**Model Answers**
**M.Sc. (Third Semester) Examination, 2015**
**Paper-LZT 303 B (Fish Culture and Pathology)**

## Section A

**Q. 1- Answer**

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|---|---|---|---|---|
| (i)- (b) | (ii)- (a) | (iii)- (a) | (iv)- (a) | (v)- (a) |
| (vi)- (c) | (vii)- (a) | (viii)- (c) | (ix)- (d) | (x)- (d) |

## Section B

**Q.2. Fish Culture in Ponds:** Fish farming aims at the cultivation of selected varieties of fishes in ponds. The success of a fish farm depends upon the careful planning and the management. Following factors should consider before the construction of fish farm.

- Construction and lay out of fish farm and ponds.
- The number of fish ponds and selection of the type of fish culture.
- Selection of suitable fishes for culture.
- Stoking densities, estimates of fish stocks and methods for systematic control of their development. Availability of natural food resources and their better utilization.
- Methods of harvesting of fishes and their utilization
- Transportation, preservation and processing facilities.

**Construction and layout of fish pond:** Before starting the construction, the layout plans have to be drawn for the location design and the number of various types of ponds. Fish farming requires many different types of ponds and an elaborate management.

**Types of Ponds:**

**On the basis of water supply**

a) Spring water pond: These ponds are supplied by ground water.
b) Rain water pond: These ponds are filled with rain water.
c) Well water ponds: Such ponds are filled with well water.
d) Water course ponds: Such ponds are placed on the course of flowing water and are of two main types:
   i. Barrage Pond system: Ponds supplied by spring and rain water and are called the dams or barrage ponds. They are often provided with a bypass to drain off excess water.
   ii. Diversion ponds: In this type all the ponds are supplied by the same by pass channel but each pond has its individual supply and the out let.

**On the basis of use:** Ponds are also classified according to their usage in the fish farm. These are constructed in accordance to the requirements of the fishes or their stage of life cycle.

I. Head Pond: The purpose of this pond is to meet the water requirements of the entire farm.
II. Hatching ponds: it is also called as spawning ponds and is used for hatching the fertilized eggs. A continuous but slow flow of water is required for aerating the eggs.

III. Nursery ponds: Young fry about 3 to 5 days old are transferred from spawning ponds to nurseries where they remain for about 30 days. The main objective of constructing nurseries is to create suitable conditions of food availability.

IV. Rearing ponds: Such ponds may be seasonal or perennial of 90x30x4 feet in size and are used for rearing advanced fry for 2-3 months.

V. Stocking ponds: these are large ponds more than 6 feet deep and are so constructed that it may facilitate netting.

3. In spite of an already rich and diverse fish genetic resource of India, more than 300 exotic species have been introduced into the country so far. While a vast majority of them are ornamental fishes which remain, more or less, confined to the aquaria, some others have been introduced in aquaculture and open water systems with varying degrees of success. Three larvicidal fishes *viz., Lebistes reticulatus, Nothobranchus* sp. and *Gambusia affinis* were introduced for containing the insect larvae in confined waters. Silver carp and the three varieties of common carp were brought into the country with the objectives of broadening the species spectrum in aquaculture and increasing the yields through better utilization of trophic niches. In recent years, the bighead carp *Hypophthalmichthys nobilis* and *O. niloticus* have been reported from the culture systems of eastern India. After unauthorised introduction, these two fishes are becoming popular among the aquaculturists of the region. While a few of the introduced species proved to be a boon in aquaculture and acted as an instrument for yield optimisation from ponds, the accidental and deliberate introduction of some of the exotic fishes into the open-waters has generated a lot of debate in recent years. There is a growing concern in India about the possible deleterious impact of the exotic fishes on the fish species diversity of the Indian rivers.

*Oreochromis mossambicus, Hypophthalmichthys molitrix, Ctenopharyngodon idella, Cyprinus carpio communis, C. carpio specularis* and *C. carpio nudus* have gained entry into the reservoir ecosystem through accidental or deliberate introduction. Among them, tilapia, silver carp and common carp could make a negative impact on the fisheries in various reservoirs in the country.

***Tilapia***

The tilapia, *O. mossambicus* was first introduced into the pond ecosystem of the country in 1952 and soon it was stocked in the reservoirs of south India. By the end of 1960s, most of the reservoirs in Tamil Nadu and those in the Palakkad and Trissur districts of Kerala were regularly stocked with tilapia. Performance of tilapia in ponds of south India has been discouraging mainly due to its early maturity, continuous breeding, over-population and dwarfing. It is reported to mature at 6 cm length at an age of 75 days and to breed at an interval of one month under the tropical conditions.

