Current and Future Status of Fish Seed Production Industry in the State in Assam

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**An Overview on the Status of
Fish Seed Production in Assam**

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Abstract

Having over one hundred carp eco-hatcheries in Assam, at the private sector, the State is apparently capable of producing the required quantum of fish seed to stock all available water resources. Lack of any fish breeding plan in the hatcheries results in generation of genetic underclass carp seeds and leads to low production of fish in culture operations. Production of inter specific hybrids and release in natural water bodies has derogatory affects. Need of policy with support services to assure production of quality fish seed is stressed for the interest offish farming industry and sustainable development of the potential resources.

Introduction

In the developing countries fish is the single largest animal protein for augmenting the nutritional standard of-human diet. It is also one of the most important commodities of economic value to its producers and sellers. In the later half of the twentieth century there has been a phenomenal growth in production and trade in fisheries. However, evidence from around the world fisheries sector suggests that, as we are moving towards the 21st century, the majority of fish stocks will be over fished and increasingly impacted by degraded aquatic environment. All these are going to happen due to human activities. In the current transitional state, while fisheries scientists are seeking new technologies to improve state of fish production in captivity and to manage natural stocks in better ways, the time has come to frame policies and measures, whereby we might strive to increase and sustain the supply of fish for consumption and raise economic benefit from this sector. This is an area where significant policy improvements are needed at the Government level.

The North Eastern Region of India has immense potentialities for fisheries development. Studies conducted by the Agricultural Finance Corporation and the Central Inland Fisheries Research Institute (1991) indicate that the region can reach near self sufficiency in fish requirement, if the potentialities are properly utilized (Table I). The vast potential resources are still underutilized due to lack of concerted effort. Global experience suggests that land pattern, labour and fund do not constitute a fundamental problem for development of productive resources and managing them at sustainable level, when concerted efforts are made.

Culture Fishery Sector in Assam

Contribution from culture fishery to total fish production in Assam is less than twenty percent. Only a few selected fish farmers in the State are in a position to achieve fish production in the range of 2.5 tons/ha/yr. Size of operation, management skill coupled with technical knowhows and fund are some of the major constraints for commercial scale fish culture operations. However, the homestead pond fisheries may contribute substantially as the management skill is upgraded with a backup of training of the fishers and periodic monitoring. There has been a good effort in this direction from the concerned Government agencies and the State Institute of Rural Development.

Observations over the past years however, lead us to another bottleneck for progress of culture fisheries. On one hand, it has been an added advantage that during past two decades, more than one hundred eco-hatcheries have been developed in the state for carp seed production at the private sector. Millions of carp spawn are being produced by each of these hatcheries every season. Many of these hatcheries are located in Nagaon district and there has been a gradual development in other areas. Apparently a near sufficient status has been reached in the capability of producing carp fish seed in the State, without any foreseeable support from the government departments. On an average over hundred million carp seeds are produced by each of the private sector hatcheries every year.

Table 1 : Fishery Resources of the North Eastern Region

State	Rivers (Kms)	Reservoirs (Ha)	Beel/Lake Swamps (Ha)	Pond/mini Barrages (Ha)	paddy cum fish areas (Ha)
Arunachal	2,000	- (160)	2,500 -	250 (1,250)	575 (2,925)
Assam	5,050	10,730	1,00,000	22,500	- (20,000)
Manipur	2,000	100 (40,000)	40,150 -	5,000 (4,500)	- (10,000)
Meghalaya	5,600	8,430 -	375 -	500 (1,900)	85 (4,915)
Mizoram	1,700	32 -	- -	1,795 -	120 (1,440)
Nagaland	1,600	- (27,100)	215 -	500 (1,500)	2,000 (3,000)
Tripura	1,200	4,00 (1,500)	500 -	10,264 (3,136)	- -
Total	19,150	23,792 (68,760)	1,43,740	40,809 (12,286)	2,780 (42,280)

(Figures in parenthesis indicate resources that can be developed for fisheries)

The low survival and reduced growth potential of hatchery produced carp seeds are attributable to the following reasons, singularly or severally. (i). No selection of brood fish stock - even fishes of three hundred grams in weight, attaining maturity are bred in these hatcheries; very old fishes are also subjected to induced breeding. The generated spawn from such fishes of low growth potential and old aged ones are of degraded quality. (ii). No upgradation of brood stock - in most of the hatcheries there exist no definitive plan of up gradation of the brood stock. No genetic diversity is maintained among the stock. Rather over the years progeny raised from the same stock, are being subjected to induced breeding; thus drawbacks of inbreeding are evident in the hatchery raised carp seeds. (iii). Compounded with these two hurdles there is another factor - indiscriminate interspecific hybridization in eco-hatcheries. Almost all hatchery facilities do not have adequate number of ponds to raise brood fishes, species wise or to segregate. For one economic operation of the hatchery facility, a minimum of fifty kilograms brood fishes are required. Thus, no hatchery, produces single species spawn but always an admixture of all fish species available in the farm. This practice results in production of interspecific hybrids and purity of strains and species in hatchery raised carps practically getting lost over the years.

Years of experiments on polyculture of carps in the country resulted in a package of practice for assured level of fish production. These techniques are respondent to pure strains of carp species. So far we have no defined culture technology for different types of hybrid carps, which are being produced by these hatcheries. Indiscriminate production of hybrids is unethical and in the long run it may lead to loss of pure strain carps in hatcheries, as many of such hybrids have been found to be fertile. At the same time the hybrids are largely non respondent to the available culture technologies, to yield an assured level of fish crop.

Science and Ethics for Progress

To bridge the increasing gap between supply and demand of fishery products, scientists on one hand are working to produce super fish through selection and genetic improvement, while farmers are introducing more exotic species and in this case inbred stock and interspecific hybrids. Genetic engineering has many useful applications for agricultural crops and to a certain extent in animal husbandry and fisheries. However, there must be regulatory limits on its advancements. Over the years many genetically improved fishes have been created, having both advantages and disadvantages, from the parental stock. Genetically engineered animals should be no worse off than the parent stock and ideally be better off. So long as such created animals remain in confined laboratory or location for scientific studies, we are not confronted with ethical concerns. But in the context of aquaculture and fisheries management, reasons to produce genetically modified fishes or

release in the environment, have ethical concerns, with regards to value systems and ecological risks. Release of hybrid fishes into an eco-systemcontaining either or both parental species, introduce the genetic risks of back crossing and introgressive hybridization, as often the hybrid fishes are fertile. The effects of both these two biological phenomena are not at all beneficial.

Certain key issues posed by commercial scale production of genetically modified fishes in the hatcheries of the State have not yet been critically examined. However, based on the available knowledge of genetics, one foresees more disadvantages of uncontrolled interspecific hybridization.

To achieve certain degree of success in the agricultural sector the quality of seed plays an important role. The same is also true for pisciculture. In Assam, over the years the pisciculturists have understood the need of water quality management practices to certain extent for increasing the productivity of water. However, as is evident now, quality offish seed produced in the hatcheries is a questionable matter, it is not likely that the State would be able to progress in fish production, even if supporting services are provided. Thus stringent measures have to be adopted to produce certified carp seeds in days ahead. Policy must be framed to match advances in fish genetics and breeding technology and prevent generation of genetic underclass fish species by the hatcheries in order to achieve progress in fish production.

There is ample information and evidence that the fish hatchery operators of the State have endeavoured to cross the barriers set by nature, only for certain temporary economic gains but at the same time it is due to lack of any scientific exposure in fish genetics. Although no hatchery operator is concerned about the ethical aspect of producing genetic underclass fish species, it in turn is gradually bringing in a doomsday to the enti1"e fish culture industry in the State. We have no other alternative than to appreciate this. Ethical reflection has become an essential component of development of science and technology. Without an internal change in our own intellectual emphasis, loyalities to the society, affections to nature and convictions to human needs, we are not going to achieve any important change of our ethical considerations. At the same time ethical reflection alone will help us take stock of the critical status of fish seed production in the State at the fag end of the century and at least facilitate dialogues between scientists, government, hatchery operators, entrepreneurs and the public in general for the interest offish culture industry.

Measures Proposed for adoption

Examining the state of affairs of fish seed production in the State it has been felt necessary that certain steps the government has to exercise, to ensure production of quality fish seed very urgently. All carp eco-hatcheries in the State must be enlisted and registered as small- scale industrial units. All hatchery operators are facilitated with a comprehensive

training in brood stock improvement technology, fish genetics and breeding technologies. Applicable tax holidays are provided only to those hatcheries, who ensure quality fish seed production through a definitive and verifiable fish breeding plan. Production of quality seed by the hatcheries are monitored by the concerned department involving scientists, NGO (s) and extension specialists. Development of new eco-hatcheries are restricted in absence of definitive plan based on need of the locality duly approved by concerned department and registered.

It is necessary also to consider another aspect, while exercising the suggested measures. Almost all the existing eco-hatcheries were developed by the private sector fanners and hardly there is any governmental support at the time of infrastructure building. All these operating hatcheries are source of income to the owners and they also provide source of employment to a large number of seed growers and fish seed sellers. The present status is that no matter what quality of fish seed they are growing or producing, almost all ventures are economically viable and profitable. Therefore, there has to be some support and incentives for the hatchery owners to encourage them to adopt the measures for upgradation of the brood stock and produce pure strains of carp seed. Framing policies and adoption towards advancement of fish breeding technologies to generate quality fish seed alone are not likely to bring in an impact in the long run and ensure quality seed. This is a sector in which the concerned department could not retain its hold and control and the private sector intervened in such a big way that without the active support of these private hatcheries future prospective plan offish culture in the State cannot be thought of. Thus it is necessary that the hatchery owners have to be motivated and in the process some incentives and support have to be offered. It is also true that none of the hatcheries require financial support or incentives for the basic infrastructure is already there. The incentives has to be in the line of marketing facilities to group of hatcheries, cooperative activities and support service for periodic replenishment of the brood stock from known sources. On the basis of a realistic assessment a definitive plan can be framed in this regard for adoption by the government. It alone shall safeguard the prospects offish culture industry in the State.

We are running. out of time, the twenty first century shall be the age for knowledge based society; our available scientific knowledge towards sustainable growth of culture fisheries in the State shall be feasible only on assurance of production of quality fish seed, as has been assessed.

Fish Seeds: Quality V s Quantity
A Practical Approach to Quality Fish Seed Production

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Abstract

Genetic deterioration has lately been reported in hatchery population. This may be due to poor brood stock management, unconscious negative selection of brood stock, mating female and male spawners from a finite population, unplanned cross breeding in hatchery stock, close mating of spawners (possibly brother and sister or parents & offspring) resulting in inbreeding etc.

The paper highlights the genetic erosion occurring within hatchery population and suggests measures to reduce its dangerous impact on aquaculture production in Assam. The paper also recommends setting up of a State-level network among the farmer seed producers, Govt. officials and scientists concerned for development of a sustainable fish seed production industry in the State of Assam. This paper is rather written in the form of manual for its practical application.

Introduction

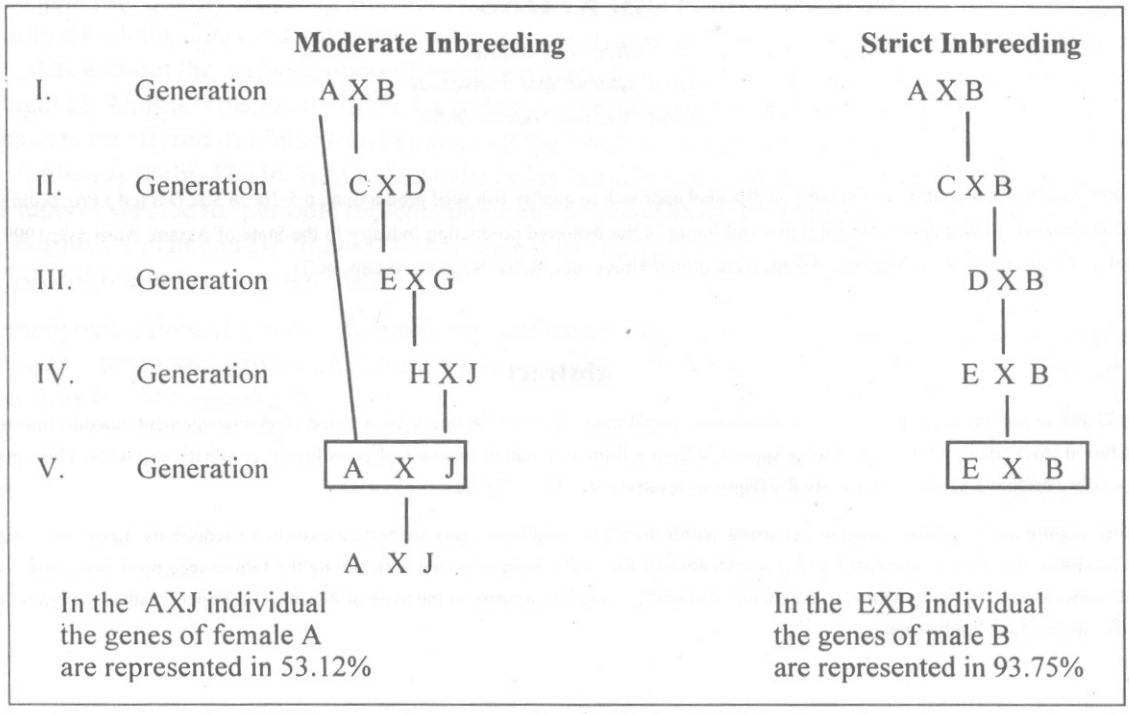
Induced breeding offish is no longer a complicated technique. In Assam, a large number of hatcheries estimated over 100, have already been established based on the Chinese design in the private sector and presently contributing to more than 95% of the total spawn production. Although, the State department of Fisheries reported that during 1997-98, the State produced about 2245 million fry-sized fish seeds from these hatcheries, the market fish production has not improved significantly. If 20% of the produced fry-sized seeds survived to the stage of market size (assumed: each fish on average grows to 500 gms in 1 calendar year), the annual fish production would have increased to about 2.241akh tons. However, the current fish production of the State from all sources is stated to be 1.55 lakh tons. It is assumed that either there is a large-scale mortality during the early stage of fish or slow growth of the produced seeds. Lack of quality fish seeds may be one of the primary reasons for the low fish production in the State, as the fish seeds of desirable quality is the basic input for aquaculture in tanks, ponds and for culture-cum capture fisheries.

