

UNIT

8

Bundh Breeding

Structure

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8.1 Introduction

In various countries, pond breeding species are generally preferred for fish culture as they do not involve the difficulties in the collection and transportation of young fish. But the widely cultured species of carps reputed for their very fast growth and culture conditions do not ordinarily breed in ponds and as such their young ones have necessarily to be collected mainly from the flooded rivers where these carps spawn annually during-the short monsoon season. Indian major carps ordinarily breed in flooded rivers during the south-west monsoon months of June to August. They also breed in reservoirs, tanks and irrigation dams. In the confined waters of ponds they do mature but do not breed. If these matured breeders are transferred from confined waters to semi-confined rain-fed ponds, where the pond bottom is of muddy nature, the fish breeds whenever there is a good rainfall and a drop in temperature of water. This indicates that the few

factors which are responsible for breeding may not be found in the ponds. The semiconfined rain-fed seasonal water bodies have more dissolved oxygen, light, waves, water current and turbidity, and less temperature, which stimulate ovulation. Based on the above factors, the places where excess of rain water is used in creating riverine conditions, which stimulate ovulation in fishes, are known as bundhs. The bundhs are suitable places in producing fish seed.

8.2 Types of bundhs

The bundhs are of two types viz. wet and dry bundhs.

Wet bundhs

These are also known as perennial bundhs. The wet bundh is a perennial pond located on the slope of a vast catchment area of undulating terrain with proper embankments having an inlet facing towards the upland and an outlet towards the opposite lower ends. During summer, only the deeper portion of the pond retains water containing breeders. The remaining portion is dry and is used for agriculture. After a heavy rain a major portion of the bundh gets submerged with water flowing in the form of streamlets from the catchment area and excess water flows out through the outlet. The fish starts spawning in such a stimulated natural condition in the shallow areas of a bundh.

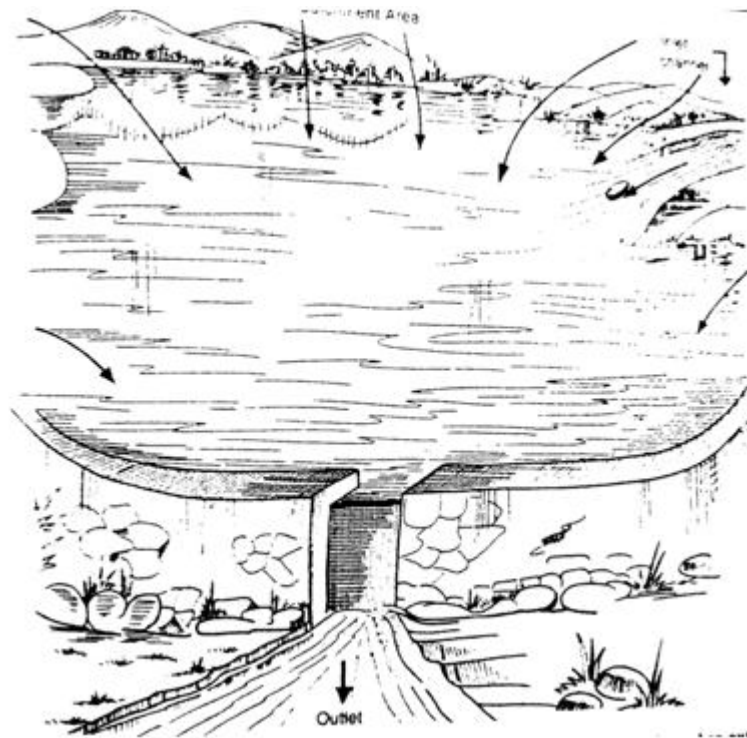


Fig. 8.1 Wet bundh

The outlet is protected by fencing to prevent the escape of breeders. The wet bundhs are comparatively much bigger in size than the dry bundhs. These are also known as perennial bundhs.

Dry bundhs

A dry bundh is a shallow depression enclosed by an earthen wall, which is locally known as a bundh, on three sides, and an extensive catchment area on the fourth. Bundhs get flooded during the monsoon, but remain completely dry for a considerable period during the remaining part of the year. These are seasonal rainfed water bodies, and are also known as seasonal bundhs. The topography of the land has a great role to play in the location and distribution of the dry bundhs. It is preferred to have undulated land because it provides a large catchment area and facilitates quick filling of the bundh even with a less rain, at the same time quick and easy drainage due to gravitation. In West Bengal, a catchment area of more than five times the bundh area is considered most suitable (Saha, 1977), whereas in Madhya Pradesh a ratio of 1:2.5 is considered essential (Dubey and Tuli, 1961). In Bankura district of West Bengal, most of the dry bundhs are fed with water from storage tanks, constructed in the upland area.

