CHHIRAPANI EXPERIMENTAL FISH FARM CHAMPAWAT:

LEAPING FORWARD

Bulletin No. 13

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Foreword

The upland region of the country including Himalayas and peninsular Hill Ranges form an entirely different eco-geographical entity. The mountainous region bestowed with vast and varied water resources in the form of rivers, rivulets, streams, streamlets, lakes, ponds, tanks and reservoirs. The diverse aquatic habitats of the hills region harbour rich piscine diversity. Owing to complex microclimatic conditions coupled with thermal variables, the production from upland region is still at very low pace. Though, the attempts for fish culture in the upland states of the country has been initiated since 1863, but the culture fishery remained in infant stage, till recently. Now, the scenario has changed and several progressive farmers have started mono and composite fish culture in small ponds and a few of them have achieved considerably good production. The Directorate of Coldwater Fisheries Research (erstwhile NRCCWF), Bhimtal, Uttarakhand has played pivotal role in development of location specific feasible and viable fish farming techniques, breeding protocols, feed and standardized husbandry practices at its farm-Experimental Fish Farm, Chhirapani, Champawat (Uttarakhand). Besides, perusing various research projects, the farm is providing inputs to the fish farmers in the form of training, quality seed and technical support under its transfer of technology programmes. The center has played pivotal role in development of fish farming activities in the Pati Block of Champawat district and other adjacent places. One of the pioneer farmers of the block Pati- Mr. Krishna Nand Gahtori recommended by the CFR got prestigious IARI Farmer Award at IARI, Pusa, New Delhi on 26.02.2009. The farm has privilege to open sale of one of the finest quality exotic fish- rainbow trout to the people of the area for the first time in the Kumoun region since 14.02.2001. This document would provide a rare piece of baseline information to the fishery scientists, extension officers, academicians, researchers and planners to carry out further research and development activities in cold-water fish farming.

