival was 89.4, 85.5, 79.5 and 71.6 in the respective stocking density groups.

Mean values bearing different superscript (a, b) in the same column differ significantly ($p < 0.05$)

| Stocking density | Initial weight (g) | Final weight (g) | Percentage survival |
|---|---|---|---|
| 100 nos/m$^3$ | 0.191 ± 0.012 | 9.12$^b$ ± 0.31 | 95.7% |
| 150 nos/m$^3$ | 0.193 ± 0.013 | 98.95$^b$±0.61 | 96.1% |
| 200 nos/m$^3$ | 0.192 ± 0.011 | 8.27$^{ab}$±0.52 | 95.3% |
| 250 nos/m$^3$ | 0.191 ± 0.02 | 7.87$^a$±0.36 | 95.5% |

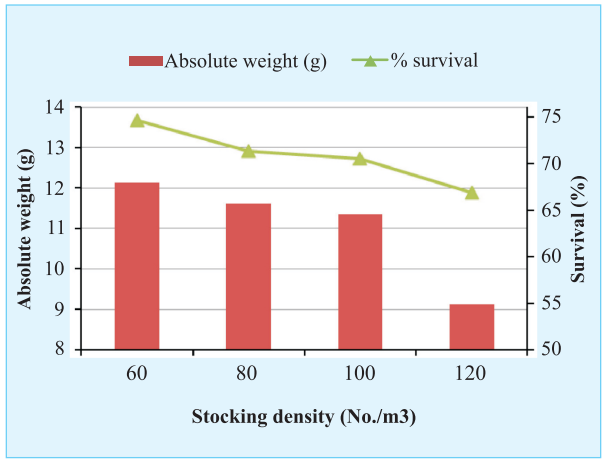
*Table: The growth performance and percentage survival of golden mahseer reared in floating cages at different stocking densities (Mean± SD).*

Results revealed that the optimum stocking density for in situ seed rearing of golden mahseer in floating cages may be recommended as 150 Nos/m3.

After the experimental trial, cage reared advanced fingerlings of golden mahseer were harvested and brought to the DCFR's Mahseer hatchery complex and conditioned for a period of two days. Subsequent to conditioning, the fingerlings were oxygen packed (40 nos/6L pack) and transported to Naukuchiatal lake on the occasion of an awareness programme on "mahseer bachao jagrukta abhiyan and seed ranching programme" organized by DCFR on 10th October, 2013. One thousand of cage reared advanced fingerlings alongwith 25,000 nos. of hatchery produced seed (fry) of golden mahseer were ranched in the Naukuchiatal Lake on the occasion.

Ranching of golden mahseer in Naukuchiatal lake

The fry of common carp of average weight 0.732g and average length 2.3cm were collected from DCFR nursery ponds and stocked in four stocking densities viz. 60, 80, 100 and 120 Nos/m3 during the end of August, 2013. The fry are being fed with formulated diet ad libitum twice a day containing 30 % crude protein and 6% lipid.




The growth and water quality parameters like DO, pH, nitrate, temperature, ammonium, sulphate etc were monitored. At the end of experiment (six month), the fishes attained the stockable size i. e the average absolute growths of common carp fry were 12.13, 11.62, 11.34 and 9.12g in the stocking density of 60, 80, 100 and 120 Nos/m3 respectively. The % survival was 74.6, 71.3, 70.5 and 66.8 in the respective stocking density groups. Hence, the optimum stocking density for in situ rearing of common carp fry in floating cages for stock enhancement found to be 100 No./m3.

Stocking of common carp fry in cage

Further, the experimental trial for optimizing the feeding frequency during rearing of golden mahseer fry in floating cages at our earlier standardized stocking density (150 Nos/m3) has been initiated. The mahseer fry (average weight 0.064g) were collected from DCFR Mahseer Hatchery Complex and stocked in floating cages in three treatments. Three feeding frequency treatments viz. once a day, twice a day and thrice a day ad libitum are being tested with a formulated diet containing 35 % crude protein levels. After four months of feeding, the growth increased from an average weight of 0.064g to 1.89, 2.08 and 2.12g in the respective frequency treatments. The important water quality parameters were also monitored. The experimental trial is in progress.

### 4.2.7 Growth Performance of Hungarian Common carp

Breeding of improved strain of Hungarian common carp Champa-1 (Ropsha scaly) Champa-2 (Felsosomogy Mirror Carp) was done at DCFR experimental field center Champawat.

Seeds of Hungarian Common carp

Breeding of Champa1 & champa-2 at Champawat Fish farm

Brooders of Champa-1, Champa-2 and Bangkok strain were harvested from the ponds of Pocket-'B' and kept in breeding pond. They were fed twice daily to satiation. Breeding trials were conducted in the mid May month at water temperature ranging between 17.5-220 in happa.

Average survival was recorded to be 45%. Seeds of Common carp, Champa-1 & Champa-2 bred at DCFR field center Champawat were distributed to the different farmers of district Champawat, Udham Singh Nagar, Pithoragarh of Uttarakhand, Himanchal Pradesh and NE states for rearing purpose.

Performance of Hungarian Common carp were evaluated and physicochemical parameters such as air temperature, water temperature, pH, hardness, chloride, nitrate, dissolved Iron, fluoride of water were analyzed.

Among all the sites, the maximum growth were found in, state fish farm Bilashpur, Himachal Pradesh (400-650 gm) followed by Rangpo fish farm at East Sikkim (200 gm to 340 gm) while minimum growth were reported (15-35 gm) in the fish pond of St. Antony College of Shillong in one year. The maximum water temperature were recorded in October (28.70C) at Nagaon Assam followed by east Sikkim (270C) while minimum temperature were recorded at Shillong180C. pH ranges were recorded from 6.5 to 7.5 at all the sites.

Experiment on different feed on the growth performance of Hungarian common carp were conducted at Champawat fish farm by using two experimental feed along with control diet of locally available feed. Control feed contain 35% rice polish: 35% wheat bran: 30% oil cake. Experimental I feed contains 35% rice police: 35% wheat bran: 28% oil cake: and 2% spilac (Feed supplement). Experimental II feed contains: 25% rice police: 25% wheat bran: 18% oil cake and 30% soya powder and 2% vitamin mix. 20 fishes of Hungarian common carp weighting 1.4gm to 1.53gm having size of 4.3 cm to 5.3 cm in sizes were taken. The fishes of experimental and control group were reared in fiberglass tank for 45 days and were fed twice a day @ 2% body weight. The length and weight were recorded at every 15 days interval. Water temperature was recorded in experimental and control fiber tanks varied from 7.5 °C to 16.4 °C. The results of Experimental I feed showed 14% higher growth as compared to control while Experimental feed II showed 50% higher growth as compared to Control group.

### 4.3 Health Management

#### 4.3.1 Parasitic,Fungal and Non-infectious Disease Evaluation

Reddening and ulceration in lower and upper jaw, mouth cavity, exophthalmia, dark coloration and ulceration in lower abdominal was observed in diseased rainbow trout specimens. Ulceration of gills and gill cartilage in advance stage of infection also found. Petechial

haemorrhages in internal organs and yellowish mucoid fluid deposition in abdominal cavity has also been found in RMD infected fishes. Blind rainbow trout of grow out raceways were mostly found infected. Initially low mortality observed, however, with increase of raceway water temperature mortality increase many folds.

Reddening and ulceration of upper and lower jaw

Trout showing lower abdominal ulceration

Mouth region showing typical reddening of jaw region

Among all health problems, loss due to reddening of mouth varied between 06.0 - 49.4% of total diseased fishes. Lowering of water temperature in subsequent month along with antibiotics medication helped in reduction of this infection. Thermal stress and pollution in raceways acted as a probable predisposing factor. Whitish cartilage like deposition over whole eye seen in infected fishes. In extreme cases, loss of whole eye ball with a hemorrhagic hole like appearance in eye noticed. Mortality rate varied between 2.30-14.73%. Sharp decline in eye infected trout loss have been recorded in winter months indicating less incidences of secondary infections which actually aggravate the condition. Adult 3+ year old stock of trout reared in nursery raceways at Champawat farm found free of eye infection. Compared to normal 4+ year old female trout. Quantification of weight and egg loss during breeding season in eye infected specimens indicated average weight loss of 34.68% with average functional egg fecundity reduction of 31.0%.

Post larval loss in indoor rearing at Champawat was studied. Under elevated water temperature range (13.8-16.00C) coupled with associated stress factors, mass kill (15-20%) of newly hatched trout larvae in size range of 53mg - 83mg recorded. Discoloration of skin, gill necrosis, blackening of tail end with large number of bacterial population and fungal hyphae in skin and gill smear of moribund specimens observed. Deformity also found in few died post larvae.

Trout post larval mortality few showing deformity

Infected eye with complete loss of lens

Eye infected trout with blood oozing

Deterioration of water quality parameters in rearing raceways resulted to large scale mortality during summer months. Surfacing, excessive mucus secretion, darkening of skin colour, emaciation, petechial discoloration, rotting of tail and fins, mucoid like deposition at the base of dorsal fins were main clinical features. From chronically moribund trout specimens, trichodinids and monogenean flukes isolated from skin and gills. Among seasonal health problems, maximum loss of juvenile and adult rainbow trout reported during April-June month probably due to impaired water supply coupled with prolonged higher water temperature >210C in culture raceways.

Stray incidences of non- tripped female trout loss observed in grow out raceways. Swollen abdominal cavity, reddening and enlargement of genital opening were main external clinical features recorded. Opening of abdominal cavity showed raptures of ovary, presence of putrefied eggs in whole body cavity. Internal examination showed enlargement of liver, infection in internal organs, rapture of ovary and putrefied eggs presence in body cavity. Fluctuations in climatic conditions may be affecting the normal oocyte atresia in the fishes and probably delaying the process. During breeding season fishes that have old eggs in the abdominal cavity released fewer eggs.

Putrefied eggs of different types and sizes

Reddening of eye in fungal infected *Garra* sp.

Winter kills in *Baralius sp* and *Garra sp.* observed during December-January months. With lowering of water Temp <6.00C in nursery raceways, mortality of Barilius sp. (10.81-20.13 g) and Garra sp. (7.56- 34.6g) observed with growth of Saprolegnia over the body and reddening of eye. Drug sensitivity test undertaken for the bacterial samples collected from gill, liver and, kidney of infected Barilius sp. Among tested drugs, Cephalothin, Co-Trimoxazole, Clindamycin, Ofloxacin and Gentamicin were found effective while Penicillin-G and Vancomycin were not effective.

Drug sensitivity test

Among parasites, presence of monogenean flukes in gills of silver carp, grass carp and common carp recorded from the farm tanks and from adopted farmer's tanks during the study period. Physicochemical parameters of culture raceways, carp tanks and hatchery monitored regularly.

Annual calendar of non-infectious and infectious trout diseases was prepared with a view to minimize the loss during rearing and seed production. Based on common health problems commonly occurring in mid hill trout farm and hatchery, improved management practices for trout farmers has been prepared.

### 4.3.2 Study in Coldwater Viral Disease

In order to address non-specific amplification in diagnostic PCR, there was an urgent need of positive controls for an effective diagnosis of IPNV, IHNV and VHSV that were being targeted in this project. The samples that tested positive using monoclonal antibodies in dot-ELISA did not bear the signatures of virus making it difficult to conclude the results of RT-PCR. Meanwhile, dot-ELISA results too could not be relied upon, in the absence of positive controls. To deal with this problem, we have synthesized VP2-gene of IPNV besides the ecto-domain of the glycoprotein genes of IHNV and VHSV. So far we have been able to verify the nucleotide sequence of the synthetic VP2 gene of IPNV. A nested PCR for detection of IPNV has been standardized. Moreover, PCR conditions for the detection IHNV and VHSV using their synthetic genes as a positive control have also been standardized (Fig.1 and 2).

**Fig.1:** Amplification of IPNV VP2-gene. Lane 1: 100bp plus DNA ladder, lane 2: negative control, lane 3 & 4: full length VP2-gene, lane 5:1180 bp product of VP2, lane 6:524 bp product obtained from nested PCR of IPNV VP2-gene.

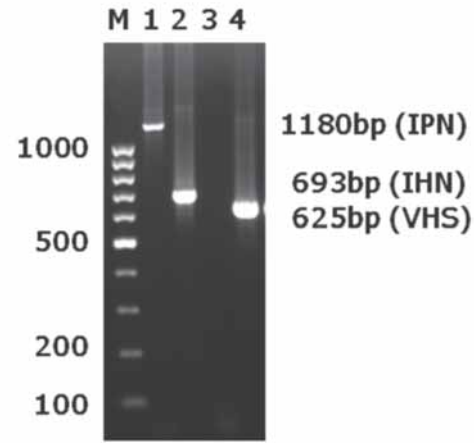



**Fig. 2:** Results of PCR of synthetic G-gene of IHNV and VHSV. Lane1: 1kb ladder, lane 2& 3: PCR products from IHNV G-gene, lane4: VHSV G-gene PCR product.

### 4.3.3 Bacterial Pathogens in Rainbow trout

Individual samples from muscle, gill, liver, gut, eye, spleen, gull bladder and kidney were obtained from 34 apparently healthy rainbow trout, Oncorhynchus mykiss and some fishes with lesions in dorsal and caudal peduncle regions and corneal opacity. Tissue and water samples from rearing environment were processed aseptically on nutrient, tryoptic soya agar (TSA) for estimation of total plate count (TPC) as well as preparation of pure cultures for their biochemical and molecular identification. Total plate counts (CFU/ml) for water samples in storage tank and rearing tank were ranged from 8.8 x 102 - 6.5 x 103 and 9.5 x 102 - 7.4 x 104 respectively.

In total, 89 pure cultures of bacterial isolates were recovered from sampled fish. Performed biochemical assays showed 90% of bacteria were G-ve, motile, rod, fermentative, oxidase, catalase and gelatin positive. Enzyme assays (Protease, lipase, amylase, gelatinase, casinase & DNase) and hemolytic test on (sheep blood agar & fish blood agar) showed that 65% of pure cultures were pathogenic in nature. From biochemical analysis and molecular characterization (16S rRNA, gyrB gene & rpoD gene), identified pathogenic bacteria isolates were grouped into 9 different genera; Aeromonas, Pseudomonas, Escherichia coli, Klebsiella spp, Yersenia spp, Enterobacter spp, Hafnia spp, Micrococcus and Rahnella spp. Non-pathogenic isolates (35%), identified, were belonged to genera Brevibacillus, Acidovorax (agriculturally important bacteria), Bacillus & Shewanella spp. Selected profile (Pathogenic & Non-pathogenic) of identified bacteria with laboratory designated strain numbers were recorded in table 1:

| Bacterium | Tissue/Water sample | Laboratory strain no. | NCBI Access. no. |
|---|---|---|---|
| *Aeromonas hydrophila* | Kidney | RTK08 | KC603616 |
| *Aeromonas hydrophila* | Muscle (lesion) | RTMCX1 | JX390650 |
| *Aeromonas hydrophila* | Gill | RTG33 | KC603615 |
| *Aeromonas popoffii* | Gull bladder | RTGL26 | KC603614 |
| *Aeromonas allosaccharophila* | Gut | RTGT19 | KC603617 |
| *Aeromonas veronii (A. ichthiosmia)* | Cataract induced eye | RTCE02 | KC582608 |
| *Aeromonas* spp | Cataract induced eye | RTCE07<br>RTCE04 | JX390649<br>KC582609 |
| *Aeromonas veronii ichthiosmia)* | Gull bladder | RTGBCX2 | JX390651 |
| *Pseudomonas fluorescence* | Gill | RTG31 | SNB |
| *Pseudomonas* spp | Muscle (lesion) | RTMCZ1 | SNB |
| *Gamma proteobacterium* | Muscle | RTM05 | KC603621 |
| *Morganeall* spp | Cataract induced eye | RTCE01 | KC582607 |
| *Shewanella* spp | Cataract induced eye | RTCE06 | KC582610 |
| *Brevibacillus agri* | Gull bladder | RTGL27 | KC603618 |
| *Enterobacter* sp | Muscle | RTM01 | KC603619 |
| *Bacillus* sp | Liver | RTL12 | KC603620 |
| *Bacillus* sp | Gut | RTG15 | SNB |
| *Acidovorax facilis* | Eye | RTCEN1 | SNB |
| *Escherichia coli* | Intestine | RTIBX02 | SNB |
| *Hafnia alvei* | Water | RTWS8 | SNB |
| *Micrococcus* spp | Water | RTWR3 | SNB |
| *Escherichia coli* | Water | RTWR9 | SNB |
| *Aeromonas* spp | Water | RTWR18 | SNB |

*Table 1: Showing profile of pathogenic & non-pathogenic bacteria and accession number; SNB: Sequence not submitted*

The predominant genus of bacterial isolates was *Aeromonas* (60.34%). Virulence property of *Aeromonas hydrophila*, RTMCX1 (JX390650) was established by intraperitonial injection of *A hydrophilla* @ 105 to 108 CFU/rainbow trout. Antibacterial susceptibility test of bacteria recorded 90% of isolate showing resistant to Bacitracin (B10) & Penicillin (P2, P10) out of 16 tested market antibiotics.

Rainbow trout tissue samples were also collected from Dachigaon and Kokernag trout farms, Jammu & Kashmir. 23 bacterial isolates were recovered from tissues samples collected from trout farm, Dachigaon, whereas 12 isolates were recovered from tissue samples collected from trout farm, Kokernag. Based on hemolytic activity, virulence tests and serum activity study some important bacterial pathogens from Kokernag trout farm were identified by amplification of 16s rRNA, gyrB gene & rpoD gene (Table -2)

| Sl. No. | Bacterium | Lab Strain no. | Gene | NCBI Acc. No |
|---|---|---|---|---|
| 1 | *Aeromonas allosaccharophila* | RTKKO1 | 16S rRNA | KC816585 |
| 2 | *Aeromonas allosaccharophila* | RTKKO1 | gyrB | KC865056 |
| 3 | *Aeromonas allosaccharophila* | RTKKO1 | rpoD | KC865055 |
| 4 | *Aeromonas sobria* | RTSKO3 | 16S rRNA | KC816586 |
| 5 | *Aeromonas sobria* | RTSKO3 | gyrB | KC865057 |
| 6 | *Pseudomonas fluorescence* | RTSKO6 | 16S rRNA | – |

*Table 2: Showing NCBI access No. of 16S rRNA, gyrB, rpoD genes of submitted bacterial isolate from trout farm, Kokernag, Jammu& Kashmir*

Bacteria flora of Dachigaon farm was as follows; *Bacillus pumilus, B. subtilis, Aeromonas hydrophila, Aeromonas sp., Hafnia alvei, Citrobacter sp, Serratia sp, pseudomonas fluorescence, Enterobacteriaceae* etc.

250-300 numbers of trout were observed with eye infection at Thakur trout farm, Joginder Nagar, Himachal Pradesh. Affected fishes were exhibiting clinical signs of darkening of body, hemorrhages in and around the eye leading to unilateral & bilateral corneal opacity (whitish eye). This corneal opacity finally resulted into endothalmic condition and complete loss of eye in trout. Water samples are collected from race-ways & dissolve oxygen, conductivity, total dissolve & water temperature was measured immediately on the spot with help of a digital meter found in optimum range. Ca hardness and nitrite concentration are measured in laboratory to find out effect of environmental stressors on dark coloration of body as well as eye infection. 4-5 numbers of moribund fish with eye infection are collected from race ways. Tissue samples (eye, liver, heart, spleen, kidney, gill) were collected aseptically for bacteriological analysis. For immediate analysis, swab from liver & eye was prepared and allowed to streak on streptococci selective agar medium. Bacterial colony grown in streptococci selective agar medium was stained with Grams stain and observed under microscope. Presence of single and chain forming gram +ve cocci bacteria in all the samples indicated that this eye infection may be due to bacteria belonged to Enterococcus group. Genomic DNA was extracted from 35 representative samples for molecular characterization (16S rRNA) of bacterial isolates. The developed bacterial profile from tissue samples of trout with eye infection was stated in table no. 3.

Antibacterial susceptibility test of Enterococci showed resistant to Nalidixic acid(Na30), Ketocomazole(Kt10), Clindamycin (Cd2), Lincomycin(L2), Cephalexin(Cp30), Polymyxin B(Pb50), Amphotericin B(AP100), Ceftazidine-Ca30/10, Cloxacillin Cx5, Metronidazole (MT5), Fluconazole (Fu10), Fluconazole (Fu25), Amphotericin B(AP20), Itraconazole(It10), Oxacillin (Ox5), Sulphamethoxypyridazine (St300), Methicillin (Met10) out of 36 tested market antibiotics.

| Bacterium | Tissue/Water sample | Laboratory strain no. |
|---|---|---|
| *Enterococcus feacalis,* | Infected eye | RTE01 |
| *Entercoccus sp.,* | -do- | RTE02 |
| *Enteroccus faecium* | -do- | RTE03 |
| *Enterococcus feacalis,* | Gill | RTG04 |
| *Enterococcus faecium* | -do- | RTG05 |
| *Enterococcus feacalis,* | Liver | RTL06 |
| *Enterococcus sp.* | -do- | RTL07 |
| *Enterococcus faecium* | -do- | RTL08 |
| *Aeromonas hydrophila* | Kidney | RTK09 |
| *Aeromonas sp.,* | -do- | RTK10 |
| *Enterococcus feacalis* | -do- | RTK11 |
| *Enterococcus faecium* | -do- | RTK12 |
| *Bacillus sp* | -do- | RTK13 |
| *Enterococcus feacalis,* | Heart | RTH14 |
| *Enterococcus sp.* | -do- | RTH15 |
| *Enterococcus sp.* | Gull bladder | RTGB16 |
| *Enterococcus feacalis,* | Lower intestine | RTLI17 |
| *Enterococcus sp* | -do- | RTLI18 |
| *Stenotrophomonas maltophilia,* | Water | RTW19 |
| *Pseudomonas geniculata* | -do- | RTW20 |
| *Plantibacter sp.* | -do- | RTW21 |
| *Paenibacillus* | -do- | RTW22 |
| *E. coli* | -do- | RTW23 |
| *Pantoea sp* | -do- | RTW24 |
| *Aeromonas hydrophila* | -do- | RTW25 |
| *Enterbacter* | -do- | RTW26 |
| *Enterococcus feacalis* | -do- | RTW27 |
| *Kluwea sp* | -do- | RTW28 |

## 4.4 Genetics and Breeding

### 4.4.1 Molecular Characterization of Coldwater Fishes

Using next generation RNA sequencing technologies, attempt was taken to develop a reference database from liver cDNA library of Schizothorax richardsonii to identify a set of genes for future application in adaptation to changing environment. S. richardsonii was subjected to temperature stress and total RNA was isolated from liver of test as well as control samples. The sheared poly (A)+ RNA were isolated and converted to cDNA followed by sequencing in Illumina HiSeq 2000 which produced 72,601,298 and 65,428,283 raw reads for test and control sample respectively. The read length of 101 x 2 (paired end reads) generated almost ~19.1 and ~18.9 giga bases (Gb) of raw data, respectively. The base quality and composition generated by the sequencing is first assessed. The low quality bases and read portion showing specific base bias is trimmed from the raw reads. Overall first 20 bases are trimmed off each read and the trimed read sequences from both samples are used to generate a reference transcriptome for Snow trout. As the species is a non model organism, transcriptome assembly was performed by de novo approach using SOAPdenovo-Trans program (k-mer = 31). The SOAP denovo-Trans program produced a total of 527,817 transcripts. The assembled transcript length and its GC distribution are shown in figure A and B respectively. Although majority of the transcripts are less than 150 bp, 157,218 transcripts (29.7%) are >=150 bp in length (mean length of the transcript = ~194bp). The longest transcript is of length 12,540bp. Further, analysis for functional annotation is under process.