Neither the State Fisheries department nor any research institutes have earlier taken any initiatives to create an awareness on these issues and monitor the hatchery activities. If the unplanned breeding activities are allowed to continue, it will jeopardize the seed production industry of the State. Already to some extent, the gene pools of our indigenous varieties of carps viz : Rohu, Catla & Mrigal have been contaminated. As a result, in near future it is feared that pure seeds of these indigenous carps, endemic to this region shall gradually disappear from the culture system.

In many hatcheries of Assam, every year initially only the fast growing fry or fingerling sized fish seeds are sold and surplus unsold seeds are stocked in ponds at a high density. Some of these fish seeds showing comparatively slower growth rate' are reared in ponds until they attain sexual maturity. Selection of brood fishes from this stock may be termed as negative selection. If such small-sized brood fishes are considered for induced breeding, due to heredity factor, the resultant off springs shall not only exhibit slow growth rate but also shall be weaker and most shall die before attaining stocking size.

Most hatchery operators do not have a planned & systematic breeding programme and breed Catla, Rohu, Mrigal, Gonius etc. in a single breeding pool. Due to identical chromosome numbers, hybrids are often produced among these closely related species in hormonally induced breeding programme. If such unplanned breeding of indigenous carps is allowed to continue, the resultant hybrid seeds arisen out of mixed spawning may lead to ecological disaster when escaped to natural waters during monsoon. Although, the actual data on production of hybrid carps and their status are not available, the situation is very alarming as almost all the seed producers are engaged in mixed spawning.

Fig. 1 : Methods of inbreeding within the same population (source : J. Bakos)



Selection of brood fish

While selecting brood fish for spawning, small size and young fish should be avoided. Although most carps attain first maturity in their 1 to 2 years, there is an optimum age and weight at which they should be selected for induced breeding. Table 1 shows suitability of various cultivable carps depending on their weight and age.

Table. 1

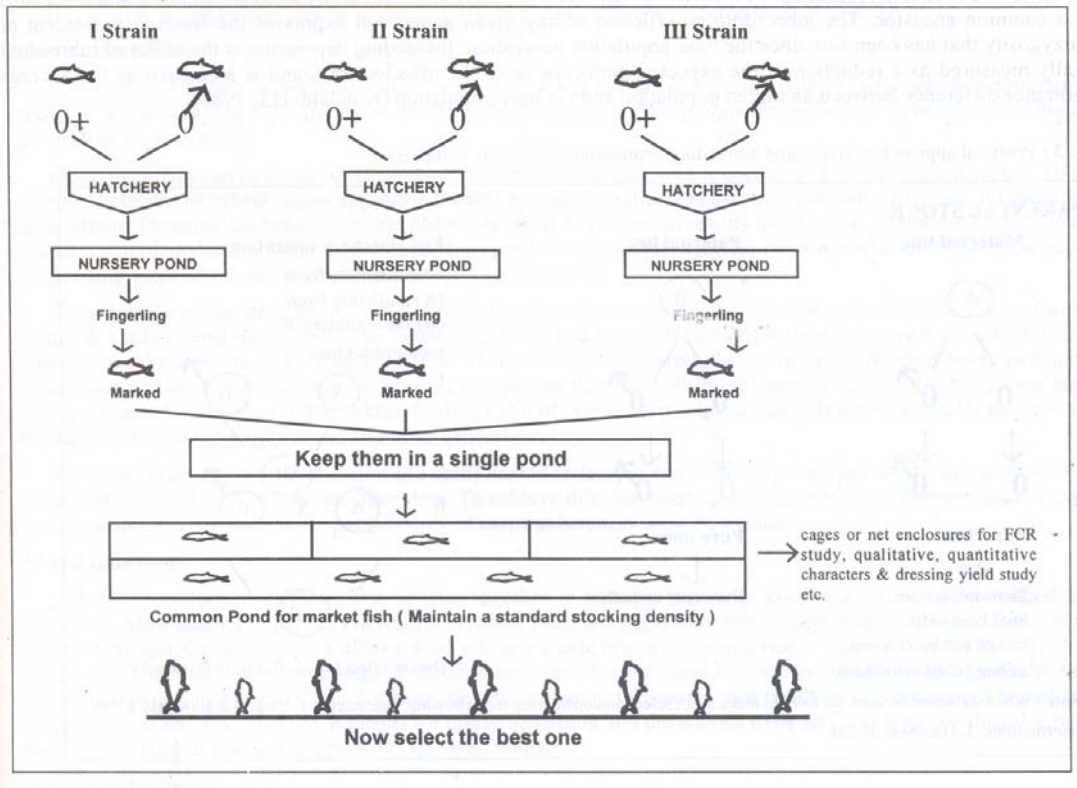
Fish Prices	Weight (kg)	Age (Yr)
Catla	>3.0	3
Rohu	>1.0	2
Mrigal	>1.0	2
Grass Crap	>2.0	2
Silver Carp	>1.5	2
Common	>1.0	1

Individual selection should be the basis for collecting young brood fish candidate. In the individual selection, it is necessary to know about the

- Origin of population
- Performance of the given strain
- Typical external characteristics of species

After selection, the young brood fishes are kept under optimal conditions before choosing the most appropriate female and male individuals for hatchery operation.

Fig.2 : Performance testing of different Strains



Line Breeding

Line breeding is the way of developing breeding lines from outstanding female and male parents. A male with good quality in his trait has great importance as a family founder in development of a new population. To develop an inbred population, conscious and strict selection should be done to remove or cull the genetically declined individuals.

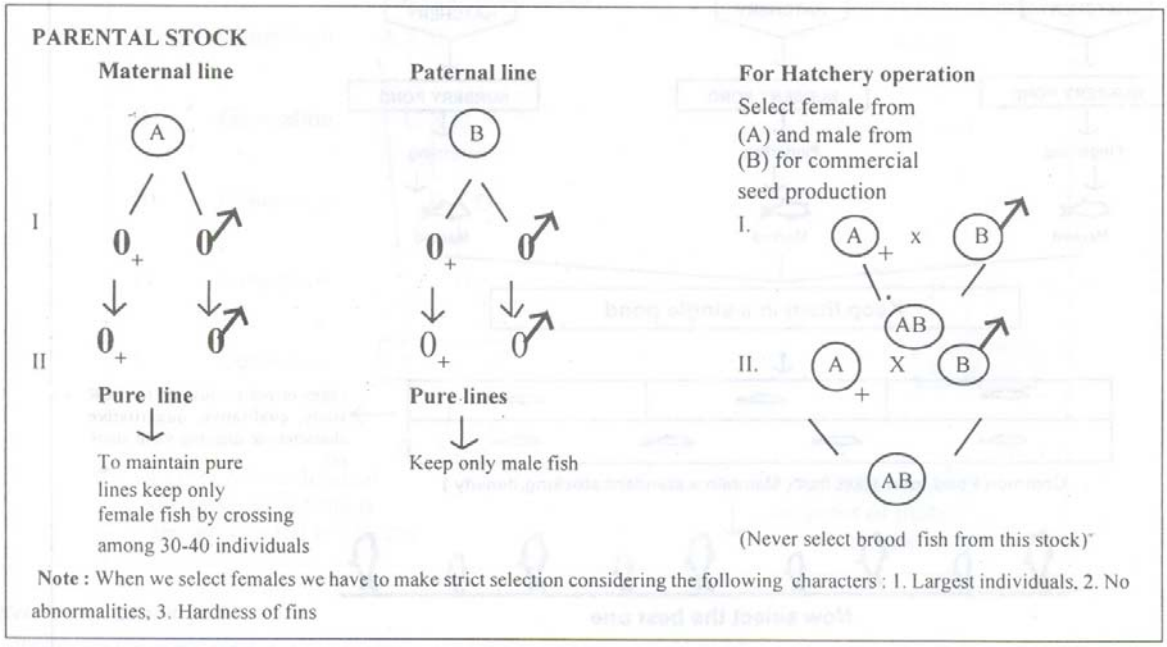
Inbreeding

Any fishery operation that results in a limited number of fish being available to produce progeny for use as brood stock in the next generation may lead to a constriction in the gene pool of that population, either in a hatchery pr in a natural fishery. One of the genetic erosions occurring in the most hatchery of Assam is the crossing between closely related species, such as crossing between brother-sister or parents - offspring. Pairing relatives or genetically similar individuals is termed as inbreeding which results in homozygosity. In fish culture, harmful effects of inbreeding appears moderately because of the high number of offsprings. Effects of inbreeding in fish population as a result of some of the recessive alleles are as follows:

a) Fish growth is retarded.
b) Reproductive capability is reduced (eg: fecundity, egg size, hatchability)
c) Offspring may show low survivality, deformities, poorer growth, less food conversion efficiency or may even suffer from various diseases.

It is reported that in case of sib crossing at the F I generation itself overall quality is reduced. Fig. I shows two different types of inbreeding. Inbreeding is measured by a value called "the inbreeding co -efficient" which is normally represented by the symbol "F". The inbreeding co-efficient (F) is the probability that two alleles at any locus are identical and descended from a common ancestor. The inbreeding co-efficient of any given generation expresses the fraction or percent of heterozygosity that has been lost since the base population generation. Inbreeding depression is the effect of inbreeding normally measured as a reduction in the expected performance of the affected trait, and is measured as the average performance difference between an inbred population and the base population (Kinclaid, H.L.I983)

Fig. 3 : Practical approach to overcome inbreeding depression (Guided by J. Bakos)



Note : When we select females we have to make strict selection considering the following characters : 1. Largest individuals, 2. No abnormalities, 3. Hardness of fins

How to avoid inbreeding depression

- Hatchery operators should have detailed informations on pedigree of brood stock.
- Cultured populations should be identified using a proper marking system. Females & males have to be originated from two different lines.
- Inbreeding in commercial fish farm should be handled carefully or avoided.
- Individual fish with poor constitutional conditions or anatomical abnormalities should be culled.

Cross breeding (Hybridization)

Mating of two different genotypes offish during induced breeding is termed as hybridization. Crossbreeding does not create new genes; only the combinations will appear in the gene pools of two parents. Interspecific or intergeneric hybrids can be produced crossing a female and a male having different origin in its species or genera.

Intraspecific crossing occurs through mating a pair of fish originated from the same species. Parents used for cross breeding are selected by several aspects:

- Pairing two individuals outstanding in two different characters eg: survival and growth rate which may be realised in the FI progenies hopefully.
- Pairing two individuals outstanding in the same character to faster or improve this trait in the F1 hybrid and become more heritable.
- Attain positive heterosis effect suitable for production.

Single cross

It is used to improve one special property through mating with the selected male at a given time.

Species transformer

It is a cross breeding between two individuals to develop new progeny. This type of cross breeding programmes are based on a male, having high quality of quantitative characters and its proportion in the new hybrid become higher from generation to generation.

Heterosis effect can be observed if some of the characters appear on a higher level than its original parent. The special effect of heterosis or hybrid vigour appears in the first hybrid generation and decrease gradually in the second and subsequent generations. Crossing for heterosis effect has not resulted in successful results in all cases. Sometime F1 progenies show poorer results than the parental lines. To obtain high productive heterosis hybrids; professional knowledge, good experience; in breeding work and to some extent luck factors are essential.

Considerable works on interspecific hybridization have been carried out in India and out of all, the performance of Rohu & Catla hybrid was found to be better than Rohu and poorer than Catla interms of growth. Unlike Indian Carps, Chinese carp hybrids are rarely found in nature. However, Chinese carp hybrids are easily & often developed in hatchery sometimes aimlessly without any purpose. It is reported that the hybrid between Silver and Bighead carp has strong disadvantages. Firstly, the phytoplankton feeding habit of Silver carp is lost in the hybrid and secondly the growth rate is decreased drastically in the second and third generation.

The cross breeding or hybridization is a complicated technique which involves multigenerational studies to obtain a most useful hybrid with all desired characters. To achieve this, one needs to have professional knowledge and experience in fish geneties. Therefore, the cross breeding of carps at hatchery must be avoided.