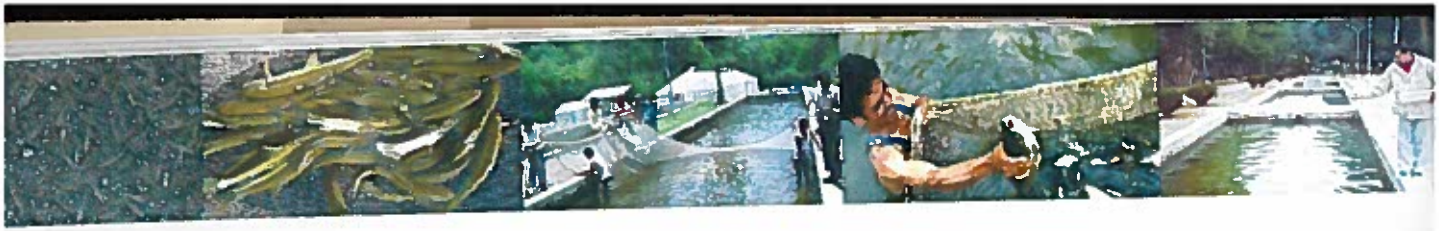
Contents

An Introduction to Champawat

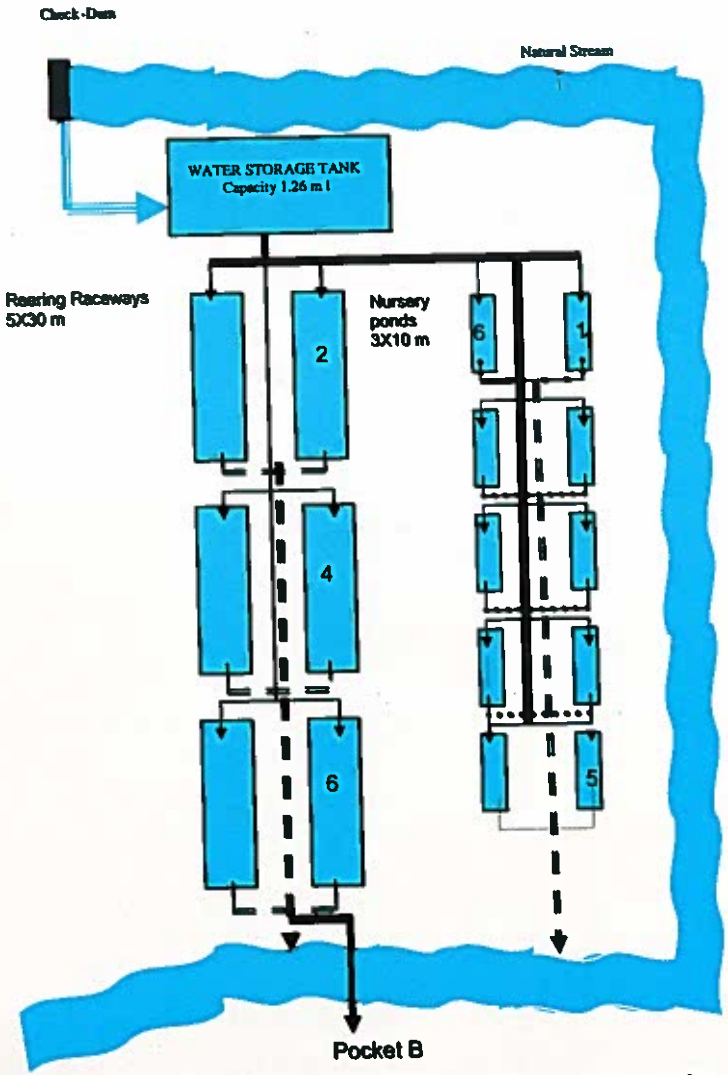
Champawat is an old historical township with remnants of Chand dynasty of Kali Kumoun. It is located in Lower belts of Central Kumoun Himalayas at an altitude of 1550 msl. District Champawat was carved out from Pithoragarh and Nainital districts of Kumoun region. The district is known for its beautiful lush green forest canopy consisting of deodar, pine, rhododendron and kafal trees, voluminous and fast flowing rivers and gushing streams. The land area mainly consists of mountain ranges, large valleys, uneven landscape, braked cliffs, rivers and rivulets. The major rivers traversing through the width and length of Champawat are Kali-Sarda, Saryu, Ladhia, Lohawati, Panaar and Ramganga (E). All these rivers debouch into the river Kali at Panar, Rameswar, Pancheswar etc. On the basis of geographical distribution Champawat district can be divided in three main geographical parts such as, Terai area that are important from the agriculture point of view possesses an average altitude of 200 to 250 meter; Shiwalik mid hills which is situated at a height of 250 to 1200 meter represents a sloping and uneven topographical land consisting of dense forests and Hilly area with an average height of 1500 meter.

Experimental Fish Farm

The land of Experimental Fish Farm of Directorate of Coldwater Fisheries Research (then NRC-CWF) was procured at Chhirapani, Tarkeswar about 7 km away from Champawat town in the year 1988. The farm is situated on the banks of a holy stream Gandaki in 3.13 hectare land area (Long. 80° 07 'N, lat. 29° 30 'E, 1620 msl) in Central Kumoun Himalaya. The stream originates from southern extremity of the Kranteswar range of the hills at an elevation of 1860 msl in District Champawat and has high religious importance due to its North flowing nature. A number of streams of primary and secondary order originating from Kranteswar, Banlekh and Hingla hill ranges also debouch in the stream. The Gandaki is a perennial stream and receives water from discharge of the springs and seepages and through faults and permeable layers.



Sketch of Pocket "A"



Not to Sacle

mountain peaks receives occasional snowfall during winter months. Nearly 70% area of the stream catchments s under dense forest cover, which is almost in pristine condition and the rest of the area is under cultivation. Both the banks of the stream have human settlements, though mostly sparse in density. The human settlement n the catchments depends on the stream for potable water and minor scale irrigation.

Table-1. Relevant water quality parameters in trout ponds (under flow through conditions)

S.N.	Month	Water temperature (°C)	Dissolved oxygen (mg/l)	Free carbon-di-oxide (mg/l)	pH
1.	January	4.5-6.5	8.2-10.0	0.0-1.0	7.8-8.0
2.	February	4.5-8.5	8.4-10.2	0.0-0.8	7.8-8.2
3.	March	7.0-14.5	7.6-9.0	0.6-1.2	8.0-8.2
4.	April	13.0-17.5	5.4-8.6	1.8-2.4	8.0-8.2
5.	May	15.5-22.5	5.4-8.2	1.8-2.8	8.0-8.4
6.	June	18.5-21.5	5.4-8.2	2.0-2.6	8.0-8.4
7.	July	18.0-20.5	6.2-8.8	1.4-1.8	8.0-8.2
8.	August	18.0-21.5	5.0-8.8	2.0-2.2	8.0-8.2
9.	September	18.5-20.5	6.8-9.2	0.6-1.2	8.0-8.2
10.	October	15.5-20.0	6.8-8.8	0.8-1.6	8.0-8.2
11.	November	9.5-12.5	8.0-9.6	0.0-1.0	8.0-8.2
12.	December	6.5-10.0	8.0-9.6	0.0-1.0	8.0-8.2