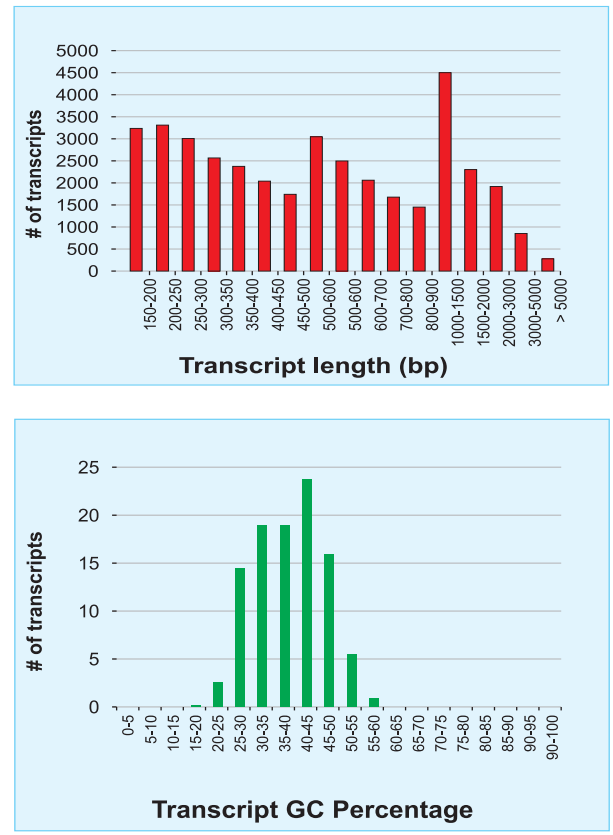
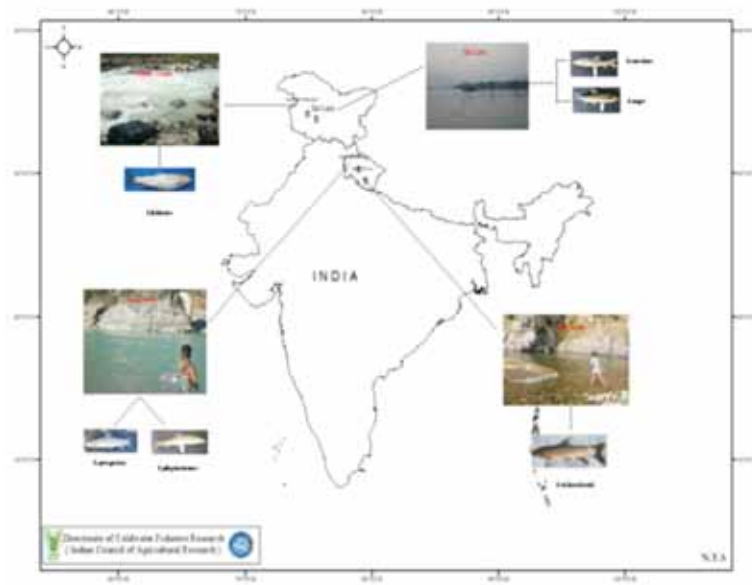



**Fig.** A) Transcript length and B) GC distribution

### 4.4.2 Complete Mitochondrial genomes of Snow trout species

Specimen of. *S. richardsonii* from river Kosi, Uttarakhand; *S. progastus* and *S. plagiostomus* from river Alalknanda, Uttarakhand; *S. esocinus* and *Schizopyge niger* from Dal lake, Srinagar; *S. labiatus* and *S. curvifrons* from lidder stream near Pahalgam, Jammu and Kashmir were collected.




Sample collection at Chamba (H.P)

Sample collection at Srinagar (J&K)

Fin tissue samples of *Schizothorax esocinus, S. plagiostomus, S. labiatus, S. progastus* and *Schizopyge niger* were collected from different geographical locations of Uttarakhand and Jammu & Kashmir. Total mitochondrial DNA of these Snow trout species was sequenced. The mitochondrial genome of all the fish species is about 16 kb in size and comprised of 13 protein coding genes, 22 tRNA genes, 2 rRNA genes and 1 non-coding d-loop region. All the sequences were submitted to NCBI GENEBANK (Table 1). One of the sequence (*Schizopyge niger*, Accession no. NC_022866.1) have been validated by NCBI and included in Refseq database (Figure 1).

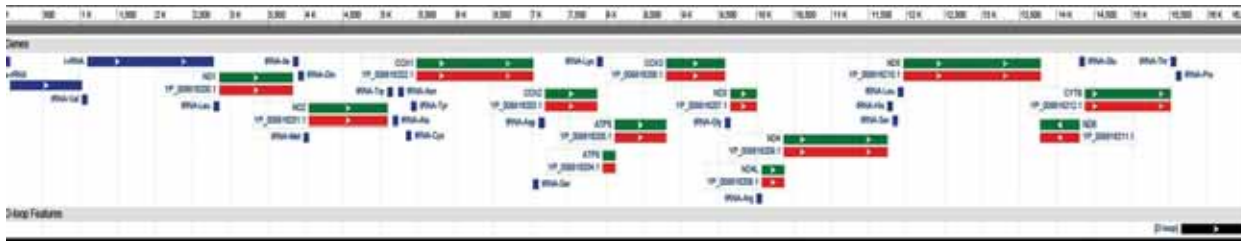


Figure 1: Complete gene arrangement of reference mitochondrial genome of *S. niger*

| Species | Genome Size (bp) | Accession number | Protein coding genes | tRNA | rRNA | A + T content | G +C content |
|---|---|---|---|---|---|---|---|
| *Schizopyge niger* | 16,585 | NC_022866 | 13 | 22 | 2 | 55.2% | 44.8% |
| *Schizothorax labiatus* | 16,582 | KF739398 | 13 | 22 | 2 | 55.3% | 44.7% |
| *S. progastus* | 16,575 | KF739399 | 13 | 22 | 2 | 55.2% | 44.8% |
| *S. esocinus* | 16,583 | KF600713 | 13 | 22 | 2 | 55.2% | 44.8% |
| *S. plagiostomus* | 16,576 | KF928796 | 13 | 22 | 2 | 55.8% | 44.2% |

*Table 1: Details of complete genomes of different Schizothorax species.*

Tissue Sampling

In order to study the genetic variation present in the rainbow trout stock present in the country, samples were collected from different trout farms. The trout samples were also collected from Dachigam trout farm for the study which is under progress.

## 4.5 Externally Funded Project

### 4.5.1 National Surveillance Programme for Aquatic Animal Diseases

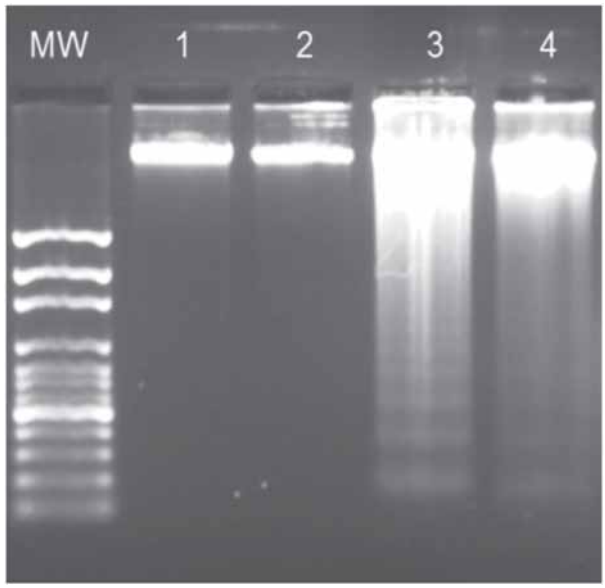
The project work has just been initiated and first survey was conducted in the Districts of Kullu and Mandi from 26th-28th Match 2014 in which 10 farms were visited and data collected on the occurrence of disease besides collecting samples from the said sites. A total of 80 samples were collected which are being analyzed for the presence of IPNV and VHSV besides IHNV using RT-PCR and dot-ELISA.

### 4.5.2 Molecular Characterization and Development of a Diagnostic test for the identification of a filterable agent isolated from Diseased Rainbow trout (DBT)

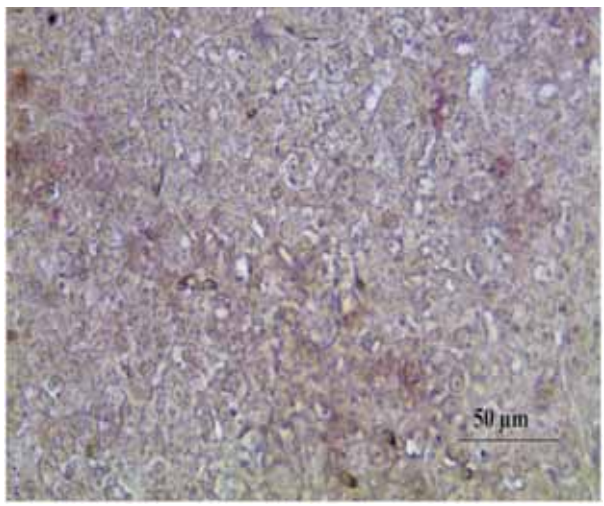
A total of 621 samples were collected from different trout farms of J&K (207), Himachal Pradesh (8), Sikkim (114), Uttarakhand (290) and Arunachal Pradesh (2) to detect viral infections in trout. 392 samples were screened for cytopathic effect (CPE) of which CPE could be detected in 60 samples in the first passage. These were further inoculated in cell culture, but CPE could not be observed after 3rd passage in any of the tested samples. The samples were screened by Dot-ELISA before inoculating them in to cell culture. A total of 240 samples were tested by dot-ELISA to detect the presence of IPNV & VHSV using anti-IPNV and anti-VHSV monoclonal antibodies. In addition the samples were also tested to detect the presence of IHNV by anti-IHNV hyperimmune serum. 82 samples tested positive for IHNV using IHNV hyperimmune serum, 57 samples tested positive for IPNV using IPNV monoclonal antibodies and 32samples for VHSV using VHSV monoclonal antibodies. It was observed that the samples, which demonstrated CPE in cultured fish cells also tested positive in dot-ELISA thus confirming the similar results. The samples were further tested by RT-PCR for the confirmation of virus. A total of 302 samples were tested for the presence of IHNV virus using IHNV gene specific primers. Of the total samples tested 27 samples were found positive using N-gene specific primers. 303 samples were tested for the presence of IPNV using IPNV gene specific primers. Out of the total samples tested 22 samples found positive using VP3 and VP2-gene specific primers. Similarly, 286 samples tested by RT-PCR for detection of VHSV of which two samples were detected positive using N-gene specific primers. However, the nucleotide sequence of the PCR positive samples had no similarity with the sequences of corresponding viral genes, possibly suggesting their absence. The suspected samples were also tested for presence of any emerging fish viruses using sequence independent single primer amplification (SISPA) a technique that has been employed to detect several novel viruses. 119 samples were tested by SISPA and amplicons were obtained in 18 samples. However, the nucleotide sequence of these amplicons had no similarity with any of the known viral sequence.

### 4.5.3 Evaluation of Genetic Toxicity and ecological damage caused by coal mines on fish fauna of Simsang river, Garrohills, Meghalaya and development of microbial bioremediation measures : (DBT Twining)

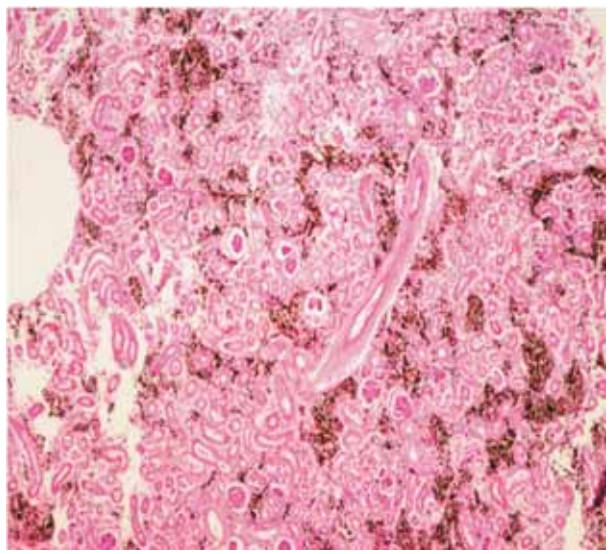
Gene toxicity was evaluated from AMD water collected from Nongal bibra, Simsang River, Meghalaya for toxicity evaluation. The collected water has very low pH (pH < 3) and fish fauna was completely absent in the water body. The gene toxicity was established in golden mahseer fingerlings using DNA laddering, TUNEL assay, histology and Comet assay. The acid water was found to be highly toxic to gill and liver. DNA laddering was consistent with gene toxicity. In histology vacoulation of cells and shrinkage of nucleus was detected.

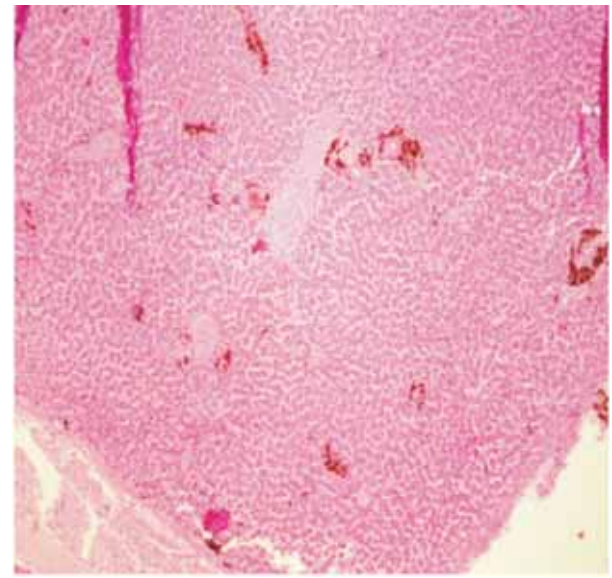



DNA laddering test

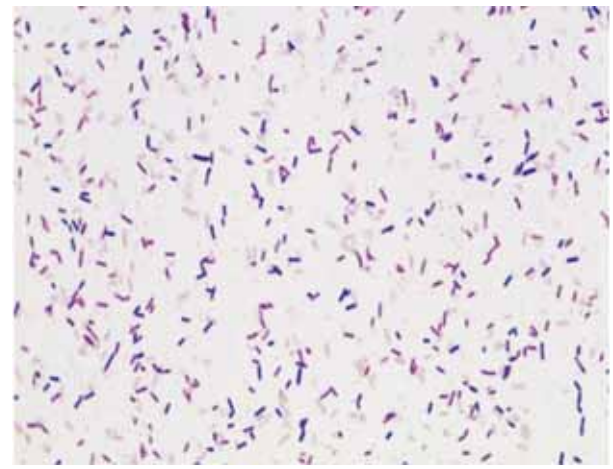



TUNEL assay





Kidney and liver of exposed fish were showing severe damage at cellular level




Isolation of Bacteria from AMD water was done and characterization is under progress for their ability to modify the pH of water.


### 4.5.4 Development and Characterization of Microsatellite markers and Assessment of genetic diversity of Schistura *sikmaiensis* from North-East India : (DBT Twin )

*Schistura sikmaiensis* was reported from India in Chindwin-Irrawady basin of Yunan river of Manipur, Assam, Meghalaya, Tripura, Nagaland and also reported from Myanmar. The species is small in size and have ornamental value. Body tinged with broad dark brown bars on yellowish-white background, inter space narrower. Caudal fin base with a dark complete bar; black spot at the base of first few dorsal rays; a dark bar near outer border of dorsal fin.

*Schistura sikmaiensis* collected from Meghalaya

To obtain repeat motifs in DNA sequences. Samples of Schistura sikmaiensis were collected from three different locations of Simsang river of Garo Hill, Meghalaya and the whole samples were preserved in absolute ethanol and stored at -20 oC before processing for DNA isolation.

Standardization for constructing partial genomic DNA library was taken up using various protocols.

Linker DNA was commercially synthesized (Operon, India) with one end as phosphorylated. It was ligated to the purified DNA in presence of high concentration T4 DNA ligase and Pdm I (50 U) which prevent self ligation of linker DNA.

Genomic DNA was enriched by using Dynabead Enrichment Method for microsatellite -containing DNA fragments. Four different biotinylated oligos (GT)12, (AT)12, (AAC)6, and (AAG)6 were pooled at a time and incubated with the linker ligated DNA for enrichment. Hybridization of oligos to DNA was performed in Mastercycler® gradient (Eppendorf, Germany) by running program OLIGOHYB.

The linker ligated (enriched) DNA fragments were separated from the rest of DNA by using Dynabeads® Magnetic Separation method (Invitrogen, USA). StrataClone PCR cloning kits (Agilent, USA) was used to ligate the enriched DNA into cloning vector pSC-A and its transformation into competent cells. The transformed cells were plated on IPTG+X-Gal+amp+ media to detect transformed colonies (Figure 1 & 2).

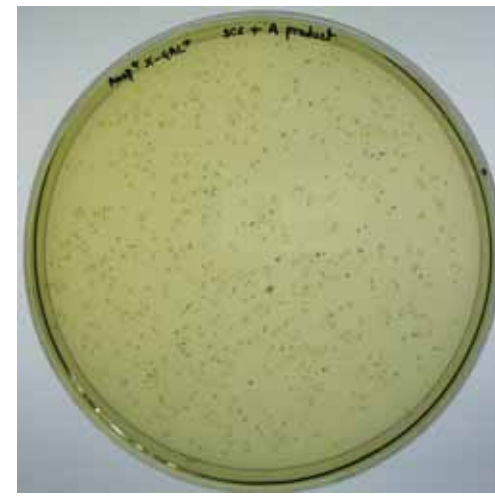


Figure 1: Blue-white selection of transformed clones.

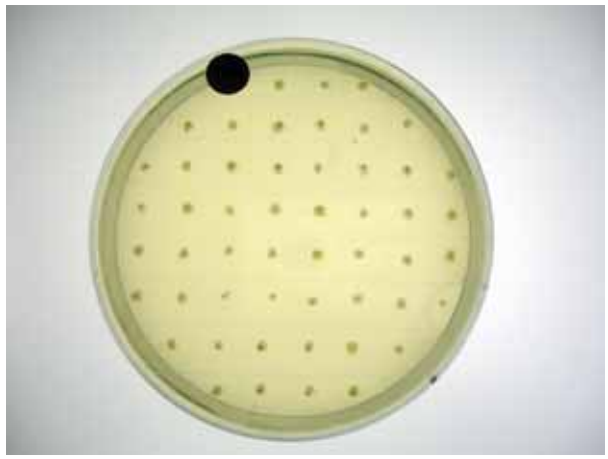


Figure 2: Grading of putative microsatellite motif containing clones.

Colony PCR method (Figure 3) was used to confirm the insert size of cloned DNA. A universal set of primers (T3-Forward and T7-Forward) was used to amplify the recombinant region. So far 125 clones were processed for plasmid DNA isolation and were sequenced in both directions with same primers formerly used for insert confirmation using ABI 3730 Genetic Analyser housed at Scigenom (Kochi) using Bigdye terminator cycle sequencing Kit (ABI, USA).

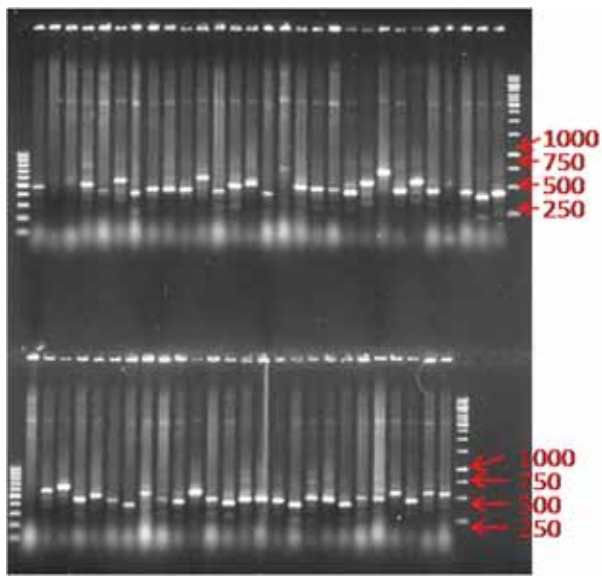



Figure 3: Colony PCR confirmation of insert size of SSR library.

To design primers for PCR amplification. FASTA_QC files generated from DNA sequencer were analyzed in CLC main workbench v.6.0 to remove vector sequence and linker sequence region. All the sequences were analyzed in WebSat to identify the microsatellites region. Initially 36 sequences were identified containing microsatellite loci. All these sequences were submitted to NCBI GENBANK under the accession # KJ545923-KJ545958. Primers were designed for all the microsatellite loci

### 4.5.5 Transcriptome Profiling of Immune responsive genes in Golden mahseer (*Tor putitora*)

The project was sanctioned by DBT in the month of November 2013. Samples are collected from Ramnagar, Uttarakand, and were kept in pond for acclimatization.

### 4.5.6 Economic Development of SC/ST Community of mid hill region of Pithoragarh District through Aquaculture Intervention(DBT)

In Dharchula block aquaculture is entirely a new concept, so preliminary survey was conducted in different areas to locate the suitable sites. Group meeting were held in villages. Based on the resource availability, land suitability and the interest of the farmers' twelve potential farmers were selected. Out of 12 farmers 2 belong to SC and 10 to ST community. Twelve (12) water harvesting structures were created in their available land. Out of twelve, 2 ponds were created under DBT and 10 under TSP.

Keeping in view the water seepage problem in hill terrain and low productivity and high expenditure in cemented pond we have created polythene (Silpauline UV treated to resist radiation) based pond.

In the first year 12 farm families were selected to initiate the work. A base line data was collected in targeted area regarding the socio-economic status of selected farmers and their knowledge of fisheries using semi structure interview schedule.

Awareness programmes were conducted in 6 villages viz Pangu, Himkhola, Chalmachilanso, Galati, Baluwakot and Gothi villages for educating the villagers on aquaculture method, its advantages and to motivate them for the enterprise.

Group meeting in village

Water harvesting structure created in village

Awareness programme

Keeping in view the available land size, water availability and the slow fish growth due to low temperature it was conceptualized that the ornamental fish production would be a better preference for aquaculture. To experiment on it brood stock of koi carp and gold fish were raised in institute's farm and were successfully bred. Around 3000 fingerlings are now ready to stock in farmers' pond. For ornamental fish production women will be targeted.

Ornamental fish seed production at Bhimtal

Seeds of carp *Cyprinus carpio* (Normal common carp and Hungarian carp), *Hypophthalmichthys* molitrix (Silver carp) *Ctenopharyngodon idella* (Grass carp) were distributed to 20 farmers and stocked in ponds. Farmers were provided with feed, hand nets, nets to cover the pond for pond management activities.

Since the aquaculture is a new introduction to the area was taken up the work in demonstration mode with active participation of the farmers. Training-cum-demonstration was organized for 10 selected farmers on 23 August 2013 at Gothi village and for 25 selected farmers in village Pangu on 27-28 September 2013. Under the training programme the farmers were explained about the pond management practices, feeding management and also the health management. Besides, they were briefed about the role of plankton in fish culture and their assessment methods.


