PART - IV

PISCICULTURE
INTRODUCTION

In a country like India, the intake of meat and milk is low, so fish has special importance as a supplement to ill-balanced cereal diets. It is estimated that, about 8.5 million tons of fish is required annually to meet the present day demand of fish protein in the country against an annual production of only 1.7 million tons.

In India, inland water with potentialities of fish culture is approximately 7.5 million hectares or 2.34% of the total area of the country. Many of the water reservoirs remain either unused or not properly used for the pisciculture for want of proper scientific knowledge. In recent years research conducted by the Central Inland Fisheries Research Institute (CIFRI) have revolutionised fish culture in India and a net production of 85,000 kg hectare⁻¹ year⁻¹ has already been achieved.

Fish culture operations commence with the construction of ponds. Different types of ponds required for the culture of Indian major carps in farms are: nursery, rearing and stocking ponds. Schaperclaus (1933) has given the following ratio of various types of ponds required for a fish farm under European conditions:

- **Breeding ponds**  - 0.25% of the area.
- **Nursery ponds**  - 2.75% 
- **Fingerling ponds**  - 10.00%
Rearing ponds for second year fish - 23.00% of the area.
Ponds for over-wintering the above - 3.00% "
Rearing ponds for third year table fish - 60.00% "
Holding ponds for spawning stock - 1.00% "

According to Alikunhi (1957), under Indian conditions a 4-ha farm should be divided into: nursery ponds, 0.2 ha; rearing ponds, 0.8 ha; and stocking ponds, 3 ha. Considering the recently enhanced rates, the stocking and survival of spawn, fry and fingerlings (Saraccllpore, 1973), the ratio of different types of ponds in a farm needs reconsideration.

The role of predatory and weed fishes in nursery ponds has been discussed by Alikunhi et al. (1955), Ibrahim (1957) as well as Chaudhuri (1960b). Chaudhuri (1960b) has also studied the food, feeding habits, fecundity and breeding of common species of weed fishes with particular reference to their role in the survival of carp spawn in nurseries.

The main object of manuring nursery ponds is to augment the production of zooplankton, the natural food of carp spawn. For this the nursery ponds are first limed (dose depending upon the pH of soil) just after removal of unwanted predatory and weed fishes (Jhingran, 1983).

Recently, the Department of Fisheries, Government of Maharashtra, Bombay (Anon, 1969a) has evolved the following day-to-day schedule of fertilizing nurseries in order to get an average survival of 45% from spawn to fry stage, the stocking density of spawn being 6 million per ha. The initial dose of fertilization per ha on the day preceding stocking is:
superphosphate of lime, 150 kg + triple superphosphate of lime, 50 kg + cowdung or any cattle dung, 700 kg + oilcake, 700 kg. All these four types of manures after being mixed thoroughly by water sufficient to make a thick paste are spread throughout the nursery. The nursery is then inoculated initially with 30-50 ml of Daphnia and Moina. On the second day of stocking, oilcake and cattle dung are applied at the rate of 350 kg and 87.5 kg/ha respectively. On the third day of stocking, the dose of oilcake and cattle dung is reduced to half that of the previous day. From 4th to 9th day of stocking, cattle dung and rice bran are employed at the rate of 87.5 kg, 22 kg and 100 kg per ha respectively. Murty and Saha (1979) demonstrated increased fish production by fertilizing the fish farm with nitrogen alone. Sarkar (1983), obtained encouraging result of fish production by fertilizing the fish farm with nitrogen alone.

Soon after stocking, spawn start feeding voraciously on zooplankton. At this time the feeding requirements of spawn are so large that, within 2-3 days of stocking, the food available in the nurseries becomes very low. Alikunhi (1956a) observed that, for the first two days after feeding commences, the spawn do not take artificial feed but subsist almost completely on natural food. After this it requires artificial food.

According to Mitha and Das (1965), artificial food like til oilcake, rice powder and brack gram account for higher survival and yields of carp spawn. However, Chakrabarty et al. (1973) found that zooplankton alone was the best food for all the three species viz. Catla catla, Labeo rohita and Cirrhinus...
mrigala. Of his various feeds like mustard oilcake, rice bran mixture, groundnut oilcake, wheat bran mixture, silkworm pupae, soyabean and prawn waste, soyabean gave the best result in C. catla and silkworm pupae and groundnut oilcake-wheat bran mixture in C. mrigala and L. rohita. Recently, Tripathy et al. (1979) obtained a very high survival of over 80% by using a diet comprising a 1:1:1 mixture of fish meal groundnut oilcake and rice bran. Kahen et al. (1980) observed, free living nematodes as a dietary supplement in rearing of fish fry hatching.

