Dayanand Science College, Latur

Department of Zoology and Fishery Science

Class: B.Sc. I Year

Subject: Fish Seed Production & Hatcheries Mangement (IV)

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UNIT I

1) Natural Seed collection
   i. Spawn resources investigation technique
   ii. Selection of spawn collection site
   iii. Gears used for collection of spawn
   iv. Methods of collection of spawn
2) Bundh Breeding: Types of bundh breeding
   i) Wet bundhs ii) Dry bundhs iii) Modern bundhs

UNIT II

1) Artificial fertilization by stripping
i) Dry Method ii) Wet Method
2) Induced breeding by hypophysation
   i. Introduction
   ii. Identification & selection of brooders
   iii. Dissection and removal of pituitary gland
   iv. Preservation and storage of pituitary gland
   v. Preparation of gland suspension for injection and dosage
3) Hormones responsible for induced breeding
4) Synthetic hormones used in induced breeding

UNIT III

Hatcheries and management (Principle, structure and management)

1) Hatching happa
2) Glass jar hatchery
3) Bin hatchery
4) CIFE D 80 model (Dwivedi – 80)
5) Chinese circular hatchery

UNIT IV

1) Fish seed transportation
   i. Open transportation system
   ii. Close transportation system
   iii. Causes of mortality in transportation
   iv. Use of chemicals in live-fish transportation
   v. Anesthetic drugs use in transport
   vi. Antiseptic and antibiotics used in transportation
   vii. Technique of fish seed release.

2) Fish seed trade
   i. Classification of fish seed
   ii. Identification techniques
   iii. Different units of fish seed counting
   iv. Fish seed trade in India

UNIT I

2) Natural Seed collection
   i. Spawn resources investigation technique
   ii. Selection of spawn collection site
   iii. Gears used for collection of spawn
   iv. Methods of collection of spawn
3) Bundh breeding
   Types of bundhs : i) Wet bundhs ii) Dry bundhs iii) Modern bundhs

1) Natural Seed collection

Fish seed is the most important component for fish culture. The freshwater resources of our country for fish culture are estimated to be 2.85 million hectares of pond and tanks. In addition to this, another 2.05 million hectares of water area is available in the form of reservoirs or lakes. It has been estimated that nearly 14250 million fry would be required for stocking even the present available cultivable resources of 2.85 million hectares on a conservative stocking rate of 5000 fry/ha. The present production is 15007 million fry. Apart from this, at least an additional quantity of 4100 million fry are required for stocking the available area of lakes and reservoirs with an average stocking rate of 2000 fry/ha. This indicates that there is a necessity to raise the fry to stock the available water resources.

The fish seed is obtained from 3 sources – riverine, hatcheries and bundhs. The collection of seed from riverine source was an age old practice. This method is strenuous and we get the mixture of wanted and unwanted fish seed. Hatcheries are the best way of getting fish seed. Apart from these, the bundh breeding is also a good method to collect the fish seed by creating a natural habitat.

The different river systems of India display variations with regard to the distribution and abundance of their fish fauna. This is mainly due to their individual ecological conditions, such as gradient, terrain, flow, depth, temperature, substrata, etc. The northern rivers are perennial and support rich commercial fisheries. Except for the deltaic regions, the fishery of the peninsular rivers is poor both in the upper and middle reaches.

i. Spawn resources investigation technique

The Central Inland Fisheries Research Institute (CIFRI) located at Barrackpore, Kolkata, during 1959 – 1964, conducted a pioneering program of seed prospecting investigations on various river system with a view to ascertaining the quality and quantity of fish seed, availability, gears for spawn collection, method of collection, measurement of fish seed, factors responsible for fluctuation in seed availability, etc. on an all-India basis. The diverse geographical and climatic conditions of India greatly influence riverine resources of the country. The most important carp seed resources are: eggs, spawn, and fry and fingerlings**.**

In order to select the spot of maximum availability of spawn within a specified stretch of the river concerned, a number of trial nets are simultaneously operated at a number of suitable spots. After selecting the spot, the operation is started with full battery of nets. Once it is done, the collection from the tail piece of each net is scooped one after the other in quick succession every 15 minutes or depending upon the intensity of spawn. The contents of the gamcha are then scooped immediately in to a container half filled with river water. The collection is then passed through a mosquito netting sieve so that the unwanted organisms and non floating debris can be removed. The spawn are measured and kept in hapas for conditioning, then transported to fish farms and stocked in nurseries.

ii. Selection of spawn collection site

A pre-monsoon survey is conducted to ascertain the topography of the terrain and bank features at and in the vicinity of a site to determine the extent of operational area. The topography of dry beds and bank features to gauge the likely current pattern of the river at different stages of flooding. The distribution and composition of the fish fauna in the selected stretch of the river, resident or immigrant, for assessing the abundance of major carps during the monsoon season. The location of tributaries, rivulets and canals along with their main river, as they might constitute important connecting links between the river and breeding grounds. The identity and accessibility of the site. The bends and curves of various shapes in the river course often show a precipitous, fast eroding bank on one side called erosion zone and a flat, gently sloping bank exactly opposite called shadow zone. These banks are not useful for spawn collection. Best seed collection sites lie on the side of the sloping bank but at the spot the current force the seed to the sides by centrifugal force. These spots are best to operate nets to collect large amounts of spawn.

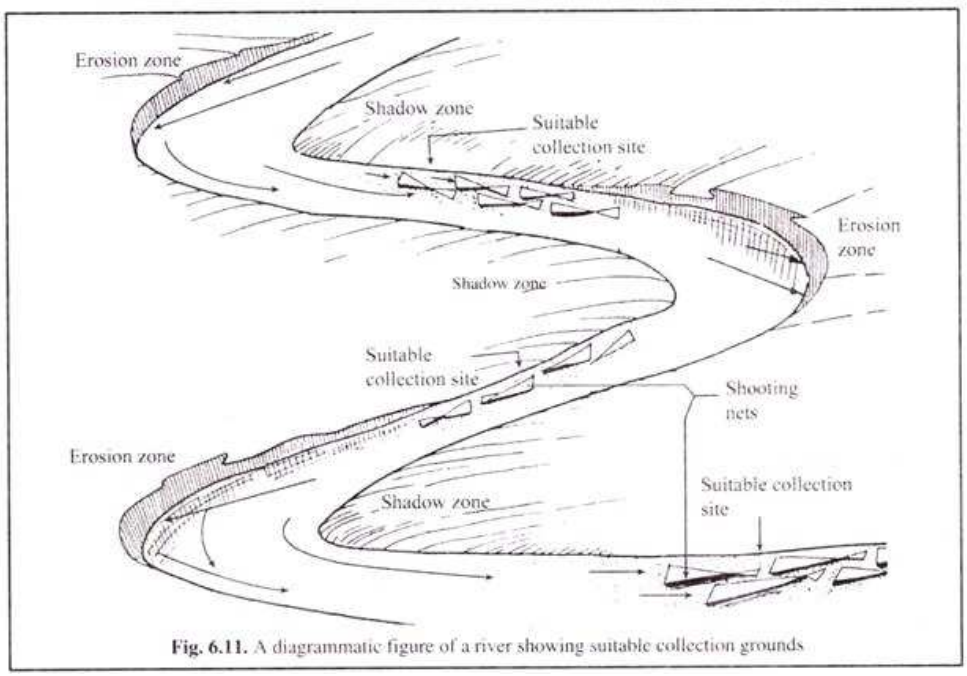


Fig. 6.11. A diagrammatic figure of a river showing suitable collection grounds

iii. Gears used for collection of spawn

- The most used net is '*Shooting net*' which is a funnel shaped net of finely woven netting

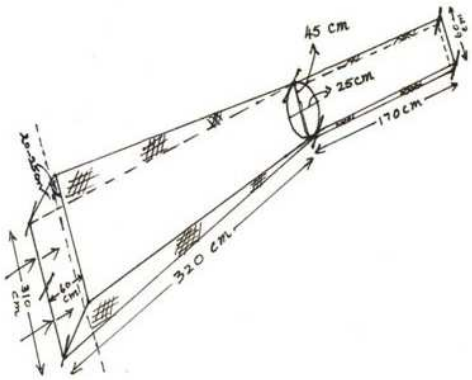


Figure : A typical shooting net (Midnapore type) used to collect riverine fish spawn

Figure : A battery of shooting nets ready to be commissioned for riverine/brackishwater fish seed collection (Photo courtesy : Dr Utpal Bhowmick)

iv. Methods of collection of spawn

Generally shooting nets are used to collect the seed in the rivers. A shooting net is a funnel-shaped net of finely woven netting, and is fixed with the mouth of the net facing the current. It is operated in the shallow margins of a flooded river. At the tail end of the net, there is a stitched – inning of split bamboo or cane, and to this is attached, during the operation, a receptacle, termed the gamcha. A gamcha is a rectangular open piece of cloth. The seed moving along with the marginal current collects in the gamcha, and is stored in hapas or containers after removal.