The stream bifurcate the farmland into two pockets. The upper earlier developed part is known as Pocket "A" and the lower one as Pocket "B

Table-2. Relevant water quality parameters in the carp ponds (under stagnant condition)

S.N.	Month	Water temperature (^{0}C)	Dissolved oxygen (mg/l)	Free carbon-di-oxide (mg/l)	pH
1.	January	4.5-7.0	10.8-12.0	0.0-2.0	7.6-7.8
2.	February	5.5- 6.5	9.6-12.0	1.6-2.0	7.4-7.6
3.	March	7.0-15.0	10.6-11.6	0.8-2.0	7.4-7.8
4.	April	15.0-18.0	9.0-9.6	0.8-1.6	8.0-8.2
5.	May	17.5-20.0	8.0-9.4	0.6-1.2	8.0-8.2
6.	June	20.0-24.5	7.6-8.8	0.6-1.2	8.0-8.2
7.	July	19.5 -22.5	7.6-8.4	1.4-2.0	7.8-8.2
8.	August	18.0-23.0	7.6-8.4	0.8-2.0	8.0-8.2
9.	September	18.5-20.0	8.0-8.6	0.4-1.6	8.0-8.2
10.	October	12.0-15.0	8.4-9.0	0.0-1.0	8.0-8.2
11.	November	8.0-11.0	8.4-9.2	0.0-0.8	8.0-8.2
12.	December	6.0-9.0	8.4-9.2	0.0-0.6	8.0-8.2

Water supply

Water supply to the farm is maintained through a pipeline fitted to the check dam built across the Gandaki stream about 150 meters ahead of the farm. Average annual water availability to the farm is estimated between 110 to 1200 lpm, while the minimum requirement during lean period remains between 400 to 500 lpm. The inadequate water supply often causes fungal, bacterial and even viral infection to the stock, which leads to diseases and mortality. The scarcity of water at the farm is a major hurdle in its expansion and development programmes. Efforts are underway for augmentation and recycling of the available water to fulfill its requirements particularly during lean period.

Infra-structural facilities

Construction of six raceway ponds (RP) and ten nursery ponds (NP) having total water area of 1200 m^2 was completed in the pocket "A" in 1991. The size of the each RP and NP is 30x5x1.25 m and 10x3x1.25 m, respectively. In addition, twenty iron circular tanks (CT) were also constructed for experimentations on hatching and early fry rearing. A water storage tank having a capacity of 1.26 million liters was constructed during 1993 in order to maintain regular supply to the farm as well as buffer stock of water.

A small circular carp hatchery was established at the farm during 2005 for the purpose of easy availability of carp

Further, under expansion plan of the farm, the pocket "B" was developed. Ten ponds each having water area of 75 m2 , a culvert over the stream and approach road was broadened during 2006.

Hatcheries

A trout hatchery with hatching capacity of 1,00,000 eyed eggs/year in a year was constructed in first phase. The hatchery set up is housed in a hatchery building well equipped with hatching troughs, trays, feeding troughs and a small overhead tank. Further a small circular carp hatchery with required breeding capacity for 10 kg carp brooders at a time is also established in the farm premise in pocket-A.

Carp Hatchery

Trout Hatchery

Buildings

The above facility is further supported with 2 stores, one feed store in pocket-A and another general store in pocket-B. Four numbers of "Type 3" staff quarters in the pocket "B" are recently taken over from CPWD and are being used as office at farm site. Office-cum-Laboratory building is under construction in pocket "B". A bore-well with installed capacity of 36 lpm is under final stage to supply water to the staff quarters and office building.

Staff quarters

New ponds in pocket "B"

Experiments on rearing of the fish stocks

The newly constructed ponds were stocked with snow trout for the first time during 1992. Later, the experiments were started on mono and poly culture of exotic carps (grass, silver and common carp) during the 1993-94. Further, a few attempts were made to establish brown trout stock from state fish farm Talwari, but due to shortage of water and resultant rise in temperature the stock perished later on. The first successful attempt to introduce and establish rainbow trout at the farm was taken on 26. 01.1999 and 20,000-eyed eggs of Norwegian rainbow trout were brought from Patlikuhl hatchery (Himachal Pradesh).