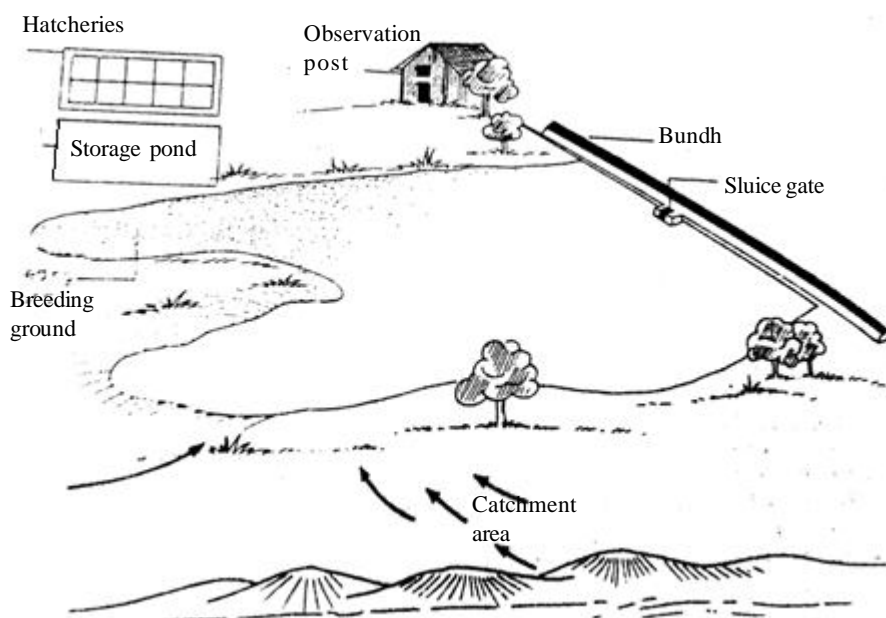


Fig. 8.2 Dry bundh

Bundh breeding being practiced since a century, has been given a greater importance. Since last three decades particularly after it has been reviewed in Madhya Pradesh, it has gained importance to such an extent that in some of the states like West Bengal, Rajasthan and Andhra Pradesh, besides rivers, the contribution of spawn production from bundhs is quite significant, particularly the spawn from dry bundhs as this source yields 100% pure spawn. It is known for its simplicity and mass production at one time.

8.3 Management of Bundh breeding

Site selection

The efficiency of the bundhs depends on many factors. The following criteria may be kept in mind when designing bundhs for fish breeding.

1. Extensive upland area from where, with heavy rains, considerable amount of rain water carrying soil and detritus enters the main pond.
2. The pond should have extensive shallow marginal areas which serve as ideal spawning grounds.
3. The soil should be of gritty nature which is considered to be the most suitable for the breeding of fishes.
4. Increase in oxygen contents of water which is due to the vast and shallow area of the pond.

The land should provide a place where a good sized pond can be made with a small dam. The place with a flat area surrounded on three sides by steep slopes should be selected. The fourth side, where the area drains out, should be as narrow as possible. The side slopes should constrict to shorten this up the construction area or axis of the dam.

Catchment area

A water shed with more than fifteen hectares of hard land for every hectare of water surface in the pond is considered essential. If the soil is retentive in nature, then forty hectares of watershed for each hectare of surface water is a better proposition. The fields must not erode. If the water shed is found either too big or too small even then it may be possible to correct the situation by using diversion terraces. If water is more, excess watershed may often be cut off and the water disposed off elsewhere. If more water is needed, a diversion terrace will increase the effective water shed.

Embankment

The embankment must be constructed at the low level side. The slopes must be built on each side of the dam. On the lower side the slope should be 20%, i.e., two feet on horizontal distance for each foot of vertical rise. The upper or pond side slope requires more attention. If the fill material has a very high proportion of clay, it may safely be built to the 2 to 1 dimension. If it is loamy or silty or with any sand or gravel in it, this slope should be broadened out to 3 to 1. For one hectare pond, a minimum of 4 feet width is desired at the top and a free board of 2 feet is essential.

