1. **Title:** Innovative approach for addressing the problem for fish seed in-availability in proper time for stocking in NE India.

2. **Category:** Most significant success story in the field of aquaculture.

3. **Challenge:**

   The state of Assam has high potential for developing the fishery sector as a lucrative industry on the basis of vast water resources, rich freshwater fish biodiversity, very high domestic demand for fish, export potentiality to the neighbouring states as well as availability of suitable fish culture technology and competent human resource to man the sector. However the task is riddled with several inherent constraints. Ecological factors like chronic flood due to very high rainfall, low pH of soil and water and inadequate environmental temperature during the four winter months in particular (November to February) are the major factors that are hampering the growth of this sector. In addition, the culture fishery sector, in particular has been facing some managerial constraints, out of which unavailability of quality stocking material at the right time of stocking is one. The right time for stocking fingerlings in the ponds is March-April, when the environmental temperature in the state rises and the fish farmers can avail the maximum period of optimum temperature (April-October) for fish culture. On the contrary, the breeding season for the cultivable carp fish species normally commences from the last part of April with the advent of monsoon with rising ambient temperature and rain. As such fingerlings of right size for stocking become available only during July-August (taking 90 days rearing period to attain fingerling stage). On the other hand, with the advent of winter, the ambient temperature falls below the optimum and fish fingerlings when stocked in July – August can get the desired level of temperature only for 2-3 months up to October. To address this mismatching of environmental temperature and availability of fingerlings, it has become essential to advance the fish seed production for at least two months in Assam by scientific interventions. However there was dearth of scientific technology to advance the breeding and seed production.

   The cultivable carp species have specific annual breeding rhythm that coincides with the optimum environmental condition of the year. Environmental temperature is the key factor for gonadal development and breeding in these fish. A manipulation of environmental temperature and photoperiod length during winter season, when the fish are normally in early maturity stage may trigger rapid gonadal development resulting in early maturation and breeding. With this hypothesis a project had been formulated to study the feasibility of advance breeding through enhancement of environmental temperature by using UV stabilised LDPE film cover over pond and accelerate the gonadal development process for advance breeding, so as to ensure market availability of stocking size quality fish seeds during March-April for the fish farmers of Assam.

   It was expected that the development of the advance breeding and fish seed production technology would benefit two groups of entrepreneur, one the fish farmer or the fish growers and the other the fish seed producers and traders. The fish farmers can stock their ponds in right time and harness maximum productivity from available resources, whereas the fish seed producers can produce fish seeds well in advance to cater the need of fish seed traders and fish growers thus capture the market. The state of Assam currently has more than 60,000 ha pond area, as such the current need of fish fingerlings is around 500 million (under semi intensive level of
management). With the continuous horizontal expansion and vertical development of
the sector, the need for fish fingerlings will be much higher in coming days. Assam is
the feeder state for fish seeds for the entire NE region. As such to cater the need of the
growing fish culture sector of the Region, the fish seed production sector of the state
of Assam should be well equipped with technology for seed production in right time
and with right kind of quality.

4. Initiative:

Initiatives were taken to fill the gap of scientific information through a research
project with the following objectives:

1. Advanced breeding of carps through enhancement of environmental
temperature and manipulation of photoperiod
2. To ensure availability of quality fish seed at the right time of stocking (March-
April) for the fish farmers of Assam.
3. To study the economic and technical viability of the system.

Activities done to address the challenge:

1. A polyhouse was constructed (420 m²) by using UV stabilized LDPE film to
enhance and retain ambient temperature during winter so as to create an optimum
condition for gonadal development, growth and breeding of cultivable fish
species.

2. A concrete pond (320 m²) was constructed under the polyhouse where brood stock
of different cultivable fish species was raised during winter.

3. The polyhouse system was connected with a heater and filter system. The pond
water is passed through the filter then through the heater and the filtered and
warmed water is recycled back to the pond. This system was meant for enhancing
the water temperature to the desired level as well as to maintain the water quality.

4. The brood fish stock was supplied with balanced feed during the period of
culture.

5. Time to time health check up and gonadal development study, water quality
monitoring was done during the period.

6. A portable hatchery was installed inside the polyhouse for breeding of fish during
winter.

7. Induced breeding of different species was tried during December to February.

8. Successful induced breeding of Labeo gonius and L. calbasu could be achieved in
the month of February.

9. Seed raising trials were conducted successfully under polyhouse condition.

10. Fish seed (spawn and fry stage) has been distributed to different farmers of Assam
during February-March, which could address the problem of non availability of
fish seed at the right time of stocking.
11. The knowledge generated has been imparted with farmers, scientific community, entrepreneurs and policy makers through demonstration, publication as well as media coverage.