Distribution of tilapia is more or less restricted to the tropical belt as the fish is constrained with slow growth and winter mortalities in the higher latitude. Attempts to introduce the fish in Baghla, a small irrigation impoundment in the Gangetic plain have not succeeded. The ongoing debate on the introduction of tilapia centres round its:

1. suitability to enhance yield through niche utilization,
2. propensity for affecting or even replacing the native ichthyofauna, and
3. consumer preference.

One of the main considerations in determining introduction of exotic fishes is their feeding habits. Since none of the Indian culturable carps feeds on Cyanophyceae blooms like *Microcystis aeruginosa*, tilapia is often cited as a welcome addition to the blue-greens-dominated water bodies.

Tilapia (*O. mossambicus*) has entered the Indian scene, when the inland fisheries contributed negligibly to the total fish production in the country and the ecosystem management was in its infancy. Today, a number of indigenous species are available for stocking to broaden the species spectrum, bridge the gaps in niche utilization and increase the yield. Barring a very few reservoirs, tilapia-dominated fishery invariably leads to low yields.

***Silver carp***

Silver carp, *Hypophthalmichthys molitrix* was introduced in India in 1959 and unlike tilapia, it has not strayed into many reservoirs. However, silver carp has attracted more attention from the ecologists and fishery managers, generating a more animated debate. Importance of silver carp in reservoirs emanates mainly from:

1. its reported ability to utilise *Microcystis*
2. the impressive growth rate, and
3. its propensities for affecting the indigenous species, especially *Catla catla*.

The silver carp has a specialised structure of gill rakers adapted to microplankton feeding. Gut analysis of the fish carried out at the Central Inland Fisheries Research Institute revealed a wide feeding range including Chlorophyceae, Cyanophyceae, Chrysophyceae, Bacillariophyceae, Dinophyceae, Protozoa, Rotifera, Cladocera, Ostracoda, and Copepoda).

It is significant to note that despite its entry into a number of Indian reservoirs, by accident or otherwise, silver carp failed to get naturalised anywhere except Gobindsagar. Considering that the reservoir, with its temperate climate, is closer to the original habitat of the fish and has a distinctly cold water hypolimnion due to the discharge from Beas, the silver carp seems to have found a congenial habitat for growth and propagation

***Common carp***

The three varieties of the Prussian strain of common carp, *viz.*, the scale carp *(Cyprinus carpio communis)*, the mirror carp *(C. carpio specularis)* and the leather carp *(C. carpio nudus)* were introduced in India during 1939. They were stocked in several high altitude ponds and lakes during the 1950s. Later, in the 1957, the Chinese (Bangkok) strain of the common carp was brought into the country, primarily for aquacultural purposes, considering its warm water adaptibility, easy breeding, omnivorous feeding habits, good growth and hardy nature.

4. Fertilizers are natural or synthetic substances that are used in ponds to increase the production of the natural food organisms to be eaten by the fish. These organisms include phytoplankton, zooplankton and insects. By increasing the availability of major nutrients, fertilizers promote the development of planktonic algae, which provide food for many fish. Fertilization also leads to the development of animals which feed on algae, including some fish such as the silver carp and the Nile tilapia.

Organic fertilizers

In many instances, especially for small farmers, organic fertilizers are the most effective way of increasing natural food supply in ponds to improve fish production.

*Different kinds of organic fertilizer*

Several kinds of organic material, mostly waste materials, can be used as organic fertilizers. Most common are the following:

- animal manures, mostly from farm animals;
- slaughterhouse wastes;
- agro-industrial wastes;
- biogas slurry;
- natural vegetation;
- compost, a mixture of various kinds of organic matter.

*Animal manures as organic fertilizers*

As pond fertilizers, *animal manures* have such great advantages that they should be preferred whenever' possible. As *direct food*, they can partly replace supplementary feeds. For example, on manuring days additional feeding may be cancelled. They are a source of additional carbon dioxide ($CO_2$), which is very important for the efficient utilization of the nutrients present in the water. This is especially so when used together with inorganic fertilizers.

They increase the abundance of bacteria in the water, which not only accelerate the decomposition of organic matter, but also serve as food for the zooplankton, which in turn also increases in abundance.

They have beneficial effects not only on the bottom soil structure but also on the bottom fauna, such as the chironomid larvae.

However, animal manures also have some disadvantages, mostly related to their low content in primary nutrients, their negative effect on dissolved oxygen content and the reluctance of some fish farmers to use animal wastes directly in fish ponds.