A spillway and sluice are a must in the bundhs also. The spillway or flood outlet is a surface drainage way that will carry surplus water during heavy rains. Without this, the whole dam may be lost by overflowing in some sudden monsoon cloudburst. It must be placed around one end of the dam in hard ground. When required the pond can be emptied completely with the help of sluice gates. Spillway and sluice should be provided with strong iron netting, so that the fishes may not escape from the breeding bundh.

Factors responsible for spawning

Hora (1945) stated that heavy monsoon and flood are the primary factors responsible for spawning of Indian major carps. The strong current is necessary to influence the breeding intensity of carps. Mookherjee (1945a) observed that a low depth of water is quite sufficient for fish breeding. Das and Dasgupta (1945) believed that the molecular pressure of water particles and silt on the body of natural breeders has a stimulating effect for spawning in conjunction with rising temperature. Dasan (1945) reported that monsoon floods from the hills, having a peculiar smell, specific chemicals and physical properties, were responsible for breeding of fishes in the bundhs. The availability of shallow ground was also considered to be a factor for spawning (Khan, 1947). According to Saha (1957), temperature has no specific influence on spawning, but cloudy days accompanied by thunder storm and rain seems to influence the spawning. Mookherji (1945) stated that pH and oxygen content of water do not influence spawning in fishes. Bundhs having highly turbid waters with a distinct red colour, low pH between 6.2-7.6, 5-8 ppm of dissolved oxygen, low total alkalinity and 27-29°C temperature provide favourable conditions for spawning in bundhs.

Fish breeding techniques

Rohu, catla, mrigal, common carp, silver carp and grass carps are used to breed in bundhs. 100% pure seed can be produced in bundhs. Besides, more seed can be produced at a time. Once the bundhs are constructed, they can be used for many years to get more profits.

The brooders are collected in May and stocked in storage tanks where they are kept sex wise till the first monsoon showers. As soon as water accumulates in the bundhs, a selected number of these breeders are introduced into these bundhs and a constant vigil is maintained. In the olden days no importance was given to maturity, sex ratio, etc. The techniques were improved later and the breeding was done with a better understanding of sex, ratio and number of breeders. Fully ripe females and males 1:2 in number and of 1:1 weight were introduced into the bundhs on rainy days. Successive spawning could also be achieved as many as 5 times in one season.

In the modern techniques few pairs of females and males are being injected with either pituitary, or HCG or ovaprim extract and are released in the bundhs. This process, "sympathetic breeding in dry bundhs" has been used in West Bengal. By this method of partial hypophysation all the limiting factors for spawning like rain, thunder, storm and current of water can be bypassed. It is reported that about 160-200 million spawn of major carps has been produced. Recently at Mogra, the farmers have created a cement pond of about 75' x 25'. The bottom of the pond is pucca, but divided into two portions possessing a gradual slope. When water is filled into the pond, the first part possesses about one meter depth of water and lower one has about 2 meters depth. The owners called it as West Bengal bundhs. The bottom is filled with 6" of fine river sand. Before releasing them into the pond, the male and female breeders are partially hypophysed. It is reported that 160-200 million spawn of major carps has been produced here.

Fish in bundhs generally commence to breed during the early hours of the morning and continue to breed throughout the day. Catla prefer deeper waters, when compared to rohu or mrigal, which breed in shallow waters varying in depth from 0.5-1 metre. In wet bundhs, the brooder stock may be maintained throughout the year or replenished prior to the monsoons. The brooders are generally not injected with pituitary extracts but are stimulated to breed due to the current of rainwater from the catchment area, like in the case of dry bundh breeding,

Collection and handling of eggs

As soon as breeding commences, arrangements for collection and hatching of eggs are made. The eggs are collected by pieces of nylon net or mosquito netting, cloth or gamcha after lowering the water level and hatched in the double walled hatching hapas, ordinarily fixed in the bundhs. Collection of all the eggs is impossible, especially in case of wet bundhs, due to its larger areas. About 70% of eggs can be collected from the bundhs. In Madhya Pradesh, the hatching of eggs is carried out either in double-walled hatching hapas fixed in the bundh

itself or in rectangular cement hatcheries measuring 2.4 x 1.2 x 0.3 m. However, in West Bengal, the eggs are kept for hatching in specially dug out small earthen pits with mud plastered walls. The hatchlings are lifted from the pits by dragging muslin cloth pieces after 12 hours of hatching and are transferred to similarly prepared bigger earthen pits. The survival rate is about 35-40% in the hapas. It can be increased to 97% by using modern hatcheries.