Distribution of Feed, Net and seed by Chief Guest A. S. Hyanki (IAS)

Training-cum demonstration at village Pangu (Dharchula)

### 4.5.7 Use of plastic in Agriculture (Fisheries component) Enhancement of carp Pproduction by using polytanks in mid hills under APA Programme in Collaboration with VPKAS, Almora (All India Coordinated Research Projects)

It was recorded that, polytank is a suitable structure for the polyculture of the exotic carp in mid hill for better production. Further, it was found that the polytank structures, with bottom sand (4 inches) result better growth of all 3 exotic carp. Sand bed in this structure favors the dense population of plankton (1.6-3.2 ml/50 lit), especially the zooplankton (rotifers) and polythene surface of the side slope of pond provide the substratum for periphyton production and also keep the water warm (2-6.0°C), even in the late evening hours. Among all 3 species, grass carp performs better and its feeding is easy for the farmers. The growth curve of all 3 species reflects that fish grows only during the 1st week of March to 3rd week of November and remaining period is a lean period for the growth of carp fish. This seasonal effect is location specific and is more or less related to the water temperature. Water temperature below 12°C retards the growth and reduces the feed intake; even fish loses the weight during this winter dormancy period. In the case of earthen and cemented tanks, this period was observed for 98 days, while it was 84 days in the all types of polytanks. It was observed that the size of all 3 carps does not reach up to the marketable size by end of one year, but good size was achieved by end of second year for all the species. Further, yearlings of stunted growth having the size of 30-40 gm were reared in the polytanks and observed average size of 540-890gm in 9 months (March- Nov.). It was observed that table sized fish can be produced in polytanks having bottom sand layer in 9 months ( March- Nov.) after stocking of of stunt yearlings of the size 30-40 gm @ 2.5-3.0 nos/m3 during the month of March. Water stirring is helpful for promoting feed intake during winter. Feeding should be done after 2PM, because surface water remains warmer during this period. 45 min prior feeding to grass carp is helpful for proper feed availability to other carps. Air exposed surface of the poly tanks should be covered with tarfelt to prolong the polythene life.

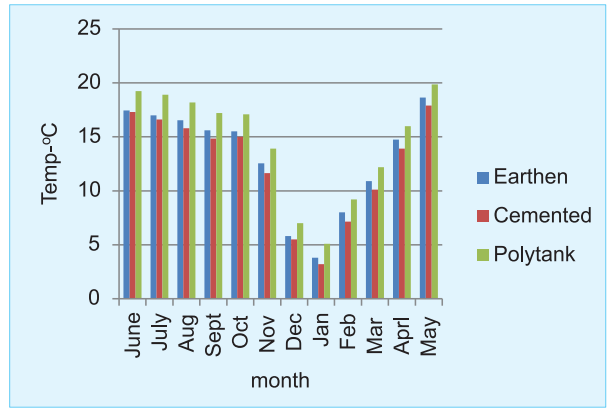



Fig. Seasonal trend of water temperature (°C) in different types of ponds

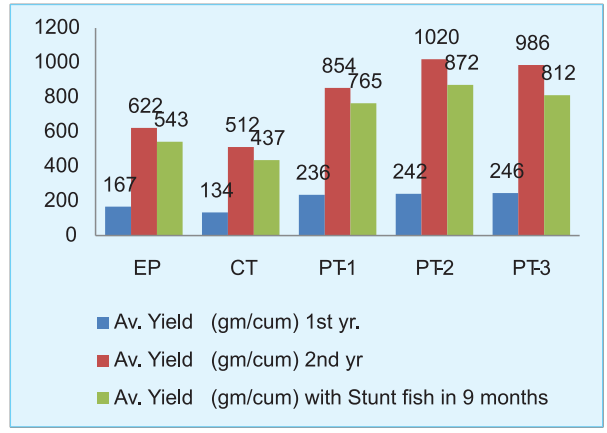



Fig. Production in the different types of ponds

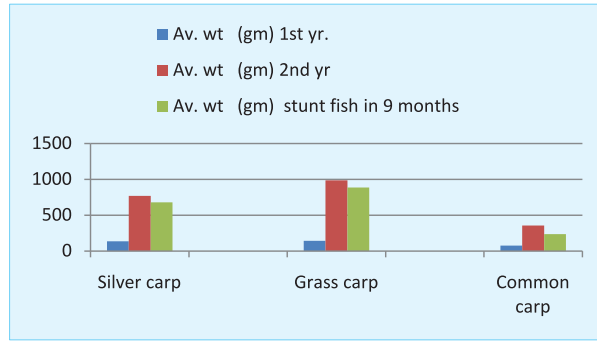



Fig. Growth performance of different fish species

# 5 - Important Events and Meetings

## 5.1 ICAR Institutes Helping Hands Towards Uttrakhand Disaster

Due to heavy rainfall on 16 to19 June 2013 entire Uttrakhand faced the heavy disaster and caused the losses of thousands of human beings

Relief to 80 years old lady

as well as animals. In response to this disaster mitigation a group meeting was held in chairmanship of Director, DCFR and decided to operate a immediate rescue and relief plan in the area, accordingly two relief program was followed.

### 5.1.1 Relief Camp at Naya Basti

In consequence of joining hands of ICAR to recently torrential rain disaster affected areas of Uttrakhand, on dated 29.6.2013 a relief team comprising of scientists and other staff of Directorate of Coldwater Fisheries Research, Bhimtal had proceeded for Dharchula region of District Pithoragarh to distribute the relief items in the form of food ration and necessary medicines to the affected families. The relief and rescue programme was coordinated by DCFR with the support of all ICAR institutes located in the Kumoan region of Uttrakhand. By virtue of the generous contributions from the employees of DCFR and other ICAR institutes of the region, a sum of rupees 2.3 lakhs had been raised for this noble cause.

| ICAR, Relief team | |
|---|---|
| Dr. R. S. Patiyal, DCFR | Sr. Scientist |
| Dr. Prem Kumar, DCFR | Sr. Scientist |
| Shri. B. C. Pandey, DCFR | AF & AO |
| Shri. Amit Joshi, DCFR | Technical Officer |
| Mr. T.B. Pal, VPKAS, Almora | Technical Officer |
| Dr. N. N. Pandey, DCFR | Sr. Scientist |
| Dr. M. S. Akhtar, DCFR | Scientist |
| Shri. Shishir Chaturvedi | Volunteer |
| Shri. Rohit Gurung | Volunteer |

Scaling all the hurdles under the leadership of Dr.R.S.Patiyal the team comprises of Dr Prem kumar, Shri B.C.Pandey, Shri Amit joshi Shri Tejpal and other staff reached at Baluwakot via Pithoragarh and arranged a relief distribution camp in Baluwakot, Nayabasti, Gothi, and Charchum. The relief items were distributed among two hundred affected families of the region in presence of "Rung kalyan Sanstha officials" Shri Mahiman Singh Hyanki and Shri Diwan Singh Patiyal.

A view of Uttrakhand disaster that caused the heavy losses of aquatic animal and biodiversity too

Flag off by Dr. A. Barat, Director, DCFR, Bhimtal

DCFR scientist carrying relief items

DCFR scientist rescuing a stranded family in midnight

ICAR Relief & Rescue team with RKS officials

ICAR Institutes relief camp at Naya Basti

Families in que to recieve the relief items

### 5.1.2 Relief Camp at Dharchula

After the first relief camp it was felt that relief measure is very little in comparison to huge destruction of the several villages in the district Pithoragarh. Several tribal villages still could not be explored due to loss of connectivity so that DCFR, Bhimtal has taken lead in **2nd phase** distribution of relief materials to the affected people during 24.8.2013 and 25.8.2013 at Dharchula. During the last visit, it was observed that shelter was the priority requirement of the people, who lost their house during the flood. Therefore, a second consignment of 150 blankets and 50 number of Tarpaulin were sent to distribute among the affected people. The distribution was made though "Rung Kalyan Sanstha" in presence of Shri N.S. Napalchiyal (IAS), Chief Information Commissioner & Ex-Chief secretary (Govt. of Uttarakhand); District Magistrate, Pithoragarh, S.S.P.Pithoragarh and other dignitaries from Uttrakhand Government.

Relief camp at Dharchula organised by different Agencies

Shri N.S. Napalchiyal (IAS), Chief Information Commissioner & Ex-Chief secretary (Govt. of Uttarakhand) distributing relief material

Beneficiary at Naya Basti, Dharchula

Blanket distribution at Naya Basti, Dharchula

To join helping hands for disaster affected areas Dr. A. Barat Director DCFR, has taken immediate initiatives to help the affected people due to natural disaster and collected sum of Rs. 2.36151/- from the staff of all ICAR Institutes located in the Kumoan region of Uttrakhand. DCFR, Bhimtal (Rs.1,12,151/-) VPKAS, Almora (Rs.25000/-), PDFMD, Mukteshwar (Rs.25000/-), Reginal Centre of CITH Mukteshwar, (Rs.11000/-), Regional Centre of NBPGR, Bhowali (Rs.15800/-) and CIBA, Chennai. (Rs.47,200/-).

## 5.2 Research Advisory Committee Meeting

The RAC meeting was held on 9-10th April 2013 at Bhimtal, chaired Dr. K. K. Vass. Dr. Krishna Gopal, Member, attended the meeting. Dr A Barat, Acting Director, welcome the members and the scientists. The esteemed committee critically examined the progress and achievement of ongoing and completed projects presented by Principal Investigators of the different projects.


Research Advisory Committee meeting


Institute Research Committee meeting

## 5.3 Institute Research Committee

Institute Research committee meeting was held on13th May 2013 under the Chairmanship of Dr. A. Barat, Director Acting. Dr. S.D. Singh ADG (I.Fy.) ICAR. Also attended the meeting. Dr Barat welcome Dr. Singh and the Scientists of the Directorate. Scientists presented their research achievements followed by discussions. Dr. Singh expressed his happiness with the research progress made by the scientist. He also appraised with the new incentive taken by DCFR for NEH and TSP work program.

## 5.4 World Environment Day

The World Environment day was celebrated on 5th June 2013.In this occasion one awareness Meeting was the Organized which was presided by Dr.(Ms) P.K. Sahoo, Principal Scientist. Dr. R.S. Chauhan , Professor, college and Fisheries, GBPUAT, Pantanagar was invited as the Chief Guest and delivered a talk on the importance of the World Environment day and the duty and responsibility of researchers in maintenance of our environment. Other staff also expressed their views.

Dr. R S.Chauhan Chief Guest planting a tree

## 5.5 Independence Day

Flag hoisting was observed on the eve of Independence Day on 15th August 2013. A. Barat, Director (Acting) hoisted the national flag on this occasion and congratulated all the staff of DCFR, for their effort in making this directorate a successful organization in terms of research and extension.

## 5.6 Institute Management Committee Meeting

Institute Management committee meeting was conveyed on 8th August 2013 under the chairmanship of Dr. A.Barat, Director (Acting). The respected Members, Dr. S.D. Singh, ADG (I.Fy.), ICAR, Dr. A.B. Pandey, IVRI, Mukteshwar, Dr. P.K. Aggarwal, Principal Scientist & Head, Division of VPKAS, Almora, Dr. P. Punia, Principal Scientist, NBFGR, Lucknow, Dr. Malovika Das, Professor, College of Fishery Science, GBPUAT, Pantnagar and Shri Y.S. Dhanik, Member Secretary attended the meeting. Dr. S.K. Srivastava, Sr. Scientist and Shri B.C. Pandey, AF & AO attended the meeting as special invitee. Some issues related to

Institute Management Committee Meeting

Institute procurement and management were discussed and the committee also approved the agenda proposed by the Directorate.

## 5.7 Quinquennial Review Team Meetings

First Quinquennial Review Team (QRT) held at DCFR, Bhimtal during 11.9.2013 to 13.9.2013 under the chairmanship Dr. M. Sinha. Other members presented in the meeting are Prof. M.M. Goswami, Prof. M.H. Balkhi, Dr. Prem Kumar (Member secretary) and Dr. P.C. Mahanta was special invitee by the chairman. The committee visited the facilities and Infrastructures, field centre Champawat. The QRT team discussed with all the scientists on different research programmes.

QRT meeting at Bhimtal

Infrastructure visit by QRT team

Essay writing competition in Hindi week

QRT team at farmer's field

Award Distribution to Hindi Secretary

The second QRT meeting was held at Shillong during 18-20.11. 2013 and was attended by Dr. M.M. Sinha, Chairman, Dr. M.M. Goswami, Member, Dr. M.H. Balkhi, Member, DR. V.R. Chitranchi, Member, Shri B.D. Sharma, Member and Dr. Prem Kumar (Member secretary). The team visited farmer's field adopted by DCFR under NEH programme. The following members attended the meeting.

## 5.8 Hindi Week Observed

The Institute calibrated Hindi week on 14 to 20 September 2013 during which several Hindi competitions like Essay writing, translation, noting-drafting, word power and typing etc.were organized among the staff of the Institute to promote the use of Hindi in official work. The entire winner was given prizes by Dr B.S. Bisht Ex-Vice chancellor Pantnagar, during inaugural function of Hindi workshop.

## 5.9 Scientist's Interaction Meeting

Under the HRD activity of PME two days scientist interaction meeting was arrange on 3-4th September, 2013. Dr. Kanta Das Mahapatra, Principal Scientist, Dr. B. Pillai, Principal Scientist and Dr. P.K. Sahoo, Principal Scientist from CIFA were invited for the programme. Dr. Mahapatra and Dr. Pillai presented a vivid account of selection breeding programme in carp and prawn respectively Which was followed by discussion. It was concluded that to attend a better growth in snow trouts, individualselection can be attempted. Dr. P.K. Sahoo, Principal Scientist presented a elaborate account of carp disease on its remedy. He emphasized on the maticulas planning of experiment to identify the pathogens and to find out the mode of action of immune system. DCFR scientists also present the aquaculture practices in coldwater sector, breeding behavior or important fishes and also the study taken up in genomics and disease. There was a nice exchange of knowledge between the two graphs. All the scientists feel rejuvenating with the programme and expressed to have a scientist knowledge exchange programme in continuous practice.

❑

# 6 - Tribal Sub Plan (TSP) Activities

To disseminate the aquaculture technology to the grass root level, during 2012 – 13, different activities under TSP related to aquaculture were taken up in the states of Uttarakhand, Jammu & Kashmir, Himachal Pradesh, Assam and Darjeeling area of West Bengal.

## 6.1 Uttarakhand

In Uttarakhand total 33 Farmer were selected in two districts i.e. Pithoragarh and Udhamsingnagar. Constructions/renovation activities of 28 ponds were undertaken. During 2012-13 and in 2013-14 five ponds in Nanak Matta area and Udhamsing nagar were renovated. Aquaculture was a new introduction to all this area. Ponds located in high and mid altitude were lined with polythene to avoid water seepage. All the 33 ponds were stocked with carp fingerlings. Eighteen ponds were located in the high altitude flood affected area of district Pithoragarh where aquaculture was introduced for income generation. These areas are badly affected by flood and all communication network including roads were collapsed. However, the renovation and stocking of ponds were taken up as rehabilitation major.

The seed and feed were provided to all farmers as critical inputs. The physico-chemical parameters of each pond were regularly monitored. All the activities were under taken on participatory mode. Growth of fishes in few ponds sampled in Khatima area found to be varies from0.8-1.5 kg within 8 month of culture period. A field training-cum-awareness program was organised at Khatima on 10.7.13 in which 30 farmers were participated. They were briefed about the scientific procedure of fish culture and the expected income.

As seed is the prime requirement for the fish culture breeding and seed production were targeted. To start with along with brood stock raising a portable FRP carp hatchery of CIFA has been installed in one of the farmers' field. Along with breeding and seed production, this unit will help in practical demonstration to the farmers. Thirty-five landless women farmers

Fish production(0.8-1.5 kg) in Sukhdevs farm

Distribution of poultry birds


Portable Carp Hatchery installed in Tribal Farmers land

New sites identified for trout raceway in block Dharchula, Pithoragarh

staying around the adopted ponds were supported for backyard poultry farming. After surveying the physibility of the sites this year two new farmers were identified for establishment of trout raceway in Distt. Pithoragarh Uttarakhand..

## 6.2 Himachal Pradesh

A visit was made to Dalan Maidan, Lahaul-Spiti district of Himachal Pradesh to assess the feasibility of trout farming by local tribal community. A detailed discussion was held with 10 farmers of village Dalang Maidan and Sissu who showed their interest for trout farming. However, most of the farmers do not have suitable land for the construction of raceways. Water scarcity is another problem which further restricts trout farming. However, after intensive discussion and visit of different sites in the area two farmers were selected who have sufficient water from small perennial stream and suitable site for the construction of 3 raceways having the size of 3x10x1.5 m. This area receive heavy snow fall during winter season from the month of November to April and remain inaccessible during this period. Therefore, the raceways may be protected from heavy snow fall by constructing shed over the raceways.

A training programme on **"Culture, Processing & Value addition of Trout"** was conducted for the trout growers of Kullu and Lahaul Spiti district of the Himachal Pradesh.

Fielf Survey in Himanchal Pradesh

Training on Trout pickle preparation

### 6.3 Assam

The site selected in Assam is the tribal villages of Haflong, Dima Hasao District. The activities were undertaken in collaboration with

Haflong Govt. College, Haflong. Total 30 farmers, 16 from Moti Daodung (Naben) village and 14 from Longmailai village were selected for integrated fish farming.Construction of animal shed and renovation of ponds works have been initiated.

### 6.4 Darjeeling area of West Bengal

Survey was conducted in Kalimpong area for fisheries development. As per survey report Sindebong and Pabak villages near Kalimpong are suitable for carp culture where as Gorkhey, Daragaon, Sirikhola, Timbure, and Phedikhola areas are found suitable for trout culture because of favourable thermal regime. After survey ten farmers have been selected for scientific intervention to upscale 'Jhora fisheries' in Sindebong village and ten farmers in Sirikhola and Timbure of Pulbazar block, Darjeeling are identified for development of Rainbow trout culture.

### 6.5 Jammu & Kashmir

Surveys were carried out in Leh area to find out the suitable site and farmers for trout farming. Five farmers were selected in village Chuchot. Five new raceways were constructed and two raceways were renovated. After the winter the raceways will be stocked with rainbow trout fry.

Raceways developed in Leh

# 7 - North East Hill (NEH) Activities

Under the NEH programme various activities were undertaken in Assam, Arunachal Pradesh, Meghalaya Assam and Sikkim states.

## 7.1 Arunachal Pradesh

Seed production of rainbow trout and brown trout was carried out at Shergaon Govt. Trout Farm of Bomdila Dist. of Arunachal Pradesh. 25000 Brown trout seed and 10000 Rainbow trout seed were produced during the period. The brown trout seed produced at the hatchery was stocked in Sella and PTso lakes of Tawang dist. in collaboration with state fisheries department, Arunachal Pradesh. A one day training cum awareness program was organized at Tawang and Bomdila to attract the private fish farmers to adopt trout farming as their vocation. 20 farmers of both the dist. participated in the training program. Construction of an ova house for the trout was initiated in the premises of Shergaon trout farm, Bomdila, Arunachal Pradesh to accommodate and rear more nos. of seed.

Small scale Integrated fish farming for upliftment of rural livelihood at Tirap, Arunachal Pradesh


Trout farming activities at Shergaon and Nuranang trout farm, Arunachal Pradesh



Integrated fish farming for up-liftmen of rural livelihood at Zirom, Arunachal Pradesh

## 7.2 Assam

Adopted 12 farmers of the village Phulguri, Puthimari & Khorkhori (District, Kamrup) for integrated pig-cum fish culture in collaboration with Department of Zoology, Gauhati University and also in Halflong in collaboration with Halfling Govt. College. The existing ponds were renovated and necessary inputs were provided for the upliftment of rural livelihood security.


Renovation of the ponds in Khorkhori village, Kamrup, Assam & Moti Daodung at Halflong Sikkim

## 7.3 Sikkim

There is an inherent potential of trout farming in Sikkim State having good water quality and sufficient quantity of cool, clean and flowing water. 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 is being maintained at different Government trout farms with the technical guidance of 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 3 lakh eyed ova.

Trout brood bank in Uttarey

DCFR Scientist demonstrated the trout breeding procedure at State trout farm, Uttarey (West Sikkim) and bred 256 brooders in 4 batch. A preparatory dose of Ovaprim @ 0.1 ml/kg was given to selected females during first week of September, which showed 14 days earlier maturity. Brooders of the age of 3-5 years showed earlier maturity ( III week of November than the brooders of 2 years old (II week of Dec.). Last batch was bred during the II week of Feb. Dry method was applied for the stripping at the water temperature of 9-14.4OC. 147 males were used to fertilized eggs of 109 females (weighing 202 kg.) with fecundity of 1500 eggs/Kg., fertilization rate 94%, survival upto eyed ova 87%, hatching rate 92% and cumulative survival of 78%. Milt of 3 males was mixed with eggs of 2 females to reduce inbreeding. Direct exposure to light was avoided by covering fertilized eggs and developing ova with black colored polythene. Incubation period was 25-32 days at 5-14OC (310 degree days). The size of resultant yolk-laden alevin (early fry) ranged from 15-18 mm. Advance alevin started feeding after 11-14 days, when 3/4th absorption of the yolk sac had been completed and fed with specially prepared starter feed having 50% protein. The fry attained average length of 26.0±3.0 mm with corresponding weight 0.45±7.0 g during II week of March. In the hatching troughs, the volume of dissolved oxygen in the inlet and outlet water recorded as 10.0 and 9.6 mg l-1, respectively. In previous year, the low cumulative survival (48%) might be attributed to the stress faced by the brood stock due to poor feeding, insufficient water flow ( 94LPM) and low dissolved oxygen in the pond water at farm, during summer months. Technical assistance was given for the brooders rearing and breeding of brown trout at Momencho farm.

A wooden stripping stand has been designed to reduce the man power, physical stress of brooder during stripping operation and to increase the working efficiency of the breeder. The device was practically demonstrated at Uttarey trout farm to the department personnel and trout growers. Two person can perform stripping of 120 kg brooder in 6 hrs, while it is only 70 kg with manual operation. There is less physical stress on brooder and breeder with least post stripping mortality. The approximate manufacturing cost of this stand is Rs. 3500/-.

Breeding of rainbow trout in Sikkim

## 7.4 Meghalaya

25 farmers were selected to adopt integrated fish cum pig farming units and were provided technical knowhow along with inputs such as fish fingerlings, fish feed, weaned piglets to improve the livelihood security in the village of Rtiang, Laitkyrhong, Myrang, Laitmawroh and Pynhurslla of Ri-bhoi, East Khasi hills and West Khasi hills dist of Meghalaya. The farmers adopted the protocol of integrated fish farming in mid Himalayan region very successfully and were motivated to expand it in a scientific manner. The QRT team also visited the sites and stocked fish seed to the fish farmer's ponds.

Distribution of fish seeds, piglets and providing technical know –how to the fish farmers

# 8 - Award and Recognition

- Dr. A. Barat, Principal Scientist has been conferred Life Fellow of the Academy of Environmental Biology, India by The Academy of Environmental Biology, Lucknow, India.
- Dr. Shahnawaz Ali, Scientist, has been conferred Life Fellow of the Academy of Environmental Biology, India by The Academy of Environmental Biology, Lucknow, India.
- Dr. R. S. Patiyal, Sr. Scientist received the best paper presentation award during Hindi Seminar" Parvatiya Chetron Mai Jaljeev Palan Vividhikaran". Organized at DCFR, Bhimtal from 23-24 September 2013, Title of the presentation was "Himalay Shetro mai Sajawatee Machliyo ke Palan se Jeewika Suraksha kee Sambhawnayei"
- Chirag Goel awarded the Ph.D. degree under the supervision of Dr. A. Barat, Principal Scientist and Dr. Veena Pandey, Head, Department of Biotechnology from Kumaon University, Nainital for his dissertation work on "Molecular Cloning and Sequencing of a cDNA Encoding Mannose Binding Lectin Honologue in Schizothorax richardsonii and Comparison with Other Species Analogues"

Dr. R. S. Patiyal, receiving the best paper presentation award

# 9 - Extension Activities and Other Services

Extension played a major role in catering the need of farmers and also to deliver the lab findings to the field. Since cold water fisheries is relatively a new emerging sector continuous interaction with the farmers help in developing the suitable technology that is need of the sector and also to develop the skill of farmers to adopt the technology and also to refine the technologies. DCFR under the NEH and TSP programmes reached the farmers of the very difficult areas. Research output of the directorate has been transferred to end user through training, demonstration, field visit, farmers meet and also by displaying them in exhibition, Kisan Mela etc.