*The composition of animal manures*

The chemical composition of organic manure varies greatly according to the animal from which it originates - namely the species, age, sex, the nature of its diet - and according to the way the manure is handled, namely its relative freshness, conditions of storage and rate of dilution with water. In some cases, total wastes made of dung and urine are available, while in others only solid wastes can be collected.

Throughout the world, most animal manure is obtained from a limited number of species such as buffalo, cattle (bullock, dairy cows or fattening beef), horses or donkeys, sheep, goats, pigs, rabbits and poultry (chicken, ducks, geese).

Chicken droppings are the richest in nutrients. Pig dung is usually richer than sheep *or* goat dung. Manures from cattle and horses are poorer in nutrients, especially when the animals feed on grass only. Their fibre content is relatively high. Buffalo dung is the poorest manure of all.

5. In most cases, fungi serve a valuable ecological function by processing dead organic debris. However, fungi can become a problem if fish are stressed by disease, by poor environmental conditions, receive poor nutrition, or are injured. If these factors weaken the fish or damage its tissue, fungus can infest the fish. All fungi produce spores--and it is these spores which readily spread disease. The fungal spore is like a seed which is resistant to heat, drying, disinfectants and the natural defence systems of fish The three most common fungal diseases are discussed here. They are known as Saprolegniasis, Branchiomycosis, and Ichthyophonus disease.

**Saprolegniasis:** Saprolegniasis is a fungal disease of fish and fish eggs most commonly caused by the *Saprolegnia* species called "water molds." They are common in fresh or brackish water. *Saprolegnia* can grow at temperatures ranging from 32° to 95°F but seem to prefer temperatures of 59° to 86°F. The disease will attack an existing injury on the fish and can spread to healthy tissue. Poor water quality (for example, water with low circulation, low dissolved oxygen, or high ammonia) and high organic loads, including the presence of dead eggs, are often associated with *Saprolegnia* infections.

Disease Signs: Saprolegniasis is often first noticed by observing fluffy tufts of cotton-like material--coloured white to shades of grey and brown--on skin, fins, gills, or eyes of fish or on fish eggs. These areas are scraped and mounted on a microscope slide for proper diagnosis. Under a microscope, Saprolegnia appears like branching trees called hyphae. With progression of infection fish usually becomes lethargic and less responsive to external stimuli. So fish under such conditions is a target to predators.

Management and Control: Saprolegniasis is best prevented by good management practices--such as good water quality and circulation, avoidance of crowding to minimize injury (especially during spawning), and good nutrition. Once *Saprolegnia* is identified in an aquatic system, sanitation should be evaluated and corrected. Common treatments include potassium permanganate, formalin, and povidone iodine solutions. Over treatment can further damage fish tissue, resulting in recurring infections. Environmental management is essential for satisfactory resolution of chronic problems.

***Branchiomyces:*** *Branchiomyces demigrans* or "Gill Rot" is caused by the fungi *Branchiomyces sanguinis* (carps) and *Branchiomyces demigrans* (Pike and Tench). Both species of fungi are found in fish suffering from an environmental stress, such as low pH (5.8 to 6.5), low dissolved oxygen, or a high algal bloom. *Branchiomyces* sp. grow at temperatures between 57° and 95°F but grow best between 77° and 90°F. The main sources of infection are the fungal spores carried in the water and detritus on pond bottoms.

Disease Signs: *Branchiomyces sanguinis* and *B. demigrans* infect the gill tissue of fish. Fish may appear lethargic and may be seen gulping air at the water surface (or piping). Gills appear striated or marbled with the pale areas representing infected and dying tissue. As the tissue dies and falls off, the spores are released into the water and transmitted to other fish. High mortalities are often associated with this infection.

Management and Control: Avoidance is the best control for Branchiomycosis. Good management practices will create environmental conditions unacceptable for fungi growth. Formalin and copper sulphate have been used to help stop mortalities; however, all tanks, raceways, and aquaria must be disinfected and dried. Ponds should be dried and treated with quicklime (calcium oxide). A long term bath in Acriflavine Neutral or Forma-Green for seven days helps this condition. Ponds should be dried and treated with quicklime (calcium oxide) and copper sulphate (2-3kg / ha). Dead fish should be buried.

**Icthyophonus:** Icthyophonus disease is caused by the fungus, *Icthyophonus hoferi.* It grows in fresh and saltwater, in wild and cultured fish, but is restricted to cool temperatures (36° to 68°F). The disease is spread by fungal cysts which are released in the faeces and by cannibalism of infected fish.