Mixed spawning

Induced breeding of different fish species together in a single breeding pool at a time may be termed as mixed spawning. Most hatchery operators in Assam in recent years are engaged in mixed spawning of different fish species, such as Rohu, Mrigal, Catla, Gonius, Calbasu, Bata etc. in a single operation giving rise to many unknown hybrids. Although, the origin of hybrids, their percentage production and reproductive capability are yet to be studied, gradually 1he native carps such as Rohu, Mrigal, Catla, Calbasu, Gonius are being threatened as a result of this unplanned mixed spawning programme. (Das, S.K. 2000 b). Reasons for mixed spawning and the actions to be taken to stop this illegal activity have been highlighted in a separate report by Das, S.K. 2000a.

What is to be done?

The basic input for quality seed production in a hatchery is the healthy brood fish. Initially different strains of a fish species should be collected from various sources of origin.

The fish seeds produced from different strains at a hatchery should then be marked and reared to the size of fingerling. Detail study must be conducted on FCR (Food conversion ratio), growth, quantitative & qualitative characters etc. before selecting them to rear as brood fish as shown in Fig: 2. In a hatchery to maintain a commercial fish population, two lines "A" & "B" would be ideal to keep simultaneously in closed groups with strict selection in every generation. Females can be selected from line "A" and males from line "B" for providing brood fish to produce good quality seeds for market fish production (Fig.3).

Recommendation

Immediate Measures:

1. Only fast growing fingerlings should be maintained to use as brood fish.
2. Hatchery operators must keep the brood fish under optimal conditions and choose the most appropriate well maintained young brood fish fed with nutritious diets for spawning to ensure better quality of seeds.
3. Breeding of small sized (both age & weight) brood fish must be avoided.
4. Hatchery operators must stop inbreeding (brother-sister and parents-offspring crossing) and avoid the tendency to cross breeding of different carp species.
5. Carp fingerlings may be collected from the river and may be grown to supply as brood fish.
6. Hatchery operators-should form a network for exchange of their brood stock, ideas, technologies etc. among themselves with supports from concerned scientists and Govt. officials.
7. Develop more economically viable small-scale hatchery facilities for resource-poor / marginal farmers. This shall enable the seed producers to breed fish species wise as the requirement of brood fish can be reduced in a small-scale hatchery unlike the large-scale hatchery where in more than 50 kg of brood fishes are required for a single operation.

Long term measures **:**

1. Establish a live gene bank in Assam atleast initially for the IMC (Indian Major Crap, Viz. Catla, Rohu & Mrigal) to supply pure strains of these indigenous carps. Govt. may support establishing such facilities.
2. Fish seed producers, hatchery operators should be trained on appropriate technologies concerning selective breeding, brood stock management etc.
3. Initiate participatory research with farmer hatchery operators on induced breeding, selective breeding, line crossing, hybridization, nursery management, transportation etc. The Government or Financial Institutes should help in establishing field laboratories for the purpose.

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Genetical Aspects of Carp Seed Production
What the Breeders Should Know!

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Abstract

Breeding is the practical aspects of the science of genetics. By practicing artificial breeding, the breeders change the gene pool of a fish population knowingly or unknowingly. Gene pool is modified consciously by selective breeding offish for some commercial gain such as increased growth rate or disease resistance ability. On the other hand, due to the lack of awareness on the principles of genetics, the breeders tend to misuse fish gene pool due to improper breeding practices like mixed spawing or the use of low number of broodstock for breeding. Use of low number of brooders cause inbreeding and genetic ~rift, which reduce the genetic quality of fish seed. The practice of mixed spawing leads to inadvertent hybridization in. the hatchery causing genetic pollution in the precious carp species (Catla, Rohu and Mrigal). The long term impacts of genetic pollution will be reduction of genetic diversity in these species. In this article, improper breeding practices done in carp hatchery will be discussed: Also, some suggestions are made for the fish breeders to avoid these unwanted practices so that the genetic health of the carps are not affected. The methods of genetic improvement of fish stocks are discussed briefly.

Introduction

The primary goal of aquaculture genetics is to produce" quality fish seed". In genetic term, 'quality seed' may be defined as "those having better food conversion efficiency, high growth rate potential, better ability for adapting to changing environmental conditions and to resist diseases' (Padhi and Mandai, 1999). It is anticipated that culture of 'quality seed' will improve aquaculture productivity further.

Seed production is a complex art. It requires knowledge on hormoneimtuced breeding, population genetic principles and the art of hatchery and nursery management. The seed production technology can be described under following points:

(a) Broodstock collection and management, (b) Artificial breeding, (c) Hatchery and nursery management

1.1 Broodstock Collection and Management: Collection of broodstock in adequate number, cataloguing of their geographical origin, their genetic characterization and maintaining their

pedigree record are important pre-requisites for breeding programme. These aspects are of much genetic relevance which will be elaborated below. Further, proper feeding of brood stock and their health maintenance are some important management aspects.

1.2 Artificial Breeding: Artificial breeding has hormonal and genetic components. Treatment of appropriate dosage of gonadotrophin (e.g. crude pituitary extract) or any other inducing agent like gonadotrophin releasing hormone (GnRH) analogue (e.g. Ovaprim) is required for obtaining gametes for artificial fertilization. Artificial fertilization can be done by handstripping or seminatural breeding. Handstripping involves mixing of milt and eggs on a petridish or a tray for artificial fertilization. This process is laborious. On the other hand, semi-natural breeding allows the hormone induced fishes to spawn on their own in a "breeding pool". This type of spawning practice is more covenient and economical.

Artificial breeding has genetic implications, which can be understood by comparing natural breeding with artificial breeding (Table I).

Table 1 : Natural breeding and artificial breeding : A Comparison

Natural breeding	Artificial breeding
1. Mating occurs at random. The population size is large.	1. Mating guided by breeder's choice few broodstocks are used.
2. High Competition for food and alertness to evade prodators.	2. Food plenty and no predator.
3. High mortality in fish is compensated by high fecundity.	3. High fecundity but mortality rate reduced by hatchery management. High survival rate in hatchery make fish prone to inbreeding.

Artificial breeding leads to domestication and brings about changes in fish gene pools. Thus, the breeders are liable to do mistakes if they are not aware about the population genetic aspects, which are discussed below.

1.3 Hatchery and nursery management: Fertilized eggs need conducive environment for proper embryonic development. In fish farms it is provided in 'hapa' or in 'hatchery'. It takes about 16 hrs at 26° C for the hatching of the fertilized eggs of Indian major carps.

The 'hatchlings' or 'spawns' have indogenous feeding machinery in the form of 'yolk sac', which provides food to the hatchlings for 72 hrs. Then there occurs a shift from endogenous to exogenous feeding. Thus, nursery management assumes great significance, which involves subtle measures that ensures the availability of food and conducive limnological conditions.

Thus, seed production involves biological, hormonal, limnological and genetic aspects. In this article, the genetical aspects of carp seed production are examined. However, it will be

useful in the beginning to analyse the genetic aspects of current carp breeding methods to point out the lapses. Later, genetic aspects of carp stock improvement are also discussed.

2. *A genetic appraisal of Indian major carp breeding practices*

Breeding is the practical aspects of the science of genetics. By developing the ability to breed fish, the breeders have acquired the capability to play with fishgene pools. It is noted that due to ignorance, genetical aspects are not properly cared by the breeders. It was first revealed by two seminal research papers published by Allendorf and Phelps (1980) and Ryman and Stahl (1980). The adverse impacts due to improper breeding practices can be summarized in following points :

a. Inbreeding, b. Genetic drift, c. Mixed spawning

2.1 Inbreeding: The mating between the closely related individuals leads to inbreeding. It increases the proportion of homogeneous individuals in a population. An example is illustrated in Fig.1, which considers a hypothetical population consisting of a predominant proportion of heterozygous (Aa) genotype. It shows how the mating of close relatives leads to the reduction of heterozygosity to 1/8th proportion in three generations.

Fishes are more prone to inbreeding in hatchery environment for their high fecundity. For example, the species of Indian major carps can produce about 0.25 million eggs per female per breeding season. The hatchery environment ensures high rate of survival in the absence of competition for food and challenges from predator and (parasite. So, logically speaking broodstocks in a carp hatchery can be obtained from a single pair of parents. If the broodstocks are not exchanged or replaced, the hatchery manager will breed the close relatives. This has happened in some Indian major carp hatcheries in Southern India, where the brood stocks remained genetically close. The inbreeding rate in these hatcheries were found to be between 2 to 17% (Eknath and Doyle, 1990).

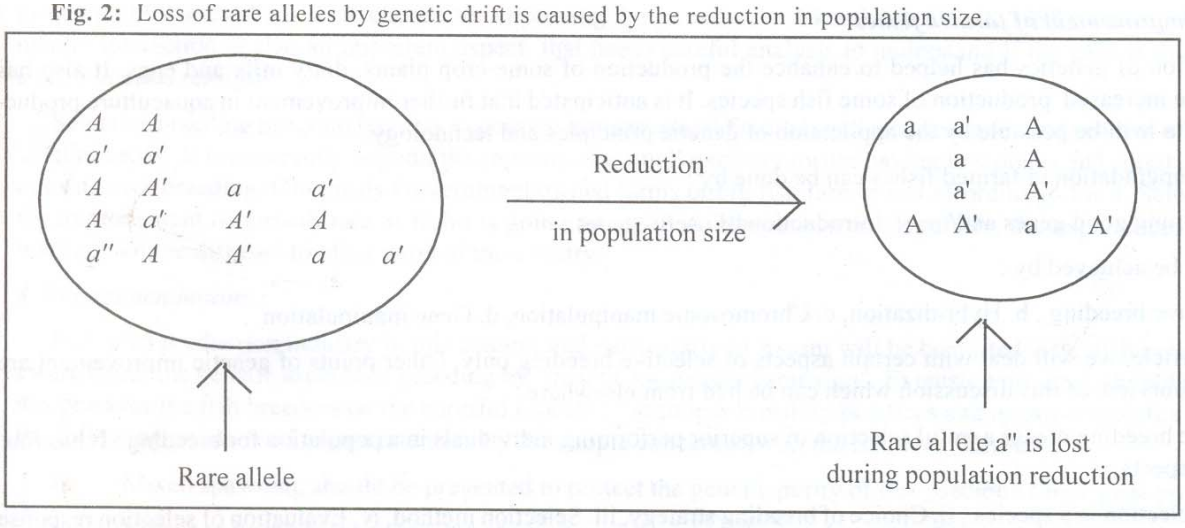
The effects of inbreeding was examined in several species of fishes including common carp, channel catfish zebra fish etc. by sib-mating (Bondari and Dunham, 1987; Padhi and Mandal, 1994). Now it is well known that inbreeding leads to reduction in growth, food conversion efficiency and survival rate and increased production of abnormal offspring. This phenomenon is called inbreeding depression. For example one generation of inbreeding in common carp reduced 10-20% in growth rate.

Fig. 1 : Inbreeding reduces the level of heterozygosity. It may be noted that heterozygosity level get reduced to half after each generation of inbreeding.

Generation	Genotype	Heterozygosity level
Parents	Aa X Aa	1
F1	¼ AA ½ Aa ¼ aa ↓ Aa X Aa	½
F2	1/8 AA ¼ Aa 1/8 aa ↓ Aa X Aa	¼
F3	1/16 AA 1/8 Aa 1/16 aa	1/8

2.2 Genetic drift: In carp hatchery few broodstocks are used for breeding at a time, which leads to *genetic drift.* It is a phenomenon that leads to a random changes in the gene frequency in a founder population, which may not carry some alleles due to sampling error (Fig.2). The loss of alleles reduces genetic variance in the hatchery population. Allendorf and Phelps (1980) first addressed this problem of hatchery practices leading to genetic drift in Cutthroat trout *Oncorhnchus clarki* (Wallbum). They showed the loss of alleles due to genetic drift by comparing the allelic frequencies in hatchery and their wild relatives. Genetic drift makes a population unfit for selective breeding as occurred in case of Tilapia nilotica. It was also found that genetic drift led to the extinction of certain strain of channel catfish (Tave, 1991).

Fig. 2: Loss of rare alleles by genetic drift is caused by the reduction in population size.



2.3 Mixed spawning: Polyculture of Indian major carps, Catla, Rohu and Mrigal, is a customary practice recommended by the fishery scientists for obtaining high production per hectare of water bodies. This naturally prompts the fish farmers to ask the fish breeders for supply fish seeds of these species in a desired proportion. For example, if Catla, Rohu and Mrigal are the only components of polyculture, the recommended proportion of seeds in these species is 20,60 and 10, respectively (Jhingran, 1985). Artificial breeding of these

fishes is generally done in 'breeding pools' in modern farms. These species are hormonally induced and released together in the 'breeding pool' to spawn on their own. This practice is called as 'mixed spawning' (Padhi and Mandai, 1994).

Mixed spawning leads to hybridization inadvertently because of their genetic kinship (Padhi and Mandai, 1997). These species produce inter-generic hybrids in nature and under captive breeding condition (Tripathi, 1992). The identical chromosome number, identical isozyme gene expression, and ease of producing fertile hybrids on a large scale indicate their close genetic relationship. Further the synchronization of spawning time of these carp species occur due to hormone treatment, also enhances the incidence of hybridization.

Hybrids of these species are not much beneficial from cultural point of view (Tripathi, 1992). Inadvertent hybridization between IMCs and backcrossing of F1 hybrids with parents would cause genetic introgression, causing genetic contamination of their gene pools. This 'genetic pollution' will affect the genetic diversity and genetic integrity of these species. As a result it will bedifficuJt to get pure stock of 'Catla' or 'Rohu', which will affect selective breeding program for genetic improvement in future.