12. The system has paved the way for advance breeding of fish in this part of the country for availing the optimum temperature regime (i.e. April-September) for fish culture which will lead to higher productivity from the available resources.

5. Key result/insight/interesting facts:

Temperature enhancement could be achieved to the tune of 5.0 – 16.0°C in different seasons through the impact of the poly house as well as water recycling and warm water influx. The water temperature of the poly house pond was 24.0 – 28.0°C during the period of experiment, when the temperature of the control pond under normal condition had 8.0 – 22.3°C. The photoperiod in the poly house pond was extended to 2 hours by artificial illumination.

Rapid gonadal development has been observed resulting in early maturation of the brood fish in experimental pond. The maturation process as depicted by monthly Gonado Somatic Index (GSI) value for both sexes (Fig. 1 & 2) for both experimental and control ponds indicate faster maturation process in the experimental in comparison to the control. This indicated that the optimum water temperature prevailed in the experimental pond along with longer photoperiod, played a key role in accelerating the maturation process.

Based on the gonadal development study, the breeding period for the fishes was determined and induced breeding trials were conducted in the month of February, by using synthetic hormone Gonopro at standard dose and in two separate series of experiments using nylon hapa and using portable hatchery. The induced breeding trials was quite encouraging with 80-100 % spawning rate, 85-90 % fertilization rate and 90-95% hatching rate in hatchery and 80- 90% spawning, 75-93% fertilization and 73-83% hatching in nylon hapa system. This indicates that the effect of enhanced water temperature and prolonged photoperiod have significant positive impact on the fish stock by advancing gonadal maturity and breeding season by a minimum of two months.

The seed raising experiment conducted by using cages made of nylon nets (Fig-) also revealed higher growth rate by 48-60% and higher survival rate by 20-28% under enhanced temperature in comparison to the normal ambient temperature. Significant difference was observed in length of fish fry after raising for 15 days under different temperature (Fig-). This again supports the positive impact of artificially enhanced temperature on the growth and survivability of the fish seed.
6. Impact: Impact of the findings of the present study is found to be far reaching in addressing a critical issue that has been faced by the fish farmers of Assam, i.e. unavailability of fish seed at the right time for stocking. This study paves the way for bringing about the needed change in fish seed production sector to cater the market demand as well as in the aquaculture sector for higher production from available resources.

A good number of entrepreneurs are expressing their interest to adopt the technology of advancing breeding and fish seed production of cultivable fish species by setting up polyhouse pond and hatchery system. This would definitely help in mushrooming business enterprises at primary and secondary level.
The study also helps to find out the impact of enhanced temperature on growth, development and breeding in fish under the prevalent agro climatic condition of the state vis a vis to select the climate resilient fish varieties that can be cultured under changing climatic condition of rising environmental temperature.

7. Lessons learned:

i. The difficult task during the process was to maintain the water temperature during winter season when the ambient temperature was average 10°C. To address this challenge standardization of volume and temperature of recycled water (through regulation of the heater) according to the volume and temperature of water in the pond was done with trial & error method. Electricity failure was major problem which was overcome by installing generator.

ii. The original rubber water pipes of the system were found to be not suitable for hot water enhanced were replaced with cast iron pipe after one year of experiment.

iii. If the project is to be done again the area of the system should be increased to minimum 700sqm so that bigger sized brood fishes can be reared. To raise the fish seed produce in advance (during Jan-Feb) nurseries with polyhouse and warm water facilities is needed.

8. Supporting quotes and Images:

Photo-I: The polyhouse (420sqm) with filtration and heating systems constructed for artificial enhancement of environmental temperature for the study
Photo-II: Concrete pond (320sqm) inside the polyhouse lined with black polyethylene to prevent leakage, to enhance and retain water temperature.