Benchi jal is used to collect the seed in Bengal. Midnapur net is also used in Bengal, especially in the south-western parts, to collect the seed. The shooting net is fixed in line with the water current direction. The bamboo poles are fixed firmly at the selected site and the net is fixed to bamboo poles. Two bamboo poles are fixed near the mouth and other two poles are fixed at tail ring. The anterior end of gamcha is then tied round the tail ring. The gamcha is fixed in position with the help of two more bamboo poles.

2) Bundh breeding

Types of bundhs: i) Wet bundhs ii) Dry bundhs iii) Modern bundhs

Bündhs are special type of perennial and seasonal tanks or impoundments where riverine conditions are created during monsoon months. Majority of bundh type tanks where major carps are known breed are situated in MP. and West Bengal. The bundhs, after a heavy

shower, receive large quantities of rain water with washings from their extensive catchments and provide large shallow larginal areas which serve as breeding (spawning) grounds for the fishes.

i) Wet Bundhs: Wet bundh is a perennial pond specially constructed for fish breeding having water throughout the year. An inlet is formed at the higher level of bundh for the entrance of water while an outlet is constructed in low lying area for the exit of the water from the bundh. The flow of water from the outlet is controlled with the help of bamboo fencing. The major portion of such bundhs get submerged with water. The shallow area of the bundhs, where fishes actually spawn are called moans'

ii) Dry bundhs: A dry bundh is a seasonal shallow pond enclosed by an earthen walI (embankment) on three sides and an open area from one side (Fig. 2). During the monsoon season, rain water rushes from the vast catchment area and accumulates in the pond. Breeders from nearby ponds are introduced in the shallow ponds. Breeding takes place after a heavy shower when the bundh is flooded with fresh rain water. It has been noticed that the carps migrate to shallow water, where after a little sexual play, they spawn. The eggs are collected by means of a mosquito net and transferred to small ditches or cloth hapa of the size of 4' x 3 for hatching. After 3 to 5 days fry are transferred to nurseries. When the monsoon is over, dry bundhs get dry up after a month or two. Dry bundhs are also situated in U.P. and W.B.

iii) Modern bundhs: After successful breeding of carps in the dry bundhs in Sonar Talliya in M.P., various dry bundhs of improved designs were constructed, called Modern bundhs or Pucca bundhs. The sluice gate at the lower most level of this bundh is the characteristic feature. The total exit of water is possible by this gate of modern bundh so that. after each spawning, bundh is cleared of water. The selection of the type of bundh for spawning is done on the basis of the breeding nature of different fishes.

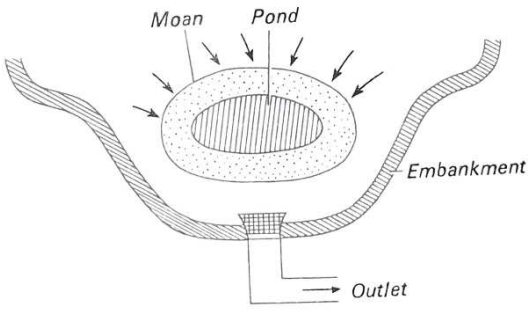


Fig. 1. Wet bundhs.

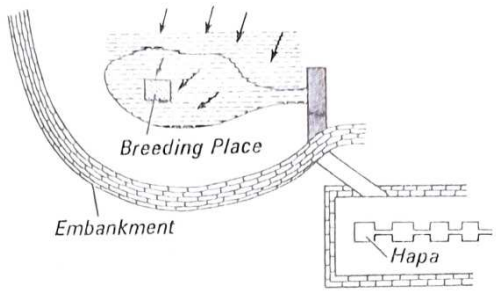


Fig. 2. Dry bundh.

UNIT II

5) Artificial fertilization by stripping
   i) Dry Method ii) Wet Method
6) Induced breeding by hypophysation
   i. Introduction
   ii. Identification & selection of brooders
   iii. Dissection and removal of pituitary gland
   iv. Preservation and storage of pituitary gland
   v. Preparation of gland suspension for injection and dosage
7) Hormones responsible for induced breeding
8) Synthetic hormones used in induced breeding

1) Artificial fertilization by stripping

i) Dry Method ii) Wet Method

Eggs of certain species of carps can be artificially fertilized by stripping. In this procedure, the eggs forced out of the body by gently massaging the belly of with female fish. The eggs are then mixed the milt similarly procured from the mature male of selected fish species, to complete the process of fertilization. It is of two types (1) Dry method, (2) Wet method.

i) Dry method: Eggs and sperms (which are just taken out by stripping) are mixed thoroughly and left in this condition for 30 minutes. Now water IS added this mixture after the fertilization of the eggs.

ii) Wet method: Eggs are kept in water and milt of the selected male fish species is spread directly over into this water. This method is generally used for sticky eggs.

Eggs so fertilized are transferred to the hatching pits. Often the stripping is done after the brood fishes are injected with hormone.

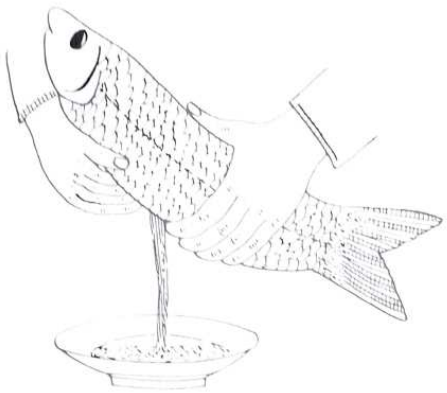


Fig. 3. Induced spawning by stripping.

2) Induced breeding by hypophysation

i. Introduction
ii. Identification & selection of brooders
iii. Dissection and removal of pituitary gland
iv. Preservation and storage of pituitary gland
v. Preparation of gland suspension for injection and dosage

i) Introduction

Induced breeding is a technique whereby ripe fish breeders are stimulated by pituitary hormone introduction to breed in captivity. The stimulation promotes a timely release of sperms and eggs from ripe gonads. In Simple words, spawning in fishes induced by some artificial breeding stimuli may be called "induced breeding"

Advantages: (1) By inducing the fish to spawn separately in pond, the risk of fish seeds getting mixed with undesirable and predaceous fish spawn is overcome. (2) Collection, identification and establishment of nurseries at the spawning site and transportation of fish seed require strenuous management and manpower, affecting the income of the farm. All this can be saved by adopting induced breeding technique at the fish farm. (3) The spawn of desired species can be obtained the in desired numbers, depending upon demand in the fish farm. (4) The induced breeding technique is simple and can be easily learnt even by a layman. (5) It requires no typical surgical instrument.

For induced breeding, hypophysation is the first and foremost step. Induced breeding requires the knowledge about location of pituitary and its dissection, preservation and storage, preparation of its suspension, dosage and method of its injection.

ii) Identification & selection of brooders

For success in induced breeding it is important to select good, healthy breeders well in advance, and keep them in breeding tanks. They should preferably be of medium size, 1-5 kg in weight, and in the age group of 2-4 yrs. The breeders are given balanced supplementary food for healthy growth of the body and attaining advanced gonadal maturity. They are fed with cheap artificial food consisting of rice-bran oil cake, powdered cotton seed, etc daily for 15-30 days before injection of the pituitary extract @ 1 % of their body weight.