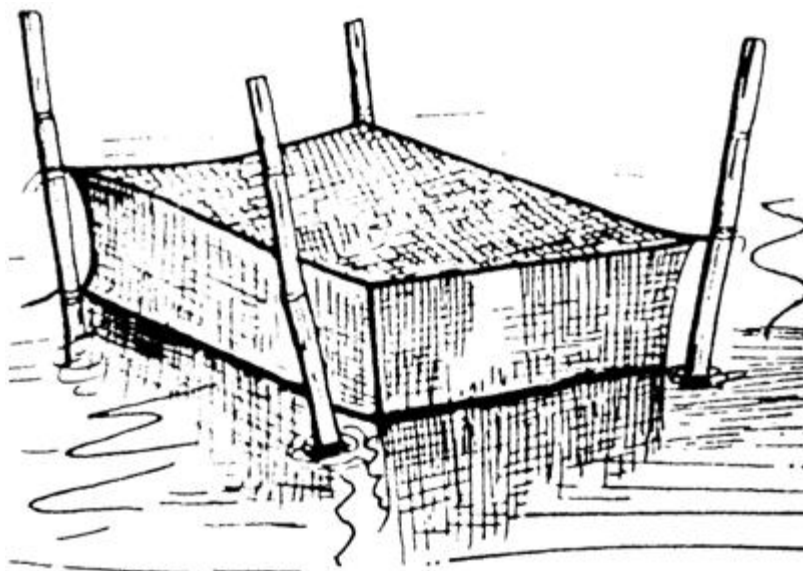


Fig. 8.3 A double hatching hapa

Improved features of dry bundhs

The dry bundhs can be improved keeping in view the following points:

1. Selecting shallow sloping depressions and undulating terrain of sandy soils with maximum catchment areas.
2. Constructing a small earthen bundh at the far end of the depression opposite to the catchment area so that water could be retained for a certain period. A maximum depth of 2 meters of water is maintained in the bundhs and a fine meshed wire netting protects any overflow water.
3. Constructing a battery of 10-20 rectangular cement hatcheries measuring 2.4 x 1.2 x 0.3m.
4. Constructing a small double storied building which could serve as an observation tower cum store cum shelter.

8.4 Advantages and Disadvantages of Bundh

Advantages

1. Since major carps generally breed almost at any place in the shallow bundhs, it may be advantageous to prepare spawning grounds at different levels so as to get them flooded at different water levels in the bundh. But, it is necessary to have the spawning ground away from the direction of the current.
2. A few storage tanks, cement cisternae or earthen ponds can also be provided adjacent to the bundhs to store the breeders temporarily prior to their introduction in the bundh.

Disadvantages

The problems encountered in bundh breeding are :

1. Sometimes it is difficult to coordinate the collection and hatching of large quantities of eggs at a time, particularly in the case of wet bundh breeding.
2. During egg collection from wet bundh, often unwanted fish spawn, and, predatory insect larvae, etc. are also collected.
3. In most cases, the hatching rate of eggs and survival of hatchlings upto the spawn stage have been poor, even when the fertilization rate of eggs was high. This could be improved by using modern hatchery techniques.
4. Presence of fairy shrimps (*Streptocephalus* sp. and *Branchinella* sp.) is in large numbers in dry bundhs particularly when breeding is late, i.e., three weeks of water accumulation during the collection of eggs. They can be controlled by applying bleaching powder at the rate of 1 ppm on the first day of water accumulation,
5. Most of the dry bundhs primarily belong to the government. These are basically meant for drinking water and irrigation purposes. Fish breeding in these bundhs is, therefore, a secondary activity. No control on the inflow and outflow of waters for fishery activities is possible.
6. The brood fish are mainly collected from the wild habitats for dry bundh breeding. Gillnets or cast nets are used for catching the brood fish thereby causing injuries to the brood fish.
7. Brood fish may carry some infection or injury.
8. When the rains are heavy after spawning is over the influx of water is so strong that much of the gonadal products are destroyed by mechanical injury.