Significant achievements

Rearing and Breeding of Rainbow Trout, *Oncorhynchus mykiss*

Rainbow trout is native to the Pacific drainages of North America, ranging from Alaska to Mexico. The fish may be the world's most widely transplanted fish species. By 2006, 65 countries were reporting rainbow trout farming production. Many have relatively insignificant output in comparison to the production from the larger systems that are located in the primary producing countries in Europe, North America, Chile, Japan and Australia. Global production of rainbow trout is greatly expanding from 1950s onwards after development of its pelleted feed. Rainbow trout is a highly priced with better growth rate and maximum cultivable traits amongst coldwater species.

Though, efforts for trout culture in the upland region of India had been initiated since 1863 trial for transplantation in Uttarankhand state dates back to 1910 with the transplantation of eyed-eggs of

Later on another consignment was received in 1912 and trout fingerlings were stocked in Kumaon lakes. The trout eggs were also procured from Kashmir to Kaldyani and Talwari hatcheries in Garhwal region in the year 1910. The trout thrived in the hatcheries and some tributaries in the Garhwal region but could not survive in Kumaon hills, due to comparatively high summer temperature.

In recent past, the efforts were further initiated by the DCFR (erstwhile NRCCWF), Bhimtal during 1992-95 for introduction of the trout at the Chhirapani farm and rainbow trout was successfully introduced in the year 1999. In a culture experiment conducted at the farm the fish attained maximum growth of 200 gm, 1100 gm, 2100 gm and 3000gm respectively, during 1-4 year's life span (Joshi *et al.*, 2005). In subsequent efforts the trout yearlings attained maximum growth of 300-350 g in the farm. The stock was fed on two formulated diets (table-3) with 47.10 and 57.68 % protein level.

Table-3. Proximate composition of the experimental diets (% dry weight)

Parameters	Diet-1	Diet-2
Crude protein	47.10	57.68
Ether extract	12.85	9.38
Crude fibre	4.65	1.35
Ash	8.90	11.93
Nitrogen free extract	26.50	19.66

Artificial propagation of rainbow trout

The male rainbow trout attained maturity after 2nd year and female after completion of 3rd year. The female rainbow trout produced 547-2000 eggs/kg of bodyweights, depending upon age and the size. The hatching of the stripped eggs completed after 61 days post fertilization at ambient water temperature between 4.5 - 7.5 0C at the farm with a survival rate of 42.6 % (Joshi, 2009).

Produced table size rainbow trout at the farm for the first time in Kumaon region and sold the surplus stock to the local people since 14.02.2001.

Domestication and breeding of Asela snow trout, *Schizothorax richardsonii*

The studies were conducted on domestication and rearing of *Schizothorax richardsonii* (Gray) at Champawat farm. The newly hatched early fry (9.5-13.5 mm. in length) with corresponding weight of 0.021-

0.032 g were reared in nursery ponds. The stocked fish merely attained an average length of 8.4 cm, 12.1 cm, 15.6 cm, 18.2 cm, 20.4 cm, with corresponding weight of 5.2 g, 10.6 g, 25.8 g, 44.6 g and 72.0 g. during 1st to 5th year life span, respectively (Joshi *et al*, 2005). The cumulative survival was 68.6 % during the study period.

Artificial breeding technique for *S. richardsonii* was successfully developed at the farm. The brooders ranging 40.0-65.0 gm. (male) and 65.0- 190.0 gm. (female) collected from nearby stream were stripped by "wet method " (Joshi, 2004). The fertilization rate of 80.0-94.2 % was achieved at ambient water temperature between 22.5-24.00C. The overall survival during incubation was recorded 58.0-81.0 % (water temperature 20.0-24.50 C) and 76.29-84.06 % during rearing from fry to yearling stage at water temperature between 4.5-28.50C.

This opens up the possibility of producing seed of this important species under controlled conditions. The y attained total body length between 74.0-103.0 mm. and corresponding weight 3.6-5.8 g with a cumulative rvival of 34.20 % within a rearing period of one year.