Before the commencement of the rainy season males and females are segregated in separate ponds. A male carp can be easily identified during the breeding season by the roughness of the dorsal surface of the pectoral fin, which is very smooth in the female. Ripe male oozes milt at a slight pressure on the abdomen. A fully ripe gravid female has a soft, bulging, rounded abdomen with a swollen, reddish vent. In the ripe male, the abdomen is almost flat, the vent is not swollen, and its pectoral fin is slightly longer than that of the female.

The breeders should be handled carefully as rough handling may cause injury and infection. Periodic examination of the fish should be carried out to determine the condition of the gonads. For determining the sex, the breeders are taken out one by one by a hand net to prevent the fish from struggling too much.

iii) Dissection and removal of pituitary gland

Sharp knife or a hand saw is used for dissection of fish head, with oblique stroke; a portion of the skull is at first removed. Grey matter and fatty substances are removed by a blunt forceps, when the brain is exposed. The entire brain is now lifted up by detaching the olfactory and optic nerve. The pituitary gland is located ventrally just posterior to the optic chiasma covered by a thin membrane. When the gland is exposed, it is carefully picked up by a twiser or forceps. Care should be taken so that pituitary gland is not damaged.

iv) Preservation and storage of pituitary gland

The glands are stored in 100% alcohol at ordinary temperature. After each 24 hours, 100% alcohol is changed for further dehydration and defattening. The gland is weighed and stored in a refrigerator. The glands may be stored inside the dessicator containing anhydrous calcium chloride. Dessicator may be kept inside a refrigerator. Extract may also be preserved in glycerine (3 ml extract + 1 ml water + 2 ml glycerine). The weight of gland shows variation from 7.0-18.8 mg in Rohu having the weight 1.0 -3.6 kg and 3.0-22.8 mg in Mrigal having weight of 0.3-3.5 kg.

It is not definitely known at what high (temperature, the hormones are denaturated. However, satisfactory results have been obtained by using the pituitary glands even kept at room (temperature rising upto 40°C for a few weeks.

v) Preparation of gland suspension for injection and dosage

- The extract preparation should be carried out just before injection.
- The required quantity of glands is taken out of vial and they are dried on a filter paper by allowing the alcohol to evaporate.
- The glands are then homogenized with distilled water or saline in a tissue homogenizer.
- If acetone-dried glands are used, they can directly be taken for maceration.
- One-third of the media is used for homogenization, while the remaining two-third is used for rinsing the homogenizer and the glass rod.
- Recommended dilution rate is 20-30 mg in 1 ml of the media.
- The extract is centrifuged at 5,000 rpm for 5 minutes.
- The clear supernatant solution containing gonadotropins is taken in syringe for injection.

Types of injection

***Homoplastic injection*:** Injecting pituitary from one fish to another fish closely related to the donor fish. E.g. carp pituitary gland extract to carps.

***Heteroplastic injection*:** Injecting pituitary from one fish to another fish distantly related to the donor fish. E.g. carp pituitary gland extract to catfish and vice versa.

Methods of injecting fish brooders

There are three methods of injecting brooders.

1. *Intra-muscular injection*:

- It is administered into the muscle on the caudal peduncle or behind the dorsal fin, but above the lateral line.

- It is most effective, convenient, simple and less risky.
- It is widely practiced.

2. *Intra-peritoneal injection*:

- It is give through the soft regions of the body, generally at the base of the pelvic fin or the pectoral fin.
- It is risky as it may damage the gonads or liver.

3. *Intra-cranial injection:*

- In this method, the injection is given through the cranium and is also risky as it may damage the brain.
- The pituitary extract is administered through a glass or disposable syringe, 2.0 ml capacity, having 0.1 ml graduation.
- The size of the needle depends upon the weight of the brooder to be injected.
- Needle number 22 is used for fish weighing 1-3 kg, No. 19 for larger fish and No. 24 for smaller fish.
- When two injections are given, one is given on the side that did not receive the first injection.

Dosage of pituitary extract

Assessment of proper dosage is most important for successful spawning. In practice, the female receives two injections, while the male receives only one injection, i.e. at the time of second injection to the female. Hypophyseal dosage depends chiefly upon the proper stage of sexual maturity of the breeders. Besides, the potency of glands also vary depending on the stage of maturity of the donor fish and also on proper preservation of gland material.

A single injection of 5-10 mg of homoplastic Pituitary gland per kg body weight of a female Breeder and 2-3 mg/kg of body weight of male beeders gives satisfactory result at optimum temperature. If first injection does not work, a second injection is given 8-10 hours after the first injection. Generally, third injection is satisfactory results recommended. More not are obtained when female alone is given a preliminary dose of 2-3 mg/kg body weight and kept it Segregated. After 6 hours a second dose of 5-8 mg/kg body weight is given to the female and first dose of 2-3 mg/kg body weight is given to e male. Two males per female by weight are given a single dose, each of 2-3 mg/kg weight at the time of second injection to the female, if pawning is not affected.

First (I) Dose or Provocative or preliminary dosage and second (II) Dose or effective or resolving dosage. The interval between the two doses is 6 hours.

Carp glands to major carps

	Female	**Male**
I Dose	2-3 mg/kg b.w.	nil
II Dose	5-8 mg/kg b.w.	2-3 mg/kg b.w.

3) Hormones responsible for induced breeding

Hormones responsible for induced breeding. The gonadotropin hormones (FSH and LH) secreted by hypophysis influence the maturation of gonads and spawning in the fishes.

4) Synthetic hormones used in induced breeding

- Studies conducted by numerous investigators on induced breeding of fishes have indicated the superiority of several ovulating agents over fish pituitary extract.
- Although fish pituitary extract was initially used extensively for fish breeding all over the world, synthetic spawning hormones are now being increasingly used due to their efficacy and convenience.
- Banerjee et al. (1989) succeeded in the purification of pituitary gonadotropic hormone from *Channa punctatus* and *Catla catla*.
- Mammalian pituitary hormones in combination with fish pituitary gland extract precipitated spawning in fish.
- Of all the mammalian hormones tested on fish, chorionic gonadotropin (CG) has given successful result in inducing fish to breed, probably because CG behaves primarily as a luteinising hormones (LH).
- Synahorin (a mixture of CG and mammalian pituitary extract) in combination with pituitary gave positive results when injected to rohu.
- Sinha (1969) reported the fractionisation of pituitary extract from carps and tilapia. He obtained success in spawning of carps.
- Bhowmick et al. (1979) found mammalian hormones antuitrin-s, leutocyclin and RH-LH ineffective when injected singly or in combination with carp pituitary extract.
- The CIFRI, Barrackpore undertook detailed studies on the use of LH-RH alone or in combination with progesterone and obtained breeding success which ranged between 25-49% in carps and 100% in catfish.
- Commercialized by Syndel Laboratories, Inc., Vancouver, British Columbia, Canada, under the trade name ovaprim.
- The ovaprim spawning kit - use with salmonids, cyprinids and other freshwater cultured fish- wide success.
- In India- ovaprim and ovatide for induced spawning of Indian major carps and exotic carps is economically advantageous.