## 9.1 Transfer fo Technology

### 9.1.1 Training to Farmer

In the month of May 2013 two Farmer's meet were organized by Dr. A.Pandey and Dr. Haldar. One in the area of Upper Sindebong village (Kalimpong Block) and the other in Sirikhola (Darjeeling Pulbazar Block) under Darjeeling Hills to facilitate a face to face interaction with the scientists of this Directorate and the local Tribal Fish farmers. Thirty four fish farmers with State fisheries officials and local Panchayat Sabhasad were present at Sindebong while 27 Tribals participated in the Farmer's Meet and were keen to take up trout farming at Sirikhola and Timbure. Based on the survey it is evident that Sindebong and Pabak villages near Kallingpong and Bungkulung near Mirik are suitable for carp culture while the villages Gorkhey, Daragaon, Sirikhola, Timbure and Phedikhola are suitable for trout culture because of a favorable thermal regime.After the survey, ten farmers have been selected for scientific intervention to upscale Jhora fishery in Sindebong village under Kalimpong-I Development Block. Ten farmers in Sirikhola and Timbure village of Darjeeling Pulbazar Block have been selected for Rainbow trout culture.

Farmers Meet at Sirikhola (1900 msl)

Farmers Meet at Sindbong Village

Stripping of Rainbow Trout in Uttarey Farm

A training on "Culture and Breeding of Rainbow Trout" was provided by DCFR Scintist Dr. N.N.Pandey and Dr.Haldar to the farmers of West Sikkim on 28th November 2013. Training was imparted on various aspects of trout farming with practical demonstration to Twenty five trout growers from Shree Badam, Simphok, Begha, Dhampaley, Uttarey, Lingay and Sopakha area along with Departmental personnel were participated in the training programme.

### 9.1.2 Fish Farmer's Day Celebration

To commemorate the Induced fish breeding success, Directorate of Coldwater Fisheries Research (DCFR), Bhimtal celebrated Fish farmer's Day at village Tharu Teeshora, in Udham Singh Nagar, Uttarakhand on 10th July 2013. The programme was presided over by Dr. Ashoktaru Barat, Director, DCFR, Bhimtal, Uttrakhand. Dr.R.S.Patiyal, Sr. Scientist and programme coordinator of the programme welcomed all the farmers, entrepreneurs, dignitaries and media persons.

In the inaugural address, Dr. Barat welcomed all the farmers and highlighted the importance of rural aquaculture for income generation and for livelihood security particularly for the poor farmers with smaller land holdings. He said this may be a small beginning today; however, he assured the gathering that in future also Directorate will regularly organize such progrmaes in the area for development of

Distribution of nets to beneficiary

aquaculture activities. Dr Barat requested local fish farmers to be in touch with scientist and also visit DCFR,Bhimtal for better utilization of available farming technologies. Under the directorate TSP programme. Seed, feed Plankton nets, hand net, cast net and thermometer were distributed to adopted progressive fish farmers of the area.

### 9.1.3 Farmer's Field Day

- DCFR Field Centre at Champawat organized Farmers Field Day on 12th February, 2014 at village Katarh in Champawat District. In this village Shri Laxman Singh the only farmer of Champawat District growing rainbow trout in 7 raceways participated. He is also practicing the fish cum poultry farming. The farmers were explained the trout culture practices. Sampling for growth, and health condition was undertaken. Physico-chemical parameters of raceways also collected. During

View of trout raceways at village Katarh Champawat

the visit, algal growth in trout raceways was observed. Farmer was advised to remove the algal mat from the raceways and provide balance farm made diet to trout juveniles. Programme was cordinated by Dr. Suresh Chandra.

Sampling of tanks

Sampling of trout raceway

View of poultry cum fish integration

- A cluster of trout growers was developed in the Upper Rimbi area in West Sikkim with 6 raceways of tribal farmers. Training was imparted for these tribal trout growers and farm advisory service was provided by the DCFR, Bhimtal. Unfortunately, there was a great disaster loss in this area due to the heavy rain and cloud burst on 30th July, 2013. Out of 6 trout raceways of the tribal farmers, 3 have been completely washed out and 3 were partially damaged. Technical and financial support was provided for reconstruction and renovation of those raceways to revive that trout farming cluster. It would be very helpful for rehabilitation of these affected 6 families and to provide a better way to sustain their livelihood.

Private raceway at upper Rimbi

Technical and financial assistance was given to Uttarey trout farm for the feeding of brood stock and renovation of ova house facility. Dr. Madhumita Mukherjee, Executive Director, NFDB, Hyderabad, interacted with trout growers in the area and observed the breeding activities during her visit at Uttarey Trout farm on 27th November 2013.

- Polyculture of exotic carp in polythene lined pond is a proven technology for the mid hill region. A polytank having the size of 15x8.5x1.5M (Capacity-1.9 lakh lit.) was established at KVK Kafligarh. Pond was inaugurated by Hon'ble Secretary DARE & DG, ICAR on 1st June 2013. Advance fingerlings of the size of 30-40g were stocked during the month of June 2013 @ 3 fish/m3 . Fish were fed with rice polish and MOC @ 3% of their body weight. Grass carp was fed with green farm foliage. The drain water from the pond is also used for the vegetables plots. Fish grown well due to the increasing water temperature during day hours and reached upto the size of 300- 500 gm in 8 months. This pond is used as the demonstration unit for the farmers training.

Program was cordinated by Dr. N. N. Pandey

KVK demonstration Pond in Kofhgarh

### 9.1.4 Participation in Exhibition

The institute participated in the following exhibition related to fisheries and aquaculture activities in different parts of the country during the year 2012-13.

- Exhibition during Kisan Mela organised by VPKAS, Almora on 13th April, 2013
- Exhibition in connection with "International symposium on Green Fisheries: twards Green technologies in fisheries" during 21-23 May, 2013 organised by CIFT, Cochin and Society of fishery technologists.
- Exhibition in "Farmers Meet" organised by KVK, Kafligarh on 1st June, 2013.
- Exhibition organised by NBFGR during "Expert consultation on fish genomic research in India" at Manglore on 2nd August, 2013.
- Exhibition in Kisan Mela organised by VPKAS, Almora on 25-26th Sept., 2013.
- Exhibition in Kisan mela & Agro industrial exhibition organised by G.B. Pant University of Ag. & Tech. Pantnagar during 4-7th Oct, 2013.
- Exhibition in farmer training organised by DCFR, Bhimtal in collaboration with KVK, Bajoura and CIFT, Cochin at Bajoura, Kullu ( H.P) during 11-13 Dec. 2013.
- Exhibition in consultation workshop on self sufficient and sustainable aquaculture in NE region, organised by CIFA at Agartala on 5th Feb, 2014.
- Exhibition in Kisan mela, organised by IARI, New Delhi during 26-28th Feb. 2013.
- Exhibition in Meen mahotsav at Itanagar, Arunachal Pradesh during 21-22 November, 2013.

### 9.1.5 Interaction with Farmer and Students

- Two Scientists from Scotland visited DCFR and interacted with Scientists of Directorate regarding trout farming on 11th April, 2013.
- A batch of 19 students from Kumaon University visited DCFR and interacted with Scientists on 18th July 2013.
- A batch of 25 students from College of Fisheries, G.B.Pant University of Ag. & Tech Pantnagar visited DCFR and interacted with Scientists on 27th Sept. 2013.
- A batch of 11students from Bhartiyam International School, Rudrapur visited DCFR and interacted with Scientists on 8th Oct. 2013.


Exhibition stall of DCFR, Bhimtal in Kisan mela at IVRI, Bareilly

Exhibition stall of DCFR, Bhimtal in Kisan mela at VPKAS, Almora

Scientist interacting with the farmers of Haflong, Assam

Exhibition in Meen Mahotasav at Itanagar, AP.

- A group of 14 students from College of Fisheries, G.B.Pant University of Ag. & Tech Pantnagar visited DCFR and interacted with Scientists on 28th Oct. 2013.
- A group of students from College of Technology, G.B.Pant University of Ag. & Tech Pantnagar visited DCFR and interacted with Scientists on 22 Nov. 2013.
- Exposure visits were under taken in two batches of students from MITR, Haldwani to DCFR on 20th & 22nd Nov. 2013.
- A group of 22 students from D.A. College of Agriculture, Ag. University Anand, Gujrat visited DCFR and interacted with Scientists on 29th Nov.
- A group of 20 students from City College Kolkatta visited DCFR and interacted with Scientists on 9th Dec.2013.
- A group of 54 students from Ranyas College, University of Delhi visited DCFR and interacted with Scientists on 13rd Dec. 2013.
- Students from Deptt. Of Zoology, AMU, Aligarh visited DCFR and interacted with Scientists on 7th March,2014.
- DCFR provided farm advice to the 42 trout growers of the West Sikkim district and 14 farmers of East Sikkim.

## 9.2 Farm Activities

### 9.2.1 Rainbow Trout Breeding at DCFR Field Centre, Champawat

Total 76 female rainbow trout brooder of weight and length of 537-1559g and 350 - 470mm were stripped for seed production in four trials on 9,10,13,&31st January, 2014 at DCFR Field station Champawat. In comparison to previous years, female brooder maturity was observed

about 10-15 days earlier. At the time of stripping, about 20-30% female trout showed hydration in ovary which resulted to fluidly egg release with poor fertilization rate. This may probably due to over maturation in raceways. The functional fecundity of above used rainbow trout stock recorded between 63-185g. Total about 1, 14,000 eggs of rainbow trout have been stripped which are being incubated in 12 troughs in hatchery. During incubation, water temperature of egg rearing trays ranged between 3-60C and 40-47 days were taken to hatch the eggs.

Stripping of rainbow trout at Champawat farm


Maintaining hygienic condition in trays


Damged eggs and eyed ova of rainbow trout

Regular lifting of unfertilized eggs

### 9.2.2 Breeding and Seed Production of Ornamental Fishes at Bhimtal

The DCFR, Bhimtal has initiated the work on breeding and seed production of ornamental fishes under DBT Project. To experiment on it 300 brood stock of barilius sps,koi carp and gold fish were raised in institute's pond and bred successfully. Around 3000 fingerlings of gold fish and koi carp are now ready to stock in farmers' pond.

Successful breeding of the Gold fish (*Carassius oratus*) in the month of March and 2013 was carried out at DCFR Bhimtal campus. Brood stock was purchased from market and acclimatized in poly lined ponds for 1 year. Mature healthy Gold fish brooders were segregated from pond (Temp 21-26) and kept in FRP tanks (Temp 15-19). The breeding was done in FRP tanks without introducing a hormone.

Aquatic macrophytes hydrilla were introduced into the tank for eggs. All female released viable egg after 42 hrs and hatching took placed in 120 hrs. A hatching success was achieved 50%.

The induced spawning of Koi carp (cyprinus carpio) was carried out in the DCFR campus Bhimtal on August 2013.The breeding was done in FRP tanks( Temp.18-23) .Mature healthy koi carp brooders (200-250 g) reared in cemented pond (Temp.19-25) were selected for breeding. The spawning was induced by intra-peritoneal injections of ovaprim at a dose of 0.3 mL/kg body weight. The egg release was witnessed within 15 hrs and hatching was observed in 84 Hrs. A hatching success was achieved of about 80%.

## 9.3 Advisories and on Farm Demonstration

- Shri Amber Bahadur Gurung, resident of Upper Sree Badam, west Sikkim basically a cardamom farmer was developed as a progressive trout grower. Started Trout Farming during the year 2011 and constructed a trout raceway of the size of 15m x 2m x 1.5m. He stocked 500 fingerlings of rainbow trout during the month of May, 2012. DCFR Scientists visited his site and provided technical support and maintenance of the raceway, feed &feeding, health care and other intercultural activities. He procured seed and feed from the state trout farm, Uttarey and used pelleted trout feed @ 4% of the biomass twice a day. After technical support he harvested 302 kg fish of the size of 600-1000 g. in the month of June 2013 and sold in fresh condition to the resort at Kaluk Bazar @ Rs. 600/kg. He earned around one lakh rupees by selling the trout fish grown at his own backyard.
- Mr. Kushal Gupta, trout fish farmer cum restaurant owner, Kullu (HP) was extended the technical knowhow by DCFR on basics of trout farming like feed, feeding, health management, breeding and larval rearing. He also attended hands on training on preparation of value added products of trout. Thus khusal could manage and introduce his trout production as a new trout fish meals in menu of his restaurant.


Mr. Kushal Gupta

# 10 - Consultancy

## Study on Fish and Fisheries of Yamuna and Tons & its Tributaries in Uttrakhand under Institutional Consultancy

The River Yamuna is the largest tributary of the river Ganga in northern India. It originates from the Yamunotri Glacier point near Bandar Punch (38o 59' N 78o 27' E) in the Mussourie range of the lower Himalayas in the district of Uttarkashi (Uttarakhand). After traversing lower Himalayas for about 75 km, the river forces its way through the Shiwalik range and emerges out of Himalayas in Doon valley. The river meets several of its tributaries on the course of its flow. The major tributaries of the river are Hanuman Ganga, Vadyar Gad, Kamal Nadi, Aglar river and Tons river in Upper Yamuna basin (Uttarakhand) and Betwa, Chambal, Ken and Sindh in Lower Yamuna basin. The Tons river originates from the high Bandarpoonch mountain and flow through Himachal Pradesh and meets Yamuna below Kalsi near Dehradun, Uttarakhand. Different developmental processes such as abstraction of water for various purposes and construction of hydroelectric projects may have impact on the aquatic flora and fauna. A field study was carried out to collect primary data on aquatic flora and fauna of Yamuna and Tons & its tributaries.

The field studies were conducted during March-April and May-June 2013 at 28 locations in Yamuna starting from Janaki Chatti to Ponta Sahib and in Tons from Naitwar-Mori till confluence of Yamuna and Tons for collecting the primary data on physico-chemical parameters of water and aquatic flora & fauna in the study area.

Among phytoplankton Baccillariophyceae (15 genera), Chlorophyceae (14 genera), Cynophyceae (7 genera) form the dominant groups while Dinophyceae, Eugliniphyceae and Xanthophyceae are poorly represented. Baccillariophyceae (50-80%) dominated the bulk of plankton community followed by Chlorophyceae (30-60%) and Cyanophyceae (1-8%) other group contributed less than 6% of total plankton community. Zooplanktons are mainly comprises of Prtozoans, Rotifera, Copepoda, Ostracoda and Insect larvae. The Protozoan (40-70%) were the main contributor in the total zooplankton community followed by Rotifers (30-60%), Copepods (10-30%), Ostracods (5-10%) and Insect larvae (2-5%). Occurrence of benthic macrobiota was generally low in the upper reaches of Yamuna and Tons probably due to low thermal regime and low level of suspended organic material. The benthic microbiota was dominated by Ephemeroptera (7-60%) followed by Tricoptera (5-42%), Coleoptera (2-12%), Odonata (1-2%) and Diptera (<1%). Ichthyofauna: Fish abundance was higher in the lower reaches of Yamuna and Tons as compared to upper reaches. Important fish species recorded were *Schizothorax richardsonii*., *Nemacheilis* spp. *Barilius* spp., *Raimos bola*, *Tor* spp. *Puntius* sp., *H. molitrix*, *Labeo dero*, *L. dyochelius*, *L. rohita*, *Cirrhinus mrigala*, *Cyprinus carpio*, *Bagarius bagarius*, *Pangasius pangasius*, *Ompak bimaculatus* and *Mestacemblus armatus*.

A haul of fish from Barnigad (Yamuna)

Brown trout caught from Rupin

Golden Mahseer

Cast net operation

- Under Institutional consultancy for cumulative environmental Impact assessment studies of Satluj basin in HP as partner Institute with ICFRE, Dehradun, a survey on the occurrence of important fish fauna in the river Sutlej was conducted by a team of Scientists from Directorate of Coldwater Fisheries Research (DCFR).

- Dr. D. Sharma provided consultancy service regarding "Construction and Establishment of Mahseer Hatchery" to Assam Bhoreli Angling and Conservation Association, Tezpur, Nameri, Assam, Department of Fisheries, Govt. of Himachal Pradesh and LANCO Energy Pvt. Ltd., Teestha-VI project, Sikkim.

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# 11 - Training/Symposia/Workshop/ Seminar Organised

## 11.1 National Hindi Workshop on " Parvatiya Chetron Mai Jaljeev Palan Vividhikaran".

Two days Hindi workshop was organized at DCFR, Bhimtal from 23-24 September 2013. The main theme of this workshop was "**Parvatiya Chetron Mae Jaljeev Palan Vividhikaran**". The chief guest on this occasion was Dr B.S. Bisht, Director, BIT, Bhimtal and Ex -Vice chancellor Pantnagar . Other Hon'ble Dignatories Dr. Madan Mohan, ADG (M.Fy.), ICAR, New Delhi, Prof. I.J. Singh, Dean, College of Fisheries, GBPUAT, Pantnagar, Dr. P.C. Mahanta, Former Director, DCFR, Bhimtal and Dr. B.C. Tyagi, Ex-Principal Scientist, DCFR, Bhimtal were presented. Major objectives of the workshop were (i) Coldwater fish resource management. (ii) Diversification of cold water fisheries and (iii) Livelihood security through aquaculture and participation of woman. There were three technical session of the workshop as of themes. The themes of the each

Dr.B.S. Bisht, Inaugurating the Hindi workshop by lighting the lamp

Release of abstract book by dignitaries

Inaugural address by Chief guest Dr B.S. Bisht

Dr. Madan Mohan, ADG (M.Fy.), ICAR addressing the gathering

technical session were started with a key speaker followed by theme papers and discussions. Dr. A. Barat, Acting Director, DCFR gave a presentation on the comprehensive achievements of the Directorate. The other Key persons in the workshop were; Dr. P.C. Mahanta, Former Director, DCFR, Dr. I. J. Singh, Dean College of Fisheries, Pantnagar, Dr. B.C. Tyagi, Ex-Principal Scientist, DCFR and Deputy Director (Fisheries) Uttarakhand. Following recommendations were finalized in the plenary session of the workshop.

- Inventory and temporal change in the fishery resources should be carried out using modern tools like Geoinformatics.
- It is necessary to Investigate implications on climatic changes and bio-diversity of the sector.
- To establish the breeding and culture protocol of potential fish species in order to diversify the hill aquaculture.
- To explore the potential ornamental fishes for hills which can be a small venture for women empowerment and livelihood security.

## 11.2 Training Program on "Culture and breeding of important Coldwater Fishes

During 1-6 July, 2014 at DCFR, Bhimtal Twenty senior officers and progressive fish farmers from the Department of Fisheries, Govt. of Meghalaya were trained for 6 days regarding culture and breeding important coldwater fishes at DCFR, Bhimtal. The participants were trained at the mahseer hatchery of DCFR and at its field centre, Champawat regarding trout farming. Both lecture and practical demonstration were given to the participants.

Demonstration of Mahseer seed productions

## 11.3 Hands-on-training Programme on Molecular Techniques for Fish Biodiversity Analysis

One week hands on training programme on "Molecular techniques for fish biodiversity analysis" was conducted at DCFR, Bhimtal From 1-6th July 2013 under NEH activity. The training was organized for the researchers from collaborating institutes of Northeast India, to develop technical skills in molecular techniques. Twelve participants from different institutes like Guahati University, Assam; Rajiv Gandhi Hill University, Arunanchal Pradesh; St. Antony College, Shillong along with the students of DCFR attended the training program. The program was inaugurated by Dr. Ashoktaru Barat, Director (Act.), Bhimtal. The training programme was co-ordinated by Dr A Barat. The

Practical session of the training.


Certificate distribution

training programme covered the theory as well as practical aspects of fish genetic diversity analysis using mtDNA markers and development of SSR markers. Elaborate demonstration of data analysis using various Bioinformatic software was also demonstrated.

### 11.4 NEH Training Programme on Coldwater Fish Farming in Meghalaya: New Approaches

A training program on "Coldwater Fish Farming in Meghalaya: New Approaches" was organized on 24-25 October, 2013 at ICAR Research Complex for NEH Region, Barapani in collaboration with ICAR Research Complex, Barapani and Department of Fisheries, Govt. of Meghalaya. Total of 100 participants from the state fisheries department, KVK's as well as fish farmers' form the different districts of Meghalaya participated in the programme. The program aimed to impart training to the farmers, so as to increase the fish production in the state and thereby by improving the socio economic status and livelihood security of the rural farmers. Dr. Debajit Sarma, Principal Scientist , Dr. S.K. Gupta, Scientist, DCFR and Dr. Arnab Sen, Head, Animal Science Division (ICAR, Barapani) delivered various lectures on culture and breeding of trout, mahseer as well as integrated fish farming in hills. A field visit was carried out in the different villages like Laitkyrhong, Laitmawroh, Umshning, Umran, Kyrdem, Upper Shillong, Zirang, Umkteih with the involvement of fish farmers of the local vicinity. A practical demonstration was given at the farmer's field regarding scientific management of the aquaculture pond.

Training at ICAR Research Complex for NEH Region, Barapani and Field visit to Laitkyrhong village of Meghalaya

### 11.5 Farmer's Training Programme on Culture & Breeding of Rainbow trout at Sikkim

There is a great scope of trout farming in Sikkim State having good water quality and sufficient quantity of cool, clean and flowing water. DCFR, Bhimtal in collaboration with State Fisheries Department of Sikkim extended full support for promotion of Trout farming. Along with enhancing trout production emphasis has been given for seed production. Healthy brood stocks are being maintained at different Government trout farms with the technical guidance of DCFR. Need felt hands on training have been provided by DCFR on various aspects of trout farming. In this connection, a need felt Farmer's training on "Culture and Breeding of Rainbow Trout" was conducted with practical demonstration to the farmers of West Sikkim on 28th November 2013.

Dr. N. N. Pandey (Sr. Scientist) and Dr. R. S. Haldar (Sr. Technical Officer) demonstrated the trout breeding procedure at State trout farm, Uttarey (West Sikkim) and bred about 100 female brooders with the production of 1.75 lakh fertilized eggs. Twenty five trout growers from Shree Badam, Simphok, Begha, Dhampaley, Uttarey, Lingay and Sopakha area along with Departmental personnel were participated in the training programme. A constant technical support has been provided by the DCFR to the State with the hope that the State would be a hub of trout seed and feed for the entire North-East region.

Egg counting

Egg arrangement in troughs

Discussion with Farmers

## 11.6 Farmers' Training Programme on Culture, Processing and Value Added Products of Trout at Kullu ( HP)

A need based hands on training was conducted for the trout growers of Kullu and Lahaul Spiti district of the Himachal Pradesh in collaboration with CIFT, Cochin and KVK, Bajoura during 11- 13 Dec. 2013. It is an intervention of the DCFR, Bhimtal to popularize the new value added products of the Rainbow trout in tourist places like Kullu, Manali and Lahaul Spiti. Training was conducted at KVK, Bajoura and coordinated by Dr. N. N. Pandey, Sr. Scientist and Dr. S. Ali, Scientist, DCFR Bhimtal. Dr. A. Barat, Director (Act.) DCFR and Dr. C. N. Ravishankar, Principal Scientist & HOD, CIFT, Cochin inaugurated the programme on 11th Dec, 2013.

Dr. Chandrakanta and Dr. Deepali Kapoor SMS of KVK, Bajowa were associated in organization. The training programme demonstration for the preparation on Trout fillet, trout streak, trout cutlets, trout ball, trout fingers, trout wafers and feed preparation by using trout silage was given by Dr. Bindu. J. Sr. Scientist and Dr. Mohan, C. O., Scientist from CIFT and their technical staff. Technical knowledge of culture and breeding of the trout was provided by the DCFR. 50 farmers of the distt. Kullu and Lahaul Spiti participated in the training programme and prepared the value added products of trout. This was learning by doing exercise for the participants and they took keen interest in learning different recipes of the trout.