9. Before the release of brood fish or at the time of spawning and development of the spawn, adequate attention is not paid to monitoring the water quality as regards dissolved gases, toxic substances and predatory organisms.
10. In the late monsoon with accumulation of more waters, some dry bundhs start overflowing, thus increasing the risk of loss of seed from the bundh.
11. In the post-monsoon months with receding water level, the fingerlings are exposed to the risk of predation by the birds.
12. In some dry bundhs having a uniformly flat basin, when the water is reduced to critical level, seed collection becomes difficult and there may be mortality due to rise in temperature and turbidity in shallow sheets of water caused by repeated netting operations.
13. Late harvest of fish seed with decreased amount of water further aggravates the problem of poaching.
14. The early major carps are voracious in their feeding habits. If adequate food is not made available to them they become cannibalistic, especially if there is a noticeable difference in the size groups. This is especially true when brood fish are released in batches.
15. Often, when the dry bundh is supporting a good number of fish seed, water is drained out for irrigation purposes. This may also cause loss of sizeable stock from the dry bundh.
16. In most cases the spawn is allowed to stay uncared for in the dry bundh under natural conditions. If in excess, the silt, predatory insects and copepods cause heavy damage to the developing eggs and subsequently to the juvenile fishes.
17. When spawning occurs the water may recede to critical levels thereby exposing a large amount of eggs in the peripheral areas of dry bundh thus causing large scale mortality of spawn.

Economics

In an experiment in Nain Thallia, about 20 million eggs were produced per hectare. In Midnapore and Bankura, 75 lakhs of spawn was produced at a time, and 160-220 million spawn produced in a season. With the increasing pace in the creation of a large number of bundhs, it is necessary to mention that spawn production through dry bundhs, is quite economical. Many crops of seed can be easily obtained from one bundh in a season of 4 months. By utilising the

rain water which would otherwise have been waste water, we can produce carp seed and reap good profits.

The bundhs are not only useful for fish breeding but also useful to culture fish after breeding. If the water is available for at least 6 months, those bundhs can be utilised to culture the fish. The fish seed of cultivable fishes can be introduced in the seasonal rain-fed bundhs and can be cultured for six months. Without providing supplementary feed and inorganic manures the yield can be about 1000 kg/ha/6 months. By providing supplementary feed and inorganic manure the yield can be increased to about 2500 kg/ ha/6 months. It indicates that the bundhs are useful for both breeding and culture, and are highly profitable.

8.5 Seed Transportation

Transportation of breeders, fry and fingerling is a common phenomenon in fish culture systems. The fish seed are transported from hatchery units to the fish farm to rear them in culture systems. The breeders are usually transported from culture system to hatchery units for breeding either by induced breeding or naturally. The fish seed is also transported from natural collection centres to the fish farm. Hence, transportation of fish seed is an important step in the fish culture practices. Now-a-days, there is an awareness for taking up fish culture almost throughout the country, whether it is freshwater or brackish water, due to non-availability of fish seed at the place where it is required.

Reasons for Fish Mortality during Transportation

Effect of CO₂ and Dissolved Oxygen

Mortality of fish seed may be expected during transportation. It is mainly due to the depletion of dissolved oxygen and accumulation of gases like ammonia and carbon dioxide in the medium of fish seed carriers. These gases are lethal as they may reduce the oxygen carrying capacity of fish blood. However, the lethal limits owing to carbon dioxide in fish depends on the level of dissolved oxygen. It has been reported that fry of more than 40 mm in size may die at 15 ppm of carbon dioxide at a dissolved oxygen level of less than 1 ppm. Such fry may die only at 200 ppm, if the dissolved oxygen is around 2 ppm. Carbon dioxide given out during respiration dissolves in water and renders it more and more acidic which is injurious to fish. In transport of fish the shortage of oxygen has to be tackled either by replenishing the oxygen which is used up or by economising its use by regulating the number of fish seed and by reducing its oxygen demand. The oxygen utilisation of fish in transport is dependent upon a number of factors like the condition of the fish - normal, active and excited condition of fish, temperature, size and species. The oxygen consumption of different species of the same size or weight varies considerably. For example, 400 common carp

fingerlings of 40-50 mm size can be transported for two days in seven litres of water under oxygen packing. Only half of the number of other major carps and 1/8 of number of milk fish fingerlings of the same size can be transported under same conditions. Low to moderate temperatures are preferred for fish transport, since the amount of oxygen in water increases with the decrease of temperature and keeps the fish less active. Increase of CO₂ depresses the active metabolic rate. Further increase proves fatal. In an oxygen packed closed system CO₂ forms a limiting factor. Mortality of seed in such a system is mainly due to bacterial load in the medium. With the death of a few seed, bacteria increase enormously and utilise more oxygen. Bacteria increase from 250/ml in the beginning to over 110 million/ml in 24 hours. CO₂ is found toxic to seed at 2.5-5 ppm concentration.