Photo-III: Advance breeding trial by using portable hatchery system installed within the polyhouse. Observed and appreciated by Hon’ble Vice Chancellor, Dr. K.M. Bujarbaruah
Photo-IV: Seed raising trials conducted in enclosures fitted in polyhouse pond being observed and appreciated by Dr. G.N. Hazarika, Director of Research (Agri), AAU, Jorhat

Photo-V: Fish seed produced under polyhouse condition are ready for disposal to farmers during March, minimum two months advance then the normally produced seed.
9. Additional information:

i. The project was financially supported by Rastriya Krishi Vikash Yojana (RKVY), Govt. of India through the Nodal Unit under Directorate of Research, Assam Agricultural University, Jorhat during 2011-12.

ii. The reports on the achievements were published in different Newspapers, Annual reports of AAU, etc. Documentary evidence as follows:
**Advance fish breeding season, slash export**

**SMITA BHATTACHARYYA**

Jorhat, April 6. Fish farmers of the state may no longer need to buy fish fingerlings from outside the state if the Fisheries Research Centre under Assam Agricultural University succeeds in advancing the breeding time of cultivable fish species.

Around 50 crore fingerlings are required for the state. Bibhas Chetia Borah, senior scientist and in-charge of the centre, said in Jorhat, because of the climatic conditions, fish fingerling breeding from April-end and fish fingerlings became available only from June-July and do not grow adequately in winter.

The breeding season is in most of the cultivable fish species in the region generally confinement from the last part of April for climatic reasons. As a result, fingerling stage stock becomes available locally from the months of June-July. The growth rate of fish is reported to slow down with the advent of winter, that is, from October onwards, which means that fish fingerlings stocked in June-July get a very short span of optimum temperature (July-September) for their growth and development," Chetia Borah said.

The scientist said because of the unavailability of fish fingerlings at the proper time, farmers of the state were forced to buy fingerlings from outside.

This resulted in the increase in cost and the fingerlings were not of very good quality, either.

"The inter-crop of rohu is one of the major ecological constraints for low production of fish in the state. To overcome this constraint, the Centre put forth an innovative idea for advancing the breeding season of the cultivable fish species through scientific intervention," he said.

The proposal was mooted by AAI vice-chancellor K.M. Bajracharya, for advance breeding by increasing water temperatures by utilising solar radiation.

This came in the wake of the farmers' plea for early availability of good quality fish seed to the chief minister of Assam in his presence a few months ago.

A research project based on the one proposed by the fisheries research centre to want, which a fund of Rs 1 crore has been received under Rashtriya Krishi Vikas Yojana.

At the experimental stage, a 50-square feet poly house is with solar plates to enhance water temperature will be constructed and fishes of different species will be fed in.
AAU-bred fish grows just in time for Bihu

GUPTA BHARTANATHYA

On your grave.

Jorhat, April 19: If the Fisheries Research Centre at Assam Agricultural University here had worked to the same extent and with the same enthusiasm as the Jorhat-Bihu year, the year's bumper crop of fish would have been delivered to fish farmers ahead of Bihu.

AUA assistant director K.K. Bajracharya said the research centre had raised fish to spawn much ahead of the usual time under the actual climatic conditions in the North-east.

"This would allow the fish to grow and mature on a par with fish from other states with warmer climates. We have been able to supply fish breeders with live seeds for Bihu Bihu, and the fully grown fish are expected to fetch a high price," he said.

Bajracharya said the experiment came in the wake of an interaction with fish farmers in the province of Assam chief minister Sarbananda Sonowal a year ago when one breeder said that he could supply fry in February-March instead of the usual breeding season in May-June, when the weather becomes warmer.

"We worked towards enhancing the fish breeding season by raising the temperature and, in accordance with the usual climate, we set up a greenhouse where the water and air temperatures were increased up to the normal levels and the fry survived in daily raids. They spawned much ahead of the usual time," he said.

Bhu Otha Bora, scientist and curiam in charge, who had implemented the project, said in this sphere of research, they were ahead of other full-scale fish research institutes in the country where experiments had been conducted to advance the reproductive stage of fish eggs with and without diet.

"One of the reasons for low fish production was the adverse environmental condition during the peak period of fish breeding and growth, which leads to import of fish fry from outside the state. Fish being dependent on water temperature, which is more dependent on environmental temperature," he said.

Since the cold and dry climate during the post monsoon period in Assam is not ideal for fish breeding, it was seen that the reproduction period started in October and continued till July-August, which meant that the breeding season was too late for Bihu.

"The prolonged fish need is often low quality, as it gets transferred during long journey from the breeding site to fish farms in Assam. This caused heavy loss for the farmers," Bora said.

