TYPES OF PONDS AT THE HATCHERY

The salient features of different types of ponds are:

Broodfish Ponds

A broodfish pond, depending on the magnitude of operations, may vary in area from 0.2 ha to 2.5 ha and, for the sake of ease of netting operations, should be of a rectangular shape, with width not exceeding 25 m. Its water depth may vary from 1.5 m to about 2.5 m. A brood fish pond must be drainable and should be supplied with adequate quantities of organic and inorganic fertilizers for sufficient natural pond productivity and for proper gonadal development of the breeders.

The number of broodfish ponds in a hatchery depends on methods of dealing with different species. The alternatives are: (1) poly-culture of broodfish of both sexes of all the species of Chinese and Indian major carps in the same pond; (2) segregation of a combination of two or more species of both sexes in the same pond; (3) segregation of both sexes of a single species and (4) sex-wise segregation of different species in separate ponds.

Nursery Ponds

They are small in size (0.01-0.1 ha) and are drainable with depth around 0.5 to 1.2 m. Pond bottom should gently slope towards outlet. They are typically rectangular in shape and have a convenient width for netting operations. A harvesting basin is preferred in front of the drain or outside the pond for safe and convenient collection of fry.

Rearing Ponds

Rearing ponds are larger than nursery ponds and are 0.8 to 2 m deep. Pond bottom should be gently sloping towards outlet. They

are rectangular in shape and width is far less than commercial units for convenient and on demand netting operations. Like nursery ponds, a harvesting basin is maintained for safe collection of fry and fingerlings.

Drainability of both nursery and rearing ponds is highly desirable because during the slack season, it would enable the pond bottom to be exposed to sun, aeration, mineralization and aerobic oxidation of the organic load which otherwise might lead to hydrogen sulfide production, which is toxic.

Location of Ponds in a Hatchery

The area closest to the hatchery building should be planned for water treatment, (filtration, sedimentation units, aeration tower) laboratory, hatchery office and residential area for the staff. This arrangement will place the nurseries closest to the hatchery proper, which is a logical arrangement. The fish breeding tanks from inside the hatchery building may lead to outdoor nursery ponds by suitable conduits. As hatchlings grow into fry and fingerlings, they can be, with least expense, conveniently transferred from nursery to rearing to stock ponds. According to the aforementioned construction scheme brood fish ponds are the farthest from the hatchery proper hence need proper watch and ward arrangements.

THE HATCHERY PROPER

A modern hatchery is a facility for induced breeding for multiple species of fish. It is a system composed of holding tanks, breeding tanks, hatching jars and larvae rearing tanks. The system of these components can be adjusted as per the commercial requirements of the quantity of fish seed. It has a major role in providing the quality fish seed in required numbers at appropriate times.

The purpose and functioning of different components are described below:

a. Holding tanks

The primary purpose of a holding tank (Fig.4) is to hold ripe breeders before hypophysation, and before spawning, but they also serve other purposes such as holding or even rearing of fry, holding of fingerlings before sale, and providing space for the application of treatments to fish. If the holding tanks are meant as multipurpose in a hatchery, their dimensions may be adjusted as per requirements of the system maintaining their desired attributes and their number.

b. Breeding Tanks

These are used to hold injected or otherwise ripe breeders awaiting induced or natural spawning and fertilization. Fitted with an adjustable stand pipe they have a slope towards central drain for complete drainage of tank water when and where required. The inlet provides uninterrupted flow of oxygenated fresh water.

c. Circular Spawning, Hatchery and Larvae Rearing Tanks

Circular spawning tanks (Fig.3) create a natural environment and facilitate fish spawning. Furthermore, there are no dead areas and the water flow throughout the tank is uniform and water inlet and outlets can be precisely controlled. These circular tanks can serve as breeding tank, hatching tank as well as larval rearing tanks simultaneously.

A convenient size of a breeding tank is 2 m diameter and 1 m deep which would hold about 1,800 liters of water. To maintain water in circular motion, small inlet pipes, upper ones facing the wall and lower ones facing the central drain pipe are installed to keep eggs and fry in suspension with uniform distribution throughout the tank. Normal flow rate in these tanks is 18 L min^{-1}.

CARP BROODFISH SELECTION AND MANAGEMENT

Prior to natural or induced spawning, brood stock should be reared under optimum water quality conditions and suitable types of feed. Formulated feed and/or natural food can be provided to optimize gonadal development. Appropriate and standardized stocking density and species combination ratio is another important parameter to consider for healthy development of gonads (Mirza and Bhatti, 1993).