A successful interaction session was also held between scientists of DCFR, CIFT and private trout growers, Association of anglers, Press of Himachal Pradesh.

Demonstration for filleting

Demonstration for value added products

Value added products of Trout

### 11.7 Hands on Training on Laboratory Procedure, Diagnosis & Control of Coldwater fish diseases at DCFR, Bhimtal

A "Hands on training on laboratory procedure, diagnosis & control of coldwater fish diseases" was organized from 28th February - 6th March, 2014 by Fish Health Section of the DCFR. Total 14 participants of State Fisheries Departments, faculties and research scholars of Gauhati and RGU university participated in this training. The course program covering theoretical as well as practical aspects of viral, bacterial, fungal and parasitic diseases in coldwater fish species, their diagnosis, and identification of causative agents, treatment methods and therapeutics. A training manual was prepared and released on this occasion. Mr. Sumanta Kumar Mallik, Dr Amit Pande, Dr Neetu Shahi, Dr R. S. Haldar, Dr Suresh Chandra and Dr Debajit Sarma, Nodal officer for NEH activity coordinated the program. Dr A. K. Singh, Director, DCFR, Bhimtal chaired the valedictory session of the program and congratulated all the participants for their successful completion of the training. He also emphasized the importance of this training in communicating basic as well as advance techniques for location specific fish health management practices.

Valedictory address by Dr. A. K. Singh, Director

Release of training manual

### 11.8 Training on "Aquaculture Practices in Tarai Babar"

On10th July 2013 one day training programme on "Aquaculture practices in Tarai Babar" was orgonised at village Tharutisaur, Khateema for tribal farmers. In the morning session, a lively farmer - scientist interaction meet was organized to solve the problems of farmers. The expert scientists Dr. R.S. Patiyal, Dr. S.K. Srivastava, Dr. Suresh Chandra, Dr. S. K. Gupta

and Dr. M.S. Akhtar and Javaid I.Mir of DCFR, Bhimtal participated in the interactive session to address the queries raised by the farmers. In the second half of the day field demonstration programme was orgonised and on feeding, netting, pond health monitoring, growth checking was demonstrated. Training was attended by about fifty men and women farmers of the area.

Plankton assessment

Demonstration of fish feed preparation

Seed in release in farmers pond

## 11.9 A Capacity Building Training Programme for SC/ST farmers at village Pangu, Uttrakhand

A training programme for SC/St farmers was organized at Pangu village, Pithoragarh under the DBT project entitled "Economic development of SC and ST community of mid hill region of Pithoragarh district through aquaculture intervention on 29 -30th September, 2013. 35 Participants from border villages namely Pangu, Himkhola, Baiku, Gothi, Chalmachilanso Uttarakhand were imparted training on know-how on polytank fish culture. Coordinator of the programme Dr. R.S.Patiyal briefed about the aim and objective of the project and training programme.

In the inaugural address Chief guest Shri Arvind Singh Hyanki IAS appreciated DCFR target specific efforts for the farmers of remote and disadvantageous border areas and emphasized a importance of rural aquaculture for income generation and livelihood security. During the programme chief guest distributed seed, feed and fishing gears etc. to 35 farmers.

Field demonstration at village Pangu

# 12 - Linkages

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

## ICAR Institutes

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

## State Ministries/Department

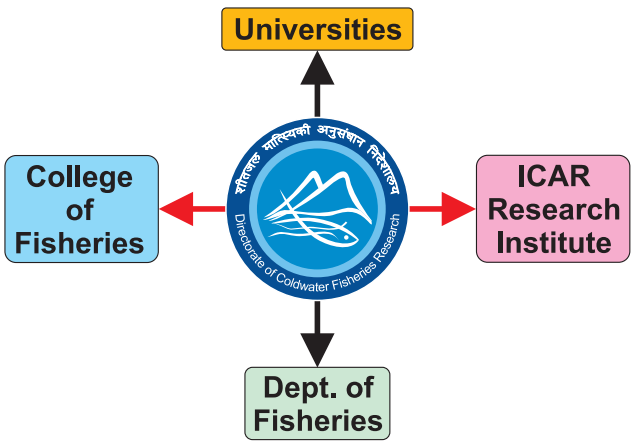
- Department of Fisheries, Arunachal Pradesh
- Department of Fisheries, Sikkim
- Department of Fisheries, J&K
- Department of Fisheries, H.P
- Department of Fisheries, Uttarakhand

## Universities & College

- GBPUA&T, Pantnagar
- Rajiv Gandhi University, Itanagar, Arunachal Pradesh
- GB Pant Institute of Himalayan Environment and Development, Almora, UK
- College of Fisheries, SKUAS&T, Srinagar, J&K
- CSKHP Agri. Univ., Palampur, H.P
- Kumaun Univ., Nainital, UK
- HNB Garhwal Univ., Srinagar, UK
- Guawahati university, Guawahati, Assam

## Central Ministries/Departments

- Department of biotechnology
- National Agricultural Innovative Project



# 13 - Publications

## 13.1 Research Papers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### 13.4 Proceedings/Training Manual

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## 13.5 Nucleotide sequences submitted to GeneBank

| Sr. No. | Contributors | Perticulars | Accession numbers |
|---|---|---|---|
| 1. | Goel, C., Sahoo, P.K., Bhat, F.A., Balkhi, M.H. and Barat,A. | *Schizopyge niger* mitochondrion, complete genome | NC_022866 |
| 2. | Barat, A., Sahoo, P.K., Patiyal, R.S., Ali, S., Sati, J. and Kumar, R. | *Tor putitora* ATP synthase 8 and ATP synthase 6 genes | KF356210-KF356211 |
| 3. | Belwal, K. and Pande, A. | Charactertization of TLR-5 in *Schizothorax richardsonii*, partial coding sequence. | KF742778 |
| 4. | Belwal, K. and Pande, A. | TLR -3 of *Tor putitora*, partial coding sequence. | KC894742 |
| 5. | Belwal, K., Kumar, A., Thakuria, D. and Pande, A. | *Barilius bendelisis* Toll-like receptor 3 (TLR3) mRNA, partial coding sequence. | JX566893.2 |
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| 7. | Chaturvedi, P., and Pande, A., | Hepcidin gene in *Tor putitora* (golden mahseer) partial nucleotide sequence. | KC693650 |
| 8. | Chaturvedi, P., Dhanik, M. and Pande, A. | Characterization and Structural Analysis of Hepcidin Like Antimicrobial Peptide From *Schizothorax richardsonii* (Gray) complete coding region | KC894741.1 |
| 9. | Goel, C., Sahoo, P.K. and Barat, A. | *Schizothorax plagiostomus* mitochondrion, complete genome | KF928796 |
| 10. | Goel, C., Sahoo, P.K., Bhat, F.A., Balkhi, M.H. and Barat, A. | *Schizothorax labiatus* mitochondrion, complete genome | KF739398 |
| 11. | Kumar, R., Barat, A. and Sahoo, P.K. | *Schistura sikmaiensis* SSR sequences | KJ545923-KJ545958 |
| 12. | Sahoo, P.K., Barat, A. and Goel, C. | *Schizothorax progastus* mitochondrion, complete genome | KF739399 |
| 13. | Sahoo, P.K., Goel, C., Bhat, F.A., Balkhi, M.H. and Barat, A. | *Schizothorax esocinus* mitochondrion, complete genome | KF600713 |

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Chandra, Suresh, Ravindra, Patiyal, R.S. and Mir, J.I., 2014. Study on mid hill tree Mahal or Mol (*Pyrus pashia* Buch & Ham.) leave extract as external disinfectant during hatchery incubation of rainbow trout eggs.16 IASFC (22-23 Feb, 2014)on Nano-biotechnology approaches for sustainable agriculture and rural development organised by Bioved Research Society, Allahabd. Page no.31, OR Abstract No.6.

Chandra, Suresh, Radheyshyam, Saha, G.S., Safui, Lekha, Adhikari, S., Barik, N.K., Eknath, A.E. and, De, H.K ., 2014. Fish disease surveillance and control measures in village community ponds in Khurda and Puri Districts of Odisha. 16 IASFC (22-23 Feb, 2014) on Nano-biotechnology approaches for sustainable agriculture and rural development organised by Bioved Research Society,Allahabd. Page no.32, OR Abstract No.61

# 14 - List of Project

## 14.1 Institutional Projects

| Project Code | Project title | Project Leader & Associate | Year of Start | Year of completion |
|---|---|---|---|---|
| AQ3 | Performance of chocolate mahseer *(Neolissochilus hexagonolepis)* in freshwater aquaculture system in Kumaun Himalaya | Debajit Sarma<br>M.S. Akhtar | 2008 | 2013 |
| AQ8 | Development of molecular marker for identification of usable traits in important Coldwater fishers | A. Barat<br>P.K. Sahoo<br>R.S. Patiyal<br>S. Ali | 2011 | 2014 |
| AQ9 | Performance of indigenous minor carps *L.dero and L.dyocheilus* as candidate species for hill aquaculture | N.N. Pandey<br>R.S. Haldar<br>Prem Kumar<br>R.S. Patiyal<br>S. Ali | 2011 | 2015 |
| AQ10 | Evaluation of seed rearing techniques of Common carp and golden mahseer stock enhancement in semi temperate himalayan lakes using floating cages | M.S. Akhtar<br>S.K. Mallik<br>N.N Pandey<br>Debajit Sarma<br>R.S. Haldar<br>Santosh Kumar | 2011 | 2015 |
| AQ11 | Study on viral diseases in trout producing states of India | Amit Pande<br>R.S. Haldar | 2011 | 2014 |
| AQ12 | Seasonal incidences of parasitic fungal and non-infectious diseases of Coldwater fishes and evaluation of herbal extracts for their Control | Suresh Chandra<br>Amit Pande<br>S.K. Mallik | 2011 | 2013 |
| AQ13 | Potential bacterial pathogens in rainbow trout farms from northern India and maintenance of bacterial agents | Neetu Shahi<br>S.K. Mallik<br>Suresh Chandrsa | 2011 | 2016 |
| AQ14 | Performance evaluation of improved strain of Common carp champa-1 & champa-2 at different thermal regimes | S.K. Srivastava<br>Suresh Chandra<br>R.S. Patiyal<br>S.K. Gupta<br>Debajit Sarma | 2011 | 2014 |
| CF3 | Ornamental fish resources in Coldwater region of India :Investigation and Documentation | S.K. Gupta<br>Debajit Sarma<br>S.K. Srivastava | 2011 | 2014 |
| CF4 | Study on selection of suitable sites for aquaculture in selected Coldwater area using GIS tools | Prem Kumar<br>R.S. Haldar<br>Amit Kumar Saxena | 2011 | 2014 |
| CF5 | Development of database and evaluation of culture and breeding status of rainbow trout (*onchorhynchus mykiss*) in India | S. Ali Prem Kumar<br>P.K. Sahoo<br>R.S. Patiyal | 2011 | 2014 |

## 14.2 Inter-institutional Outreach Activities (Fisheries Division-ICAR)

| Project Code | Project title | Project Leader & Associate | Year of Start | Year of completion |
|---|---|---|---|---|
| NP1 | An outreach activity: Development of larval feed of L. dyocheilus for better growth, survival and quality seed production | N.N. Pandey<br>M S Akhtar | 2014 | 2017 |
| NP3 | An outreach activity: Nutrient profiling and evaluation of fish as a dietary component | Debajit Sarma<br>N.N. Pandey<br>Neetu Shahi<br>M.S. Akhtar | 2013 | 2017 |

## 14.3 National Surveillance Project

| Project Code | Project title | Project Leader & Associate | Year of Start | Year of completion |
|---|---|---|---|---|
| NP1 | An outreach activity: Development of larval feed of L. dyocheilus for better growth, survival and quality seed production | N.N. Pandey<br>M S Akhtar | 2014 | 2017 |
| NP3 | An outreach activity: Nutrient profiling and evaluation of fish as a dietary component | Debajit Sarma<br>N.N. Pandey<br>Neetu Shahi<br>M.S. Akhtar | 2013 | 2017 |

## 14.4 Externally Funded Projects

| Project Code | Project title | Project Leader & Associate | Year of Start | Year of completion |
|---|---|---|---|---|
| NAIP (Comp-3) | Enhancement of livelihood security through sustainable farming systems and related farm enterprises in North-West Himalaya | Prem Kumar | 2009 | 2013 |
| DBT | Molecular characterization and development of a diagnostic test for the identification of filterable agent isolated from diseased rainbow trout | Amit Pande<br>N.N. Pandey | 2011 | 2013 |
| DBT | Economic development of SC and ST Community of midhills region of pithoragarh district through aquaculture interventions. | R.S. Patiyal<br>P.K. Sahoo | 2012 | 2015 |
| DBT | 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. (DBT Twin program with NE) | Debajit Sarma<br>Neetu Shahi<br>S.K. Mallik | 2012 | 2015 |
| DBT | Development and characterization of microsatellite markers and assessment of genetic diversity of *Schistura sikmaiensis* from North-east India (DBT Twin program with NE) | A. Barat<br>P.K. Sahoo | 2012 | 2015 |
| DBT | Transcriptome profiling of immune responsive genes in Golden mahseer (*Tor putitora*) | A. Barat<br>P.K. Sahoo | 2013 | 2016 |
| AICRP | Enhancement of carp fish production by using polytanks in mid hills under APA programme in collaboration with VPKAS, Almora | N.N. Pandey<br>Prem Kumar | 2010 | 2013 |

# 15 - Participation in Conference/Symposia/Seminars/ Workshop/Training/Meetings and others

## 15.1 Abroad

- Debajit Sarma attended the 10th AFAF, CAA4 2013 at Yeosu, Korea from April 30-May 04 2013 organized by Asian Fisheries Society.
- Neetu Shahi attended and presented the research work at Aquaculture 2013 conference at Las Palmas, Gran Canaria, Spain from 2nd to 7th November 2013, organized by Elsevier.
- S.K. Gupta attended a three months International training programme at Ghent University, Belgium on Plant based Nutraceutical in feed of aquatic organism from December 19th 2013 to March 3rd 2014.

## 15.2 India

### Conference/symposia/seminars/workshop

- A.Barat, N.N.Pandey and R.S Patiyal attended International symposium on Green Fisheries: towards Green technologies in fisheries' organised by CIFT, Cochin and Society of fishery technologists and presented a paper during 21-23 May, 2013.
- A.Barat participated in the Directors' Conference at Delhi from July 15-17, 2013.
- Amit Pande and S chandra participated in the Launching of the workshop of "National Surveillance Programme on Aquatic Animal Diseases" held at NBFGR, Lucknow, w.e.f. May 27-28, 2013.
- N.N. Pandey attended consultation workshop on "Self sufficient and sustainable aquaculture in NE region, organised by CIFA at Agartala on 5th Feb, 2014
- Prem Kumar and M. S. Akhtar attended the workshop on 'Development of digital knowledge platform for fisheries' organized by ICRISAT (Hyderabad) at CMFRI, Kochi during 29 – 30 April, 2013.
- A. K. Singh and Prem Kumar participated in National Seminar on Climate Reliance and Sustainable livelihood in hills during 10-11.3.2014 at NASC, Delhi organized by VPKAS, Almora.
- Suresh Chandra, R. S. Patiyal and S.K. Gupta participated in the National Hindi Seminar on "*Parvative Chetron Mein Jaliejeev Palan Vividhikaran* during Sept., 23rd – 24th, 2013 organized by DCFR at Bhimtal.
- Suresh Chandra, N.N.Pandey, and R.S.Halder participated in National Workshop on Appraisal & development of fisheries in Himachal Pradesh during July, 23rd – 24th, 2013 organized by Dept. of Fisheries, Himachal Pradesh at Bilaspur.

## 15.3 Training/Meetings and Others

- A. Barat associated with Secretary DARE & Director General, ICAR New Delhi at Leh from September 13-16, 2013.
- A.Barat attended DBT Task Force Meeting at Delhi on 28.05.2013
- A.Barat attended Directors' conference at Baramati, Pune during January 19-20, 2014.
- A.Barat attended Scientists-Farmers Interaction meet at KVK, VPKAS Kafaligair (Bageshwar) under the chairmanship of the DG ICAR during 31.05.2013 to 01.06.2013

- A.Barat attended the meeting at Sunderban, Bali, under the chairmanship of Secretary DARE & Director General, ICAR on October 2, 2013.
- A.Barat attended the meeting for National mission on Himalayan ecosystem chaired by DDG, NRM at NRM division KAB-II, ICAR, New Delhi on February 28, 2014.
- A.Barat attended the meeting of all the ICAR Institutes located in Uttarakhand region in connection with rehabilitation and mitigation measures in the State as per instructions of the Secretary DARE & DG ICAR at VPKAS, Almora on June 21, 2013.
- A.Barat attended the meeting with chairman of QRT and Deputy Director General (Fy.) at SMD on July 25, 2013.
- A.Barat attended the meeting with Department of Fisheries, West Bengal under the chairmanship of Secretary DARE & Director General, ICAR, New Delhi at Kolkata on November 23, 2013.
- A.Barat participated in the meeting convened by the Principal Secretary (Fisheries), Government of Himachal Pradesh during June 5-8, 2013.
- A.Barat participated in the EFC/SFC meeting at ICAR Headquarter New Delhi on November 13, 2013.
- Amit Pande participated in the Brain storming session on "Prioritization of Research Areas on Nano-bio information Technology" held at GBPant University AG&Tech, Pantnagar from July 12-13, 2013.
- Debajit Sarma and M. S Akhtar participated in Meen Mahotsav, 2013 organized by Department of Fisheries, Govt. of Arunachal Pradesh at Itanagar during 21-22nd November.
- M. S. Akhtar participated in the ICAR sponsored CAFT training programme on "Development and nano-sizing of biotechnological products for fisheries and aquaculture" at Central Institute of Fisheries Education, Mumbai during 5-25th February, 2014.
- N.N.Pandey attended Uttarakhand state level joint meeting for Ag. Development, organised by CSWCRTI, Dehradun and performed a presentation on 13th May, 2013.
- Neetu Shahi attended the DBT, task force meeting at New Delhi on 11th November 2013.
- P.K. Sahoo attended the Expert Consultation meeting on Resilient Aquaculture – Vision 2050 at CIFA and participated in the discussion on September 6, 2013.
- Prem Kumar and M. S. Akhtar participated in the 2nd meeting to finalize DCFR's 12th Plan EFC document along with CIFR's EFC Memo during 23-25 July, 2013 at CIFRI, Barrackpore, Kolkata.
- R.S.Patiyal attended the DBT, task force meeting at New Delhi on 8th October 2013.
- R.S.Patiyal attended the meeting on "Contingent Plan for relief " with CDO Pithoragarh On 22 June 2013

## 15.4 Workshop/Training /Meeting/Demonstration Organized

- Amit Pande and R. S. Haldar organized a "Farmers Meet" in the village of Sirikhola on 18th May 2013 to promote rainbow trout farming under tribal sub plan.
- Amit Pande R. S. Haldar organized a "Farmers Meet" in the village of Upper Sindbong (Kalimpong-1 Block, Darjeeling) on 17th May 2013 to motivate the Jhora fish farmers for promoting Jhora fishery under tribal sub plan.
- D. Sarma and S.K.Gupta organized a training program on "Coldwater Fish Farming in Meghalaya: New Approaches" organized on 24-25th October, 2013 at ICAR Research Complex for NEH Region, Barapani in collaboration with ICAR Research Complex, Barapani and Department of Fisheries, Govt. of Meghalaya.
- Front line demonstration on integrated fish farming was conducted at Village Balkheda, Dist. Udhamsingh nagar, on 17th October, 2013 by S.K. Srivastava, S.Chandra

and S.K.Gupta.

- Prem kumar organized National workshop in Official language *"Parvative Chetron Mein Jaliejeev Palan Vividhikaran* during Sept., 2$^{3rd}$ – 2$^{4th}$, 2013 organized by DCFR at Bhimtal.
- S K Srivastava organized Field day at Haflong in Dima Hasao district of Assam on January 14$^{th}$, 2014
- S. K. Srivastava organized awareness camp at Kamrup district Assam on January 22,2014
- S.Chandra and S.K.Gupta organized a field day on 11$^{th}$ Nov. 2013 at Village Katharh, Champawat to impart the technical know how of scientific methods of carp culture in hilly region.
- S.K. Srivastava, S.Chandra and S.K.Gupta organized farmers field school at village Bheti, in Lohaghat on 10$^{th}$ October, 2013.
- Suresh Chandra worked as Co-Chairman of a Technical Session-on carp aquaculture-status scope and development during the National Workshop on "Appraisal and Development of Fisheries in Himachal Pradesh "at Bachat Bhawan, Bilaspur, HP on 24$^{th}$ July, 2013.
- Suresh Chandra demonstrated Fish disease investigation and fish health management methods to the trainnes from Meghalaya on 14$^{th}$June,2013 at DCFR Field Centre, Chamapawat.
- Suresh Chandra organized demonstration programme on coldwater parasitic disease diagnosis methods to the participants of Meghalaya on 14$^{th}$June,2013 at DCFR Field Centre, Chamapawat.
- Suresh chandra worked as as Co-coordinator of the Training Programme on "Hands on Training on Laboratory Procedure, Diagnosis and Control of Coldwater Fish Diseases" organized by DCFR,Bhimtal during 28$^{th}$ Feb-06$^{th}$ March,2014 under the NEH activity.
- A meeting of farmers interest group from village Katharh, Bheti, Toli, and Kharkbagar was organized at DCFR field centre Champawat on 5$^{th}$ October, 2013 by S.K. Srivastava, S.Chandra and S.K.gupta
- R. S. Patiyal and Prem kumar organized a "Farmers Meet" in the village Gothi on dated 23.8.13 and distributed fish seed and feed to farmers.
- Front line demonstration on carp culture in poly lined pond was given by R. S. Patiyal at village Pangu of Distt. Pithoragarh in mid hill region on dated 1.9.13 .
- R. S. Patiyal and Prem kumar organized awareness camp at Khateema village for the promotion of integrated fish farming On 8.1.14 .
- Field day was orgonised at Lalkunwa Bindukhata on 10.12. By R. S. Patiyal
- R. S. Patiyal organized a "Farmers Meet" in the village of Thal , Distt Pithoragarh on 4th Feb 2014 to promote integrated fish farming in midhill region under tribal sub plan.
- R. S. Patiyal organized seed distribution programme on 13.4.13 in village Salmatta, Lamkhena and Karghata Khateema
- Scientist- Farmers interaction meet on health monitoring in trout raceways organized by Dr S.Chandra at village Katarh, Champawat on 08. 01. 2014.
- Dr S.Chandra and Dr R.S.Patiyal organised mobile advisory Service on feeding and fish tank management and Scientist farmers interaction meet organized at village Sauvra, Khatima, U.S. Nagar on 28.02.2014.
- Dr S. Chandra organised mobile advisory Service on management measures for minimizing cold stress in fish tanks given to fish farmers of village Toli, Champawat on 9$^{th}$ January, 2014.
- Dr S.Chandra organised Farmers Field School at village Bheti, Lohaghat on fish farming for livelihood development on 26.02.2014.
- A success story on–Integrated fish farming in mid hill was monitored and demonstrated by S. K. Sriwastava, S. Chandra and S. K. Gupta.