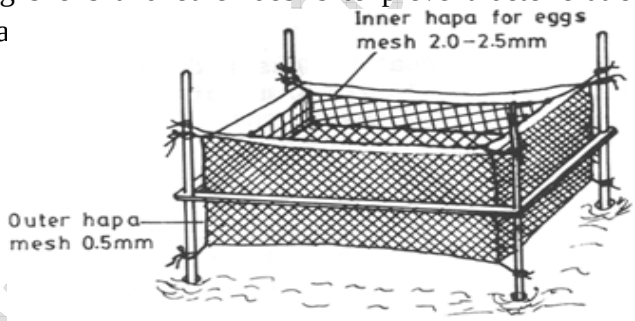
UNIT III

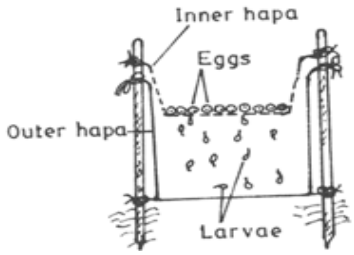
Hatcheries and management (Principle, structure and management)

6) Hatching hapa
7) Glass jar hatchery
8) Bin hatchery
9) CIFE D 80 model (Dwivedi – 80)
10) Chinese circular hatchery

1) Hatching Hapa

1. It is a traditional net enclosure with the inner net being smaller than the outer one.
2. The outer net consists of a fine mesh (0.5 mm) sieve-cloth tank about 2 x 1 x 1 m in dimension, while the inner chamber, made of the same material, has a mesh size of 2.0 – 2.5 mm.
3. The whole device is placed in a protected water body where the water is well oxygenated. The fertilized eggs are evenly spread in the inner hapa.
4. The hatched larvae fall or pass through the larger meshes of the inner hapa and are retained by the outer hapa as the small meshes of the outer hapa prevent them from escaping.
5. After hatching of the eggs get completed, the inner hapa is removed together with the dead eggs, egg shells and other debris to prevent deterioration of the water quality within the hapa





2) Glass jar hatchery

A glass jar hatchery is a much modified set-up than the earthen pot hatchery. It is comprised of:

(a) Water supply system

(b) Breeding tanks

(c) Incubation and hatching jars, and

(d) Spawnery.

Location: Glass jar hatchery is generally installed by the side of a water source which may be a perennial pond or a river or a water supply from a tube-well. It should be kept in a well-ventilated room with adequate light and proper drainage system.

Construction:

(a) Overhead Tank: Available water from the source is pumped up into an overhead tank (Fig. 6.26), which is installed above a brick wall. If water is drawn from a river, then a desilting tank should be provided. A fine meshed wire-netting is provided in the pump system.

This helps to prevent the entry of organisms commonly present in the water of river and pond. A deep tube-well is of much facility as it provides clean water. The tube-well should be installed in an arsenic-free area.

(b) Breeding Tank: As hatchery is a self-contained unit, it generally contains a breeding tank with arrangement for overhead showers. This tank is provided for spawning the fish. An outlet is present in each tank, for draining the excess water. A breeding tank is made of 1.8 m x 0.9 m x 0.9 m in dimensions. Generally, in a farm there are 2-3 breeding tanks where 2-4 breeding hapas can be fixed at a time. However, the number of breeding tanks in a hatchery depends on the spawn production target. In a hatchery where there is no provision of breeding tanks, the operation is undertaken in hapas fixed in ponds and the fertilized eggs are released into the glass jar for incubation and hatching. Sometimes, the spawnery itself can be used as a breeding tank.

(c) Incubation and Hatching Jars:

There are different types of incubation and hatching jars used, ranging from the glass jars, and synthetic jars to Zong jars, with temperature controlled water supplies.

Glass Jars: Glass jars are conical in shape. They are open at the top and gradually tapering towards the bottom. The various measurements of the jar are given in Fig. 6.27.

The glass jars are set up vertically through the circular holes made in a wooden table (Fig. 6.28). The table is of 4.05 m x 0.6 m with a height of 0.9 metre. The detailed plan for the sequential placement of jars on the table is given in Fig. 6.28. The jars are fitted in two rows at a gap of 22.9 cm. They are kept in a vertical position with the help of clamps (Fig. 6.26).

The top of the jar is fitted with a galvanised iron ring with a beak (Fig. 6.27). It serves as an outlet for water coming out of the jar. The jars are connected with rubber tubings at the bottom with respective taps (Fig. 6.26).

Each glass jar has a capacity of 6.35 litres and can accommodate 50,000 carp eggs at a time. A long open galvanised conduit (Fig. 6.26 and 6.28) is fitted in such a way that the overflowing water from each jar passes into it and flows down to the spawnary.