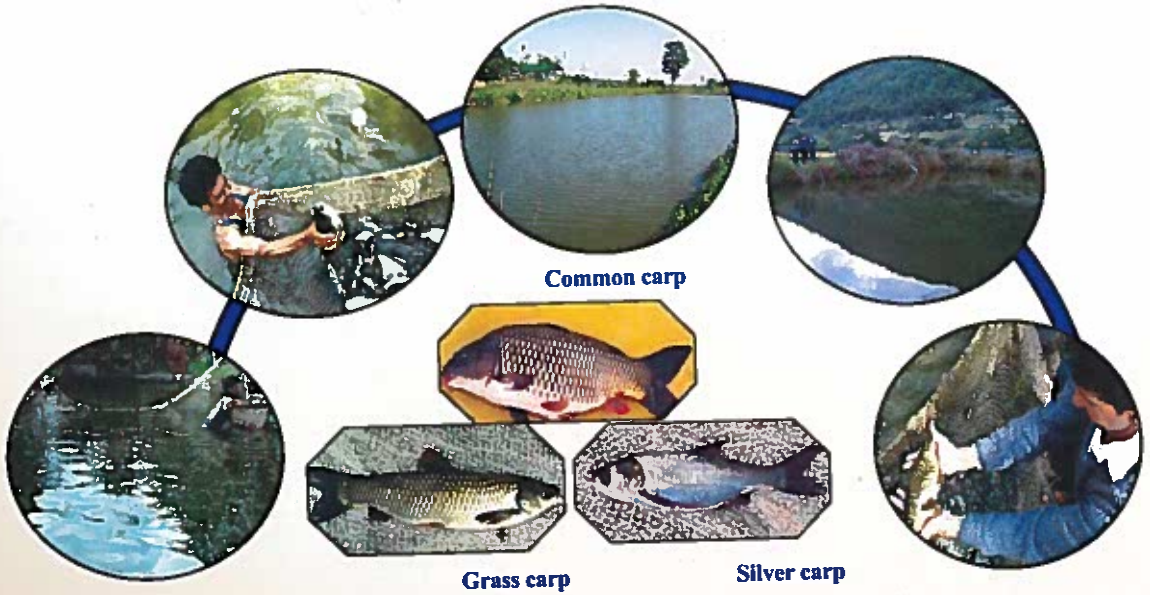
aptive breeding of snow trout

An attempt has been made on rearing of *Schizothorax richardsonii* brooders in the farm conditions and rtificial breeding in captivity. The potential male and female brooders collected from nearby rivulets were eared in Nursery ponds at the farm since September 1998 onwards. The stocking density was maintained at 0.5 g./m^2. The compounded feed was fed to the stock @ 2-5% of body weight and comprised soya flour, groundnut il cake, rice polish, fish meal and vitamin-mineral premix. The most of the brooders reared in the nursery pond t the farm attained gonadal maturity in September 1999. Out of these 12 ripe females and 18 males (1:1.5 ratio) were used for stripping purpose during September 13-18,1999. The healthy viable hatchlings were produced successfully from the stripped eggs after 120 - 168 hrs. of incubation in flow-through indoor hatchery at 15.0 - 17.0 °C water temperature (Joshi, 2006).

Culture and breeding of Exotic carps

In the upland waters the Indian major carps do not grow well, due to the low thermal regime. Therefore, [illegible] trials. The Chinese carp found suitable for

the Mid-Himalayan region based on the 41 experiments conducted at the farm on composite carp farming system. It involved the three major Chinese carps namely grass carp (feeds on all types of aquatic and terrestrial grass), silver carp (feeds on plankton) and common carp (feeds on semi digested faecal material of grass carp, unutilized feed on pond bottom) stocked @ 2.8-4 fish/m^3 (having advantage of higher oxygen level) in the ratio of 4-5:2-2.5:3-3.5, respectively. The supplementary feed prepared from locally available ingredients-oil cake, rice polish/bran etc. and fed @ 2-3 % of the body weight and fertilization of pond was done with raw cow dung (RCD) @ 9000 kg/ha/yr to ensure consistent growth. Average annual fish production of 1870 kg/ha and 3708 kg/ha had been achieved by monoculture of common carp and polyculture of grass, silver and common carp respectively, in an experiment conducted at the farm (Tyagi and Behl 1998, Tyagi *et al.*, 1999).



Chinese carp based culture system

Further, comparatively higher fish production @ 0.34-0.68 kg/m² /yr (3400 to 6800 kg/ha/yr) has been ested from the earthen ponds of Uttarakhand state located in middle Himalayan region (800-2000 msl) er transfer of technology programme of the institute. The DCFR has widely popularized the fish farming niques among the fish farmers of the region and presently several farmers are successfully pursuing it in r ponds.

Developed and standardized the technique for brood stock management and artificial breeding of grass silver carp in the Himalayan region. The maturation inducing hormones (MIH) like HCG and PG extract + prime at 18.0-26.00 C were found effective to reduce the maturation period.

The potential broodstock of grass carp *(Ctenopharyngodon idella)*, silver carp *(Hypophthalmichthys litrix)* and common carp *(Cyprinus carpio communis)* belonging to 1- 7 years age group were reared and intained in Chhirapani Experimental Fish Farm, Champawat.