According to Jhingran (1983), the artificial food may be sprayed at a fixed place during specified hours on the water surface or fed as a thick paste in small shallow earthen vessels kept suspended water. Spawn of major carps are observed to feed usually at the surface in the morning, but seen in lower layers of waters or shady patches well before noon.

The aim of the pisciculture is to obtain maximum yield of palatable and nutritive fish within limited time span. Major carps are best culturable fish in India having following qualities.

1) Carps feed on zooplankton and phytoplanktons, decaying weeds, debris and other aquatic plants.
2) Carps can be survived under certain higher temperatures and also in turbid water.
3) Carps can tolerate oxygen variations in water.
4) These are fast growing fishes, most palatable and nutritive.

Pisciculture is a complicated process, so far an
ideal fish culture, one should have a concrete idea about the different stages of fish culture, i.e., topographic situation, water quality, source of water, and other physical, chemical and biological factors. Ponds are the sites where fishes develop and grow. The management of ponds is the most important aspect from the point of view of breeding, hatching, nursing, rearing and stocking. For successful rearing of spawn and fry, therefore, proper preparation and management of nursery and rearing tank is essential. Keeping in view the various stages of fishes, the following different types of ponds in Sambalpur fish farm have been discussed here.

Requirements of Nursery and Rearing Ponds -

**NURSERY PONDS**

The nursery ponds are small set of rectangular shallow water reservoir present near the hatching hapas. The area is of 0.03 hectare and depth is of 0.75 metre.

During summer, in the month of June, the nursery tanks were dewatered by pumping followed by a liming at the rate of 100 kg per acre of dry bed area for increasing pH. Then at the monsoon period (i.e., before the spawn preparation) it was manured by giving cowdung and superphosphate. Raw cowdung at the rate of 100 ppm which enriches the pond water with sufficient food reserve in the form of microscopic fish food organism, i.e., zooplankton and phytoplankton. Superphosphate at the rate of 10-20 ppm was given to increase the pond fertilization.
Before entering the fries, these ponds were made free from harmful organisms like predatory fishes, aquatic insects, tadpoles and aquatic weeds etc.

**Eradication:**

(i) By repeated netting with drag net, predatory fishes were removed.

(ii) Application of kerosene oil at the rate of 30 litres per acre as well as Tarptentine on the water surface was found to be successful to eradicate predatory insects like *Netto natus*.

(iii) Bleaching powder was also used here to remove shrimps, which were found in rainy season and was certainly detrimental to spawn rearing.

Repeated netting was found to be better and safest measure against predatory fishes.

**Natural and Artificial foods:**

Natural food was plankton developed by manuring and artificial food considered of finely powdered groundnut. Oil-cake and high quality of rice bran or polish in equal proportion was given daily. Above all rice bran was found to be quite successful and productive. The preference of rice bran by the fishes was more than any other artificial food. The food was supplied to the nursery ponds upto the date of disposal of the fry.

When the fry become 1" size, it was sold to the fish farmer. Inside a polythene bag (Plate No. 6) it was packed and the bag was supplied with oxygen and the mouth of
the bag was tied by a rope (Plate No. 6) In this spawn stage it was supplied to different places of Sambalpur district, i.e., Padampur, Rairakholo, Kuchinda, Barpali, Bamleli, Maneswar, Bargan. The fry size within 2" was sold at the rate of rupees fifty per 1000 and the sizes above 2" was sold at the rate of Rs. 100/1000 fry.

The netting of fry was made by fry drag net (Plate No. 6).

Growth of Fry, Thinning and Harvesting:

The stocked spawn with proper feeding, grew fast in the first few days. When they grew, they demanded more food and wider space for their activities. If they were to remain in the original pond that might cause shortage of food and deterioration of water quality resulting in restriction of the growth of fry and even mortality.

Therefore, after 10-14 days rearing in the nursery tank when they were of 20-25 cm size, the fries were thinned out and transferred to another rearing tank where they could be grown to fingerling size. The change of fries to rearing tank could bring better and quicker growth than the parent tank.

REARING POND

The technique of preparation of rearing tank was identical to that of nursery tank consisting of weed clearance, eradication of unwanted fishes and fertilization. The area was of 0.08 hectare and depth was of 1.5 metre. The depth 1.5m
was hampering the growth of growing fishes. Hence the depth of 1.5m was taken as standard depth of rearing pond.

Daily Inspection of Ponds:

Persons who were in charge of the nursery and rearing ponds made a regular inspection of the tanks 3 times daily in the morning, noon and evening to observe the water condition and activities of fry and fingerlings.