2.4 Simple measures to avoid improper breeding practices in the hatchery :

i. The broostocks should be partially replaced periodically in hatchery. Exchange of brood stocks between the local hatcheries is an useful way.
ii. Broodstocks of different age groups should be bred together. This helps in reducing the chance of loss of some valuable alleles due to genetic drift.
iii. Natural stocks may be inducted periodically to increase the heterozygosity.
iv. The cryopreserved spermatozoa may be used, if possible, to maintain heterozygosity in the hatchery population.
v. The pedigree record should be maintained to avoid the mating of close relatives.
vi. Crossing of different lines of fishes would increase heterozygosity. Separate lines of fish can be maintained by keeping the record of the families of different strains bred in the hatchery. .
vii. Indian major carps should be spawned separately in the breeding pool to avoid inadvertent hybridization between these species.

3. *Genetic improvement of farmed fishes*

Application of genetics has helped to enhance the production of some crop plants, diary milk and eggs. It also has helped in the increased production of some fish species. It is anticipated that further improvement in aquaculture productivity in India will be possible by the application of genetic principles and technology.

Genetic upgradation in farmed fishes can be done by :

i. Combining good genes and/or; ii. Introduction of useful genes.

This can be achieved by :

a. Selective breeding, b. Hybridization, c. Chromosome manipulation, d. Gene manipulation

In this article, we will deal with certain aspects of selective breeding only. Other points of genetic improvement are beyond the purview of this discussion which can be had from elsewhere.

Selective breeding means careful selection of superior performing individuals in a population for breeding. It has four important aspects:

i. Trait selection in a species, ii. Choice of breeding strategy, iii. Selection method,

iv. Evaluation of selection response

Growth rate, disease resistance and age of maturation are certain economically important traits. However, growth rate is the most important trait in cultured fishes, including IMCs.

Selective breeding program intends to exploit the existing natural genetic variation in a population by combining together the good genes present in it. Genetic variation in a population are of two kinds: additive and non-additive genetic variation remains stable for generation, but non-additive variation is disrupted every generation. By *Pure breeding* additive genetic variation is exploited and by *cross-breeding/hybridization* non-additive genetic variation is utilized for genetic improvement.

For pure breeding, superior performing individuals are selected. The selection of better individual in a population is based on their *breeding value* i.e. how much superior the selected individual from the population average. The breeding value is estimated from the mean phenotypic value. Since the phenotypic value is influenced by environmental factors, it is difficult to estimate the genetic component of a trait. The genetic worth of an individual brood stock can be judged by several methods: (i) mass selection; (ii) between family selection; (iii) within-family selection and (iv) combined selection.

Mass selection is the simplest form of selection, where the best individuals are selected from a population on the basis of their own 'phenotypic value' compared to the population means. Generally the top 10 to 15% individual are selected.

Between-family selection: Of the several families only those showing good phenotypic value are selected.

Within family selection: Here each family is considered a sub-population and individual from a family are selected or culled based on their relation to their family mean. This method is more efficient than the above two methods.

Combined selection: Within family selection and between families selection can be combined in a single program where best individuals of the best families can be bred together. The advantage of this method is that the additive genetic variation between and within the families can be exploited to have a better selection response.

Selective breeding programme has helped to improve the aquaculture productivity of Atlantic Salmon in Norway, Channel catfish in USA and *O.niloticus* in Phillipines. By mass selection the body weight in *o.niloticus* could be increased to about 15%. However, selection

for growth rate was either unsuccessful or showed a negative impact in certain cases. For example, five generation of selective breeding for increasing the growth rate in Common carp in Israel had led to decrease in the body size. This was due to lack of genetic variation in the domesticated population.

Selective breeding is a very tricky, expensive and laborious task. It requires knowledge on fish biology, reproduction and genetic aspects. Without sound knowledge on these aspects the breeders may do certain mistakes. In lieu of gaining, he may go for negative selection that will reduce productivity. This has happened in fish farm in South India, where slow growing older individuals were chosen for improving the growth rate (Eknath and Doyle, 1990). Genotype and environmental interaction is also an important aspect that needs careful analysis to understand if the gain is due to genetic or environmental reasons.

Selective breeding program requires expensive infrastructural facilities and also needs several years of effort to develop 'quality seeds'. It is apparently beyond the capacity of a small hatchery owner having few ponds and small capital to carry out selective breeding. Obviously Government owned farms or big fish farmer can afford to go for it. Selective breeding for improvement of growth rate in Rohu is going on at CIF A, Bhubaneswar. Hopefully, the experiences gained at this institute will be diffused to other parts of the country.

4. *Recommendations:*

Fish seed production industry in this country and particularly in Assam will be benefited if the fish breeders are made aware about the genetic aspects of breeding by "genetic awareness campaign". Extension program should be specifically designed for the fish breeders on the harmful aspects of improper breeding practices and negative selection. Besides this, the following points need urgent attention by the people concerned with the fish seed industry:

i. Mixed spawning should be prevented to protect the genetic purity of our 'precious carps' gene pools.
ii. Efforts to be made, as suggested above, to reduce inbreeding and genetic drift in the hatchery.
iii. Broodstock collection and maintenance centre should be set up at Government's initiative to carter the need of brood stock by the fish breeders.

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Magur Breeding and Hatchery Management

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Abstract

The Asian catfish *clarias batrachus* (Magur) is one of the highly sought after fish of the fish eaters of the entire North East India. The non-availability of its stocking material from the natural resources is considered one of the main bottle neck for the fish farmers not adopting to its culture. The fish can successfully be bred in hatchery condition provided requisite methodologies are followed. In North east India, particularly in Assam, the magur can be successfully spawned only during the months of July/August. Healthy brooders, size of the food particles provided to larvae, height of water column in fry rearing tanks, fluctuation of water temperature etc are some of the vital points to be remembered while undertaking magur breeding. The paper highlights different steps involved in the magur breeding.

Introduction

Clarias batrachus (Magur) is one of the most easily culturable indigenous air breathing cat fish in India. The fish is marketed alive and is highly esteemed table fish, because of its nutritive, invigorating and therapeutic values. The fish has great market demand and fetches comparatively higher price than Indian Major carps in the North-East parts of India.

Magur is well adopted to adverse ecological conditions and can be cultured well in water unsuitable for conventional culturable species.. The fish can also be cultured in paddy fields, cages and pens.

Although the culture of magur involves less risk and simple management as compared to carps, the commercial culture of this species has not yet been widely practiced by the fish farmers of the region. The reasons are:

1. Non availability of stocking material - magur fingerling, 2. High cost of fish feeds, 3. Farmers ignorance about the latest technological know how.

Magur seeds in large numbers are generally not available in the natural water bodies of the region. Further, the cost of the seeds that may sometimes available in the market is also very high. Considering the need of stocking material of the species, particularly in

Assam, higher thrust has been given to produce magur seed under the laboratory conditions.

Magur usually does not breed in confined waters. In natural condition, the fish migrates to shallower areas of the adjoining paddy fields, make small pits along the margin, congregate in pairs and spawn with onset of monsoon. The male guard the young ones for a few days, while the female moves out of the pits. The fry move in search of foods once the yolk sac is absorbed.

Breeding of magur in the laboratory or hatchery conditions is quite different from that of carps.

To breeding magur under controlled condition, a magur hatchery, comprising of a shed (thatched/asbestos/CI Sheet roof etc.) where in plastic tubs (30 cm dia and 8 cm depth) flow through system, larval & fry rearing tanks (1.0 x 0.5 x 0.3 m & 3 x 1.0 x 0.5 m respectively) are need to be constructed. Provisions, made with either cement cisterns (3m xl m xl m) or earthen ponds (25 m2) are essential for maintenance of good brood stock.

As good quality water is a prerequisite for a hatchery, magur hatchery is also not exceptional to that. For magur hatchery iron free clean water is very essential. It is observed that the water containing more than 1.0 mg I litre is unfavourable & detrimental to the process of larval development. The simplest way to remove iron view is to install a biological filtration unit.

To undertake the magur breeding & larval rearing process successfully, certain other facilities viz, aerators, free air compressor (lHP), facilities for live fish food culture etc are essential too. An electric generator is also a must at the time of power failure.

Further, optional arrangement for a water cooling system is considered to be important to control the temperature fluctuation within an optimum range.

While undertaking magur breeding programme, the first step is to maintain a good stock of brooders. Generally, fish weighing more than 100 gm (1+age) are selected as brooders & are reared in brood stock rearing tank atleast 2 to 3 months ahead of the breeding operation. During rearing period, the fishes are fed with protein rich diet. The trash fish is considered as one of the important & easily available ingredients in the diet of magur. Waste from slaughter house, chicken processing unit, white ant & their pupae also proved good while rearing magur brooders. The fishes should be fed at 10% of body weight level. Water replenishment either partially or fully at fortnightly interval is a must during the rearing period.

In Assam & North Eastern Region, magur spawn naturally at the time of onset of monsoon from the month of May onwards. However, observation has revealed that under laboratory condition good spawning response of magur in this region may be expected only during the latter part of monsoon season i.e. during July and August.

For the breeding operation, a few pairs of healthy magur brooders are selected from brood stock pond & are kept separately in a plastic bucket with minimum water. Males &

females are segregated based on secondary sexual characters which are very prominent during spawning season. Gravid female is round & bulged and the vent is red in colour. The genital papilla of female fish is round & button shaped. In case of male the same is elongated and pointed.

Both male & female brooders are treated with hormone for spawning under the hatchery condition. Although several hormones have been successfully used to spawn magur, considering the easy availability & efficiency, ovaprim (Glaxo) & carp pituitary glands are considered quite suitable.

The quality of ovaprim & carp pituitary extract used for spawning magur in laboratory conditions are as follows:

(a) Carp pituitary:- Female :- 40 - 50 mg/kg, Male :- 10-15 mg/kg,

(b) Ovaprim :- Female - 0.5- 0.6 ml/kg, Male;- 0.1-0.2 ml/kg.

Hypodermic syringe with smaller size needle (No.24) need to be used to inject hormones in case of magur. The fishes are injected during evening hours, male & female fishes should be kept separately.

The injected male fishes are taken out after about 12-15 hours scarified and fishes are taken out to prepare sperm suspension. 0.9% saline solution is required to prepare spawn suspension. Prepared suspension may be stored in refrigerated condition if necessary.

After the preparation of sperm suspension, the female fish is stripped on a previously washed dry enamel tray. Sperm suspension is then added with the help of a dropper and mixed thoroughly with the help of a disinfected feather. Little fresh water is then added, the tray is shaked gently & kept for 1-2 minute. More water is added to clean dirt, blood clotting etc. The fertilized eggs are sprayed in a single layer in incubating tubs of flow through system. All the fertilized eggs get attached to the between & sides of the tubs.

During incubation period in the tubs, continuous water circulation (10 1/hr/tub) and aeration is a must. Water temperature ranging from 27°c to 31°c is considered best for satisfactory development & hatching. Under the said temperature range, hatching process is completed within 26 hrs of fertilization. The absorption of yolk sac is completed in 4 days. The larvae start feeding only after the yolk sac is absorbed. The larvae thereafter transferred to larval rearing tank. The stocking density in larval rearing tank is 2000 to 4000 nos/m2. continuous aeration and daily replacement of at least 50% water along with unutilized food & excreta is very essential. Feeding should start on the 4th day (as yolk sac absorption time varies) it self. 'While feeding the larvae, size of the food materials or organisms (live feeds) should be kept in mind. Size of the food particles should be 20 to 30 micron and the same may be increased to 50 to 60 micron for one week fry.

Feeding the larvae with live ogranisms (smaller zooplankton) has proved always best. However, boiled eggs yolk, single cell protein, white & red ant pupae also showed good survivality of larvae. Visual observation on food acceptability at different stages is the best

way of selecting feed. The larvae are reared for 10-12 days larval rearing tank by which time they reach a size of about 20-25 mg. They also develop aerial respiration after 10-12 days of hatching . At this stage fry are transferred to fry rearing tanks.

Fry rearing containers are comparatively larger in size and are stocked @ 1000 fry per M2.The fry may be fed with zooplankton viz. Tubifex, Chironomid larvae, molluscan meat, crushed trash fish flesh etc. Continuous aeration is not essential at this stage of rearing. The rearing period is about 10-12 days and at the end of rearing period the fry attain a weight of about 0.8 to 1 gm. Fry of this size may be transferred to nursery ponds or may be released to the properly prepared grow out ponds.

The aerial respiratory habit of fish which commences in the fry rearing stage, makes the fry to undertake vertical trips to the surface of water to gulp atmospheric oxygen. Thus, for this habit of fry, the height of water column should be kept at optimum so as to avoid the exhaustion of fry for the vertical trips. Further; excreta of the fry and decaying food materials should also be siphoned out to avoid stress from amonical substances.