She said fish breeders could now adopt this technology and set up businesses to supply fry to fish farmers in Assam.
An innovative approach to address inadequacy in environmental factors for development of aquaculture in Assam

Authors
Bibha Chetia Borah* Ranjit Borah**
Department of Fisheries Research Centre
Assam Agricultural University
Jorhat-785002
Assam, India
Email: bchetia@jorhat.assam.gov.in
rborah@jorhat.assam.gov.in

The State of Assam: A glance

Assam, the second largest and the most populous state of North eastern Region of India is situated in the eastern Himalayan region between 24°47’ and 26°10’ N latitude and 91°90’ and 95°40’ E longitudes. The State covers a geographical area of 78,438 km² that forms 2.4 percent of the country’s total geographical area. As per 2011 census, the population of the State is over 3 crores (31,60,272 souls), which is the highest among the States of NE region and 2.65% of the country’s total population. The population density of the State (507/sq km) is 4% higher than the country’s population density. The State, with a literancy rate of 73.36%, as per 2011 census, predominantly depends on agricultural and allied activities for its economy. Around 86% of the population lives in rural area while some live below poverty line. Majority of the farming community (67.5%) is marginal farmers (occupational land holding below 1 ha) and around 18.3% are small farmers (occupational land holding 1.5-2.0 ha). The climate of the State has specific characteristics owing to several dominant factors such as orography, the alternating pressure cells of NE India and Bay of Bengal, the predominant maritime tropical air mass (mT), the rising periodic western disturbances and the local Mountain and valley winds (Borthakur, 2009). Humid and wet summer and mild to moderately cold dry winter are the specific characteristics of the climate of the State. The food habits of around 95 percent of the population is non-vegetarian with high preference for fish and fisheries products; the State has high potential for the development of fishery sector.

Fisheries potentiality
The State is bestowed with vast and varied aquatic resources covering around 2.94 lakhs ha of area that includes 2.1 lakhs ha of rivers, 1.8 lakhs ha of lakes, 43,349 ha of ponds and tanks etc. The State has a rich freshwater fish biodiversity comprising 216 species belonging to 90 genera, 20 families and 18 orders. A dominant background for the development of fishery sector prevails in the State by way of high demand for fish, sub tropical climate, available human resource and export potential to neighboring States.

Fish production trend
The fish production in the State has been exhibiting a steady upward trend during the last five years. There is a 28.2% enhancement in fish production during this period from 190.32 thousand MT in 2007-08 to 243.97 thousand MT in 2012-13 (Fig. 1). The fish production of Assam is the highest among the North Eastern States, contributing around 75% to the Region’s total fish production. Although there is substantial development in fish production in the State, the trend is not up to the level...
Fishing Chimes. Vol. 33 No. 7 / October 2013

Keep pace with some of the rapidly growing fish production States of the country like West Bengal, Andhra Pradesh, Uttar Pradesh etc. As per recent estimates of Fishery Statistics, the present annual fish production for the 95% population of Assam is around 32,000 MT. The gap between demand (326 thousand MT) and production (243,387 thousand MT) is met through importing from the above-mentioned States.

Inherent problems

Although the State has vast potential for augmenting fish production through culture, the task is hindered with several ecological and managerial constraints. Due to geographical location, the State is influenced by ecological constraints like riverine floods, low pH of soil and water, high intensity rainfall in certain areas as well as inadequacy of certain climatic factors that govern fish production. The floods in Assam are characterised by extremely large magnitudes, high frequency and extensive devastation. The State experiences four of flood every year with frequency of occurrence ranging from 2 to 5 times and the months of occurrence, extending from May to October. The State has around 5,251 fish ha of chemically fixed areas that include marshland potential fishery reservoir. The pH of soil ranges from 4.6-5.5 in most parts of the State which reduces seed productivity of soil and water to a large extent. 85-100% of soil in different districts of Assam is acidic in nature. At the same time, Lower Brahmaputra Valley has 91.3% and Upper Brahmaputra Valley has 96% of acid soil. Low pH of water in the State is one of the prime causes for poor fish production status which is because of the low growth rate of fish and the occurrence of diseases like KDA. The State receives an average annual rainfall of 2800-3500 mm except in certain rain shadow belt of Karbi Anglong and Nagaon districts. The highest rainfall is at 0.255 mm in Dibrugarh, while the lowest is at 0.02 mm, in Imphal. High intensity rainfall creates problems like overflow of water bodies, top soil loss of over 40%, and adverse impacts on soil and water quality, on transport and communication, and other activities related to fishery management. The trend of monthly mean rainfall pattern during last five years in Assam is depicted in Fig. 2.

While in the managerial front, unavailability of quality fish seed in the right time of stocking, unavailability of other essential inputs including fish feed, improper transportation and market facility, particularly in the rural areas, frequent power failures, unavailability of efficient craft and gears, lack of infrastructure for storage, processing, and value addition etc. are the major constraints faced by the fish farmers of the State.