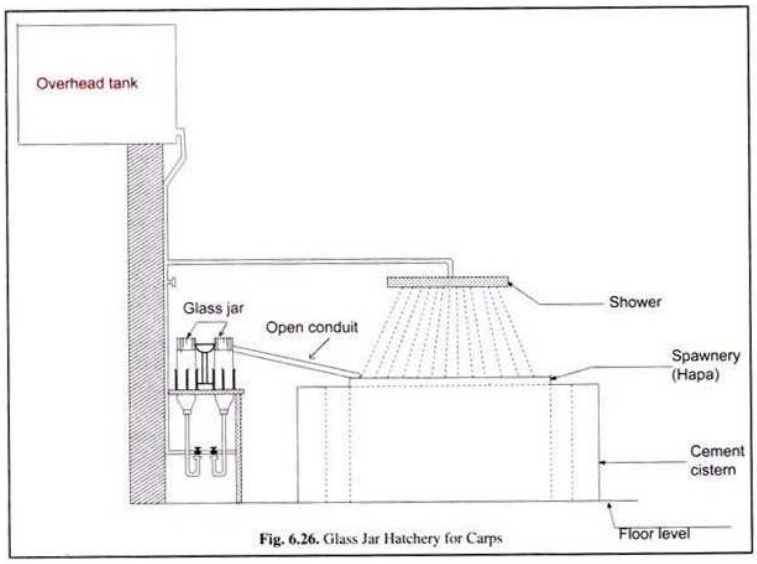


Fig. 6.26. Glass Jar Hatchery for Carps

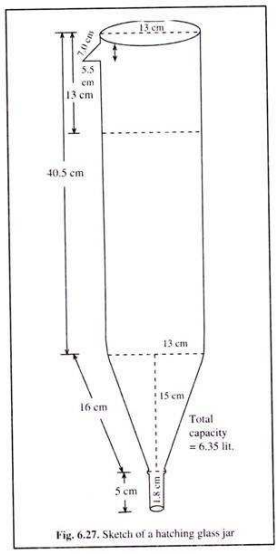


Fig. 6.27. Sketch of a hatching glass jar

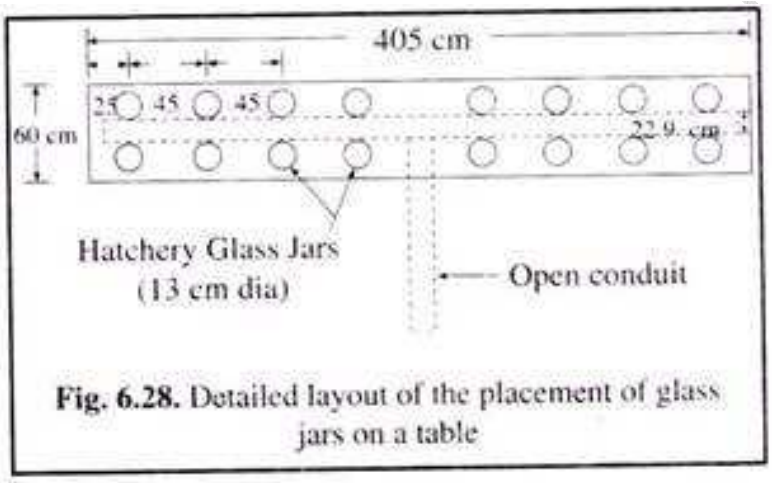


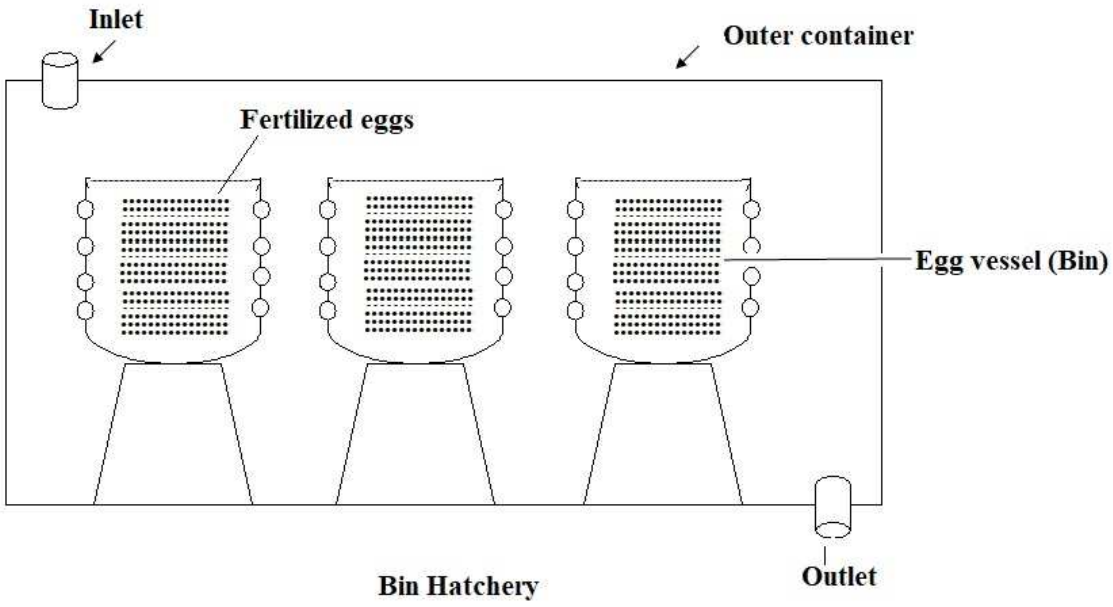
Fig. 6.28. Detailed layout of the placement of glass jars on a table

3) Bin hatchery

The hatchery consists of a outer hatchery container in which three single egg vessels are placed. Each unit consists of outer container and the inner common egg vessel, suitable to hold major carp's eggs as well as common carp eggs.

Structure of outer hatchery container: this is a rectangular aluminum sheet tub having dimension of 54X18X22" which is divided into three chambers. The containers have a capacity to circulate 243 liters of water. At a time, at the rate of 8 liter of for each hatchery unit are placed with eggs for hatching. The important part of the container are – inlet pipe, outlet pipe, drain pipe.

Management of common egg vessel: The common egg vessel is made of aluminum/ FRP/Plastic material which has perforation. It is cylindrical in shape having small holes with a perforated lid covering to avoid the overflow of eggs from egg vessels. These vessels are placed on a stand at required depth. Each vessel can hold about 2 lakh of major carp's eggs.



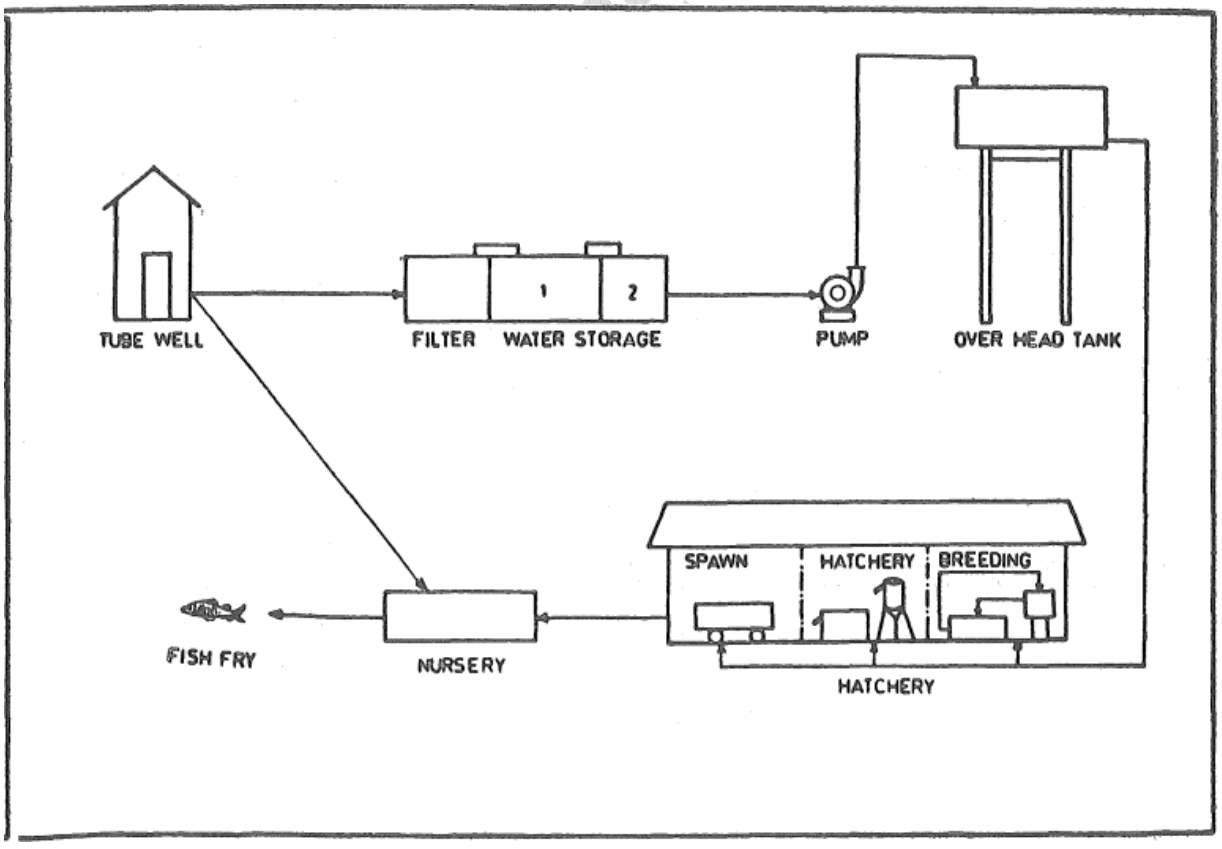
Bin Hatchery

4) CIFE D 80 model (Dwivedi – 80)

In 1980, a carp Hatchery named "MODERN CARP HATCHERY MODEL CIFE D-80" has been designed (Dwivedi & Ravindranathan, 1982). In this hatchery system there is a provision to control the environmental conditions. The system ensures controlled optimum temperature, silt free clean, cool, highly oxygenated water, slow current and continuous removal of metabolites. Hence, fishes are induced to breed in this unit where natural conditions as prevalent in rivers have been simulated. A revised Hatchery Jar D-85 of 0.8 million eggs capacity has been designed.

Modern Carp Hatchery essentially consists of breeding and Hatching units. The breeding unit comprises of large pools with spray, ·showers, cooling towers and water circulatory system. The Hatchery unit consist vertical jars each having a capacity of 40 litres. Filtered and oxygenated water is used in the unit. Showers and spray systems are provided to cool and aerate the water and increase oxygen content. The hatchery unit ensure sufficient oxygen, prevents accumulation of $C0_2$ and other metabolites.

Both the breeding and hatchery units are installed in an air conditioned or air cooled room which ensures controlled conditions. This new system provides controlled temperature around 27^0 C, high oxygen between 7 to 9 mg/1, slow water current, continuous removal of metabolites and assures breeding and percentage of hatching above 90%. In dry climate air cooling itself gives desired results.



5) Chinese circular hatchery

Chinese investigators have developed circular hatching tanks, in which water is in a continuous state of flow in a circular direction. This is popularly known as Chinese hatchery system. This system, within a small space, simulated some aspects of riverine environment and has proved it a very successful method of breeding carps where commercial production of carp seed is required. The Chinese hatchery system comprises sand filter, overhead tank, spawning pool, incubation or hatching tank and spawn rearing tank.

Sand Filter:

The water should be free from any kind of pollution to avoid any damage to brooders, eggs and spawns of fishes from any kind of contamination. Sand filter contains different sized gravels to get water filtered.