Fingerlings after attaining a length of 20 cm were transferred to another pond, called stocking pond which was felt necessary to thin out the rearing pond for better growth.

Stocking Pond:

The ponds were free from overflowing, its bottom was not rocky, gravelly or sleep silled. The depth of water was more than 5 inches in mid-summer months. There was adequate assured water supply to the ponds. The weeds are cleared away and predatory fishes are netted out. The size of each pond was of 0.2 hectare to 1 hectare and are rectangular for easy netting.

As sufficient food is essential for good growth of fishes, proper manuring was done (i.e., cowdung and superphosphate). The groundnut oilcake, rice bran were commonly used as artificial food for the fishes. The feeding was in the evening usually 5 p.m. to 6 p.m. Generally the stocking rate was 50,000 to 75,000 nos./hectare in different species ratio. Some different combinations of species ratio were given below:

- *Catla catla* (surface feeder) - 30-40%
- *Labeo rohita* (column feeder) - 15-20%
- *Cirrhina mrigala* (bottom feeder) - 40-45%
Grass carp - 5-15%

6 species combinations (Jhingran, 1983) such as -

Catla - 10%
Rohu - 10%
Mrigal - 5%
Silver carp - 30%
Grass carp - 20%
Cyprinus carpio - 25% and following

% of fingerlings to be stocked in 4 species combinations -

Catla - 25%
Rohu - 37.5%
Mrigal - 15%
Cyprinus carpio - 22.5%

% of fingerlings to be stocked in 3 species combinations -

Catla - 30%
Rohu - 40%
Mrigal - 30%

Supplementary feeding:

General amount of food given to the fishes per day/ha were as follows:

1st 3 months - 1.5 kg GNOC + 1.5 kg RB/ha/day
2nd 3 months - 3.0 kg GNOC + 3.0 kg RB/ha day
3rd 3 months - 4.5 kg GNOC + 4.5 kg RB/ha day
4th 3 months - 6.0 kg GNOC + 6.0 kg RB/ha day

(GNOC - Ground Nut Oil Cake; RB - Rice Bran)

Sampling:

Sampling was done every month to ascertain the quality
of food to be given during subsequent month, as well as to observe the well-being of the fish.

Harvesting:

After attaining standard growth, well-grown fishes were netted from the pond by fish dragnet (Plate No. 3) and marketable size fishes were transferred to local market (Golbazar and Kamali bazar fish market) and smaller ones were once again released into the stocking ponds for proper growth (Plate No. 8). Average fish growth per year as calculated is -

i) Catla = 750 gm ± 50 gm
ii) Rohu = 500 gm ± 40 gm
iii) Mrigal = 550 gm ± 50 gm

Seasonal harvesting was felt to be far superior practice than the perennial practice.

Netting time:

(1) Total timing for netting from May, 1983 to April, 1984 = 72 times.
(2) Weight of total netted fish = 971.450 kg.
(3) Marketing = 971.450 kg.

Methods of fishing:

Only one type of fishing net was used. It was drag net (Plate No. 8). It was provided with a main rope which carries floats and a footrope bearing sinkers. Length of the net was 200 to 250 feet and breadth was 35 to 40 feet. Its mesh size was 2 cm and 1.75 cm. It extended from bank to bank and needed 10 to 12 fishermen to drag it (Plate No. 8). This rope was made up of nylon. Nylon drag net was proved to be durable and fish catch was more than cotton drag net.
FISH MORTALITY IN PISCICULTURE TANKS,
ITS CAUSE AND REMEDIES:

The general well-being of the fishes depend on the environment which they live. Water being the primary requisite for pisciculture it should be in most favourable conditions for the existence of fishes as well as other aquatic organisms which form the main source of food for the fish. As the physical and chemical characteristics of pond water have bearing on the fish production, it is being studied properly by the pisciculturist.

Depth, temperature, turbidity and light constitute the more important physical characteristics of water on which the productivity of a pond depends. Similarly different gases, solids and nutrients dissolved in the water and its pH constitute the more important chemical parameters influencing the fish life. Besides the aquatic plants (Algae and weeds) and organic matters present in the pond greatly influences the fish life. Fish mortality which occasionally occurs in this fishery farm is generally due to one or more of these factors.

Fish Mortality due to Oxygen Depletion:

Of all the dissolved gases in water, oxygen is the most essential constituent for the life of the fish. The oxygen consumption in water takes place during respiration by the aquatic animals and by the putrification of organic matter. Thus it causes imbalance in oxygen level especially during night.