Constraints due to climatic factor

- Inadequate ambient temperature: Fishes being cold blooded animals are more dependent on the environmental temperature than by warm blooded animals. Generally, the warm water fish species respond to a higher temperature of the environment by a faster metabolic growth rate. Due to prevailing cold and dry climate during winter season, the State is characterised by having a short period with optimum ambient temperature range required for growth and other biological processes of cultivable fish species during winter months only, i.e., during April to September. Major fish species cultured in the State are the carps i.e., Indian Major Carps, Asian carp like grass carp, silver carp, common carp and mirror carps like Catla and Grass. The optimal temperature range for growth and breeding of most warm water fish species lies between 26-30°C. With Assam, the range of temperature during the summer period varies from 13.6-29.4°C (minimum) and 23.5-38.2°C (maximum). Although the lowest level of minimum temperature during this season (Table 1) is not within the optimum range, the maximum temperature range (Table 2) is more on the lower side, which can explain the low productivity of the cultivable fish species.

On the other hand, during winter months i.e., from November to March, the minimum ambient temperature goes down to as low as 5-8°C in the State along with decrease in photoperiodic length, as recorded during the last five years (Table 3). The number of days having 5-16°C minimum temperature range during winter season (November-March) was recorded to be 8-30 during different months. December, January and February are the coldest months of the year having the minimum temperature of 5-16°C in almost all the days of those months during the last five years (Table 4). Hence, during those months the ethological growth rate, food intake and gonadal development of cultivable fish species are at the minimum level. This inadequacy in environmental factor has tremendous impact on the fish production as well as productivity of the aquaculture sector of the State as the growth rate of the cultivated fish species is generally slowed down with the advent of winter and decreases in atmospheric temperature from October onwards. The fluctuation in monthly mean temperature during the year 2008-12 is depicted in Fig. 3.7.

- Mismatching of availability of fish seed and culture period: Successful breeding of fish is the result of a variety of factors out of which environmental conditions are the most important. Reproduction in fish is therefore taken up in a particular season which guarantees the most conducive environmental condition for the process and also for survival of their progeny. Under the climatic conditions of Assam, the gonadal maturation cycle of the cultivable fish species (except common carp) generally commences from October and completes in July and the breeding season generally commences from April-May and extends to July-August with peak during May-June. With the advent of increased associated with the rising temperature and long photoperiod, the breeding of those fish species is greatly enhanced. As a consequence, fish seed of stockable size (49.0cm) produced in Assam become available from the month of June-July only. As such, the fingerlings stocked during the months of June-July get the benefit of optimal ambient temperature range before the start of the winter months (July-September) only. Assam...
Inauguration of poly-house for advanced breeding of carps
Fisheries Research Centre, Assam Agricultural University, Jorhat, Assam: 16 April 2013

Unavailability of right size of carp fish seed in the proper time of stocking is one of the major problems hampering the growth of aquaculture sector in the State of Assam. With the objective of advancing the gonadal maturation process and breeding season of carps through manipulation of environmental temperature, a poly-house made of UV stabilized LDPE film was installed at Fisheries Research Centre, Assam Agricultural University, Jorhat. This poly-house has been set up over a plastic-lined pond with all other amenities for enhancing and retaining the water temperature within optimum range during winter spell, as well as for maintaining the other important parameters in the fms structure of its kind in the country.