Induced breeding of grass and silver carp was successfully conducted at the farm during 9th -16th July 02. Fully mature female grass carp in 1.5-2.5 kg body weight were induced for spawning with ovaprim @ 17 /kg in three fractional doses. Whereas, the female silver carp were induced with ovaprim @ 13 ml/kg in three it doses but males were injected only once @ 3 ml/kg. The embryonic developmental stages of both the carps re studied in the climatic condition of the farm and the fry obtained from the experiment were reared at the m.

periment on vitamin supplementation in fish feed

In order to assess the impact of vitamin fortified diets on fish growth and survival in coldwaters, a basal et (control) was prepared having 32% crude protein using soybean meal (38%), ground nut oil cake (20%), fish eal (20%) and rice polish (20%) as ingredients along with mineral mixture (2%). The test diet prepared by dding vitamin-A (8000 IU/Kg), vitamin-E (100 IU/Kg) and vitamin-C (400 mg/Kg) in different combinations,

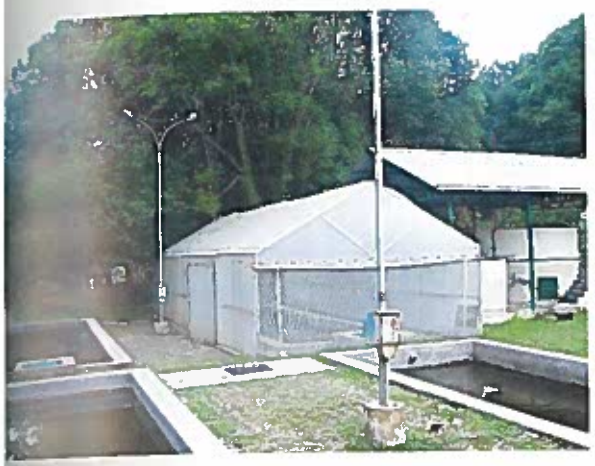
golden mahseer *(Tor putitora)* and exotic carps *(Cyprinus carpio, Ctenopharyngodon idella, Hypophthalmichthys molitrix)* were stocked in circular tanks at the rate of 20 fry/m^2, 2 fingerlings/m^2 and 5 fingerlings/m^2, respectively. After 9 months of experiment the dietary groups having combination of vitamin-E+C and vitamin A+E+C exhibited significantly higher ($P<0.05$) growth by 10.2% and 17.4%, respectively as compared to control in Schizothorax richardsonii. Similarly higher weight gain of 21.2% and 32.9% was recorded in golden mahseer fed with diets fortified with combinations of vitamin A+C and vitamin A+E.

Use of Polyhouse in fish farming

The experiments were carried out at the farm during winters (November to February, for 118 days) in 2 cement ponds (Joshi and Tyagi, 2008). The pond bottom was filled with 10 cm soil layer, to provide it semi-natural bottom texture. The experimental ponds were completely covered with semi-transparent polythene sheet (single layer) while the control ponds were open and without polyhouse. The polythene sheets of polyhouse were mounted on galvanized iron angle structure with minimum height of 2.0 m. The proper airtight door and windows were also provided in the polyhouse pond. The windows were kept closed and the doors only opened for a short period to feed and monitor the stock, during experimental period. The ponds were filled before the onset of the experiment and further water added only to maintain the required water level, during the period under study. Common carp and grass carp fry were used as experimental fish. The healthy stock of common carp weighing 1.0 ± 0.26 g with corresponding length range between 25-40 mm and grass carp weighing 1.0 ± 0.31 g with corresponding length range 30-40 mm were taken from the acclimatization pond. The fry were stocked at the rate of 2 fry/m^2 after neatly cleaning and disinfections of the ponds.

The fry were fed a laboratory-formulated wet feed comprising 32 % crude protein, @ 1-2 % of the fish biomass and regulated as per temperature variation and feeding intensity of the fishes.

The air and water temperatures in the experimental ponds were drastically increased as a result of the



nimum range), while it was 9.24 °C higher in the afternoon (maximum). Likewise, the water temperature in polyhouse-covered pond rised 7.06 °C in the morning and 10.96 °C at the afternoon in comparison to control ds.

In the study, growth rate attained by common carp fry in the experimental ponds was 39.07 % higher than t of the control ponds. The grass carp fry also registered marginally higher (3.41 %) growth rate over the trol ponds, but it was significantly less than the growth attained by the common carp. Due to hardy nature d better adaptability, the survival rate of common carp fry in both the conditions was recorded 100%, but vival was 96.6% in the grass carp fry in control pond.

Low water temperature during winters is a main limiting factor in hill aquaculture, particularly in the h altitudes. Hence, rising of water temperature by use of polyhouse is of immense potential for fish farming the region. The present study thus paves the way for harnessing of the potential of polyhouse for various vital nperature linked aquacultural activities like hatching, nursery rearing, brood stock raising and also for aring of table size fish.