## 15.5 Students Guided

- Kaustav Bhagawati from CIFE Mumbai completed his master thesis on the topic of "Effect of zinc on dietary growth and survival of golden mahseer" under the co-supervision of Dr. D. Sarma
- Miss Geetanjali Bhaisoara from Kumaun University completed her M.Sc. thesis on the topic entitled "Histopathological and scanning electron microscopic studies of *Barilius bendelisis* infected with fungus" under the supervision of Dr. D. Sarma
- Mr. Ravindra Kumar of Kumoun University, Bhimtal completed his dissertation thesis on the topic "Biochemical characterization of bacterial flora associated with fertilized eggs in Rainbow Trout, *Oncorhynchus mykiss* during hatchery incubation at Champawat, Uttarakhand and efficacy evaluation of a herbal disinfectant for their control" under the supervision of Suresh Chandra, and Neetu Shahi.
- Mr. Amir Bashir from Department of Zoology and Biotechnology, Garhwal University (A Central University), Srinagar, Garhwal Uttarakhand is pursuing Ph.D. under the co-supervision of R. S. Patiyal on the topic of Molecular Characterization of Fish Species of Selected Families
- Mr. Chirag Munjal on the topic "Histopathological and ultra structural studies of rainbow trout infected with fungal disease" under the supervision of Dr. D. Sarma
- Ms. Monika Gupta from CIFE Mumbai is pursuing Ph.D. under the co-supervision of N.N. pandey on the topic of "Study on induced breeding and seed production of indigenous carp, *L. dyocheilus* ( McClelland) in captivity under coldwater condition".
- Ms. Neha Saxena from CIFE Mumbai is pursuing Ph.D. under the co-supervision of R. S. Patiyal on the topic of Gonadal Development and Captive Breeding of Hill Stream Fish *Barilius Bendelisis* (Hamilton, 1807)
- Puspita Das from Department of Zoology, Kumaun University, Nainital Completed her thesis on "Comparative studies of nutrient quality on Mahseer and Trout in Eastern and Western Himalayan region" under the supervision of Dr. D. sarma

## 15.6 Technical Lectures/Talks

- Ashoktaru Barat, delivered a lecture on "Mitochondrial DNA markers" at Department of Zoology, Guwahati University, Assam on 21st November, 2013.
- Debajit sarma delivered lecture on "Development of coldwater fish farming in Arunachal Pradesh" during Arunachal Meen Mahotsav, 2013 organized by Department of Fisheries, Govt. of Arunachal Pradesh at Itanagar during 21-22 November, 2013.
- M. S. Akhtar delivered a lecture on 'Coldwater fish nutrition and feed formulation' to the officers of State Fisheries Department, Govt. of Meghalaya under the training programme on 'Culture and breeding of important coldwater fishes' during 10-16 June, 2013 organized by at DCFR, Bhimtal.
- M. S. Akhtar delivered a lecture on 'Nutrition and fish health' to the participants under the training programme on 'Hands on training on laboratory procedures, diagnosis and control of coldwater fish diseases, 28 Feb. to 6 March, 2014, organized at DCFR, Bhimtal.
- M. S. Akhtar delivered a talk on 'Nutrition and feeding of Golden mahseer' to the officers of State Fisheries Department, Govt. of Himachal Pradesh under the training programme on 'Seed production and hatchery management of mahseer' during 1-6 July, 2013 organized by DCFR at Bhimtal.
- N. N. Pandey delivered a lecture on "Coldwater fish farming' in farmers training programme organised by KVK, Kafligarh on 23 Jan. 2014.
- N. N. Pandey delivered a lecture on "Culture and breeding of trout" in training

programme on "Culture, breeding and value added products of trout" organised by DCFR, Bhimtal during11-13 Dec, 2013.

- N.N.Pandey delivered a lecture in training programme on "Culture and breeding of important coldwater fishes' organised by DCFR 11th June, 2013.
- N.N.Pandey delivered a lecture on coldwater fish farming in training programme for Fisheries inspectors organised by College of Fisheries, Pantnagar 14th June, 2013
- N.N.Pandey delivered a lecture on Fish fungal diseases in training programme on "Hands on training on laboratory procedure, diagnosis & control of coldwater fish disease" organized by DCFR, Bhimtal on 6th March, 2014.
- Neetu Shahi delivered a lecture on 'Coldwater fish disease' to the officers of State Fisheries Department, Govt. of Meghalaya under the training programme on 'Culture and breeding of important coldwater fishes' during 10-16 June, 2013 organized by at DCFR, Bhimtal.
- Neetu Shahi delivered a lecture on 'Molecular identification of fish pathogenic bacteria' to the participants under the training programme on 'Hands on training on laboratory procedures, diagnosis and control of coldwater fish diseases, 28 February, 2014 to 6 March, 2014, organized at DCFR, Bhimtal.
- Neetu Shahi delivered a lecture on "Algal bloom management in aquaculture pond" in training programme on "Culture and breeding of important coldwater fishes' organised by DCFR 11th June, 2013
- Prem Kumar delivered an invited talk on 'Coldwater fisheries resource assessment and management' in National workshop in Official language "Parvatiya Chetron Mai Jaljeev Palan Vividhikaran" Organized by Directorate of Coldwater Fisheries Research, Bhimtal during 23-24 September 2013.
- Prem kumar delivered an invited talk on "Enhancement of Livelihood Security through aquaculture in polytanks in mid hills". During Seminar on Climate Reliance and Sustainable livelihood in hills during 10-11.3.2014 at NASC, Delhi organized by VPKAS, Almora.
- R. S. Patiyal, delivered a lecture on "*Himalay Shetro mai Sajawatee Machliyo ke Palan se Jeewika Suraksha kee Sambhawnayei* during National seminar on "Parvatiya Chetron Mai Jaljeev Palan Vividhikaran" Organized at DCFR, Bhimtal from 23-24 September 2013.
- R.S.Patiyal delivered a lecture on Aquculture practices in Tarai-Bhabar region in the occasion of "Matsyapalak Divas" organised in Tharootisaur village Sitarganj,U.S.Nagar on 9.7.13 to 10.7.13 .
- R.S.Patiyal, delivered a lecture *on Mahseer culture and Conservation* during NEH Training program on "Culture and Breeding of Important Coldwater Fishes" on 12.6.13 for NEH officials at DCFR, Bhimtal
- S. Chandra delivered a lecture on common parasitic diseases of fish in the training programme on Culture and breeding of important coldwater fishes on 13-14th June, 2013.
- S.K. Gupta delivered an invited talk on '*rang birangi machhiliyan/Sajawati machhaliyan*" in National workshop in Official language "Parvatiya Chetron Mai Jaljeev Palan Vividhikaran" Organized by Directorate of Coldwater Fisheries Research, during 23-24 September 2013.
- S.K. Gupta delivered a lecture on "Trout Culture breeding and Hatchery Management" in training program on "Coldwater Fish Farming in Meghalaya: New Approaches" organized on 24-25 October, 2013 at ICAR Research Complex for NEH Region, Barapani in collaboration with ICAR Research Complex, Barapani and Department of Fisheries, Govt. of Meghalaya.
- S.K. Gupta delivered a lecture on "Trout farming" in training program on "Coldwater

Fish Farming in Meghalaya: New Approaches" organized on 24-25 October, 2013 at ICAR Research Complex for NEH Region, Barapani in collaboration with ICAR Research Complex, Barapani and Department of Fisheries, Govt. of Meghalaya.

- S.K. Gupta delivered a lecture on "Ornamental fish culture" in the training programme organized by GRAS (General rural advancement society) on 13th September 2013 for the fish farmers of BAPRU cluster at patan , Lohaghat.
- Sumanta K Mallik delivered a lecture on 'Biochemical identification of fish pathogenic bacteria' to the participants under the training programme on 'Hands on training on laboratory procedures, diagnosis and control of coldwater fish diseases, 28 February, 2014 to 6 March, 2014, organized at DCFR, Bhimtal.
- R.S.Patiyal given talk on technical know-how about Hill Aquaculture Practices, Seed production of carp and ornamental fishes to hundred farmer in the year.

## 15.7 Exhibition

- D. Sarma participated in exhibition in Meen mahotsav at Itanagar, Arunachal Pradesh during 21-22th November, 2013.
- DCFR, participated in exhibition in consultation workshop on self sufficient and sustainable aquaculture in NE region, organised by CIFA at Agartala on 5th Feb, 2014. (N. N. Pandey)
- N. N. Pandey & Santosh kumar participated in Exhibition in "Farmers Meet" organised by KVK, Kafligarh on 1st June, 2013.
- N. N. Pandey & Santosh Kumar participated in exhibition in Kisan mela, organised by IARI, New Delhi during 26-28th Feb. 2013.
- N. N. Pandey & T. M. Sharma Exhibition in Kisan mela & Agro industrial exhibition organised by G.B. Pant University of Ag. & Tech. Pantnagar during 4-7th Oct, 2013.
- N. N. Pandey and Santosh Kumar participated in Exhibition during Kisan Mela organised by VPKAS, Almora on 13th April, 2013.
- N. N. Pandey, S. Ali & Santosh Kumar DCFR, participated in exhibition in farmer training organised by DCFR, Bhimtal in collaboration with KVK, Bajoura and CIFT, Cochin at Bajoura, Kullu ( H.P) during 11-13 Dec. 2013.
- N.N.Pandey, R.S.Patiyal & T.M.Sharma participated in exhibition in connection with "International symposium on Green Fisheries: towards Green technologies in fisheries" during 21-23 May, 2013 organised by CIFT, Cochin and Society of fishery technologists.
- S.K.Gupta, Santosh Kumar & T.M.Sharma participated in exhibition in Kisan Mela organised by VPKAS, Almora on 25-26th Sept., 2013.

# 16 - Staff News

## 16.1 Joining

Dr. A. K. Singh joined the Directorate of Coldwater Fisheries Research, Bhimtal as Director on 19 February 2014.

## 16.2 Promotions

Dr Amit Pande, promoted as Principal Scientist under CAS of ICAR w.e.f. 13.08.2013 .

### OBITUARY

The Director and all the Staff of DCFR express their condolence and deepest sympathies on the sad demise of **Sh. Prakash Akela, skilled supporting staff,** DCFR, Bhimtal who has left for heavenly abode on 15th February, 2014. May his soul rest in peace and Almighty God give strength to his bereaved family.

# 17 - Library & Information Services

The DCFR library and Documentation unit acts as a repository of literature and Information. It provides latest information in the field of fisheries and allied aspects.

During the 2013-14, Directorate subscribed 12 Indian Journals and procured 281 scientific books of both Indian and Foreign author. The current holding of the library includes 3191 books, 1693 volumes of foreign journals, 536 volumes of Indian Journals and 3000 other publications. The library provides services to the scientists and other staff members of the Institute apart from scholars, researchers, student and other person from local organizations interested in scientific literature on coldwater fisheries and allied subjects. The total expenditure incurred by the library during the year under report was Rs 16, 53,000.00.

## 17.1 Library Automation

The various activities of library have been computerized using TLSS software. The records of books, journals bulletins etc. were entered in the database. The bar coding of books and periodical are actively being done. The digitization work of the Institute publications has been done.

### 17.1.1 Information Services

The library also provides facility to access free online downloads of publications and articles

Exhibition of scientific books at DCFR

of many international and national journals through www.cera.jece.in. The library is further continuing its efforts in collection, processing and disseminating scientific/technical information to the potential users.

### 17.1.2 Reprography Services

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

### 17.1.3 Exchange Services

The library maintained exchange relationship with various research organizations and institute of national and international level. The annual reports, special publications and technical bulletins published from time to time have been mailed to about 250 organizations, institutions and fishery agencies.

## 17.2 Documentation Section

The documentation section of the library is entrusted with responsibility of publications of scientific bulletins, brochures, pamphlets, annual reports and newsletters. During this period, this section published annual reports 2012-13 and newsletter.

# 18 - Distinguished Visitors

- Dr. Mangala Rai, Former Secretary DARE & DG, ICAR, New Delhi
- Dr. (Mrs.) B. Meenakumari, DDG (Fisheries), ICAR, New Delhi
- Dr. K.K. Vass, Former Director, CIFRI, Barrackpore
- Dr. S.D. Singh, ADG (I.Fy.), ICAR, New Delhi
- Dr. Madan Mohan, ADG (M.Fy.), ICAR, New Delhi
- Dr. Krishna Gopal, Deputy Director, IITR, Lucknow
- Dr. J.C. HodesuModern Research Institute, Edinburgh, UK Scientists from Scotland
- Prof. R.S. Chauhan, College of Fisheries, GBPUAT, Pantnagar
- Prof. M.M. Goswami, Department of Zoology, Gauhati Unversity, Guwahati
- Dr. B.S. Bisht, Vice Chancellor, GBPUAT, Pantnagar
- Prof. I.J. Singh, Dean, College of Fisheries, GBPUAT, Pantnagar
- Dr. Asha Dhawan, Dean, College of Fisheries, GADVASU, Ludhiana (Punjab)
- Dr. Kanta Das Mahapatra, Principal Scientist, CIFA, Bhubaneswar
- Dr. P.K. Aggarwal,Principal Scientist & Head, VPKAS, Almora
- Dr. Piyush Punia, Pr. Scientist, NBFGR, Lucknow
- Dr. A.B. Pandey, Head, IVRI Station, Mukteshwar
- Prof. Malovika Das,College of Fisheries, GBPUAT, Pantnagar
- Dr. M. Sinha, Advisor(Fisheries), Govt. of Tripura (Agartala)
- Prof. M.H. Balkhi, Dean, College of Fisheries, SKUAS&T, Kashmir (J&K)
- Dr. P.C. Mahanta, Former Director, DCFR, Bhimtal
- Dr. B.C. Tyagi, Ex Pr. Scientist, DCFR, Bhimtal
- Dr. K.C. Bansal, Director, NBPGR (ICAR), New Delhi
- Dr. Suman Govil, Advisor, DBT, Govt. of India, New Delhi
- Dr. B. Pillai, Principal Scientist, CIFA, Bhubaneswar

International Farmers visit to the Institute

Visit of QRT Members


Some students visit to the Institute

# 19 - Important Committees

## 19.1 Member of the Research Advisory Committee

| | | |
|---|---|---|
| 1. | Dr. J.R. Dhanze, Dean, College of Fisheries,<br>Lembucherra, Agartala – 799 210, Tripura | Chairman |
| 2. | Dr.H.S. Raina, Ex-Principal Scientist,<br>Shiv Ram Enclave, Post Office – Sidhra – Sidhra,<br>Jammu – 180 019, J&K | Member |
| 3. | Shri B.A. Bhatt, Chief Project Officer,<br>Trout Fish Farming Centre, Kokernag,<br>Distt. Anantnag – 192 101, Kashmir, J&K | Member |
| 4. | Dr. Sunit K. Singh, Senior Scientist,<br>Centre for Cellular & Molecular Biology,<br>R&D Building, Ist floor, Uppal Road,<br>Hyderabad – 500 007 | Member |
| 5. | Dr. S.N. Mohanty, Ex-HOD (CIFA),<br>A4/21, Indira Gandhi Coop. Housing Society,<br>Post – Shishupal Garh, Bhubaneswar – 751 002<br>Odisha | Member |
| 6. | Shri Balbir Singh Yarki,<br>Mohalla : Jarad Ghutti Colony, P.O. Shamshi,<br>Tehsil & District Kullu – 175 126 Himachal Pradesh | Member |
| 7. | Dr. S.D. Singh, ADG(I.Fy.),<br>ICAR, New Delhi | Member |
| 8. | Dr. Amit Pande, Sr. Scientist<br>DCFR, Bhimtal | Member Secretary |

## 19.2 Member of the Quinquennial Review Team

| | | |
|---|---|---|
| 1. | Dr. Maniranjan Sinha, Raghubir Sadan,<br>District Judge's Compound, Civil Lines,<br>Gorakhpur – 273 001, U.P.<br>09436459502 | Chairman |

| | | |
|---|---|---|
| 2. | Dr.M.H. Balkhi, Dean, Faculty of Fisheries, S.K. University of Agricultural Sciences & Technology of Kashmir, Rangil (Nagabal), Ganderbal, Post Box No. 1079, G.P.O., Srinagar – 190 001, J & K 09419004020 | Member |
| 3. | Dr.B.D. Sharma Former Director, Department of Fisheries,Govt. of H.P., Village & P.O. Dangar, Tehsil – Ghumarwin, Distt. Bilaspur – 174 023, H.P. 08262991294 | Member |
| 4. | Dr.M.M. Goswami, Professor, Department of Zoology, Guwahati University, P.O. Jalukbari – 781 014, Guwahati, Assam 09435348461 | Member |
| 5. | Dr.V.R. Chitranshi, Former Pr. Scientist & ADG(I.Fy.), SMD, ICAR 09968092556 | Member |
| 6. | Dr. Prem Kumar, Sr. Scientist, Directorate of Coldwater Fisheries Research, Bhimtal | Member Secretary |

### 19.3 Member of the Institute Management Committee

| | | |
|---|---|---|
| 1. | Dr. A. Barat, Director, DCFR, Bhimtal (Till 18.02.2014) | Chairman |
| 2. | Dr. A.K. Singh, Director, DCFR, Bhimtal (W.e.f 19.02.2014) | Chairman |
| 3. | Dr. S. D. Singh, Asstt. Director General (I. Fy.), ICAR, KAB II, New Delhi | Member |
| 4. | Dr. A.B. Pandey, Head, IVRI Station Mukteshwar, Uttarakhand | Member |
| 5. | Dr. P.K. Agarwal, Principal Scientist & Head, VPKAS, Almora, Uttarakhand | Member |
| 6. | Dr. Pradeep Katiha, Principal Scientist, CIFRI, BarackporeWest Bengal | Member |
| 7. | Dr. Piyush Punia, Principal Scientist, NBFGR, Lucknow, U.P. | Member |
| 8. | Shri S.R. Chanyal, Joint Director, Department of Fisheries, Govt. of Uttarakhand, Dehradun, Uttarakhand | Member |
| 9. | Shri Farooq Nawchoo, Joint Director, Department of Fisheries, Govt. of J & K, J & K | Member |

| | | |
|---|---|---|
| 10. | Dr. Malovika Das, Professor, College of Fishery Science, GBPUAT, Pantnagar, Uttarakhand | Member |
| 11. | Shri Ashish Srivastava, Finance & Accounts Officer, IVRI, Izzatnagar, U.P. | Member |
| 12. | Shri Y.S. Dhanik, AO, DCFR | Member Secretary |

### 19.4 Members of Institute Technology Management Committee

| | | |
|---|---|---|
| 1. | Dr. A. Barat, Director, DCFR, Bhimtal (Till 18.02.2014) | Chairman |
| 2. | Dr. A.K. Singh, Director, DCFR, Bhimtal (W.e.f 19.02.2014) | Chairman |
| 3. | Dr. D. Sarma, Principal Scientist, DCFR, Bhimtal | Member |
| 4. | Dr. S.K. Srivastava, Senior Scientist, DCFR, Champawat | Member |
| 5. | Dr. S. Ali, Scientist, DCFR, Bhimtal | Member |
| 6. | Dr. P.K. Agarwal, Principal Scientist, VPKAS Almora | Member |
| 7. | Dr. Prem Kumar, Senior Scientist, DCFR, Bhimtal | Member Secretary |

### 19.5 Members of Project Monitoring & Evaluation Cell

| | | |
|---|---|---|
| 1. | Dr. (Mrs.) P.K. Sahoo, Principal Scientist, DCFR, Bhimtal | Officer In charge PME Cell |
| 2. | Dr. R.S. Haldar, Sr. Technical Officer, DCFR, Bhimtal | Member |
| 3. | Sh. Amit Kumar Joshi, Sr. Technical Officer, DCFR, Bhimtal | Member |
| 4. | Sh. Amit Kumar Saxena, Sr. Technical Assistant, DCFR, Bhimtal | Member |
| 5. | Sh. Vijay Kumar Singh, Sr. Technical Assistant, DCFR, Bhimtal | Member |
| 6. | Mrs. Susheela Tewari, PS to Director, DCFR, Bhimtal | Secretarial Assistance |

### 19.6 Members of Project Monitoring & Evaluation Committee

| | | |
|---|---|---|
| 1. | Dr. A. Barat, Director, DCFR, Bhimtal (Till 18.02.2014) | Chairman |
| 2. | Dr. A.K. Singh, Director, DCFR, Bhimtal (W.e.f 19.02.2014) | Chairman |
| 3. | Dr. D. Sarma, Principal Scientist & Incharge, Aquaculture DCFR, Bhimtal | Member |
| 4. | Dr. Amit Pande, Senior Scientist & Incharge, Fish Health DCFR, Bhimtal | Member |

| | | |
|---|---|---|
| 5. | Dr. N.N. Pandey, Senior Scientist & Incharge, Res. Assessment & Extension, DCFR Bhimtal | Member |
| 6. | Dr. S.K. Srivastava, Senior Scientist & Incharge, Exp. Field Centre, Champawat DCFR, Champawat | Member |
| 7. | Dr. Prem Kumar, Senior Scientist & Incharge, AKMU, ITMU & GIS, DCFR, Bhimtal | Member |
| 8. | Dr. (Mrs.) P.K. Sahoo, Principal Scientist, DCFR, Bhimtal | Member Secretary |

## 19.7 Institute Joint Staff Council

### 19.7.1 Official Side

| | | |
|---|---|---|
| 1. | Dr. A. Barat, Director, DCFR, Bhimtal (Till 18.02.2014) | Chairman |
| 2. | Dr. A.K. Singh, Director, DCFR, Bhimtal (W.e.f 19.02.2014) | Chairman |
| 3. | Dr. S.K. Srivastava | Member |
| 4. | Shri Y.S. Dhanik | Member |
| 5. | Shri Harish Ram | Member Secretary |
| 6. | Shri B.C. Pandey | Member |
| 7. | Smt. Khilawati Rawat | Membe |

### 19.7.2 Staff Side

| | | |
|---|---|---|
| 1. | Shri J.C. Bhandari | Member |
| 2. | Shri P.S. Bisht | CJSC Member |
| 3. | Shri Santosh Kumar | Member |
| 4. | Shri T.M. Sharma | Member Secretary |
| 5. | Shri Bhola Dutt Mouni | Member |
| 6. | Shri Sushil Kumar | Member |

## 19.8 Members of Result Framework Documentation

| | | |
|---|---|---|
| 1. | Dr. (Mrs.) P.K. Sahoo, Principal Scientist, DCFR, Bhimtal | Nodal Officer |
| 2. | Dr. S. Ali, Scientist,DCFR, Champawat | Co - Nodal Officer |
| 3. | Dr. Prem Kumar, Senior Scientist DCFR, Bhimtal | Member |

## 19.9 HYPM, PERMISNET & PIMS

| | | |
|---|---|---|
| 1. | Dr. Prem Kumar, Senior Scientist DCFR, Bhimtal | Nodal Officer, HYPM, PERMISNET & PIMS |

# 20 - Personnal

## Staff list on 31.03. 2014

### 20.1 Research Management

Dr. A. K. Singh, Director

### 20.2 Scientific

| | | |
|---|---|---|
| 1. | Dr. P. K. Sahoo, Principal Scientist | Fish & Fishery Science |
| 2 | Dr. Ashoktaru Barat, Principal Scientist | Animal/Fish Genetics & Breeding |
| 3. | Dr. Debajit Sarma, Principal Scientist | Fish & Fishery Science |
| 4. | Dr. Amit Pande, Principal Scientist | Biotechnology (Animal science) |
| 5. | Dr. Nityanand Pandey, Senior 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 | Animal/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. | Md. Shahbaz Akhtar, Scientist | Fish & Fishery Science |
| 14. | Dr. Dimpal Thakuria, Scientist | Biochemistry (Animal science/Study Leave) |
| 15. | Dr. Ananda Kumar B.S., Scientist | Veterinary Microbiology (Study Leave) |
| 16. | Dr. Sanjay Kumar Gupta, Scientist | Fish & Fishery Science |