Disease Signs: Because the primary route of transmission is through the ingestion of infective spores, fish with a mild to moderate infection will show no external signs of the disease. In severe cases, the skin may have a "sandpaper texture" caused by infection under the skin and in muscle tissue. Some fish may show curvature of the spine. Internally, the organs may be swollen with white to grey-white sores.

Management and Control: There is no cure for fish with *Icthyophonus hoferi;* they will carry the infection for life. Prevention is the only control. If Icthyophonus disease is identified by a trained diagnostician, it is important to remove and destroy any fish with the disease. Complete disinfection of tanks, raceways, or aquaria is encouraged. Ponds with dirt or gravel bottoms need months of drying to totally eliminate the fungus.

6. Sewage is universally considered as a valuable organic fertilizer as it contains abundant quantities of nutrient elements. In general way, the term sewage is used for a combined liquid waste discharged from all domestic, municipal and industrial sources within a given area.

The use of sewage effluent for raising fish productivity was recognised much earlier in countries like China, Taiwan, Malaysia, Thailand and Indonesia, however in India this potentiality of sewage was noticed much later. Rearing of fish in sewage fed ponds have become very popular nowadays in West Bengal and other states like Uttar Pradesh, Madhya Pradesh, Maharashtra,' Tamil Nadu, Kerala, Karnataka and Bihar as they are utilizing sewage effluent for pisciculture.

**Characteristics of sewage:**

Sewage discharge of different places may vary in their chemical composition and physico-chemical nature according to dietary habit of people, composition of trade waste and water consumption of a particular place. Besides, its organic and inorganic constituents, sewage contain living bodies, especially bacteria and protozoa.

The water content of sewage may vary from 99% to 99.9%. The carbon and nitrogen ratio of sewage is around 3:1. Sewage produced from industrial areas may have more organic carbon. Indiscriminate use of synthetic detergents in urban areas accounts for the presence o an appreciable amount of these chemicals in urban sewage discharge. Besides, carbon and nitrogen, minute quantities of zinc, copper, chromium, manganese, nickel and lead are also present in sewage. Gaseous component of sewage includes ammonia, carbon dioxide and hydrogen sulphide.

Use of raw sewage to fertilize a pond for fish culture is not recommended because of its detrimental effect to fish life. The harmful effects of raw sewage on aquatic life is because of its—

(i)High biochemical oxygen demand (BOD)

(ii)Low dissolved oxygen content ($D0_2$)

(iii) High carbon dioxide content

(iv) High ammonia and sulphur value

(v) High bacterial load

**Fish culture in sewage fed ponds in India:**

For fish culture sewage water of stabilizing tank as well as the water after dilution can be utilized. Air breathing fishes are more suitable to be cultured in sewage treatment ponds as they can survive in water with lesser dissolved oxygen content. The fish like Clarias batrachus, *Heteropneustes fossalis, Channa spp., Tilapia mossambicus* and *Ctenopharyngodon idella* (grass carp) are the species of choice to be considered for culture in sewage treated ponds.

**7** . Many fishes suffer from nutritional disorders because of a poor diet. Nutritional disorders are the most common reason for sickness and death in aquarium, tank or fishpond fishes.

Reasons and Prevention

1. Nutritional imbalance in commercial food: Fishes can be either plant eaters (herbivores), meat eaters (carnivores), or both (omnivores). And although commercial food is available for fishes, a nutritional disorder can still occur because each species of fish has a different nutritional requirement, which is not always fulfilled by the commercial food. Therefore, fishes will need more than one type of commercial food to meet their dietary requirement.

2. Incorrectly stored food: Improperly stored food is another reason fishes acquire nutritional disorders. Dry food should be stored in a cool, dry place and replaced after two months.

3. Vitamin deficiency: Nutritional disorders in fishes can also be due to a vitamin deficiency. Vitamin C or *ascorbic acid* deficiency leads to Broken back disease – where the backbone of the affected fishes get bent (deformed). Vitamin B-complex (thiamin, biotin, niacin, and pyridoxine) deficiency can cause brain, spinal cord and nerve disorders in fishes. Unfortunately, vitamin deficiency is diagnosed only after the fish's death. Therefore, it is important you give your fish a vitamin-rich diet.

4. Infected live food: Food that is alive and infected with bacteria, viruses, fungi and parasites can lead cause problem in your fishes. To prevent such infectious diseases, buy live food only from reputable sources.