Overhead Tank:

Available water from the source is pumped up into an overhead tank, which is installed above a brick wall. If water is drawn from a river, then a desilting tank should be provided. A fine meshed wire-netting is provided in the pump system. This helps to prevent the entry of organisms commonly present in the water of river and pond. A deep tube-well is of much facility as it provides clean water. The tube-well should be installed in an arsenic-free area.

Spawning Pool (Breeding Pool):

It is a circular masonry / concrete pond with an inside diameter of 8 m. It has 50 cubic metres of water holding capacity. The inside depth at the periphery is 1.20 m which slopes down to the centre at1.50 m. A water supply line is laid along the outside of the wall and the inlet to the pond is provided at 14-16 places equally spaced and fixed at an angle of 45° to the radius of the tank using a 20 mm diameter pipe with a nozzle mouth called duck pipes, all arranged in one direction. These are fixed to the vertical wall and the nozzle mouth is flush with cement plaster face and near the bottom along the periphery of the pond. The water showers are fixed to fell the rainy environment. On opening the valve placed at the center of the spawning pool, fertilized eggs along with water are transferred into incubation pond for hatching. The water flows in the spawning pool create an artificial riverine condition for the fish to breed. The shower and a perforated galvanised iron pipe are useful to increase the dissolved oxygen and reduction of the temperature of the water. About 70 kg of males and 70 kg of females can be kept in the spanning tank which can yield 10 millions of eggs in one breeding operation.

Incubation or Hatching Pool:

Hatching pool is circular in shape and is constructed with cement and bricks. It consists of two concentric circular tanks. The two chambers have inside diameters of 1.6 m and 5.0 m. A water of 0.92 to 1.0 m depth is maintained by an outlet pipe fitted in the middle of the inner circular tank. The inner circular tank has gaps on its body, through which water passes into the inner space. This gives the shape of a double doughnut. One wall of the double doughnut lies at the periphery, while the other at the inner end that lies surrounding the outlet.

Prior to the introduction of eggs, the inner wall or chamber is separated from the outer by a fine nylon screen which is stretched and fitted on an iron frame. The floor of the outer

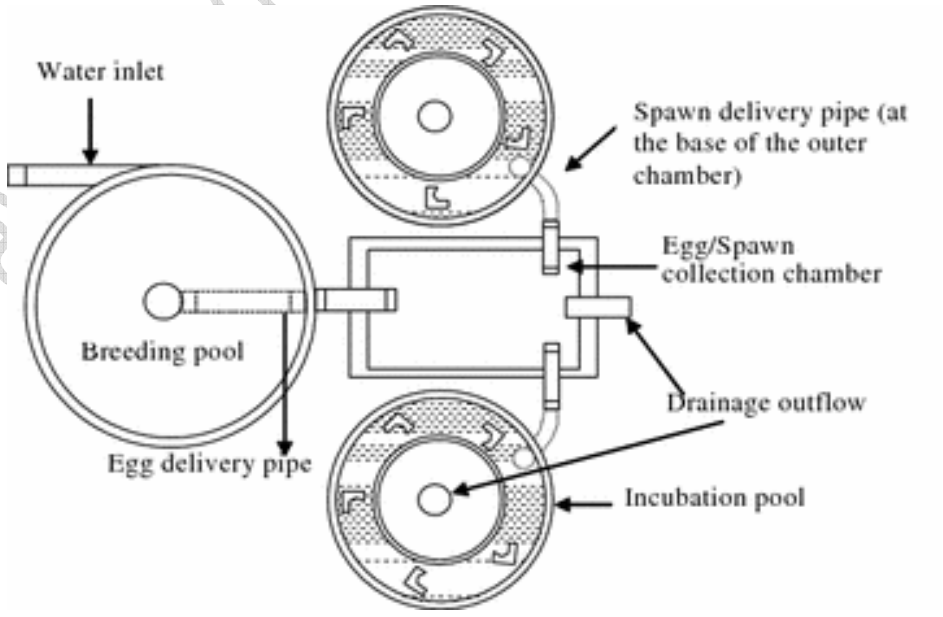
compartment has a number of diagonally fitted pipes which face in one direction, thereby providing the circulation of water (clockwise) when the taps are opened.

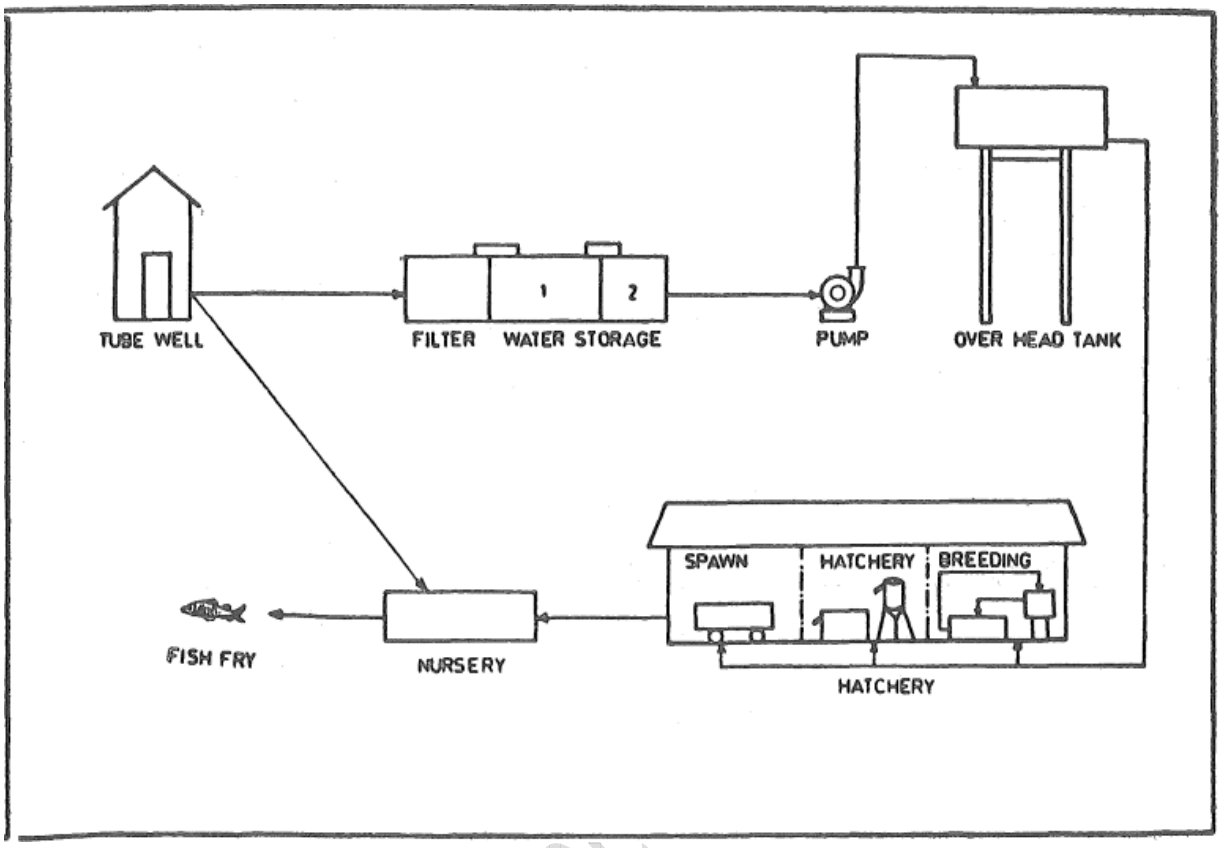
Operation of Chinese circular hatchery:

After pituitary injection, the male and female brooders are released into the spawning pool. The hatchery is made ready prior to the introduction of eggs and the level of water is maintained by adjusting the outlet pipe. The eggs may be brought mechanically from the spawning pool or may be drained directly into the outer chamber of the hatchery through underground pipe system.