The poly-house for advanced breeding of carps at Fisheries Research Centre, Assam Agricultural University (AAU), constructed under the project, "Advanced breeding of carps through enhancement of environmental temperature by using UV-stabilized LDPE film (BS-6871), was inaugurated by Dr. S. Ayappa, HOD (Director General, ICAR) and Secretary, DARE, Govt. of India, in the presence of Dr. B. Monakomari, Deputy Director General, (Fisheries) ICAR, and Dr. K.M. Begum, Vice Chancellor, Assam Agricultural University, Jorhat on 16th April, 2013. All the statutory officers of AAU including the Registrar, Dean, Director of Extension Education, Director of Research, all the Heads of the Departments and faculty members of AAU and ICAR were present on the occasion. Senior scientists and scientists of the Centre, Dr. Bibha Chetia Borah welcomed them. Dr. S. Ayappa and Dr. B. Monakomari along with other dignitaries explained the objectives of the poly-house. The Vice Chancellor, AAU informed all the dignitaries present about the genesis of the poly-house concept for advanced breeding of carps. The Director General expected advanced production of fish seed during the early culture season from the next year. He further added that his department would facilitate production of needed quantities of the right size of fish seed at the right time. Dr. S. Ayappa congratulated Dr. Bibha Chetia Borah for the progress made so far and assured further help and support from ICAR for the development of fisheries research in the University. The dignitaries also released breed fish in the poly-house on that occasion.
Fifty six outbreaks of Classical swine fever were recorded in 17 districts of Assam. Lakhimpur, Sivasagar and Dhemaji districts were having 7 outbreaks each which were quite high. 
Peste-des-petits ruminants continue to be the emerging disease of goats in Assam and 7 outbreaks were recorded in 4 districts.
Not a single outbreak of Anthrax was recorded during the year.
ORF or contagious ecthyma is another emerging disease of goats in Assam and occurred in epidemic form in some districts of Assam mainly Kaziranga, Dhubri districts.
Among bacterial diseases of poultry, outbreak of fowl cholera was found to be the highest in Assam.
Ramikhet (New Castle Disease) is one of the major important viral diseases of poultry in Assam causing high mortality; a total of 15 outbreaks were recorded from 11 districts during the year 2013-14.
All total 9 outbreaks of Duck Plague were recorded from four districts of Assam.
Among helminthic disease, incidence of fasciolosis, paragonimiasis and anphistomiasis was recorded in all species of animals in different districts of Assam.
No clinical cases of blood protozoal infection in animals were recorded.
All total 501 serum samples from different species of animals like cattle, pig, sheep, goats were collected and tested for presence of antibodies against brucellosis, IBR, PPR and classical swine fever.
Detection of antibodies against IBR is a major concern although till now no clinical cases of IBR could be detected in field condition.

4.4 Fishery
Fishery research activities of the University are being carried out at Fisheries Research Centre, AAU, Jorhat (established in 1982) and College of Fisheries, Raha. The Director of Research (Agri) and the Director of Research (Vety) coordinate the fishery research activities. During the year under review, 5 research projects sponsored by different agencies were in operation besides quality seed production and balanced fish feed production. Some of the salient research findings are as follows:
The College of Fisheries, AAU, Raha has developed technology of ‘Fish Fichie preparation’ where bamboo shoot extract was used instead of vinegar. Chemical and Organoleptic studies indicated that the product remains in acceptable condition for six months. This low cost technology was transferred to MS Meghal Food Products, a Jorhat based entrepreneur on August 24, 2013 after signing an MoU between AAU and the entrepreneur. Finally, the product was launched on October 8, 2013 at AAU, Jorhat in presence of Dr. K.M. Bejbarhaniah, Hon’ble Vice Chancellor, AAU and other dignitaries of AAU.
Successful advanced breeding and seed production of indigenous minor carps, Labeo gonius and Labeo calbasu during February-March, 2014 through enhancement of water temperature during winter months by using polyhouse made of UV stabilised LDPE film and increasing photo period length through illumination (Fig. 4.33). The results will pave the way for seed production of cultivable species in advance which will enhance the availability of stocking material in proper time i.e. during March-April for the farmers of Assam.

4.5.18 Pox Viral Infections in Animals
A total of 30 orf (contagious ecthyma) samples (Pock lesion and serum sample) and 7 fowl pox samples had been collected from different districts of Assam and Nauvali. Out of 30 orf samples 28 samples (93.33%) and all seven (100%) fowl pox samples had been found positive.

Fig. 4.33: Advanced breeding and fish feed production under polyhouse.
A new digenetic trematode parasite, *Hapareochis hypodurostil* has also been identified from *Wallago attu* with morphometric and molecular characterization.

In a study on community based cage culture in 5 selected beelts of Nagaon and Morigaon district of Assam, raising fish seed for 45 days duration led to production of the fish fry stock with average weight of 0.4 g - 0.6 g and length of 2.0 cm - 3.0 cm and a phenomenal growth rate up to 10.0 cm - 22.0 cm in length. The survival rates of the fishes cultured in all the cages were also found to be more than 70% which was most encouraging as compared to the survival rates in rearing ponds.

Several fish samples were collected from the Thokra beel in Morigaon district by net fishing and population growth, breeding biology, recruitment pattern of *G. chapea* were studied.
iii. Dr. Bibha Chetia Borah  
   Principal Scientist & In charge  
   Principal Investigator of the project on ‘Advance breeding......LDPE film’  
   Fisheries Research Centre, AAU, Jorhat  
   Email: drbchetia@yahoo.com

iv. Further work on economic viability and popularization of the system need to carried out.