Effect of Ammonia

A large amount of NH₃ is excreted by fishes. If ammonia concentration is 20 ppm, total mortality of fish occurs in oxygen packed packets. As NH₃ increases in water, the oxygen content of blood decreases and its CO₂ content increases. NH₃ interferes with O₂-CO₂ exchange capacity of blood with the outside medium. The rate of NH₃ excretion increases 10 times with a rise in water temperature from 8- 15°C. Increase in water temperature and decrease of dissolved oxygen reduce the tolerance of fish to NH₃.

Effect of temperature

Temperature has a distinct effect on oxygen utilised by the fish. Metabolism increases continuously with increased temperature till the attainment of lethal temperature limit. Each species displays its own characteristic rate of increase at a given range of temperature.

Fish, prawn and their seed face hyperactivity during transportation. As a result, lactic acid tends to accumulate in their tissues and severe oxygen debts are created. Fish take a long time to overcome this oxygen debt even in their natural life in ponds and other habitats. This may be due to the death of fish after few hours after handling, transport and liberation even in oxygen-rich water. Hence, the use of sedatives is most important in modern live-fish transport technology. Due to hyperactivity the bigger fish often suffer injuries which may cause death or severe external infection. If the fish and their seed are of different sizes, the smaller ones are very much affected and die. This risk may be avoided by selecting for transport fish of uniform size, and by sedating the fish.

By taking the above factors in to account, suitable steps are to be taken in tackling these problems and deciding the number of individuals to be put in the containers depending upon the time and duration of transport. The fish seed to

be transported is kept under conditioning so that their bellies are empty and excretion during transport is limited. Further, the conditioning will help in acclimatizing the fish to limited space in the containers. If the fish is brought directly from the pond into the container it is very active and hits to the sides of the container thus getting injured. The transport medium, water, should be filtered through a plankton net so as to make it free from phytoplankton and zooplankton which are present in the water and consume some oxygen themselves.

Techniques of Transport

Several types of containers are used in the transport of fish seed. These are mud pots, round tin carriers, double tin carriers, oxygen tin carriers and tanks fitted on lorries. The containers are transported by bicycles, carts, rickshaws, boats, lorries, trains and aeroplanes.

Mudpots

Mudpots are commonly used in Assam, West Bengal and Orissa for transporting spawn, fry and fingerlings. This is a traditional method. Mud pots of about 15 litres capacity are used for transportation of fish seed. The pots are filled with water of spawning ground to about two thirds of their capacity. After filling the pot with water, about 50,000 spawn are introduced. It is better to condition the spawn in the hapas for about three days without feeding prior to transportation. Otherwise, due to feeding more excreta is produced which pollutes the water in the pot, leading to the death of fish seed. To avoid the mortality of fish seed due to asphyxiation, water is changed once in every five hours. The temperature of water in mudpots is not affected easily, which is an advantage in transport. This method, however, has several drawbacks, such as, the mudpots are liable to break in transit, which may result in the loss of the seed. Fish seed may be injured due to the shaking of pots.

Possible for transportation only for short distances and short durations. Frequent changes of water may result in mortality of fish seed due to difference in water quality. Considering these factors modern methods of transportation have now been propounded.

Round Tin Carriers

Round tin carriers are used for transport of fish seed from several years. The tin is made up of galvanised iron sheet. It is a round container having a diameter of 18" and height 8". The lid has a number of small holes, which are useful to get oxygen. This container has a capacity of gallons of water, but is filled up only with 8 gallons of water. The seed is introduced into it and transported to various places.

Double tin carriers

Double tin carriers are made up of galvanised iron and has two parts - outer and inner tins. The outer tin is 13" x 13" x 8" and the inner one is slightly smaller than outer one and can be easily kept inside the outer tin. The outer tin is open and with a handle. The inner tin is closed with a lid and entire tin has small openings. The inner tin is filled with water after keeping it in the outer tin, then fish seed is introduced into it. It holds about 6 gallons of water and is generally used for carrying a small number of fish seed by hand.