Basing on the biological informations, and knowledge of the tank, the following remedial and preventive measures were being taken to avoid mass mortality of fishes due to
asphyxia and to prevent its re-occurrence.

(i) Seating of water surface with bamboo poles were done to increase the oxygen content of water.

(ii) Banana plants were cut into pieces and floated over the water or the plant's juice are extracted and mixed with pond water to prevent sudden mortality by decreasing acidity of water bodies.

(iii) Freshwater were allowed to let in by using a pumpset.

(iv) \( \text{K}_2\text{HPO}_4 \) was also applied to the water to increase its oxygen content.

(v) Quicklime was added, if the oxygen depletion was found to be due to heavy decomposition and putrification of organic matters at the pond bottom.

(vi) The tanks were netted with drag net to facilitate the release of abnoxious gases, if any.

(vii) Artificial feeding and fertilization were stopped forth with till normal condition was restored.

(viii) Growth of heavy phytoplankton (blooming) was checked by doing composite culture with silver carps which feed on them.

Fish Mortality by diseases:

In the last year, mainly fungal diseases and gill rot were found in this farm. These diseases were controlled by 3-5% common salt bath to fishes for 5-10 minutes.

Besides this, other fish diseases were also found in this farm which are caused by Fungi, Bacteria, worm and crustacea.
Remedial measures:

(i) Bacterial diseases like fin rot and tail rot were checked by treatment with 0.5 ppm of CuSO\textsubscript{4} solution.

(ii) Dropsy caused by the \textit{Bacterium aromonae} in catla was checked by treatment with 5 ppm KMnO\textsubscript{4} solution.

(iii) Protozoan diseases were treated with 2-3\% NaCl solution for 2-3 days.

(iv) Worm diseases were controlled by giving salt water bath for 5 minutes.

(v) Fishes suffering from gas diseases or asphyxiation were cured by simply transferring them to other ponds.

Drawbacks of the Fish Farm:

1. As the farm is situated near the Kamali Bazar which is a thickly populated place and mostly illiterate people do live there, the abuse of the water is mostly met (Plate No. 3). It should be wise to construct a fish farm far away from such local people.

2. Lack of proper guidance for pisciculture.

3. Non-cooperative nature of thickly populated locality.

Conclusion:

In this farm, composite fish culture is an old practice and species like \textit{Catla catla}, \textit{Labeo rohita}, \textit{Cirrhinus mrigala} are generally stocked together in the same pond. But in recent years, together with these indigenous species, some exotic species such as silver carp, grass carp and common carp are being cultured together. The combination of these species
have been found to be not only suitable, but also more profitable, because these species do not compete with the Indian major carps for food and at the same time make the best use of the available food in water to which the Indian carps do not take.

Optimum stocking density, dissolved oxygen content in the water, space, shape and size of the ponds are some of the primary factors affecting the growth and well-being of fishes.

Importance of natural food, role of supplementary feed, methods of feeding, conditions influencing the consumption and assimilation of food conversion factors between protein in the fish are necessary conditions for augmenting the fish production per unit area of water.
The energy of carbohydrate formed represents the gross and net primary production and is the sum of the energy present in photosynthesis. The high rate of primary production may be attributed to the favourable physicochemical parameters which in turn help in fish growth. The increased nutrient concentration and higher temperature results in higher algal population, which in turn helps in higher primary production. In the present dissertation, the higher rate of net primary production is met with the growth period of carps in this farm. Since the rate of production is higher in this lentic system, the rate of growth of fish is also enhanced accordingly and is found to be satisfactory.

The maximum population in summer may be due to the higher ambient temperature and more organic deposition (scum and rot) and during rainy season, it may be due to breeding activities of fishes (i.e. during breeding periods, the fishes do not have a habit of feeding).

Vertical migration of zooplankton and phytoplankton on the basis of variation in the light intensity, temperature and transparency has been described by several authors like Bhora (1977), Agarwal (1980), Jakhar et al. (1981), Majumdar (1982), Patel & Gouder (1982), Seshagiri Rao & Khan (1982).

The phytoplankton population shows their maximum density on the surface layer in the daylight and reaches at the peak at 1200th at noon. During night, they are comparatively less in number, as they migrate to the bottom. This shows a regular pattern of fluctuation (Clarke, 1954). Buglena virudies
show their maximum presence as the day advances. *Closlerium sp*, *Nostoc sp* are reported to be maximum at 1200h.

Almost all the zooplankton exhibit a characteristic circadian pattern of increasing in number at the surface layer during night time and decrease in day hours. Jakhar et al. (1981) Seshagiri Rao and Khan (1982) have already reported such a trend. However, Krishnamoorthy and Viswanathan (1968) reported in day hours.