The eggs in the outer chamber are kept in circulating condition due to the circulation of water made possible by the circular arrangement of pipes fitted on the floor. Continuous water circulation in the incubation tank helps to maintain a high oxygen level of the water and churning of eggs throughout. The chosen flow rate of water helps to maintain the required temperature necessary for high hatching success. The flow rate was increased during hatching because of the high oxygen demand during the process. At about 11 to 12 hours after fertilization, hatching of the embryo starts and gets completed within 4 hours.

After all the eggs have hatched, the flow rate of water was decreased. To avoid bacterial disintegration the eggs shells, unfertilized eggs, dead hatchlings, etc. are removed periodically from the incubation chamber. This is done either by siphoning or by dipping a jute rope with a weight into the outer chamber. The circulating egg shells get attached to the jute rope, which is periodically taken out; the egg shells removed and the rope is again put into the outer chamber, till nearly all the egg shells are removed. Some unfertilized eggs remain behind in the hatcheries and these are the focus for fungal infection caused by Saprolegnia. A common method of controlling fungal disease in the incubator is by the application of malachite green at a concentration of 0.02 g/litre of water for about 20-25 minutes after stopping the flow of water. When the flow is resumed, the chemical is washed out from the incubator.





UNIT IV

3) Fish seed transportation

i. Open transportation system
ii. Close transportation system
iii. Causes of mortality in transportation
iv. Use of chemicals in live-fish transportation
v. Anesthetic drugs use in transport
vi. Antiseptic and antibiotics used in transportation
vii. Technique of fish seed release.

4) Fish seed trade

i. Classification of fish seed
ii. Identification techniques
iii. Different units of fish seed counting
iv. Fish seed trade in India

1) Fish seed transportation

Transport of hatchlings, fry and fingerlings of culturable species is a common necessity in aquaculture. Transport of fish seed in earthern pots, taken either as head loads or on slings from seed collection centers to spawn markets and to nurseries for stocking is an ancient practice in certain parts of the world. These traditional methods often entail heavy mortality during transport. Recently improvements have been made in the techniques of live fish transport with the knowledge of the basic physiological requirements of fishes in different stages of their life history (hatchling, fry, fingerlings, juveniles and adults) and also of the causes of mortality of fishes during transport. Fish transport technology has developed from the transport of simple earthern pots, as already referred to, to transport in polythene bags under high pressure of oxygen and use of anaesthetics and chemicals. Under anaesthesia fish can be transported without water even, provided the skin and gills are kept moist under low temperature.

i. Open transportation system

The simplest transport carrier is the earthern vessel, such as the traditional "Hundi" used in Bengal in India. The earthern hundi is now being replaced by aluminium vessels which are unbreakable, but the earthern hundies have the advantage that they keep the temperature of the water inside cool by means of evaporative cooling. During transport, the bottom sediments are periodically removed by mopping them up with a rough cloth rope - the water is also partially renewed depending on the need. The addition of red soil and change of water permit transport of fry upto a duration of 30 hours.

Larger containers mounted on motor vehicles have also been in use. In some of these a semi-rotatory pump has been added producing sprays of water over the water surface in the tank, through a delivering tube with two rows of holes at 45° to each other. Fish fry have been transported in such motor vans (semi-insulated) over a distance of 500 km with mortality less

than 5%. Several other adaptations of open transport carriers mounted on motor vehicles are also in vogue.

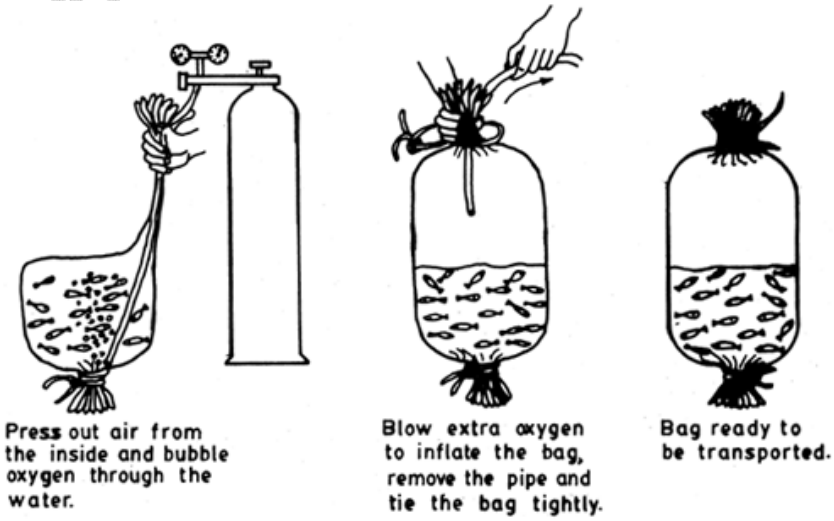
In spite of being cheaper, open packing system for transport of fish seed is going out of fashion mainly because it involves continuous vigilance and frequent renewal of water during long journeys. It is obviously not worthwhile or economical to transport bigger fingerlings and adults in small packing units. For this purpose, truck-mounted open tanks with mechanical aeration and water circulation (as the one explained) have been in use.

ii. Close transportation system

For transporting live fish and fish seed over exceedingly long distances and from one country to another, closed system of transport is most suitable. In this system of transport live fish/seed materials are packed in closed containers with oxygen under pressure with airtight seals. Polythelene or vinyl chloride or other plastic bags of various capacities ranging from 15–35 liter are in use. These bags can be purchased ready made from the market or, if needed in larger quantity, can be made from cylindrical rolls. Widely used size is 47 cm × 46 cm which can be accommodated in 18 liter capacity biscuit tins after being filled with water up to one-third of its capacity. The water for such use should be clean and preferably from a tube well. Number of seed materials to be packed per bag varies according to their size and expected duration of transport. Carp hatchlings numbering 20,000 – 40,000, 300 – 600 fry (30 – 40 mm) and 40 – 70 fingerlings per bag depending on the distance are packed and transported in this manner.

After putting the required number of fish seed in the plastic bag containing water, oxygen is pumped into the water until it is saturated. The bag is then partially blown up with oxygen and tied with a leak proof knot. In this system the water surface is exposed to compressed air or pure oxygen introduced to fill the zone over the water surface in the carriers which are sealed air-tight.

These plastic bags are individually packed in cardboard, metal or wooden boxes to prevent any damage to the bags during transport. Biscuit or oil cantainers of 18 liter capacity are widely used for such purpose. It must always be kept in mind that the live fish packets should not be exposed to temperature over 30°C. Best results are obtained when it is kept between 20–28°C.



iii. Causes of mortality in transportation

The main reasons for the mortality during transportation are:

1. Depletion of dissolved oxygen in ambient water due to the respiration of fish and also due to oxidation of any organic matter, including excreted waste of the fish, by micro-organisms.
2. Accumulation of free carbon dioxide (CO_2), resulting from respiration, and ammonia (NH_3) as excretory end product.
3. Sudden fluctuations in temperature.
4. Hyperactivity and stress due to handling and 'confined space' - these result in lactate accumulation and affect again lessening of blood oxygen capacity and also 'fatigue collapse'
5. Ion-osmotic imbalance due to stress.
6. Physical injury due to handling before transport and during transport.
7. Diseases.

iv. Use of chemicals in live-fish transportation

Drugs and chemicals are either used as tranquilizers and sedatives or as antiseptics and antibiotics. General listing of anaesthetics for fish has been given by several workers. Sedatives are generally used for:

i. Seducing metabolic rates, mainly oxygen consumption and excretion of carbon dioxide and ammonia.

ii. Reducing excitability of fish and injury, and

iii. Convenience in handling fish.