5. Feed toxicity: Nutritional disorders caused by toxins found in food occur frequently in aquarium fishes. The most common of these is the *aflatoxin* produced by the growth of the mold, Aspergillus flavus, in the stored food. Aflatoxin causes tumors and is fatal in fishes. Store your fish food hygienically and replace it every two months, or when there appears to be mold in it.

8. Integrated fish farming refers to the simultaneous culture of fish or shell fish along with other culture systems. Generally integrated farming means the production or culture of two or more farming practices but when fish becomes its major component it is called as integrated fish farming. Fish culture can be integrated with several systems for efficient resource utilisation.

Paddy cum fish culture

Advantages of paddy cum fish culture

1. Economical utilization of land
2. Little extra labour is required
3. Saving on labour cost towards weeding and supplemental feeding
4. Enhanced rice yield by 5 -15 %, which is due to the indirect organic fertilization through the fish excreta
5. Production of fish from paddy field
6. Additional income and diversified harvest such as fish and rice from water and onion, bean and sweet potato through cultivation on bunds
7. Fish control of unwanted filamentous algae which may otherwise compete for the nutrients
8. Tilapia and common carp control the unwanted aquatic weeds which may otherwise reduce rice yield up to 50 %
9. Insect pests of rice like stem borers are controlled by fish feeding on them mainly by murrels and catfishes
10. Fish feed on the aquatic intermediate host such as malaria causing mosquito larvae, thereby controlling water-born diseases of human beings.

Types of paddy fields for integrated system:

Preparation of the paddy plot can vary according to the land contours and topography.

1. Perimeter type: The paddy growing area may be placed at the middle with moderate elevation and ground sloping on all sides into perimeter trenches to facilitate easy drainage.
2. Central pond type: Paddy growing area is on the fringe with slopes towards the middle.
3. Lateral trench type: Trenches are prepared on one or both lateral sides of the moderately sloping paddy filed.

- Suppose the area of the integrated system is 100 m X 100 mi. e., 1 ha. The area to be utilized for paddy should be 82 m X 82 m -i.e., 0.67 ha. The area to be utilized for fish culture should be 6m X 352 m -i.e., 0.21 ha (4 sides).
- The embankment area should measure 3m X 388 m i.e 0.12 ha. and the area for fruit plants should be 1m X 388 m i.e., 0.04 ha. This is an ideal ratio for preparation of an integrated system.

Rice varieties used for integrated system:

- The most promising deep water varieties chosen for different states are PLA-2 ( Andhra Pradesh ) , IB-1, IB-2 , AR-1, 353-146 ( Assam ) , BR-14, Jisurya ( Punjab ), AR 61-25B, PTB-16 ( Kerala ) , TNR-1, TNR (Tamil nadu), Jalamagan (Uttar Pradesh), Jaladhi-1, Jaladhi-2 (West Bengal) and Thoddabi (Manipur).

Culturable species of fish in rice fields

- The fish species which could be cultured in rice fields must be capable of tolerating shallow water (>15 cm depth), high temperature (up to $35^0$ C), low dissolved oxygen and high turbidity.
- Species such as *Labeo rohita, Catla catla, Anabas testudineus, Clarias batrachus, , Channa striatus, Channa punctatus, Channa marulius, Heteropneustes fossilis, and Mugil sp* have been widely cultured in rice fields.

Types of fish culture in rice fields

Fish culture in rice fields may be attempted in two ways, viz. simultaneous culture and rotation culture.

Simultaneous culture:

- Rice and fish are cultivated together in rice plots, and this is known as simultaneous culture.
- Rice fields of 0.1ha area may be economical. Normally four rice plots of 250 $m^2$ (25 X 10 m) each may be formed in such an area. In each plot, a ditch of 0.75 m width and 0.5 m depth is dug.
- The dykes enclosing rice plots may be 0.3 m high and 0.3 m wide and strengthened by embedding straw.
- The water depth of the rice plot may vary from 5 - 25 cm depending on the type of rice and size and species of fish to be cultured.
- Five days after transplantation of rice, fish fry are stocked at the rate of 5000/ha or fingerlings at the rate of 2000/ha. The stocking density can be doubled if supplemental feed is given daily.

Rotational culture of rice and fish:

- In this system fish and rice are cultivated alternately. The rice field is converted into a temporary fish pond after the harvest.
- This practice is favoured over the simultaneous culture practice as it permits the use of insecticides and herbicides for rice production.

- A greater water depth up to 60 cm can be maintained throughout the fish culture period.
- One or two weeks after rice harvest, the field is prepared for fish culture.
- The stocking densities of fry or fingerlings for this practice could be 20,000/ha and 6,000/ha respectively.