Extension Activities

The new Chinese carp culture technique developed by the DCFR is becoming popular among the fish farmers of the region. Adopting this technology the farmers have achieved fish production @ 0.34-0.80 kg/m/yr (3400 to 8000 kg/ha/yr). Presently over 150 farmers and organizations in Champawat, Pithoragarh, Almora and Bageshwar districts of the Uttarakhand state and furthermore, a good number of farmers in Manipur, Arunachal Pradesh and Sikkim are also successfully pursuing it in their ponds.

Different extension activities are being conducted at the farm on demonstration and training and distribution of fish seed to the farmers.

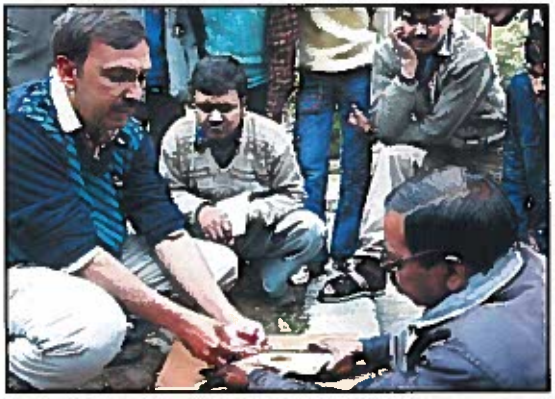
Seed distribution to the Fish farmer

Trout Fish Sale

Trainees from Sikkim

Trainees from Tehri

Discussion of Trainees with Fish Farmer



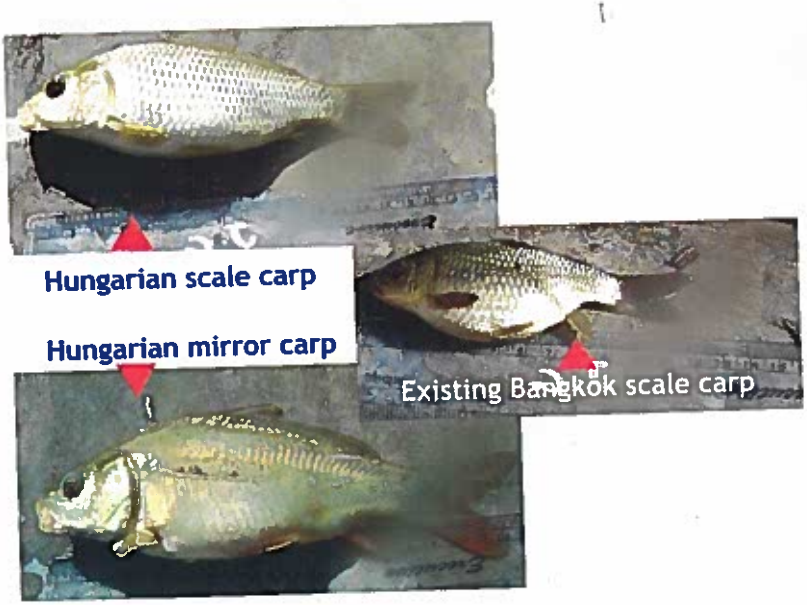
Training on Carp breeding

ıgoing Research Activities

oject: Evaluation of growth performance in different strains of Common carp

Common carp *(Cyprinus carpio)*, an introduced species is an integral component of aquaculture in the lands. Slow growth rate and unwanted reproduction have been identified as potential constraints on yields common carp in aquaculture and cultural-based fisheries. The Institute has imported two Hungarian strains

at the farm to ascertain their cultivable traits. Existing local strains of common carp are being used for studying comparative growth performance and breeding programme. The studies are underway on characterization for genetic diversity by using suitable molecular markers.



Comparative Growth of Different strain of Common Carp

Project: Study on water budgeting and water management for coldwater aquaculture system

There is marked water shortage during the summer at the farm, which limits the growth, survival and production cycle of the stocked fishes. This is a paradox based on the description of the physical environment of the area. Nonetheless, there is no comprehensive package of water management options that can be taken up immediately. There is a need to set a research agenda and undertake participatory research which will involve not only indigenous technologies but also exogenous ones, such as water budgeting by collection of time series data on water availability and water losses, analysis of water quality, calculation of water requirement

d water management by opting suitable alternate and recirculation system. Therefore the captioned search project is underway to solve acute water shortage of a coldwater fish farm.