The sedatives and drugs have to be used very carefully, for slight increase in dosage and/or exposure time can cause irretrievable loss of fish. Different drugs have been studied for use as anaesthetic for transport of fish. They are sodium amytal, chloral hydrate, tertiary amyl alcohol, methyl paraphenol (Dormison), tricaine methane sulphonate (MS 222 Sandox), urethane, quinaldine, hydroxy quinaldine, novocaine, amobarbital sodium, barbital sodium etc.

v. Anesthetic drugs use in transport

Use of anesthetics and disinfectants in fish breeding and live transport

- Sedation would reduce the metabolic activity and decrease the oxygen consumption by fish. It also reduces the excretion of ammonia, carbon dioxide and other toxic wastes.
- It controls the excitability of the fish, thereby reducing the chances of injury and the time required for handling them.
- However, care should be taken in selecting the sedative and also its dosage. Sedation should be such that it should not totally suppress the escape reaction of fish and it should be possible to revive the fish quickly.

- Some of the sedatives like MS-222, novocaine, amobarbital, thiouracil, quinaldine, hydroxyl quinaldine, sodium amytol, etc. are found to be adequate for the successful transport of fish seed and brood-fish.
- Jhingran and Pullin (1988) stated that while fingerlings need not be essentially anaesthetized before being transported, brood fish must be anaesthetized.

vi. Antiseptic and antibiotics used in transportation

- The accidental introduction of infectious diseases and parasites along with fish consignments is a possibility that must be guarded against.
- This calls for prophylactic measures like the use of antiseptics and antibiotics in the transport medium or short-term bath prior to transport.

The recommended chemicals and their dosages are as follows:

Methylene blue	-	2 ppm
Acriflavin	-	10 ppm
Chloromycetin	-	8–10 ppm
Copper sulphate	-	0.5 ppm
Sodium chloride	-	3%
Potassium permaganate	-	3 ppm

A prophylactic bath of fry and fingerlings in the above mentioned chemicals is recommended while handling the fish prior to transport, for prevention and spread of diseases - pathogens and parasites.

vii. Technique of fish seed release.

The packed seeds in closed polyethene bags are often carried further with care in baskets made of bamboo splints or curtains, provided with cushion in sides using old gunny sacs, to ponds. Upon arrival to the destination, the closed bags on the surface of receiving water to balance the temperatures of transport water and pond water. Check the condition of seeds for their position, swimming, resting behaviour, agility or reaction to light and touch and dead individuals before release into pond.

Transport of fish seed is undertaken during night or in the early morning to avoid temperature fluctuations. Warming of water is prevented by covering the containers with wet cloth or ice. After transport to nursery, spawn, fry and fingerlings should not be rereleased in to the pond immediately. In order to equalize the temperature, the vessel is kept immersed in the water of the nursery for some time. After this some pond water is added to the container, after which fry are allowed to escape into the nursery.

2) Fish seed trade

i. Classification of fish seed

Fish seed is the small sized fish which is stocked in pond to make it marketable size fish. Fish seed refers from hatchling life stage to fingerling.

Hatchling ⟶ Spawn ⟶ Fry ⟶ Fingerling

Hatchling: The larvae emerging from the fertilized eggs after hatching are called hatchling. It is characterized by the presence of yolk sac hanging below from where it draws its nutrition for 2-3 days. At this stage the mouth is not formed and hence it does not take food from outside.

Spawn: As soon as the yolk sac of the hatchling is absorbed it known as spawn. At this stage mouth is formed and it starts taking small zooplankton like rotifers and supplementary feed like egg yolk, finely powdered oil cake, rice bran etc.

Fry: A soon as the spawn assume the shape of the fish and grow to about 1-2 cm it is known as fry. At this stage they are primarily smaller size zooplankton feeder. It takes about 07 to 10 days for the spawn to grow up to fry stage.

Fingerling: As soon as the fry grow up to 10-15 cm size or roughly equal the size of a finger it is known as fingerling. Fingerling is the proper size for stocking in adult table fish production ponds. It takes about 30-60 days for the fry to grow up to size.

ii. Identification techniques

Distinguishig Features of Seeds of Major Indigenous Carps

	Fish seed	Catla	Rohu	Mrigal
1.	Eggs	Non-floating. Non-adhesive	Non-floating. Non-adhesive	Non floating. Non adhesive
	Diameter (mm)	5.3 to 6.5	5.0	5.5
	Shape	Round	Round	Round
	Colour	Yolk light red	Reddish	Golden
2.	Hatchlings	4.68 mm	3.7 mm	4.68 mm
	Size	(average)	(average)	(average)
	Yolk sac	Both, the bulbous and narrower parts of yolk sac are equal in length	Like *Catla*	Bulbous part smaller than narrower part
	Somites	About 26 pre anal and 14 post anal myotomes	Like *Catla*	28 pre anal and 14 post anal somites
3.	Fry	Dorsal fin rays more than 11	Like *Catla*	Like *Catla*
		Head large.	Head small.	Head small, body slender.
		No spot at caudal peduncle.	Transverse band at caudal peduncle.	A triangular dark spot is present on caudal peduncle.
		No barbel,	A pair of	No barbel.
		Lips thick, Unfringed	maxillary barbel present, lips fringed	Lips thin, unfringed, posterior edge is concave
4.	Fingerlings	Head large. No spot on caudal peduncle.	Head moderate. Dark transverse band at caudal peduncle.	Head moderate. Spot becomes diamond shaped.
		No barbel.	2 pair of barbels (maxillary and rostral).	Barbels, apparently not visible.
		Lips thick and unfringed.	Lips thin and fringed.	Lips thin but not continuous at corners of mouth.
		Dorsal, anal, and caudal fins are dark grey in colour.	Dorsal, anal, and caudal fins have reddish tinge with dirty grey margins.	Tip of lower lobe of caudal fin is reddish.

iii. Different units of fish seed counting

Different types of methods are used to count the fish seeds. In recent years machine fish seed counting and fish seed counting by image processing are used. Most widely used method by using counted sample units such as beaker or any fixed sized containers are used and the method is explained as follows.

- Take 3 - 4 random samples by volume using a small perforated cup to count the number of seeds per cup and to determine number of cups per bag or consignment required for transport.
- Sometimes, random sampling of fish seeds is done on weight basis to determine number of seeds per given weight, say 200 seeds counted in 100 gm weight and a total of 8 kg seeds packed or transported to get 16000 number of seeds. Pan of balance made of bamboo splints is used to drain out water while weighing quickly for weight based samplings.
- Weight based samplings gives a chance to account water while weighing since it is done quickly before water drains out fully. Volume based sampling is preferred over the weight based sampling since latter is stressful.

iv. Fish seed trade in India

India is the 3rd largest fish producing and 2nd largest aquaculture nation in the world after China. The Blue Revolution in India demonstrated importance of Fisheries and Aquaculture sector. The sector is considered as a sunrise sector and is poised to play a significant role in the Indian economy in near future. In the recent past, Indian fisheries has witnessed a paradigm shift from marine dominated fisheries to inland fisheries, with the latter emerging as a major contributor of fish production from 36% in the mid-1980 to 70% in the recent past. Within inland fisheries, a shift from capture to culture-based fisheries has paved the way for sustained blue economy.

Although inland fisheries and aquaculture have grown in absolute terms, the development in terms of its potential is yet to be realized. The unutilized and underutilized vast and varied resources, in the form of 191,024 km of rivers and canals, 1.2 million Ha of floodplain lakes, 2.36 million Ha of ponds and tanks, 3.54 million Ha of reservoirs and 1.24 million Ha of brackish water resources offer great opportunities for enhanced production along with livelihood development and ushering economic prosperity.

Traditionally carp seeds were collected from the natural water bodies when product quality was low and transportation cost from collection grounds to the farm site was high. The collection season has been short and the quantity of the annual collection fluctuated considerably with the variation of environmental conditions. Deterioration of river environments has resulted in quick decline in both quantity and quality of collection. Revolution of sorts was created by the induced breeding technique (hypophysation) from latter parts of the fifties. Indian scientists have successfully achieved artificial breeding of Asiatic carps (including IMCs and Chinese carps) by applying this technique and it significantly contributed to the methodology of fish seed production under controlled conditions and as per the choice of the farmer. Carp hatcheries in both the public and private sectors have contributed towards the increase in seed production from 6,321 million fry in 1985-1986 to around 40,000 million fry, produced by around 2000 hatcheries.