The most important points to be kept in mind for undertaking magur breeding in the hatchery are :

1. Always select good healthy brooders.
2. Change the brood stock atleast every three years.
3. Replenish the brood stock with brooders collected from wild.
4. Choose the hormone dose according to the ripeness of brooders.
5. Always keep an eye on the size of food particles, particularly in larval rearing phase.
6. Install water cooling device in order to reduce laval mortality due to temperature fluctuation.
7. Use iron free water in the flow through system.
8. Monitor the height of water column in fry rearing tanks. ,
9. Remove/replenish fully or partially the water, excreta and unconsumed food materials from the larval and fry rearing tanks.
10. Feed the young fish properly to avoid cannablism.
11. Shed may be provided to reduce cannablism. .
12. Short out bigger ones from the smaller one to reduce cannibalism.
13. Maintain hygienic condition in the hatchery.
14. Always keep ready an electric generator as stand by arrangement.
15. Routine checking of different rearing systems.

The larval rearing phases are the most crucial period for magur hatchery. Large-scale mortality occurs during these development stages. Water quality and feeding plays an important role in increasing the survivality of larvae. Success depends on the managerial skills.

Induced spawning and seed production of the highly sought after fish, magur, is an urgent necessity in the North Eastern States. Large-scale or small-scale magur hatchery may be constructed to have steady supply of stocking material so that fish culturists get encouraged to undertake magur culture on commercial scale.

Common Fish Diseases of Fresh Water Carp Hatchery

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Abstract

Common fish diseases in hatcheries and in early rearing systems are caused by protozoan, ciliates, myxosporodians, worms, opportunistic bacteria and fungi. Production of healthy fish seed and survivality depends on the hygiene condition, particularly on maintenance of the water quality within the tolerance limits of the species. The paper highlights the different types of diseases, causative agents and their control measures in fresh water carp hatcheries and nurseries.

Introduction

Disease is one of the major problems associated with aquaculture. This has become a limiting factor in enhancement of fish production, where, producers, traders and consumers are mostly affected resulting in heavy economic losses.

In recent years, the intensification of aquaculture system has led to major problems in outbreaks offish diseases, High stocking densities, excess feeding and artificial fertilizations are common husbandry practices followed in intensive carp culture systems. These offer an ideal environmental conditions for the growth of different types of fish pathogens and as a result the host organism suffer from stress. Thus, fish become more susceptible to various infectious organisms such as protozoa. helminths, crustacea, bacteria, fungus and virus. Fish may be affected externally as well as internally. Depending on the nature and severity, the disease may cause mass mortality or small-scale mortality and can even reduce the growth of the fish population. Therefore, it is essential to adopt suitable health management measures to reduce the loss due to disease outbreaks in culture systems.

The risk of disease induced mortality is equally serious in carp hatcheries and in early spawn rearing systems. The immature immune system in fish makes the early developmental stages more susceptible to infectious diseases. The immune system plays an important role in defence mechanisms in fish and it helps in combating against some fish pathogens in water. Therefore, proper care should be taken during hatching and early larval

stages to protect them from any external factors which can suppress the activity of the immune system. One of the important external factors is the deterioration of water quality. This creates maximum stress to the fish and suppress the immune system resulting in reduction in resistance of the fish and consequently fish become susceptible to pathogens present in water. Thus, one of the important aspects is to maintain a stable environment to avoid stress to the fish. Moreover, farmers should watch the health condition of fish at all levels and take prophylactic measures before disease outbreak. The common fish diseases which arc found in carp hatchery, nursery and rearing systems of Indian major carps and exotic carps are discussed below in brief.

1. Parasitic diseases :

A. Protozoan diseases :

(a) Ichthyophthiriasis : The causative agent is *Ichthyopthirius multifiliis.* Fry and fingerlings of Indian major carps are affected in nursery and rearing ponds. This is an obligatory parasite. It is spherical in shape and the cilia are evenly distributed over the whole surface. The large horse-shoe shaped macronucleus is visible under the mIcroscope.

Clinical signs: The infected fish becomes covered with small white spots in skin, fins and gills which are nodular in form.

Prevention and treatment: Prophylaxis: Filtration of contaminated water, avoid over crowding and provide proper nutritious feed.

Treatment: Malachite green: 0.15 - 0.20 mg/L for Ih bath for 2-3 days.

Sodium chloride solution: 2% Nacl : Bath: for 7 days or more.

(b) Trichodiniasis : Trichodiniasis is caused by Trichodina spp. Fry and fingerlings of Indian major carps and exotic carps are affected. This protozoa occurs in the skin and gills of host fishes. Smears from the skin and gills are examined under microscope and can be seen as round "saucer shape" with fringe of cilia around the perimeter.

Clinical signs: Greyish -blue veil like coating over the body surface, darkening of the skin and excessive mucus secretion occur.

Prevention and treatment: Prophylaxis: Presence of trichodina indicates deterioration of water quality. Water quality should be improved and stocking density be reduced.

Treatment: Sodium chloride bath treatment at 2-3 % ; Potassium permanganate treatment 4 mg/l in pond. Formalin treatment 25 mg/l in pond.

(c) Sporozoan diseases: Myxosporidia are the most common offish sporozoa. All organs and tissues are possible sites of infection. The infective stage of the myxozoan diseases is the matured myxozoan spore. The spore structure forms the basis for identification of different species.

Clinical signs: Infected fish show whirling swimming action *(myxosoma cerebralis),* some species form,boils or cysts on the body surface *(Myxobolus pfeifferi* and *M piriformis).*

Prevention and treatment: Prophylaxis: Reduce the stocking density of fishes in ponds.

Treatment: Treat the pond with mahua oil cake and lime by which the infective spores are destroyed (recommended dose). Sodium chloride treatment at 3-5% destroy the spores and other developing stages, if present.

B. Helminth diseases:

Many of the helminth parasites have complicated life cycles, require one or more intermediate host for completing its life cycle. However, skin fluke, *Gyrodactylus* and gill fluke, *Dactylogyrus* need not require intermediate host.

(a) Dactylogyrosis and Gyrodactylosis : These worms mainly affect to the skin or gills with their attachment organs and parasites the host. Mostly fry and fingerlings ofIndian major carps in nursery and rearing ponds are affected.

Clinical signs: In dactylogyrosis, the colour of the gills fade and there is excessive secretion of mucus. In gyrodactylosis, there is fading of the normal body colour, small spots of blood on the body surface may be seen. Dropping of scales and excessive mucus secretion may also occur. These worms can be seen with the naked eye or with the help of magnifying lens.

Treatment: (i) Sodium chloride bath treatment at 3-5% for 101-5 minutes, kills the worms on fish or, (ii) Formalin bath treatment at 100 mg/l kills the worms, (iii) Formalin treatment in pond at 25 mg/l is effective in controlling the worms or in, (iv) potassium permanganate treatment in pond at 4mg/l is effective.

(b) Black spot disease: Metacercarial larval stage of the species *Diplostomum* is responsible for this particular disease. Fry and fingerlings of catla, rohu and mrigal and silver carp in nursery and rearing ponds are affected.

Clinical signs: Black ovoid patches are visible on the body surface of the affected fishes. These are pigmented patches overlaying cysts of the metacercarial larvae. Number of cysts may be few to hundreds.

Treatment: Removal of the molluscan population (first intermediate host) in the affected ponds and also the aquatic birds (final host) around it.

C. *Crustacean diseases:*

(a) Argulosis : This disease is caused by *Argulus sp.* and commonly known as " Fish louse" . The larvae and adults of Argulus are parasitic to fish. This parasite penetrates the upper layers of the host's skin and feeds on blood and body fluids. Fry, fingerlings and adults of Indian major carps are affected.

Clinical sign: Affected fishes become restless with erratic swimming movements. Attachment sites shows sign of ulceration. Adult parasite is oval, flat, transparent to whitish in colour with two conspicuous black spots. The Argulus can be seen quite clearly with the naked eye.

Treatment: (i) Sodium chloride bath treatment at 3-5 % till the fishes are stressed., (ii) Gammaxene treatment in pond at 4mg/1 or, (iii) potassium permanganate treatment in pond at 4 mg/l.

(b) Lernaeosis : Lernaeosis is caused by *Lernae sp.* The adult female is parasitic, has anchor like appendages at the anterior end and egg sacs at the posteriror end. The parasite burrows deep into the body fluids. Fingerlings and adults of catla, rohu and grass carp are affected in the culture ponds.

Clinical signs: At initial stage fish become restless and try to rub its body against the sides and bottom of the pond due to irritation. Heavily infested fishes become moribound with erratic movement. Infestation with this parasite is easily diagnosed.

Treatment: (i) Potassium permanganate treatment in pond at 4mg/l, (ii) Sodium chloride bath treatment at 3-5%.

II. Bacterial diseases

(a) Eye disease of *Catla catla* : Advance fingerlings of catla are affected by this specific disease, which is caused by Aeromonas liquefaciens.

Clinical signs: Eyes look reddish due to vascularization and later become opaque.

Treatment: Prophylaxis: Treatment with Potassium permanganate at 1 mg / 1 and maintain high dissolved oxygen in the pond.

(b) Dropsy: Aeromonas hydrophila is responsible for causing dropsy in juveniles of Indian major carps.

Clinical signs: Accumulation of water in the body cavity or in scale pockets. Scale becomes loose. Abdomen is bulged and very often due to secondary infection scales fall off.

Prevention and treatment: Prophylaxis: Water body is treated with 1 mg/ 1 of Potassium permanganate.

Treatment: Potassium permanganate at 5mg/1 is recommended for containing the disease.

III. Fungal diseases

(a) Saprolegniasis : This is caused by saprolegnia parasitica. Eggs, fry and fingerlings of Indian major carps and exotic carps are affected. This occurs in fishes suffering from other diseases and mechanical injuries on the body surface of the fish.

Clinical signs: Infection is characterized by the presence of cotton wool like growth on fish or fish eggs. The woolly growth may be white or may vary depending on the colour of particles trapped in it.

Prevention and treatment : Prophylaxis: (i) Maintain optimum water quality (ii) Stock optimum density offish (iii) Feed fishes with nutritious feed (iv) Treat the pond with 1 mg/ l of Potassium permanganate

Treatment: (i) Give swab treatment for small delicate fishes with Potassium dichromate at 100 mg/ 1 for one week., (ii) Give bath treatment to affected fishes with Sodium chloride at 3-4% solution, (iii) Give bath treatment with Malachite green 1-2 mg/l for half an hour, (iv) Effected fish eggs are to be just flushed with 2 mg/l Malachite green for 5 days, (v) Ponds are to be treated with 20 mg/ 1 Formalin.

IV. Environmental mediated diseases

(a) Gas bubble disease: Small fry and fingerlings of mrigal and rohu are mainly affected. This is caused by high load of organic fertilizers at the pond bottom.

Clinical signs: Young fishes show erratic movement and gradually die exhibiting a whirling movement. The abdomen is swollen.

Treatment: (i) Stop application of fertilizers, (ii) Add fresh water to the ponds

(b) Algal toxicosis disease: Fry, fingerlings and adults of Indian and exotic carps are affected.

Clinical signs: Surfacing offish occur with erratic movement and mortality in many cases. The causative agent is blue green algae *(Micro cystis, Anabaena sp.)*

Treatment: (i) Copper sulphate is applied in pond 0.5 mg/ 1 (ii) Cow dung 100 kg/ha is sprinkled over the surface of water, (iii) Some surface area of pond is covered with water hyacinth to prevent the sunlight penetration.

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An overview of Fish Breeding Programme of Assam Initiated by the State Department of Fisheries

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Abstract

In Assam, the present annual fish production from all sources is about 1.55 lakh tonnes as against a demand of 2.5 lakh tonnes. The State has attained self-sufficiency in carp seed production, however the quality seeds of fingerling size are yet to be achieved uniformly through out the State. The paper highlights the various steps initiated by the State fisheries department in popularizing the fish breeding programme and suggests measures to improve the quality of the seeds at hatcheries and to protect the natural fish stock.

Introduction

From time immemorial, carp culture is being practiced in Assam and it is believed to be as old as carp culture in other North-Eastern States of India and South China. During the last three to four decades, the traditional carp culture practices is rapidly transforming into scientific farming in several parts of India and Assam is not exception to that Although Assam is endowed with varieties of water bodies like - Riverine Fisheries (2.05 lakh ha) , Beel Fisheries (1.0 lakh ha), Derelict water bodies (0.10 lakh Ha) and Ponds and tanks (0.25 lakh ha) covering altogether 3.47 lakh ha. Carp culture is restricted mostly to ponds and tanks besides certain selected beel fisheries under the management of Assam Fisheries Development Corporation (A.F.D.C.) Ltd. The area readily available for carp culture is reported to be about 30% of the total water area available in the State, while the area under actual scientific culture practice is less than 10% of the potential water area,

Departments initiatives

The present annual fish production from all sources is about 1.55 lakh tonnes as against a demand of2.50 lakh tonnes. The demand is likely to go upto about 3.2 lakh tonnes by 2000 A.D.

Though the State is rich in fishery resources of varied type as mentioned above, we are in deficit in fish production for many reasons of which one is the dearth of quality fish seeds. As the other reasons/factors responsible for low production offish has no scope to discuss in this forum, we would like to confine to the subject relating to improvement of the quality fish seed production in Assam and fishery department's activities in various directions through different schemes.

For achieving the above fish production, the department of fisheries is trying its level best to fulfill a part of the demand of fish seeds under its various schemes directly or indirectly through the departmental fish farms or through private fish farms starting from riverine collection of fish seeds to eco-hatchery's production during the various plan periods.