Oxygen tin carriers

Tins of 18" x 28" size and big polythene bags of 17" x 15" size are used in this method. In this technique, fish seed are transported by road, train and air. The polythene bags are filled with water, seed and oxygen and packed in the tin, then transported. This is the most common method of fish seed transportation and the latest in technique of transporting the fish seed. After checking the damage, the good polythene bags are kept in a tin container and about 1/3 of its capacity is filled with aerated pond water. The fish seed, starved for one day and acclimatized are then carefully introduced into the bag. 20,000 fry can withstand packing in one bag for a journey of 12 hours. Similarly 200 fingerlings in one bag can withstand a journey of 12 hours. The number of fish seed to be packed in a bag has to be decided depending on the distance and size of the seed. A tube from the oxygen cylinder is then allowed into the bag and the portion of the bag, about 10 cm from the top is twisted and a string is kept ready for tying. The oxygen is then drawn in from the cylinder through the tube until 2/3 of the bag is inflated or the top of the inflated bag is slightly below the top of the tin. The string is tied round and the tin is closed. The packed tins are kept in a cool place. To ensure better survival rate, the tins should be transported during the morning or evening. Card board containers are used in place of tin containers.

Tanks Fitted on Lorries

For road transport lorries with one or two large tanks of suitable dimensions fitted at the rear can be advantageously used. This will facilitate seed transport problem to a large extent.

Use of Anesthetics in Transportation

Recent investigations have shown that the fish seed could be anaesthetised for transportation for ensuring better survival rate. The purpose of this is to ensure that the fish seed survives for a longer period of time, and also to minimise the concentration of toxic gases like ammonia and carbon dioxide in the medium by lowering the metabolic rate of the fish seed. Anaesthetised fish seed have been

found to survive for double the time of unanesthetised seed, besides ensuring a better survival rate, which is about 90%. Carbonic acid has been found to be the best anesthetic compared to others such as quinaldine, sodium amytal, urathane, veronal chloroabutanal and TMS-222 (Tricaine Methan Sulphonate). Carbonic acid is not only cheap but also safe and easy to use. To about 8 litres of water in bag containing fry, 8 ml of 7%, sodium bicarbonate solution and 8 ml of 4% sulphuric acid are added so as to produce 500 ppm concentration of carbonic acid. This anesthetised bag should be immediately filled with oxygen.

Absorbants are added to the medium during transportation to eliminate toxic ammonia from the medium and safeguard the fish seed from mortality. These absorbants are permutit, synthetic amerlite resin, pulverised earth and clinoptilolite. Addition of sodium phosphate, which acts as a buffer, at a rate of 2 gm/lit. of the medium may bring about a favourable pH of the medium for fish seed during transit. Due to the non-availability of some anesthetics and the risk involved in the improper use by laymen, the method has remained at the level of a scientist only.

Estimation of Quantity of Fish Seed for Transportation

The number of fish seed to be transported in closed and oxygen packed containers may vary according to the type and size of the fish seed, mode of transport, duration of transport and the environmental temperature, etc. The number of fish seed for transportation in containers can be calculated using the following formula

$$N = \frac{(D - 2) \times V}{R \times H}$$

$$N =$$

$$R \times H$$

Where : D is dissolved oxygen in ambient water in ppm.

V is volume of water in litres.

R is the rate of oxygen consumption by individual fish seed in mg/kg/hr.

H is period of transportation in hours.

N is number of seed to be introduced.

Short Answer Type Questions

1. What is bundh breeding ?
2. Mention the types of bundhs in bundh breeding.

3. What is wet bundhs ?
4. Write any two advantages of bundh breeding.
5. Mention any two disadvantages of bundh breeding.
6. Write any two reasons for fish seed mortality during transportation.
7. Write the formula estimation of quantity of fish seed for transportation.
8. What is the use of anesthetia in fish seed transportation ?
9. Write the effect of temperature during the fish seed transportation.
10. Define the term 'Conditioning' used during transportation of fish seed.

Long Answer Type Questions

1. Describe the wet and dry bundh breeding.
2. Explain the fish breeding techniques and factors responsible for spawning in bundh breeding.
3. Describe the reasons for fish seed mortality during transportation.
4. Describe the techniques of fish seed transportation.