From the point of view of fertilization as well as hatching, the specimen Mrigal exhibits best performance as its mean is highest among the three averages and at the same time, its standard deviation is low for fertilization and almost same as other for hatching. Accordingly the Rohu and catla rank second and third in fertilization while they rank third and second in hatching.

In this farm, composite fish culture is an old practice and species like *Catla catla*, *Labeo rohita*, *Cirrhinus mrigala* are generally stocked together in the same pond. But in recent years, together with these indigenous species, some exotic species such as silver carp, grass carp and common carp are being cultured together. The combination of these species have been found to be not only suitable, but also more profitable, because these species do not compete with the Indian major carps for food and at the same time make the best use of the available food in water to which the Indian carps do not take.

Optimum stocking density, dissolved oxygen content in the water, space, shape and size of the ponds are some of the primary factors affecting the growth and well-being of fishes.
Importance of natural food, role of supplementary feed, methods of feeding, conditions influencing the consumption and assimilation of food conversion factors between protein in the fish are necessary conditions for augmenting the fish production per unit area of water.

Bimodal nature of population peaks for phyto and zooplankton, its standing stocks, per cent composition vary seasonally and corelates \( r = 0.632 \) with the feeding habits of fishes. Also due to high temperature in summer the planktons are dormant and suppressed. But after the 1st sower of rainfall there is exuberant growth of the planktons which also coincides with the initial breeding period of the fish. But after multiple bouts of rain there is increase in the turbidity as well as the depth of water following which the planktons move downwards and are settled down at the bottom. Also during late summer when high temperature and certain other adverse abiotic factors, scum formation and algal rot and more abuse of the water by the interference of local people inhibit the growth of carp fishes. Whereas in early summer and early as well as late winter make the ambient environment suitable for plankton growth which in turn feed the growing fishes and offer satisfactory yield.

During rainy season, though the ambient aquatic environment becomes well-built with the biotic and abiotic structures on the part of growing as well as gravid fishes, but due to breeding activities of gravid fishes, they undergo fasting in most of the times, the food (i.e., phytozooplankton) remain unused by the feeders (i.e., fishes), the population peaks of food organisms
(plankton) get rise and may attain the population peaks. However, there is complete interaction and inter-relationships between the consumers (i.e. fishes) and food organisms (Plankton: Primary producers and primary consumers). Thus both prey and predators bounded by food chain and food web phenomenon live together keeping in harmony with one another and have been continuing as such from time immemorial.

This fish farm under study is one of such aquatic ecosystems (lentic) having different tropic levels obeys natural laws, i.e. prey and predators live together in such ecosystem with perfect phenomenon of natural built-in lock and key system.

From the statistical point of view, it may be concluded that, the rate of fertilization and hatching decrease with the increase of pituitary dose extraction injection. Out of three specimens (i.e. Catla catla, Labeo rohita and Cirrhina mrigala) Mrigal exhibits best performance in respect of fertilization and hatching, to Horu and Catla come second and third respectively.

The data presented in this thesis may be helpful in the selection of breeders with proper weight group, in the proper ratio and the dose of the pituitary extract. Above all, the hydrobiological parameters should be considered in proper condition before starting hypophysation. As a result high yield would be met with after careful consideration of the aforesaid data.
A healthy environment of the pisciculature ponds is all along necessary for high yield. The existing ponds are always exposed to different types of pollutions like animal and human bathing, cleaning of clothes and utensils by soap and detergents, cleaning of automobile vehicles etc. In the rainy season sometimes, there is inflow of drain water due to overflow as it runs by the side of the ponds. Sufficient precautions should be taken to prevent all these unwanted pollutions for a better piscicultural environment.

It is observed that, overcrowding of breeders has got an adverse effect on breeding. So limitation of the breeders in a particular size of happa is preferable. A special mention should be made on the ratio of the female and male breeders. The weight of the male in single or jointly should be more but not too much on the higher side. The female-male ratio which yield maximum fertilization and hatching is limited on the average 1 female to 2 males frequently. However, further more study is to be conducted on the happa size and the crowding effect on fertilization and hatching.

The pituitary extract preparation needs more sophisticated instrumentation for determining its proper concentrations and efficiency from time to time. We have in our study conducted experiments to know the best hydrobiological conditions where high yield is possible. Also the breeders are accurately specified for maximum output.
So this can form a guideline to workers in the fish farm. Instead of choosing breeders at random, they can confine to the specified weight group and sex ratio as described in the thesis. We hope, our piece of work will be very much informative in many aspects not only to Sambalpur fish farm but also to many other farms which are involved in induced breeding.