The department has taken utmost interest in producing more fish in the State by collecting river spawns and after rearing the same in the Govt. farms, seeds were distributed to the fish farmers since 1964. However, the process was discontinued recently in the present context of self-sufficiency in induced breeding offish. Simultaneously with the invent of hypophysation method for breeding of carps, department of fisheries has been producing quality fish seeds in its departmental fish farms. The department is organising practical training and demonstration to the local fish farmers as well as to the trainees of the regular fishery training programme under departmental schemes, FFDA and DRDA etc. which motivated a large number offish farmers to take up hapa breeding, bundh breeding & Chinese type of eco-hatcheries in the State. This is apart from the control breeding of common carp which is also popular among the private fish seed producers.

The induced breeding technology became popular among the progressive fish farmers who slowly switched over from hapa breeding to eco-hatcheries . The first such hatchery was established in the year 1984 at Padumoni and Nilbagan. The State has attained self-sufficiency in carp seed production in the stage of fry. Recent expedences reveal that the availability of genetically improved actual stocking material, the fingerling of size seed (125-150 mm) is yet to be achieved uniformly at the time of stocking.

The State as a whole (both Govt. & private) produced about 2245.57 million fry - fingerlings during 1997-98, which included grass carp, Silver carp, Common carp & I.M:C. This comfortable position was achieved due to commission of 61 Nos. of eco-hatcheries, 9(nine) minibundhs and more than 300 Nos. of hapa breeders in the State, majority being in the private sector. These infrastructures of seed production also help in direct and indirect employment of more than 8,000 people (1990-91) as fish seed producers/traders; besides seasonal engagement of a large number of 'sellers' at Nilambazar, Barpeta Road, Rangiya, Dhekiajuli and Tintengia.

In this context, we have the privilege to mention that the fish farmers co-operatives at private sector with their own interest accelerated the growth of fish seed industry and helped us to achieve the above status.

As we are approaching towards 21st century, we expect more quality seed production of

carps as well as other culturable species of fish particularly Magur. For this, more infrastructures have to be developed through ongoing ARI ASP programme, of world bank, Govt. agencies like FFDA, DRDA, COF etc in the State for production of genetically improved fish fingerlings. .

In addition, we also experienced many constraints, (both scientific and administrative) related to organisation of training, brood fish maintenance, spawning season, mixed breeding of Carps, water quality management, nursery management practices etc. which need to be discussed at length with fishery workers for redressal. Above all it is also observed that in many cases, poor financial status of fish farmers some times prevent them in implementing the right technology in their farms.

Conclusions

Following points have been recommended for discussion in the workshop.

1. Amendment of fishery rules pertaining to brood fish killing and the wanton killing of fry-fingerlings during breeding seasons including ban on the use of chat-jal.
2. Streamlining of technical know-how on pisciculture through lab to land and Vis-a-versa programme for better implementation/ achievement and feed back.
3. Unplanned construction of hatchery should be checked to avoid creation of infrastructure in haphazard manner.
4. Hatchery owners may be requested to display their actual record of production for statistical data collection, assessment and planning.
5. The seed producer may use uniform measuring cup for measuring spawn etc through out the State.
6. The department of fisheries may register seed producers/traders with renewal provision for assessment of number and to make rules for easy transportation of fish seeds.

Fish Seed Production and Strategy for Marketing in the North East Region with particular reference to Assam

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Abstract

The N.E. region though endowed with rich natural aquatic resources, the development in the field of fisheries is still lagging far behind the rest of the country. Considerable progress in last few years has been made in the field offish seed production particularly in Assam but due to lack of organised marketing network, the industry is yet to give a boost to the fish production. Maintenance of healthy good brood stock, stock improvement, organised marketing network, fish seed market, training and extension are some of the areas needing serious attention. Further lack of monitoring, assessment of fish seed selling and stocking in aquaculture units are another few more important areas where emphasis should be laid. Assam, at present having more than 80 private fish seed entrepreneurs can take the lead in the entire N.E. Region.

Introduction

At the door step of 21st century, the N.E. Region, though endowed with vast natural aquatic resources still lagging far behind in the field of fisheries development in comparison to the other parts of the country. The states of this region comprise of the natural resources like rivers (18,968 km), reservoirs (8,091 ha.), beels/lakes (143,491 ha.) and tanks/ ponds (42,782 ha.), besides paddy fields, low lying areas and forest fisheries (94,577 ha.). The state-wise utilisation of existing resources is reported to be Tripura almost 100%, Manipur (44%), Assam (37%), Nagaland (19.8%), Arunachal Pradesh (10.6%), Meghalaya (10.6%) and Mizoram (9.5%). Considering the location, water resources, communication and other factors, the State of Assam has the prospect to playa vital role in the development of fisheries in the entire N.E. Region. In such a situation, Assam can take a lead in organising the marketing network in the other states of this region too.

Fish seed prolluction

Leaving aside the table sized fish production, there is a considerable rise in fish seed production (134%); in 1st two years of the seventh plan during 1991-92 it rose to 392%. Assam recorded a phenomenal growth in fish seed production till *1989-90.* As per the latest

record, the fish seed production has increased in the 1st half of the decade to 1052% in the NE Region. It is ironical that in spite of rapid growth in the fish seed production sector, the yield of fish is not matching. It has beel) observed that there is a big gap between the seed sellers and the buyers regarding the survivality of seed to table sized marketable fish.

Development of fish seed industry

One of the factors behind the phenomenal growth of fish seed production is the upcoming of the fish seed production units in private sector. There is need to develop network for effective recording of the sale of seed and the farming. An effective extension network to disseminate the technology of fish seed production in the small -scale private sector i.e. at farmers level is the need of the hour. This requires to evolve a policy of the planners in this direction.

The development of the fish seed industry will have to be based on a organised marketing strategy. Since fish seed is a perishable commodity, it has to be handled through a healthy marketing network. Only such conservative effort will be able to give benefit to the fish growers, seed producers, ancillary material units etc.

The fish seed marketing in most of the cases are depended upon the Govt. agencies. It is necessary to develop a suitable production, marketing and distribution system of the fish seed. In integrating the said items, it is also necessary to study the economics of the fish seed farms, present production and marketing system offish seed, requirements offish seed farms, purchase behaviour offish farmers, organisational design, requirement of personnel, training and other operating parameters.

Strategies for fish* seed *marketing

Since marketing is one of the most important tricky matters to be dealt by the fish seed producers & growers, it is necessary to develop a sustainable marketing strategy *for* their economic upliftment. Some of the minimum basic requirements in developing a suitable marketing strategy have been discussed below:

(i) **Maintenance of good and healthy brood stock:** The success of quality fish seed production lies in the maintenance of healthy brood stock. It is also necessary to improve the stock of brood fishes by periodical replenishment so as to stop inbreeding. Effective monitoring of the production units by the scientists, research institutes, Fisheries department etc is needed so that the negative effect is reduced.

(ii) **Small-scale units for the marginal seed producers:** It has been observed that without having basic infrastructure and resources most of the private entrepreneurs always try to venture into a bigger hatchery units. This is required to be restricted considering the marketing network available in the specific areas. Small units with low - cost manageable capacity backyard hatchery is advisable to the marginal fish seed producers. This will certainly help in producing quality fish seed and marketing. .

(iii) **Nursery units:** In fish seed production centres, the nursery ponds play an important role in raising the seed in a successful way. Well designed nurseries with scientific management is the key to success. Nursery units must be constructed in accordance with the total quantity of fish seed produced. If a marginal seed grower does not have the adequate resources to manage a set of nursery unit, the seed may be raised in a nearby farm or at the nearest larger hatchery owners farm. There needs a better coordination among the hatchery owners, Government organisations and the seed growers so that all are benefited properly.

(iv) **Development of ancillary units:** It is always necessary to make available some of the ancillary items like packing material (polythene bags), oxygen cylinder, breeding & hatching equipments etc at the time of need. These markets are to be developed at the nearest accessible areas *for* the benefit of seed producers and growers.

(v) **Creation of trained marketing groups:** Unscientific and careless handling of fish seed often lead to high mortality in transportation and selling. Training may be organised for the benefit of seed producers and unemployed youth in handling of fish seed, transportation etc. so as to get maximum retrieval which will certainty give profitable return. .

(vi) **Transportation facilities:** Efficient and safe transportation of fish seed is one of the most important areas which needs to be strengthened. Modem scientific transportation devices are required to be developed so that fish seed get no injury during transportation. It has been observed that many seed growers use traditional method of transportation system resulting in great loss to the fish seed. Research institutes, fishery departments may organise training programmes *for* the fish seed growers *for* adopting well devised transport system to ensure better survival. If needed assistance may be rendered to seed growers for acquiring such transport system.

(vii) **Fish seed markets:** Till today no organised fish seed selling markets have been established in the State. Identified fish seed markets in different areas will certainly help in effective marketing of the seed. Local marketing bodies may be created with fish seed growers including all categories (marginal & bigger) as members of these bodies. This type of market will help particularly the small seed producers who are unable to acquire their own transport facilities. These markets will also help in getting remunerative prices to the farmer seed producers.

(viii) **Institutional finance:** It is always advisable to obtain institutional finances for small fish seed producers on a short term basis. Emphasis should be laid on operating small-scale hatcheries instead of a big hatchery so that I many farmers can take up the work. Farmers may be advised to take up seed raising practice for short term benefits with small investment.

(xi) Training and extension network: Extensive training programmes are required to educate the farmers for adopting scientific and correct procedure in fish seed production and marketing. This will also require correlation among seed producer and seed growers, effective marketing strategy and adoption of scientific culture practices. Extension works may be collaborated with the scientists, research institutions and others at the grass root level.

As the entire North Eastern States possess the potential fishery resources covering freshwater to cold water ecosystems, the requirement offish seed will certainly be depended on the culturable adaptability and acceptance. It is heartening to note that projects like cold water fish farming is also coming up in Arunachal Pradesh which may cater to the need of the cold water zone. It is necessary to priorities the fish species suitable to release in different hilly states according to the need and acceptability. In such a situation, production and marketing of fish seed for these agro climatic zones have to be fixed in a rational way.

Conclusion

Considering the eco-geographical advantage and other co-related factors, Assam has the vast potentials to take the lead in fish seed production and marketing in the entire NE Region. The two valleys namely, Brahmaputra and Barak comprise an ideal areas for fish seed production of all commercial species with a much needed production- marketing-transportation -distribution strategies.

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Institutional Credit Support for Fish Seed Development in North East Region*

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Abstract

The paper discusses the fisheries resources of the N.E. Region with greater emphasis on quality fish seed production. Various credit supports offered for fish seed hatchery by commercial banks, concessions available and NABARD's refinancing policies in the region are the other important issues highlighted in this paper.

Introduction

Fisheries plays an important role in rural economy and is capable of dismal employment scenario of rural areas particularly of NE Region. North East presents a periodical picture of being 'poor' in the midst of plenty particularly in fisheries sector, for example, in the State of Assam, about 90% of the population consume fish as an essential supplement to their staple food. The per capita consumption offish in the State is at 6.70 Kg per year against a desirable rate of 11 kg/annum. Despite having low rate of consumption, production falls short of demand of2.70 lakh tonnes. It is unfortunate that despite having very good potential of inland waters, the development of fisheries sector has remained tardy in the region.

Major constituent in the development of fisheries in the North-Eastern Region are low productivity, acidic nature of soil, poor extension, high rate of illiteracy and therefore farmer still adopting traditional methods, lack of entrepreneurship, lack of credit and less but not the least availability of quality seed.

The fishery resources of all the North East seven States comprises of 15,680 Km rivers/canals, 0.36 lakh ha of reservoirs, 0.781akh ha of ponds and tanks; 1.38 lakh ha of bee Is and derelict water bodies. If these water resources, which are gold mines from regions point of view could be developed scientifically in planned manner, the region would not only become self sufficient but would also export fishes. But to achieve this goal the basic input required is quality seed. Of late, Assam is producing about 2246 million fry per year and stated to be self sufficient but it is not so in the case of other sister States. In Assam, this achievement was possible because of installation of 80 eco hatcheries mostly in

private sector. Even though the State of Assam can boost of its seed sufficiency but I am afraid the position may not remain same if all the culturable water areas are adequately stocked with optimum stocking densities. Even if the State has to produce targeted production of 1.75 lakh tonne's in the IXth five year plan period, the seed so far being produced may not be adequate. It is therefore important that Fish Seed Hatchery programmes are taken up in the entire North Eastern Region.

Credit Support

As in aquaculture or in any fisheries activities the seed production also require initial investment for constructing hatchery, arranging water source, building over head tank, brooders tank, nursery areas, rearing ponds, purchasing equipments etc. The cost of such hatchery programmes vary from state to state, area to area and also species to be bred. The poor entrepreneurs of the region do not have resources to start the programme on their own and therefore extending credit facilities by financing institution is prerequisite for the development.

While we do not have enough information about precisely how much credit has beep. given to Fish Seed Development Programme but since over all fisheries has a dismal picture with regard to credit disbursement, the condition of credit inflow for hatcheries is not difficult tovisualise. National Bank for Agriculture and Rural Development (NABARD) is aware of the poor take-off of bank credit in fisheries in general and it has taken several steps like preparing state wise banking plans, organising State level credit seminars, fisheries workshops, fixing unit costs of different activities, giving concessional rate of interest and providing higher refinance to bankers for their support in NE Region. For instance NABARD prepared banking plan for the State of Assam for the years 1995-96 and 1996-97 with a total financial outlay of Rs.59.59 lakhs and Rs.127.37 lakhs respectively. As against these targets, the refinance for fisheries sector during past four years were Rs.48.363 lakhs (1995-96), Rs.6.483 lakhs (1996-97) Rs.6.0121akhs (1997-98) and Rs.7.490 lakhs (1998-99).