In addition to formulated and natural feed, application of inorganic and organic fertilizers is also important for maintaining beneficial plankton levels of at least 50 ml per 1,000 L^{-1}. High protein (at least 30%) artificial diet at 2% of their wet biomass is advisable to supplement the natural food in a pond. Catla carp breeding and subsequent rearing is very limited and demands comprehensive research work to resolve its issue of breeding and supply which is always in high demand but unfortunately production is very low.

Reproductive Biology and Induced Breeding of Carps

The Indian major carps and the Chinese carps breed naturally only in the flowing waters of their natural habitat during the rainy season (Mirza *et al.*, 1992). Prior to introduction of induced spawning, the required quantity of seed was collected from natural waters which were frequently contaminated with undesirable species harboring unwanted contaminants and disease causing pathogens. Induced breeding produces seed of much greater consistency and fish can be spawned on demand when it matures. It also provides ample opportunities for stock improvement by selective breeding and hybridization.

Feeding the Broodfish

Special dietary care is required for the different species of broodfish.

***Ctenopharyngodon idella* (Grass carp)**

1. ***Grass Carp:*** In Pakistan, the spawners of grass carp are typically fed once daily, during autumn and spring, on wheat and paddy sprouts, corn grains and bean cakes in equal proportions at 1-2% of their body weights besides macro-vegetation which is fed at 30% of their body weight to enhance fecundity and promote proper gonad development.

2. ***Bighead and Silver Carp:*** These fishes are planktophagous. Fertilization of pond with organic manures at the rate of 1.5 to 2 tons per hectare at an interval of every ten days is recommended. Should the gonad development remain poor, supplementary feeding with powdered bean cakes, peanut cakes and wheat or rice bran may be given in equal proportions at 1-2% of body weight per day may

be given. Formulated pelleted brood stock feeds should also soon be on the market.

Aristichthyhs nobilis **(Bighead carp)**

Hypophthalmicthys molitrix **(Silver carp)**

Catla: For proper gonadal development, organic manuring with cattle dung and/or chicken and duck droppings, and production of zooplankton at 30-50 ml per 1,000 L^{-1} of water are very important. Formulated feeds containing soybean meal and/or fish meal (30% protein) with rice bran or wheat bran with appropriate levels of oilcakes at 3-5% of body weight daily are also valuable.

***Catla catla* (Thaila)**

Mrigal, Rohu and Common Carp: These species are naturally detritus eaters or browsers. Feeds based on soybean meal, rice bran or wheat bran and oilcakes in equal proportions at 3-5% of body weight per day benefit their gonadal development. An alternate feed is a mixture of wheat bran, mustard oilcake, coarse wheat flour and fish meal or soybean meal in the ratios of 4:4:1:1. Mustard oilcake, if used, should be presoaked (for softening) in water overnight.

***Labeo rohita* (Rohu)**

***Cirrhinus mrigala* (Mori)**

***Cyprinus carpio* (Common carp)**

BROOD STOCK SELECTION AND MAINTENANCE

Factors influencing breeding in fishes

1. *Temperature:* Cloudy and rainy weather (temperature range of 24^0C to 31^0C) is good for the stimulation of breeding events in carps. Different events in natural and induced breeding of carps are:

2. *Environmental stimuli* → Receptors → Brain Centre (Hypothalamus) → Pituitary gland → Gonadotrophin hormone → Gonads → Spawning/Natural Breeding

3. *Inducing agents*: During the course of induced spawning of these carps, Carp Pituitary Homogenate (CPH) or some synthetic hormones (gonadotropin analogues) can be used to stimulate early maturation of gonads and spawning.

Stages of Maturation of Adult Carps

Although the development of eggs in the gonads and maturation of eggs is a continuous process, it can be divided into various stages of development and maturation. Once the ovaries have become opaque, granular and somewhat grayish, they occupy about one third of the body cavity of the female. At this stage, the abdomen of the female fish shows a conspicuous bulge which extends past the pelvis up to genital aperture. Further development of the ovary is very fast, especially in increasing day-length and rising temperature.

While sexes in these carps are morphologically similar, they do exhibit some seasonal sexual dimorphism. The more important external distinguishing features of ripe female and male Chinese carps and Indian major carps are that the pectoral fin of male is relatively long and prominent with well-developed thick outer-most ray with a rough inner surface.

The reproductive cycle of the major carps can be divided into following four periods.

i.	Preparatory Period	February – March
ii.	Pre-spawning period	April – May
iii.	Spawning Period	June – August
iv.	Post Spawning Period	September - January

The periods mentioned above are variable according to the environmental condition especially the air and water temperature in the area. Pre-spawning period is associated with the increasing

photoperiod and spawning phase is associated with environmental factors prevailing during the monsoon season. Spawning phase includes maturation and ovulation. In induced breeding operation, the purpose of injecting gonadotropin as fish pituitary gland or its synthetic analogue is to help in maturation and ovulation.