### 20.3 Technical

| | | |
|---|---|---|
| 1. | Dr. R. S. Haldar | Sr. 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. Gopal | Technical Assistant |
| 9. | Sh. R. K. Arya | Technical Assistant |
| 10. | Sh. T. M. Sharma | Technical Assistant |
| 11. | Sh. Hansa Dutt | Technical Assistant |
| 12. | Sh. Manoj Kumar Yadav | Sr. Technician |
| 13. | Sh. Partha Das | Technician |

## 20.4 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. Hayat Singh Chauhan | LDC |
| 13. | Sh. Hansa Singh Bhandari | LDC |

## 20.5 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- |

# 21 - Appendix

## DCFR Field Centre Champawat

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

*Address :*
Scientist-in-charge
DCFR Field Centre Chhirapani, Champawat
Distt. Champawat, Uttarakhand, India, Pin- 262 523
Phone: 05965 - 230052

# हिन्दी अनुभाग

# 1 - हिन्दी सारांश

## 1.1 अनुसंधान अभिनव उपलब्धियाँ

भारतीय कृषि अनुसंधान परिषद के अर्न्तगत मत्स्य संसाधनों के विवेकपूर्ण प्रबन्धन, शीतजल जीव पालन एवं संरक्षण के लिए अनुसंधान को बढ़ावा देने हेतु वर्ष 1987 में इस संस्थान की स्थापना की गयी। शीतजलीय मत्स्य जैव विविधता एवं संसाधन, मत्स्य आनुवंशिकी, मत्स्य जीव पालन और मत्स्य स्वास्थ्य से जुड़े विविध मुददों पर शोध हेतु शीतजल मात्स्यिकी अनुसंधान निदेशालय एक अग्रणी संस्था के रूप में उभरा है। इस वर्ष निदेशालय द्वारा छः बाहय तथा ग्यारह संस्थान द्वारा पोषित विभिन्न शोध परियोजनाओं के माध्यम से कार्य चलाऐ गऐं।

### जलजीव पालन

चॉकलेट महासीर (नियोलिस्सोचिलस हैक्सागोनोलिपिज) की उत्तरजीविता एवं वृद्धि परीक्षण के लिए चॉकलेट महाशीर को एकत्र कर उनको भीमताल में स्थित तालाब में डाला गया। चॉकलेट महाशीर में वृद्धि के लिए स्पीरूलीना के साथ प्रतिपूरक आहार दिया गया। 5% स्पीरूलीना युक्त प्रतिपूरक आहार से उनमे बेहतर वृद्धि प्रदर्शन के साथ–साथ उच्च उत्तरजीविता दर देखी गयी साथ ही यह 5% स्पीरूलीना युक्त प्रतिपूरक आहार मूल्यवर्धित भी था। इस प्रकार स्पीरूलीना युक्त प्रतिपूरक आहार को नए वातावरण में नर्सरी तालाबों में चॉकलेट महाशीर के लिए एक प्रभावकारी आहार के रूप में देखा जा सकता है।

पॉलीथीन बिछे हुऐ तालाबों में चॉकलेट महासीर को पालने पर और सुनहरी महाशीर की वृद्धि से पता चला कि वे आपस में बहुत अधिक सह–सम्बन्धित थे (r=0.80)। वृद्धि पदर्शन के परिणाम यह बताते है कि सुनहरी महाशीर की तुलना में चॉकलेट महाशीर की लम्बाई, भार व एस0जी0आर0 में जीरा से अंगुलिका स्तर तक 20% बेहतर वृद्धि दर देखी गयी। लम्बाई–भार सम्बन्ध, कन्डीशन, फैक्टर, रिलेटिव कन्डिशन फैक्टर बताते हैं कि नए वातावरण में सामान्य स्तर पर चॉकलेट महासीर बेहतर स्थिति में पायी गयी। चॉकलेट महाशीर के जीरे मांसाहार सर्वभक्षी थी। आँतो में बालू एवं मिट्टी की उपस्थिति से पता चला कि यह तालाब में मध्य स्तर एवं तलहटी में रहती है। अण्डों का आकार 700–900 मिमी0 था पूंछ की लम्बाई 2.8 से 3.1μ तथा फिकनडिटि उनके शरीर के भार के 6000–8000 अण्डे/किग्रा0 थी। प्रजननकाल अप्रैल–मई एवं अगस्त–सितम्बर, उत्पादकता तथा हैचिंग की दर क्रमशः 95 एवं 8 प्रतिशत थी । निषेचित अण्डों से ऊष्मायन की अवधी 38–40 घण्टे थी।

पर्वतीय क्षेत्र में मत्स्य पालन हेतु पूर्व में किऐ गऐ अध्ययनों के अनुसार लेबियोडेरो और डायोचिलस (3 वर्ष से अधिक आयु) का प्रजनन जुलाई के तीसरे सप्ताह और अगस्त के अंतिम सप्ताह में 18–22.8 डिग्री सें0ग्रे0 पर किया गया। परिपक्वता की शुरूआत दो सप्ताह पूर्व प्राकृतिक अवस्था में (नदियों में) थी। गोनैडो सोमेटिक इन्डैक्स (GSI) अप्रैल से जुलाई तक क्रमवार रूप से बड़ा तथा मादाओं में अगस्त माह में घटी। तालाब में पाली गई मादा मछलियों में जी0एस0आई0 की सीमा 3-245 ± 0-153 ± 1-212 (प्रोपेटरी हारमोन की खुराक से पूर्व) तथा प्राकृतिक अवस्था में मादाओं में 4-136± 0-254 से 15-546-±1-104 थी। मादाओं को उनकी कोमलता बड़े एवं फूले हुए पेट के रूप में जबकि नर मछलियों को उनके पैक्टोरल पंखों के खुरदुरेपन द्वारा वर्गीकृत किया गया। अप्रैल के अंतिम सप्ताह से उनके शरीर में ये खुरदुरापन दिखायी दिया तथा सितम्बर के प्रथम सप्ताह में समाप्त हो गया। 1 जून को प्रजनन हेतु मादा मछलियों को उनके शरीर के भार के बराबर 0.2 मिली/किग्रा0 दर से ओवाप्राइम का इंजैक्शन (इन्ट्रामस्क्युलर) लगाया गया। नर मछलियों को इस प्रकार का कोई उपचार नही दिया गया। 15 जून 2013 को पुनः उन्हीं मादा मछलियों को उनके शरीर के भार के बराबर 0.2 मिली/किग्रा0 की दर से ओवाप्राइम इंजैक्शन दिया गया। 1 जुलाई 2017 को पुनः उनके शरीर के भार के बराबर 0.7 मिली/किग्रा0 की दर से ओवाप्राइम की अंतिम खुराक दी गयी साथ ही नर मछलियों को भी उनके भार के बराबर 0.2 मिली/किग्रा0 की दर से मादा मछलियों के साथ ही ओवाप्राइम दिया गया। हारमोन्स की देख–रेख के पश्चात, नर एवं मादा दोनो मछलियों को रात भर एफ0आर0पी0टैंकों जिसमें लगातार पानी बहता था में रखा गया ताकि वे उसमें अण्डे दे सकें। 22 घण्टों तक हारमोन्स संचालन के पश्चात मछलियों ने 18–22

डिग्री से0ग्रे0 के तापक्रम पर सफलतापूर्वक अण्डे दिऐ। उनके ऊष्मायमान की अवधी 20–38 घण्टा रिकार्ड की गयी। अण्डों की संख्या के सन्दर्भ में मादा मछलियों के शरीर के भार के बराबर उर्वरता का सामान्य अनुपात 123400–143600 था। निषेचित अण्डों को जल प्रवाही प्रणाली के अर्न्तगत ट्रफों एवं ट्रे में ऊष्मायमान हेतु सेंका गया।

लेबियोडायोचिलस एवं लेबियो डेरो के लार्वों का पालन दो भिन्न प्रणालियों– एफ0आर0पी0 एवं पौलिटैंको में 4 माह तक प्रयोग किऐ गऐ। पौलिटैंको में पाली गयी मछलियों की अधिकतम लम्बाई 36-4 ± 2-2 मि0मी0 प्राप्त की गयी जो कि एफ0आर0पी0 टैंको में पालित मछलियों की तुलना में ($P<0.05$) अधिक थी। इसी तरह पौलीटैंको के लार्वो का भार 0-493 ± 0-041 ग्रा0 था, जो कि प्रभावकारी रूप से सर्वाधिक ($P< 0.05$) था। पौलिथीन टैकों में पालित लार्वों की लम्बाई 846-51 ± 6-2 तथा भार में 7042 ± 26-50% की वृद्धि देखी गयी। उत्तरजीवितता दर पौलिटैंको और एफ0आर0पी0 टैंकों में क्रमशः 75 ± 2-29% एवं 72 ± 2-05 पायी गयी।

पिंजरों में सुनहरी महाशीर के बीज के पालन मे घनत्व का मूल्यांकन हेतु सुनहरी महाशीर को चार विभिन्न पिंजरों में भण्डारण किया गया संचयन घनत्व क्रमशः–60 संख्या/मी$^2$ 70 संख्या/मी$^3$, 80 संख्या/मी0$^3$ तथा 90 संख्या/मी$^3$ में जीरा से वयस्क अंगुलिका स्तर तक प्रयोग किऐ गऐ। यह प्रयोग 10 माह तक जारी रखे गए। इस प्रयोग के अंत में यह पता चला कि 90 संख्या/मी$^3$ के संचयी घनत्व में सुनहरी महाशीर के जीरों के पालन–पोषण पर वृद्धि प्रदर्शन व उत्तरजीविता का कोई प्रभाव नही पड़ा। इसलिए पुनः तैरते हुऐ केजों में सुनहरी महाशीर के बीजों को 0.91 ग्रा0 भार के जीरों को विभिन्न संचयन घनत्वों–100, 150, 200 एवं 250 संख्या/मी$^3$ में रखा गया तथा उनको दिन में एक बार प्रतिदिन 35 प्रतिशत प्रोटीन युक्त प्रतिपूरक आहार दिया गया। तापमान, क्षारियता मुक्त कार्बनडाईऑक्साइड, पी0एच0, टी0डी0एस0, फॉस्फेट, नाइट्रेट, अमोनिया, सल्फेट, घुलित ऑक्सीजन आदि जैसे मछली की वृद्धि उतरजीविता एवं पानी की गुणवत्ता वाले महत्वपूर्ण मानकों का निरन्तर निरीक्षण–परीक्षण किया गया। इनका भार 9.12, 8.95, 8.27 व 7.87 ग्रा0 था तथा संचयन घनत्व क्रमशः 100, 150, 200 एवं 250 संख्या/मी0$^3$ था। उत्तरजीविता का प्रतिशत 85.4, 85.5, 79.5 व 71.6 था।

प्रयोगों के पश्चात् सुनहरी महाशीर की अंगुलिकाओं को पिंजरों से निकालकर नौकुचियाताल झील में डालने हेतु डी0सी0एफ0आर0 के वैटलैब में में लाया गया तथा दो दिनों तक उनका अनुकूलनतः किया गया। अनुकूलनतः के पश्चात अंगुलिकाओं को ऑक्सीजन युक्त पैकेटों में रखकर दिनॉक 10 अक्टूबर, 2013 को निदेशालय द्वारा आयोजित ''महाशीर बचाओ जागरूकता अभियान एवं सीड रैंचिग कार्यक्रम'' के माध्यम से

नौकुचियाताल झील में महाशीर बीज संचय कार्यक्रम

नौकुचियाताल झील में छोड़ा गया। पिंजरों में पालित 1000 अंगुलिकाओं के साथ हैचरी में उत्पादित महाशीर के लगभग 25000 जीरों को भी झील में संचय किया गया।

उच्च वंशी प्रवेशी कॉमन कार्प, चम्पा का विभिन्न भू भागों में वृद्धि परीक्षण के लिए निदेशालय के चम्पावत स्थित मत्स्य प्रक्षेत्र में परिष्कृत हंगेरियन प्रजाति चम्पा–1 (रोप्सा स्केली) तथा चम्पा–2 (लैसोसोमोगी मिरर कार्प) का प्रजनन किया गया। पाकेट 'बी' के तालाबों से चम्पा–1 व चम्पा–2 तथा बैंकाक प्रजाति के प्रजनकों को निकालकर प्रजनन तालाबों में रखा गया तथा उनको प्रतिदिन दो बार भोजन दिया गया तथा 17.5–22 डिग्री से0ग्रे0 जल के तापक्रम पर हापा में मई माह के मध्य में प्रजनन कार्य किया गया। लगभग 3500 बीजं का उत्पादन किया गया। इनकी उत्तरजीवितता 45 प्रतिशत रिकार्ड की गयी। चम्पावत स्थित प्रयोगिक मत्स्य प्रक्षेत्र में प्रजनित कॉमन कार्प, चम्पा–1 व चम्पा–2 के बीजों को चम्पावत, ऊधमसिंह नगर तथा पिथौरागढ़ जिलों के मत्स्य पालकों को वितरित करने के साथ ही हिमाचल प्रदेश को भी दिऐ गए।

चम्पावत स्थित प्रयोगिक क्षेत्र में सजावटी मत्स्य पालन हेतु पाकेट 'बी' में (20m$^2$) के क्षेत्रफल वाले 2 पॉली टैंको का निर्माण कर उनकी तलहटी में छोटे–छोटे कंकड़–पत्थर रखे तथा चल्थी के समीप लधिया नदि से गारा गोट्यला एकत्रित करके उनको उसमें संचयित किया गया। मत्स्य नमूने एकत्रण के समय नदियों के विभिन्न स्थलों में कास्ट नेट का प्रयोग किया गया और नमूनों की लम्बाई तथा भार सम्बन्धी आँकड़े रिकार्ड किऐ गऐ। मछलियों को 15 दिनों के लिए सीमेंट के तालाबों (30मी$^2$) में अनुकूलन के लिए छोड़ दिया गया। भौतिक रासायनिक मापदण्ड यथा– तापमान–19.0 डिग्री से0ग्रे0, पी0एच0 7.3, घुलित ऑक्सीजन– 6 पी0पी0एम0, कठोरता–25 पी0पी0एम0 नाइट्रेट–10 पी0पी0एम0 तथा घुलित आयरन–0.1 पी0पी0एम0 आदि का लेखा रखा गया।

चम्पावत फार्म

कुछ गारा गोट्यला नमूनों का शव–विच्छेदन भी किया गया ताकि उनके परिपक्वन स्तर का पता लग सके। आँतों के विश्लेषण से पता चला कि अधिकांश मछलियॉ प्राकृतिक रूप से शाकाहारी थीं। इन्ट्रामस्क्युलर इंजैक्शन देकर उत्प्रेरित प्रजनन के प्रयास किऐ गऐ किन्तु मादा मदलियों के सम्बन्ध में नियमित सैमपलिंग के दौरान कोई परिपक्वता नही देखी गयी। इसके अतिरिक्त मादाओं में उत्प्रेरित परिक्वन के प्रयास प्रगति पर है।

पर्वतीय क्षेत्रों में मत्स्य पालन हेतु प्लास्टिक का उपयोग किया गया जिससे पता चलता है कि मध्य पर्वतीय क्षेत्रों में विदेशी कार्प के पालन हेतु पॉलीटैंक एक उपयुक्त संरचना है। इसके अतिरिक्त पॉलीटैंको की तलहटी में 4 इंच तक मिट्टी रखने से सभी तीनों विदेशी कार्प प्रजातियों के अच्छे वृद्धि परिणाम सामने आऐ। इन टैंको में मिट्टी होने से वह प्लवको के उत्पादन में सहायक होते हैं तालाब के किनारो पर ढालान वाली पॉलीथिन सतह पर पैरीफाइटन के जमने तथा तालाब के पानी के तापमान को गरम (2–6 डिग्री से0ग्रे0) रखने में सहायक भी होते है। तीनों प्रजातियों में ग्रास कार्प में सबसे अच्छी वृद्धि दर्ज की गयी और मत्स्य पालकों को उसे आहार खिलाने में भी काफी सरलता रही। सभी तीनों प्रजातियों की वृद्धि अवस्था यह बताती है कि मछली में वृद्धि मार्च के प्रथम सप्ताह से लेकर नवम्बर के तीसरे सप्ताह तक ही होती है ।

सीमांत धारचूला खण्ड में मत्स्यपालन हेतु यह नवीन अवधारणा थी। इस हेतु क्षेत्र के ग्रामों में मत्स्यपालन को बढ़ावा देने हेतु विभिन्न सभाऐं आयोजित की गईं। संसाधनों की उपलब्धता, भूमि की उपलब्धता और मत्स्य पालन में रूचि रखने वाले कृषकों की इच्छा के आधार पर 12 योग्य मत्स्य पालकों का चयन कर तालाबों का निर्माण कर मत्स्यपालन का कार्य आरम्भ किया गया जिनमें से 2 अनुसूचित जाति व 10 जनजाति समुदाय के थे। इसके अतिरिक्त छः ग्रामों–पांगू, हिमखोला, छलमाछिलांसो, गलाटी, बलुवाकोट तथा गोठी में मत्स्य पालन तथा इससे जुड़े लाभों के बारे में जागृत करने के उद्देश्य से एक जन–जागरण कार्यक्रम भी आयोजित किया गया।

## मत्स्य स्वास्थ्य

भारत के ट्राउट उत्पादित राज्यों में विषाणु रोगों पर अध्ययन विस्तार से अध्ययन किया गया। नैदानिक पी0सी0आर0 में गैर विशिष्ट प्रवर्धन विस्तारण का पता लगाने के लिए आई.पी.एन.वी.,आई.एच.एन.वी.,वी.एच.एस.वी. का निदान करने हेतु एक सकारात्मक नियंत्रण की अत्यन्त आवश्यकता थी जिसके लिए इस कार्य को लक्षित किया गया। जिन नमूनों का परीक्षण किया गया वे मोनोक्नोनल एण्टीबाडी द्वारा जहां एक ओर डौट इलीसा में धनात्मक पाए गए वहीं दूसरी ओर इनमें विषाणु की उपस्थिति नही पायी गयी जिससे कि आर.टी. पी.सी.आर. के परिणामें की पुष्टि नही हो पायी। इस समस्या एवं आई.एच.एन.वी. व वी.एच.एस.वी. के ग्लाइको प्रोटीन जीनों को संश्लेषित किया गया। और संश्लेषित वी.पी. 2 जीन का न्यूक्लिओटाइडर का क्रमाकमण द्वारा पुष्टि की गयी। आई.वी.एन. की पुष्टि के लिए एक नेस्टेड पी.सी.आर. भी मानकीकृत किया गया।

चम्पावत फार्म में परजीवी फफूँद तथा असंक्रमित बीमारियों का अध्ययन किया गया। रेन्बो ट्राउट के नमूनों में ऊपरी तथा निचले जबडों, में लाल रंग के छाले, बाहर निकली हुयी ऑखे, उदर के निचले हिस्सों में गहरे रंग के छाले तथा मुँह में कैविटी (माउटा कैविटी) आदि रोगों का अवलोकन किया गया साथ ही गलफड़ों में छाले और विकसित अवस्था में गिल–कार्टिलेज भी पाऐ गये। आर0एम0डी0 संक्रमित मछलियों के आन्तरिक भागों में अत्यधिक रक्तस्त्राव एवं उदर गुहा में पीले रंग का न्यूकोआड द्रव्य का जमाव भी देखा गया। रेसवे (तालाबों) में पाली गयी रेन्बो ट्राउट मछलियाँ अंधी और अधिकतर संक्रंमित थी। बाद के महिनों में जल के तापक्रम में कमी होने के साथ–साथ एंटीबायोटिक के द्वारा इन संक्रमणों को कम किया गया। संक्रमित मछलियों की आँखों के ऊपर पूर्ण रूप से सफेद कार्टिलेज का जमाव पाया गया। मृत्यु दर 2.30–14.73 प्रतिशत के बीच थी। आँख में संक्रमण वाली मछलियों की संख्या में सर्दियों के महिनों में तेजी से गिरावट रिकार्ड दर्ज की गयी। चम्पावत प्रक्षेत्र में नर्सरी तालाबों में पाले गए 3 वर्ष से अधिक के वयस्क ट्राउट मछलियों की आँखों में कोई संक्रमण नही पाया गया।

चम्पावत प्रक्षेत्र में अन्दर रखे गए टैंकों में पाले गए पोस्ट लार्वों का अध्ययन किया गया। 13.8–16.0 डिग्री सें0ग्रे0 वाले जल के तापक्रम में नवोद्भिद ट्राउट लार्वा अत्यधिक थकान के कारण व्यापक पैमाने पर मरे हुऐ (15.20 प्रतिशत) पाएं गऐ साथ उनकी त्वचा में धब्बे, गिलों में परिगलन, पूंछ के अंत में कालापन व त्वचा में बैक्ट्रिया एवं फँफूद आदि की उपस्थिति देखी गयी, साथ ही कुछ पोस्ट लार्वो में विकृति भी देखी गयी।

ट्राउट मछली की आंख में बिमारी

रेसवे तालाबों में मत्स्य सम्वर्द्धन में जल की गुणवत्ता के मानकों में गिरावट के कारण बड़े पैमाने पर गर्मी के महिनों में मृतता पायी गयी। मौसमी स्वास्थ्य समस्याओं के अलावा अप्रैल तथा जून के महीनों में मर्त्यता पायी गयी। मौसमी स्वास्थ्य समस्याओं के आलावा अप्रैल तथा जून के महीनों में लम्बे समय तक 21 डिग्री से0ग्रे0 तक उच्च तापक्रम के साथ–साथ जल की कम आपूर्ति के कारण भी वयस्क तथा किशोर मछलियों में मृत्यु दर अधिक रिकार्ड की गयी। सर्दियों के महिनों (दिसम्बर–जनवरी) में बेरिलियस तथा गारा प्रजातियों में मृतता पायी गयी। इस अवधी में नर्सरी रेसवेज में जल का तापक्रम 6.0 डिग्री से0ग्रे0 से कम पाया गया। मरी हुयी गारा मछलियों के शरीर के ऊपर सौरोलिग्निआ तथा आँखो पर लालिमा देखी गयी। संक्रमित बेरिलियस प्रजातियों की किडनी, लिवर, गिल्फ आदि से बैक्टीरिया के नमूनों को एकत्र कर उन पर दवा की सक्रियता का परिक्षण किया गया पेनिसिलीन तथा वेन्कोमाइसीन प्रभावी नही थे जबकी सीफैलोथीन, को ट्राइमोक्साजोल, क्लीन्डामाइसिन, ओलोक्सासिन तथा जेन्टामाइसिन दवाओं की सक्रियता प्रभावी थी।

विषाणु संक्रमण के आंकलन के लिए पूर्ण रूप से स्वस्थ्य 34 रेन्बोट्राउट (ओनकोरिकस माइकिस) मछलियों के पेशी, गिल, यकृत, आँत आँख, स्पलीन, गौल ब्लैडर (पित्ताशय) तथा किडनी आदि के नमूने एकत्र किऐ गऐ साथ ही कुल प्लेटलेट्स की संख्याओं का आंकलन एवं नमूनों की जैव–रासायनिक तथा आणविक पहचान भी की गयी। टैंको में संग्रहित जल तथा रेअरिंग टैंको में इनकी प्लेटलेट्स संख्या क्रमशः $8.8x10^{2}$-$6.5x10^{3}$ तथा $9.5x10^{2}$-$7.4x10^{4}$ थी। मत्स्य नमूनों में कुल 89 विषाणुओं को पृथक किया गया। जैव रासायनिक अध्ययन से पता चला कि 90 प्रतिशत विषाणुओं G-ve, गतिशील, रौड, उत्तेजक, आक्सीडेज, कैटालेज तथा धनात्मक जिलेटिन थे। प्रोटेज, लाइपेज, एमिलेज, जिलेटिनेज, कैसिनेज तथा D Nas एंजाइमें के विश्लेषण तथा भेड़ के रक्त अगार तथा मछली के रक्त अगार पर हीमोलेटिक परीक्षण करने पर पता चला कि 65 प्रतिशत बैक्टीरिया की प्रवृत्ति रोगजनक होती है। आणविक वर्गीकरण तथा जैव– रासायनिक विश्लेषण के द्वारा रोगजनक बैक्टीरिया के नौ विभिन्न वंशों– ऐइरोमोनाज, सीडोमोनाज, इस्चीरिया कोली, क्लीब्सीला, येरसीनिया, एन्टीरोबैक्टर, हफीना, माइक्रोकोकस तथा रहनील्ला का पता लगा। इसी प्रकार गैर रोगजनकों की भी पहचान की गयी जो कि ब्रोवीबैसिलस, एसिडोवोरैक्स (कृषि के रूप में महत्वपूर्ण बैक्टीरिया), बैसिलस एवं सीवैन्नीला के वंशों से सम्बन्धित थे।