'oposed water re-circulatory unit

The one raceway (no.6) would be used for sedimentation-cum filtration unit. The pond will be dug out cording to meet the daily requirement of the water.

'oposal for sedimentation-cum filtration unit

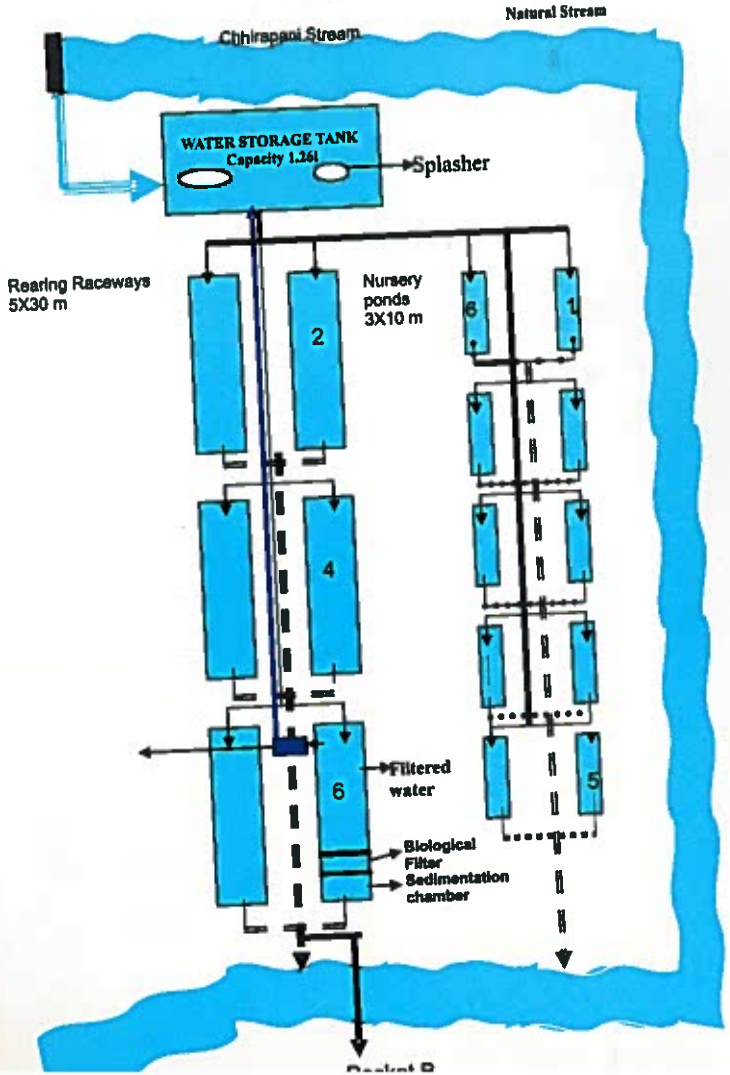
tal drain rate from rearing unit = 160 lpm

ater to be recalculated to need the demand of deficit =109 lpm

'oposed scenario:

The outflow from the pond is proposed to re-circulate to the tank. The quantity being 2 lps since stream also contributing at 2 lps discharge. Thus discharge of 1.75 lps is proposed to safely dispose from the system to e stream down to the system. This will fulfill the water requirement and address the problem of water ortage during the lean period flow.

Layout: Proposed Re-circulatory System



sh Farmer of DCFR got IARI Award

Shri Krishna Nand Gahtori, a fish farmer of Toli block, Champawat was trained, guided and encouraged der transfer of technology programme of the Directorate of Coldwater Fisheries Research (DCFR), ampawat and got prestigious Farmer Award of Indian Agricultural Research Institute, Pusa, New Delhi. The rmer was honoured in Agriculture fair - Pusa Krishi Vigyan Mela organized at IARI campus, New Delhi from -26th February 2009. Shri Sharad Pawar Ji, Honourable Minister of Agriculture, Consumer Affairs, Food And blic Distribution, Government of India inaugurated the fair on 23.02.2009. Dr. R.S.Paroda, Ex-Secretary RE & Director General ICAR presented the award to Shri Gahtori in the closing ceremony held on 26.02.2009.

Shri Krishna Nand Gahtori, Pati, District Champawat, Uttarakhand has achieved fish production between 4 and 0.8 kg/m/yr from different ponds. He integrated fish culture with agriculture, vegetable crops, ckery, and dairy.

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QRT members at the farm

QRT members at farmer's field

RAC members at farmer's field

VIP's at the Farm

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Mr. J. M. Lingdoh, Chief Election Commissioner, Govt. of India (18.03.2002)

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