Even though the apex financing institution is not very happy about the above results, but has gone ahead optimistically for next five years.

As per potential linked Plans for Assam, NABARD projection for IXth Five Year Plan period from (1997-98 to 200 I-2002) ranges from Rs.11.26 crores to Rs.20.87 crores with a cumulative target of Rs.71.25 crores. Similar, credit programmes have been prepared for other States as well.

Support for fish seed hatcheries

As stated earlier, for large scale fisheries development programme, production of quality fish seed is first priority and therefore NABARD since inception has been supporting this activity. In fact NABARD implemented World Bank assisted Inland Fisheries project of developing 1.6 lakh hectares of pond culture areas and installation of 14 modern fish seed

hatcheries in five States to produce 2000 million fish seeds. Successful completion of this project in eighties paved the way for launching of fish seed hatcheries programmes far and wide including NE Region. The general tempo created during that time led to installation of hundreds of Eco-hatcheries in private sector with institutions credit support. These hatcheries have come up in almost all regions of the country including NE Region.

Institutional credit is available at concessiorial rate for fish seed hatcheries programmes through any schedule banks like commercial banks, State Cooperative Banks, and Regional Rural Banks.

NABARD extends refinance to these banks for providing financial support on long term, medium term and short term basis. It supports by giving 90% of the bank loan extended to the beneficiaries. Beneficiaries could be any individual, Cooperative Societies, Corporate Houses, and Development Corporations etc.

Concessions to North Eastern Regions

The North Eastern Region of India has always been an area of concern for credit institutions of the country, besides the 90% refinance on bank loans other concessions available are :

1. Banks in NER having 50% recovery have been made eligible for drawl of unrestricted refinance as against 60% recovery norms in other regions of the country. .
2. Seasonal agricultural operations limits to State Cooperative Bank and Regional Rural Banks are sanctioned liberally by relaxing over due criteria.
3. NABARD charges concessional rate of interest to State Cooperative Banks against its financing for Seasonal agricultural operations at 4% in the NER against 4-6.5% charged in other parts of the country.
4. Considering inadequate transport facilities banks in NER are encouraged to finance vehicles for transportation of passengers and goods and NABARD refinance is available for the same only in this region.

For installing a moderate size of eco-hatchery in NE Region an investment ranging from Rs.3.00 lakhs to Rs.7.00 lakhs would be necessary. The investment varies because of several constraints of poor infrastructures, poor communication, vagaries of nature etc. The rate of interest charged for such investment is 12% per annum (Pathak, 1998). The interest to be charged on principal amount is decided by individual banks. In addition to capital cost of installation also provides working capital for first year operational cycle. This is worked out in detail and included in the bank loan provided for the purpose.

Fish seed Hatchery Programme is commercially feasible, in the NE Region and therefore bankable. Nowadays, several designs of hatcheries are available in the country. Any hatchery model which is suitable for the area can be selected and banks could be approached for credit assistance.

The Bankers have programmes of supporting agricultural credit which also includes

aquaculture and seed production but there is lack of enthusiasm in bankers mind due to poor recovery performance of fisheries loans. This is an all India phenomenon but the problem is very acute in N.E. Region. Unless bankers are assured of repayments and recoveries of loans they would continue to be negative. Non-payment of bank dues in time is not a good practice and is self destructing. Government agencies, Agricultural Universities, Extension workers, Scientists have important role to play in educating farmers about this aspect. Bankers, more particularly NABARD, have ambitious programmes of supporting fisheries and seed production programmes but it would be possible only if a coordinated efforts are made. Bankers would have to be assured with positive signals from all sides. If large number offish seed hatcheries, say around 500 numbers are commissioned in NE Region in next five years it would bring in real revolution in the region and fisheries would become back-bone of region's economy by contributing to its N.D.P.

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Role of North-Eastern Development Finance Corporation (NEDFi) - as a Developmental Financial Institution of the North East

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ABSTRACT

The States in the North Eastern region comprising of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura are endowed with rich natural resources such as oil, natural gas, limestone, coal, other minerals, forest resources and abundant hydel power potential. However, what was not realized a few years ago is the potential that this region has in the field of aquaculture because of the suitable factors on the supply side like climate, abundance of water as well as on the demand side with plenty offish eaters. Amongst many factors which have hindered .the growth of this sector, one must be the lack of financial support. Having realized this, NEDFi has taken up some steps to remove this lacuna. However, the communication gap between NEDFi and the farmers still exists. This article is a small attempt to bridge this gap. The first part of the article discusses the organization and the rest of the article will discuss the steps taken by it to promote aquaculture.

Introduction

The main objective of NEDFi is to provide financial and other facilities for promotion, expansion and modernisation of industrial and infrastructure projects in the region. Eventually, NEDFi will provide a wide range of facilities and services tailor-made to meet the requirements of industrial units, including providing working capital, discounting/re-discounting of bills, guarantees, subscription to and/or underwriting of shares & securities, issuing letters of credit & providing consultancy & research facilities. It has also been entrusted with the function of refinance and disbursement of transport and capital subsidy by the Central Government in the 1998-99 budgets.

NEDFi's avowed aim is also to help the first generation entrepreneurs during implementation and early operation stages of their projects by providing hand-holding services so as to mitigate the problems arising out of inexperience.

NEDFi's mission is to be a dynamic & responsive organisation for assisting the development of the region by identifying & financing commercially viable industrial & infrastructure projects so that they lead to fix capital formation without causing any significant environmental degradation and through this maximise the wealth of the region & the well-

being of its people. Although in the original memorandum, the activities to be financed were limited to industries and infrastructure it has now been resolved that even agriculture and allied services will be eligible for financing. Aquaculture thus become an important sector for development in the North East. .

NEDFi is an officers-based orgainzation, fully computerised and with a modem outlook. The representation of all the North-eastern states in its workforce has given the corporation a north-eastern look and this has instilled a sense of confidence in the minds of the entrepreneurs as he/she can talk in his/her own language to express views in a better way. Since most of the entrepreneurs in the primary sector are not used to dealing with modem financial institutions, the officers in NEDFi have been guided to take care of such cases.

NEDFi-Birth of a Bank for the North East, of the North East

Of late it has become apparent that the North East Region is yet to experience industrial development on a scale achieved by many States in the rest of the country. The reasons for this backwardness are not hard to find. One is definitely the infrastructure as indicated by the CMIE compiled index which is 76 for the NER compared to 100 for All India. The other main obstacle is the lack of connectivity. These, combined with the local environment vis-a-vis the rest of the country call for development requirements which are unique to the region. It was proposed by the Barthakur Committee Report that a special financial institution would go a long way in solving many of these requirements, if not all. Accordingly, the Honourable Finance Minister in his budget speech for the year 1995-96 announced setting up of a separate development bank for the Region. Pursuant to the announcement, was born the North Eastern Development Finance Corporation Ltd. (NEDFi), incorporated on the 9th of August, 1995, with its headquarters at Guwahati. It was inaugurated by the then Prime Minister on 23 February, 1996.

Resources

NEDFi was incorporated with an authorised share capital of Rs. 500 crores. The initial paid up capital of Rs. 100 crores has been contributed by IDBI (25%), SIDBI (10%), IFCI (10%), ICICI (10%), UTI (10%), LIC (15%), GIC & its subsidiaries (5%) and SBI (15%). There are provisions for raising future resources by way of borrowing through issue of fixed deposits, bonds, Govt. loans, grants etc. to meet its requirements. NEDFi will raise further equity as required for its operations in due course. Meanwhile, some steps are being taken up to tap International Development Financing agencies. At present, NEDFi's investment in various Financial Institutions and companies is about Rs.115. crores, which is to be mobilised for disbursement as and when required.

Management

The management of NEDFi has been entrusted upon the Board of Directors comprising of eminent persons from the NE region and outside having wide experience in industry, economics, finance, and management. At present, the Board has ten members; three from the participating institutions, two from the seven states represented by the Chief Secretaries in rotation; one from the banking division, Ministry of Finance, Government of India; one from the industry in the NE; the Secretary, NEC; one from financial sector and the Chairman, NEDFi.

The corporation has a highly motivated team of professionals, drawn from all over India, with considerable experience in related fields and sound academic qualifications. The office at present is a technology driven, service oriented, modern outfit. Care is taken to give the officers best of facilities and proper training.

NEDFi- More than a lending institution

Since its inception two years ago NEDFi has positioned itself not just as a lending institution but as guardian and path-leader of the entrepreneurs of the region, helping them in identifying viable projects, identifying technical consultants and even helping them in registering their units with respective Directorate of Industries and Registrar of Companies. Most of the promoters in the North Eastern (NE) region are first generation entrepreneurs and lack exposure. NEDFi soon realised that unlike their counterpart in other states of the country, entrepreneurs in the NE region need more than the credit facilities extended by the banks/ FI of the region. In pursuit of this objective, NEDFi regularly conducts seminars and workshops all over North-East involving entrepreneurs, bureaucrats, minister and intellectuals of respective states.

a) Seminars and Workshops: NEDFi has conducted over 20 seminars and workshops in various parts of the NE Region in past three years of its operation. In these seminars/workshops entrepreneurs are exposed to NEDFi's lending programmes, other sources of finance, modalities of assistance and viable projects for that region/state are also discussed. Although there have been meetings in the diary, poultry, handloom & handicrafts sectors, no meeting specially related to fishery has been held so far. Officials, Universities and farms should take advantage of this facility to conduct seminars beneficial to this sector.
b) State-specific Operation Strategy: As a pro-active step towards development in the region, NEDFi is working on State specific programmes for all the seven NE States. Recently, NEDFi officials visited States of Arunachal Pradesh, Manipur, Mizoram and Meghalaya and held discussions with Govt. officials, bureaucrats, entrepreneurs, industry experts and ministers concerned to identify thrust areas for development in these States, their credit needs and operation strategy for NEDFi's participation in these States.

c) Industry/Sector study: In the process of identifying suitable projects for the region and also to provide ready information to the entrepreneurs, NEDFi conducts industry/sector studies relevant to the NE region by engaging outside agencies, consultants and also through its in-house economics wing. For projects related to fisheries, studies may be done if NEDFi feels the need. As of now, small studies in the areas where fishery projects are being evaluated for financing have been done.

New initiatives

NEDFi is constantly trying to orient itself to meet the needs of the industry in the NE Region. Suitable credit delivery programmes like Working Capital Loan Scheme, Composite Loan Scheme, North East Equity Fund, Databank on NE etc. have been designed to meet the specific requirements of the region.

a) North East Equity Fund: Non-availability of adequate owners' equity capital has become an acute problem in this part of the country. In view of this, NEDFi has set up a North East Equity Fund for extending loan and equity contribution to promising entrepreneurs in the region. In view of the difficulty in arranging working capital, one cycle of working capital is also in this composite scheme. Thus, in a project between 10 to 15 lakhs, the Term loan would be 60%, NEDFi's equity contribution is 25% and owner's equity is only 15%. Such a scheme has been highly successful in the Hill states. Fishery projects have also been received under this scheme.

b) Data Bank for the N.E. on NICNET& Internet: Lack of access to relevant economic information acts as a major deterrent for entrepreneurs & promoters interest in making investments in the NE region. So, creation of a comprehensive Regional Resource Database and its wide dissemination was therefore felt necessary. With NEDFi's initiative" NE Databank Project" involving around Rs.35 lakhs has been launched in association with National Informatics Centre (NIC), Guwahati. NICs expertise and nation-wide Information Technology (IT) infrastructure will be utilised in development and dissemination of the database. The proposed database will attempt to cover a wide spectrum of business related critical information.

c) Fund for Entrepreneurs, Product and Market Development: An amount of Rs.l crore has been set aside for development of entrepreneurs and markets for NE Products. Identified entrepreneurs, craftsmen are sponsored by NEDFi for getting proper training outside the region. Products of this region will be given exposure by helping organizations to take part in trade fairs, fashion shows. This is one scheme which should lielp the fish farmers and associates to learn new things without having to spend their own money.

d) Micro Credit: In view of the potential which Micro credit programme holds for a backward region like the North East, modalities for such a programme is being worked out for its implementation by NEDFi. In the first year, an amount of Rs.25

lakhs will be lent under this programme. NGOs from all the NE states will be involved for its implementation.

e) Techno-Economics Development Fund: NEDFi has been given a one time grant of Rs.20 crores by the Central Government through NEC to fund techno-economic feasibilities studies for industry and infrastructure projects suitable to the region. Work is under progress. The Advisory Committee has met on the 26th March 1999, to finalise details.

f) A Programme for flood affected people: NEDFi has also launched a unique program whereby the people are taught to adopt agricultural practices in tune with the floods. The first such experiment is being done in the Nalbari district. If innovative projects in aquaculture can be formulated to cope 'with the floods, NEDFi will be ready to finance them.

In addition to the above, the Central Government in the Budget of 1998-99, has declared its willingness to make NEDFi the nodal institution for disbursing capital subsidies and transport subsidies in the North East. The modalities for operationalizillg the schemes are being worked out. Thus, NEDFi is being seen as an important institution, capable of perform ing the tiuties of a development financial institution in totality.