अनुवांशिकीय विष के अध्ययन के लिए मेघालय की नोलंग विब्रा, सिमसांग नदी की विषाक्तता का मूल्यांकन किया गया। एकत्रित फिश–फौना पूर्ण रूप से गैर मौजूद थी। मछलियों के गिलों व लिवर में सबसे अधिक विषाक्त अम्लीय जल पाया गया।

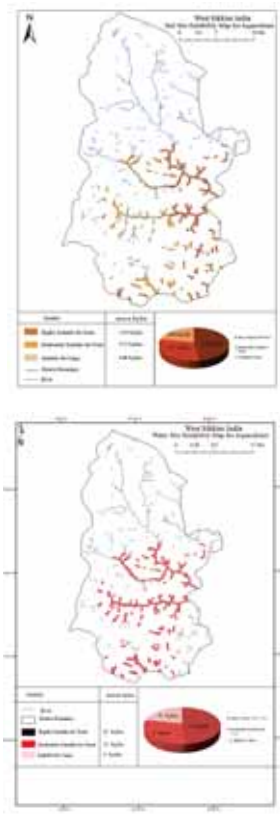
नेशनल सर्विलांस प्रोग्राम फॉर एक्वेटिक एनिमल डिजिज के अर्न्तगत 26. 28 मार्च, 2014 को कुल्लू तथा मण्डी जिलों में प्रथम सर्वेक्षण किया गया। यहॉ 10 फार्मों का भ्रमण कर उपलब्ध नमूनों में परिलक्षित रोगों पर ऑकड़े एकत्र किऐ गऐ तथा उनका विश्लेषण किया गया।

## संसाधन

भू स्थैतिक सूचना एवं दूर संवेदी तकनिकियों का प्रयोग जलजीव पालन पालन हेतु स्थलों के चुनाव की योजना एवं विकास के लिए किया जा सकता है। इस तकनीकी के द्वारा सामान्य प्रश्नों जैसे– स्थान यथा–स्थिति, अवस्था– प्रचलन परम्परा तथा मॉडलिंग आदि को हल किया जा सकता है। इन प्रश्नो के उत्तरों से प्रामाणिक निर्णय लेने में सहायता मिलती है जो कि वास्तविकताओं पर आधारित होते है। मानचित्र एक लम्बी अवधी तक योजनाकारों को मत्स्य पालन के विकास की रूप–रेखा प्रदान कर सकते है। इस पद्यति से सर्वप्रथम पश्चिमी सिक्किम जिले को अध्ययन हेतु चुना गया। अध्ययन से पता चला कि पश्चिमी सिक्किम का क्षेत्रफल 1157 वर्ग किमी0 है जिसमें 683 वर्ग किमी0 वन क्षेत्र, ग्लेशियर तथा बर्फिले क्षेत्र एवं 196 वर्ग किमी0 ऊसर क्षेत्र है। कृषि योग्य भूमि 165 वर्ग किमी0 है।

भारत में रेन्बो ट्राउट के प्रजनन एवं पालन के स्तर के यथास्थिति, का मूल्यांकन तथा डाटाबेस का विकास हेतु भारत के निजि तथा सहकारी दोनों शीतजल क्षेत्रों (अरूणांचल, हि0प्र0 जम्मू कश्मीर, सिक्किम,तमिलनाडु एवं उत्तराखण्ड) में रेन्बो ट्राउट के पालन–पोषण, प्रजनन तथा उत्पादन के स्तर से सम्बन्धित आधारभूत सूचनाओं का संकलन किया गया। हिमालयी तथा गैर हिमालयी क्षेत्रों में ब्राउन ट्राउट एवं रेन्बोट्राउट का स्वतंत्र रूप से प्रत्यारोपण किया गया। जम्मू कश्मीर के तीन मुख्य प्रांत हैं। यथा– जम्मू–कश्मीर एवं लेह व लद्दाख, एक वर्ष में जम्मू एवं कश्मीर में ट्राउट उत्पादन काफी बढ़ गया है तथा वर्तमान में देश में यह राज्य ट्राउट उत्पादन में बहुत

बड़ा योगदान दे रहा है, 2002–03 में ट्राउट उत्पादन 90 टन से बढ़ कर 2012–13 में 260 टन हो गया। मात्स्यिकी विभाग ने ट्राउट की खेती और उसके विकास के लिए लगातार प्रयास किऐ हैं। राज्य में उपयुक्त स्थानों पर ट्राउट की खेती आरम्भ करने के लिए राज्य मत्स्य विभाग ने निजि मत्स्य पालकों को प्रोत्साहित करने हेतु कदम उठाऐ हैं। अब तक (2012–13) लगभग 268 ट्राउट इकाईयाँ निजि क्षेत्रों के अर्न्तगत स्थापित की जा चुकी हैं जो कि 2010–11 में केवल 126 ही थी। राज्य में इस क्षेत्र (ट्राउट खेती) में दो साल में दो गुना वृद्धि हुयी है जो कि राज्य में ट्राउट के विकास का एक उत्साहवर्धक संकेत है। हिमाचल प्रदेश भी ट्राउट मत्स्य पालन राज्य एवं बीज उत्पादन का एक अग्रणी राज्य है। यहां के सभी 12 मत्स्य बीज फार्म हिंमाचल प्रदेश के राज्य मत्स्य विभाग के नियंत्रण में हौं जिनमें 6 ट्राउट फार्म है तथा 6 अन्य कॉर्प फार्म है। इस राज्य के क्षेत्र चम्बा घाटी, कैन्नूर घाटी, कूल्लू घाटी, लाहौल स्पीति क्षेत्र, पब्बार घाटी, हुक घाटी 'ट्राउट जोन' के रूप में घोषित है। राज्य में 2009–10 में ट्राउट का उत्पादन 44.9 मीट्रिक टन था तथा विभाग ने ट्राउट की बिक्री द्वारा 211.74 लाख रूपये का राजस्व एकत्रित किया। 2007 में राज्य में जहां केवल 44 ट्राउट पालक थे वहीं 2011–12 के अंत में ये बढ़ कर 75 हो गऐ। निजि मत्स्य पालक मुख्यतः कुल्लू, चम्बा, शिमला, कैन्नौर



मछली पालन के लिए भूमि एवं जलउपयोगिता मानचित्र

तथा मण्डी जिलों में स्थित हैं। प्रत्येक के फार्म में सामान्यतः वर्ष में 2–5 टन ट्राउट का उत्पादन होता है। सिक्किम देश के उत्तर–पूर्वी क्षेत्र में स्थित एक प्रमुख ट्राउट उत्पादक राज्य है। यहॉ 1954 में इस दिशा में कार्य हुआ, जम्मू कश्मीर में 2010–11 में जहॉ रेन्बो ट्राउट का उत्पादन लगभग 53.4 टन ता बीज उत्पादन 2.4 लाख था वहीं 2013–13 में यह बढ़कर 80.0 मिट्रीक टन हो गया। कुमायूँ के पर्वतीय क्षेत्र में ट्राउट पालन का कार्य 1910 में आरम्भ हुआ। वर्तमान में यहां केवल बैरांगना ट्राउट फार्म में 3 लाख आइडओवा तथा 2 लाख वयस्क फ्राई प्रतिवर्ष का उत्पादन होता है। 2009–10 में यहॉ से 1.85 लाख बीज उत्पादन के ऑकड़े उपलब्ध है। यहॉ कूल 35 रेसवेज है। राज्य में अभी तक ट्राउट की खेती निजि किसानों तक नही पहुँच पायी है।

## आनुवंशिकी

आनुवंशिक चरित्र चित्रण के लिए विभिन्न ट्राउट फार्मों जम्मू एवं कश्मीर (2.7) हि0प्र0 (8), सिक्किम (114), उत्तराखण्ड (290) व अरूणांचल प्रदेश (02) से कुल 621 नमूनों को एकत्रित कर उनमें वायरस के संक्रमण का पता लगाया गया तथा डौट इलीसा विधि के द्वारा उनका सेल–कल्चर किया गया। साथ ही नमूनों में एण्टी आई.एच.एन.वी. की उपस्थिति को भी ज्ञात किया गया। नमूनों में वायरल की पुष्टि के लिए उनका बाद में आर टी–पी.सी.आर के द्वारा भी परीक्षण किया गया। संदिग्ध नमूनों को जिनमें कोई वायरस को उपस्थित थी सीस्पा तकनीक के प्रयोग द्वारा परीक्षण किया गया।

भारत में सेचिसटूरा सिक्किमैन्सिज यमुना नदी के चिनविस इरावदी बेसिन के मनीपुर, असम, मेघालय, त्रिपुरा नागालैण्ड के साथ–साथ मयन्मार से भी रिर्पोट की गयी। माइक्रोसैटेलाइट माकरकर्स विकसित करने के लिए सेचिस्टूरा सिक्किमेनिसज के नमूनों को गारो हिल्स के सिमसैंग नदी के तीन विभिन्न क्षेत्रों से एकत्रित किया गया तथा सभी नमूनों को डी.एन.ए. आइसोलेसन से पूर्व पूर्ण इथैनोल में 20 डिग्री से0ग्रे0 पर संरक्षित किया गया।

गोल्डन महाशीर (टौर प्यूटिटोरा) के ट्रांसक्रिप्टोम प्रोफाइलिंग के लिए उत्तराखण्ड के रामनगर से नमूनों को एकत्र कर उनको तालाबों में अनुकूलन के लिए रखा गया कार्प के बीजों को तालाबों में संचयित किया तथा तालाब प्रबन्धन के लिए कृषकों को आहार, हैड नेट तथा जाल आदि उपलब्ध कराऐ गऐ। 26 अगस्त, 2013 को गोठी ग्राम में 10 चयनित कृषकों को प्रशिक्षण के साथ–साथ तालाबों में लेजाकर प्रर्दशन भी किया गया। इसी प्रकार 27–28 सितम्बर, 2013 को पांगू में 25 चयनित कृषकों को प्रशिक्षित किया। प्रशिक्षण कार्यक्रम के अन्तर्गत कृषकों को तालाब–प्रबन्धन, आहार–प्रबन्धन के साथ –साथ स्वास्थ्य प्रबन्धन के बारे में भी विस्तार से बताया गया।

## 1.2 जनजाति उप योजना गतिविधियां

इस योजना के तहत विभिन्न वैाानिकों ने देश के विभिन्न क्षेत्रों में गतिविधियॉ आरम्भ की। उत्तराखण्ड के दो जिलों–पिथौरागढ़ और ऊधमसिंह नगर के कुल 33 तालाबों का चयन किया गया। 2012–13 में 28 तालाबों का निर्माण/पुर्ननिर्माण किया गया तथा 2013–14 में 5 तालाबों का निर्माण नानकमत्ता क्षेत्र में किया गया। इन सभी क्षेत्रों में मत्स्य पालन की अवधारणा बिल्कुल नयी थी। सभी 33 तालाबों में कार्प अंगुलिकाओं का संचयन किया गया। 18 तालाब पिथौरागढ़ जिले के अत्यधिक ऊँचाई वाले क्षेत्रों में तथा बाढ़ प्रभावित क्षेत्रों में थे। यहां पर मत्स्य पालन को एक आजिविका के साधन के रूप में आरम्भ किया गया।

8 माह में सुखदेव (मत्स्य पालक) के तालाब में 0.8-1.5 किग्रा. मत्स्य का उत्पादन

हिंमाचल प्रदेश के दालान मैदान, लाहौल स्पीति जिले में भी ट्राउट की खेती की संभावनाओं का पता लगाने के लिए एक सर्वेक्षण किया गया। यहां पर 10 मत्स्य पालकों ने ट्राउट की खेती हेतु अपनी इच्छा प्रदर्शित की।

असम के हाफलौंग ग्राम के जनजातिय समूहों के लिए स्थलो का चुनाव किया गया। हाफलौंग सरकारी कॉलेज के सहयोग से यहाँ पर गतिविधियाँ आरम्भ की गयी। यहाँ से कुल 30 मत्स्य पालकों का चयन किया गया। जिसमें 16 मत्स्य पालक मोती दाओयुंग (नाबेन) ग्राम से, 14 लौगमाइलाइ ग्राम से थे।

मात्स्यिकी विकास के लिए कलिंगपोंग क्षेत्र में भी सर्वेक्षण कार्य किया गया। सर्वेक्षण रिपोर्ट के अनुसार कलिंगपोंग के समीप पाबाक एवं सिन्डेबोग ग्राम कार्प पालन के लिए उपयुक्त स्थान है जबकी गोरखे, दारागांव, सीरीखोला, तिम्बूरे व फेदीखोला जेसे क्षेत्र ट्राउट पालन के लिऐ उपयुक्त हैं यहां पर अनुकूल तापीय स्थिति है। यहाँ से 10 कृषकों को चयनित किया गया।

## 1.3 उत्तर-पूर्वी क्षेत्रों में गतिविधियाँ

अरूणांचल प्रदेश के बोमडीला जिले के शेरगॉव सरकारी ट्राउट फार्म में रेन्बोट्राउट और ब्राउन ट्राउट का बीज उत्पादन किया गया।इस अवधी में यहॉ पर 25000 ब्राउन ट्राउट के और 10000 बीज रेन्बो ट्राउट के उत्पादित किऐ गऐ।

जन्तु विज्ञान विभाग, गोवाहाटी तथा हाफलौंग सरकारी कॉलेज के सहयोग से असम में फूलगुरी, पुथीमारी व खोरखेरी (जिला कामरूप) ग्रामों से 12 कृषकों का चयन सुअर–सह–मत्स्य पालन के लिए किया गया। यहॉ पूर्व में विद्यमान तालाबों का जीर्णोद्धार किया गया और ग्रामीणों की खाद्य सुरक्षा के लिए आवश्यक बीज आदि की सुविधाऐं उपलब्ध करायी गयी।

सिक्किम में सरकारी ट्राउट हैचरी को पुनर्निमित किया गया ताकि बीज उत्पादन का कार्य सरलतापूर्वक हो सके। 2013 की अवधी में यहॉ 2.7 लाख आइड ओवा का उत्पादन हुआ। यहॉ ऊपरी रिम्बी पर 6 मत्स्य तालाबों को प्राकृतिक

अरूणाचल प्रदेश में समन्वित मत्स्य पालन

आपदा के कारण काफी नुकसान पहुॅचा। शीतजल मात्स्यिकी अनुसंधान निदेशालय भीमताल ने राज्य मत्स्य विभाग के माध्यम से इन तालाबों के जीर्णोद्धार के लिए वित्तीय एवं तकनीकी सुविधाऍ उपलब्ध करायी।

इसी प्रकार मेघालय से भी सुअर–सह–मत्स्य पालन के लिए 25 किसानों का चयन कर उन्हें तकनीकी सुविधाऍ उपलब्ध करायी। डी0सी0एफ0आर0 द्वारा इस क्षेत्र के टीयांग, लेटखिरोंग मायरंग, लाइटमावरो तथा पेनहुरसला ग्रामों की आजीविका सुरक्षा को ध्यान में रखते हुऐ यहां के किसानों को मत्स्य बीज, अंगुलिकाऐं आदि उपलब्ध करायी।

शीतजल मात्स्यिकी अनुसंधान निदेशालय में राज्य मत्स्य विभाग मेघालय सरकार के 20 वरिष्ठ अधिकारियों को शीतजल की प्रमुख मछलियों के प्रजनन एवं पालन से सम्बन्धित जानकारी देने के लिए 6 दिवसीय प्रशिक्षण कार्यक्रम चलाया।

## 1.4 महत्वपूर्ण घटनाक्रम एवं बैठकें

- दि0 16.19 जून, 2013 को उत्तराखण्ड राज्य में आयी भीषण आपदा के कारण हजारों लोग बेघर हो गए तथा उनके मवेशी मारे गऐ, इस दिशा में डी0सी0एफ0आर0 के निदेशक की अध्यक्षता में भा0कृ0अनु0 परिषद के आस–पास

के संस्थानों ने मिलकर आपदा ग्रस्त लोगों की मदद करने का निर्णय लिया तथा भोजन, कपड़े, दवा आदि की व्यवस्था कर पीड़ित लोगों तक पहुँचाया, इस दिशा में निदेशालय की ओर से डॉ0 आर0एस0 पतियाल के निर्देशन में डॉ0 प्रेम कुमार, अमित कुमार जोशी, बी0सी0 पाण्डे व विवेकानन्द पर्वतीय कृषि अनुसंधान परिषद, अल्मोडा के श्री तेजपाल के दल ने राहत कार्य किया।

- दिनॉक 9–10 अप्रैल, 2011 का डॉ0 के0के0 वास की अध्यक्षता में संस्थान की अनुसंधान सलाहकार समिति की बैठक हुयी। डॉ0 ए0 बराट कार्यवाहक निदेशक ने बैठक के सदस्यों का स्वागत किया। बैठक में वर्तमान में चल रही परियोजनाओं पर तथा पूर्ण हुयी परियोजनाओं पर समालोचनात्मक टिप्पणियाँ की गयी।
- दिनॉक 13 मई, 2013 को कार्यवाहक निदेशक डॉ0 ए0 बराट की अध्यक्षता में निदेशालय की अनुसंधान समिति बैठक हुयी। इस बैठक में डॉ0 एस0डी0 सिंह,

80 वर्षीय वृद्वा आपदा राहत ग्रहण करते हुए

सहायक उपमहानिदेशक (अर्न्तस्थली मात्स्यिकी) भा0कृ0अनु0 परिषद ने भी भाग लिया, बैठक में वैज्ञानिकों द्वारा अपनी अनुसंधान उपलब्धियों को प्रस्तुत किया था। डॉ0 एस0डी0 सिंह ने वैज्ञानिकों की अनुसंधान उपलब्धियों पर प्रसन्नता प्रकट की। उन्होनें निदेशालय द्वारा उत्तर पूर्वी क्षेत्र में जनजाति उपयोजना के तहत किऐ जा रहे कार्यों की भी सराहना की।

- दिनॉक 5 जून,2013 को संस्थान के पर्यावरण दिवस मनाया गया। इस अवसर पर एक जन–जागरण बैठक आयोजित की गयी, तथा गोविन्द बल्लभ पन्त कृषि एवं प्रौद्योगिकी विश्व विद्यालय के प्रोफेसर डॉ0 आर0एस0 चौहान को मुख्य अतिथि के रूप में बुलाया गया। उन्होनें पर्यावरण की महत्ताा तथा उसके प्रति अपने कर्त्तव्यों के निर्वहन के बारे में बताया।

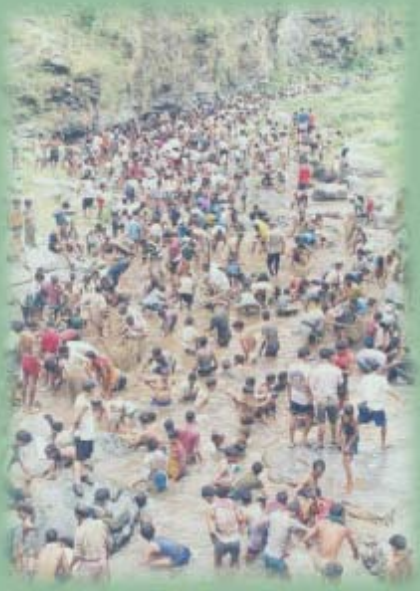
अनुसंधान समिति की बैठक

- दिनॉक 15 अगस्त, 2013 को संस्थान के प्रांगण में स्वतन्त्रता दिवस बड़े उल्लासके साथ मनाया गया। संस्थान के कार्यवाहक निदेशक डॉ0 ए0 बराट ने ध्वजारोहण कर सभी सदस्यों को बधाई दी तथा निदेशालय के लिए एकजुटता के साथ कार्य करने का आहवान किया।
- दिनॉक 8 अगस्त, 2013 को कार्यवाहक निदेशक डॉ0 ए0 बराट की अध्यक्षता में संस्थापक की प्रबन्धन समिति की बैठक हुयी। बैठक में कार्य सूची की विभिन्न मदों पर चर्चा की गयी।
- दिनॉक 11.09.2013 से 13.09.2013 तक डॉ0 एम0 सिन्हा की अध्यक्षता में क्यू0आर0टी0रिव्यू टीम की प्रथम बैठक निदेशालय में सम्पन्न हुयी। बैठक में डॉ0 एम0एम0 गोस्वामी, प्रोफेसर एम0एच0 बल्खी, डॉ0 प्रेम कुमार (सचिव) व डॉ0 पी0सी0 महन्ता ने भाग लिया। इस टीम ने चम्पावत के प्रयोगिक मत्स्य प्रक्षेत्र, अभिसंरचनात्मक सुविधाओं का भी निरीक्षण किया।
- दिनॉक 14–20 सितम्बर, 2013 को संस्थान में हिन्दी सप्ताह समारोह का आयोजन किया गया। इस अवसर पर विभिन्न हिन्दी प्रतियोगिताऐं आयोजित की गयी तथा प्रतियोगिता में प्रथम, दूसरा व तीसरा स्थान प्राप्त करने वाले प्रतिभागियों को पुरस्कृत भी किया गया।

क्यु.आर.टी. सदस्यों का फार्म में भ्रमण

- दिनॉक 23–24 सितम्बर ''पर्वतीय क्षेत्रोंमें जलजीव पालन विविधीकरण 2014'' का निदेशालय में एक शीर्षक पर दो दिवसीय राष्ट्रीय हिन्दी कार्यशाला का आयोजन किया गया। जिसमें देश के विभिन्न गणमान्य सदस्यों, अनुसंधानकर्ताओं, वैज्ञानिकों, हिन्दी से जुड़े लोगों ने भाग लिया। कार्यशाला का तीन सत्रों में बांटा गया था। प्रत्येक सत्र में वैज्ञानिकों ने अपने–अपने पेपर हिन्दी में प्रस्तुत किऐ। कार्यशाला के सफल आयोजन के लिए श्री अमित कुमार जोशी को पुरस्कृत भी किया गया।
- दिनॉक 3–4 सितम्बर 2013 को पी0एम0ई की मानव संसाधन विकास गतिविधियों के अर्न्तगत दो दिवसीय वैज्ञानिक इन्टरफेस बैठक आयोजित की गयी। इस कार्यक्रम में डॉ0 कान्ता दास महापात्रा डॉ0 बी0 पिल्लई, प्रधान वैज्ञानिक, डॉ0 पी0के0 साहू, प्रधान वैज्ञानिक, सीफा से आमंत्रित किऐ गऐ, डॉ0 महापात्र व डॉ0 पिल्लई ने कार्प एवं झींगा के प्रजनन से सम्बन्धित विस्तृत परिचर्चा की। डॉ0 साहू ने कार्प के रोगों से सम्बन्धित जानकारी दी।

हिन्दी सप्ताह समारोह में निबन्ध प्रतियोगिता में भाग लेते हुए कर्मचारी एवं अधिकारी



# शीतजल मात्स्यिकी अनुसंधान निदेशालय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