Workshop Recommendations

The plenary session was chaired by Dr. O. K. Dutta, O.S.D. and was assisted by S.K. Das, convenor of the workshop. In the plenary session, several recommendations from each paper presented were discussed at length. S. K. Das, convenor, also presented several immediate and long term measures which were thoroughly discussed with the participating fish seed producers, Govt. officials & scientists concerned and finally following recommendations were accepted by all. Scientists from the College of Fisheries; Central Inland Capture Fisheries Research Institute of ICAR, Guwahati; Gauhati University; Saha Research Centre, Calcutta; North Eastern Council, Shillong; Department of Fisheries, Govt. of Assam and the fish seed producers of Assam participated in the plenary session for giving a final shape to the recommendations suggested.

Immediate Measures

1. Hatchery operators must keep the brood fish under optimal conditions and choose the most appropriate well-maintained young brood fish fed with nutritious diets for spawning to ensure better quality of seeds.
2. Breeding of smal1 sized (both age & weight) brood fish must be avoided.
3. Hatchery operators must stop inbreeding (brother -sister and parents- offspring crossing) and avoid the tendency to cross breeding of different carp species. Mixed spawning of Catla, Rohu, Mrigal in a single breeding pool must be stopped. .
4. Carp fingerlings and brood fish may be col1ected from the river and may be grown to supply as brood fish by periodically replenishing the old brood stock.
5. Hatchery operators should form a network for exchange of their brood stock, ideas, technologies, results etc. among themselves with supports from concerned scientists and Govt. officials.
6. Encourage more economically viable small-scale hatchery facilities for resource-poor/ marginal farmers.
7. Breeding and culture of economical1y important indigenous fish should be encouraged.
8. Genetic awareness campaign should be launched to educate the fish seed producers on planned breeding programme.
9. Concerned authority should take appropriate actions to prevent unnecessary delay or harassment at police check post while transporting live fish seeds or brood fish from one place to another in the State.
10. All fish seed traders should register themselves and the concerned authority should issue license to them.
11. For measuring and counting offish seeds, a standard perforated "bati" be used and

the concerned department should supply such standard "bati" to all the fish seed traders.

12. Unplanned construction of hatchery should be avoided.
13. Catching of fish from natural waters during breeding season must be stopped.
14. Refreshers courses for Govt. officials and scientists concerned with fish seed production should be organised.
15. Fish seed marketing network be established with proper packaging and marketing technologies.
16. Actual data on fish seed production be procured.
17. Important information on quality fish seed production be published in local Assamese and English news papers/magazines.
18. A directory offish seed producers of the State of Assam be published.

Long term measures

1. Establish a live gene bank in Assam atleast initially for the IMC (Indian Major Carp, Viz Catla, Rohu & Mrigal) to supply pure strains of these indigenous carps. Government or any other appropriate agencies may support establishing such facilities.
2. Fish seed producers, hatchery operators should be trained on appropriate technologies concerning selective breeding, brood stock management, hatchery management, nursery management etc.
3. Initiate participatory research with farmer hatchery operators on induced breeding, selective breeding, hybridization, nursery management, transportation etc. The Government or financial institutes should help in establishing field laboratories for the purpose.

List of Participants in the Workshop

APRIL 08-09,1999
College of Fisheries
Assam Agricultural University
Raha, Nagaon, Assam

Sl. No.	Name	Address	Occupation
1.	Md. Abdul Noor	Vill - Bakulguri, P.O.- Barapghi Via - Jamunamukh, Pin - 782420	Farmer Fish Seed Producer
2.	Mr. Bipin Neog	Makum , Tinsukia , Phone - 0374 835709	- do -
3.	Mr. Biren Bhagabati	Biswantha Chariali, Phone - 22256	- do -
4.	Mr. Amiya Roy	C/o, Dr. Hemen Dutta Biswanath Chariali, Phone - 77185	- do -
5.	Mr. Mridul kr. Saharia	Vill - Namkhola, P.O.- Deodhanighat Distt. - Darrang , Phone - 83405	- do -
6.	Mr. Sidhartha Rajkhowa	Gahpur, Distt- Sonitpur	- do -
7.	Mr. Dharmeswar Rabha	Dungpara , Distt- Darrang	- do -
8.	Mr. Jofaullah	Rupahi, Nagaon	.- do -
9.	Mr. Moniruddin Ahmed	Mousita, Darrang	- do -
10.	Mr. Mohendra Borkataky	Lakhimpur	- do -
11.	Mr. Azizul Haque	Kharupetia, Darrang	- do -
12.	Md. Sabur Ullah	Kharupetia, Darrang	- do -
13.	Md. Abdul Mannan	Morigaon	- do -
14.	Md. Faruk Hussain Answari	Dhekiajuli	- do -
15.	Mr. Milan Ch. Bhuyan	Dhekiajuli	- do -
16.	Mr. Bhairab Doimari	Vill- Nalbari, Dhekiajuli	- do -
17.	Mr. Bikul Goswami	North Lakhimpur	- do -
18.	Md. Raful Amin	Dagaon, Nagaon	- do -
19.	Mr. Sisir Ranjan Nath	Muktasara, Hailakandi	- do -
20.	Mr. Abdul Motin	Rowmari, Nagaon	- do -
21.	Mr. Noorjaman Fakir	Silpukhuri, Morigaon	- do -
22.	Mr. Sanatan Kalita	Bagta(Hajo), Kamprup (Assam)	- do -
23.	Mr. Pradip Kr. Phukan	Sibsagar, (Sonali Seed Prod.)	- do -

24.	Mr. Sanjeeb Hazarika	Jamugurihat, Sonitpur	- do -
25.	Mr. Ajoy Chetri	Erabari, Sonitpur	- do -
26.	Lutfur Rahman	Nilbagan fish seed farm, Nagaon	-do-
27.	Md. Ali Akbar	Junukabari, Morigaon	
28.	Mr. Tilendra Chetia	Sibsagar (Assam)	- do -
29.	Mr. Harish Ch. Saharia	Sipajhar, Darrang	- do -
30.	Mr. Birendra Kr. Nath	Sipajhar, Darrang	- do -
31.	Mr. Nabin Ch. Konwar	Bhurbandha, Morigaon	- do -
32.	Mr. Naba Ch. Bashumatari	Barbari, Hatikhali, Nagaon	- do -
33.	Mr. Ripunjoy Kalita	Vill- Deurigaon, P.O. - Patiapam (Kampur) Distt.- Nagaon (Assam)	- do -
34.	Mr. Dipen Chakraborty	Rangiya, Kamrup (Assam)	- do -
35.	Mr. Prakash Borah	Guwahati	- do -
36.	Mr. Samilya Das	Bongaigaon	- do -
37.	Sayed Abdul Haque	Nazira, Sibsagar	- do -
38.	Mr. Birinchi Borah	Koliabar, Nagaon	- do -
39.	Mr. Santanu Borah	Kaliabar, Nagaon	- do -
40.	Miss Lakshita Pator	Amsoi, Nagaon	- do -
41.	Md. B. Uddin	Padumani fish seed farm, S/o Abdul Hannan, Mourajhar Bazar, Nagaon - 782 439	- do -
42.	Nabin Ch. Konwar	Morigaon Girl's H.S. school	Teacher.
43.	One representative from Burha gaon, Darrang Panchayat	Burha gaon Panchayat State resource Centre, Assam	Farmer
44.	Mr. Chandra Kr. Gogoi	Subdivisional Fishery Development Officer, Sonari, Sibsagar	Government Officer
45.	Mr. G. C. Nath	D.F.D.O. Govt of Assam Department of Fisheries , Kamrup (Assam)	- do -
46.	Mr. D.C. Bandopadhyai	Lecturer, R.F.T.I., Govt. of Assam, Amronga, Kamrup, Assam	- do -
47.	Dr. P. N. Goswami	Fishery Extension Officer, Kamrup, Assam	- do -
48.	Mr. M. Hussain	A.E.O. Deptt of Fisheries Ulubari Fish Farm, Ulubari, Guwahati	- do -
49.	Mr. Nilotpal Saikia	Fishery Extension officer, Deptt of Fisheries J. B. Garh Fish Farm, Bagariguri Raha, Nagaon	- do -

50.	Mr. A. B. Siddique	N.E.D.F. I Corp, G. S. Road, IDBI building, Guwahati	Manager (Agri)
51.	Mr. Arup Rajkhowa	CEO, Edi-NGO, Bamunimaidan, Guwahati	NGO Official
52.	Dr. Amiya Sarma	N.E.D.F. I Corp, G. S. Road, IOBI building, Guwahati	Manager (Economist)
53.	Mr. Manoj Das	Fishery Instructor, Deptt of Fisheries, Joisagar, Sibsagar,Assam,	Government Officer
54.	Mr. Simanta Konwar	Fishery Extension Officer, Deptt of Fisheries Hailakandi	- do-
55.	Mr. B. K. Sarma	D.F.D.O., Deptt of Fisheries, Nagaon (Assam)	- do-
56.	Mr. A. Rahman	D.F.D.O., Deptt of Fisheries, Morigaon (Assam)	- do-
57	Mr. Maheswar Bayan	Fishery Demonstrator, Deptt of Fisheries, J. B. Garh Fish Farm, Bagariguri, Raha, Nagaon	- do-
58.	Mr. S. S. Alam	D.F.D.O., Deptt. of Fisheries, Tezpur, Sonitpur, Phone - 20792	- do-
59.	Mr. S. Sarma	FEO, Deptt of Fisheries, Nagaon	- do-
60.	Mr. A. Bora	FEO, Deptt of Fisheries, Nagaon	- do-
61.	Prof. (Dr) A. N. Mukhopadhyay	Vice-Chancellor Ass Agricultural University, Jorhat -13	Scientist
62.	M. S. Rao, I. A. S.	Secretary, Agriculture, Govt of Assam & Project Director, ARIASP, World Bank, Agriculture Complex Khanapara, Ghy -22	Government Officer .
63.	Dr. S. C. Pathak	Chief General Manager, National Bank for Agriculture & Rural Development (NABARD), Panbazar, Guwahati': 781001	Bank Official
64.	Dr. P. C. Mahanta	Technical Advisor (Fisheries), North Eastern Council, Shillong, Meghalaya	Scientist
65.	Dr. O. K. Dutta	Officer on special Duty, College of Fisheries Assam Agricultural University, Raha, Nagaon, Assam, Pin - 782103	-do-
66.	S. K. Das	Associate Professor, College of Fisheries Assam Agricultural University, Raha, Nagaon	- do-
67.	Dr. P. K. Goswami	Associate Professor, College of Fisheries Assam Agricultural University, Raha, Nagaon	- do-

68.	Dr. V.V. Sugunan	Principal Scientist & Head of Division (Flod Plain) Central Inland Capture Fisheries Research Institute (CICFRI), ICAR, Rajgarh Road, Guwahati	- do-
69.	Dr. B. K. Padhi	Saha Research Institute, Calcutta (West Bengal)	- do-
70.	Dr. P. K. Saha	Principal Scientist, CICFRI, ICAR, Rajgarh Road Guwahati	- do-
71.	Dr. D. Das	Dean, College of Veterinary Science Assam Agricultural University, Khanapara, Guwahati - 22	Scientist
72.	Dr. A. B. Sarkar	Director of Research (Veterinary), College of Veterinary Science, Khanapara, Guwahati -22	Scientist
73.	Mr. P. Barna	Anthropologist, PIU ,ARIASP, (World Bank), Agriculture Complex, Khanapara, Ghy-22	Government officer
74.	Dr. U. C. Goswami	Professor & Head, Department of Zoology Gauhati University, Jalukbari, Guwahati	Scientist
75.	Dr. A. Dutta	Professor, Zoology Department Gauhati University, Jalukbari, Guwahati	- do -
76.	Dr. K. Kalita	Associate Professor, College of Fisheries Assam Agricultural University, Raha, Nagaon, Assam, Pin -782103	- do -
77.	Mr. S. Borthakur	- do -	- do -
78.	Mr. P. Sarma	- do -	- do-
79.	Dr. A. Ali	- do -	- do -
80.	Mr. K. K. Tamuli	- do -	- do -
81.	Dr. B. Kalita	- do -	- do -
82.	Mr. K. Sarma	Assistant Professor, College of Fisheries Assam Agricultural University Nagaon, Assam, Pin - 782013	- do -
83.	Mr. J. Sarma	- do -	- do -
84.	Mr. S. Ahmed	- do -	- do -
85.	Mr. D. Sarma	- do -	- do -
86.	Mr. P. C. Bhuyan	- do -	- do -

87.	Mr. S. K. Bhagabati	Teaching Associate, College of Fisheries Assam Agricultural University, Raha, Nagaon, Assam, Pin - 782103	- do -
88.	Dr. A. K. Bhagowati	Scientist, Fisheries Research Centre Assam Agricultural University, Jorhati - 13	- do -
89.	Mr. Rupak Nath	CMFRI, ICAR, Cochin, Kerala	Research fellow
90.	Mr. Pabitra Saharia	Fisheries Research Centre, Assam Agril. University, Jorhat - 13	- do -
91.	Mr. A. R. Mandal	Raha Higher Secondary School, Raha Nagaon (Assam) -782103	

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